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The Heterogeneity of Triple Negative Breast Cancer: The Role of Multimodality Imaging and Treatment Response Evaluation

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BODY

Triple-negative breast cancer (TNBC) is a heterogeneous and aggressive group of tumors characterized by the absence of estrogen and progesterone receptors and lack of HER2 overexpression. TNBC accounts for 8%-13% of breast cancers and is the second most common breast cancer subtype among all age groups. TNBC accounts for a higher proportion of breast cancers in younger women, compared to older women. It disproportionately affects non-Hispanic Black women, who have a higher mortality rate from TNBC than do women of other races and ethnicities. TNBC includes a wide spectrum of tumors with different histology. Approximately 80% of TNBC are invasive ductal carcinomas. Rare histologic subtypes such as metaplastic, medullary, adenoid cystic, and secretory carcinoma are often TNBC. Conversely, it is uncommon for invasive lobular carcinomas to be TNBC.

TNBCs are associated with germline BRCA mutations more often than other subtypes of breast cancer. TNBC accounts for nearly 60% of breast malignancies in premenopausal women who carry the BRCA1 mutation. BRCA2 mutations are also associated with TNBC, although to a lesser extent; 16% of breast malignancies in BRCA2 mutation carriers are TNBC. Other mutations have also been identified in TNBC patients including mutations in the TP53 gene, BARD1, PALB2, and RAD51D. Currently, the National Comprehensive Cancer Network guidelines recommend genetic risk assessment with possible genetic testing for all TNBC patients aged ≤60 years.

Mammography can be suboptimal for the early detection of TNBC. Contributing factors include rapid tumor growth, increased mammographic density in young women, and the absence of typical features of malignancy on imaging. Interval cancers, which are cancers diagnosed between regular mammographic screenings, are two times more likely than screen-detected cancers to be TNBC. The majority of TNBCs present as an irregular mass without calcifications. About 8%-32% are round or oval masses. Less common presentations include asymmetries, architectural distortions and masses with associated calcifications. The variability of the imaging features of TNBC has been shown to correlate with the patient's menopausal status. TNBC in premenopausal patients is more likely to present as an oval or round mass, while TNBC in postmenopausal patients is more likely to present as an irregular mass.

Sonography is superior to mammography for TNBC detection, although some of their benign imaging features can lead to misdiagnosis. The typical sonographic presentation of TNBC is an irregular, hypoechoic mass with noncircumscribed margins. However, TNBC may also present with features seen in benign tumors, including circumscribed margins, parallel orientation, and posterior acoustic enhancement. Given that TNBC may resemble a benign tumor such as a fibroadenoma on sonography; careful review of the tumor margins is crucial to evaluate if any features would necessitate biopsy.

Breast MRI is the most sensitive modality for TNBC detection and for the evaluation of treatment response. The most frequent MRI characteristic is an enhancing mass, which is observed in 82%-95% of patients. While the margins can be irregular or circumscribed, circumscribed margins are more suggestive of TNBC. Rim enhancement is the most common internal enhancement pattern in TNBC. High T2 intratumoral signal and intratumoral necrosis are two additional imaging characteristics strongly suggestive of TNBC. Nonmass enhancement is not a typical imaging characteristic of TNBC. TNBCs are more likely to be unifocal, with multifocal or multicentric disease is seen in 27% of cases. Regarding TNBC imaging response, concentric shrinkage is most common, and usually a favorable predictor of pathologic completely response (pCR). In recent studies, breast MRI in TNBC has shown high negative predictive values of 60%-90% indicating that if breast MRI shows a complete response after neoadjuvant chemotherapy, the likelihood of pCR at surgical pathology is high. Breast MRI is also the imaging modality with the highest correlation of residual tumor size following neoadjuvant chemotherapy when compared to pathologically determined residual tumor size.

TNBC is a heterogeneous group of tumors with different epidemiology, histologic, imaging features and response to neoadjuvant chemotherapy. Understanding these differences is essential to delivering personalized and effective treatment for patients with TNBC.

TAKE HOME POINTS

TNBC is an aggressive and heterogenous breast cancer that disproportionately affects younger and non-Hispanic Black women.

TNBC is more often associated with genetic mutations than other breast cancer subtypes. Patients diagnosed with TNBC should undergo multi-gene panel testing.

TNBC is an aggressive tumor with different imaging profiles and variable response to treatment. The high negative predictive value of MRI in TNBC patients is highly valuable to predict pCR. Breast MRI has a high agreement between the imaging-determined size of the residual tumor after neoadjuvant chemotherapy and the pathologically determined size of the residual tumor.

TNBC may exhibit benign imaging characteristics such as parallel orientation, posterior acoustic enhancement, and circumscribed margins, leading to misdiagnosis. Misdiagnosed TNBC may progress rapidly to a higher stage if not properly diagnosed and treated.

Chapter on CEM

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BODY

Contrast-Enhanced Mammography (CEM) has emerged as a revolutionary imaging modality, leveraging dual-energy techniques and iodinated contrast to produce images resembling both traditional 2D mammography and subtraction breast MRI. Since its diagnostic approval in 2011, the global adoption of CEM has been evident through the surge in related publications and the increasing number of CEM units worldwide.

Traditionally, CEM interpretations relied on the lexicons of the American College of Radiology (ACR) BI-RADS® for mammography and breast MRI. Recognizing the need for a dedicated lexicon tailored to CEM's unique characteristics, the ACR, in 2022, introduced a specialized lexicon supplementing the ACR BI-RADS® Mammography 2013 Atlas, 5th edition.

The foundation of this novel lexicon borrows from the mammography and breast MRI terminologies but incorporates modifications based on CEM-specific data. It categorizes findings into three imaging scenarios:
1. Findings on low energy (LE) images only;
2. Findings on low energy images with associated enhancement on recombined images (RC);
3. Findings on recombined images only (RC-only).

While low-energy-only findings retain the original mammography lexicon, findings with associated enhancement now include descriptions of internal enhancement patterns, enhancement extent, and enhancement degree relative to background parenchymal enhancement (BPE). Recombined-only findings draw parallels with breast MRI descriptors, introducing the term 'enhancing asymmetry' for single-view enhancements and omitting terms like 'focus', 'dark internal septations', and 'clustered ring' deemed non-identifiable in CEM. Descriptors for tissue density and BPE remain consistent with their mammography and breast MRI counterparts.

This inaugural CEM lexicon signifies a pivotal step in consolidating CEM's position in breast imaging. As CEM continues to gain traction, this lexicon is poised to evolve, reflecting the collective insights and experiences of global practitioners.

TAKE HOME POINTS

1. **Growing CEM Use**: The rising adoption of CEM underscored the need for a formal lexicon.
2. **BI-RADS® Foundation**: The new lexicon is adapted from existing BI-RADS® for mammography and MRI.
3. **Consistent Reporting**: A standardized lexicon promotes uniform reporting, paving the way for robust research.
4. **Unified Language**: Using consistent terminology fosters a shared language, ensuring solid data analysis.
5. **Understanding Malignancy Likelihood**: The lexicon aids in comprehending the association between descriptors and malignancy risks.
6. **First Version's Significance**: While the inaugural lexicon may spark debates, its introduction is crucial for the field's advancement.

RADIO-PATHOLOGIC CORRELATION

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BODY

Radio-pathological correlation (RPC) is one of the fundamental pillars that support an adequate level of quality in Breast Pathology Units. It consists of relating the pathologist's diagnosis with each of the lesions observed by the radiologist and, in case of discordance, evaluating its possible impact on the patient's management. Although it may seem, at first glance, a simple task, reviewing the literature, however, the high percentage of discordances, both major and minor, between the radiologic and pathologic diagnosis is surprising.

In the multimodality era, MRI is positioned as the most accurate technique for staging malignant lesions and, although it may overestimate the size of lesions in some cases, it shows better agreement with the pathologic study and higher detection rate of additional lesions than conventional imaging techniques.

Good understanding and the use of appropriate and inclusive language between radiologists, pathologists, and surgeons facilitates the correct macro-microscopic study of biopsies and surgical specimens and improves patient understanding and management.

It is necessary to define RPC criteria adequately to detect possible weaknesses and opportunities for improvement within the Unit.

Disciplinary committees are a good setting for this type of discussion, although it can be difficult to find the time to systematically comment on discordant diagnoses.

We will propose and discuss the necessary keys for the RPC of surgical specimens from the radiological, pathological, and surgical points of view. In addition, we will evaluate the possible difficulties for its implementation in daily clinical practice.

TAKE HOME POINTS

1. A detailed preoperative radiological mapping of the disease including preoperative biopsies targeting, at least, the most distant lesions to verify the multiplicity of the lesions and the radiological extent of the disease, best in three dimensions and in relation to the normal anatomical structures of the breast
2. Preoperative multi-disciplinary conference to discuss the radiological findings with the surgeon and the technician
3. Specimen radiography (methacrylate plate) to verify the presence of all the radiologically suspicious lesions within the specimen and to assess the margins
4. Multiple large-format histopathology sections facilitate three-dimensional understanding of the lesions
5. Postoperative multi-disciplinary conference to correlate the preoperative radiological findings to postoperative pathologic ones, judge the completeness of the surgical intervention, estimate the risk of remaining tumor foci within the breast after the surgery, and indicate the need for complete surgical intervention and radiotherapy.

Prognostic value of breast MRI after neoadjuvant chemotherapy

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BODY

Objective: To correlate response evaluation after neoadjuvant chemotherapy (NAC), assessed by magnetic resonance imaging (MRI) and pathology, with disease-free survival (DFS) in breast cancer patients, according to the subtype.

Methods: This single-center, IRB-approved, retrospective cohort study included consecutive breast cancer patients who underwent NAC and preoperative breast MRI. Pathologic response was assessed through the residual cancer burden (RCB) system, and absence of invasive carcinoma in the breast and axilla was defined as complete pathological response (pCR ou RCB-0). Radiological complete response (rCR) was defined as the absence of abnormal enhancement in the tumor site on MRI. Kaplan-Meier estimator was used to estimate the disease-free survival. Cox regression analysis was used to estimate hazard ratio (HR) values.

Results: 571 patients were included with mean age of 46 years (range: 26-90 years). The most common immunophenotype was Luminal (n=241; 39.9%), followed by triple-negative (n=180; 31.5%) and Her-2 overexpressed (n=150; 26.3%). Almost half of the patients (n=285; 49.9%) had clinical stage III at diagnosis. Overall, 35.2% of the patients had rCR, while 37.5% had pCR. During a mean follow-up of 67 months, patients who had both rCR and pCR had a better DFS curve, when compared to patients who had non-rCR and/or non-pCR (LogRank p=0.001). The statistically significant difference on DFS curves persisted for triple-negative (LogRank p<0.001), but not for Luminal (LogRank p=0.451) and Her-2 overexpressed subtypes (LogRank p = 0.727).

Disease-Free Survival Curves According to Radiological and Pathological Response after Neoadjuvant Chemotherapy in Breast Cancer Patients.
Cox regression showed that response assessment through RCB and MRI was a better predictor of DFS than RCB alone for patients with triple-negative breast cancer; a higher risk of recurrence was observed in patients with non-rCR and non-pCR (HR: 14.159; p<0.001), when compared to patients with rCR and pCR.

Conclusions: The association of MRI and pathological responses after NAC might better stratify the risk of recurrence and prognosis in triple-negative breast cancer patients.

TAKE HOME POINTS

The assessment of response after neoadjuvant chemotherapy using both pathology and MRI allows for more effective prognosis stratification in triple-negative breast cancer patients compared to relying solely on pathological response.

Disease-Free Survival Curves According ro Radiological and P athological Response after Neoadjuvant Chemotherapy in Breast Cancer Patients.

Dedicated breast CT

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BODY

Spiral breast CT using a photon-couting detector is a new breast imaging modality providing true isotropic 3D datasets of the breast at low radiation dose. As breast CT does not require breast-compression, it is a completely pain free alternative to mammography or tomosynthesis. In a prospective study in more than 1.500 patients undergoing opportunistic screening examination with adjunct ultrasound, a high cancer detection rate of 1.4% was found. Using iodinated contrast media, a better dipiction of soft-tissue lesions in dense breasts is possible.

TAKE HOME POINTS

Spiral breast CT allows completely painfree acquisition of high resolution isotropic 3D datasets.
Due to the low radiation dose, spiral breast CT is suitable for breast cancer screening.
In a prospective study on opportunistic screening, a high cancer detection rate was found.

External validation of breast cancer risk prediction models for risk-based screening in the PRISMA cohort

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PURPOSE

The Personalised RISk-based MAmmascreening (PRISMA) study is an observational prospective cohort study which aims to assess the added value of risk-based screening in the Netherlands. The first step is to identify the optimal breast cancer risk prediction model in the context of risk-based screening.

METHODS

The PRISMA study is embedded in the Dutch biennial breast cancer screening programme. Between September 2014 and June 2019, the following data was collected from screening participants: mammograms (n=67,168), questionnaires (n=38,716), blood samples (n=10,166), and saliva samples (n=600). In total, 20 screening units from four of the five Dutch screening regions participated in the study. Linkage to the Dutch Cancer Registry showed that 705 women were diagnosed with breast cancer (as of February 2020). Information from the questionnaires was used in three established risk prediction models (Gail, IBIS, and BOADICEA). Initially, discrimination was assessed for the three models without breast density, using the area under the receiver operating characteristic (ROC) curve (AUC). Subsequently, volumetric breast density was added to IBIS (continuous measure) and BOADICEA (categorical measure). Breast density was measured using Volpara (version 1.5.0; Volpara Analytics, Wellington, New Zealand). The performance of both 2-year risk and 5-year risk models was assessed.

RESULTS

Preliminary results show that the ability of these models to distinguish between women with and without breast cancer is very comparable and still relatively limited, with an AUC ranging from 0.582 to 0.599 for the three 2-year risk models without breast density. Adding breast density had little effect on the estimates, with an AUC of 0.619 for IBIS and 0.561 for BOADICEA. The 5-year risk models gave similar results. Analyses on model calibration are still ongoing.

CONCLUSION AND SUMMARY STATEMENT

The first analyses in PRISMA indicate that the performance of risk prediction models needs to be improved for use in the context of risk-based screening.

Value of supplemental US in screening

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BODY

There are potential clinical benefits of supplemental breast cancer screening ultrasound (US) for women with dense breasts, those at elevated risk for breast cancer, or those newly diagnosed with breast cancer. Dense breast tissue is an important reason for failed early diagnosis of breast cancer on mammography and an increased incidence of interval or advanced breast cancers.

Multiple studies confirm the incremental cancer detection capabilities of whole-breast US. In a summary of the literature on the use of US in women with dense breast tissue, the average incremental cancer detection rate was 2.0/1000 (range: 0-6.8/1000) for physician-performed handheld US (HHUS) and 2.7/1000 (range: 1.8-4.1/1000) for technologist-performed HHUS. Automated breast US (ABUS) shows similar performance results as HHUS. The average incremental cancer detection rate of ABUS after mammography was 2.5/1000 (range: 2.0–3.8/1000). The cancers detected only by US tended to be invasive, small, and node-negative. However, this supplemental detection with US is accompanied by higher rates of false-positive findings and short-term follow-up and a lower positive predictive value for biopsy when compared with mammography or MRI. Recently, digital breast tomosynthesis (DBT) has been considered the most popular breast screening modality; hence, comparing the performance of US and DBT and the benefit of using supplemental US after DBT screening were questioned. Although US showed a higher cancer detection rate compared to DBT in many studies, it is important to note that this increased cancer detection was accompanied by a rise in false-positive recall cases in those studies.

Until now, no outcome study has demonstrated a direct decrease in patient mortality following the detection of these additional small and mammographically occult cancers. However, rationally, the early detection and treatment of additional small breast cancers with interval cancers should improve outcomes.

This lecture will cover the performance, value, and practical adoption of supplemental US, including HHUS and ABUS, in clinical practice.

TAKE HOME POINTS

1. Supplemental screening US detects mammographically occult invasive, node-negative breast cancers in women with dense breasts, and women with US-detected breast cancers had excellent outcomes.
2. Automated breast US, Elastography and Doppler imaging can be used to overcome the issue of reproducibility and false positives.
3. Understanding the comparative performance of other supplemental screening tests can provide an optimal guide for the use of supplementary US.

Quality assurance and PERFORMS

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BODY

Quality assurance (QA) of mammography interpretation plays a key role in breast screening to maintain reporting standards and support performance improvement. Real-life performance data are considered the gold standard for QA; however, reader performance cannot be calculated for several years using real-life data – interval cancer data are needed for sensitivity calculations and data from the next screening round are needed for specificity. PERFORMS (Personal Performance in Mammographic Screening) is a well-established mammography QA and self-assessment scheme, started in the UK and running for over 34 years; now delivering to thousands participants internationally. Recent studies have shown that PERFORMS performance metrics correlated with those measured from real-life data (cancer detection (CDR): $p<.001$, recall rate: $p=.002$, and positive predictive value (PPV): $p<.001$), and underperforming outliers identified from PERFORMS had poorer real-life performance in terms of CDR and PPV ($p=.002$, $p=.006$, respectively). Further, a correlation was identified between the number of breast cancers a reader missed in real-life and in PERFORMS ($p<.001$). These data evidence that PERFORMS can rapidly provide a useful insight into real-life performance, which can help radiologists identify their weakness and improve their skills. Indeed, a recent survey including a large number of breast screening readers across Europe highlighted that more than 65% of participants considered QA tests as a tool to improve their skills and 57% had the opinion that assessment test results do reflect their performance in the clinical practice. Together, these findings demonstrate the value of effective QA for performance benchmarking and improvement in breast screening programmes.

TAKE HOME POINTS

External Quality Assurance (EQA) like PERFORMS can rapidly provide a useful insight into reader's real-life image interpretation performance and help driving improvement in breast screening programmes.

The impostor syndrome

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BODY

Impostor syndrome (IS) is a behavioral health phenomenon described as self-doubt of intellect, skills, or accomplishments. The IS is common in high-achieving individuals, and it has been commonly recognized in the academic and medical fields. In its more severe presentation, individuals with IS cannot internalize their success and are subject to experience pervasive feelings of self-doubt, anxiety, depression, and/or apprehension of being exposed as a fraud in their work, despite verifiable and objective evidence of their successfulness. The IS has been found at all levels of academic career, and it seems to be more common in female and minorities, suggesting the presence of environmental factors that could exacerbate the symptoms. Normalize the feelings typical of to the IS, as a common issue in specific communities, and help the person focusing on data and concrete evidence of their high performance could help overcoming the obstacles related to this phenomenon.

TAKE HOME POINTS

The impostor syndrome (IS) is common in the medical and academic communities.
The IS can negatively influence the life and well-being of the affected individuals and can have negative ripercussion on their career development.
Environmental factors can affect significantly affect people at risk for IS.
Recognizing the sympotms related to IS could help overcoming the phenomenon.

B3 lesions treated with vacuum-assisted excision (VAE): preliminary results of a systematic review and meta-analysis

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PURPOSE

To perform a systematic review and meta-analysis of the upgrade rates to malignancy and of the surgical excision rates of B3 lesions treated with vacuum-assisted excision (VAE) after core-needle biopsy (CNB), also analyzing the procedural complication rate of VAE.

METHODS

After protocol registration on PROSPERO (CRD42023396663), PubMed and EMBASE were searched for articles published up to 15/04/2023 reporting the use of VAE on B3 lesions diagnosed at CNB, taking surgical pathology and/or follow-up as reference standard.

Three readers independently performed article selection and extracted data for the following endpoints: immediate upgrade rate, rate of complications, rates of immediate and long-term surgical excision, upgrade rates after immediate surgical excision and during follow-up. Random-effects meta-analyses of single proportions were performed for each endpoint.

RESULTS

Sixteen studies (3941 patients, 3975 VAE procedures) from 6 countries, published between 2008 and 2023, were included in quantitative synthesis. The summary immediate upgrade rate at VAE was 4.0% (95% CI 1.4–7.6%).
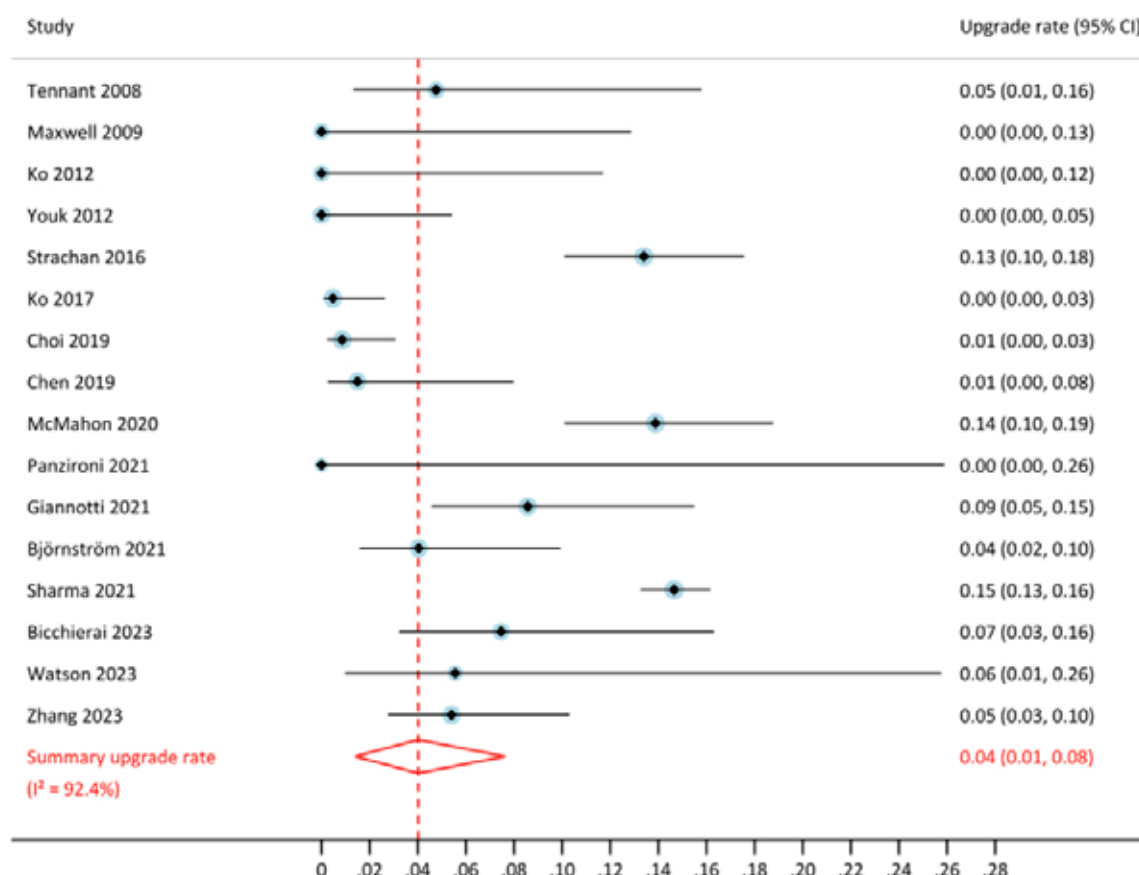
Upgrade to malignancy after VAE
A total of 81 complications were found among 854 patients and the overall summary complication rate was 6.6% (95% CI 1.3–14.6%): 79 (97.5%) were minor complications whereas only 2 (2.5%) were major complications.

B3 lesions treated with vacuum-assisted excision (VAE): preliminary results of a systematic review and meta-analysis
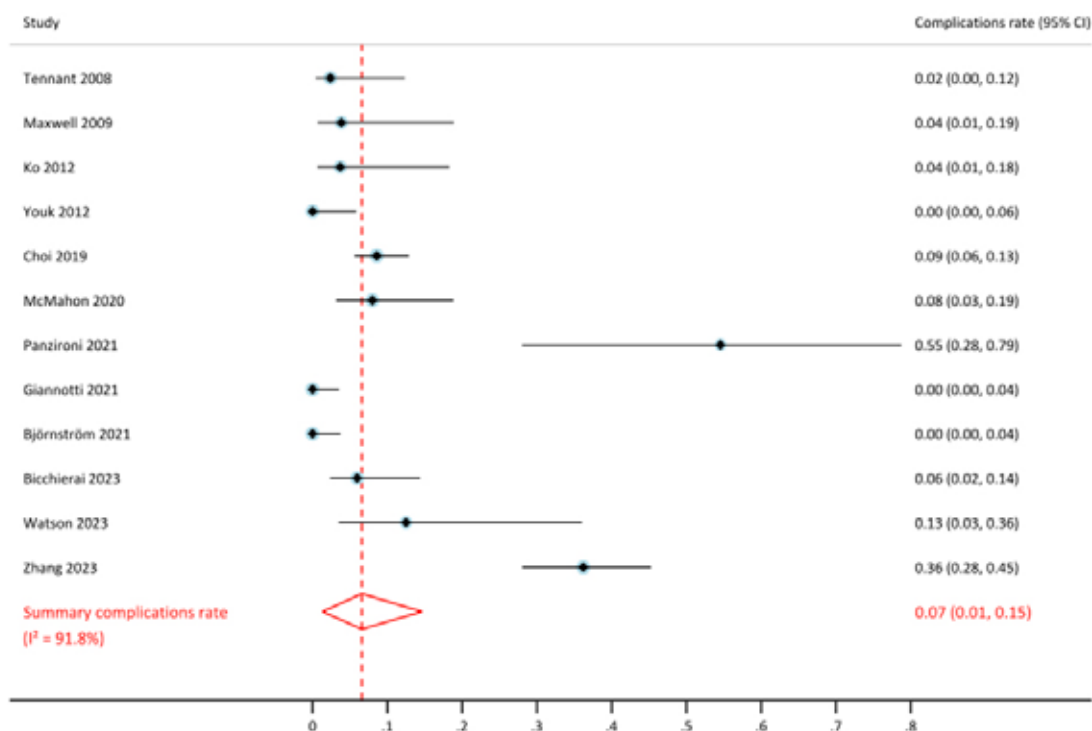
Complications

Immediate surgical excision was performed in 214 cases, with a 1.5% immediate surgical excision summary rate (95% CI 0.1%–3.6%) and a corresponding 25.4% summary upgrade rate (95% CI 11.0–42.4%).
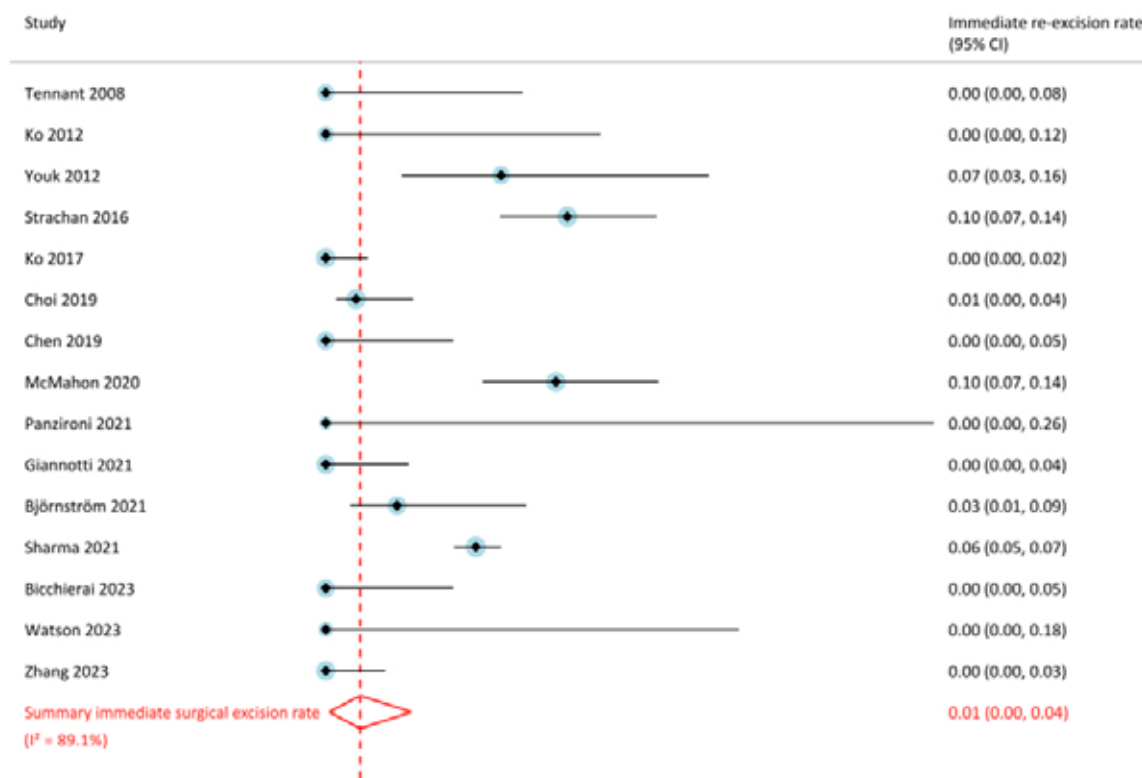
Immediate surgical excision

Among 1375 patients in follow-up, surgical excision was performed in 39 cases, with a 1.5% summary rate of surgical excision during follow-up (95% CI 0.1%–3.5%) and a summary upgrade rate during follow-up of 0.01% (95% CI 0.0–0.6%).

B3 lesions treated with vacuum-assisted excision (VAE): preliminary results of a systematic review and meta-analysis

Study		Long-term re-excision rate (95% CI)
Tennant 2008		0.29 (0.13, 0.53)
Ko 2012		0.00 (0.00, 0.12)
Youk 2012		0.00 (0.00, 0.06)
Strachan 2016		0.00 (0.00, 0.02)
Ko 2017		0.03 (0.01, 0.06)
Choi 2019		0.06 (0.03, 0.11)
Chen 2019		0.01 (0.00, 0.08)
McMahon 2020		0.04 (0.02, 0.07)
Panzironi 2021		0.00 (0.00, 0.26)
Björnström 2021		0.07 (0.02, 0.18)
Bicchierai 2023		0.00 (0.00, 0.06)
Watson 2023		0.00 (0.00, 0.23)
Zhang 2023		0.04 (0.02, 0.10)
Summary long-term surgical excision rate (I^2 = 74.1%)		0.02 (0.00, 0.04)
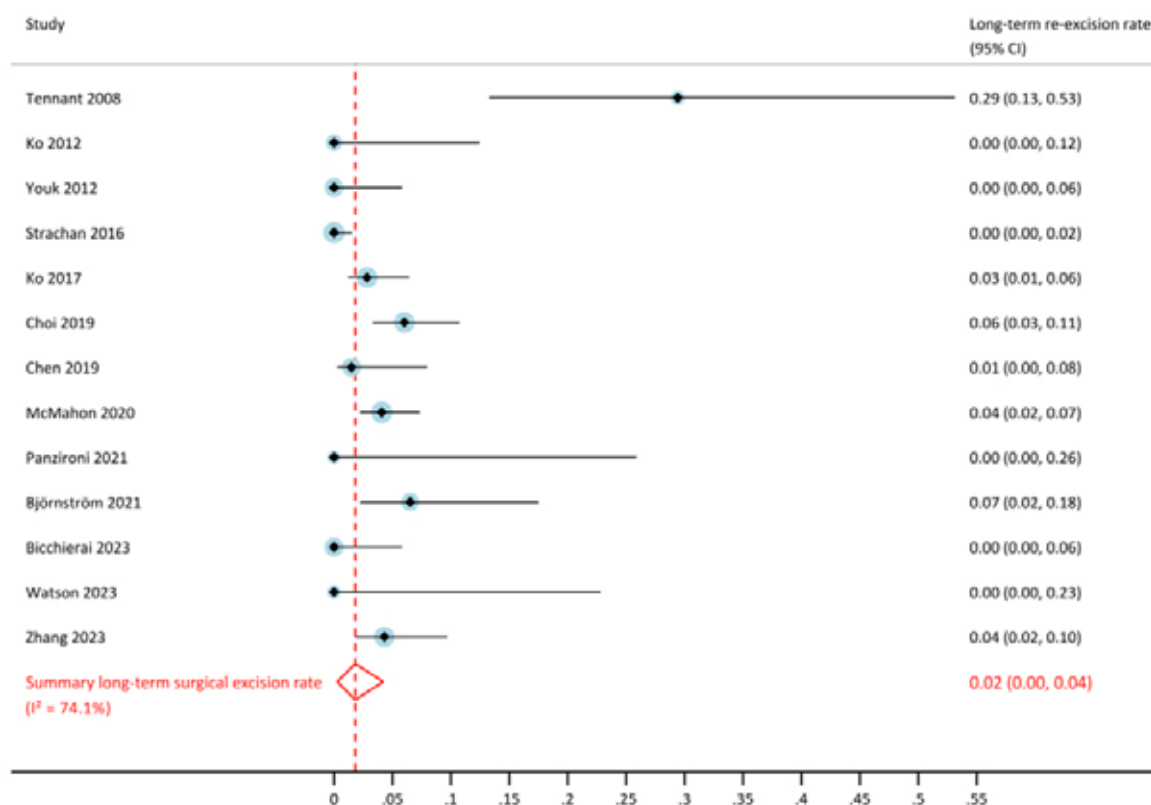
Long-term surgical excision

CONCLUSION

This systematic review and meta-analysis demonstrates low rates of procedural complications and of immediate upgrade after VAE, with similar rates of immediate and long-term surgical excision. The upgrade rate after immediate surgical excision was 6-fold higher than the immediate upgrade rate after VAE.

SUMMARY STATEMENT

VAE of B3 lesions has low rates of procedural complications, immediate upgrade to malignancy, and surgical excision, highlighting its promising role as first-line treatment of high-risk lesions.

A panoramic view for supine breast MRI

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PURPOSE

A wearable breast coil (BraCoil) for supine MRI has recently been introduced [1], enhancing signal-to-noise ratio significantly while improving patient comfort. Supine positioning allows maintaining the same breast shape as in ultrasound, biopsies and surgery, facilitating the correlation of findings. However, supine image visualization in Cartesian view is inefficient. To overcome this issue, a novel panoramic view [1] is proposed and compared to standard breast MRI.

METHODS

The study was approved by the local ethics committee (EK No. 2137/2021) and informed written consent was obtained from all subjects. Clinical breast assessment protocols were acquired on 4 healthy volunteers and 3 patients using a 3 T MRI scanner, the flexible BraCoil (supine), and a standard rigid breast coil (prone) as reference. Acquired images were evaluated by two experienced breast radiologists.

Panoramas were created using 3D Slicer [2] by applying two consecutive curved planar reformatting transforms along manually drawn curves (sagittally along the sternum, and axially along the breast shape) shown in Fig 1.
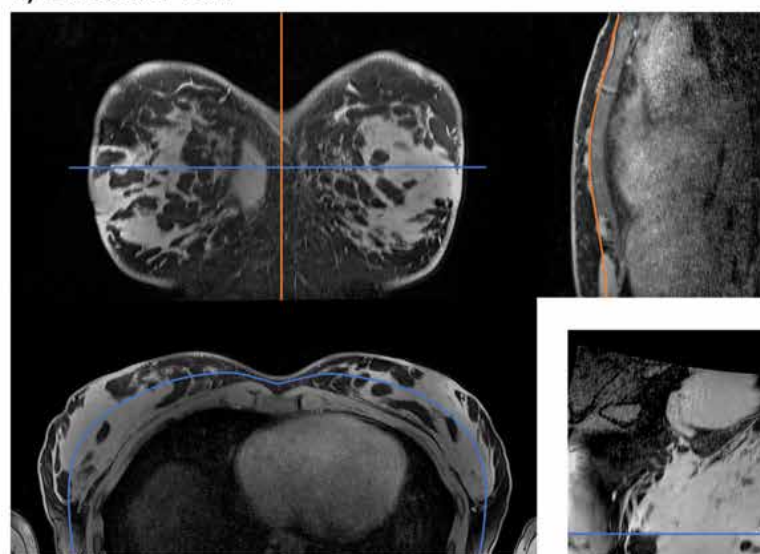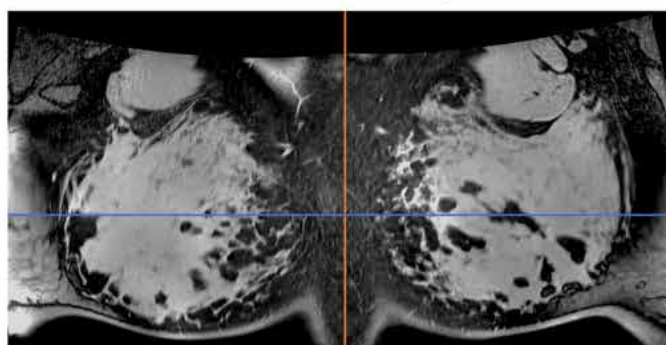
Fig. 1: Workflow for panoramic breast image generation (taken from ref [1]): a) In the Cartesian view two lines are manually identified: 1) along the sternum sagittally (orange) and 2) following the shape of the breast axially (blue). b) The panoramic view is created by consecutive curved planar reformatting along both previously identified lines.
After manual breast segmentation and panoramic transformation, the volumes were cropped to the extent of the breast tissue to calculate the slice reduction achieved by the panoramic transform.

A panoramic view for supine breast MRI

RESULTS

The panoramic view yielded considerably fewer slices containing breast tissue compared to the reference. A slice reduction (Fig. 2) of 52-73% was shown on 3 volunteers, with higher reduction for smaller breasts.
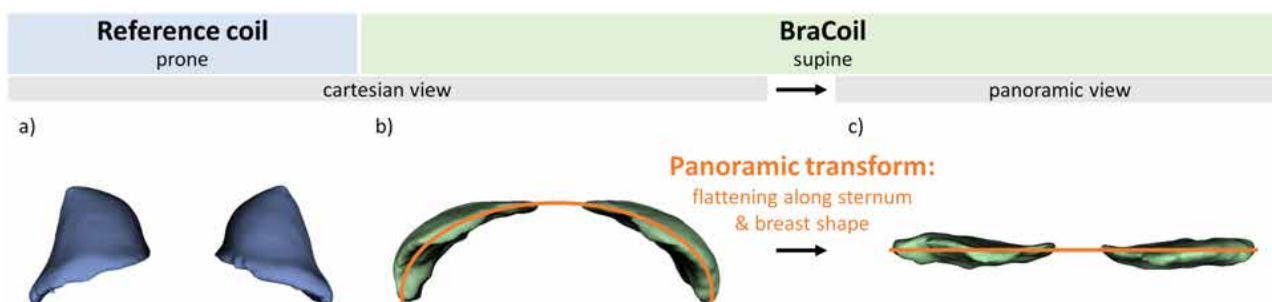
Fig. 2: Comparison of segmented breast volumes: a) Images acquired with the reference coil and b) with the BraCoil in Cartesian and c) panoramic view. The orange line indicates the curve which was used for curved planar reformatting.
Fig. 3 shows a comparison between the panoramic and Cartesian views for varying volunteer breast sizes.
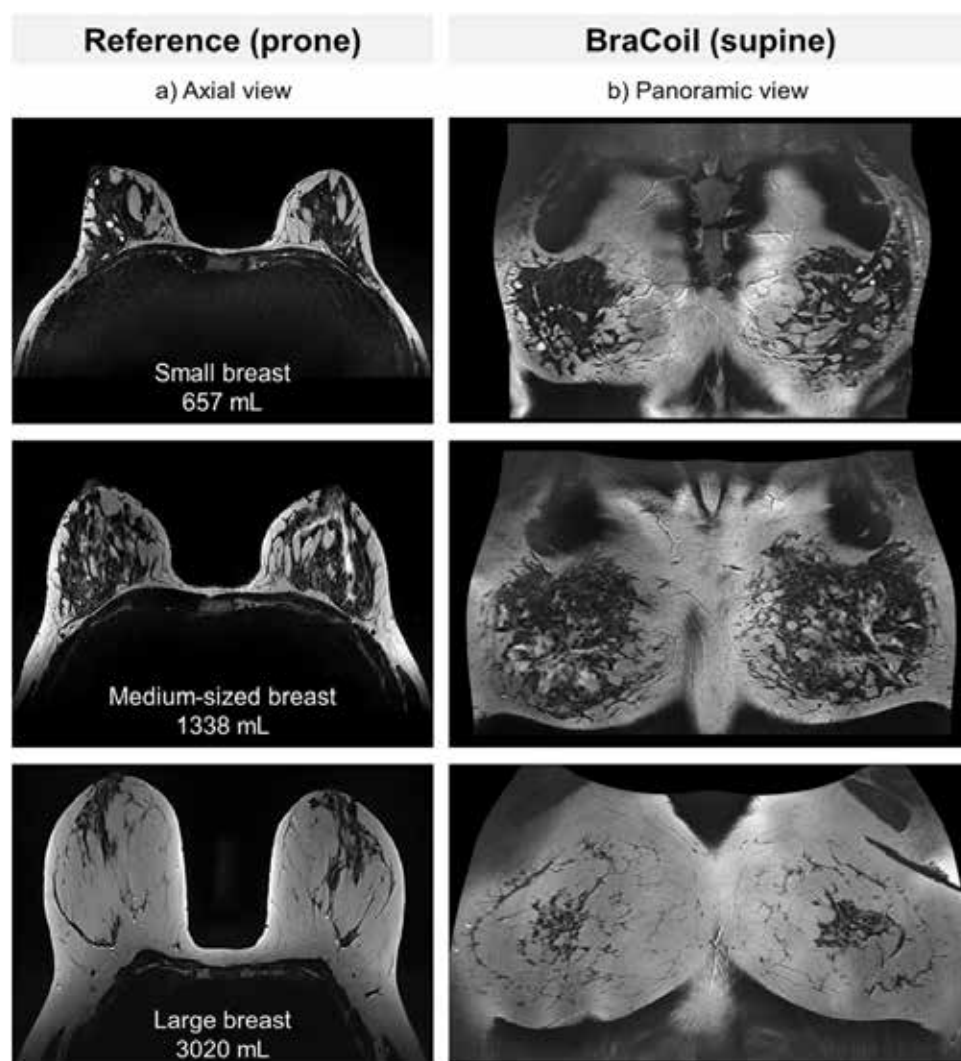
Fig. 3: Comparison of different views for varying breast sizes: a) Axial images acquired in prone position with the reference coil; b) panoramic view of images acquired in the supine position with the BraCoil. T2w images with resolution < 0.6x0.6x1.8 mm3 are shown.
In Fig. 4 a comparison between the views is presented for multiple contrasts in three patient cases. In patient 1 and 2 invasive breast cancer was diagnosed, in patient 3 a fibroadenoma.
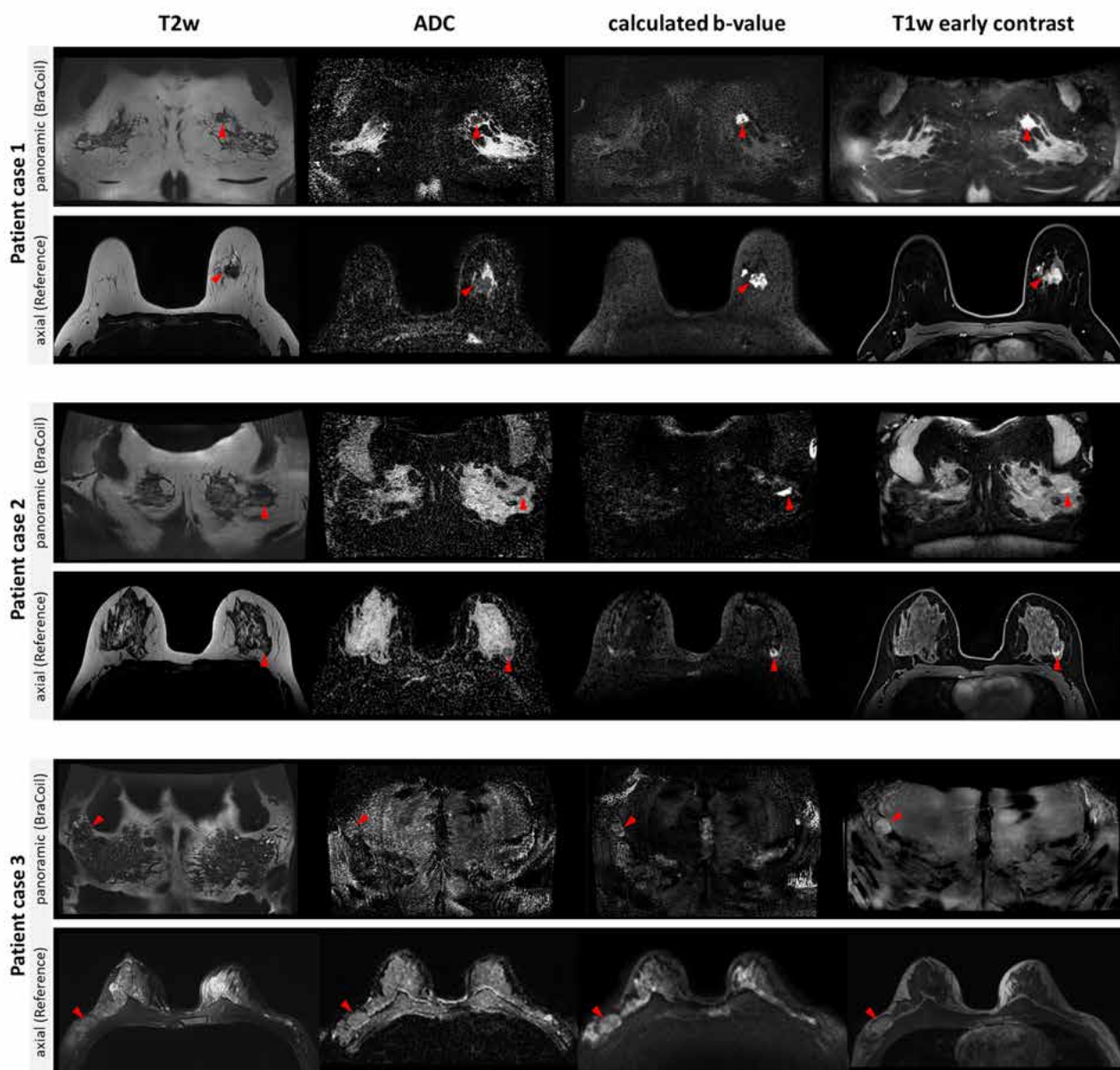
Fig. 4: Patient cases in panoramic and axial view: a) T2w images, b) ADC maps, c) calc. high b-value maps (bcalc=1200-1400 s/mm², b=0/800 s/mm²), d) CE T1w images. For case 3 in axial view b=800 s/mm² is shown and different FS settings (in T1w and T2w images) are used. Red arrows indicate lesions.

To demonstrate the potential of the panoramic view, Fig. 5 shows how breast and axilla can be assessed simultaneously, enabling easy and intuitive lesion description (which could in the future be automatized).

A panoramic view for supine breast MRI
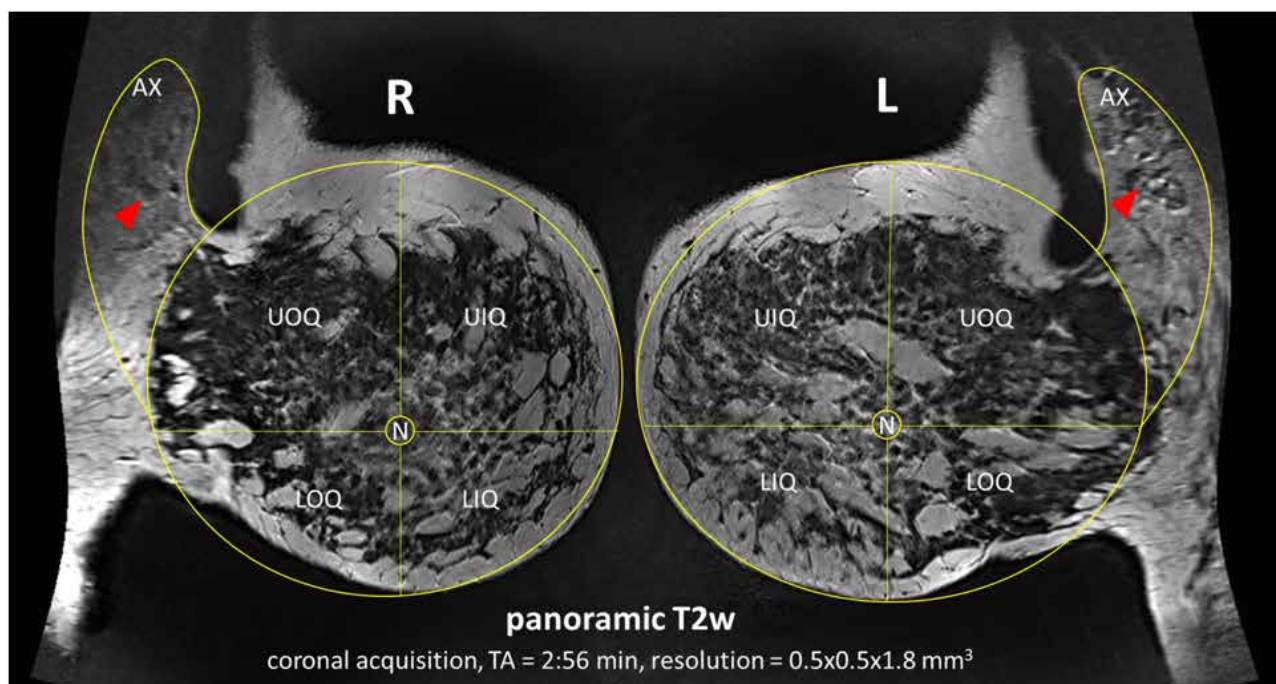
Fig. 5: Panoramic view of the breast and axilla: Image acquired with the BraCoil in supine position. Quadrants, the nipple and axilla area are labeled. Red arrows indicate axillary lymph nodes.
Current limitations are the laterally lower resolution arising from non-isotropic acquisition resolution and geometric distortion in the edges of the panorama. In future studies, isotropic voxels and flattening following a 3D surface [3] are targeted.

CONCLUSION AND SUMMARY STATEMENT

We propose an intuitive panoramic view of supine breast images, enabling the simultaneous viewing of breast and axilla while reducing the number of slices to be read, potentially facilitating the description of lesion position.

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New ultrasound techniques for improved breast care

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Radboudumc, Medical Imaging, Nijmegen, NL

BODY

Currently, a revolution in ultrasound imaging is taking place. Innovative ultrasound technologies allow frame rates up to 10.000 images a second, blood flow quantification down to mm/s, and resolutions in the order of 10 microseconds. This will boost ultrasound-based breast cancer detection and characterization.

Ultrafast plane wave ultrasound imaging will boost 3D ultrasound by making it close to real-time. In ultrafast plane wave imaging, an image is not acquired line-by-line by sending a multitude of narrow ultrasound beams, but by transmission of a plane covering the full region of interest. In this way, scanning will be 100 to 250 times faster increasing the frame rate up to 10.000 images a second. In this way, by using matrix array technology or dedicated breast scanners with translating transducers, full volume breast scanning becomes feasible in a few seconds. A downside of ultrafast plane wave imaging is the reduced penetration depth and decreased contrast. However, by applying advanced processing techniques which combine multiple plane transmissions at different steering angles, the contrast, resolution, and penetration depth can be increased. Quantitative analysis demonstrates that even conventional ultrasound imaging can be outperformed by this technology. Another benefit of ultrafast imaging is the potential to quantify very low flow rates making neovascularization around lesion visible. By smart filtering of multiple high frame rate images, slow flow information can be derived even in small arteries. This so-called ultrasensitive Doppler cannot only visualize low flow in arteries but also the slow flow in the lymphatic system can be detected with this technology. Finally, by combining ultrafast imaging with ultrasound contrast agents, a resolution in the order of 10 microns can be obtained providing detailed information on the vasculature down to the arterioles. This opens new possibilities to detect and quantify the vascularization around lesions. Very recently, a new technology using the red blood cells as contrast agent have been presented, that might obviate the use of contrast agents in the near future.

Conclusion: in the upcoming 5 years, newly developed innovative ultrasound techniques will revolutionize ultrasound imaging based breast cancer detection and characterization.

TAKE HOME POINTS

1. There are new ultrasound imaging techniques currently being availanble or being developed that will boost the performance dramatically
2. In the near future, new ultrasound techniques will have huge impact on breast care since image quality, 3D imaging, and quantification of vasularisation will significantly improved.

Real-world Use of AI in Breast Imaging – from Evidence to Implementation
AI as an independent reader for screening mammograms

K. Dembrower
Stockholm, SE

BODY

At Capio S:t Görans Hospital, Lunit AI is used in daily clinical practice, as an independent reader in breast cancer screening, since April 2020 and since June 2023 replacing one radiologist.

In this session, Dr. Dembrower covers an advancement where, at Capio S:t Göran Hospital, for the very first time, AI takes on the role of interpreting mammograms as an independent reader in a structural and validated setting. The innovative approach not only enhances productivity but also reduces the necessary workforce by half in the double screening setting. She will present how you can leverage AI technology in a safe, scalable, and effective manner.

The decision to adopt Lunit INSIGHT MMG by S:t Göran Hospital was bolstered by the results of the world's first prospective medical AI study. Led by Dr. Fredrik Strand at Karolinska University Hospital. The study examined data from 55,581 Swedish women provided by S:t Göran Hospital. The study demonstrated that the combined analysis of one radiologist and AI achieved higher cancer detection rates and lower recall rates compared to the analysis performed by two radiologists.

Sweden currently struggles with a pronounced shortage of radiologists, posing challenges to efficient mammography analysis. In response, Lunit INSIGHT MMG is poised to play a pivotal role in addressing this shortage and enhancing the efficacy of cancer screening programs. By harnessing the power of artificial intelligence, the solution assists radiologists in accurately interpreting mammography images, alleviating the burden on limited resources.

The evolving role of US VAB throughout the patient journey, from advanced diagnostic to percutaneous lesion excision

V. Dominelli
Milan, IT

BODY

Vacuum-assisted breast biopsy (VAB) has become a widely used method for the diagnosis of breast diseases.

This percutaneous breast biopsy procedure is safe and easy to use, and it provides reliable diagnostic accuracy with higher sensitivity and specificity compared to core needle biopsies.

Recently the vacuum-assisted system has started to be used also for the complete excision of benign lesions and B3 lesions with surprising results: the US-guided vacuum-assisted breast excision (VAE) is in fact highly accurate for diagnostic purpose and highly successful for complete excision, especially for target smaller than 2 cm. Many studies show that VAE is a good alternative approach for the management of B3 lesions reducing the need for open surgical procedures.

Furthermore, recent studies suggest that VAB might reliably exclude residual cancer in patients who underwent neoadjuvant chemotherapy with radiological complete response and many groups are analysing the potential of this technique to select patients for de-escalation of surgical treatment.

Changes in mammography

P. R. Eby
Seattle, US

BODY

The BI-RADS committee of the American College of Radiology is nearly finished with the revised 6th edition of the atlas. This presentation will highlight the major updates and changes expected in the sections of Mammography and Auditing and Outcomes Monitoring.

TAKE HOME POINTS

Changes to the Mammography section include:
· New structured clinical indications
· New DBT guidance chapter and benefits
· Revised breast density language
· Updated descriptors for:
· Masses
· Calcifications
· Asymmetries
· Solitary dilated duct

Changes to the Auditing and Outcomes Monitoring section include:
· Updated benchmarks for 2D Mammography, DBT, Ultrasound and MRI
· Modality neutral indications, assessments, and definitions
· New required audit for BI-RADS 3, (probably benign) findings
· New optional audit for MRI for Extent of Disease
· New section: What not to audit

Imaging and interventions in patients treated with immune therapy

F. Galati
Rome, IT

BODY

Immunotherapy in breast cancer began more than 20 years ago, however its integration into patient care was slower than in other tumor types. Metastatic triple-negative breast cancer was the first setting in which immunotherapy was used. In particular, treatment of triple-negative breast cancer has been transformed with the successful development of immune checkpoint inhibitors (ICI). Studies examining the efficacy of immune checkpoint inhibition in breast cancer have primarily focused on antibodies targeting cytotoxic T-lymphocyte antigen-4 (CTLA-4), programmed cell death 1 protein (PD-1), and programmed cell death ligand 1 (PD-L1). Since then, several clinical trials have investigated the efficacy of immunotherapy in other settings: in the adjuvant and neoadjuvant setting for both triple-negative breast cancer and other molecular subtypes. Ongoing studies are evaluating combination strategies pairing immune checkpoint blockade with additional chemotherapeutic agents, targeted therapy, vaccines, and local ablative therapies to enhance response. Over the past few years, a number of minimally invasive imaging-guided treatments have been tested in order to further reduce invasiveness, including radiofrequency, microwaves and laser ablation, cryoablation, and high-intensity focused ultrasound. With the exception of cryoablation, all the above-mentioned techniques use hyperthermia that melts cell membranes causing protein denaturation. In contrast, cryoablation leaves tumor proteins and tumor-associated antigens intact. Therefore, one of the most intriguing aspects of cryoablation is the potential for immune activation. Theoretically, in situ cryoablation is ideal for generating an anti-tumor immune response, also based on the mechanism by which cryoablation kills cancer cells. Necrosis, as occurs with cryoablation, is characterized by cellular breakdown and release of intracellular contents, many of which are immunostimulatory. Several studies have shown that necrotic cells will lead to increased dendritic cell maturation and macrophage activation. In contrast to cryoablation, most other cancer therapies induce apoptosis rather than necrosis. Apoptosis leads to an inhibition of pro-inflammatory cytokines, and immunosuppressive dendritic cells that trigger clonal deletion and anergy. Therefore, the synergy of different therapeutic strategies that first prime the immune system, as cryoablation does, and then expand and strengthen the pre-existing immune response, as ICIs do, could lead to clinical control of the disease. The combined approach may be potentially superior to other therapeutic strategies and become an additional tool in the oncological treatment of breast cancer.

TAKE HOME POINTS

Immunotherapy in breast cancer is a constantly evolving field. Breast imaging can predict treatment outcomes and tailor therapeutic strategies.

Cryoablation can induce a local and systemic tumour-specific immunological response. The combined approach of cryoablation and immunotherapy may open new therapeutic strategies for breast cancer treatment.

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Changes in ultrasound

G. Ivanac
Zagreb, HR

BODY

The BIRADS fifth edition includes the second edition for the breast ultrasound (US). Modifications achieved harmonizing lexicons across mammography, US and magnetic resonance (MR), anticipated the growing trends of supplemental screening, automated breast ultrasound and sonoelastography and helping to guide us toward efficient interpretation and reporting.

At ultrasound examination one should first mention the dominant tissue composition that should correlate with mammographic density patterns.

In selecting the BIRADS category the descriptors for the mass margin in ultrasound must be divided into circumscribed (suggesting benignity but not specific) or not circumscribed, with latter having subcategories of indistinct, angular, microlobulated and spiculated margins. The descriptor orientation, echo pattern and posterior acoustic features are ultrasound specific, and secondary to the shape and margin when estimating the likelihood of cancer; vertically oriented lesions are most likely being malignant. Regarding calcifications BIRADS recognizes calcifications in a mass, calcifications outside of the mass or intraductal calcifications. There are more and more occasions when the US is used for correlating with mammographic calcifications.

Associated features are very important, as duct and skin changes, edema, architectural distortion, vascularization (none, marginal or penetrant) of lesions and above all evaluation of elasticity/stiffness of the lesions by shear-wave or strain sonoelastography. BIRADS also provides many "special cases" findings.

TAKE HOME POINTS

1. To explain which are the typical ultrasound findings of malignancy.
2. To demonstrate several breast ultrasound cases with BIRADS descriptors.
3. To demonstrate ultrasound, mammography and MRI correlation.

Breast Cancer Screening: Today and Tomorrow

C.K. Kuhl
Aachen, DE

BODY

In this lecture, a review of current breast cancer screening and provide an outlook to future strategies will be given. The understanding of breast cancer as a heterogeneous group of diseases has increased since the 1970s, when current breast cancer screening strategies were developed. Now, after decades of mammographic screening, breast cancer mortality has seen a small but still modest reduction. Although in Europe, systematic mammographic screening has been offered for years, still breast cancer remains the main cause of death in women. This indicates that the current "one size fits all" approach to breast cancer screening needs refinement. This lecture will review the current level of evidence of supplemental or alternate breast cancer screening methods.

Identifying normal mammograms in a large screening population using artificial intelligence

K. Lång
Lund, SE

BODY

In this retrospective study, the purpose was to understand whether AI could identify normal mammograms in a screening population. The population consisted of 9581 double-read screening exams, a subcohort of the prospective population-based Malmö Breast Tomosynthesis Screening Trial. It included 68 screen-detected cancers and 187 false positives. The exams were analysed with a deep learning–based AI system (Transpara v. 1.4.0). The AI system categorises mammograms with a cancer risk score increasing from 1 to 10. The effect on cancer detection and false positives of excluding mammograms below different AI risk thresholds from reading by radiologists was investigated. In addition, we evaluated the radiographic appearance, type, and visibility of screen-detected cancers assigned low-risk scores ($\leqslant$ 5). The reduction of normal exams, cancers, and false positives for the different thresholds was presented with 95% confidence intervals (CI). We found that if mammograms scored 1 and 2 were excluded from screen-reading, 1829 (19.1%; 95% CI 18.3–19.9) exams could be removed, including 10 (5.3%; 95% CI 2.1–8.6) false positives but no cancers. In total, 5082 (53.0%; 95% CI 52.0–54.0) exams, including 7 (10.3%; 95% CI 3.1–17.5) cancers and 52 (27.8%; 95% CI 21.4–34.2) false positives, had low-risk scores. All, except one, of the seven screen-detected cancers with low-risk scores were judged to be clearly visible. In conclusion, the evaluated AI system can correctly identify a proportion of a screening population as cancer-free and also reduce false positives. Thus, AI has the potential to improve mammography screening efficiency.

TAKE HOME POINTS

- Retrospective study showed that AI can identify a proportion of mammograms as normal in a screening population.
- Excluding normal exams from screening using AI can reduce false positives.

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MRI: Field strength, coils and image reconstruction

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F. Laun

Universitätsklinikum Erlangen, Friedrich-Alexander Universität Erlangen-Nürnberg, Institute of Radiology, Erlangen, DE

BODY

This talk will cover three aspects of breast MRI.

First, the impact of the main magnetic field strength is discussed. Field strengths of 1.5 T and 3 T are currently used in the overwhelming majority of cases for breast MRI. Nonetheless, lower and higher field strengths increasingly have gained attention recently. On the one hand, portable and point-of-care MR systems have been presented [1], but also new low-field systems operating at roughly 0.5 T have been introduced [2]. These system may present a cost-effective alternative in certain cases providing a sufficiently good image in many cases (c.f. Fig. 1 for an example T1-weighted image acquired at 0.55 T). Ultra-high field MRI at 7 T at the other side of the spectrum offers unique features in terms of image resolution and much increased contrasts (for some MR contrasts) [3]. For example, imaging of further nuclei like sodium becomes possible allowing unqiue insights into lesion homoeostasis (c.f. Fig. 2, [4]). The talk will summarize recent developments in this field and discuss advantages and disadvantages.

Figure 2. Proton and sodium breast MR images of a 44-year old women with invasive ductal carcinoma (arrow) in the right breast. By courtesy of Olgica Zaric from the Danube Private University, Krems, Austria.

Figure 1. T1-weighted breast image acquired at 0.55 T with deep learning reconstruction. By courtesy of Sabine Ohlmeyer (University Hospital Erlangen).

While „coils" usually refers to radio frequency coils in the MRI jargon, the second part of the talk will deal with with another coil class, local gradient coils (Fig. 3). Such coils are not commercially available, but are explored in research projects [5]. They may allow the application of magnetic field gradients larger than 1 T/m, which is more than one order of magnitude larger than currently available on most clinical scanners. In particular, this may allow the exploration of completely new regimes of diffusion-weighted imaging [6]. The challenges to desing such coils and approaches to overcome the challenges will be shortly presented. First image examples will be shown and perspectives will be discussed. Traditionally, the

Figure 3. Breast gradient coil during construction. Litz wire was wound onto a 3D-printed form (upper left). All components were combined into a housing (right) including water cooling. The coil was cast in epoxy (lower left). By courtesy of Sebastian Littin (University Hospital Freiburg) and Tristan Kuder (German Cancer Research Center). >

k-space data has been converted to image space data with a conventional Fourier transform in MRI. With the advent of increasingly powerful computer systems, the use of more advanced image reconstruction approaches has become feasible [7] [8]. A short presentation of recent technical advances will be given and image examples showing the power of the new approaches will be presented. Figure 1 presents an example of an image reconstructed with deep learning methods.

TAKE HOME POINTS
Breast MRI is mostly performed at 1.5 T and 3 T, but lower and higher field strengths become increasingly available and may offer new opportunities.

In reserach projects, local gradient coils are currently explored that provide gradients increased by more than a magnitude compared to clinical scanners.

Deep learning supported reconstructions are making their way into the clinics.

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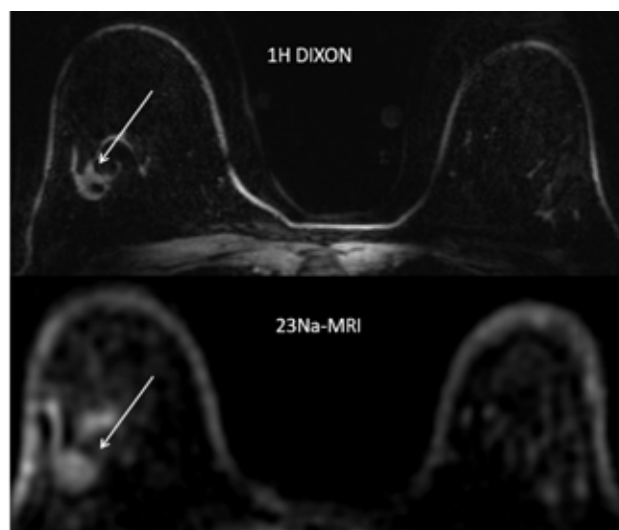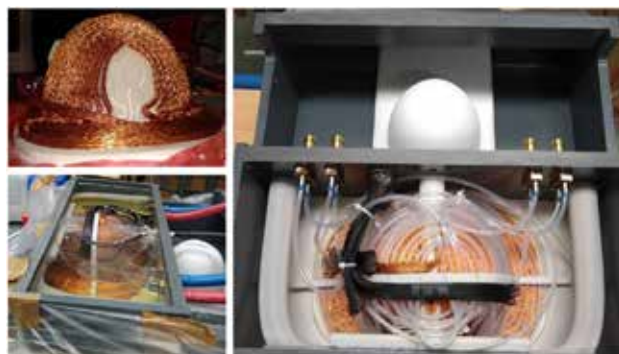[5] *Feng Jia, Sebastian Littin, Philipp Amrein, Huijun Yu, Arthur W Magill, Tristan A Kuder, Sebastian Bickelhaupt, Frederik Laun, Mark E Ladd, Maxim Zaitsev, Design of a high-performance non-linear gradient coil for diffusion weighted MRI of the breast, Elsevier, J Magn Reson, 107052, 331*

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AI in Breast Cancer Risk Stratification

C. Lehman
Boston, US

BODY

Since the creation of the Gail model in 1989, breast cancer prediction models have supported risk-adjusted screening and prevention, and their continued evolution has been central to breast cancer research and clinical practice.1–8 That evolution included adding mammographic breast density to patient and family history, which improved model performance slightly; however, predictive accuracy remained relatively modest at best, with AUC values of .61-.62 depending on the population studied. The majority of these "traditional" risk models were developed on predominantly Caucasian populations1,3,4 and were limited in predicting risk for other racial groups.9-12 These combined factors limited widespread clinical adoption.

In 1998, the FDA approved the first CAD software to assist the radiologist in interpreting mammograms. Both discoveries, the first being the importance of future breast cancer risk assessment and the second being the value of "computer vision" to assist radiologists in detecting cancers on a mammogram, have come together in the new era of AI, supporting novel applications of deep learning to image assessment in order to predict future, as well as detect and diagnose current, breast cancers.

The first publication of an image-based AI model (Yala, 2019) to predict future breast cancer from the screening mammogram was by the research labs at MIT (PI: R. Barzilay) and Mass General Hospital/Harvard Medical School (PI: C. Lehman)13. Their conclusions were that a deep learning model that directly leveraged full resolution mammograms in addition to traditional risk factors outperformed Tyrer-Cuzick v8 and was consistent across demographic subgroups, including race. These results supported the hypothesis that mammograms contain indicators of risk not captured by traditional risk factors, not visible to the human eye, and accessible to deep learning computer vision techniques.

Since that time, several breast cancer risk prediction models have been developed using AI tools. The MIT MGH original models were further developed into the current DL research model (Mirai) and have been tested in multiple centers globally14-15. Dembrower et al at the Karolinska Institute compared performances of a novel deep learning risk model to mammographic breast density models and found a deep neural network trained on mammographic screening images and breast cancer outcome could more accurately predict which women were at risk for future breast cancer than density-based models, with lower false-negative rates for more aggressive cancers.16 Arasu et al compared five AI image-based breast cancer risk prediction models and found that AI predicted incident cancers at 0 to 5 years better than the Breast Cancer Surveillance Consortium traditional risk model (which uses personal and family history along with breast density). They also found slight improvement in performance when combining the Breast Cancer Surveillance Risk model with the AI models17.

Taken together, deep learning (DL) risk models have consistently demonstrated superior predictive accuracy in future breast cancer risk assessment compared to traditional risk models across global institutions. Image-based DL models have advantages beyond accuracy, as they do not require knowledge of the patient's family history or personal history of prior biopsy and pathology, hormone use, menopausal status, or other risk factors required by traditional risk models. DL models have demonstrated equivalent predictive accuracy across diverse patient ages, races and breast density and has been trained and validated in all patients undergoing screening, including those with a known genetic mutation and/or personal history of breast cancer.

Despite the significant potential advantages, further research is needed to more fully understand the impact of a DL score on patient care. For example, can the DL models (given their higher predictive accuracy) provide better support for risk-based over age-based screening? In a recent publication, Lehman et al compared the ability of a patient's prior mammogram's DL risk score to the patient's traditional risk score to identify patients most likely to be diagnosed with cancer in a large cohort due for screening18. They found the DL risk model outperformed traditional risk scores in this specific clinical application of identifying patients at highest risk of cancer based on their prior mammogram's DL score. The implications are that DL models can support feasible and effective risk-based screening across diverse patient populations and are superior to traditional models to identify patients destined to develop cancer in large screening mammography cohorts.

TAKE HOME POINTS

1. In screening mammography, artificial intelligence (AI) tools are available for applications in lesion detection and diagnosis, breast density assessment, triage of exams from low to higher risk, and future risk of breast cancer.
2. For future risk assessment, AI tools can address the significant challenges with traditional risk models of moderate accuracy in all women and poor performance in women who do not identify as European Caucasian.
3. AI tools can extract significantly more information from

the mammogram than the information contained in breast density assessment alone in helping guide decision making to support more effective risk-based screening.

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What do you need to know about implant complications and injectables

A. B. Luengas
Medellin, CO

BODY

Breast augmentation is the most common performed aesthetical surgical procedure. Saline, silicone implants and autologous fat injections are common choices for breast augmentation. The silicone implant surgery is by far the most common option with over one million silicone breast implants surgeries worldwide. There are several types of implants available, including different types of silicone implants, saline, double lumen, and polyacrylamide gel.

Implant complications can be classified into two categories: local complications which occur in the breast and adjacent soft tissue, and
systemic complications such as autoimmune disorders and breast implant illness (BII).

Early post-operative local complications in breast implant surgery include hematoma, infection, and seroma. Late post-operative local complications which occur months or years after the procedure include capsular contracture, infection and implant rupture. Notably, with the increasing number of patients with breast implants, less common complications can be seen such as breast implant-associated anaplastic large cell lymphoma (BIA-ALCL), breast fibromatosis associated with implants, granulomas, and gel bleeding.

Injectable fillers are still used in many countries. Free silicone, autologous fat and biopolymers are some of the materials utilized. Complications associated to injectable fillers include infection, granulomas, chronic cellulitis. Imaging these patients for breast cancer screening and diagnosis is extremely challenging as mammography and ultrasound are significantly limited on these patients.

Breast MRI without contrast is considered the gold standard for evaluation of the breast implant integrity. Breast MRI is also the preferred imaging modality for evaluating breast implant complications as well as the optimal supplemental imaging modality to mammography in patients with free injectable materials.

The aim of this presentation is to review common and uncommon complications associated with breast implants and free injectables materials.

TAKE HOME POINTS

- Breast augmentation is the most common performed aesthetical surgical procedure.
- Implant complications can be classified into two categories: local and systemic complications.
- Post-operative local complications can be classified in early and late complications.
- Complications associated to injectable fillers include infection, granulomas, chronic cellulitis.
- Breast MRI without contrast is considered the gold standard for evaluation of the breast implant integrity.

R. M. Mann

Nijmegen, NL

BODY

Medical practice is increasingly dictated by guidelines and practice recommendations. However, recommendations and guidelines are shockingly different across the world and between guiding bodies, despite the fact that they are based on the same evidence. As a practitioner, it may therefore sometimes be hard to know what guideline to follow, and why. In this lecture, some of the aspects of guideline development will be discussed. Most modern guidelines are based upon evidence based medicine (EBM). Studies are ranked and pooled and evidence is subsequently weighted in one or the other ranking system. However, EBM in the classic form integrates the best (epidemiological) evidence with physician experience and best practices as it is acknowledged that no study can capture all aspects of care. This implies that knowledge of the subject is imperative for creation of good guidelines and realistic appreciation of available data. This implies that EUSOBI will never write a guideline on breast surgery or creation of self-driving cars, but will issue recommendations for breast imaging practice. Unfortunately, some organisations appreciate subject knowledge as a bias and produce guidelines based on very dry interpretation of specific studies, discarding tons of evidence because either the format is not good (e.g. no randomized controlled trial) or because not all items are listed in the report of a specific study, unfortunately very often not wondering whether the setup and performance of the study was acceptable.

It should be realized that guidelines may have different purposes that are not always clearly stated. Many have a financial or political incentive and aim to keep costs at bay or achieve a similar care for all (not necessarily the best care). In essence that is not a bad thing, it remains important to see how we divide the care we can offer to patients as the discrepancies are huge. Still, when this is done, it should be stated in order to allow readers to understand why recommendations are formulated as they are. Such guidelines are usually very conservative, requiring in their evidence rating for example effects on mortality to qualify stuidies as good, which usually comes so late that the techniques are at least 20 years old if not more. Other guidelines may aim to move a field forward, making bolder statements that are based on more recent evidence, but usually lack this kind of data. Most EUSOBI guidelines fall in the latter category, as EUSOBI aims to evolve our field. We understand that this may sometimes lead to criticism, but at the same time see that our work paves the way for implemenation of new techniques, and is commonly followed by other societies.

TAKE HOME POINTS

Guidline variability is due to different interpretation of data and different incentives of the guidelines.
EUSOBI guidelines are usually aimed to move the field forward and should be appreciated as such.

AI in image generation

E. Marcus
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BODY

In this talk, I'll focus on the role of Artificial Intelligence in creating usable medical images. In particular, topics of synthetic mammography, generative AI, and image reconstruction will be highlighted. The talk will address the advantages and disadvantages of employing AI in image reconstruction processes. Specific imaging modalities, including Mammography, MRI, and DBT, will be highlighted to illustrate both the innovations and limitations inherent to AI-based approaches.

TAKE HOME POINTS

AI has the potential to improve and enhance image quality across all modalities.

There must, however, also be good explanations of why, how, and when AI models are to be used.

Need for monitoring in B3 lesions?

M. A. Marino
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BODY

B3 lesions, alternatively referred to as breast lesions with uncertain malignant potential or high-risk lesions, encompass a diverse array of breast conditions. These primarily include atypical ductal hyperplasia (ADH), lobular neoplasia (LN), flat epithelial atypia (FEA), radial scar (RS), papillary lesions (PL), and phyllodes tumors (PT). High-risk lesions are heterogenous diseases with a possible coexistent component of ductal carcinoma in situ (DCIS) or invasive carcinoma at the periphery. Consequently, the needle-sampling might not be representative of the whole lesion, and these can also explain the wide range of upgrade to malignancy (9-35%) at open surgery. B3 lesions are considered non-obligate precursors of malignancy because they can develop into higher-grade lesions, predominantly DCIS and less frequently low-grade invasive tumors. Furthermore, women diagnosed with a proliferative breast disease with atypia face a fourfold to tenfold higher risk of developing breast cancer compared to those without atypia in any location of the same or the contralateral breast. The management and surveillance of surgically excised B3 lesions continue to be debated. Over the past few decades, there have been numerous endeavors to standardize the management of high-risk breast lesions. Open surgery remains the prevailing approach for ADH cases. However, a trend toward less aggressive strategies is emerging for classical LN. In cases of RS, FEA, PT, and PL without atypia, current literature underscores the viability of opting for therapeutic vacuum-assisted excision (VAE) and active surveillance, when the lesion is completely removed in the clinical imaging. The risk of developing breast cancer is not the same for all kind of B3 lesions and it may depend on other different factors such as personal history of breast cancer, genetic predisposition, the original imaging finding, interval changes, symptomatic correlation, radiological-pathological concordance, adequate sampling as well as surgical excision at the time of the diagnosis. The aim of this talk is to provide the audience with an overview of the current evidence for the surveillance of the different type of high-risk lesions.

TAKE HOME POINTS

- Women diagnosed with a high-risk lesin with atypia face a fourfold to tenfold higher risk of developing breast cancer in the same or contralateral breast compared to those without atypia;
- The management and surveillance of surgically excised B3 lesions continue to be debated;
- Personal history of breast cancer, genetic predisposition, the original imaging finding, interval changes, symptomatic correlation, radiological-pathological concordance, adequate sampling as well as surgical excision at the time of the diagnosis play a pivotal role in the risk for a woman diagnosed with a B3 lesion of developing breast cancer.

Performance of Node-RADS Scoring System for a Standardized Assessment of Regional Lymph Nodes in Breast Cancer Patients

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University of Rome "La Sapienza", Radiology, Rome, IT

PURPOSE

Current cross-sectional imaging modalities exhibit heterogeneous diagnostic performances for the detection of a lymph node invasion (LNI) in breast cancer (BC) patients.

Recently, the Node-RADS score was introduced to provide a standardized comprehensive evaluation of LNI, based on a five-item Likert scale accounting for both size and configuration criteria.
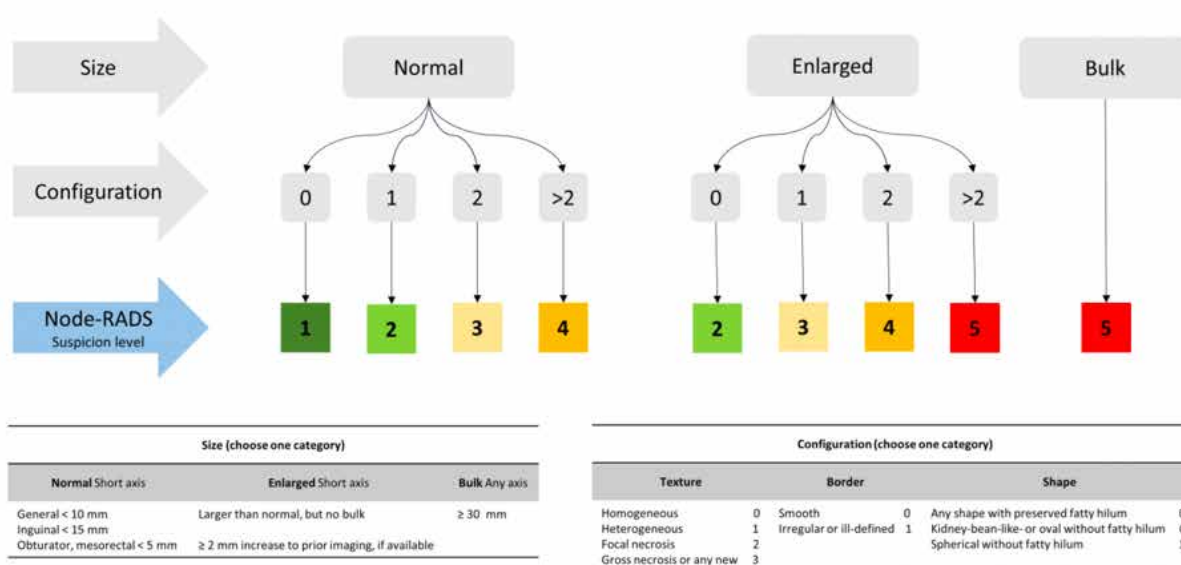
Node-RADS scoring system adapted from the original publication. Elsholtz, F.H.J.; Asbach, P.; Haas, M.; Becker, M.; Beets-Tan, R.G.H.; Thoeny, H.C.; Padhani, A.R.; Hamm, B. Introducing the Node Reporting and Data System 1.0 (Node-RADS): A Concept for Boa_Image_Frameized Assessment of Lymph Nodes in Cancer. Eur. Radiol. 2021, 31, 6116–6 [REF01]

In the current study, we hypothesized that the Node-RADS score accurately predicts the LNI and tested its diagnostic performance. The secondary objective focuses on assessing the applicability and feasibility of the score among readers.

METHODS

We retrospectively reviewed BC patients treated with mastectomy or QUART and lymph node dissection, from January 2020 to January 2023.Patients receiving preoperative systemic chemotherapy were excluded, therefore we included only patients undergoing lymphadenectomy after sentinel node positivity, who refused neoadjuvant therapy (NT) by self-determination and patients who had contraindications to NT.A logistic regression analysis tested the correlation between the Node-RADS score and LNI both at patient and lymphnode level.

The ROC curves and the AUC depicted the overall diagnostic performance. In addition, the sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) were calculated fordi"erent cut-o" values (>1, >2, >3, >4).

RESULTS

Overall, data from 100 patients were collected. Node- RADS assigned on CT scans and CE-MRI images, was found to independently predict the LNI after an adjusted multivariable regression analysis, both at the patient (OR 3.36, p=0.004) and lymph node (OR 5.18, p<0.001) levels. Node-RADS exhibited an AUC of 0.85 and 0.90 at the patient and lymph node levels, respectively. With increasing Node-RADS cut-o" values, the specificity and PPV increased from 50.0 to 95.3% and from 50.3 to 80.0%, respectively. Conversely, the sensitivity and

NPV decreased from 100 to 40.0% and from 100 to 75.3%, respectively. Excellent inter-reader agreement was found in the classification of LN according to the NODE-RADS MRI score.
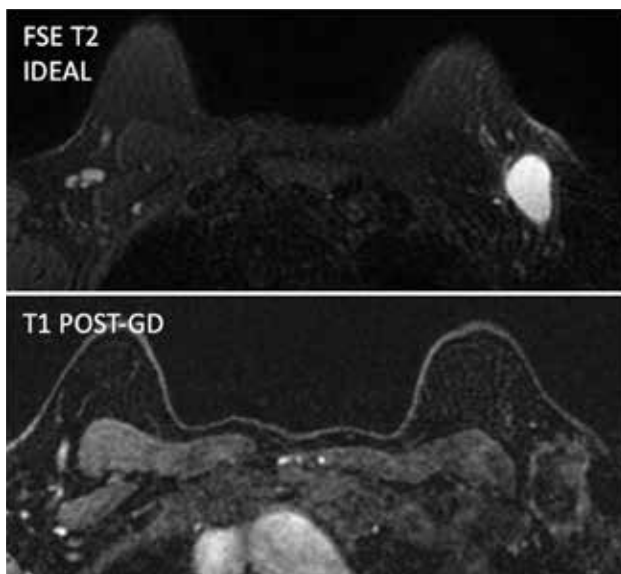
Example of a Node-RADS suspicion level 5: bulk node in the left axillary region.

CONCLUSION AND SUMMARY STATEMENT

The current study lays the foundation for the introduction of Node-RADS for the regional lymph-node evaluation in BC patients. The Node-RADS score exhibited a moderate-to-high overall accuracy for the identification of LNI, with the possibility of setting

di"erent cut-o" values according to specific scenarios. Node-RADS has only been validated in prostate and bladder cancer, showing promising results. [REF02]

References:

[REF01] Elsholtz, F.H.J.; Asbach, P.; Haas, M.; Becker, M.; Beets-Tan, R.G.H.; Thoeny, H.C.; Padhani, A.R.; Hamm, B., (2021), Introducing the Node Reporting and Data System 1.0 (Node-RADS): A Concept for Standardized Assessment of Lymph Nodes in Cancer, Eur. Radiol.

[REF02] Costantino Leonardo 1,†, Rocco Simone Flammia 1,† , Sara Lucciola 2, Flavia Proietti 1 , Martina Pecoraro 2 , Bruno Bucca 1, Leslie Claire Licari 1, Antonella Borrelli 2, Eugenio Bologna 1, Nicholas Landini 2, Maurizio Del Monte 2, Benjamin I. Chung 3, Carlo Catalano 2, Fabio Massimo Magliocca 4, Ettore De Berardinis 1, Francesco Del Giudice 1,3,,‡ and Valeria Panebianco, (2021), Performance of Node-RADS Scoring System for a Standardized Assessment of Regional Lymph Nodes in Bladder Cancer Patients, MDPI, Cancers*

Creating a work environment that keeps you happy

G. Maskell
Truro, GB

BODY

There is increasing evidence that staff wellbeing contributes to better outcomes for patients.

Happiness at work relies on three main factors:
Autonomy – the need to have control over our work lives and to act consistently with our work and life values.
Belonging – the need to be connected to, cared for and caring of others around us in the workplace and to feel valued, respected and supported.
Competence - the need to experience effectiveness and to deliver valued outcomes, such as high-quality care. This includes the need for opportunities to increase our knowledge and skills through training and development.

Healthier and happier staff are better motivated, more productive and likely to work for longer. It is tempting to think that the work environment is outside our control but this is not necessarily the case.

TAKE HOME POINTS

You have more control over your working environment than you realise.

Each of us has the ability to make either a positive or a negative contribution to the working environment of those around us and hence to the quality of care which they deliver to patients.

Take time to reflect on what your impact is on those around you. We all have a professional duty to make that impact a positive one.

Single-center retrospective evaluation of Contrast-Enhanced mammography (CEM) Enhancing Asymmetry's features.

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PURPOSE

To define which conventional imaging characteristics are more frequently correlated with the enhancing asymmetry (EAs).

METHODS

A total of 4508 CEM exams, executed at our center, between 2019 and 2022 were retrospectively assessed by two radiologists in consensus, with 5 and 10 years of experience in breast radiology, in search of enhancing asymmetries, defined as a finding seen in only one view on the recombined images [1], as stated by the brand new ACR BI-RADS lexicon for CEM (2022) [2] [3].

For each one of the EAs found we described the size, the enhancing conspicuity (degree of enhancement described as low, moderate, or high), the presence of background parenchymal enhancement (BPE) of normal breast tissue (minimal, mild, moderate, marked), the projection they have been detected on, whether there was a corresponding finding on the traditional radiology images (Ultrasound - US or digital mammography - DM) or in MRI (conducted when no correlate was detected on conventional imaging), and the biopsy results when performed, including any follow-up exams. Fisher test was applied to calculate any statistically significative difference.

RESULTS

The population was made up of 96 women aged between 34 and 87 years old (mean age 59.5 years old, median age 54 years old) with 96 EAs (2.1% of the 4508 CEMs). Among the cases, 59/96 (61.5%) underwent CEM for presurgical staging due to biopsy-proven malignant lesions, and 37/96 (38.5%) as a work-up examination after previous inconclusive exams. A total of 55 EAs were detected on CC view, 41 on MLO view.

Reassessing low energy images and second-look US [4], we categorized the findings in: focal asymmetrical densities (10/96); architectural distortions (13/96); microcalcifications (16/96); masses either seen on US (22/96) or DM (31/96); MRI findings (4/96).

After biopsy, among 96 EAs, 31/96 (32.3%) resulted as B5 lesions, 8/96 (8.3%) as B3 lesions and 57/96 (59.4%) were benign either at the histology result, at MRI or at 12 months follow-up with DM and US.

Using Fisher test, we inferred that EAs more frequently correlate with mammography masses (31/96) and have a higher risk of malignancy the larger they are (p: 0.0274) and the higher the enhancing conspicuity is (p: 0.0071)[5] [6].
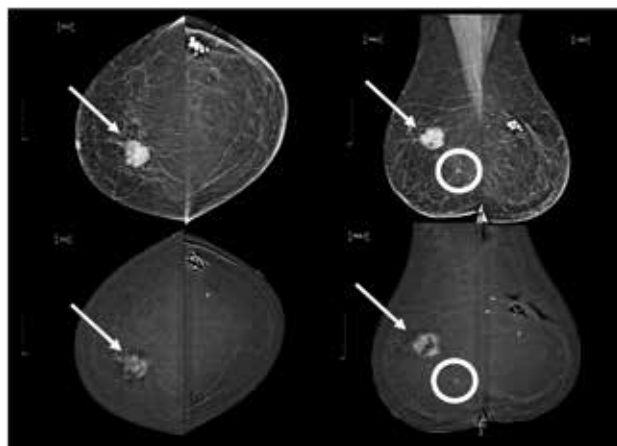
69 years old patient undergoing CEM as pre-surgical staging of a biopsy-proven B5 lesion in the right breast. In the same breast in the inferior quadrants there is an Enhancing Asymmetry, only visible in MLO, whose correlate is a mass, that resulted as an additional B5 lesion after biopsy.

CONCLUSION AND SUMMARY STATEMENT

Detecting an EA, it more likely correlates to a mass on the low energy images and it need to be assessed like the other CEM descriptors (mass and non-mass) especially larger ones with higher enhancing conspicuity.

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Breast imaging in 2040

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BODY

SCREENING MAMMOGRAPHY

Breast cancer imaging has transitioned from an anatomic assessment to one that incorporates functional information with many contrast-enhanced examinations using mammography, US, MRI, PET, and molecular imaging. In 2014, Drs Joe and Sickles wrote "The Evolution of Breast Imaging: Past to Present" to commemorate the 100th anniversary of the RSNA (13). They highlighted the development of the MLO view and other specialized mammographic views, such as spot compression and magnification views (13). Early on, breast imagers tailored the evaluation of a mammographic finding or a breast symptom to a particular woman.

The article recounted the evolution from direct exposure mammography to xeromammography and screen-film mammography (13). Digital mammography replaced analog film mammography in the early 2000s, and DBT is emerging as the new standard of care in screening mammography (14). In DBT, multiple mammographic projections are acquired over an arc; these projections are reconstructed into a series of stacked images. DBT is preferred for dense breasts. It is important to stress that screening mammography is the only imaging examination shown in multiple randomized controlled trials to reduce mortality from breast cancer. These trials consistently show a 15%–30% reduction in breast cancer deaths among women aged 40–74 years invited to screening mammography (15). Extensive population-based observational studies, which test actual screening as opposed to the invitation to screening, provide valuable information on the effectiveness of modern service screening. These observational studies, performed in Europe, Canada, Australia, and New Zealand, have shown a 38%–49% reduction in mortality from breast cancer (16–18).

BOA_IMAGE_FRAMEIZATION OF IMAGE QUALITY, QUALITY ASSURANCE, AND AUDITING

By 1985, the success of population-based screening programs and the development of methods for preoperative localization of breast lesions led to increased mammography utilization. However, there were growing concerns about the wide variability of mammogram quality (13,19,20). In 1986, the American College of Radiology (ACR) convened a committee of radiologists, medical physicists, and the US. FDA representative to develop a voluntary mammography accreditation program (19,20). In 1992, the U.S. Congress passed the Mammography Quality Boa_Image_Frames Act (MQSA). The MQSA required mammography facilities nationwide to meet uniform quality standards for early breast cancer detection. Under the law, all mammography facilities must be accredited and certified by an FDA-approved accreditation body and undergo an annual MQSA inspection. Also, the ACR offers accreditation programs for breast US and MRI.

STRUCTURED REPORTING AND EVIDENCE-BASED GUIDELINES

In 1986 ACR committee convened to develop a voluntary mammography accreditation program; the need for standardized reporting had already become evident. The standardization would require accurate interpretation and clear communication of findings and recommendations to referring clinicians (13,19). In the late 1980s, the ACR instituted the BI-RADS to standardize mammography practice reporting (13,21). The BI-RADS lexicon and reporting system enable radiologists to communicate results to the referring physician clearly and consistently, with a final assessment and specific management recommendations (22). The BI-RADS atlas, now in its fifth edition, provides standardized breast imaging terminology, report organization, assessment structure, and a classification system for mammography, US, and MRI of the breast. BI-RADS also provides a medical audit and outcome monitoring—an essential mechanism for peer review and quality assurance data to improve the quality of patient care (22). Radiologists have adopted this standardized reporting system for many organ systems throughout the human body. For example, PI-RADS and LI-RADS are modeled after BI-RADS.

Further standardization continued with the publication of guidelines and imaging protocols for performing all breast imaging modalities. Societies published statements on the role of screening mammography in women at average risk for breast cancer, further standardizing its utilization (23–25). Organizations also issued guidelines on screening breast MRI in women at intermediate and high risk for breast cancer (26,27). A meta-analysis and recommendations for supplemental screening in women with dense breast tissue and a routine screening mammogram were recently published (28–30).

MOLECULAR PROFILING AND PRECISION MEDICINE

In 2001 Sørlie et al. (31) demonstrated that breast cancer is a heterogeneous disease with intrinsic molecular subtypes associated with different overall and relapse-free survival

rates. This gene expression profiling led to precision medicine and the ability to match targeted therapies to select patients.

Precision medicine offers more than population-based screening because it is medicine optimized to an individual's genotypic and phenotypic characteristics and their specific cancer (32). Multiple genomic profiling tests help guide treatment decisions and determine the likelihood of breast cancer recurrence. Recently, the Trial Assigning Individualized Options for Treatment (Rx), or TAILORx, presented the results of their 12-year follow-up study of 10 273 women with ER+/HER2- and lymph node–negative breast cancer (33). They used a genetic profiling score to predict the likelihood of recurrence and found that chemotherapy use may be spared in women with a low-risk score.

Unlocking the genomic features of cancer led to the development of radiomics and radiogenomics (32,34). Radiomics refers to the extraction and analysis of quantitative data from medical images. Radiomics aims to develop imaging biomarkers that can help diagnose, predict, and guide cancer treatment. Radiogenomics aims to correlate imaging characteristics (i.e., the imaging phenotype) with underlying genes, mutations, and expression patterns (32,34). Radiogenomics may lead to more holistic patient-focused outcomes by incorporating phenotypic and genotypic metrics that can predict risk and patient outcomes and thereby better stratify patients for more precise treatment (32). We know that indolent cancers become heterogeneous by acquiring genetic mutations that lead to de-differentiation and the development of treatment-resistant subclones. Much research has focused on understanding the effects of the tumor microenvironment on clonal evolution by combining imaging-based data with other clinical, genomic, laboratory, and pathologic "-omics" to identify resistant subclones that eventually metastasize. These imaging biomarkers are highly complex, and AI processes and analyzes a large amount of data. We need to understand these radiomic data and determine whether these biomarkers can be surrogates for tumor heterogeneity and allow escalation or de-escalation of treatment. However, linking imaging features to molecular subtypes and clinically meaningful outcomes is challenging. The lack of standardization of these imaging features and the inability to reproduce these results in diverse patient populations have limited the clinical implementation of radiomics and radiogenomics (34).

TAKE HOME POINTS
AI AND BREAST IMAGING

AI models will steadily change how we detect and manage breast cancer. Some articles found that AI systems improved the detection of interval cancers and had a high diagnostic performance in a nonenriched population-based screening program (35,36). Other publications demonstrated that AI could improve clinical efficiency and reduce our workload by decreasing the number of false-positive findings. AI systems may also triage normal digital mammograms and DBT examinations to be interpreted solely by stand-alone AI systems (37,38). With federated learning and the increasing availability of larger, publicly available annotated data sets, AI algorithms will augment the detection and characterization of breast cancer for multiple imaging modalities, including US, MRI, and contrast-enhanced mammography. Stand-alone AI systems will help streamline our workflow, and conversational AI language tools like ChatGPT (https://openai.com/blog/chatgpt/) will generate our reports.

Novel screening technologies will play a more prominent role in risk modeling and identifying women at risk for breast cancer (14). Noninvasive liquid biopsy (ie, with blood, urine, or other body fluid) will provide inexpensive predictive genomic information by isolating tumor-derived fragments. These tumor-derived fragments include circulating tumor cells and circulating tumor DNA released from tumor tissues through secretion, necrosis, and apoptosis. In addition, multimodal deep learning models will incorporate features from all imaging modalities and outperform traditional risk assessment models based on personal and family histories like the Tyrer-Cuzick score (39).

Radiologists should acknowledge other health care trends. The COVID-19 pandemic demonstrated our patients' strong preference for at-home tests that provide quick and reliable results. Patients want to perform inexpensive tests at home to account for their breast symptoms. AI-powered US devices that use transducers driven by smartphone technology will allow patients to acquire their sonographic images (40). These AI systems will provide an immediate diagnosis with high accuracy.

These scenarios raise this troubling question: should we stop training breast imaging radiologists now? My answer is no. With AI's assistance, radiologist specializing in breast imaging can focus on being more patient-centric and developing expertise in minimally invasive breast procedures and theranostics.

Paradigm Shifts in the Screening and Treatment of Breast Cancer over the Next 50 Years

Many of us dream of detecting cancer early when it can be cured. Unfortunately, cancers will continue to mutate and develop clones resistant to treatment. But using new technologies will transform breast cancer into a manageable disease. These technologies will alert doctors to early signs of cancer or a recurrence, analyze treatment effectiveness, and deliver targeted therapies. My holy grail is to have imaging tests that can accurately monitor tumor clonal diversity and therapeutic techniques such as immunotherapy, gene therapy, and cancer vaccines that can slow down or stop clonal diversification.

Immunotherapy, especially monoclonal antibodies that block immune checkpoint inhibitors, has demonstrated clinical effectiveness in trials for many solid cancers (41). Chimeric antigen receptor T-cell therapy is an innovative, effective treatment for hematologic cancers that can achieve remission in patients where conventional treatment has failed. AI may help select patients who will likely benefit from these treatments and may lead to precision immunotherapy. Gene editing tools such as clustered, regularly interspaced short palindromic repeats, or CRISPR, may improve cancer therapy by disabling specific genes and removing cancer mutations associated with drug resistance.

Gene editing tools may potentially be used to repair DNA mutations associated with developing breast cancers. To do this, the medical imaging community would need to develop imaging biomarkers to assess response to these gene editing tools. Finally, the COVID-19 pandemic demonstrated that messenger RNA (mRNA) vaccines can be mass-produced and cost-effective. mRNA-based cancer vaccines may modulate both local and metastatic disease. Cancer vaccines may be developed for women at intermediate or high risk for breast cancer. A radiologist could administer the vaccine when a woman presents for her screening examination.

Our tool kit of screening and diagnostic tools will continue to expand. MRI is the best imaging tool because it has the highest cancer detection rate and the lowest interval cancer detection rate (14). Therefore, my ideal imaging test is a portable ultralow-field-strength abbreviated noncontrast MRI examination that can provide high-spatial-resolution images and functional information.

RADIOLOGISTS TREATING BREAST CANCER

We will see a paradigm shift in treating most breast cancers with surgery. Minimally invasive procedures such as cryoablation and microwave ablation may be increasingly performed. Breast surgery may be reserved for patients who require more extensive and complex surgery, mastectomy, and better cosmesis. Furthermore, unlike other radiologists, those specializing in breast imaging do not offer therapy for breast cancer. As more images are interpreted with AI, it is essential for breast imagers to use imaging modalities to treat breast cancer if we wish to remain clinically relevant.

Theranostics is an underdeveloped nuclear medicine therapy that will become a vital tool. Theranostics combines one radioactive drug to diagnose cancer and a second radioactive drug to deliver therapy to treat the primary breast cancer and any metastatic foci. Metastatic spread is the leading cause of cancer-related death. However, theranostics will allow the detection and targeted treatment of metastatic disease with fewer side effects. Although we may not be able to eradicate breast cancer, it may be converted into a chronic disease that will be monitored and treated, like hypertension and diabetes. Radiologists specializing in breast imaging will include nuclear medicine therapies in their armamentarium of screening and diagnostic tools.

CONCLUSION

We are at a time of transformation for medical imaging. Disruptive innovations are driven by AI and the reorganization of patient care delivery. As breast imagers, we are leaders in providing patient-centric care. AI will produce an avalanche of data to screen and diagnose breast cancer. We should embrace the role of explaining these complex data at multidisciplinary conferences. If not, non-radiologists, nonphysicians, or those outside health care will assume these roles. We will learn new skills such as AI and nuclear medicine and learn to perform advanced minimally invasive breast procedures to treat breast cancer. In this special centennial breast imaging issue, I encourage you to read the commentary by Christiane Kuhl, MD, PhD, a luminary in breast imaging, that highlights the present and future of breast imaging (42).

Top 10 All-Time Cited Original Research Articles on Breast Imaging Published in *Radiology*

Rank	Study	No. of Citations	Year Published	Title
1	Stavros et al (2)	1441	1995	Solid Breast Nodules: Use of Sonography to Distinguish between Benign and Malignant Lesions
2	Itoh et al (3)	1291	2006	Breast Disease: Clinical Application of US Elastography for Diagnosis
3	Kolb et al (4)	1263	2002	Comparison of the Performance of Screening Mammography, Physical Examination, and Breast US and Evaluation of Factors That Influence Them: An Analysis of 27825 Patient Evaluations
4	Kuhl et al (5)	1118	1999	Dynamic Breast MR Imaging: Are Signal Intensity Time Course Data Useful for Differential Diagnosis of Enhancing Lesions?
5	Berg et al (6)	1093	2004	Diagnostic Accuracy of Mammography, Clinical Examination, US, and MR Imaging in Preoperative Assessment of Breast Cancer
6	Garra et al (7)	821	1997	Elastography of Breast Lesions: Initial Clinical Results
7	Bird et al (8)	761	1992	Analysis of Cancers Missed at Screening Mammography
8	Skaane et al (9)	748	2013	Comparison of Digital Mammography Alone and Digital Mammography Plus Tomosynthesis in a Population-based Screening Program
9	Kaiser and Zeitler (10)	718	1989	MR Imaging of the Breast: Fast Imaging Sequences with and without Gd-DTPA. Preliminary Observations
10	Niklason et al (11)	701	1997	Digital Tomosynthesis in Breast Imaging

Note.—*Radiology* has been published regularly since 1923.

Top 10 All-Time Cited Original Research Articles on Breast Imaging Published in Radiology

Changes in MRI

K. Pinker-Domenig
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BODY

The BI-RADS atlas provides standardized breast imaging terminology, report organization, assessment structure and a classification system for mammography, ultrasound and MRI of the breast. BI-RADS reporting enables radiologists to communicate results to the referring physician clearly and consistently, with a final assessment and specific management recommendations. The 6th edition of the BI-RADS lexicon is up-coming.

This presentation will illustrate and highlights changes to the BI-RADS lexicon. It will include detailed descriptions of updates in the MR imaging sections with imaging examples and will provide the audience with a general overview to familiarize them with the new 6th BI-RADS edition.

TAKE HOME POINTS
- After completion of this lecture the participant will:
- Be aware of the changes to the MRI section of the BI-RADS lexicon in the 6th edition
- Be able to identify the new MRI descriptors
- Discuss appropriate use of the BI-RADS lexion in breast MRI

Enhancing the Kaiser Score for unenhanced breast MRI

N. Pötsch

Vienna, AT

BODY

The recent recommendation of expanding the indications for screening breast MRI beyond genetic high risk patients, to patients with dense breast makes a rise in the demand for breast MRI very likely. Therefore, unenhanced abbreviated protocols have been proposed to reduce scanning time and hence costs by at the same time improving access to breast MRI. A potential approach to abbreviate protocols is replacing dynamic contrast enhanced sequences by DWI. Interpreting breast MRI using the Kaiser Score, a clinical decision rule, contrast enhancement is the most important diagnostic criterion. Hence, we aimed to accordingly adapt the Kaiser Score using DWI, ADC and T2w for lesion morphology, margin features and as a substitute for contrast enhanced sequences. Lesion visibility was better in mass lesions compared to non-mass as well as invasive lesions compared to DCIS. In lesions detectable by unenhanced MRI, lesion description based on DWI/ADC and T2w derived features is feasible showing promising results for the adapted Kaiser Score.

TAKE HOME POINTS

Unenhanced abbreviated breast MRI shows favourable results in mass lesions as well as invasive lesions.
If the lesions is detected, description based on DWI/ADC and T2w derived features is feasible.

AI in cancer detection

J. L. Raya-Povedano

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BODY

Population-based breast cancer screening with mammography has proven to be the most effective method of reducing breast cancer mortality (by up to 30-40% of participating women) and is implemented in most European countries.

Despite its undoubted benefits, it is not free of problems. The main ones are false negatives (cancers not detected by the programme) and false positives (recalls due to findings that are not cancer).

Double reading (usually with consensus or arbritrium) is used in most programmes and is recommended by the European Guidelines to increase sensitivity, but at the cost of doubling the reading workload.

The use of Digital Breast Tomosynthesis (DBT) has been proposed to increase cancer detection. One of the main problems for its use is the increased reading time, which contributes to slowing down its application in population-based breast cancer screening.

The lack of expert radiologists in breast imaging, particularly in certain countries, is also a problem, due to the enormous workload of reading studies that in most cases are going to be normal.

The use of computers in breast cancer detection with the first computer-aided detection (CADe) and computer aided diagnosis (CADx) systems, despite the great interest they generated and their widespread use, has not demonstrated improvements in the behavior of radiologists. The low specificity of the systems, with an excessive number of marks (more than one per study) has not led to an increase in sensitivity but has led to a significant increase in false positive recalls.

Artificial intelligence (AI) applied to radiological imaging, with new algorithms based on deep learning, has undergone enormous development in recent years. Unlike early CADs, which were trained to detect only those signs of cancer that were previously identified by the programmer, AI-based systems learn to distinguish cancers from benign or normal findings on their own [[1]].

These systems are capable not only of identifying lesions in mammography and tomosynthesis studies, but also of assigning a degree of suspicion to each finding and to the overall study. This capability allows them to sort and classify the studies according to the likelihood of identifying a cancer. Some of these algorithms are trained to differentiate between positive (suspicious) and negative (normal) studies. Others sort the studies from least to most likely to be malignant and place most studies with cancer in a very low percentage of the total studies.

To be applicable in the clinic and particularly in screening, the use of these algorithms should warrant maintaining sensitivity in detecting cancers and should not increase referral for false positives.

The first published papers were performed retrospectively and simulated in enriched series and demonstrated that these algorithms autonomously improve the performance of human readers in terms of sensitivity and recall rate [[2]]. Their fundamental limitation is that their results are not fully extrapolable to real screening situations, where the proportion of cancers is very low.

In the last few years, several retrospective simulated studies on non-enriched screening series have been published [[3][4][5][6][7][8][9]]. All of them investigate, in different situations, the impact that IA would have on workload reduction, sensitivity and recall.

Several of these studies consider the possibility of excluding less suspicious studies from the reading and discarding them as normal [[6]]. AI would be useful in these cases when the probability of missing a cancer in the low-suspicion studies is compensated by the potential increase in detection in the higher-suspicion studies. The use of AI in this situation aims to decrease the human reading workload.

With the same objective, other studies evaluate the replacement of the second human reading of all or part of the studies by the automatic derivation of those identified as suspicious by the AI.

There are studies exploring the ability of AI to fully replace human reading [[7]], although most conclude worse results than when used in combination with human reading of part of the studies, or review by radiologists of those studies identified by AI as suspect.

The main limitation of these retrospective studies is that, although they are based on unenriched series, it is not possible to know what the reader's behavior would have been if he would have known the result of the IA when reading.

AI could also be used as reading support, without partial or total diminution of human readings and with the aim of increasing sensitivity. Published studies on reading support are all based on enriched series.

The published evidence on AI in DBT is less than in DM and the results are, to date, worse [[7]]. Several reasons have been mentioned for the inferiority of AI in DBT. First, there are fewer sets of tomosynthesis studies to train the algorithms, second, technically, the analysis of tomosyntheses is more complex and third, there are many differences in the characteristics of the images obtained by the different manufacturers, which

limits the extrapolation of the results.

Although the studies published to date report a worse performance of AI algorithms in DBT, several retrospective simulated studies suggest that replacing DM screening with AI-assisted DBT screening would lead to better results, with lower reading workload, higher detection of cancers and fewer false positive recalls [[8][9]].

To date, there are no published prospective randomised or paired studies exploring the possibilities of AI in breast cancer screening. Several studies are ongoing, but their results have not yet been published. The results of these studies may provide an impulse for the use of AI in breast cancer screening.

TAKE HOME POINTS

Artificial Intelligence is able to classify screening studies with digital mammography (DM) and tomosynthesis (DBT) according to the probability of cancer.

The ability of these systems to select a high percentage of DM and DBT studies with a very low probability of cancer would allow to avoid completely or partially reading them.

AI algorithms perform better in DM than in DBT.

The published studies are either enriched series or retrospective simulated studies. Several ongoing studies are prospectively exploring possible uses of AI in breast cancer screening. Their results are not yet published.

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Obesity and sarcopenia in breast cancer prognosis: could body composition analysis predict therapeutic response in breast cancer?

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BODY

Objective: This study aims to investigate the prognostic value of baseline body composition parameters in women with ER-positive / HER2-negative metastatic breast cancer treated with CDK 4/6 inhibitors. Specifically, we assess the relationship between individual body composition values, including Visceral Adipose Tissue (VAT), Subcutaneous Adipose Tissue (SAT), Skeletal Muscle Area (SMA), and Skeletal Muscle Index Level 3 (SMIL3), and the therapeutic response to CDK 4/6 inhibition.

Methods: A total of 52 female patients diagnosed with ER-positive / HER2-negative metastatic breast cancer were prospectively enrolled between October 2022 and April 2023. Patients meeting the inclusion criteria and providing informed consent underwent total body CT scans at baseline, after 6 months, and 12 months from the beginning of therapy. The Quantib body composition software was utilized to analyze the CT images. Therapeutic response was evaluated using the RECIST v1.1 criteria.

Results: Preliminary results indicate a significant correlation between baseline SMIL3 values and the therapeutic response after 6 months ($p < 0.001$). Lower SMIL3 values were associated with a poorer response to therapy. Additionally, a significant association was observed between sarcopenia and menopause ($p = 0.03$). Further evaluations in the subsequent months will provide additional insights.

Conclusion: Our ongoing study suggests that baseline body composition parameters, especially SMIL3, may serve as potential prognostic markers for the therapeutic response in women with ER-positive / HER2-negative metastatic breast cancer undergoing CDK 4/6 inhibition. The identification of these predictive factors could help personalize treatment approaches and improve patient outcomes. Future statistical analyses and extended follow-up assessments will provide a more comprehensive understanding of the prognostic value of these body composition parameters in metastatic breast cancer.

TAKE HOME POINTS

1. Body composition parameters (VAT, SAT, SMA, SMIL3) are relevant in predicting outcomes for ER+/HER2- metastatic breast cancer patients on CDK 4/6 inhibitors.
2. Lower SMIL3 values at baseline may indicate a poorer response to therapy.
3. Baseline body composition analysis can help personalize treatment strategies for better patient outcomes.

Imaging for treatment de-escalation

A. Rose
Fitzroy, AU

BODY

We have been de-escalating therapy for treatment of breast cancer since Bernard Fischer, chair of the NSABP, in the early 1970s challenged the prevailing dogma of the "Halstedian Hypothesis" & proposed that breast cancer was a systemic disease from inception, therefore locoregional therapy could be rolled back. Breast conserving surgery replaced mastectomy whenever possible. In the 1980s, Roland Holland published his work on serial sections of mastectomy specimens with invasive tumours ≤ 2cm. He found that 43% had tumour foci >2cm from the index. This research underpinned the use of adjuvant radiotherapy (RT) with breast conserving surgery (BCS) for early breast cancer to reduce the rate of local recurrence presumably by treating these additional foci of disease. Tamoxifen, initially developed for its contraceptive effects in 1962, was approved for use as a selective estrogen receptor modulator in the late 70s in the treatment of ER positive breast cancer. This combination of BCS, RT and endocrine therapy (ET) has formed the basis for breast cancer therapy since the 1980s. In the 1990s Giuliano and Veronesi pioneered SLNB as a safe method of assessment and treatment of the axilla with similar results to dissection but with considerably less morbidity.

However, for many women these therapies still constitute overtreatment.

More recently, breast imaging has expanded to include contrast based imaging (MRI, CEM and PET) and image guided minimally invasive percutaneous procedures to support further therapeutic de-escalations. The intent should always be to optimise therapy for breast cancer and minimise the harm of treatment. Measured outcomes should be oncological rather than just surgical.

A cascade of de-escalation has continued.

Selective omission of Sentinel Lymph Node Biopsy (CALBG, IBCSG, Milan) in Luminal A > 60-70 years

Active surveillance for DCIS (LORIS, LORD, COMET)

Tumor Ablation (Cryo, RF, ILA, FUSA)

SLNB (SENTINA) and selective elimination of ALND in NAC (Alliance A011202)

Omission of BC surgery after NAC

Contributions of Breast Imaging to De-Escalation include

Omission of RT in Early Breast Cancer

PROSPECT

Omission of surgery in early breast cancer

Small Trial

MiniVAB trial

Omission of SLNB

In cN0 patients for up front surgery

In NAC patients HER2+/TNBC

Omission of surgery for radiological CR

RESPONDER

MICRA

NOSTRA

NRG/BR005

PROSPECT, is a trial using MRI & favourable histopathology to select a group with unifocal early breast cancer where RT could safely be omitted. One of the surprising outcomes at the 5 year analysis was the substantial reduction in recurrences not only in the trial group where RT was omitted, but also in the group found to have additional malignant occult lesions, treated with standard therapy.

The rate of distant recurrences for the whole cohort was low, suggesting that management of malignant occult lesions identified with CBI may be important in this context. This pathway, with tumour burden mapped by CBI, provides a template for many different de-escalations to be tried safely.

TAKE HOME POINTS

The intent of de-escalation is to optimise therapy and reduce the harms

CBI to map disease burden is an essential starting point for planning and monitoring a successful de-escalation

Outcome measures should be oncological to modify adjuvant and neoadjuvant therapies.

Biopsy and marker placement

T. Sella
Jerusalem, IL

BODY

Therapeutic options for treatment of breast cancer are constantly evolving. Advanced immunohistochemical and genetic tests enable accurate tailoring of neoadjuvant chemotherapy to include hormonal therapy, chemotherapy, biological therapy and immunotherapy leading to improved results in many patients. Surgical options, which were limited in the past to breast conserving surgery with lumpectomy or mastectomy in more advanced cases, have expanded to include various forms of breast conserving surgery even in locally advanced disease utilizing oncoplastic techniques. These innovative approaches rely on very accurate pretreatment evaluation of extent of disease based on a combination of imaging modalities. Precision in defining the extent of disease is achieved by tissue sampling of suspicious findings in addition to the known disease to determine their nature. Well documented marking of sampled lesions using clip markers is critical for radiologist-surgeon communication to enable accurate mapping of the target for surgical excision and the success of surgery relies on this communication. In the current presentation I will focus on image guided techniques of breast and lymph node biopsy and marking and their crucial role in pretreatment staging.

TAKE HOME POINTS

1. Accuate staging with image guided biopsies enables better tailoring of surgical treatment.
2. Clip marking is crucial for radiologist-surgical communication and precise mapping of disease

What are B3 lesions

A. Shaaban[1,2]

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BODY

The pathological categorisation of core/diagnostic vacuum assisted biopsy includes 5 categories ranging from B1 (normal/inadequate) to malignant (B5a: in situ, B5b: invasive) lesions. Lesions of uncertain malignant potential (B3) are a heterogeneous group of diagnostically challenging lesions that include entities with and without atypia. Those with atypia include flat epithelial atypia (FEA), lobular in situ neoplasia, atypical intraductal epithelial proliferations (AIDEP/ADH), radial scar with atypia, papilloma with atypia and other. Some atypical B3 lesions, such as FEA, exhibit cytological atypia only while others, such as ADH, show combined architectural and cytological atypia. The overall upgrade rate to in situ or invasive malignancy on further sampling is ~17% with the highest rate reported for ADH (22%, range 0-50%). The presence of atypia is the strongest predictor of upgrade to malignancy following a B3 diagnosis. The identification and reporting of atypia is paramount to plan appropriate management. Intraduct papillomas with atypia are managed by diagnostic surgical excision while those without atypia are managed by vacuum assisted excision (VAE). In addition to the coexistence with carcinoma, some B3 lesions confer a higher risk for subsequent development of breast cancer compared with the general population.

B3 lesions can be challenging for the practising pathologist and deeper levels, immunohistochemistry, discussion with colleagues can be extremely helpful to reach a consensus diagnosis and plan management. ER and basal cytokeratins immunohistochemistry can be used to distinguish epithelial hyperplasia from ADH/DCIS. However, in other lesions, such as FEA, immunohistochemistry is not helpful and the diagnosis is based on the morphological criteria.

The diagnostic features for B3 lesions will be presented and role of immunohistochemistry discussed.

TAKE HOME POINTS

-B3 lesions (lesions of uncertain malignant potential) are a heterogeneous group of diagnostically challenging entities
-They can be associated with atypia
-Correct diagnosis, including presence/absence of atypia is essential for appropriate management
-Immunohistochemistry can be helpful to confirm the presence and extent of atypia.

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Consensus statements EUSOMA / Suisse society of senology

N. Sharma
Leeds, GB

BODY

I will present the consensus statements on behalf of EUSOMA on the management of high risk lesions. We will discuss the different types of high risk lesions and the consensus statement produced. The rationale for the statements will also be explored. Comparison will be made with the UK guidelines and the International consensus guidelines

TAKE HOME POINTS

Importance of guidelines to help standardise pathways
Highlight the key consensus statements for managing high risk lesions/B3 lesions

Real-world Use of AI in Breast Imaging - from Evidence to Implementation Implementing AI in the symptomatic breast clinic and outline of the prospective trial at Leeds Teaching Hospital NHS Trust

N. Sharma
Leeds, GB

BODY

The current breast screening practices in the UK involve a gold standard of double reading for breast cancer detection in various scenarios. Breast screening for early cancer detection includes double reading for increased accuracy, and surveillance mammograms for cancer follow-up or family history also undergo double reporting for enhanced reliability. Symptomatic breast units exhibit varying practices in terms of single or double reading, with an increasing trend towards double reporting. However, a shortage of radiologists is hindering the implementation of double reporting across centers, as there are not enough radiologists available.

To address these issues, an evaluation is being conducted to determine the non-inferiority of the Lunit INSIGHT MMG decision assist tool in conjunction with a single human reader, as compared to the current standard of double human reader assessment within mammography review at a "one-stop" breast clinic.

Primary Objectives include assessing and comparing the sensitivity and specificity of Lunit INSIGHT MMG combined with a single human reader against double human reading for non-inferiority. We will also evaluate the acceptability of Lunit INSIGHT MMG to both patients and the NHS workforce and determine the cost-effectiveness of implementing Lunit INSIGHT MMG at the "one-stop" breast clinic.

This evaluation aims to improve breast cancer screening efficiency and address the challenges posed by workforce shortages and increasing retirements among breast radiologists. The integration of AI-assisted tools like Lunit INSIGHT MMG could potentially enhance accuracy and expedite the reading process, while also providing valuable data on cost-effectiveness and stakeholder acceptance.

The concept of oligometastatic disease and the usefullness of early metastasis detection

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BODY

Oligometastatic breast cancer (OMBC) refers to a state with one or only a few distant metastatic foci, with or without local and regional involvement. OMBC has been associated with prolonged survival compared to more widespread distant disease, and cure may be possible for a select group of OMBC patients when treated with a multidisciplinary approach that includes locally ablative therapy of all distant lesions. However, questions regarding the biology, definition, optimal diagnostic, and therapeutic approach of OMBC remain unanswered mostly due to a lack of larger randomized studies. This presentation will outline our current understanding of OMBC, including perspectives for clinical practice and further study.

TAKE HOME POINTS

- The optimal definition of OMBC includes 1-3 distant metastases
- Cytologic / histologic proof of at least one distant lesion is highly desirable
- Imaging studies should have high negative predictive value to prevent intensified therapeutic choices in in case of more widespread distant disease
- Trials in OMBC should be stratified by breast cancer subtype
- Translational research should focus on distiguishing limited from widespread metastatic disease beyond counting the number of visible lesion.

Towards high-sensitive, low-dose and painless 3D breast imaging with X-ray gratings interferometry

M. Stampanoni

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BODY

The penetration of X-rays through specimens involves processes of absorption, refraction, and scattering. In current conventional medical X-ray imaging, image contrast relies solely on absorption, leading to reduced sensitivity for softer tissues. Recent years have seen considerable efforts to adapt highly sensitive X-ray techniques from synchrotron facilities for medical devices. These efforts encompass advancements in X-ray optics and methods, dedicated X-ray detectors, novel signal retrieval and processing techniques, as well as image analysis. Our team has specifically focused on gratings interferometry, a technique initially developed to measure fundamental properties of synchrotron beams but that has evolved into a sophisticated tool for advanced X-ray imaging in laboratories and even clinical applications. Grating interferometers have the potential to revolutionize the radiological approach to medical imaging by utilizing refraction and scattering, instead of absorption, to generate image contrast. This inherent capability allows for the detection of subtle differences in electron density of materials, such as lesion delineation, and the measurement of the integrated local small-angle scattering power generated by microscopic structural fluctuations in specimens, such as micro-calcifications in breast tissue.

In this talk, I will provide an intuitive understanding of the working principle behind grating interferometry and present the current status of developments towards new medical devices utilizing this technology. The objective is to improve the sensitivity and specificity of mammography (2D) and CT (3D) breast imaging for precise and painless early detection of breast cancer.

TAKE HOME POINTS

1. Gain an understanding of phase contrast X-ray imaging.
2. Recognize the challenges involved in implementing this technique in a clinical environment.
3. Assess the potential of phase contrast X-ray imaging for early breast cancer detection.

Evaluation of the axilla before during and after therapy

P. Steyerova
Prague, CZ

BODY

Surgical and oncological approaches regarding the axilla in breast cancer patients have seen changes during the last years. We are observing de-escalation of various types of treatment for patients with lower risk as well as intensification of interventions in patients with worse prognostic factors. With that, the questions radiology is addressing are evolving. Axillary imaging not only provides information on the lymph node status but needs to be placed in the clinical context of oncology outcomes of the patient.

In the session we will be discussing the value of different imaging modalities in evaluation of locoregional lymph nodes with emphasis on the impact on clinical management of breast cancer patients. New surgical approaches in the axilla in primary surgery and after neoadjuvant chemotherapy will be discussed including challenges and requirements for the radiology.

TAKE HOME POINTS

Imaging modalities provide variable level of accuracy regarding lymph node involvement.

The role of imaging must be places in clinical context of oncology outcomes.

Axillary ultrasound is the golden standard for evaluation of lymph node status.

Evaluation of lymph nodes after neoadjuvant chemotherapy can be tricky in all imaging modalities.

Various approaches are available for surgical management in the axilla after neoadjuvant chemotherapy.

The surgical approach in the axilla needs to be planned before the neoadjuvant treatment to ensure proper imaging and marking.

Breast density assessment on tomosynthesis. Artificial intelligence versus human evaluation: who did it better?

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PURPOSE
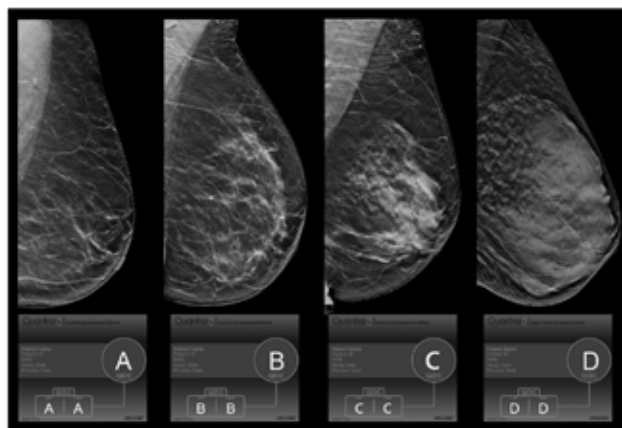
BI-RADS 5th Edition Quantra density categories (QDC). Assessment by software version 2.2.3. Category A: almost entirely fat; category B: scattered fibro-glandular densities; category C: heterogeneously dense; and category D: extremely dense.

Breast density (BD) is one of the main challenges for radiologists since it may affect the identification of lesions on mammography due to the masking effect in dense breasts. Consequently, we compared the performance of automated BD assessment performed on digital breast tomosynthesis (DBT) by Quantra with visual assessment performed by radiologists and the consensus between them, according to BI-RADS 5th Edition. Then, we evaluated the breast cancers (BC) diagnosed and if the assessment of BD impacted on their identification.

METHODS
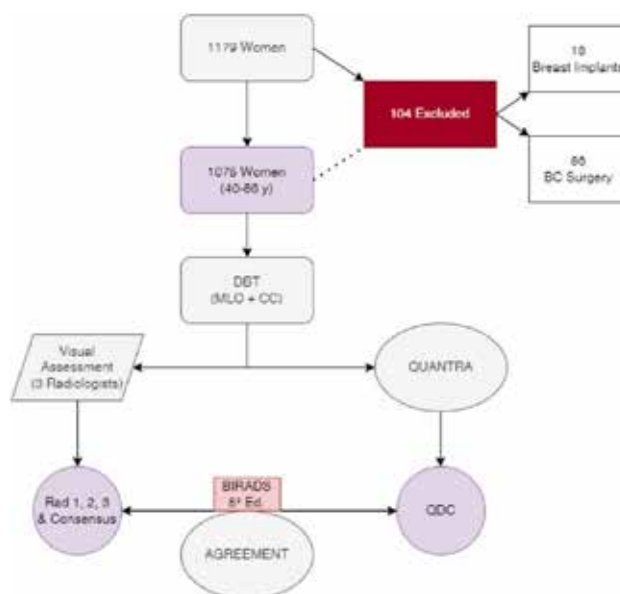
Flowchart. Study structure. DBT: Digital Breast Tomosynthesis. MLO: Medio-Lateral-Oblique projection. CC: Cranio-Caudal projection. Consensus: median value of the score assigned by the 3 radiologists. QDC: Quantra Density Category performed by the Quantra software.

A sample of 1179 DBT images from asymptomatic women aged between 40 and 86 years (58 ± 7.1) was retrospectively analyzed by three independent readers. Automated BD assessment was performed with the latest Quantra software version 2.2.3. BI-RADS assessment categories A and B were considered non-dense, and categories C and D were considered dense. Interobserver agreement was assessed with kappa statistics. A p value <0.05 was considered statistically significant. Descriptive statistics were used to compare distributions of age, BD, and early performance measures, including histopathologic tumor characteristics.

RESULTS

Observers	OVERALL			40–49			50–69			>70		
	K	CI	p	K	CI	p	K	CI	p	K	CI	p
Rad1/Rad2	0.87	(0.81–0.93)	<0.05	0.76	(0.56–0.96)	<0.05	0.88	(0.82–0.94)	<0.05	0.79	(0.54–1.04)	0.65
Rad1/Rad3	0.81	(0.75–0.87)	<0.05	0.70	(0.50–0.90)	<0.05	0.81	(0.75–0.88)	<0.05	0.81	(0.56–1.06)	<0.5
Rad2/Rad3	0.88	(0.82–0.94)	<0.05	0.81	(0.60–1.02)	<0.5	0.88	(0.82–0.94)	<0.05	0.84	(0.60–1.09)	<0.05
Rad1/QDC	0.76	(0.70–0.82)	<0.05	0.61	(0.42–0.80)	<0.05	0.77	(0.71–0.84)	<0.05	0.62	(0.37–0.87)	<0.5
Rad2/QDC	0.82	(0.76–0.88)	<0.05	0.84	(0.63–1.04)	<0.05	0.82	(0.76–0.88)	<0.05	0.65	(0.41–0.90)	<0.5
Rad3/QDC	0.86	(0.80–0.92)	<0.05	0.83	(0.62–1.04)	<0.5	0.86	(0.80–0.93)	<0.05	0.74	(0.49–0.99)	0.7
CON/QDC	0.83	(0.77–0.89)	<0.05	0.78	(0.57–0.98)	<0.05	0.83	(0.77–0.89)	<0.05	0.74	(0.49–0.99)	<0.5

K statistics. The agreement on the breast density category of dense/non-dense between radiologists and the Quantra software (QDC).

The agreement on BD categories was substantial to almost perfect between radiologists (κ = 0.63–0.83), and moderate to substantial between the consensus of radiologists and Quantra (κ = 0.60–0.77). Comparing the assessment for dense and non-dense breasts, the agreement was almost perfect in the screening age range (50-69y) without a statistically significant difference between concordant and discordant cases when compared by age. A total of 13 BC has been diagnosed; 38.5% in non-dense breasts and 61.5% in dense breasts with an almost perfect agreement between radiologists and the Quantra software (κ = 0.85); 84.6% were at an early stage and 15.4% at a locally advanced stage.

CONCLUSION AND SUMMARY STATEMENT

Observers	OVERALL			40–49			50–69			>70		
	K	CI	p	K	CI	p	K	CI	p	K	CI	p
Rad1/Rad2	0.87	(0.81–0.93)	<0.05	0.76	(0.56–0.96)	<0.05	0.88	(0.82–0.94)	<0.05	0.79	(0.54–1.04)	0.65
Rad1/Rad3	0.81	(0.75–0.87)	<0.05	0.70	(0.50–0.90)	<0.05	0.81	(0.75–0.88)	<0.05	0.81	(0.56–1.06)	<0.5
Rad2/Rad3	0.88	(0.82–0.94)	<0.05	0.81	(0.60–1.02)	<0.5	0.88	(0.82–0.94)	<0.05	0.84	(0.60–1.09)	<0.05
Rad1/QDC	0.76	(0.70–0.82)	<0.05	0.61	(0.42–0.80)	<0.05	0.77	(0.71–0.84)	<0.05	0.62	(0.37–0.87)	<0.5
Rad2/QDC	0.82	(0.76–0.88)	<0.05	0.84	(0.63–1.04)	<0.05	0.82	(0.76–0.88)	<0.05	0.65	(0.41–0.90)	<0.5
Rad3/QDC	0.86	(0.80–0.92)	<0.05	0.83	(0.62–1.04)	<0.5	0.86	(0.80–0.93)	<0.05	0.74	(0.49–0.99)	0.7
CON/QDC	0.83	(0.77–0.89)	<0.05	0.78	(0.57–0.98)	<0.05	0.83	(0.77–0.89)	<0.05	0.74	(0.49–0.99)	<0.5

Characteristics of breast cancers diagnosed with breast density evaluation. *Agreement between (CON) consensus of radiologists and (QDC) Quantra Density Category.

The categorization proposed by Quantra has shown a good agreement with the radiological evaluations, even though it did not completely reflect the visual assessment. Indeed, the perceived risk associated with dense breast was similar between radiologists and the Quantra software. Thus, the automated evaluation may be a useful instrument in the hands of radiologists but the final statement about the impact of BD on DBT images should be based on the radiologist's perceived masking effect rather than the data produced exclusively by Quantra. Furthermore, a personalized screening based on individual risk factors may help to diagnose a BC at an earlier stage.

Dealing with diagnostic errors

I. Thomassin-Naggara
Paris, FR

BODY

Misdiagnosis in breast imaging can have significant implications for patient and healthcare providers. Some of the potential implications of misdiagnosis in breast imaging include delayed diagnosis or false reassurance which can result in a delay in treatment and a potentially worse prognosis, On the other hand, misdiagnosis can also lead to unnecessary procedures (biopsies, surgeries, and other procedures) which can cause physical discomfort, anxiety, and emotional distress for patients, as well as increased healthcare costs. All these events can erode patient trust in the healthcare system and in individual healthcare providers. This can have negative implications for patient compliance with screening and treatment recommendations, as well as overall health outcomes. Moreover, misdiagnosis can also result in legal consequences for healthcare providers, including medical malpractice lawsuits and disciplinary action by licensing boards.

To minimize the risk of misdiagnosis in breast imaging, it is important for healthcare providers to use appropriate imaging techniques and interpret images accurately and consistently. This requires ongoing training and education for radiologists and other healthcare providers, as well as collaboration and communication among healthcare providers to ensure that patients receive appropriate and timely care. If a misdiagnosis does occur, it is important for healthcare providers to communicate with patients and provide appropriate follow-up care to minimize the potential implications of the misdiagnosis. This may include repeat imaging, additional biopsies or other procedures, and referral to specialists for further evaluation and management.

TAKE HOME POINTS

1. There are three main causes of errors: acquisition mistakes due to technical failures, errors which can be due to patient or lesion factors (interpretive errors) and errors missed by original paper detected by expert (perceptual errors).
2. Some of the most notable implications of misdiagnosis are Delayed or Incorrect Treatment, Worsened Health Outcomes, Increased Healthcare Costs, Loss of Trust in Healthcare Providers, Legal Consequences, Public Health Concerns.
3. If a misdiagnosis does occur, it is important for healthcare providers to communicate with patients and provide appropriate follow-up care to minimize the potential implications of the misdiagnosis.

Do we still need breast cancer screening in the era of targeted therapies and precision medicine?

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BODY

Introduction. Breast cancer (BC) care has substantially evolved over the past fifty years, with non-negligible changes in screening and diagnostics, histological analysis, surgery, radiation therapy, and systemic treatments. Increased population coverage and women's attendance to organised mammography screening together with advances in systemic treatments improved up to 90% the 5-year relative survival rate for BC. However, benefits deriving from screening and early diagnosis may become questionable when considering the efficacy of current systemic treatment options.

Methods. We performed a critical review highlighting the major landmark improvements in mammography screening and systemic treatment, to appraise their impact on BC prognosis and to question the role of breast cancer screening in the era of precision medicine.

Results. Screening attendance is associated with a mortality reduction of at least 30% and a 40% lower risk of advanced disease with stage at diagnosis remaining the strongest predictor of recurrences. Systemic treatments evolved dramatically through the introduction of aromatase inhibitors for early-stage luminal BC, targeted monoclonal antibodies for HER2 positive disease and immunotherapy for triple-negative BC; moreover. It is a challenging task to define the relative contribution of early diagnosis by screening mammography and systemic treatments in determining BC survival. We built a model by variably combining the contribution of screening mammography and chemotherapy or novel systemic treatments in four different scenario. The simulation showed that the 10-year recurrence rate would be 30% and 25% using respectively chemotherapy or novel treatments in the absence of screening, but would drop to 19% and 15% respectively if associated with mammography screening. Early detection per se has not a curative intent and systemic treatment has limited benefit on advanced stages. Both screening mammography and systemic therapies sinergically continue to positively contribute to BC prognosis.

Conclusion. We DO still need breast cancer screening in the era of precision medicine.

TAKE HOME POINTS

1. The stage at diagnosis is still crucial in determining survival outcomes for breast cancer.
2. Screening attendance is associated with a reduction of advanced-stage disease.
   ovel endocrine and HER2-targeted therapies have substantially improved survival.
3. Early diagnosis and personalised treatments synergistically contribute to improve prognosis.
4. We do still need breast cancer screening in the era of precision medicine.

DBT and the status quo bias. Why the slow implementation in screening?

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BODY

Use of digital breast tomosynthesis (DBT) or digital mammography (DM) is now suggested in the conditional recommendation for screening in average risk women aged 50-69 years according to the European Commission Initiative on Breast Cancer guidelines. Further, they suggest using DBT and not DM for women with high mammographic breast density detected in previous screening exams. Still, the use of DBT in European screening programs is sparse. In this talk, I will cover different aspects to illuminate why the challenge remains to change a very established program with 2D mammography running for 30 years.

TAKE HOME POINTS

The scientific background and recent updates in DBT literature regarding detection rates, recall rates, interval cancers, use of AI, reading time and effect in dense breasts will be discussed. Questions such as "how much more efficient do we expect a new method to be to be accepted in real life" and "how much we are prone to so-called status quo bias " will be discussed.

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