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Sonomammography versus MRI in Evaluation of BI-RADS III Breast Lesion

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ABSTRACT

Background: Breast cancer is sometimes found after symptoms appear, but many women with breast cancer have no symptoms. This is why regular breast cancer screening is so important, early detection and treatment are the most important strategies to prevent deaths from breast cancer. Breast cancer that's found early, when it's small and has not spread, is easier to treat successfully, regular screening tests are the most reliable way for early detection. **Objective:** to high light the role of sonomammography versus Magnetic Resonance Imaging (MRI) in evaluation of BI-RADS III (Breast Imaging Reporting and Data System) breast lesion.

Patients and Methods: in this retrospective study, 28 patients with BI-RADS III breast lesion were assessed by Digital mammography (DM), Ultrasound (US) and MRI. The resultant images were correlated with reports of the pathology specimens. **Results:** histopathological analysis was done for each lesion with 13 lesions (46.43%) proved to be benign, 15 lesions (53.57%) proved to be malignant. The sensitivity, specificity, Positive predictive value (PPV) and Negative predictive value (NPV) of mammography (MG), ultrasonography and MRI in BI-RADS III breast lesions were calculated. **Conclusion:** BI-RADS III lesions group is a very critical group to deal with as it exhibits characters of both malignant and benign lesions. According to our study Dynamic contrast enhanced - Magnetic Resonance Imaging. (DCE-MRI) should go hand by hand with sonomammogaphy especially in BI-RADS III patients group, patients with benign looking lesion six months follow up is recommended and those with malignant looking lesion biopsy should be done.

Keywords: Breast lesion, BI-RADS, Mammography, Ultrasound, Magnetic resonance imaging.

INTRODUCTION

Breast cancer is the most common cancer in women worldwide, this represents about 12% of all new cancer cases and 27% of all female cancers [(1)]. The BI-RADS stands for Breast Imaging Reporting and Data System which is a widely accepted risk assessment and quality assurance tool in MG, US or MRI. It is classified into six categories: BI-RADS 0, I and II are toward benign lesions, BI-RADS III: suspicious abnormality, BI-RADS IV, V and VI are toward malignancy [(2)].

BI-RADS III is an intermediate category in the breast imaging reporting and data system, category 3 lesions are common at screening work up and despite their low malignancy rate, they require additional 3-6 months follow-up and in some scenarios a percutaneous biopsy might be considered [(3)]. The BI-RADS III is the only group exhibiting similar likelihood for both malignant and benign lesions. The probability of a BI-RADS 3 lesion to be malignant and considered to be less than 2%. Therefore, the work-up of a BI-RADS 3 lesion can be a biopsy or follow-up MG after 6 months [(4)]. One should be careful of using BI-RADS III in the postmenopausal breast or a breast that had a previous cancer as fat necrosis, radiation changes and post surgical scarring can change with time [(5)].

MG is low-energy X-ray to detect the breast cancer, typically through detection of characteristic masses and/or microcalcifications [(6)]. Adding breast US to screening mammogram (sonomammography) in women with dense breast helps to decrease the relatively high false negative diagnosis of breast cancer [(7)]. MRI is a non-invasive imaging technique that can image both breasts at once and works well even with dense breast tissue. It is good at finding invasive breast cancer, imaging around breast implants, and detecting possible spread of cancer beyond the primary tumour [(8)].

The purpose of this study is to assess the role of sonomammography versus MRI in evaluation of BI-RADS III breast lesion.

PATIENTS AND METHODS

The current study was performed on 28 patients with suspicious breast lesion, their age ranges between 35-55 years. The study was conducted in private Hospitals during the period from 2015 to 2017. The patients underwent full history taking and clinical examination, MG, US and MRI examination.

Inclusion criteria included patients diagnosed as BI-RADS III breast lesion on either sonomammography or MRI while exclusion criteria are other BI-RADS categories.MG was conducted for all patients using digital MG, both mediolateral oblique and craniocaudal views with spot compression magnification view when necessary, images were analysed regarding the presence of masses, architectural distortion, asymmetrical density and calcification. The detected masses were described as regard size, site, number, margin and density, also micro calcification was described according to their shape and distribution. The breast lesion was classified according to the BI-RADS. Then US was done for all patients using a high frequency probe (7.5 MHZ), scanning was done in two planes (longitudinal and transverse). The lesions were classified into mass or non-mass like lesions, masses were evaluated according to their shape, orientation,

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margins, echopattern, lesion boundary and presence or absence of acoustic shadowing or enhancement.

The non-mass like (NML) lesions were classified according to Ko et al. into four types: (i) A duct-like structure with parallel orientation, (ii) A non ductal hypoechoic area with an indistinct shape on two different projections that does not form a definite mass and differs from the surrounding glandular tissue or the same area in the contralateral breast, (iii) A vague area of altered echotexture with associated architectural distortion and (v) An indistinct hypoechoic area with associated posterior acoustic shadowing [(9)].

Then all patients were referred for MRI, Dynamic breast examination was performed using a 1.5-T superconductive magnet, all patients were scanned with breast coil in the standard prone position, the protocol included:

- A T1 and T2-weighted axial images.
- T2-weighted imaging with fat suppression.
- Intravenous administration of gadolinium chelate at a dose of 0.1–0.2 mmol/kg was injected at 1–2 cc/s.
- Post-contrast subtracted images.
- Time/ signal intensity curve (Is/t) was obtained at the most enhanced part.

MR images were analysed as regard enhancement and Is/t. The enhancement characteristic of the lesion is classified into focal, mass enhanced and non-mass enhanced. According to El Khouli et al. the Is/t curves were classified into three types: I) Persistent enhancement, II) Plateau and III) Wash-out. Then lesions were classified according to BI-RADS criteria [(10)]. Results were expressed as frequencies (number of cases) and percentages. Comparison between categorical data was performed using Chi square test. Standard diagnostic indices including sensitivity, specificity, PPV and NPV were calculated. SPSS (Statistical Package for the Social Science; SPSS Inc., Chicago, IL, USA) computer program (version 19 windows) was used for data analysis. P value less or equal to 0.05 was considered significant and less than 0.01 was considered highly significant.

Ethical disclosures

The authors announce that no experiments were performed on voluntaries and animals in this research. The authors have obtained the collected data from private hospitals after taking the written approval from the patient to do this study.

RESULTS

The breast lesions were classified according to different imaging modalities using mammographic, ultrasonographic and MRI BI-RADS. Histopathological analysis was done for each lesion with13 lesions (46.43%) proved to be benign, 15 lesions (53.57%) proved to be malignant. The different pathologies encountered in our study are illustrated in Table 1.

Table 1: Histopathological diagnosis of the examined breast lesions.

Histopathological diagnosis	Number (%)
Benign	**13 (46.43)**
Fibroadenoma	4 (14.29)
Phylloid tumour (benign variety)	2 (7.14)
Post operative scar	1 (3.57)
Fat necrosis	1 (3.57)
Abscess	2 (7.14)
Hamartoma	1 (3.57)
Intraductal papilloma	1 (3.57)
Fibrocystic diseases	1 (3.57)
Malignant	**15 (53.57)**
Invasive ductal carcinoma	8 (28.57)
Invasive lobular carcinoma	2 (7.14)
Duct carcinoma in situ	4 (14.29)
Tubular carcinoma	1 (3.57)
Total	28 (100)

After MG 14 lesions were classified as probably benign (BI-RADS 3), 9 of them (64.28%) proved to be benign (true negative) and 5 lesions (35.71%) were malignant (false negative result). BI-RADS 4 and 5 were encountered in 9 lesions, 7 of them (77.77%) proved to be malignant (true positive result) and 2 lesions (22.22%) were benign (false positive result).

Following US 14 lesions were classified as probably benign (BI-RADS 3), 7 of them (50%) proved to be benign (true negative) and 7 lesions (50%) were malignant (false negative result). BI-RADS 4 and 5 were encountered in 11 lesions, 7 of them (63.64%) proved to be malignant (true positive result) and 4 lesions (36.36%) were benign (false positive result).

The hypoechoic pattern was present in 20 lesions (71.43%) 13 of them proven to be malignant (65%) and 7 proven to be benign (35%). The presence of non mass like lesion (NML) in US was highly suggestive of malignancy. After MRI examination 13 lesions were classified as probably benign (BI-RADS 3), 8 of them (61.54%) proved to be benign (true negative) and 5 lesions (38.46%) was malignant (false negative result). BI-RADS 4 and 5 were encountered in 10 lesions, 10 of them (100%) proved to be malignant (true positive result) and no lesion was benign (false positive result).

Lesion enhancement by MRI examination were interpreted as focus (5 lesions) 2 of them were histologically benign and 3 were malignant, mass (12 lesions) 7 of them were histologically benign and 5 were malignant, non mass enhancement (10 lesions) 3 of them were histologically benign and 7 were malignant and only 1 lesion did not take any contrast.

The dynamic behaviour of each mass lesion was assessed by the Is/t. The progressive (type I) is observed in 12 lesions, 9 of them were benign, wash out (type III) curves were observed in 11 and all of them were

malignant, finally the plateau curve (type II) was present in 5 lesions, 4were benign and 1 were malignant. The calculated P value of type I, type II and type III curves were 0.013, 0.655 and 0.000 respectively.

The overall sensitivity, specificity, PPV and NPV of MG, ultrasonography and dynamic MRI (based on BI-RADS system) in differentiating benign from malignant lesions were calculated for all breast lesions as shown in Figure 1.

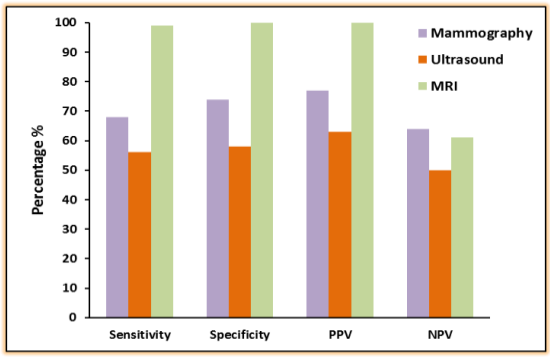

Figure 1: Clustered column chart comparing the sensitivity, specificity, PPV and NPV of MG, US and MRI based on BI-RADS categories.

Illustrative cases

CASE 1

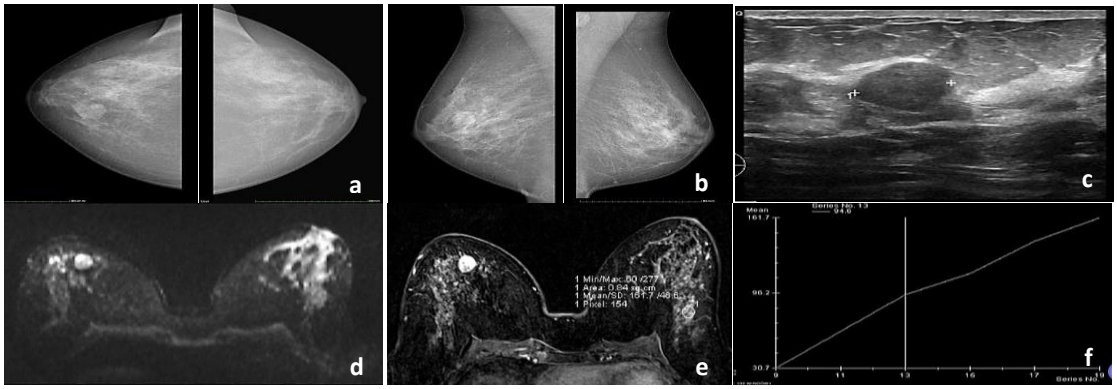

Figure 2: 42 - year - old patient with right breast mass. (a & b) mammographic craniocaudal and mediolateral oblique views showed right well defined radiopaque mass, (c) US showed right well defined hypoechoic mass taller than longer, MRI shows (d) Hyperintese mass lesion in T2 FAT SAT image, (e) Homogenously enhanced in subtracted dynamic image and (f) Type I Time /signal intensity curve.
The right breast lesion was categorized BI-RADS III by mammography and MRI, BI-RADS II by ultrasonography. The patient underwent fine needle aspiration (FNA) and histopathology was fibroadenoma.

CASE 2

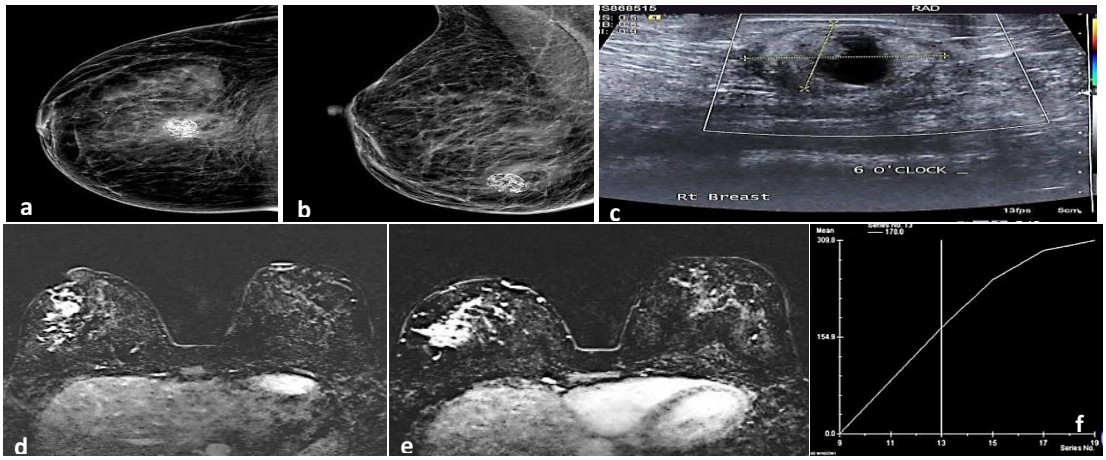

Figure 3: 38 - year - old patient with right breast lump after history of lumpectomy 3 months ago. (a&b) mammographic craniocaudal and mediolateral oblique views of right breast showed well defined radio opaque area with popcorn calcification, (c) US showed well defined isoechoic lesion with central anechoic necrotic zone, MRI shows (d) Hyperintense lesion in T2 FAT SAT images, (e)Non-mass enhancement in subtracted dynamic MR images, and (f) Type I Time /signal intensity curve.
The right breast lesion was categorized BI-RADS 3 by ultrasonography and MRI, BI-RADS II by mammography. The patient underwent FNA and histopathology was postoperative fat necrosis.

DISCUSSION

Breast cancer is the most common cancer in women was ranked as the first most common malignancy among Egyptian females representing 37.8% of all women cancer cases [(11)].

The objective of this study was to compare non invasive diagnostic breast imaging modalities including MG, US and contrast enhanced MRI in a series of women with BI-RADS III breast.

Currently, MG is the breast imaging technique for both clinical and screening purposes and it is the primary imaging modality for the early detection of breast cancer, its limitation includes mainly the presence of dense breast, according to Carney et al. mammographic sensitivity (65.6 –85.5%) and specificity (87.7 – 94.3%) in detecting breast lesion which are depended on age and breast density [(12)]. In our study the sensitivity and specificity were 68 and 74% respectively.

According to Carney et al. MG is extremely sensitive in detecting microcalcifications, the sensitivity of MG in detection of cancer and early cancer related to microcalcifications was 80.5%, and specificity was only 61.5%. The presence of microcalcifications on MG is often referred to early diagnosed breast cancers and is found in approximately 70% of minimal breast cancers and frequently in ductal carcinoma in situ (DCIS) [(13)]. In our study we encountered three lesions with microcalcifications, two of them were given mammographic BI-RADS score 4 and one was given a BI-RADS score 3. The histopathological results yielded 1 case was invasive ductal carcinoma, 1 case was DCIS and the third one was Invasive Lobular Carcinoma (ILC). The sensitivity of MG in detection of cancer and early cancer related to microcalcifications was 100%.

Lazarus et al. reported that the supplemental screening ultrasonography has the potential to detect early breast cancer not seen on MG especially in women aged 40 to 49 and its NPV for final assessment category 3 was 95% [(14)].

A non mass like (NML) lesion in US has been defined as a hypoechoic area producing a distortion of the normal breast tissue without formation of a definite mass. In our study we encountered five lesions with NML lesion in US, one of them was type I and its histopathological result was duct carcinoma in situ and four were type IV. The histopathological results yielded three of them were malignant and one was scar tissue. Ko et al. reported that identification of this lesion on breast US is very important in accurate interpretation of the US, improving the sensitivity and specificity of US in breast diagnosis and clarifying the indications for biopsy of these lesions [(9)].

The MRI has great advantage in diagnosis of breast pathology. Firstly, it produces various types of planar images (scans) prior and after the administration of contrast medium. Secondly, it produces dynamic information regarding the flow of injected contrast medium within the breast tissue. Breast MRI is emerging as problem solving modality in mammographic BI-RADS 3 lesions and although it has not been implemented in common practice it has the highest overall sensitivity, which usually exceeds 90% of all imaging techniques. MRI shows a high negative predictive value (91.7 – 100%) to safely exclude breast malignancy [(15)]. In our study the PPV and NPV for final assessment category 3 by MRI was 100 and 61% respectively.

Therefore, breast MRI can be helpful in BI-RADS 3 lesions. It not only has shown to give near to 100% (95% CI: 93 – 100%) prediction of benign lesions, which means that no further invasive diagnostic work-up is needed, it also gives a better prediction of malignant lesions [(16)].

For many years, MRI examination has been widely accepted as a diagnostic tool for evaluation of breast cancer, one of its indications, is the differential diagnosis between cancer recurrence and surgical scar, Saif El-nasr et al. reported that DCE-MRI showed 100% sensitivity, 93.9% specificity, 93.1% 'PPV', 100% 'NPV' and 96.7% accuracy in differentiating postoperative changes and related treatment changes from true recurrence [(17)]. In our study there were 2 cases who underwent lumpectomy and developed postoperative lump after operation, first one after 1 year and the second after 3 months. MRI proved benign postoperative changes, by histopathological examination was scar tissue and was postoperative fat necrosis.

DCIS is a type of non-invasive malignant neoplasm of the breast, currently its management includes surgical removal, either by mastectomy or breast conserving surgery (BCS) that minimising the volume of tissue resected leads to better cosmetic results, margin positivity is an important risk factor for recurrent disease post BCS [(18)].

Allen demonstrated that MRI was also more sensitive than X-ray MG in the detection of DCIS (92% versus 56%). Unlike MG that primarily relies on the presence of micro-calcifications, MRI detects DCIS via the administration of contrast agents. The periductal stroma associated with areas of DCIS have a higher micro vessel density than normal breast tissue. Consequently, MRI may provide a more accurate estimate of DCIS size than MG, since it may be able to demonstrate mammographically occult non micro-calcified DCIS [(19)].

The main limitation of MRI in detection of DCIS is the fact that MRI was assessed only in patients with mammographic changes that were classified as suspicious microcalcifications. Thus, non calcified DCIS lesions were not evaluated, even though they might also show enhancement on MRI [(20)].

In our study there were four cases proved pathologically as DCIS one of them yielded mammographic micricalcification and three did not. In MRI two had focal enhancement, one yielded mass enhancement and one yielded non mass enhancement.

According to Kamal et al. the sensitivity of Magnetic Resonance Mammography (MRM) was 92%, the specificity was 89.74%, the positive predictive value was 74.19%, the negative predictive value was 97.22% and efficacy was 90.29% in detecting breast lesion [(21)].

Kamal et al. reported that the false negative results for DM and MRM BI-RADS scores are 2.9, 1.9%, while false positive outcome are 35.9 and 7.8 % respectively [(21)].

In our study the false negative results for DM and MRM BI-RADS scores are 35.71 and 38.46%, while false positive outcomes are 22.22 and 0% respectively.

Inspite of the increasing role of MRI in detecting breast lesions not visualized by the traditional imaging system, still its main limitations according to Perretta et al. the high number of false positive findings and the subsequent management of incidental findings [(22)].

This was indiscordant with our result as we did not actually intercounter any false positive cases by MRI.

Perretta et al. also added that in these cases re-evaluation with US study performed after MRI and targeted at the site where MRI identified the new lesion (second-look US or targeted US) permits characterization of this lesion or confirmation of MR false positive finding [(22)].

Breast abnormality in MRI includes foci, mass and NME, El Khoury et al. reported that, in this era of widespread use of MRI as a screening tool, careful and strict analysis of the NME, which could represent the earliest stage of cancer, should be done to avoid misinterpretation [(23)].

In our study there were 10 lesions showing non mass enhancement in MRI 7 of them proved to be malignant.

According to Sarica & Uluc the sensitivity, specificity, NPV and PPV of MRI in BI-RADS III lesions were 94.2, 56.1, 90.7 and 68.1%, respectively When only sonomammograghy is used, the corresponding figures were as follows: 90.9, 56.7, 93.8 and 46.4% [(24)].

In our study the numbers were 99, 100, 61 and 100% respectively for MRI and 62, 66, 57 and 70% for sonomammograghy respectively.

According to our study we recommend addition of DCE-MRI to sonomammography especially in BI-RADS III group as this will decrease unnecessary biopsies in these patients group.

CONCLUSION

Although sonomammography is the first imaging modality to detect breast pathology, DCE-MRI produces more than one advantage over sonomammography especially in BI-RADS III patients group.

In addition to its multiplanner image and non-use of ionizing radiation it doesn't only describe the morphological characteristics of the lesion but also it determines the dynamic flow characteristics of the contrast medium during wash in and wash out creating the signal intensity curve and this demonstrates the degree of vascularity inside the lesion. Also, it provides more accurate estimation of DCIS size and better identification of its surgical margin, as well as it has higher sensitivity in differentiating recurrence from postoperative changes.

However, its main limitations are cost effective and thus it can't be used as a screening method yet.

Finally, to conclude according to our study DCE-MRI should go hand by hand with sonomammogaphy especially in BI-RADS III patients group, patients with benign looking lesion six months follow up is recommended and those with malignant looking lesion biopsy should be done.

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