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ORIGINAL ARTICLE

Role of MRI in Detection of Asymmetric Densities Mamographically

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ABSTRACT

Keyword: MRI; Mammogram; Asymmetric Densities

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Background: Asymmetric breast densities are encountered relatively frequently, being reported to occur in 3% of mammogram. In addition, MRI represents the gold standard technique in patients with breast cancer. **Aim of the Work:** To detect asymmetric densities identified on mammograms through MRI. **Methodology:** This cross sectional study was conducted at the Radiology Department of Aswan University Hospital and the Radiology Department of Aswan Oncology Center. The study population consisted of 65 female patients who had suspected breast lesions based on prior mammography examinations. **Results:** The sensitivity of the breast mammography in the breast cancer screening with reference to the pathology results is 52.6%, the specificity is 87%, the positive predictive value is 62.5% and diagnostic accuracy is 76.9%. The sensitivity of the MRI in the breast cancer screening with reference to the pathology results is 100%, the specificity is 78.3%, the positive predictive value is 65.5% and diagnostic accuracy is 84.6%. **Conclusion:** breast MRI has higher sensitivity and negative predictive value (both 100%) for breast cancer detection compared to mammography alone

INTRODUCTION

Breast MRI is an indispensable modality, along with mammography and US. As opposed to mammography and US, MRI is a functional technique. Contrast material–enhanced MRI evaluates the permeability of blood vessels by using an intravenous contrast agent (gadolinium chelate). The underlying principle is that neoangiogenesis leads to formation of leaky vessels that allow for faster extravasation of contrast agents, thus leading to rapid local enhancement[1].

Asymmetric breast densities are encountered relatively frequently, being reported to occur in 3% of mammogram. Malignancy can be found in 0 – 14% of asymmetric breast tissue biopsies. Asymmetry is an area of fibro glandular density tissue that is visible in only a single view. It should be called an “asymmetry” until it is three-dimensional. It is almost always benign due to summation artifacts (BI-RADS category 1). Routine mammographic screening after 1 year is recommended[2].

The most common examination to diagnose breast cancer early is mammography, a radiological exam that generates gray scale images of the breast. The medical specialist analyzes, and visually identifies where the lesion or lesions are located. It is known that both breasts of the same patient tend to have a high degree of symmetry. The medical specialist uses

a comparison of the mammograms of these breasts to verify anomalies based on the existing symmetry[3].

Although mammography & ultrasonography are the most widely non-invasive imaging modalities used in screening & evaluation of asymmetric breasts, these modalities may have limited sensitivity and specificity for the detection and diagnosis of breast lesions. Magnetic resonance (MR) imaging has been increasingly used for accurate diagnosis of breast masses[4].

Therefore; the aim of this study was to detect asymmetric densities identified on mammograms through MRI

PATIENTS AND METHODS

Ethical Considerations

Informed consent was obtained from all participants after being informed about the aims and process of the study as well as applicable objectives. The study was performed in accordance with the Declaration of Helsinki on medical protocol and ethics. It was approved by Institutional Review Board, Faculty of Medicine of Aswan University.

Study Setting and Design

A cross sectional study was conducted on the Female patients with suspected breast lesions by mammography examination. Referred to radiology department of Aswan oncology center for magnetic resonance imaging

Participants

All recruited patients were eligible for female patients with suspected breast lesion shown by mammography.
Any patient with one or more of the following was excluded Patients with cardiac Pacemaker, intracranial metallic surgical clips, cochlear implants, vascular stents and claustrophobic patients are considered an absolute contraindication to perform MRI, Pregnant women and Patient with contraindication to contrast agent.

Methodology

Mammography Technique: Bilateral mammographic examinations in cranio-caudal and medio-lateral oblique projections were performed for all patients According to BIRADS 5th lexicon, Cranio-caudal view was done including all the medial and lateral breast tissues with the nipple in profile and pointing straight. Medio-lateral oblique view was done with angle 45° and visualizing the areas between the infra-mammary fold in the upper abdominal wall to the axillary tail and the pectoralis muscle extending in a convex curve obliquely in the upper half of the image and extend inferiorly or to the level of the nipple. According to BIRADS 5th lexicon mammograms were evaluated for breast composition, asymmetrical density associated calcifications, architecture distortion, skin retraction and axillary lymphadenopathy. Mammography types of asymmetry: Asymmetry, focal asymmetry, global asymmetry or developing asymmetry.

MRI Technique:

Imaging will be done with 1.5 Tesla Siemens machine using breast coil. MRI examinations of the study participants within the child bearing period were performed between day 5 and 15 of the menstrual cycle to reduce any residual background parenchymal enhancement that may interfere with image interpretation. MRI BIRADS classification was applied for each lesion based on combination of morphologic and kinetic criteria, then correlated with histopathological

results. Diffusion-weighted imaging evaluation, including qualitative assessment of the lesion restriction to water diffusion. The lesion was restricted if showed a high signal corresponding to an enhancing lesion on contrast-enhanced MRI.

Statistical Analysis

Analysis of data was done using Statistical Program for Social Science version 20 (SPSS Inc., Chicago, IL, USA). Quantitative variables expressed as mean and SD and compared by Student t test while qualitative variables expressed as frequency (percentage) and compared by chi-square (X2) test. Repeated ANOVA test was used to compare duration of PR, QRS and corrected QT interval at different times of follow up in each group. Level of confidence was kept at 95% and hence, P value was significant if < 0.05.

RESULTS

This study was conducted on 65 females; examined by mammogram, and MRI. The mean age of the patients was 43.7 ± 11 years. 13.8% of the studied group suffered from pain, 24.6% had breast lump, 27.7% had discharge, 4.6% suffered from both pain and lump, while 1.5% had both pain and discharge. 27.7% came for routine check-up .

Table (1): Results of the mammogram of the studied group (N=65).

			(N=65)
Asymmetrical densities	One view	Yes No	5 (7.7 %) 60 (92.3 %)
	Global	Yes No	17 (26.2 %) 48 (73.8 %)
	Focal	Yes No	41 (63.1 %) 24 (36.9 %)
	Developing	Yes No	2 (3.1 %) 63 (96.9 %)
BI-RADS		2 3 4	9 (13.8 %) 40 (61.5 %) 16 (24.6 %)

This table (1) shows that 7.7% showed asymmetrical densities in one view by mammogram, 26.2% had global asymmetrical densities, 63.1% had focal asymmetrical densities, and 3.1% had developing asymmetrical densities. Most patients (61.5%) had BI-RADS 3.

46.2% showed mass by MRI, among these, 40% had irregular margin, and 60% had irregular shape. Most the non-mass distribution was regional (34.3%). 61.5% were with free diffusion.

Most patients (35.4%) showed BI-RADS 3 by MRI. The mean value of the ADC value was 1.2 ± 0.2.

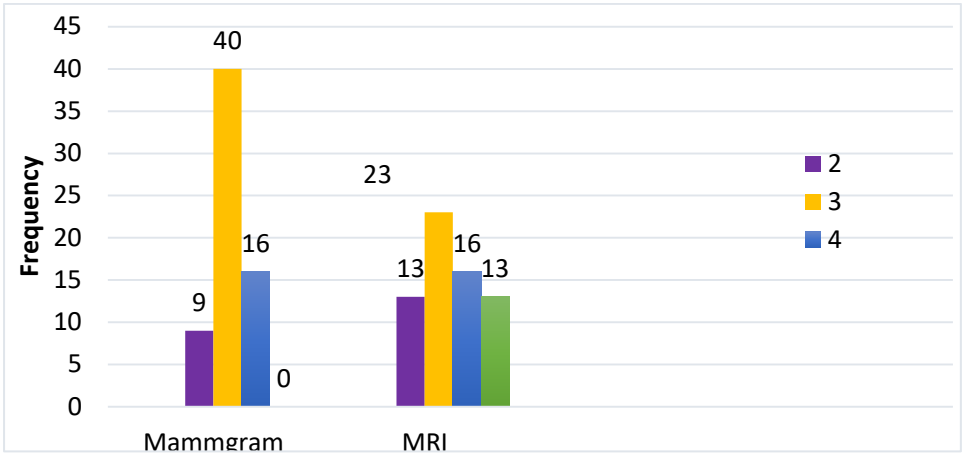

Figure (1): Bar chart displaying the BI-RADS of the mammogram and MRI of the studied group (N=65).

The pathology results were malignant in 38.5% of the cases and benign in 61.5%. The commonest benign diagnosis was fibrocystic disease (20%), while the commonest malignant diagnosis was invasive duct carcinoma (40%).

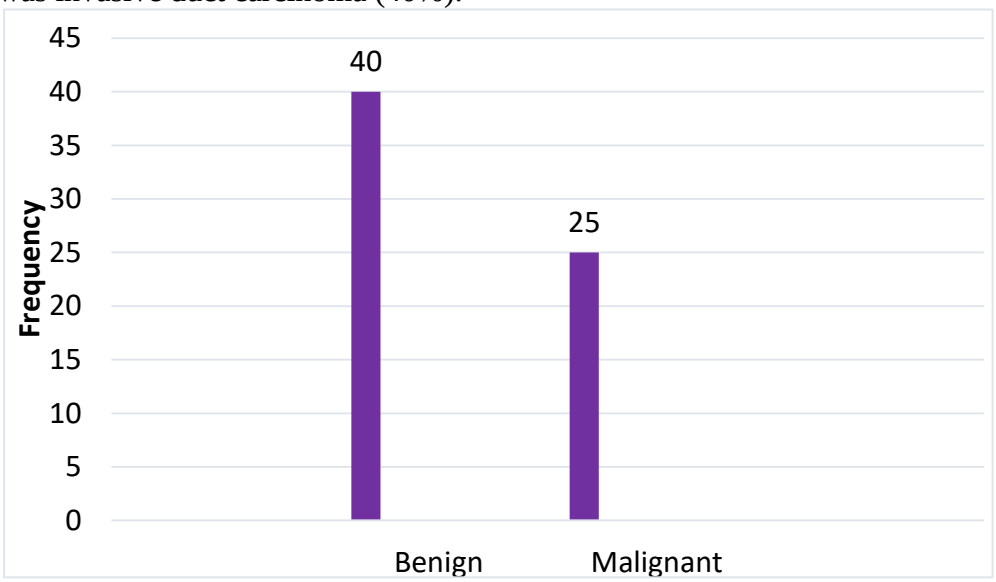

Figure (2): Bar chart displaying the pathology results of the studied group (N=65).

Table (2): Accuracy of the breast mammography in the breast cancer screening with reference to the pathology results among the studied group (N= 65).

	Pathology		
Breast mammography	**Positive**	**Negative**	**Total**
Positive	10 (TP)	6 (FP)	**16**
Negative	9 (FN)	40 (TN)	**49**
Total	19	46	**65**

TP: true positive FP: false positive TN: true negative FN: false negative

The sensitivity of the breast mammography in the breast cancer screening with reference to the pathology results is 52.6%, the specificity is 87%, the positive predictive value is 62.5% and the negative predictive value is 81.6%. Diagnostic accuracy is 76.9%.

Table (3): Accuracy of the MRI in the breast cancer screening with reference to the pathology results among the studied group (N= 95).

	Pathology		
MRI	**Positive**	**Negative**	**Total**
Positive	19 (TP)	10 (FP)	**29**
Negative	0 (FN)	36 (TN)	**36**
Total	19	46	**65**

TP: true positive FP: false positive TN: true negative FN: false negative

The sensitivity of the MRI in the breast cancer screening with reference to the pathology results is 100%, the specificity is 78.3%, the positive predictive value is 65.5% and the negative predictive value is 100%. Diagnostic accuracy is 84.6%.

Cases

A 38 years old lady Presented with left breast lump for few weeks. Mother had breast cancer at 6o years old. Married and nulliparous.

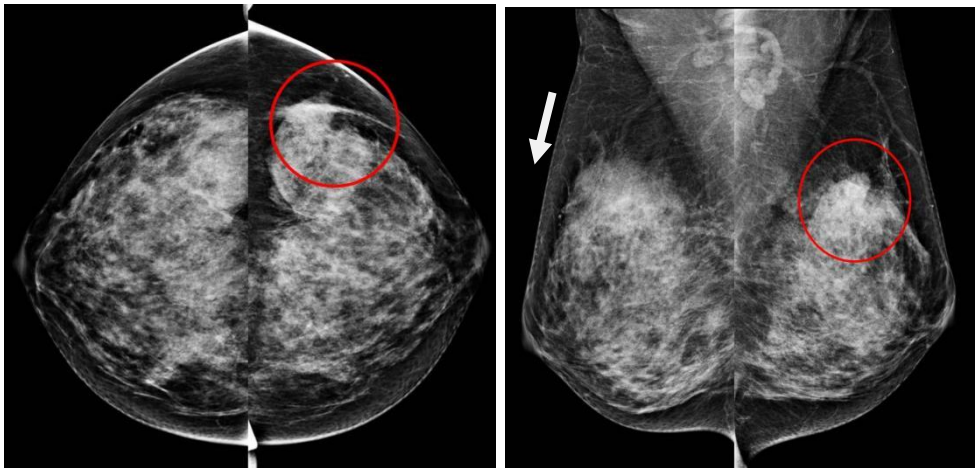

Figure (3): CC and MLO Mammogram views showed bilateral dense breasts, ACR C parenchymal density.. A focal asymmetry seen at the left upper outer region. No obvious mass lesion is seen. No suspicious clustered micro calcification. No stromal distortion.

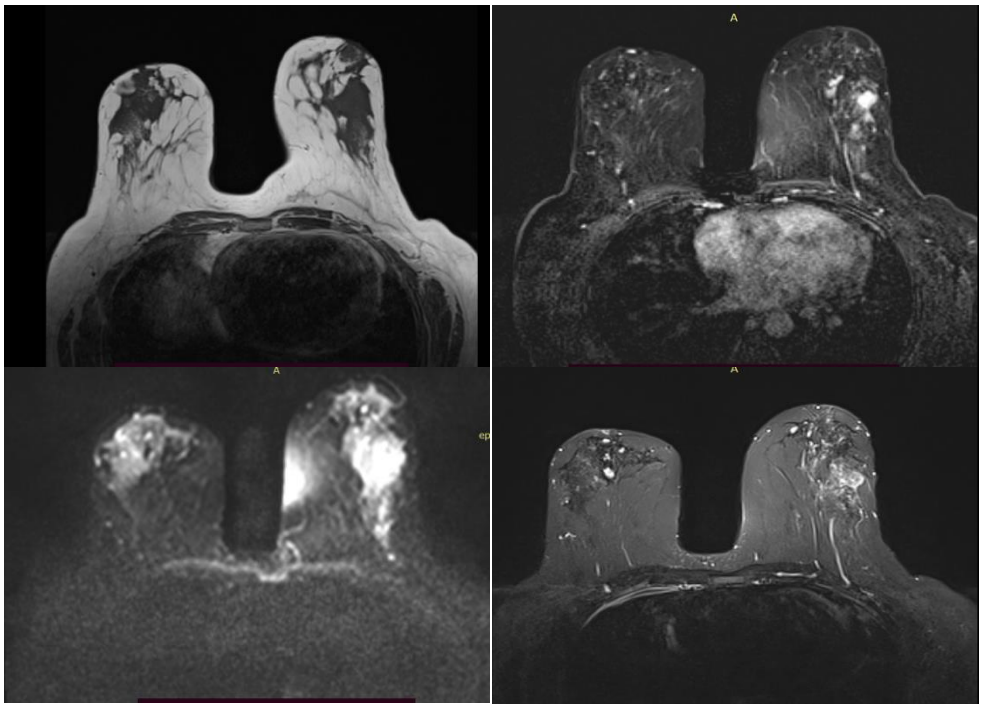

Figure (4): left breast shows a rather well defined UOQ mass lesion that surrounded by multiple similar masses but smaller in size (subcentimetric), it elicits iso intense signal on T1WI, low signal on T2WI, bright signal on STIR images, diffusion restriction and shows homogenous contrast enhancement on post contrast images. Bilateral nonspecific lymphadenopathy. Left breast UOQ multifocal malignant looking masses as described (BIRADS IV).

A 58-year-old female patient with history of right breast conservative surgery and left mastalgia.

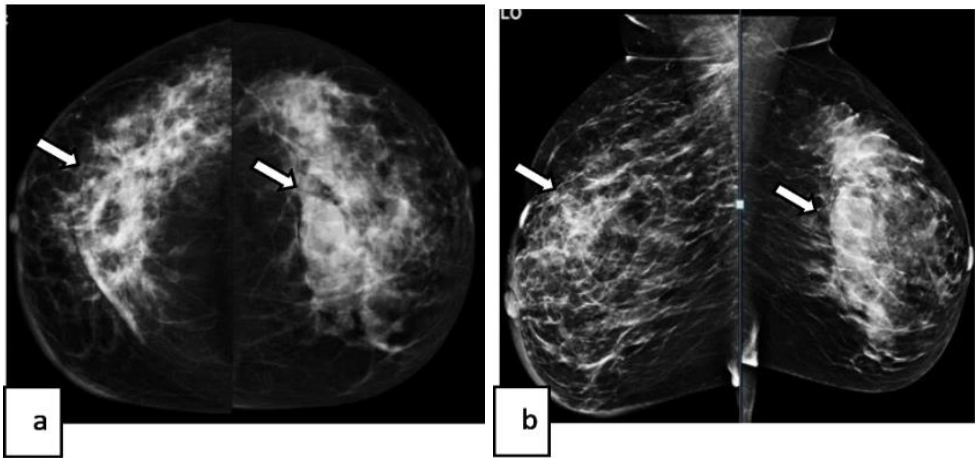

Figure (5): CC (**a**) and MLO (**b**) Mammographic views revealed breast density: ACR B, right breast: single-view asymmetry (BIRADS 3) and left breast: global asymmetry (BIRADS 4)

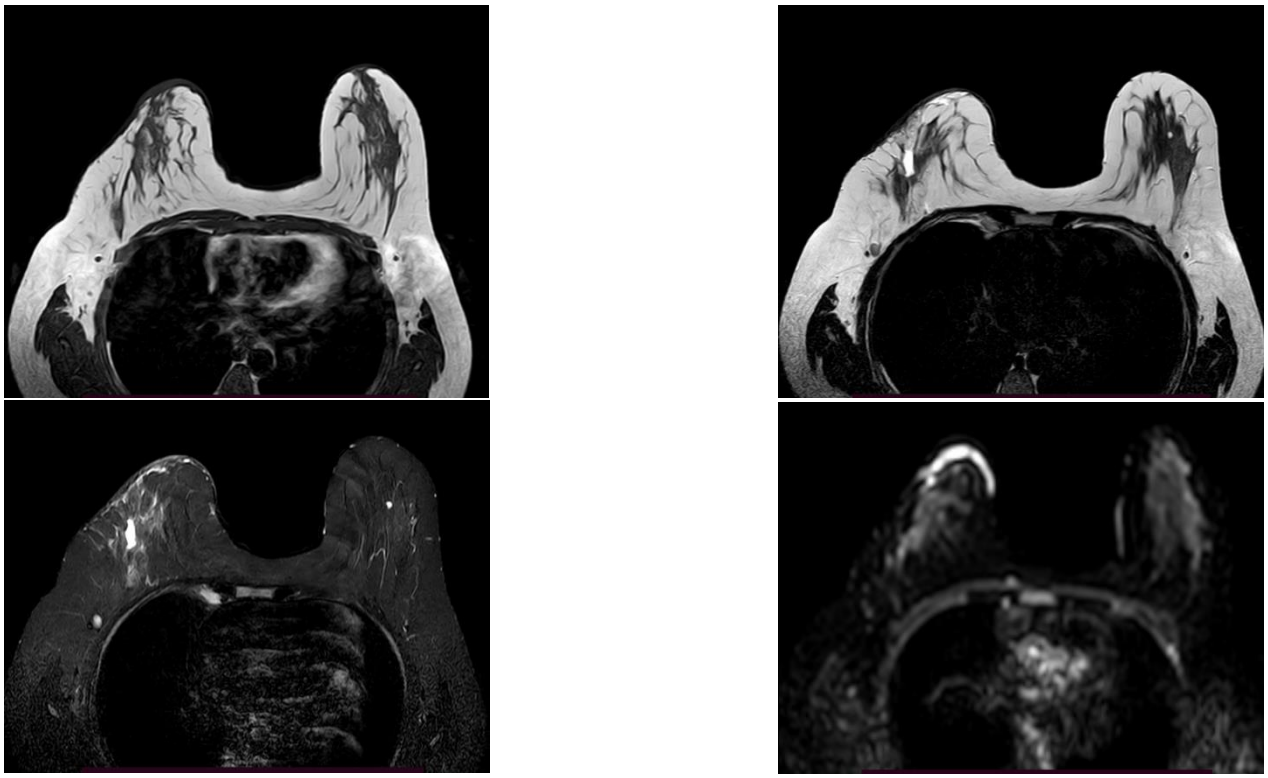

Figure (6): Irregular right breast parenchyma with architectural distortion and interstitial high T2 and STIR signal intensity of edema. Slit like area of parenchymal fluid collection within. Streaks areas of diffusion restriction with bright ADC values. Streaks of parenchyma post contrast enhancement with type I enhancement curve. Diffuse overlying skin edema and thickening. Normal MR Appearance of the fatty glandular tissue of left breast. Few tiny cysts are seen dispersed within. No detected definite solid mass lesion. (Right breast post-operative changes with intra-parenchymal small seroma. No definite residual mass lesion. Bilateral Reactive axillary adenitis are suggested. Left breast mild fibrocystic changes).

DISCUSSION

The American College of Radiology (ACR), Breast Imaging Reporting and Data System (BI-RADS) lexicon, fifth edition provides definitions for four different types of asymmetric breast findings: asymmetry, global asymmetry, focal asymmetry, and developing asymmetry[5].

The aim of this study was to assess the role of breast MRI in the assessment of asymmetric densities identified on mammograms and aid its diagnosis. This cross sectional study was conducted at the Radiology Department of Aswan University Hospital and the Radiology Department of Aswan Oncology Center. The study population consisted of 65 female patients who had suspected breast lesions based on prior mammography examinations with mean age **43.7** ± 11 years.

Wessam et al. (2019)[6] reported that, the patients' mean ages were 48.87 years ranged from 25 to 81 years.

The age of women with known breast carcinoma was 49.6 years ranged from 25 to 74 years as mentioned by ***Jochelson et al., (2013)***[7]**.**

7.7% showed asymmetrical densities in one view by mammogram, 26.2% had global asymmetrical densities, 63.1% had focal asymmetrical densities, and 3.1% had developing asymmetrical densities. Most patients (61.5%) had BI-RADS 3.

Ghada et al. (2021)[8] reported that, CESM showed that two thirds of studied patients had mass enhanced lesions and the remaining one third had non mass enhanced lesions so all cases showed enhancement.

Regarding a study aimed to assess the value of CESM in characterization of breast asymmetries and if it should be incorporated in its diagnostic work-up among 380 patients where focal asymmetry detected in 60% of them with mean age of 47 years ranged from 29 to 69 years. Associated mammography findings as edema, skin thickening, parenchymal distortion and calcifications were seen in 29% cases as reported previously by ***Kamal et al., (2019)***[9]**.**

46.2% showed mass by MRI, among these, 40% had irregular margin, and 60% had irregular shape. Most the non-mass distribution was regional (34.3%). 61.5% were with free diffusion. Most patients (35.4%) showed BI-RADS 3 by MRI.

Mandell, (2013)[10] ***& Berg & Yang (2015)***[11] stated that, wash out curve presents in 57% of malignant lesions while fast decrease in the intensity signal by 10% indicates malignancy in 87% of cases.

Bray et al. (2018)[12] studied 74 lesions, & reported that 61.1% of the malignant lesions showed wash out curve & 25% of them showed plateau curve.

In our study, the sensitivity of the breast mammography in the breast cancer screening with reference to the pathology results is 52.6%, the specificity is 87%, the positive predictive value is 62.5% and the negative predictive value is 81.6%. Diagnostic accuracy is 76.9%. the sensitivity of the MRI in the breast cancer screening with reference to the pathology results is 100%, the specificity is 78.3%, the positive predictive value is 65.5% and the negative predictive value is 100%. Diagnostic accuracy is 84.6%.

Zidan et al. (2020)[13] reported that, the calculated sensitivity and specificity of mammography in the characterization of benign and malignant asymmetries were 47% and 91.5%, respectively. The positive predictive value was 70%, negative predictive value 80%, and accuracy 78%.

Bluemke et al. (2004)[14] reported that the sensitivity of DCE-MRI ranges from 88 - 100% while specificity range is 68 - 96%.

DWI & ADC values provide a promising tool in screening & diagnosis of breast lesions without the use of contrast agents, especially in patients with contraindication to them, thus it may decrease the cost of the examination.

Wahab et al. (2015)[15] reported that the ADC cutoff value between benign & malignant lesions was 1.02 x 10-3 sec/mm2 with sensitivity of 90%, the specificity of 95%, PPV of 100%, NPV of 90.4% & the accuracy of 92%.

Zidan et al. (2020)[13] reported that, dynamic contrast-enhanced MRI (DCE-MRI) demonstrated a sensitivity and specificity of 100% and 74.3%, respectively, for characterizing benign and malignant lesions, with a positive predictive value of 62.5%, negative predictive value of 100%, and an overall accuracy of 82%. The optimal apparent diffusion coefficient (ADC) cutoff value to distinguish between benign and malignant lesions was determined to be $1.10 \times 10 - 3$ mm2/s, yielding a sensitivity of 80%, specificity of 88.6%, positive predictive value of 75%, negative predictive value of 91%, and an accuracy of 86%. Notably, the majority of benign lesions exhibited ADC values above the cutoff, while a small fraction had values below, specifically chronic breast abscesses. The combined protocol of DCE-MRI and diffusion-weighted imaging (DWI) emerged as the most effective, achieving a sensitivity and specificity of 93.3% and 94.3%, respectively, with a positive predictive value of 87.5%, negative predictive value of 97.1%, and an overall accuracy of 94%. DWI was identified as a valuable adjunctive measure, maintaining high sensitivity, increasing specificity, and maximizing the overall diagnostic accuracy of breast MRI examinations. An illustrated case of mucinous carcinoma featured a notably low ADC value of $0.56 \times 10 - 3$ mm2/s.

CONCLUSION

breast MRI has higher sensitivity and negative predictive value (both 100%) for breast cancer detection compared to mammography alone

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