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Research Article

New Era of Diffusion weighted imaging as Screening Tool for Breast Cancer

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Abstract

Background: Breast cancer has been recently known as a heterogeneous group of diseases. Early detection of breast cancer plays an important role in the treatment and control of the disease Diffusion-weighted MRI (DW-MRI) is sensitive to characteristics often disrupted in malignant breast tissues, such as cell organization, density, extracellular space, and cell membrane permeability, which may help to better discriminate between different types of breast lesions. **Aim of study:** The aim of our study was to determine if we can fully relay on DWI with conventional images alone for detection, evaluation of different breast lesions to avoid unneeded biopsy. **Subject and Methods:** This was a prospective study; it was conducted on 30 female patients at Minya oncology center & Diagnostic Radiology department of Minya University. This studied included patients with equivocal breast lesions detected by either sonograhy or mammography (BIRADS III). Then MRI was conducted. Biopsy was done to confirm diagnosis. **Results:** There were 30 female patients (mean age, 45; SD, 13.8) with 17 BI-ADS 3 lesions included (56.7%). The area under the ROC curve was 0.83. Applying the investigated ADC cutoff, sensitivity 100 %, specificity was 66.7%. The potential reduction of unnecessary biopsies was 23.3%. **Conclusion:** DWI can be great screening tool for breast cancer as well as had been helpful in at assessment of post-operative statutes.

Key Words: BIRADS III, DWI, Sono-mamograhy.

Introduction

Breast cancer is a major cause of morbidity and mortality.[1] Therefore, early diagnosis of breast cancer is essential for a more conservative surgical approach to treat the disease.[2]

The purpose of screening tests is to detect the disease asymptomatic stage allowing early intervention for best result**.** However, due to the limitations of mammography screening, breast cancer can go undetected.[3]

Breast MRI is an essential tool in breast imaging with numerous indications, including preoperative staging, therapeutic monitoring, detection of recurrences, evaluation of breast implants, screening of high-risk women, patients with tumors of unknown primary syndrome**,** and as a troubleshooting tool in those who do not clear mammography and ultrasound results**.**[4]

Diffusion-weighted imaging (DWI) is a powerful tool to complement contrast-enhanced magnetic resonance imaging (CE-MRI) of the breast.

DWI measures the random movement of water molecules, that is called Brownian movement and illustrates the diffusivity of the examined tissues.

DWI is a powerful marker of tissue micro-structure, membrane integrity and cell density and can be quantified by ADC calculation**.** Changes in the diffusion properties of water in tissues can be used to detect and characterize disease processes anywhere in the body.[5]

Aim of study:

The aim of our study was to determine if we can fully relay on DWI with conventional images without contrast administration for detection, evaluation of different breast lesions to avoid unneeded biopsy and so we can downstaging the high BIRADS breast lesions.

Subjects and methods

This study was a prospective, observational study, conducted on 30 patients. The study conducted in radiology department at Minya oncology center and El Minya university Hospital from 2022 to 2023.

Ethical approval

For any patient enrolled into the study, the purpose and design were explained to the patients in details. A written consent was obtained from each patient. We avoided utilizing deceptive practices by obtaining patient's informed consents prior to participant enrollment, which gave participants the option to withdraw from the study at any time. The ethical committee of the faculty of Medicine, Minia University approved this study (Approval No.236:6/2022).

Inclusion Criteria

1. Positive family history.
2. Patients those with equivocal breast lesions detected by sono- mammography.

All patients were subjected to:

- **Full History taking**

All patients in this study had given full history including their full name, age, menstrual cycle, family history, medical treatment and operative history.

- **Examination**

Clinical examination was done to detect any palpable lesions.

- **Screening:**

The patients above 40 years guided to do mammography. Then all patients are guided to do ultrasound by scanning the breast. Any patient of BIRADS I & II which were detected by sono-mammographic evaluation were excluded.

Our thirty patients which were assessed by sono –mammographic as BIRADS III & IV, those were guided to do MRI.

- **Magnetic Resonance Imaging studies of Breast:**

All of them were subjected to DCE-MRI and DW-MRI examination using GE Signa Explorer 1.5 T machine.

They were imaged in prone position using a dedicated double breast coils with patients lying in a prone position Both the breasts will be placed deep and centrally in the coil, with the nipple facing downwards. The entire breast tissue should be covered in coil with absent of skin folds. Patient was advised to stay immobile until the completion of scan to get images free from movement related artifact.

Result

Table (1) shows total number of cases was 30 females, their age ranging from 21-69 years old with Mean± SD 45.3±13.8. 56.7% of breast lump, 33.3% complained of mastalgia, 6.7% of nipple discharge and 3.3% of asymmetry in size. 50% of patients had positive family history for breast cancer. 13.3 % of patients had Conservative breast surgery.

Table (2) shows sono mammographic BIRADS of studied cases, 56.7% presented with BIRADS III, 36.7% presented with BIRADS IV and 6.7 % presented with BIRADS V.

Table (3) shows DWI finding of the studied cases, 36.7% with diffusion restriction, 33.3% were facilitated on DWI restriction and 30% were with no diffusion restriction.

Table (4) shows significant value in compassion between sono- mammographic BIRADS and MRI BIRADS evaluation:

- Seventeen cases were presented with BIRADS III at sono- mammographic evaluation after MRI was done four cases of them now presented with BIRADS I (23.3%), eleven cases of them now presented with BIRADS II (64.7%), one case is still presented with BIRADS III (5.9%) and one case now presented with BIRADS IV (5.9%).
- Eleven cases were presented with BIRADS IV at sono –mammographic evaluation after MRI was done four cases of them now presented with BIRADS II (36.4%), two cases of them now presented with BIRADS III (18.2 %), two

cases of them now presented with BIRADS IV (18.2%) and three of them now presented with BIRADS V (27.3%).

- Two cases were presented with BIRADS V at sono- mammographic evaluation after MRI was done still two cases presented with BIRADS V. (p value= 0.01)

Table (1): Distribution of the studied cases regards clinical data:

Data		**Total No=30**
Age	**Range** **Mean±SD**	21-69 45.3±13.8
Sex	**Female**	30(100%)
Complain	**Lump** **Mastalgia** **Nipple discharge** **Asymmetry in size**	17(56.7%) 10(33.3%) 2(6.7%) 1(3.3%)
Family history	**Negative** **Positive**	15(50%) 15(50%)
Operation (CBS)	**No** **Yes**	26(86.7%) 4(13.3%)

Table (2): Sono-mammograhic BIRADS of the studied cases (no=30):

	No	**%**
BIRADS III	17	56.7%
BIRADS IV	11	36.7%
BIRADS V	2	6.7%

Table (3): DWI findings of the studied cases (no=30):

DWI	**No**	**%**
Restricted (high at DWI and low at ADC)	11	36.7%
Facilitated (High DWI and High ADC)	10	33.3%
Non restricted (not high at DWI and high at ADC)	9	30%

Table (4): Comparing between sono- mammographic birads & combined MR birads.

Sono-mammographic BIRADS	**MR BIRADS**				
	BIRADS I	**BIRADS II**	**BIRADS III**	**BIRADS IV**	**BIRADS V**
BIRADS III (17)	4 (23.5%)	11(64.7%)	1(5.9%)	1(5.9%)	0
BIRADS IV (11)	0	4(36.4%)	2(18.2%)	2(18.2%)	3(27.3%)
BIRADS V (2)	0	0	0	0	2(100%)

P value =0.01*

Discussion

In this study, lesions that were classified into the BIRADS 3 and BIRADS 4 lesions and aimed to highlight the role of further MRI with focusing upon DW MRI.

In this study, the age of our studied cases ranged from 21-69 years with mean value of 45.3±13.8. All of them were female.

On the other hand at Hashem et al., 2021[6] it was conducted upon 90 female patients ranging from 25 and 70 years with mean value of 42± 12.9. and at Paola Clauser et al., 2021[7], that was conducted upon 657 female patient.

50% of patients were with positive family history and other 50% were with negative family history. Only 4 (13.3%) of patients underwent breast conservative surgery (BCS).

In this study, patients were presented either by lump (n=17/30, 56.7%), matalgia (n=10/30, 33.3%), nipple discharge (n=2/30, 6.7%) and Asymmetercity in size (n=1/30, 3.3%).

On the other hand, the study conducted by Hashem et al., 2021[6], presented with either breast lump/s (n=45/86, 52.3%), inflammatory manifestations (n=6/86, 7%), or screening and post-operative follow-up (n=35/86, 40.7%)

In this study, Sono-mammographic sensitivity was 88.9 % and specificity was 66.7 %.
That was higher compared to the one reported at Eisa et al., 2018[8] that showed sensitivity of 68 % and specificity of 74%. and the ones reported by Mehnati et al., 2015[9] that showed sensitivity of 30–60 and 40–80 respectively. It is an agreement with our study.

And it was less than Hashem et al., 2021[6] reported with sensitivity and specificity of 73% and 80%. it was disagreement.
In this study, the combined CE-MRI with DWI achieved a sensitivity 88.9 % and specificity of 100%.

This was less than Aribal et al., 2016[10] which was reported of a sensitivity of 97%. and Ebrahim et al., 2018[11] that were able to achieve a sensitivity of 100%, and was higher than Hashem et al.,2021 [6] that was able to achieve 73.1%.

However, the specificity in this study was much high than achieved of above studies which showed a specificity of 88.9% and 76%, 83.6 % respectively. That was dis agreement.
In this study, The DWI MRI only without contrast achieved sensitivity of 88.9 % and specificity of 88.9 %.

That is higher than Hashem et al., 2021 that showed sensitivity and specificity of 73.1% and 83,6 %.[6] It was disagreement.
In our study, ADC values were ranging from 0.5 to 2 x $10^{-3}mm^2$ /sec.

All the malignant lesions had ADC value ranging from 0.7 to 1 x $10^{-3}mm^2$ /sec with cut off value 0.9 which achieved sensitivity of 100 % and specificity of 66.7 %, with significant P value (0.01)

That is less than cut of value at Hashem et al., 2021[6] that was 1.3 x $10^{-3}mm^2$ /sec with sensitivity of 73%, and specificity of 83.7%.

As well as less specificity than the ones achieved at El Bakry et al., 2015 [12] and Yadav et al., 2018[13] who reached a respective specificity of 92.1% and 91.6%.

Conclusion

Breast MRI has been a problem-solving tool in lesions that were equivocal in the other imaging modalities. When comparing the ability of DCE-MRI and DW-MRI in assessing BIRADS 3 and BIRADS 4 lesions with the ultimate aim of reducing unnecessary biopsies. DWI alone has represented an accurate diagnostic tool and a valid alternative to CE-MRI for evaluating breast lesions. In particular, STIR and DWIBS sequences allow detecting breast nodules while T2-weighted sequences and ADC values could be useful for lesion characterization.

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