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Role of Diffusion-Weighted Magnetic Resonance Imaging for Detection of Multifocality, Multicentricity and Contra Lateral Side in Newly Diagnosed Breast Cancer: Comparison with Combined Mammography and Whole-Breast Ultrasound and Histopathological Correlation

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Abstract:

Background: Diffusion-weighted MRI is fast, unenhanced modality that shows promise in identifying mammographically occult malignancy. it demonstrates breast malignancies based on reduced water diffusivity relative to normal tissue. This study aimed to In cases of recently diagnosed breast cancer, compare the effectiveness of DW-MRI with combined mammography and whole breast ultrasound (US). **Methods:** This prospective cross-sectional study included 150 female patients newly diagnosed with breast cancer. All patients underwent breast mammography, ultrasound and DWI breast MRI, all MRI examinations were performed using 1.5 tesla (Siemens area MRI device, manufactured in Germany). **Results:** For ipsilateral tumor side DWI demonstrated a higher sensitivity (93.9%) compared to Sono-MMG (85.9%), with both modalities achieving good specificity (90/92%) and positive predictive value (PPV) of 92/95%%. The negative predictive value (NPV) was higher for DWI (89.5%) than for Sono-MMG (78.5%), In assessing tumors larger than 5 cm, DWI showed a sensitivity of 92.7% significantly outperforming Sono-MMG's 48.8%, while both methods maintained 92/97.2% specificity and PPV. The NPV for DWI was also 97.2%, compared to 83.8% for Sono-MMG, regarding muscle invasion detection, DWI showed superior sensitivity at 100%, whereas Sono-MMG had a sensitivity of 33.3%. For contralateral BIRAD scores of 3 or higher, both imaging techniques exhibited equal sensitivity of 78.6%. However, DWI demonstrated slightly higher specificity (94.1% vs. 91.9%) and PPV (57.9% vs. 50%). Both modalities had the same NPV of 97.7%. **Conclusion:** The results of our investigation indicate that DW MRI may be used in addition to sono-mammography as a screening method for breast cancer identification. Optimizing lesion evaluation by the combination of DCE-MRI and DW-MRI is the gold standard approach.

Keywords: Diffusion-Weighted Magnetic Resonance Imaging; Breast Cancer; Mammography; Ultrasound; Histopathological.

Introduction

The detection of breast cancer has evolved considerably in the past decade with the introduction of digital breast tomosynthesis (DBT) and an increased use of breast MRI [(1)]. Synchronous contralateral breast cancer is 1.0–4.6% common in women with recently diagnosed breast cancer. Finding contralateral cancer at the time of the original breast cancer diagnosis is crucial in order to prevent the need for a second round of cancer treatment [(2)]. Additional ipsilateral disease is especially important if the patient is considering breast conservation and identifying contralateral disease allows concomitant treatment.

When it comes to preoperative staging, breast MRI has proven to be a more effective method than other imaging modalities for estimating tumor size and locating extra tumor foci in both the contralateral and ipsilateral breast. It is particularly beneficial for invasive lobular carcinoma, which is challenging to detect with mammography [(3)].

In 1.4–4.1% of women, concealed contralateral breast cancer can be detected clinically and mammographically with dynamic contrast enhanced (DCE) MRI. However, a high rate of false-positive results as well as high costs restrict the use of preoperative MRI for breast cancer staging, including screening for contralateral breast cancer. Thus, diffusion-weighted imaging (DWI)-integrated multiparametric MRI schemes provide higher specificity than DCE-MRI alone, which lowers the number of false-positive biopsies [(4)]. Furthermore, the use of intravenous (IV) gadolinium-based contrast agents is not advised in women who are pregnant, have impaired kidney function, or are allergic to contrast materials [(2)].

When measuring the Brownian motion of water using motion sensitizing gradients, diffusion-weighted MRI is a quick, unenhanced method that works well. By calculating the apparent diffusion coefficient (ADC), which is a measure of the diffusion of water molecules [(5)].

In order to analyze contralateral breast cancer in women with recently diagnosed breast cancer and compare the screening efficacy of DW MRI and combined mammography and ultrasound (US) in identifying multifocal, multicentric lesions, this study compared the two methods using histopathological correlation.

Patients and methods

This prospective cross-sectional study included 150 female patients just received a breast cancer diagnosis, at Sono-mammographic and MRI unit In Radiology Department of Benha University Hospital, during the period from January 2023 to April 2024 (1.4 year).

The patients gave their informed written consent. Each patient was given a code number and an explanation of the study's objectives. The study was carried out with approval from the Benha University Faculty of Medicine Research Ethics Committee (code number: MD 17-8-2022). with allergies to contrast materials or renal impairment

Inclusion criteria were Patients who were female and had just received a new diagnosis of breast cancer using alternative imaging modalities (combined mammography and breast US, including the traditional B mode and Color Doppler examination and confirmed as breast cancer by histopathology). Every female patient had both breasts dynamically augmented and subjected to DWI.

Exclusion criteria were individuals who should not have had an MRI, shouldn't receive a contrast injection, shouldn't have had an MRI, haven't had their breast cancer histopathologically confirmed, or have had breast cancer therapy of any kind.

Every patient had a breast mammography, ultrasound, and DWI breast MRI. The 1.5 Tesla MRI machine was used for all MRI exams, and the patients were placed in the prone position inside a breast coil. The best cut-off for differentiating between benign and malignant tumors during MRI scanning was an ADC value of ≤ 0.87.

Sample size:

Five of the 155 individuals were not allowed to continue in the trial because contraindicated MRI examination as two of them had cardiac pacemakers, one was pregnant and three of them underwent neo-adjuvant chemotherapy, the remaining 150 patients were included in this study.

Statistical analysis:

IBM, Armonk, New York, USA) SPSS version 28 was used for data administration and statistical analysis. Using direct data visualization techniques and the Kolmogorov-Smirnov test, quantitative data were evaluated for normalcy. Quantitative data were summarized as means and standard deviations, or as medians and ranges, in accordance with normalcy. Numbers and percentages were used to summarize the categorical data. The Kappa statistic was used to evaluate agreement between sono mammography and DWI findings for categorical data, while intraclass correlation was used to evaluate agreement for BIRAD categorization. Sono mammography and DWI results were compared to the DCE MRI as the reference standard in order to compute diagnostic indices. Each and every statistical test has two sides. Significant P values were those with a value of less than 0.05.

Case (1): 82 years old female with palpable left breast mass. Sonomammography showed left breast showed few about three malignant looking mass lesion occupying upper inner quadrant. Histopathology revealed: IDC. MRI showed left breast showed upper inner quadrant irregular heterogeneously enhancing lesion with non-mass enhancement is seen from the dominant mass reaching nipple areola complex which is restricted visibility on DWI (strong signal on DWI, low signal in ADC). Figure 1

Case (2): 51 years old female with mastalgia with right breast showed malignant looking mass lesion occupying lower inner quadrant (BIRADS IV b). left upper quadrant asymmetry. Histopathology revealed right IDC. MRI showed Right breast showed lower inner quadrant irregular heterogeneously mass lesion which is seen restricted on DWI (high signal on DWI, low in ADC), no evidence of enhancing or restricted masses on left side or altered parenchyma or masses on US. Figure 2

Results

Table 1 shows the general characteristics (age, ACR staging for breast density, pathology and papillary carcinoma grade) of the studied patients.

Sono-mammographic, the results of dynamic contrast-enhanced MRI and diffusion-weighted imaging are shown in Table 2

Table 1: General characteristics of the studied patients

General characteristics		statistic	Value
Age (years)		**Mean ±SD**	50 ±11
ACR staging for breast density	A	**n (%)**	7 (4.7)
	B	**n (%)**	76 (50.7)
	C	**n (%)**	62 (41.3)
	D	**n (%)**	5 (3.3)
Pathology	IDC	**n (%)**	137 (91.3)
	ILC	**n (%)**	8 (5.3)
Papillary carcinoma	Grade	**n (%)**	5 (3.3)
	Grade I	**n (%)**	5 (3.3)
	Grade II	**n (%)**	87 (58)
	Grade III	**n (%)**	58 (38.7)

SD: Standard deviation; ACR: American College of Radiology; IDC: Invasive ductal carcinoma; ILC: Invasive lobular carcinoma; Grade I: Grade 1; Grade II: Grade 2; Grade III: Grade 3.

Table 2: Sono-mammographic, diffusion-weighted imaging, dynamic contrast-enhanced MRI findings of the studied patients

Sono-mammographic findings		
Side	**Statistic**	**Value**
Unilateral	n (%)	141 (94)
Bilateral	n (%)	9 (6)
UOQ affection	n (%)	113 (75.3)
UIQ affection	n (%)	23 (15.3)
LOQ affection	n (%)	40 (26.7)
LIQ affection	n (%)	18 (12)
Retroareolar affection	n (%)	14 (9.3)
Size		
1-3 cm	n (%)	49 (32.7)
3-5 cm	n (%)	81 (54)
>5 cm	n (%)	20 (13.3)
Number		
Single	n (%)	65 (43.3)
Multifocal	n (%)	68 (45.3)
Multicentric	n (%)	17 (11.3)
Lymph node		
Positive	n (%)	99 (66)
Negative	n (%)	51 (34)
Contralateral BIRADs	Median (range)	2 (1 - 5)
Muscle invasion	n (%)	3 (2)
Diffusion-weighted imaging findings		
Side		
Unilateral	n (%)	141 (94)
Bilateral	n (%)	9 (6)
UOQ affection	n (%)	104 (69.3)
UIQ affection	n (%)	35 (23.3)
LOQ affection	n (%)	43 (28.7)
LIQ affection	n (%)	21 (14)
Retroareolar affection	n (%)	16 (10.7)
Size		
1-3 cm	n (%)	34 (22.7)
3-5 cm	n (%)	75 (50)
>5 cm	n (%)	41 (27.3)
Number		
Single	n (%)	57 (38)
Multifocal	n (%)	73 (48.7)
Multicentric	n (%)	20 (13.3)
Lymph node		
Positive	n (%)	93 (62)
Negative	n (%)	57 (38)
Contralateral BIRADs	Median (range)	1 (1 - 6)
Muscle invasion	n (%)	9 (6)
DWI		
Restricted	n (%)	150 (100)
ADC		
High	n (%)	3 (2)
Low	n (%)	147 (98)
DCE MRI findings		
Number		
Single	n (%)	51 (34)
Multifocal	n (%)	74 (49.3)
Multicentric	n (%)	25 (16.7)
Size		
1-3 cm	n (%)	34 (22.7)
3-5 cm	n (%)	75 (50)
>5 cm	n (%)	41 (27.3)
Muscle invasion	n (%)	9 (6)
Contralateral BIRAD	Median (range)	1 (1 - 6)

UOQ: Upper outer quadrant; UIQ: Upper inner quadrant; LOQ: Lower outer quadrant; LIQ: Lower inner quadrant; BIRADs: Breast Imaging Reporting and Data System; BIRAD: Breast Imaging Reporting and Data System.

Both modalities showed a perfect agreement (k = 1, p < 0.001) in identifying side. For regional breast affection, the upper outer quadrant (UOQ) was identified in 113 cases (75.3%) by sono-mammogram and 104 cases (69.3%) by MRI, with excellent agreement (k = 0.851, p < 0.001). Similarly, the upper inner quadrant (UIQ) was affected in 23 cases (15.3%) by sono-mammogram and 35 cases (23.3%) by MRI, with a good agreement (k = 0.746, p < 0.001). The lower inner and lower outer quadrants (LOQ and LIQ, respectively) showed excellent agreements between sono-mammogram and DWI (k = 0.95 and 0.912, respectively, p < 0.001 for each). Retroareolar affection showed an excellent agreement with k = 0.926 (p < 0.001), Regarding tumor size, reasonable agreement (p < 0.001, k = 0.57)was observed between sono-mammogram and DWI. For tumor number, good agreement was observed between sono-mammogram and DWI (k = 0.711, p < 0.001), An excellent agreement was observed between sono-mammogram and DWI in lymph node evaluation (k = 0.913, p < 0.0001). The contralateral BIRADs median score was 2 (range 1-5) by sono-mammogram and 1 (range 1-6) by MRI, 0.612 (p < 0.001) for the intraclass correlation coefficient (ICC), indicating moderate agreement. Regarding muscle invasion, it was identified in 3 cases (2%) by sono-mammogram and 9 cases (6%) by MRI, with moderate agreement (k = 0.485, p < 0.001). Table 3

Table 3: Agreement between sono-mammographic and DWI-MRI findings

		Sono-mammogram	MRI Diffusion	Agreement	P-value
Side					
Unilateral	**n (%)**	141 (94)	141 (94)	k = 1	**<0.001***
Bilateral	**n (%)**	9 (6)	9 (6)		
UOQ affection	**n (%)**	113 (75.3)	104 (69.3)	k = 0.851	**<0.001***
UIQ affection	**n (%)**	23 (15.3)	35 (23.3)	k = 0.746	**<0.001***
LOQ affection	**n (%)**	40 (26.7)	43 (28.7)	k = 0.95	**<0.001***
LIQ affection	**n (%)**	18 (12)	21 (14)	k = 0.912	**<0.001***
Retroareolar affection	**n (%)**	14 (9.3)	16 (10.7)	k = 0.926	**<0.001***
Size					
1-3 cm	**n (%)**	49 (32.7)	34 (22.7)	k = 0.57	**<0.001***
3-5 cm	**n (%)**	81 (54)	75 (50)		
>5 cm	**n (%)**	20 (13.3)	41 (27.3)		
Number					
Single	**n (%)**	65 (43.3)	57 (38)	k = 0.711	**<0.001***
Multifocal	**n (%)**	68 (45.3)	73 (48.7)		
Multicentric	**n (%)**	17 (11.3)	20 (13.3)		
Lymph node					
Negative	**n (%)**	51 (34)	57 (38)	k = 0.913	**<0.001***
Positive	**n (%)**	99 (66)	93 (62)		
Contralateral BIRADs	**Median (range)**	2 (1 - 5)	1 (1 - 6)	ICC = 0.612	**< 0.001***
Muscle invasion	**n (%)**	3 (2)	9 (6)	k = 0.485	**<0.001***

*Significant P-value; UOQ: Upper outer quadrant; UIQ: Upper inner quadrant; LOQ: Lower outer quadrant; LIQ: Lower inner quadrant; BIRADs: Breast Imaging Reporting and Data System; MRI: Magnetic Resonance Imaging; k: Kappa statistic; ICC: Intraclass correlation coefficient.

The study assessed the diagnostic indices of sono-mammogram (Sono-MMG) and Using DWI to find multicentric or multifocal tumors (MF/MC), tumor size greater than 5 cm, muscle invasion, and contralateral BIRADs scores of 3 or higher in breast cancer patients, For detecting MF/MC tumors, DWI demonstrated a higher sensitivity (93.9%) compared to Sono-MMG (85.9%), with DWI demonstrated a higher specificity (92%) compared to Sono-MMG (90%) and positive predictive value (PPV) of 92%&95% regrading Sono-MMGand DWI. The negative predictive value (NPV) was higher for DWI (89.5%) than for Sono-MMG (78.5%), In assessing tumors larger than 5 cm, DWI showed a sensitivity of 92.7%, significantly outperforming Sono-MMG's 48.8%, while specificity of Sono-MMG 92% while DWI 97.2% and 94% for Sono-MMG and 97.2% for DWI. The NPV for DWI was also 92.7%, compared to 83.8% for Sono-MMG, regarding muscle invasion detection, DWI showed superior sensitivity at 100%, whereas Sono-MMG had a sensitivity of 33.3%. DWI achieved 100% specificity and PPV, with DWI also achieving a perfect NPV of 100%, compared to 95.9% for Sono-MMG, for contralateral BIRAD scores of 3 or higher, both imaging techniques exhibited equal sensitivity of 78.6%. However, DWI demonstrated slightly higher specificity (94.1% vs. 91.9%) and PPV (57.9% vs. 50%). Both modalities had the same NPV of 97.7%. Table 4

Appearance diffusion coefficient (ADC) and diffusion-weighted imaging (DWI) reveal enhanced diffusion in 10 cases (6.7%) and limited diffusion in 140 cases (93.3%). Malignant lesions have an ADC value ranging from 0.60 to 1.3x10−3 mm2/s, with a mean value of 0.83 ± 0.15 × 10−3 mm2/s. This range was found in 140 instances (93.3), but in 10 cases, the range was 1.30 to 1.6x10−3 mm2/s, with no real restriction noted in DWI and ADC.

Table 4: Diagnostic indices of sono-mammogram and diffusion-weighted imaging compared to the reference standard DCE MRI

	MF or MC		Size > 5		Muscle invasion		BIRAD ≥3	
	Sono-MMG	**DWI**	**Sono-MMG**	**DWI**	**Sono-MMG**	**DWI**	**Sono-MMG**	**DWI**
Sensitivity	85.9%	93.9%	48.8%	92.7%	33.3%	100%	78.6%	78.6%
Specificity	90%	92%	92%	97.2%	80%	100%	91.9%	94.1%
PPV	92%	95%	94%	97.2%	85%	100%	50%	57.9%
NPV	78.5%	98.5%	83.8%	92.7%	95.9%	100%	97.7%	97.7%

MF: Multifocal; MC: Multicentric; DWI: Diffusion-weighted imaging; Sono-MMG: Sonomammography; PPV: Positive predictive value; NPV: Negative predictive value.

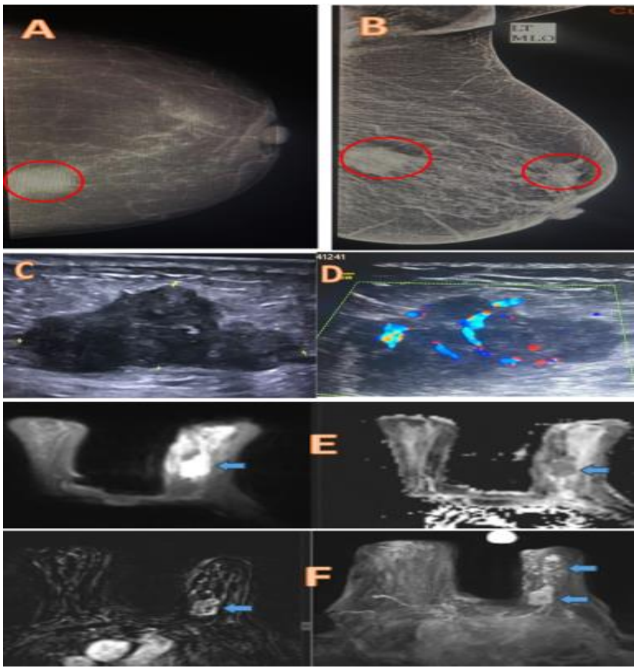

Figure 1: ((A) Left mammography CC & (B)left MLO showing dense breast (ACR b) with left UIQ irregular indistinct high-density masses (red circles). (C) US showed irregular indistinct hypoechoic mass, (D)Color Doppler examination of the mass revealed internal vascularity(E) DWI show mass of restricted diffusion reaching nipple areola complex (high in DWI, low ADC), (F)MRI-DCE show Left breast UIQ irregular heterogeneously enhancing lesion with non-mass enhancement is seen from the dominant mass reaching nipple areola complex. (blue arrow).

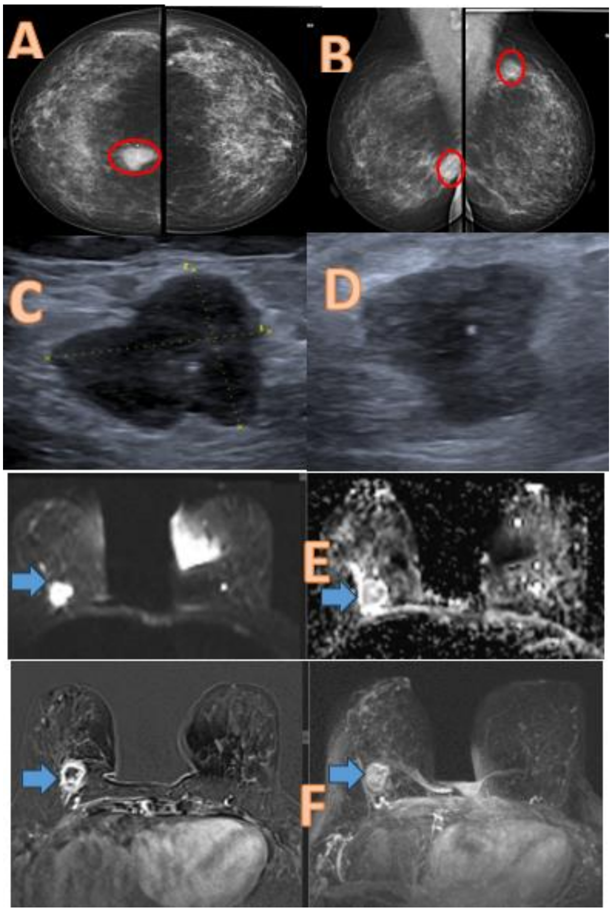

Figure 2: (A) Bilateral mammography CC & (B) MLO showing dense breast (ACR c) with right LIQ irregular indistinct high-density mass with internal microcalcification, left upper quadrant asymmetry.
(C) & (D) US show irregular indistinct hypoechoic mass with internal calcification. (E) DWI shows LIQ mass of restricted diffusion (high in DWI, low ADC),(F)MRI-DCE show right LIQ irregular indistinct heterogenous enhancing mass. (blue arrow), no evidence of enhancing mass or restricted masses on the left side.

Discussion

To begin our research of our cases, we compared the lesions' sizes found by the different imaging modalities, comparing sonomammography and DWI with reference standard is the DCE-MRI. In assessing tumor size by sono mammography the mean tumor lesion size is 4.2 ±1.73 cm, while using DWI the mean tumor size is 4.47 ±1.89 cm, correlation co efficient with DCE-MRI is 4.59 ±1.87, DWI showed a sensitivity of 92.7%, significantly outperforming Sono-MMG's our study revealed 48.8%, while DWI show 97.2% specificity and 92% regarding sonomammography . The NPV for DWI was also 97.2%, compared to 83.8% for Sono-MMG, so DWI showed a higher sensitivity than Sono-MMG's (correlated with DCE-MRI). Tumor size was underestimated by Sono mammography as it depend on operator measures and shadowing artifact of malignant tumor and surrounding desmoplastic reaction.

The study conducted by Hashem et al. [6] found that the mean lesion size by Sono-mammography was 2.61+/-2.06, the mean lesion size by CE-MRI was 3.73+/-2.64, and the mean lesion size by DWI-MRI was 2.46 +/- 2.93. The study also found that the correlation coefficient between the lesion size and postoperative pathological lesion size was.322 and the P value was.052. The strongest association between the size of postoperative pathology and MRI was discovered. However, the percentages of concordance with the gold standard for MGM, ultrasound (US), and MRI measurements were 64.3%, 76.2%, and 82.1%, respectively, in the study conducted by Azhdeh et al. [7]. Thus, the MRI-based estimates showed the highest concordance rate. Although there were more occurrences of MRI overestimation, the

US and MGM underestimation was more common (70%).

Regarding muscle invasion detection, DWI showed superior sensitivity at 100%, whereas Sono-MMG had a sensitivity of 33.3%. DWI achieved 100% specificity and PPV,Sono-MMG achieved 80% specificity and 85% and PPV 85% with DWI also achieving a perfect NPV of 100%, compared to 95.9% for Sono-MMG.

According to research by Samreen et al. [8], pectoralis muscle involvement was found in 18/23 (78%) cases by DWI and 19/23 (83%) instances by CE imaging. The regions of restricted diffusion that were found coincided, in every instance, with the imaging site of the known cancer.

In the current study, the tumor multiplicity was assessed, sonomammography revealed that 65 cases (43.3%) had a single tumor, 68 cases (45.3%) had multifocal tumors, and 17 cases (11.3%) had multicentric tumors, While DWI revealed 57 cases (38%) had a single tumor, 73 cases (48.7%) were multifocal, and 20 cases (13.3%) were multicentric. Comparing with DEC-MRI results. 51 cases (34%) were presented with a single tumor, 74 cases (49.3%) were multifocal, and 25 cases (16.7%) were multicentric. So, DWI demonstrated a higher sensitivity (93.9%) compared to Sono-MMG (85.9%), with both modalities achieving 90% and 92% Sono-MMG and DWI respectively and positive predictive value (PPV) of 92% and 95% for Sono-MMG and DWI respectively. The negative predictive value (NPV) was higher for DWI (89.5%) than for Sono-MMG (78.5%).

Park et al. [9] report that DW-MRI has demonstrated the ability to distinguish between benign and malignant lesions with a pooled sensitivity of 84% to 91% and a specificity of 75% to 84%. To improve specificity, a number of researchers have recommended using multiparametric MRI, which combines DW-MRI with DCE-MRI. A recent study on extra multifocal, multicentric lesions in breast cancer patients found that using an ADC threshold of 1.11 × 10-3 mm2/s increased diagnostic accuracy while lowering false positive rates without appreciably lowering sensitivity. A different prospective trial that employed an ADC threshold of 1.53 − 1.68 × 10−3 mm2/s revealed a 21% decrease in the biopsy recommendation rate and an 11% increase in PPV2, all without missing any malignancy. Thus, the ideal

For axillary lymph node, the current study shows Sono-MMG demonstrate better assessment for pathological lymph node status and accurate leveling than DWI. According to sonomamogram. In instances with DWI, lymph node involvement was positive in 93 cases (62%) and negative in 57 cases (38%). In 99 cases (66%) and 51 cases (34%), lymph node involvement was positive.

The current study's findings were similar to those of Elmesidy et al. (2010), who found that whereas US had higher sensitivity (100%), DW-MRI had higher specificity (63.1%) and US had higher sensitivity (36.6%). After reviewing the postoperative pathology specimen results, Hashem et al. [6] reported that 5 out of 13 (38.4%) were abnormal and 8 out of 13 (61.5%) were nonspecific. As a result, the statistical results for sono-mammography and DCE-MRI regarding the status of lymph nodes following neo-adjuvant chemotherapy were identical. This suggests that the influence of neo-adjuvant chemotherapy on lymph node constriction on DWI may be significant.

A high NPV of approximately 80% is seen in axillary US, according to Di Paola et al. [11]. In identifying non-palpable lymph node metastases, US can be quite specific when based on morphologic criteria, with a wide range sensitivity of between 26% and 76% and a specificity of 88–98%. Although MRI has 82% and 93% sensitivity and specificity, respectively, the inclusion of DWI can increase sensitivity at the expense of decreased specificity. Research has demonstrated that breast

MRI with contrast enhancement is a more accurate method of predicting pathologic positivity of axillary lymph nodes than breast MRI without contrast.

This study revealed bilateral malignancy in 9 cases (6%). For contralateral BIRAD scores of 3 or higher, both imaging techniques exhibited equal sensitivity of 78.6%. However, DWI demonstrated slightly higher specificity (94.1% vs. 91.9%) and PPV (57.9% vs. 50%). Both modalities had the same NPV of 97.7%.

Additionally, according to Ha et al. [2], the combined mammography and US (1.0%; 95% CI: 0.5%, 1.8%) had a lower cancer detection rate than DW MRI (2.0%; 95% CI: 1.3%, 3.0%).

In research by Besharat et al. [12], concurrent bilateral disease was found in 6.12% of patients using DWI-MRI, and a comparable percentage (6%) was found using sonomammography.

With a mean ADC value of 0.8 × 10^-3 mm2/s, the results indicated 98.2% accuracy, 100% specificity, 100% PPV, 83.3% NPV, and 98% sensitivity. Our findings were more in line with those of Tsvetkova et al. [13] who found ADC values between 0.87 to 0.93 × 10−3 mm2/s, which are higher than the 0.68 × 10−3 mm2/s reported by Maric et al. [14].

Conclusion

When it comes to the preoperative diagnosis and management of patients with breast cancer, magnetic resonance imaging (MRI) is a valuable tool. It is crucial for the preoperative staging of breast cancer and can alter treatment plans while also improving patient outcomes. Optimizing lesion evaluation by the combination of DCE-MRI and DW-MRI is the gold standard approach. Additionally, DWI is very effective in detecting breast cancer in patients who are contraindicated for gadolinium contrast when used in conjunction with sonomammography.When evaluating tumor size, multiplicity, and muscle invasion, it performs better than sonomamography. It also does well when evaluating the contralateral side.

Our study suggest that DW MRI should be added to all patients recently diagnosed breast cancer.

References

1. Elmi A, Conant EF, Kozlov A, Young AJ, Long Q, Doot RK, et al. Preoperative breast MR imaging in newly diagnosed breast cancer: Comparison of outcomes based on mammographic modality, breast density and breast parenchymal enhancement. Clin Imaging. 2021;70:18-24.
2. Ha SM, Chang JM, Lee SH, Kim ES, Kim SY, Kim YS, et al. Detection of Contralateral Breast Cancer Using Diffusion-Weighted Magnetic Resonance Imaging in Women with Newly Diagnosed Breast Cancer: Comparison with Combined Mammography and Whole-Breast Ultrasound. Korean J Radiol. 2021;22:867-79.
3. Bose M, Benada J, Thatte JV, Kinalis S, Ejlertsen B, Nielsen FC, et al. A catalog of curated breast cancer genes. Breast Cancer Res Treat. 2022;191:431-41.
4. Daimiel Naranjo I, Gibbs P, Reiner JS, Lo Gullo R, Thakur SB, Jochelson MS, et al. Breast Lesion Classification with Multiparametric Breast MRI Using Radiomics and Machine Learning: A Comparison with Radiologists' Performance. Cancers (Basel). 2022;14.
5. Mendez, A. M., Fang, L. K., Meriwether, C. H., Batasin, S. J., Loubrie, S., Rodríguez-Soto, A. E., & Rakow-Penner, R. A. (2022). Diffusion breast MRI: current standard and emerging techniques. Frontiers in Oncology, 12, 844790.
6. Hashem LMB, Sawy YAE, Kamal RM, Ahmed SM, elmesidy DS. The additive role of dynamic contrast-enhanced and diffusion-weighted MR imaging in preoperative staging of breast cancer. Egyptian Journal of Radiology and Nuclear Medicine. 2021;52:36.
7. Azhdeh S, Kaviani A, Sadighi N, Rahmani M. Accurate Estimation of Breast Tumor Size: A Comparison Between Ultrasonography, Mammography, Magnetic Resonance Imaging, and Associated Contributing Factors. Eur J Breast Health. 2021;17:53-61.
8. Samreen N, Lee C, Bhatt A, Carter J, Hieken T, Adler K, et al. A Clinical Approach to Diffusion-Weighted Magnetic Resonance Imaging in Evaluating Chest Wall Invasion of Breast Tumors. J Clin Imaging Sci. 2019;9:11.
9. Park VY, Shin HJ, Kang BJ, Kim MJ, Moon WK, Song SE, et al. Diffusion-Weighted Magnetic Resonance Imaging for Preoperative Evaluation of Patients With Breast Cancer:

Protocol of a Prospective, Multicenter, Observational Cohort Study. J Breast Cancer. 2023;26:292-301.

10 .Elmesidy, D. S., Badawy, E. A. M. O., Kamal, R. M., Khallaf, E. S. E., & AbdelRahman, R. W. (2021). The additive role of diffusion-weighted magnetic resonance imaging to axillary nodal status evaluation in cases of newly diagnosed breast cancer. Egyptian Journal of Radiology and Nuclear Medicine, 52, 1-12.

11. Di Paola V, Mazzotta G, Pignatelli V, Bufi E, D'Angelo A, Conti M, et al. Beyond N Staging in Breast Cancer: Importance of MRI and Ultrasound-based Imaging. Cancers (Basel). 2022;14.

12. Besharat S, Kalantary M, Julaee A, Malekpour N. Influence of Preoperative Magnetic Resonance Imaging in Surgical Planning for Breast Cancer. Int J Cancer Manag. 2018;11:e81459.

13. Tsvetkova, S., Doykova, K., Vasilska, A., Sapunarova, K., Doykov, D., Andonov, V., & Uchikov, P. (2022). Differentiation of benign and malignant breast lesions using ADC values and ADC ratio in breast MRI. Diagnostics, 12(2), 332.

14.Maric J., Boban J., Ivkovic-Kapicl T., Djilas D., Vucaj-Cirilovic V., Bogdanovic-Stojanovic D. Differentiation of Breast Lesions and Distinguishing Their Histological Subtypes Using Diffusion-Weighted Imaging and ADC Values. *Front. Oncol.* 2020;10:332. doi: 10.3389/fonc.2020.00332.

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