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Latest Updates in the Efficiency of the Novel MRI Technique Diffusion Weighted Imaging with Background Signal Suppression (DWIBS) in Comparison to Dynamic Contrast Enhancing MRI Technique in Clarifying Suspicious Breast Lesions.

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Abstract:

Background:

Breast cancer is the most common cancer in women worldwide, with nearly 1.7 million new cases diagnosed only in 2012 (second most common cancer overall). This represents about 12% of all new cancer cases and 25% of all cancers in women.

Cancer care has become more individualized for patients, and thus, better characterization for treatment planning is required.

Sono-mammography has been widely used but due to its low sensitivity, other methods were required, and biopsy was needed as the gold standard test. A newly introduced MRI sequence DWIBS allows the acquisition of volumetric diffusion weighted images with high lesion-to-background contrast, hence making the use of contrast material unnecessary and thought to decrease the rate of unnecessary biopsies

Results:

In our study the selected patients underwent both dynamic contrast enhanced MRI technique (DCE) & Diffusion weighted imaging with background signal suppression (DWIBS).

DWIBS found to be better than DCE in its sensitivity and negative predictive value; measuring 97.47% and 95.24%, compared to 94.7% and 91.7% respectively, yet DCE showed higher specificity and PPV measuring 95.7% and 97.39% compared to 87% and 92.5% for DWIBS respectively.

DWIBS valuable role was assessed in terms of its higher ability than DCE to detect the lesions correlated with the histopathological findings where DWIBS could detect 97.47% of the lesions included in our study, on the other side DCE detected 94.7% of the lesions.

Conclusion:

In our study, we found that DCE-MRI and DWIBS showed comparable results as regards to their sensitivity and specificity. DWIBS however showed higher sensitivity and negative predictive value than DCE , thus it can be very useful screening tool without the need for a lengthy MRI procedure or the need for IV contrast administration.

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Keywords:
Magnetic resonance imaging, Contrast enhanced MRI, diffusion weighted imaging, breast cancer.

Background

Imaging modalities have an important role in detection and characterization of suspicious breast lesions.

The use of DWIBS approach is thought to decrease the rate of unnecessary biopsies from false mammography results without the need for a lengthy MRI procedure or the need for IV contrast administration **(1).**

Conventional mammography as well as ultrasonography are the most popular tools used to detect and characterize breast lesions. Abnormalities may be discovered when screening an asymptomatic patient or evaluating women with breast symptoms. The presence of a speculated mass, suspicious calcifications, or both may suggest a high probability of breast cancer, but lesser abnormalities, such as asymmetry, change in a previous mammogram, sometimes may be suspicious enough to warrant a biopsy. Due to limited specificity of these diagnostic modalities invasive procedures like fine needle aspiration cytology and breast biopsies are widely used to discriminate between benign and malignant breast masses. A lot of researches revealed higher sensitivity and specificity for MRI technique in this field. This discrimination is mandatory because if a lesion is found to be benign in MRI, so it can be followed up hence reducing the need for invasive procedures **(2,3)**.

While Dynamic Contrast Enhanced (DCE) MRI is highly sensitive for the identification of breast cancers, most women do not have access to this exam due to high cost. In addition, gadolinium-based contrast agents used for breast DCE MRI can sometimes cause life-threatening complications. Minimum DCE MRI examination time is approximately 30 minutes; however adding time before the exam to insert a peripheral catheter to deliver the contrast and after the exam to monitor for possible contrast related reactions, can extend total examination time to over an hour. Identifying a non-contrast screening tool that complements mammography and is faster, less expensive, and potentially safer than DCE-MRI could have important clinical impact.

Diffusion-weighted imaging (DWI) is an MRI technique that characterizes the three-dimensional mobility of water in vivo and enables indirect assessment of tissue microstructure. DWI has shown promise for the detection and characterization of breast cancer . Apparent diffusion coefficient (ADC) values allow quantification of diffusion signal and can facilitate in differentiating benign and malignant breast tumors as well as identifying early response in tumors undergoing preoperative treatment (4).

DWI has proved high sensitivity and specificity assessment of suspicious breast lesions, yet it must be combined with dynamic contrast enhanced MR images for proper characterization .

Diffusion Weighted Imaging with Background Suppression MR mammography (DWIBS-MRM) is a new MRI technique that adds background suppression to DWI, addressing some of DWI's limitations as it intentionally uses free breathing scanning rather than breath holding or respiratory triggering to visualize (moving) visceral organs and their lesions, while enabling

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volumetric 3D image processing .This can be achieved by adjusting the b-values variables that affect the MR image contrast and using fat suppression to improve image quality.

The technique DWIBS-MRI, which requires no contrast, may provide a safe, noninvasive method for resolving suspicious mammography findings without biopsy. Among its advantages over other MRI approaches, DWIBS-MRI results can be obtained in less than 7 minutes, compared with more than 30 minutes for a full breast MRI exam, while mean reading time using unenhanced DWIBS-MRI is less than 30 seconds (2).

Thus DWIBS MRI technique has the potential of ruling out malignancy, and thus reducing unnecessary biopsies and emotional distress, for breast cancer (5).

Methods:

Prospective study from May 2018 to December 2020, 45 females with age ranging from 22 to 88 years (median of 52.28 ± 14.68) they were selected from breast clinic at El Demerdash university hospitals.

Patients with history of previous allergic reaction to contrast media,Pregnant females, or patients with renal failure/chronic kidney disease (CKD) were excluded from our study, full history was taken from all patients. Written informed consents for performing dynamic contrast enhanced MRI (DCE) were also obtained. The study was approved by the ethical committee.

According to BI-RADS system, all cases were categorized as BIRADS 4&5.
After the mammogram was done revealing suspicious findings in all patients both DWIBS and DCE MRI sequences were taken.

Inclusion criteria:

- Female Patients with suspicious mammography &/or sonographic findings.
- No age predilection.

Exclusion Criteria:

- Patients known to have contraindications for MRI, e.g. an implanted magnetic device, pacemakers or claustrophobia.
- Patients with bad general condition needing life support and those with severe renal disease (GFR<30%).

Patient preparation

Pre-procedural assessment of the renal profile, especially serum creatinine. Detailed explanation of imaging procedure. Obtaining an informed consent. Administration of 1 ante-cubital intravenous catheter.

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Image acquisition

MRI study performed on a 1.5 Tesla system.

- Field of view : AP 325
- Slice thickness : 2 mm
- Morphological sequences will be performed in multiple projections, including pre-contrast axial T1 WIs (TE =10 ms , TR = 538 ms) , axial T2 WIs (TE =120 ms , TR =4130 ms) , axial T2 STIR (TR/TI = 6637/150 , TE = 55 ms) .All these sequences are single shot spin echo with flip angle 90^{o}.
- Axial echo-planner DWI study will be performed for all cases with 4 b-values 0,200,400,800.
- Axial echo-planner DWIBS images will be taken in all patients.
- In addition, Gadolinum (0.1 mmol/kg) will be administered by injector with flow rate 2-3 ml/sec followed saline injection of 15 ml. Post-contrast gradient T1 fat suppressed dynamic study is done with subtracted images added .

Image interpretation

MRI examinations of our study were reviewed on a specialized workstation and interpreted by a radiologist with experience in breast imaging. The lesions were evaluated according the Breast Imaging Reporting and Data System (BI-RADS) for MRI, 5th edition, interpreting the morphological aspects by the type of contrast enhancement pattern , its distribution, shape, and contours, and the pattern of contrast uptake in the subsequent dynamic images. The DWI sequences were post-processed. Qualitative and quantitative interpretation were based on the ADC. For the qualitative evaluation, we depended on the grayscale ADC maps, classifying lesions with diffusion restriction as those in which there was high signal intensity on DWI and signal loss on the ADC map. For the quantitative evaluation, we calculated the mean ADC, choosing the region of interest (ROI) within the lesion, sparing areas of necrosis and cystic degeneration.

Statistical analysis:

Data were coded and entered using the statistical package SPSS version 25. It was summarized using descriptive statistics.

Inferential statistical analyses for assessment of the relation between categorical variables were performed using both contingency tables with chi-squared tests for observed and expected values and testing for correlation using the spearman-rho test. All tests were considered statistically significant at a p value equal to or less than 0.05.

Diagnostic performance indices including sensitivity, specificity, positive and negative predictive values and overall accuracy were calculated using contingency tables.

Data was presented by graphs, bar charts, and pie charts as well as tables.

RESULTS

Fourty-five patients were included in our study (with total lesions sixty-one), enrolled in the period from May 2018 to December 2020 admitted from Al Demerdash University hospital, Ain Shams University .All the patients had suspicious breast lesions on mammography (BI-RADS IV&V).All the patient underwent MRI (DCE,DWIBS and conventional MRI) and it showed

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sixty-one lesions, Of which 62% were located in the right breast (45% were on the RUQ ,17% were on the RLQ) , 38% located on the left breast (22% were on the LUQ, 16%were on the LLQ). The sizes of the lesions varied with a median of 2 cm.

The age of the patients ranged from 22 – 88 years with median of 52.28 ± 14.68. three of the patients visited the out-patient clinic complaining of discomfort, five with nipple discharge &for heaviness, sixteen patients came for screening and twenty-one patients complained of a palpable lump .Out of the fourty-five patients, seventeen (38%) had positive family history for breast cancer and twenty-eight (62%) had negative family history of breast cancer in the first degree relative.

Our study was conducted on 61 lesions, According to the histopathology which was the gold standard in our study twenty-three of the lesions were proved to be benign (36.7%) and thirty-eight were proved to be malignant(63.3%). **Figure 1**

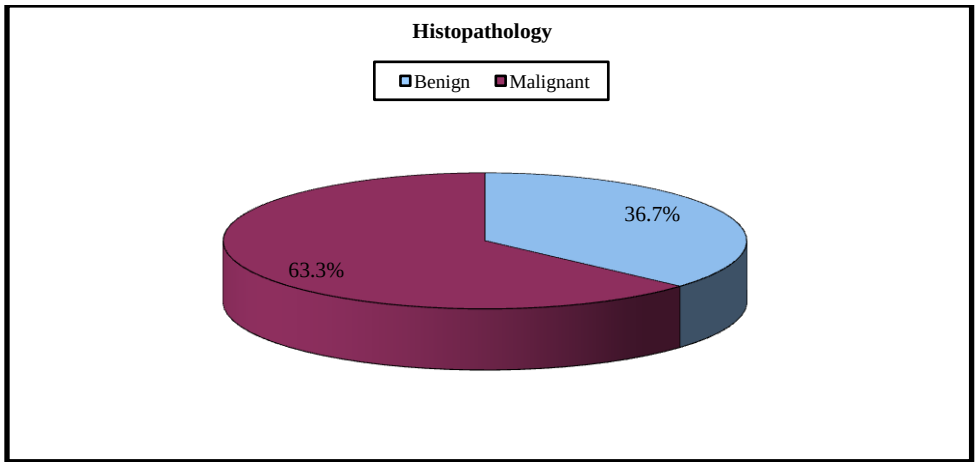

Figure 1: Distribution frequency of the lesions according to the histopathology as a gold standard.

Sizes of the lesions was varied with a median of 2cm, the benign lesions showed sizes ranged from 0.11cm to 4.5cm with a median (IQR) 1.4 and the malignant lesions sizes ranged from 0.16cm to 7.5cm with median (IQR) of 1.95. **Table 1**

Lesions sizes		**Benign**	**Malignant**	**Test value**	**P-value**	**Sig.**
		No. = 23	**No. = 38**			
Size (cm)	Median (IQR)	1.4 (0.5 - 2)	1.95 (1 - 3)	-1.766‡	0.077	NS
	Range	0.11 – 4.5	0.16 – 7.5			

P-value >0.05: Non significant (NS); P-value <0.05: Significant (S); P-value< 0.01: highly significant (HS)
*:Chi-square test; ‡: Mann Whitney test
Table 1: Lesion sizes and its distribution between benign and malignant lesions.

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On contrast enhanced images (DCE) the enhancement kinetics showed that from the 38 malignant lesions 31 showed heterogenous enhancement pattern between (NMLE ,segmental , linear or ductal enhancement patterns),and from the 23 benign lesions 17 showed homogenous enhancement pattern, 3 showed rim like enhancement and 1 showed enhanced internal septations. **Table 2**

DCE		**Benign**	**Malignant**	**Test value**	**P-value**	**Sig.**
		No. = 23	**No. = 38**			
Enhancement pattern	Hetrogenous	0 (0.0%)	31 (100.0%)	52.000*	0.000	HS
	Homogenus	17 (81.0%)	0 (0.0%)			
	Rim E	3 (14.3%)	0 (0.0%)			
	Enhanced internal septations	1 (4.8%)	0 (0.0%)			
Non-nodular enhancement	Hetrogenous	0 (0.0%)	3 (23.1%)	14.000*	0.122	NS
	NMLE/regional distribution	0 (0.0%)	3 (23.1%)			
	NMLE/Clumped linear	0 (0.0%)	1 (7.7%)			
	Linear	0 (0.0%)	1 (7.7%)			
	Regional E	1 (100.0%)	0 (0.0%)			
	Segmental/clustered E	0 (0.0%)	1 (7.7%)			
	Ductal E	0 (0.0%)	1 (7.7%)			
	NMLE,linear	0 (0.0%)	1 (7.7%)			
	NMLE ductal clumped	0 (0.0%)	1 (7.7%)			
	NMLE Clumped	0 (0.0%)	1 (7.7%)			

P-value >0.05: Non significant (NS); P-value <0.05: Significant (S); P-value< 0.01: highly significant (HS)
*:Chi-square test; ‡: Mann Whitney test
Table 2: Comparison between benign and malignant tumors by histopathology regarding pattern of enhancement in DCE.

From a total of 61 lesions all the 38 malignant lesions showed suspicious enhancement kinetics (type II and type III kinetic curves) ,and from 23 benign lesions(by histopathology) 9 lesions showed suspicious enhancement kinetics (39.1%) and 14 showed no suspicious kinetics. **Figure 2**

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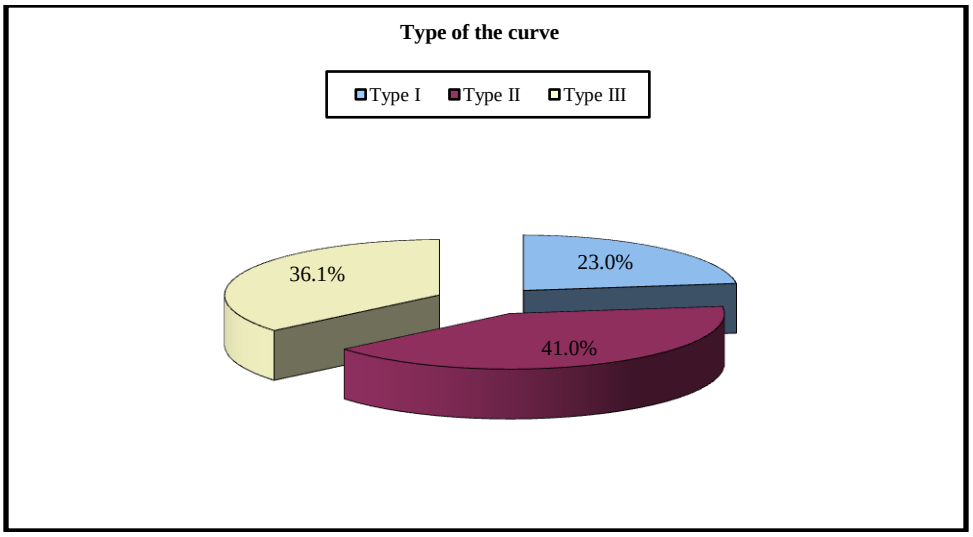

Figure 2: *Illustration of the DCE patterns in relation to histo-pathology.*

On DWI imaging sequence alone, there were 38 malignant lesions and 23 benign lesions, 30 out of the 38 patients with malignant histopathology showed high signal intenisty (78.9%) and 8 showed low signal intenisty (21.1%). Out of the 23 patients with benign histopathologies, 10 showed low signal intenisty (43.5 %) while 13 showed high signal intenisty (56.5%). **Figure 3 Table 3**

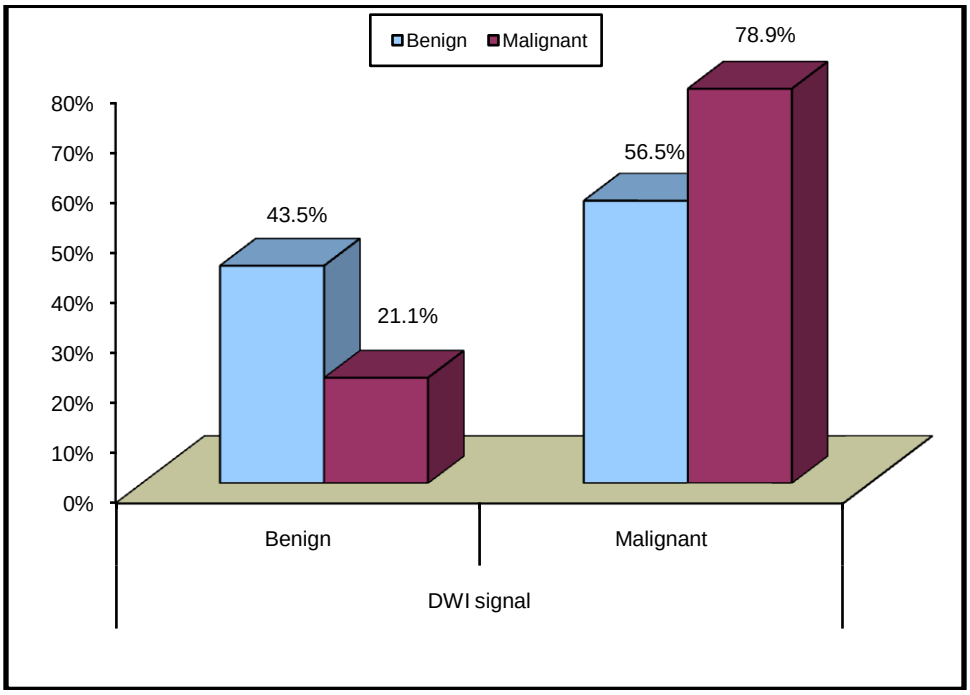

Figure 3: Illustration of the DWI signal in relation to histo-pathology.

Diffusion	**Benign**	**Malignant**	**Test value***	**P-value**	**Sig.**
	No. = 23	**No. = 38**			

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DWI Signal only	Benign(low signal)	10 (43.5%)	8 (21.1%)	3.464	0.063	NS
	Malignant(high signal)	13 (56.5%)	30 (78.9%)			

P-value >0.05: Non significant (NS); P-value <0.05: Significant (S); P-value< 0.01: highly significant (HS)
*:Chi-square test; •: Independent t-test
Table 3: Explanation of diffusion signal alone in relation to the histopathology results.

While in ADC map , there were 38 malignant lesions and 23 benign lesions, 13 out of the 38 patients with malignant histopathology showed high signal intenisty (34.2%) and 25 showed low signal intenisty (65.8%). Out of the 23 patients with benign histopathologies, 10 showed low signal intenisty (43.5 %) while 13 showed high signal intenisty (56.5%). **Figure 4 Table 4**

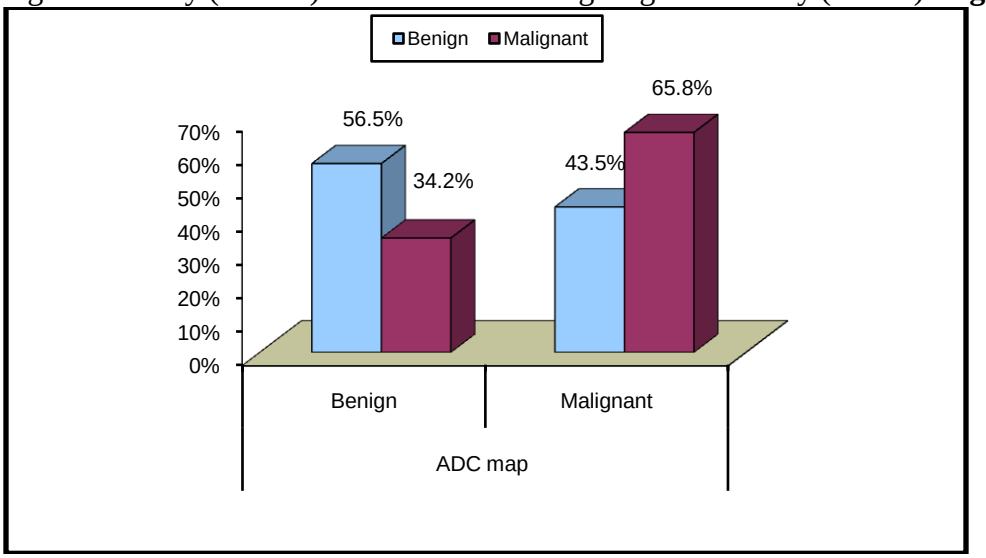

Figure 4: Illustration of the ADC map signal in relation to histo-pathology.

ADC map		**Benign**	**Malignant**	**Test value***	**P-value**	**Sig.**
		No. = 23	**No. = 38**			
ADC map	Benign(high signal)	13 (56.5%)	13 (34.2%)	2.916	0.088	NS
	Malignant(low signal)	10 (43.5%)	25 (65.8%)			

P-value >0.05: Non significant (NS); P-value <0.05: Significant (S); P-value< 0.01: highly significant (HS)
*:Chi-square test; •: Independent t-test
Table 4: Explanation of ADC map signal alone in relation to the histopathology results.

As regards the DWIBS imaging, 36 out of the 38 patients with malignant lesions showed true diffusion restriction and malignant criteria (94.7%) and 2 showed no restriction (5.3%). Out of

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the 23 patients with benign histopathologies , 19 showed neither diffusion restriction nor any suspicious criteria (82.6 %) while 4 showed diffusion restriction (17.4%). **Figure 5 Table 5**

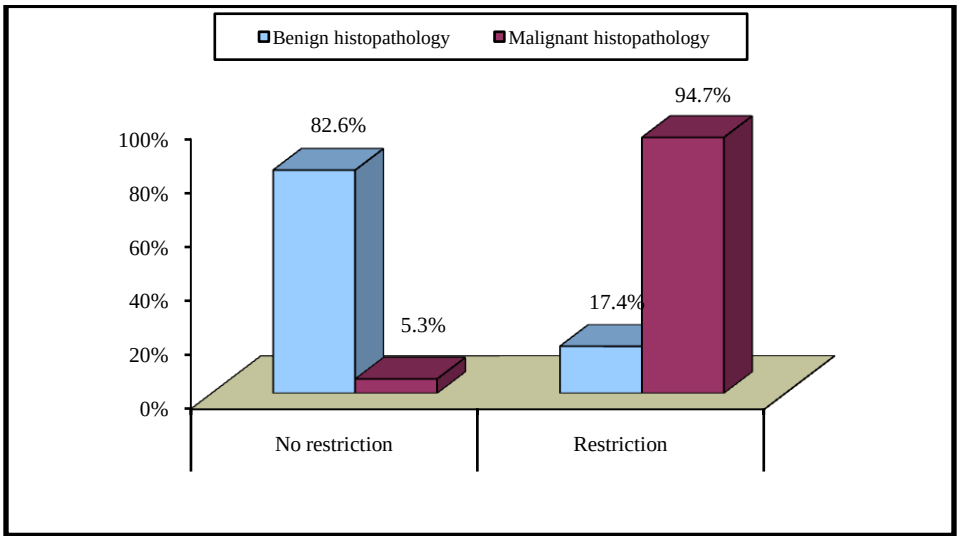

Figure 5: Illustration of the relation-ship between true restriction on DWIBS images and histo-pathology.

DWIBS		**Benign**	**Malignant**	**Test value***	**P-value**	**Sig.**
		No. = 23	**No. = 38**			
DWIBS	No restriction	19 (82.6%)	2 (5.3%)	37.969	0.000	HS
	Restriction	4 (17.4%)	36 (94.7%)			

P-value >0.05: Non significant (NS); P-value <0.05: Significant (S); P-value< 0.01: highly significant (HS)
*:Chi-square test; •: Independent t-test
Table 5: Explanation of DWIBS signal in relation to the histopathology results.

The ADC value mean SD for each group (malignant and benign) illustrated in **Table 6.**

DWIBS		**Benign**	**Malignant**	**Test value***	**P-value**	**Sig.**
		No. = 23	**No. = 38**			
Mean ADC value (x10^-3mm2/s)	Mean ± SD	1.30 ± 0.25	0.86 ± 0.21	7.285•	0.000	HS
	Range	0.8 – 1.6	0.6 – 1.40			

P-value >0.05: Non significant (NS); P-value <0.05: Significant (S); P-value< 0.01: highly significant (HS)
*:Chi-square test; •: Student t-test
Table 6: Illustration of the ADC value for benign and malignant lesions.

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We concluded that to differentiate benign and malignant lesions, the DCE MRI had a sensitivity of 94.7%, a specificity of 95.7%, a positive predictive value (PPV) of 97.39%, a negative predictive value (NPV) of 91.7%, and an accuracy of 95.1%. In the qualitative analysis, DWIBS showed diffusion restriction in 36 (94.7%) of the 38 malignant lesions. In the quantitative analysis, the mean ADC value was 1.1 × 10−3 mm2/s . Figures 1 and 2 showed examples of the lesions evaluated.

Comparing the qualitative analysis of the DWIBS sequence with the histopathological results we found that the majority of the lesions that presented with diffusion restriction were found to be malignant lesions ($p < 0.001$). For differentiating benign and malignant lesions, the DWIBS qualitative analysis showed a sensitivity of 97.47%, a specificity of 87%, a PPV of 92.5%, an NPV of 95.24%, and an accuracy of 93.44%.

The quantitative analysis of DWI was obtained by calculating the ADC value for each lesion and then comparing it with the histopathological result. The mean ADC value was higher for the benign lesions than for the malignant lesions (1.30 ± 0.25 × 10−3 mm2/s vs. 0.86 ± 0.21× 10−3 mm2/s), the difference being statistically significant ($p < 0.001$).

Analysis of the ROC curve (**Figure 6**) revealed an area under the curve of 0.905. The cutoff ADC value with the highest sensitivity and specificity, as obtained by the ROC curve, was 1.1 × 10−3 mm2/s. The ADC was lower than or equal to that cut-off value in 33 lesions, of which 38 (86.8%) were malignant, whereas 18 (78.3%) of the 23 in which it was higher than that cut-off value were benign, the difference between the two groups being statistically significant ($p < 0.001$).

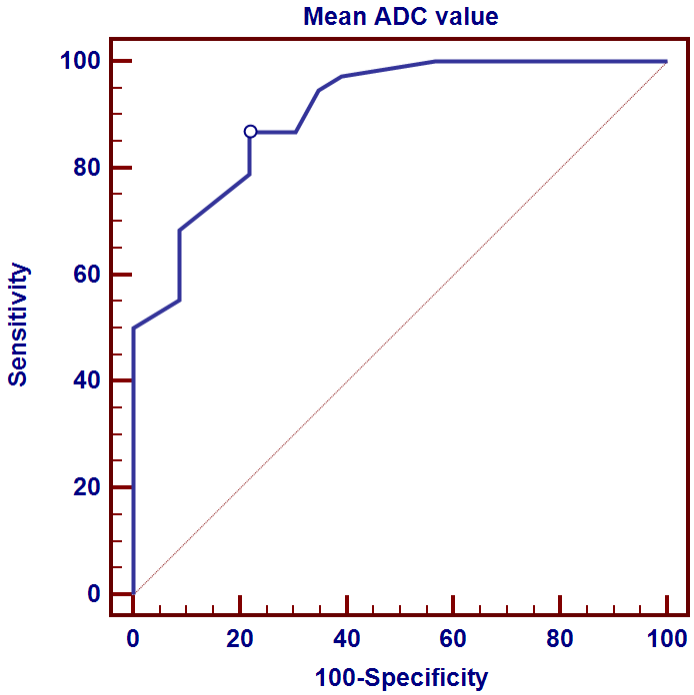

Figure 6: ROC curve of ADC value as a predictor of begin and malignant lesions by histopathology results.

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Demonstrating the sensitivity, specificity, PPV, NPV, and accuracy of DCE MRI and DWIBS, separately, the DCE showed accuracy 95.1%, with a sensitivity of 94.7% and a specificity of 95.7%, PPV 97.39% and NPV of 91.7% comparable to 93.44%, 97.47% , 87% ,92.5% and 95.24% respectively.

A detailed examples of some cases in our study are shown in Figures 7 to 9.

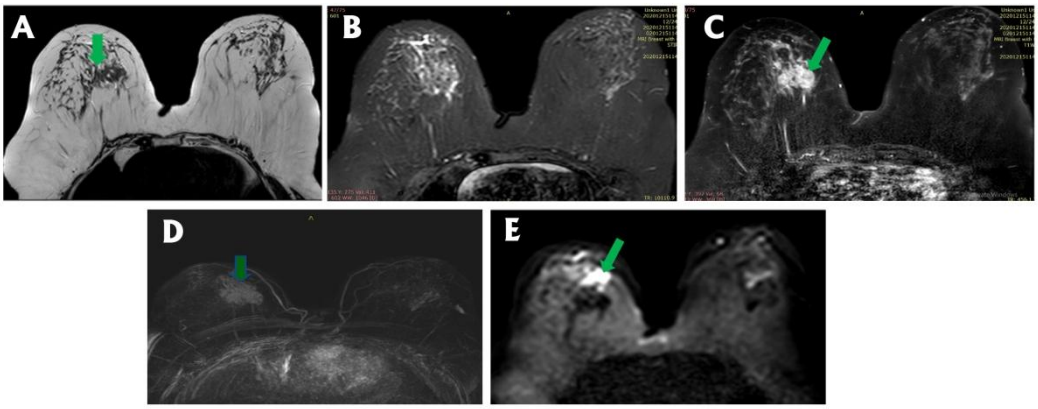

Figure 7: A case of pathologically proven invasive duct carcinoma of the right breast. It displayed the classic appearance of an irregular speculated mass with low T1 and T2 SI (A), high SI in STIR (B), heterogenous enhancement in post-contrast scans and well visualized in post contrast 3D images (C&D) truley restricted diffusion in DWIBS (E), and. Its ADC value was $0.8x10^{-3}mm^2/s$. It showed type 3 kinetic curve consistent with malignancy.

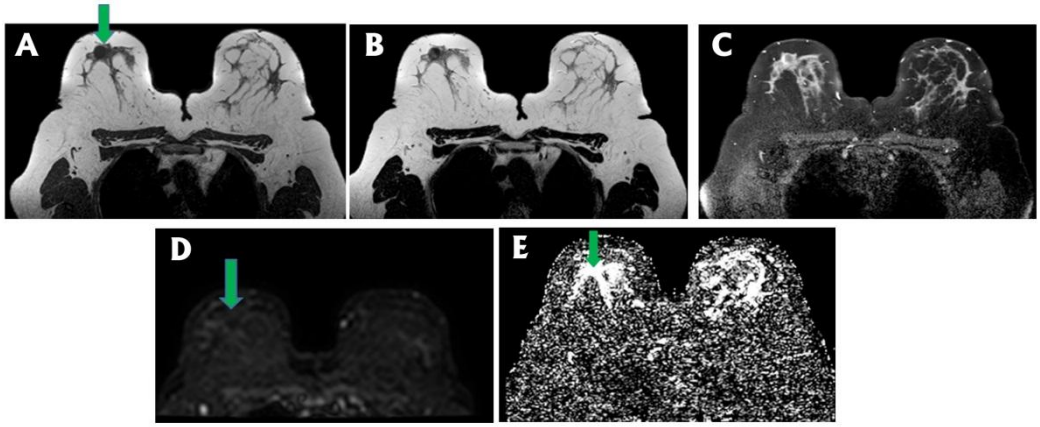

Figure 8: A case of pathologically proven fibroadenoma in the right breast. It had a well-defined regular margin and of low T1 SI, intermediate SI in T2WI (A&B), faint homogenous enhancement pattern in DCE-MRI (C),and non restricted in DWIBS (D&E). ADC value was 1.5× 10−3 mm2/s
/s.

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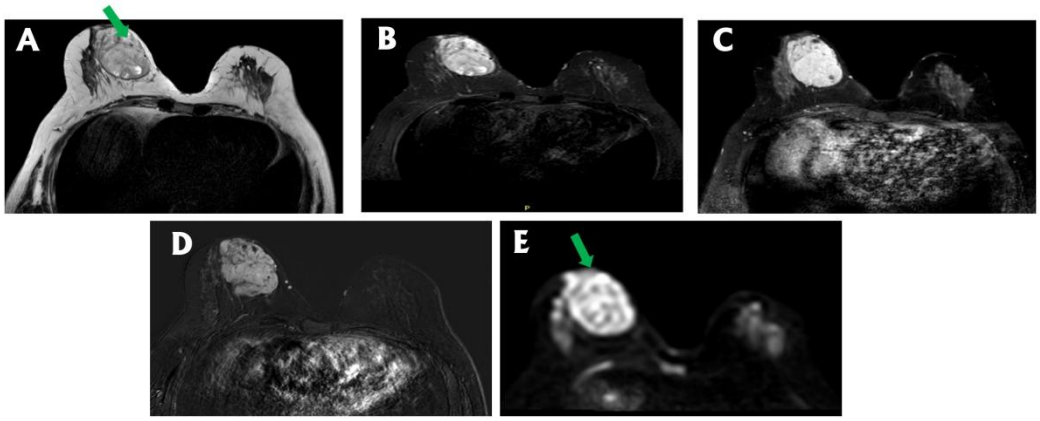

Figure 9: In the right breast, there was a mass lesion of high T2 SI (A), high STIR SI (B), strong enhancement in post-contrast scan and the subtracted post contrast images too (C&D), with high signal in in DWIBS (E), but for the ADC value it was $1.1x10^{-3}mm^2/s$. The case was pathologically proven to be malignant phyllodes tumor .

Discussion:

Breast cancer is the most commonly diagnosed cancer in females and the second most common cause of death world-wide. It is the single leading cause of death in women aged 40-49 (6).

In the past two decades, mammographic screening has led an important role in early diagnosis of breast carcinomas and hence improving the treatment out-come.

Recently, new studies assume that the addition of breast MRI as a screening tool adjacent to mammography in females with high risk of developing cancers improves tumor detection and characterization (7).

Conventional MR imaging involves the use of injection of intra-venous contrast material, which necessitates adequate glomerular filtration rate of the kidneys to avoid possible nephro-toxicity. This represents a serious draw-back to this imaging technique since it excludes all patients with kidney impairment. A new non-contrast imaging technique called "DWIBS" is suggested to overcome this draw-back and have specificity and sensitivity comparable with DCE-MRI (8).

In our cross-sectional study, 45 patients with suspicious breast lesions (BIRADS IV&V) from outpatient mammography clinic has been selected and under-went MRI breast protocol which includes T1Wi, T2Wi, STIR, DCE-MRI, DWI's as well as DWIBS (with ADC maps).

The results of our study suggest that DWIBS may have promise as a rapid unenhanced technique for supplemental screening in women with suspicious breast lesions and suffering other comorbidities.

We found that occult malignancies typically exhibited restricted diffusion,
showing higher signal intensity on DWIBS and a lower ADC by quantitative assessment, unenhanced MRI with DWIBS achieved sensitivity of 97.4% , specificity of 87%, NPV of 95.24% and PPV of 92.5%, over-all efficacy of 93.44% for detecting these occult breast lesions compared to sensitivity of 94.7%; Specificity 95.7 %; , NPV of 91.7 % and PPV of 97.39%,over-all efficacy of 95.1% to the DWIBS .

Additionally, although Contrast-enhanced MRI has the highest specificity for characterizing suspicious breast lesions, barriers to the widespread use of breast MRI include high cost,

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relatively lengthy scanning time, and contraindications related to the administration of gadolinium-based contrast material. Abbreviated breast technique like DWIBS has been proposed as a possible faster and more cost-effective alternative. Thus, a rapid unenhanced imaging approach that more closely approximates the performance of DCE-MRI would provide high clinical value .

DWI sequence already exists in almost all MRI protocols, no need to extra payment on the patients; in addition to that they have average acquisition time of less than 5 minutes. This study revealed that the qualitative evaluation based on DWIBS sequence when used alone had higher sensitivity (97.4%) than DCE-MRI (94.7.%), made it a very useful tool for screening purpose instead of using the classic lenghty MRI protocol saving time and cost for vulnerable patients. In the quantitative analysis, we noticed that malignant lesions showed lower ADC values than the benign lesions did. Hence, the quantitative DWI analysis (ADC measurement) provided best results regarding the differentiation between benign and malignant tumors in our study. ***Chen et al.*** conducted a study to evaluate the performance of the quantitative DWI analysis. They evaluated 964 lesions, of which 615 were malignant and 349 benign, and the mean cut-off ADC values for differentiation ranged from 0.9 × 10−3 mm2/s to 1.76 × 10−3 mm2/s, sensitivity and specificity ranging from 63% to 100% and from 46% to 97%, respectively. Despite the promising capacity of ADC values for differentiation among benign & malignant lesions, the ADC values for these two groups of lesions unfortunately showing overlap, leading to false-positive and false-negative results. (9)

Different studies and researches reported false-positive results for intra-ductal papilloma (10,11). In ours, we obtained false-positive results for only five lesions, two of which were subsequently diagnosed as fibro adenomas with high fibrous content, with ADC values of 0.89 × 10−3 mm2/s and 0.90 × 10−3 mm2/s, respectively and one was IDP with ADC values of 1 × 10−3 mm2/s and the forth was a case of fibrocystic disease of the breast with a thick proteinaceous content with ADC values of 1.1 × 10−3 mm2/s and the last one was small IDC falsely diagnosed by DCE-MRI . It is realized that high levels of ADC value are almost observed with benign tumors, some IC-NSTs show ADC values higher than the cut-off obtained for malignant lesions, resulting in false-negative results (10,11). The malignant histopathological subtype with the highest ADC value in all malignant lesions was mucinous carcinoma, which is known by its low cellularity and predominance of its mucin content, therefore showing false-negative results in DWI sequence **(12,13,14**). By using the ADC cut-off value settled in our study, we found false-negative results in 2 out of the 38 malignant lesions reviewed. Of the IC-NSTs for which false-negative results were noticed in DWI, most of them were large sized tumors with high histological and nuclear grades, which can be associated with cell necrosis , edema and other different factors that are related to an increase in the ADC. Here, come the importance of the dynamic MRI in such cases as it can easily characterize them by their morphological and dynamic pattern of enhancement.

Tumors with non-nodular pattern of contrast enhancement include ductal carcinoma in-situ (DCIS), lobular carcinoma and fibrocystic disease of the breast These lesions show areas of normal fibro glandular and adipose tissue, which can be a cause of the high ADC values we obtained in our study, thus leading to false-negative results(15,16). In our study there were small

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number of ductal carcinoma in -situ (DCIS) cases (n = 2) these cases showed a mean ADC value higher than that of the invasive carcinomas.

DWIBS in our sample showed its high importance role in the screening of the suspicious breast lesions particularly BIRADS-4 lesions.

In this study, using the DWIBS sequence showed great impact on the evaluation of suspicious breast lesions mainly BIRADS-4 lesions than on that lesions in other categories, resulting in a better evaluation of these lesions and guiding us as well to more successful practices. Our results are in agreement with those of Almeida et al. (14), who found that DWI can improve the diagnostic accuracy of MRI and makes the division of BI-RADS 4 lesions into the subgroups 4A, 4B, and 4C more easier.

The results of our study should be considered in the context of certain limitations. Because the examinations with technical problems such as susceptibility artifacts & image distortion were excluded. It is known that DWIBS has high sensitivity to such artifacts, and it is hoped that technical progress will bring improvements in the resolution of DWIBS image(15).

Conclusion:

In conclusion, the findings of our study concluded that the DWIBS sequence can has a positive effect on the characterization of the suspicious breast lesions and can be a very useful screening tool because of its high sensitivity even higher than DCE sensitivity, thus increasing the diagnostic accuracy of the conventional MRI technique and provide an additional screening tool for those patients who have problems with the conventional MRI technique.

List of abbreviations:

DCE-MRI: Dynamic contrast-enhanced magnetic resonance imaging.
DWIBS: Diffusion weighted imaging with background signal supression.
ADC: Apparent diffusion coefficient.
BIRADS: Breast Imaging Reporting and Data system.
IDC: Invasive Ductal Carcinoma.
DCIS: Ductal carcinoma in situ.
FNAC: Fine needle aspiration cytology.
MRI: Magnetic Resonance Imaging.
NPV: Negative predictive value.
PPV: Positive predictive value.
RUQ: Right Outer Quadrant.
RLQ: Right lower quadrant.
LUQ: Left upper quadrant.
LLQ: Left lower quadrant.

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