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EVALUATING THE DIAGNOSTIC UTILITY OF DIFFUSION WEIGHTED IMAGING COMPARED TO DCE MRI IN DETECTION OF BREAST PATHOLOGY

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ABSTRACT

To estimate diagnostic utility of Diffusion Weighted Imaging compared to DCE MR in detection of breast pathology.

Research design: *Analytical cross sectional study.*

Research settings*: Department of Radiology, Islamabad Diagnostic Center, Faisalabad, from October 2024 to December 2024.*

Method: *MRI breast scan was performed on 89 patients having breast pathologies, and complain related to breast according to the inclusion criteria. Breast lesions were characterized into BIRADS classification based on diffusion restriction and contrast enhancement. Histopathology was considered gold standard to characterize lesions into neoplastic and non- neoplastic categories. We calculate the Sensitivity, specificity, positive and negative predictive values and diagnostic accuracy of DWI and DCE-MRI . Correlations of DWI and DCE-MRI was done with histopathology.*

Results: *DWI had a sensitivity 92.6%, specificity 88.6%, positive predictive value 89.89%, negative predictive value 90.74%, diagnostic accuracy 88.57% in detection of breast lesions while DCE-MRI had sensitivity 92.6%, specificity 77.1%, positive predictive value 86.2%, negative predictive value 87.1%, diagnostic accuracy 86.5%. Significant correlation was found between DWI and histopathology and DCE-MRI and histopathology. P-value of 0.000 was calculated.* ***Conclusion:*** *DWI and DCE MRI are two best methods of breast lesion detection. Sensitivity of both these techniques are comparable but DWI offers superior specificity with less false positive results. DWI also being slightly more good at diagnostic accuracy.*

Keywords: *Diffusion Weighted Imaging, Dynamic Contrast Enhanced Magnetic Resonance Imaging, breast lesions, diagnostic accuracy, neoplastic.*

INTRODUCTION

Breast lesion being 2nd most common origin of cancer among females and most common reason of death in female population. Earlier researches classify breast lesion into non neoplastic and neoplastic lesions; but complex pathology of breast lesions leads to development of BIRADS classification for characterization of breast lesion. [1] Combating high mortality of breast cancer require increased awareness and improved diagnostic facilities for better disease management and prognosis. [2]

Mammography and ultrasound being used as conventional modalities for diagnosing breast lesions; both being less sensitive and specific in diagnosing and characterizing breast lesions, especially in women <40

years (having dense fibro glandular tissues). Magnetic resonance imaging has been emerged as highly sensitive and specific with great diagnostic accuracy in detection of breast pathologies also in women with fibro glandular tissues. [3] DCE MRI and DWI MRI are used in evaluation of breast pathologies specially where conventional imaging modalities fails to give appropriate diagnosis. In addition, DCE MRI provide strong evidence of presence of neoplastic lesion while DWI can help characterize lesion into several BIRADS classification based on their cellularity. [4]

DCE MRI has a great sensitivity although being less specific posing challenge to diagnostic accuracy of MRI in detection of breast lesion.so, DWI emerged as an alternative sequence with improved specificity, also reducing the need of contrast administration in allergic and renal patients. [5] DWI also evaluates the functional properties of tissues by assessing the diffusion of water molecules in cells providing useful information about cellularity of tissues and lesion characteristics. [6]

Englander et al. in 1997 introduced the possibility of using DWI in breast MRI; started the incorporation of DWI in routine breast imaging protocols but acknowledging DWI in final diagnosis has been slow process probably due to not established criteria of DWI findings in BIRADS classification. [7] Earlier breast lesion diagnosis was solely based on lesion morphology as described by BIRADS and kinetic (signal intensity) curve obtained during Dynamic Contrast Enhancement. However, lesion morphology and signal intensity curve of dynamic contrast enhancement characterize lesion into BIRADS categories but results in overlapping of characteristic of neoplastic and non neoplastic lesion. But DWI offering characteristic Apparent diffusion coefficient values of benign and malignant lesions and giving cellularity of lesions making diagnosis more diagnostically accurate and specific. [8]

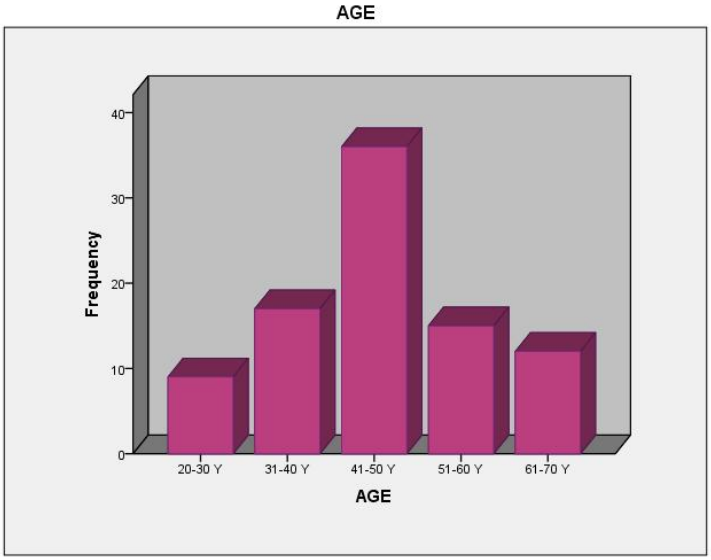
Research setting and Methodology

The study was done in the Radiology Department of Islamabad Diagnostic Centre, Faisalabad. MRI Breast scans performed during the awareness campaign of October 2024 were collected along with their subsequent reports done by 4 consultant radiologists who had long experience in interpreting breast MRI scan including DCE and DWI. After obtaining informed consent, relevant clinical information, including patient demographics and presenting symptoms, was documented. MRI scans were performed using Philips MRI 1.5T. The MRI protocol consists T2 TSE transverse, T1 TSE transverse, STIR transverse, T2 SPAIR transverse, DWI transverse, T2 SPAIR coronal, DCE transverse, post contrast DIXON sagittal and coronal to capture comprehensive information about breast pathologies. Diffusion sensitizing gradient was apply in diffusion sensitivity of b=1000s/mm^2.

89 scans were selected according to inclusion criteria and availability of histopathology reports. Data was extracted systemically from each report Final report was relay on histopathology results. Diffusion restrictions represented as hyperintense signals and high ADC value while contrast enhancement giving three types of kinetic curves. We enter data using Statistical Package for Social Sciences (SPSS) program version 23. Mean and standard deviation was calculated for quantitative data and frequencies was carried out for categorical data. Sensitivity, specificity, positive, negative predictive value and accuracy of DWI and DCE MRI were calculated.

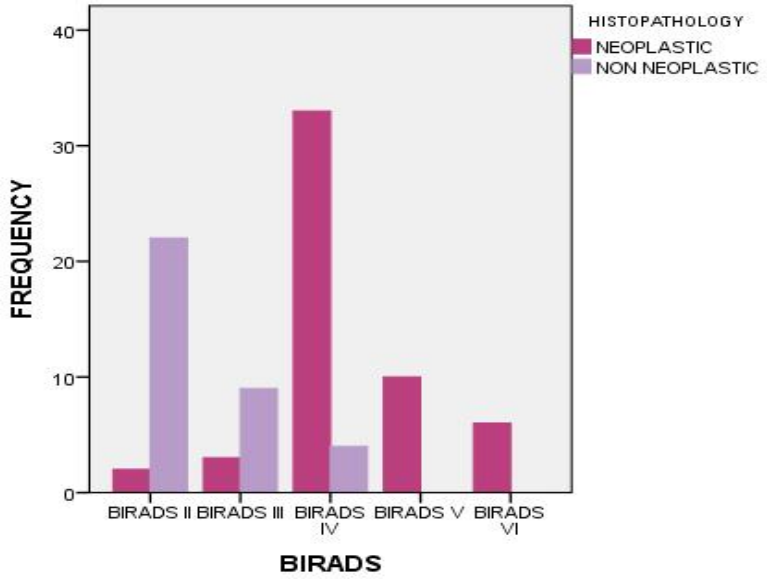
Results:

In terms of age distribution, the majority of patients (40.4%) were between 41-50 years old, followed by 19.1% aged 31-40 years, 16.9% aged 51-60 years, 13.4% aged 61-70 years, and 10.1% aged 21-30 years. Regarding breast involvement, 40.4% of cases were in the left breast, 28.1% in the right breast, and 31.5% involved both breasts. For symptoms, pain was the most common, reported in 47.2% of cases, while discharge was observed in 19.1% of cases. Clinical findings indicated that a lump was present in 49.4% of cases, and 11.2% were noted for size abnormalities. These statistics provide insight into the demographic and clinical presentation of the patient population under study.



Among the patients evaluated, contrast enhancement was observed in 58 cases (65.2%), while it was absent in 31 cases (34.8%). Regarding the diffusion pattern, 54 cases (60.7%) exhibited diffusion restrictions, which are often associated with malignancy, whereas 35 cases (39.3%) showed free diffusion, generally suggestive of benign findings.

The kinetic curve analysis revealed that 36% of cases followed curve type I, typically associated with benign lesions, 39.3% followed type II, indicating an intermediate likelihood of malignancy, and 24.7% followed curve type III, which is highly suspicious for malignancy. MRI diagnosis categorized cases based on the BI-RADS classification, with 27% classified as BI-RADS II (benign), 13.5% as BI-RADS III (probably benign), 41.6% as BI-RADS IV (suspicious), 11.2% as BI-RADS V (highly suspicious), and 6.7% as BI-RADS VI (confirmed malignancy).



Histopathological diagnosis confirmed that 54 cases (60.7%) were neoplastic, indicating malignant or pre-malignant lesions, while 35 cases (39.3%) were non-neoplastic, representing benign or inflammatory conditions. This data collectively highlights the utility of contrast enhancement, diffusion patterns, kinetic curves, and BI-RADS classification to differentiate between benign and malignant breast lesions, with histopathology serve as definitive diagnostic tool.

DWI had a sensitivity 92.6%, specificity 88.6%, positive predictive value 89.89%, negative predictive value 90.74%, diagnostic accuracy 88.57% in detection of breast lesions while DCE-MRI had sensitivity 92.6%, specificity 77.1%, positive predictive value 86.2%, negative predictive value 87.1%, diagnostic accuracy 86.5%. Significant correlation was found between DWI and histopathology and DCE-MRI and histopathology. P-value of 0.000 was calculated.

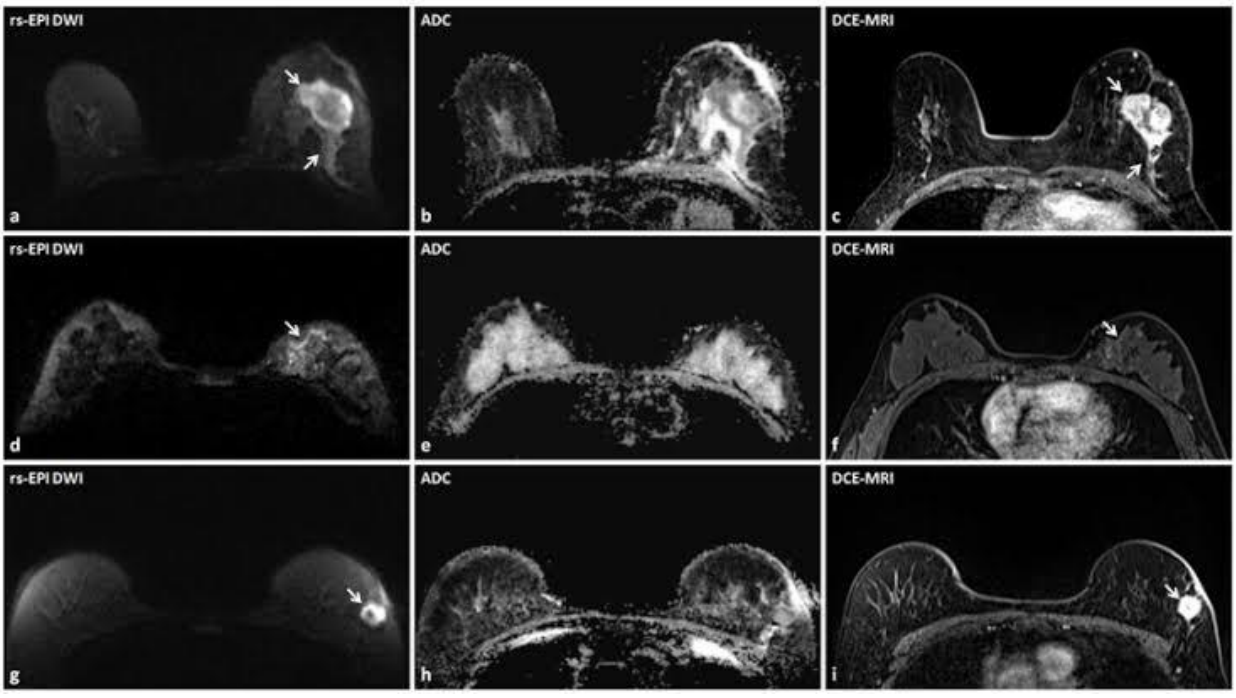
Table I: Accuracy of diffusion weighted imaging.

	DWI	DCE
True positive	44	50
True negative	38	27
False positive	03	8
False negative	03	4
Sensitivity	92.6%,	92.6%
Specificity	88.6%	77.1%
Positive predictive value	89.89%	86.2%
Negative predictive value	90.74%	87.1%
Diagnostic accuracy	88.57%	86.5%

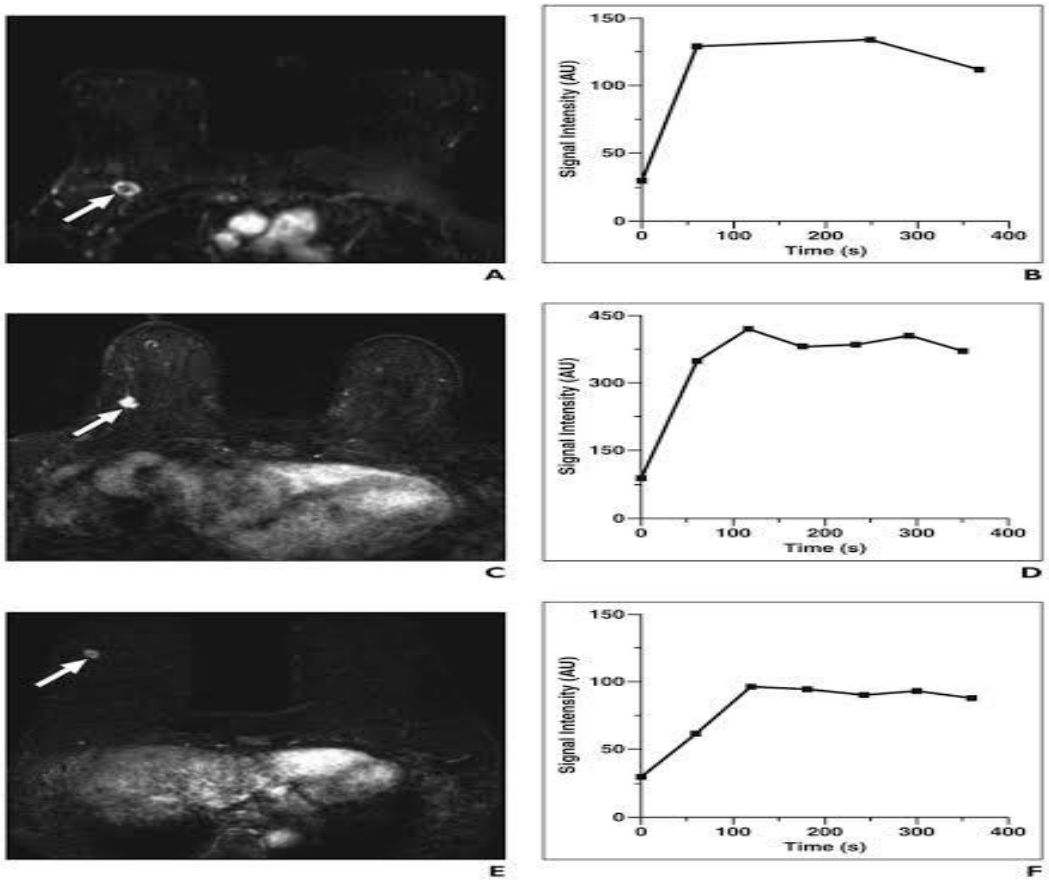
Discussion

In detection of breast lesions the study assesses the diagnostic efficacy of DWI and Dynamic CE MRI, focusing on sensitivity, specificity, and diagnostic accuracy. These imaging modalities, merged with histopathological confirmation, provide a inclusive approach to the diagnosis of breast pathologies, enabling differentiation neoplastic and non neoplastic lesion with high accuracy.

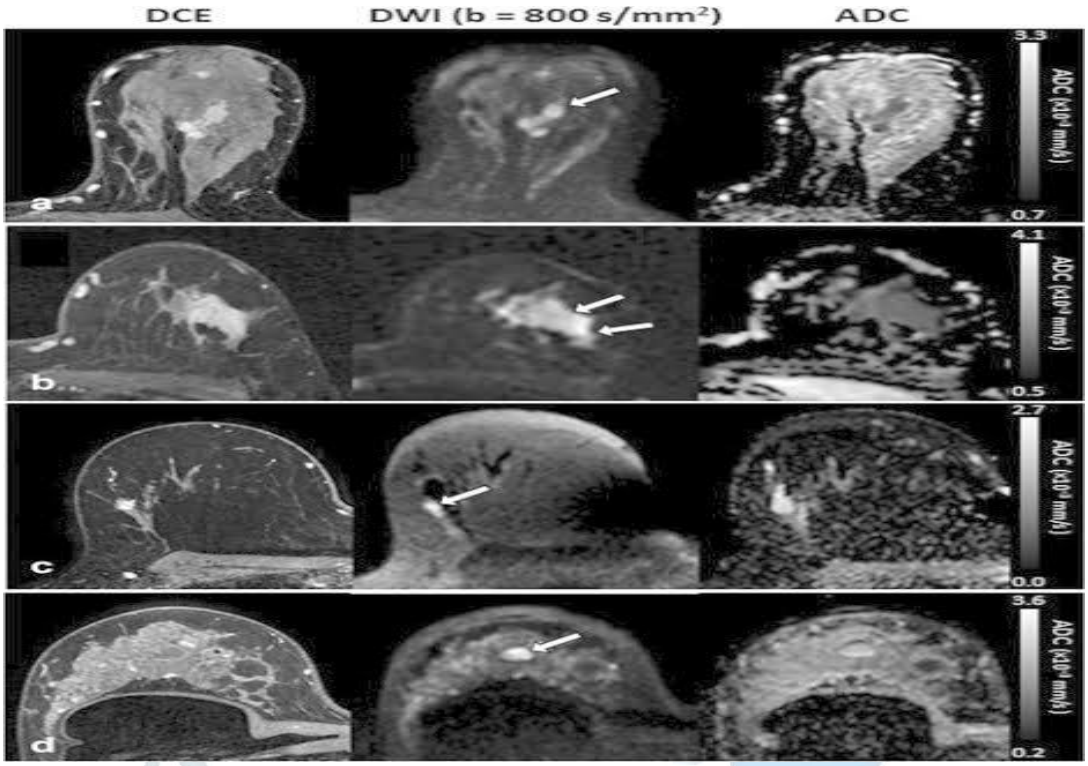
DWI demonstrated notable diagnostic performance, with a sensitivity of 92.6%, specificity of 88.6%, positive predictive value (PPV) of 89.89%, negative predictive value (NPV) of 90.74%, and diagnostic accuracy of 88.57%. These results highlight the utility of DWI in evaluating malignancy, particularly when assessing diffusion restrictions, which are strongly linked with neoplastic lesions. The high sensitivity confirms the diagnosis of most neoplastic cases, while the high specificity lessens false positives, critical for minimizing needless biopsies. Recent studies validate these findings, highlighting the pivotal role of DWI in distinguishing between neoplastic and non neoplastic breast lesions. [9,10]



Similarly, DCE-MRI exhibited a sensitivity of 92.6%, specificity of 77.1%, PPV of 86.2%, NPV of 87.1%, and diagnostic accuracy of 86.5%. While sensitivity was comparable to DWI, the slightly lower specificity indicates a higher likelihood of false positives, probably due to the overlap in contrast enhancement patterns of neoplastic and non neoplastic lesions. [11] However, DCE-MRI remains valuable for its capability to provide comprehensive morphological information, particularly through kinetic curve analysis. In this study, curve type III—which is highly suspicious for malignancy—was observed in 24.7% of cases, while curve types I and II accounted for 36% and 39.3% of cases, respectively.



The results from literature, which emphasizes role of kinetic analysis in malignancy risk stratification. [12] Histopathological analysis confirmed the diagnosis in all cases, serving as the gold standard. The study revealed a strong correlation between DWI findings and histopathology (p-value = 0.000), as well as between DCE-MRI findings and histopathology (p-value = 0.000). This statistically significant association emphasizes the reliability of these two imaging modalities in the diagnosis of breast lesions. Remarkably, 60.7% of cases were neoplastic, reinforcing the need for accurate diagnostic tools to detect and characterize malignancies timely. [13]



When comparing DWI and DCE-MRI, DWI exhibited somewhat superior specificity and diagnostic accuracy, making it a valuable modality, particularly for patients who cannot undergo contrast administration. However, DCE-MRI's ability to provide kinetic and morphological details complements DWI, and their combined use can further enhance diagnostic reliance. This multimodal approach has been advocated in numerous studies, supporting the integration of these techniques into routine clinical practice. [14]

Limitations

Despite the utility of this concept, several limitations are acknowledged. The sample size, sufficient for statistical analysis, can be stretched in further studies to validate findings across diverse populations. Additionally, inter-observer inconsistency in interpreting imaging findings was not evaluated, which could impact diagnostic reliability. Lastly, the study focused solely on breast lesions; more research is need to take a look on the applicability in these imaging techniques to other anatomical regions.

Conclusion

This study highlights the complementary roles of Diffusion weighted images and Dynamic contrast enhanced-MRI in the detection and characterization of breast cancer. Both modalities demonstrated high sensitivity and diagnostic accuracy, with DWI showing slightly superior specificity. Their integration into clinical practice, can enhance diagnostic accuracy, increase patient outcomes, and diminish unnecessary interventions. Future research should target to refine these techniques further, incorporating advanced imaging protocols and artificial intelligence to improve diagnostic workflow

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