

DIAGNOSTIC ACCURACY OF DYNAMIC CONTRAST ENHANCED MRI BREAST FOR CHARACTERIZATION OF RECURRENT LESION IN POST-OPERATIVE PATIENTS KEEPING HISTOPATHOLOGY AS A GOLD STANDARD

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Abstract

Objectives: To evaluate the diagnostic accuracy of dynamic contrast-enhanced MRI (DCE-MRI) in characterizing recurrent lesions in post-operative breast cancer patients, using histopathology as the gold standard.

Materials and Methods: This cross-sectional study, approved by the CMH Rawalpindi ethical board, enrolled patients who met the inclusion criteria and provided informed consent. DCE-MRI scans were performed using a high-resolution MRI scanner with a breast coil and gadolinium-based contrast. Lesions were evaluated based on temporal enhancement patterns, including wash-in, peak enhancement, and washout, by two blinded radiologists. Histopathological confirmation was obtained through biopsy or surgical excision. Data were collected using a pre-designed questionnaire and analyzed with SPSS version 25, with histopathology keeping as the gold standard for evaluating DCE-MRI's diagnostic accuracy.

Results: The study included 90 participants with a mean age of 41.52 ± 8.84 years. Age distribution showed 10.0% were 18-30 years, 30.0% were 31-40 years, 41.1% were 41-50 years, and 18.9% were over 50 years. Tumor types were 80.0% benign and 20.0% malignant. DCE-MRI's diagnostic performance for recurrent breast lesions showed a sensitivity of 97.2%, specificity of 72.2%, PPV of 93.3%, NPV of 86.7%, and an overall accuracy of 92.2%.

Conclusion: It was concluded that DCE-MRI is a highly effective tool for characterizing recurrent breast lesions in post-operative patients, with a sensitivity of 97.2% and overall accuracy of 92.2%. It aids in distinguishing benign from malignant lesions, highlighting its role as a non-invasive imaging modality that complements histopathology for early detection and management of recurrent breast cancer.

INTRODUCTION:

Breast cancer has become a major global health concern, contributing significantly to morbidity and mortality.(1, 2) Moreover, its rising incidence remains a critical challenge for both clinicians and researchers, emphasizing the need for improved diagnostic and treatment strategies. Recurrent breast cancer following

surgery remains a significant challenge in clinical practice, with accurate detection being crucial for timely intervention and optimal management.(3) Traditional imaging methods, such as mammography and ultrasound, can sometimes be limited in their ability to differentiate between benign post-surgical changes and recurrent malignancy.(4) Dynamic contrast-enhanced magnetic resonance imaging

(DCE-MRI) has emerged as a promising diagnostic tool, offering superior soft tissue contrast and the ability to assess lesion enhancement patterns over time.(5) However, it has two significant limitations: its specificity, which varies between 37% and 97%, and the use of contrast agents.(6) The injection of contrast material not only prolongs the examination time and increases costs but can also lead to adverse reactions, including nephrogenic systemic fibrosis in patients with compromised renal function.(7)

This study aims to evaluate the diagnostic accuracy of DCE-MRI in characterizing recurrent breast lesions in post-operative patients, using histopathology as the gold standard. By analyzing the sensitivity, specificity, and overall accuracy of DCE-MRI, the study seeks to determine its potential as a reliable, non-invasive imaging modality for differentiating benign from malignant lesions, ultimately contributing to improved patient outcomes in the post-surgical setting.

Objective: To evaluate the diagnostic accuracy of dynamic contrast-enhanced MRI (DCE-MRI) in characterizing recurrent lesions in post-operative breast cancer patients, using histopathology as the gold standard.

MATERIALS AND METHODS:

Study Design: Cross sectional study

Study setting: Department of Radiology, Tertiary Care Hospital, Rawalpindi.

Duration of the study: Duration of study was 1 year (June 2023-July 2024).

Sampling Technique: Non-probability Consecutive sampling was used for the recruitment of patients.

Selection criteria:

Inclusion criteria:

- Female patients with a history of breast cancer.
- Patients of 18-60 years of age.
- Patients presenting with a suspected recurrent lesion based on clinical examination or prior imaging.

Exclusion criteria:

- Patients with renal impairment (eGFR <30 mL/min/1.73m²) preventing the safe administration of contrast agents.
- Patients with a known allergy to gadolinium-based contrast agents.
- Patients with active infections, inflammatory conditions, or non-neoplastic lesions that may mimic tumor recurrence.
- Pregnant or lactating women.

Methods: This cross-sectional study was conducted following approval from the hospital's ethical board and research committee. Patients meeting the inclusion criteria and providing written informed consent were enrolled in the study. The study's purpose and benefits were clearly explained to all participants, ensuring confidentiality and assuring them that their involvement would not impact their future medical care. DCE-MRI scans were conducted using a high-resolution MRI scanner equipped with a dedicated breast coil to ensure optimal image quality and lesion detection. Patients received an intravenous injection of a gadolinium-based contrast agent at a standardized dose, administered through an automated injector to maintain a consistent flow rate. Dynamic contrast-enhanced sequences were obtained at multiple time points before, during, and after contrast administration to assess the temporal enhancement characteristics of the suspected lesion. These sequences helped evaluate key imaging parameters, including wash-in, peak enhancement, and washout patterns, which were crucial for differentiating benign from malignant recurrent lesions.

The acquired MRI images were interpreted by two independent, experienced radiologists who were blinded to the histopathological results to minimize bias. Lesions were systematically analyzed based on their morphology, enhancement kinetics, and Breast Imaging Reporting and Data System (BI-RADS) classification to determine the likelihood of malignancy. Morphological assessment included lesion shape, margins, and internal architecture, while kinetic analysis

focused on the pattern and intensity of contrast uptake over time.

Following imaging, all patients underwent histopathological confirmation through either a core needle biopsy or surgical excision of the recurrent lesion, depending on clinical indications. Tissue specimens were processed and examined by an expert pathologist using standard histological staining techniques to confirm the presence or absence of malignancy. The final histopathological diagnosis served as the gold standard for evaluating the diagnostic accuracy of DCE-MRI in differentiating recurrent malignant lesions from benign post-surgical changes. A predesign questionnaire was used for collection of data. Data analysis was conducted using SPSS version 25.

RESULTS:

Table 1: Distribution of age and age Groups among study participants (n=90)

Variables	Mean±SD/ n (%)
Age	41.52±8.84
Age Groups	
18-30 years	9(10.0%)
31-40 years	27(30.0%)
41-50 years	37(41.1%)
>50 years	17(18.9%)

Table 2: Classification of patients on the basis of tumors (n=90)

Tumor	Frequency (%)
Benign	72(80.0%)
Malignant	18(20.0%)

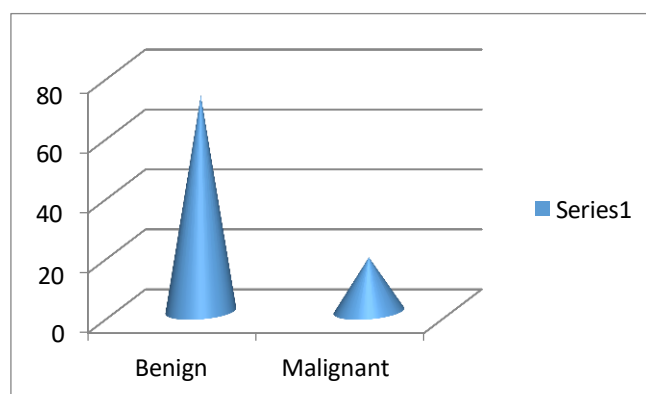


Fig 1: Frequency of Benign and Malignant tumor

Table 4: Diagnostic Performance of DCE-MRI in Characterizing Recurrent Breast Lesions

	Value (%)
Sensitivity	97.2%

Specificity	72.2%
Positive predictive value	93.3%
Negative predictive value	86.7%
Diagnostic accuracy	92.2%

Discussion: Breast cancer is the most commonly diagnosed malignancy and remains the leading cause of cancer-related mortality among women worldwide.(8) Accurate diagnosis is crucial, as it directly influences treatment decisions and prognostic outcomes, ultimately impacting patient survival and quality of life.(9) Among imaging modalities, magnetic resonance imaging (MRI) has demonstrated superior sensitivity in detecting breast cancer compared to conventional techniques such as mammography and ultrasound.(10) This higher sensitivity allows for better lesion characterization, early detection of malignancies, and improved differentiation between benign and malignant breast lesions, making MRI an essential tool in breast cancer diagnosis and management.(11)

The aim of the present study was to evaluate the diagnostic accuracy of Dynamic Contrast-Enhanced Magnetic Resonance Imaging (DCE-MRI) of the breast in characterizing recurrent lesions in post-operative patients, using histopathology as the gold standard. Accurate differentiation between benign post-surgical changes and recurrent malignancies is crucial for optimal patient management and treatment planning. Our findings demonstrated that DCE-MRI exhibited high sensitivity (97.2%) and overall diagnostic accuracy (92.2%), indicating its effectiveness as a non-invasive imaging modality for detecting recurrent breast cancer. These results align with previous studies, which have reported DCE-MRI as a valuable tool for differentiating post-operative fibrosis, scar tissue, and inflammatory changes from recurrent malignancies due to its superior contrast resolution and ability to assess vascular perfusion. The high sensitivity (97.2%) observed in our study suggests that DCE-MRI is highly effective in identifying recurrent malignant lesions. This is particularly important in clinical practice, as missing a malignant recurrence can have serious implications for disease progression and patient prognosis. However, the specificity

(72.2%) was relatively lower, which may be attributed to post-surgical changes, granulation tissue, and inflammatory responses mimicking malignancy on MRI. This is consistent with previous research indicating that false-positive results can arise due to the overlapping imaging characteristics of postoperative benign changes and tumor recurrence.

Our study also found a positive predictive value (PPV) of 93.3% and a negative predictive value (NPV) of 86.7%, indicating that most positive findings on DCE-MRI were indeed malignant, while a negative result strongly suggested the absence of malignancy. The high NPV is particularly reassuring, as it implies that DCE-MRI can reliably exclude malignancy in patients with suspicious lesions, reducing the need for unnecessary biopsies. Our findings are consistent with a study by Telegrafo et al.(6), which reported that contrast-enhanced MRI (CE-MRI) sequences achieved a sensitivity of 98%, specificity of 83%, diagnostic accuracy of 90%, positive predictive value (PPV) of 84%, and negative predictive value (NPV) of 98%. Another study conducted by Arwa Ashraf et al.(12) also supports our findings, reporting that DCE-MRI achieved a sensitivity of 95%, specificity of 90%, diagnostic accuracy of 95%, positive predictive value (PPV) of 90%, and negative predictive value (NPV) of 93.3%.

In comparison with conventional imaging modalities such as mammography and ultrasound, which often have limitations in post-operative breast assessment, DCE-MRI offers superior soft-tissue contrast and functional imaging, allowing better lesion characterization.(13) The ability of DCE-MRI to assess lesion enhancement kinetics further enhances its utility in distinguishing malignant from benign recurrent lesions. Despite its high diagnostic performance, DCE-MRI is not without limitations. False-positive results can lead to unnecessary biopsies, causing patient anxiety and additional healthcare costs. Moreover, factors such as post-radiation changes, residual surgical scar tissue, and

enhancement variability can impact diagnostic interpretation. Additionally, MRI is more expensive and less widely available than conventional imaging modalities, which may limit its widespread use in resource-limited settings.

CONCLUSION: It was concluded that dynamic contrast-enhanced MRI (DCE-MRI) is highly effective in characterizing recurrent breast lesions in post-operative patients, with an impressive sensitivity of 97.2% and overall diagnostic accuracy of 92.2%. DCE-MRI provides valuable insights into lesion morphology and enhancement patterns, enabling reliable differentiation between benign and malignant lesions. The results underline the potential of DCE-MRI as a non-invasive imaging modality that can complement histopathology, serving as an essential tool in the early detection and management of recurrent breast cancer in post-operative settings.

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