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Radio-Diagnosis

"BREAST LESIONS EVALUATION WITH DYNAMIC CONTRAST-ENHANCED MRI: A HISTOPATHOLOGICAL CORRELATION STUDY"

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ABSTRACT

Introduction: Breast cancer is the most common cancer in Indian women, accounting for 25–31% of cases in urban areas. Mammography and ultrasonography are traditional tools for breast lesion evaluation, but mammography sensitivity falls to 48% in dense breasts.[1] Its limitations-such as incomplete axillary assessment and underestimation of disease-are overcome by MRI. DCE-MRI offers high sensitivity for detecting malignant lesions and helps distinguish scar from tumour after breast-conserving therapy. As per American and European guidelines, breast MRI is the most sensitive modality for breast cancer detection.[2,3] **Aim/Purpose:** To evaluate the role of dynamic contrast-enhanced MRI in detecting breast lesions and correlating with histopathology. **Material And Methods:** This prospective analytical study was conducted at GIMSR Hospital in patients aged 18–90 years who underwent contrast-enhanced MRI on a 1.5T Philips scanner for lesions evaluation or screening, with subsequent histopathological correlation. **Results:** Kinetic curves significantly correlated with histopathology: Type I (benign 35.3%), Type II (benign 52.9%, malignant 11.4%), Type III (malignant 88.6%) ($p<0.001$). BI-RADS also showed strong association: benign mainly I–III, malignant predominantly IV (34.1%) and V (65.9%) ($p<0.001$). **Conclusion:** Dynamic contrast analysis showed that rapid initial enhancement and washout patterns were highly predictive of malignancy ($p<0.001$). Type III curves had the strongest correlation. Using BI-RADS IV as the malignancy cut-off, MRI demonstrated 100% sensitivity and 76.4% specificity, with PPV of 91.6% and NPV of 100%.

KEYWORDS : MRI, Histopathology, BI-RADS.

INTRODUCTION:

Breast cancer accounts for 25–31% of cancers in Indian women, with an age-adjusted incidence of 25.8/100,000 and mortality of 12.7/100,000. In Asia, incidence peaks in the 40s (vs 60s in the West), with ~50% of Indian cases premenopausal; Asia is projected to bear the majority of global cases in coming decades.[4,5,6.] Mammography and ultrasonography are traditional tools for breast lesion evaluation, but mammography sensitivity falls to 48% in dense breasts.[1] Its limitations-such as incomplete axillary assessment and underestimation of disease-are overcome by MRI. DCE-MRI offers high sensitivity for detecting malignant lesions and helps distinguish scar from tumour after breast-conserving therapy. As per American and European guidelines, breast MRI is the most sensitive modality for breast cancer detection.[2,3]MRI, using time–signal intensity curves obtained after contrast injection, has emerged as a valuable tool for breast cancer screening due to its high sensitivity in detecting abnormalities.[7,8]At MR imaging, the margin characteristics of a lesion and the degree of its enhancement within two minutes of contrast injection are considered the most crucial features for breast lesion diagnosis.[9]

Dynamic contrast-enhanced MRI is highly sensitive for characterizing breast lesions, enabling detection of malignancies that may be occult on physical examination, mammography and sonography.[10]

RATIONALE AND PURPOSE OF THIS STUDY:

To evaluate the role of dynamic contrast-enhanced MRI in detecting breast lesions and correlating with histopathology.

MATERIAL AND METHODS:

This prospective analytical study was conducted in the Dept. of Radiology, GITAM Institute of Medical Sciences and Research , visakapatnam over two years (June 2023–May 2025), including patients aged 18–90 undergoing contrast MRI for lesion evaluation or screening. DCE-MRI scans were scheduled between days 6–10 of the menstrual cycle, and MRI findings were correlated with histopathology.

Inclusion:

Patients 18–90 undergoing contrast MRI with histopathology.

Exclusion:

Renal impairment, pregnancy, recurrent breast cancer post-therapy.

Study Imaging Procedure:

After local examination, history and informed consent, DCE-MRI was performed on a 1.5T PHILIPS scanner with patients in prone position using a 4-channel phased-array breast coil for bilateral imaging. *Data will be collected, validated and analyzed using SSPV.20. Parameters with a p value of less than 0.05 will be considered significant.*

RESULTS:

A total 61 patients were studied over duration of 24 months from june 2023 to may 2025.Majority of people belong between the 46-65 age group.

Table 1: Fibroglandular Tissue on MRI vs Histopathology (n=61):

Fibroglandular Tissue (MRI)	Benign, n (%)	Malignant, n (%)	Total, n (%)
Almost entirely fat	0 (0.0)	13 (29.5)	13 (21.3)
Scattered fibroglandular	5 (29.4)	15 (34.1)	20 (32.8)
Heterogeneous fibroglandular	7 (41.2)	8 (18.2)	15 (24.6)
Extreme fibroglandular	5 (29.4)	8 (18.2)	13 (21.3)
Total	**17 (100)**	**44 (100)**	**61 (100)**

Out of 61 cases (benign 17, malignant 44), malignancy was more frequent with fatty (29.5%) and scattered tissue (34.1%), while benign lesions predominated in heterogeneous (41.2%). The association was significant (p=0.03).

Symmetry of Background Parenchymal Enhancement	Benign (n, %)	Malignant (n, %)	Total (n, %)
Symmetric	14 (82.4)	37 (84.1)	51 (83.6)
Asymmetric	3 (17.6)	7 (15.9)	10 (16.4)
Total	**17 (100.0)**	**44 (100.0)**	**61 (100.0)**

BPE Intensity	Benign (n, %)	Malignant (n, %)	Total (n, %)
Minimal	7 (41.2)	3 (6.8)	10 (16.4)
Mild	9 (52.9)	28 (63.6)	37 (60.7)
Moderate	1 (5.9)	12 (27.3)	13 (21.3)
Marked	0 (0.0)	1 (2.3)	1 (1.6)
Total	**17 (100.0)**	**44 (100.0)**	**61 (100.0)**

Table 2: Background Parenchymal Enhancement symmetry showed no significant association with histopathology (p=0.869). BPE intensity differed significantly (p=0.007), with benign lesions showing higher minimal (41.2%) and malignant lesions higher moderate (27.3%).

Mass Shape	Benign (n, %)	Malignant (n, %)	Total (n, %)
Irregular	**5 (29.4)**	**38 (86.4)**	**43 (70.5)**
Oval	**7 (41.2)**	**3 (6.8)**	**10 (16.4)**
Round	**5 (29.4)**	**3 (6.8)**	**8 (13.1)**
Total	**17 (100.0)**	**44 (100.0)**	**61 (100.0)**

Mass Margin	Benign (n, %)	Malignant (n, %)	Total (n, %)
Circumscribed	**9 (52.9)**	**1 (2.1)**	**10 (16.4)**
Irregular	**8 (47.1)**	**21 (47.7)**	**29 (47.5)**
Spiculated	**0 (0.0)**	**22 (50.0)**	**22 (36.1)**
Total	**17 (100.0)**	**44 (100.0)**	**61 (100.0)**

Mass Enhancement Pattern	Benign (n, %)	Malignant (n, %)	Total (n, %)
Heterogeneous	**2 (9.1)**	**9 (20.5)**	**11 (18.0)**
Homogeneous	**9 (54.5)**	**35 (80.0)**	**44 (73.9)**
Homogeneous within dark septations	**4 (23.5)**	**0 (0.0)**	**4 (6.6)**
Ring enhancement	**2 (11.8)**	**0 (0.0)**	**2 (3.3)**
Total	**17 (100.0)**	**44 (100.0)**	**61 (100.0)**

Table 3:
Mass shape, margin, and enhancement showed significant associations with histopathology (p<0.001). Malignancy predominated in irregular shape (86.4%), spiculated margin (50%), and heterogeneous/homogeneous enhancement (20.5%/80%), while benign lesions were more often oval (41.2%), circumscribed (52.9%), and homogeneous with septations (23.5%).

Initial Phase Kinetics	Benign (n, %)	Malignant (n, %)	Total (n, %)
Slow rise	**5 (29.4)**	**1 (2.3)**	**6 (9.9)**
Medium rise	**12 (70.6)**	**7 (15.9)**	**19 (31.1)**
Rapid rise	**0 (0.0)**	**36 (81.8)**	**36 (59.0)**
Total	**17 (100.0)**	**44 (100.0)**	**61 (100.0)**

Delayed Phase Kinetics	Benign (n, %)	Malignant (n, %)	Total (n, %)
Persistent	**6 (35.3)**	**4 (9.1)**	**10 (16.4)**
Plateau	**10 (58.8)**	**1 (2.3)**	**11 (18.0)**
Washout	**1 (5.9)**	**39 (88.6)**	**40 (65.6)**
Total	**17 (100.0)**	**44 (100.0)**	**61 (100.0)**

Kinetics Type	Benign (n, %)	Malignant (n, %)	Total (n, %)
I	**6 (35.3)**	**0 (0.0)**	**6 (9.8)**
II	**9 (52.9)**	**5 (11.4)**	**14 (23.0)**
III	**2 (11.8)**	**39 (88.6)**	**41 (67.2)**
Total	**17 (100.0)**	**44 (100.0)**	**61 (100.0)**

Table 4: Kinetic parameters showed strong correlation with histopathology (p<0.001). Malignancy was linked to rapid rise (81.8%), washout (88.6%), and type III curves (88.6%), while benign lesions showed medium rise (70.6%), plateau (58.8%), and type I/II curves (88.2%).

BIRADS MRI	Benign (n, %)	Malignant (n, %)	Total (n, %)
I	**1 (5.9)**	**0 (0.0)**	**1 (1.7)**
II	**10 (58.8)**	**0 (0.0)**	**10 (16.4)**
III	**2 (11.8)**	**0 (0.0)**	**2 (3.3)**
IV	**4 (23.5)**	**15 (34.1)**	**19 (31.1)**
V	**0 (0.0)**	**29 (65.9)**	**29 (47.5)**
Total	**17 (100.0)**	**44 (100.0)**	**61 (100.0)**

Table 5 : BI-RADS MRI Categories vs Histopathology (n=61):

Benign – BI-RADS I: 5.9%, II: 58.8%, III: 11.8%, IV: 23.5%, V: 0%; Malignant – BI-RADS IV: 34.1%, V: 65.9%. Significant correlation (p<0.001).

Sample Case:
A 53-year-old female presented with ill-defined hardness in the right breast. Mammogram revealed a focal asymmetry. Dynamic contrast-enhanced MRI (DCE-MRI) was performed for further evaluation.

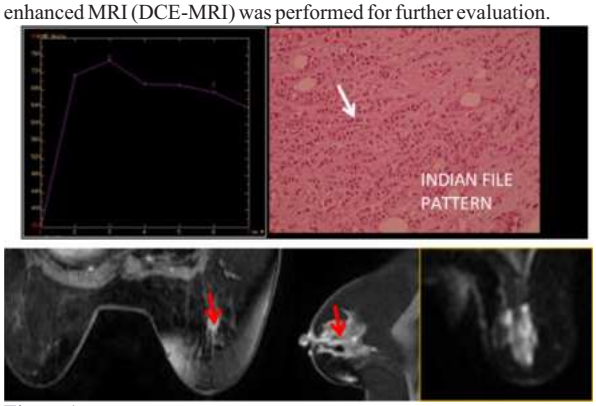

Figure 1:

MRI Findings Summary (Right Breast):
Axial VIBRANT post-contrast showed diffuse heterogeneous non-mass enhancement in the central quadrant. Dynamic sagittal images revealed early enhancement with gradual washout (Type III curve). DWI showed mild restriction. BI-RADS IVB. HPE: LCIS.

DISCUSSION:
Breast imaging advances enable early cancer detection, guiding interventions and improving outcomes. Modalities include mammography, ultrasound, and DCE-MRI, which distinguishes benign from malignant lesions and assesses hormonally responsive tissue. In India, rising incidence-driven by reproductive, dietary, and genetic factors, along with delayed presentation and low awareness-adds to the burden, with over 100,000 new cases annually. DCE-MRI assesses lesion vascularization via neo angiogenesis.

This study included 61 cases with palpable or imaging-detected breast

lesions. Mean age was 52.37 years (26–78 years), with 15 lesions detected via screening; 10 were malignant.

Morphological Parameters

Fibroglandular Tissue (FGT): 13 fatty-type cases were all malignant; 13 extreme FGT cases included 8 malignancies. FGT type was not significantly associated with lesion detection, consistent with Blumke et al.[20] and Brennan et al.[11]

Background Parenchymal Enhancement (BPE):

Mild BPE in 28, moderate in 12, and marked in 1 malignant lesion. Correlation was significant ($p = 0.007$), aligning with Baiti et al.[28] and King et al.[13]

Mass Characteristics:

Shape: Irregular masses (43 cases) were mostly malignant (38, $p < 0.001$), matching Liberman et al.[14]

Margin: Spiculated margins (22 cases) were all malignant ($p < 0.001$); irregular margins were 21/29 malignant. Circumscribed margins were mainly benign.

Enhancement: Homogeneous enhancement seen in 44 cases (35 malignant); heterogeneous in 11 (9 malignant). Homogeneous with dark septations and rim enhancement corresponded to fibroadenoma and abscess, respectively.

Contrast Dynamics

Initial Phase: Rapid rise in 36 cases (all malignant, $p < 0.001$); medium rise in 19 (12 benign, 7 malignant); slow rise in 6 (4 benign, 1 malignant).

Delayed Phase: Washout most common (40 cases, 39 malignant), followed by persistent (10) and plateau (11).

Kuhl Curve: Type III in 41 cases (39 malignant), Type II in 14, Type I in 6 ($p < 0.001$).

Histology

Most common malignant lesion: invasive ductal carcinoma (20), followed by DCIS (13). Benign lesions: fibrocystic disease (7), fibroadenoma (6), abscess, phyllodes, fibroadenomatosis, papilloma.

BIRADS MRI

BIRADS IV: 19 cases (15 malignant), BIRADS V: 29 cases (all malignant, $p < 0.001$). Sensitivity 100%, specificity 76.4%, PPV 91.6%, NPV 100%.

Comparative Studies

Literature reports sensitivity 88–100%, specificity 62–96%, PPV 73–100%, NPV 50–100% across studies (Drew[15], Giess[16], Kinkel[17], Houserkova[18], Peter[19], Blumke[20]). DCE-MRI consistently outperforms triple assessment for detection of malignancy.

Limitations & Pitfalls

Observer/ROI dependency, long acquisition obscuring washout, physiologic/post-op changes mimicking disease, and sample bias limiting generalizability.

CONCLUSIONS:

DCE-MRI showed strong histopathological correlation, with rapid enhancement, washout, and Type III curves highly predictive of malignancy ($p<0.001$). Using BI-RADS IV as cutoff, sensitivity was 100%, specificity 76.4%, PPV 91.6%, and NPV 100%.

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Conflicts Of Interest: There are No conflicts of interest.

REFERENCES:

1) Joe BN, Sickles EA. The evolution of breast imaging: past to present. Radiology. 2014 Nov;273(2 Suppl):S23-44.
2) Saslow D et al. American Cancer Society Breast Cancer Advisory Group. American Cancer Society guidelines for breast screening with MRI as an adjunct to mammography. CA Cancer J Clin.2007 Mar-Apr;57(2):75-89. Erratum in: CA Cancer J Clin. 2007 May-Jun;57(3):185.
3) Mann RM, Kuhl CK, Kinkel K, Boetes C. Breast MRI: guidelines from the European Societyof Breast Imaging. Eur Radiol. 2008 Jul;18(7):1307-18.
4) Khokhar A. Breast cancer in India: where do we stand and where do we go? Asian Pac JCancer Prev. 2012;13(10):4861-6.
5) Babu GR, Lakshmi SB, Thiyagarajan JA. Epidemiological correlates of breast cancer in SouthIndia. Asian Pac J Cancer Prev. 2013;14(9):5077-83.
6) Malvia S, Bagadi SA, Dubey US, Saxena S. Epidemiology of breast cancer in Indian women.Asia Pac J Clin Oncol. 2017 Feb 9.
7) Kuhl CK, et al. Dynamic breast MR imaging: are signal intensity time course data useful for differential diagnosis of enhancing lesions? Radiology. 1999 Apr;211(1):101-10.
8) Schnall MD, Rosten S, Englander S, Orel SG, Nunes LW. A combined architectural and kinetic interpretation model for breast MR images. Acad Radiol. 2001 Jul;8(7):591-7.
9) Macura KJ et al. Patterns of enhancement on breast MR images: interpretation and imaging pitfalls. Radiographics. 2006 Nov-Dec;26(6):1719-34.
10) Hetta W. Role of diffusion weighted images combined with breast MRI in improving the detection and differentiation of breast lesions. The Egyptian Journal of radiology and Nuclear Medicine 2015 October: 46:259-270.
11) Brennan S, Liberman L, Dershaw DD, Morris E. Breast MRI screening of women with a personal history of breast cancer. AJR Am J Roentgenol. 2010 Aug;195(2):510-6.
12) Bennani-Baiti B et al. Correction: MRI Background Parenchymal Enhancement Is Not Associated with Breast Cancer. PLoS One. 2016 Sep 8;11(9): e0162936.
13) King V, Brooks JD, Bernstein JL, Reiner AS, Pike MC, Morris EA. Background parenchymal enhancement at breast MR imaging and breast cancer risk. Radiology 2011 Jul;260(1):50-60.
14) Liberman L et al. Breast lesions detected on MR imaging: features and positive predictive value. AJR Am J Roentgenol. 2002 Jul;179(1):171-8.
15) Drew PJ et al. Dynamic contrast enhanced magnetic resonance imaging of the breast is superior to triple assessment for the pre-operative detection of multifocal breast cancer. Ann Surg Oncol. 1999 Sep;6(6):599-603.
16) Turetschek K et al. MR imaging characterization of micro vessels in experimental breast tumors by using a particulate contrast agent with histopathologic correlation. Radiology. 2001 Feb;218(2):562-9.
17) Kinkel K et al. Dynamic high-spatial-resolution MR imaging of suspicious breast lesions: diagnostic criteria and interobserver variability. AJR Am J Roentgenol. 2000 Jul;175(1):35-43.
18) Houserkova D et al. The value of dynamic contrast enhanced breast MRI in mammographically detected BI-RADS 5 microcalcifications. Biomed Pap Med Fac UnivPalacky Olomouc Czech Repub. 2008 Jun;152(1):107-15.
19) Peters NH et al. Meta-analysis of MR imaging in the diagnosis of breast lesions. Radiology. 2008 Jan;246(1):116-24.
20) Bluemke et al Magnetic resonance imaging of the breast prior to biopsy. JAMA. 2004 Dec 8;292(22):2735-42.