RESEARCH ARTICLE

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Retrospective Evaluation of Magnetic Resonance Imaging Findings for BI-RADS 5 Lesions: A 5-year Clinical Experience

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Abstract

Objectives: This study aimed to evaluate the diagnostic utility of magnetic resonance imaging (MRI) for breast cancer detection, focusing specifically on Breast Imaging-Reporting and Data System (BI-RADS) 5 lesions. The study investigated the morphological and dynamic characteristics of these lesions using MRI to identify features associated with malignancy.

Methods: A retrospective analysis was conducted on breast MRI scans performed between January 2019 and December 2023. The study included 120 patients with BI-RADS 5 lesions who underwent biopsy or surgical excision. MRI images were evaluated for breast parenchymal patterns, T2-weighted signal characteristics, lesion size, location, enhancement kinetics, and morphological features using a standardized protocol. Histopathological results were correlated with MRI findings.

Results: Among the 120 BI-RADS 5 lesions, 109 were malignant and 11 benign. Malignant lesions predominantly exhibited heterogeneous enhancement patterns (69.7%) and hypointense T2-weighted signals (56%). Most malignant lesions (82.3%) showed washout enhancement kinetics. Benign lesions, on the other hand, exhibited predominantly hyperintense T2-weighted signals (63.6%) and heterogeneous enhancement patterns (54.5%). Due to the small number of benign lesions, statistical comparisons between the malignant and benign groups were limited.

Conclusion: Breast MRI, particularly for BI-RADS 5 lesions, plays a critical role in the detection and characterization of breast cancer. The detailed assessment of morphological and dynamic features by MRI aids in accurate diagnosis and treatment planning. Understanding these MRI findings will enhance clinical decision-making and reduce unnecessary surgical interventions in patients with suspicious breast lesions.

Keywords: Breast cancer, magnetic resonance imaging, BI-RADS 5, lesion characterization, dynamic contrast-enhanced MRI

Introduction

Breast cancer remains the most frequently diagnosed cancer among women; therefore, early detection and accurate treatment determination are of vital importance.[1] Identification of early-stage breast cancer extends patient survival and improves response to treatment. Among breast imaging methods, magnetic resonance imaging (MRI) is increasingly used to diagnose breast lesions and determine treatment approaches.[1,2] It holds significant value, especially for high-risk patient groups and individuals with dense breast tissue, because it provides a more sensitive and detailed examination.[3]

Breast MRI is advantageous in diagnosing early-stage malignancies because it can reveal abnormalities that standard procedures like mammography and ultrasonography, might not be able to identify. MRI also assesses the dynamic and kinetic characteristics of breast lesions, along with providing detailed information about the size, location, and relationship of the tumor with the surrounding tissues.[1,4] This information is crucial in surgical planning, particularly in defining tumor boundaries and detecting multifocal or multicentric disease. Furthermore, MRI can be used to assess the effectiveness of the treatment process by monitoring the response to neoadjuvant chemotherapy. Another important application is the detection of occult breast cancer. Given these contributions, breast MRI has become an indispensable component of modern breast imaging practices.

The Breast Imaging-Reporting and Data System (BI-RADS) atlas defines the BI-RADS 5 category as highly suspicious lesions with a probability of malignancy exceeding 95%. In MRI, these lesions typically appear as masses with irregular or spiculated margins, heterogeneous internal structures, and rapid contrast uptake. Accurate assessment of lesions exhibiting mass enhancement is vital for distinguishing between malignancy and benignity. Parameters such as shape and margin characteristics, enhancement homogeneity, presence of septa, and enhancement kinetics should be evaluated together for a more accurate diagnosis.[4-6]

Non-mass enhancements on MRI are classified as focal, linear, ductal, segmental, regional, and multiple regional. The segmental-type

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enhancement pattern is generally interpreted as BI-RADS 5, whereas the category of other non-mass enhancement patterns is determined by considering signal characteristics, diffusion properties, and enhancement features.[5]

BI-RADS 5 lesions often exhibit a washout pattern on dynamic contrast-enhanced imaging. This kinetic characteristic is considered an indicator of angiogenesis specific to malignancies. Additionally, BI-RADS 5 lesions may show signs of invasion into surrounding tissues and exhibit multifocal or multicentric features. These characteristics, which clearly reveal the relationship and spread of the tumor with surrounding structures, are critical in determining surgical planning and treatment strategies. The detailed imaging capability of MRI facilitates the accurate and timely diagnosis of lesions with a high probability of malignancy.[1,4]

Rapid assessment and histopathological examination of BI-RADS 5 lesions are necessary. However, benign pathological results can sometimes be obtained in the BI-RADS 5 category. Surgical excision is required in cases of radiopathological discordance. To reduce unnecessary surgical excisions, better characterization of findings with a high probability of malignancy on MRI is important.

The aim of this study was to examine the morphological and dynamic characteristics of the BI-RADS 5 category on MRI and to identify the most robust MRI findings for malignancy.

Methods

This study was approved by the Medical Research Ethics Committee of Bolu Abant University Faculty of Medicine (decision no: 2024:144, date: 25.03.2024). Informed consent was obtained from all patients prior to MRI. Given that the study was conducted retrospectively, no additional approval was required. Breast MRI scans performed between January 2019 and December 2023, which were reported as BI-RADS 5 lesions, underwent retrospective review using a picture archiving and communication system. The study included 120 patients who underwent biopsy or surgical excision. Radiological images were retrospectively evaluated by two radiologists with 16 and 9 years of experience in breast radiology who were blinded to the pathological diagnosis. The lesion characteristics were reported based on consensus agreement.

MRI was performed using the General Electric Signa™ Explorer MR 1.5T closed system device (GE Healthcare, Chicago, Illinois, IL, United States). Patients were positioned prone, and their breast tissues were positioned within a dedicated surface breast coil. MRIs were obtained using axial, fat-suppressed, and fast spin-echo T2-weighted imaging sequences, along with pre-contrast and post-contrast dynamic axial T1-weighted three-dimensional, fat-suppressed, fat-spoiled gradient-echo sequences. During the MRI examinations, a comprehensive assessment and documentation of various parameters, such as breast parenchymal structure, signal characteristics of lesions on T2-weighted images, as well as lesion size, location, enhancement type, shape, margins, enhancement patterns, and kinetic curve type on dynamic contrast-enhanced images, were performed.

Histopathological results for lesions that underwent biopsy or surgical excision were obtained from the hospital information system.

Statistical Analysis

Statistical software (Statistical Package for the Social Sciences 18 for Windows, IBM Co, Chicago, IL, USA) was used for statistical analyses. Kolmogorov-Smirnov test was applied to the study variables for normality analysis. Variables that fit into normal distribution were determined using one-way ANOVA and expressed as means and standard deviations. Other variables that did not fit the normal distribution were expressed as medians (minimum-maximum) and compared using the Kruskal-Wallis test. Categorical variables were compared between study groups using the chi-square test and presented as numbers and percentages. The correlation between study variables was analyzed using Pearson's correlation coefficient.

Results

In our study, a total of 120 BI-RADS 5 lesions were included, including 109 malignant and 11 benign lesions. The median age of patients with malignant lesions was 51 years (32-77), whereas the median age of patients with benign lesions was 52 years (20-78).

Out of the 109 patients diagnosed with malignant lesions, the breast parenchymal pattern was categorized as follows: 10 patients (9.2%) had type A, 27 patients (24.8%) had type B, 36 patients (33%) had type C, and 36 patients (33%) had type D. Out of the 11 patients diagnosed with benign lesions, the breast parenchymal pattern was categorized as follows: 1 patient (9.1%) had type A, 2 patients (18.2%) had type B, 2 patients (18.2%) had type C, and 6 patients (54.5%) had type D. Comparison between the two groups could not be performed due to the small number of benign lesions.

Basal enhancement was observed in a total of 109 patients with malignant lesions, with minimal enhancement in 2 patients (1.8%), mild enhancement in 49 patients (45%), moderate enhancement in 33 patients (30.3%), and marked enhancement in 25 patients (22.9%). Among patients with benign lesions, basal enhancement was mild in 3 patients (27.3%), moderate in 5 patients (45.4%), and marked in 3 patients (27.3%).

In malignant patients, 61 lesions (56%) appeared hypointense and isointense, and 48 lesions (44%) appeared hyperintense on T2-weighted images. In benign lesions, 4 lesions (36.4%) were hypointense, while 7 lesions (63.6%) were hyperintense on T2-weighted signals.

In malignant lesions, 1 lesion (0.9%) exhibited a focus, 9 lesions (8.3%) showed nonmass enhancement, and 99 lesions (90.8%) were in a mass configuration. In benign lesions, 9 (81.8%) were mass lesions, whereas 2 (18.2%) were nonmass-enhancing lesions.

In malignant lesions, 2 (1.96%) exhibited persistent enhancement, 16 (15.7%) exhibited plateau enhancement, and 84 (82.3%) demonstrated washout enhancement. The kinetic curve did not optimally evaluate in 7 non-mass enhancement observed in malignant lesions. In benign lesions, 3 (27.3%) showed persistent enhancement, 3 (27.3%) exhibited plateau enhancement, and 5 (45.5%) demonstrated washout enhancement.

Out of 100 malignant lesions with a mass configuration, 9 were round (9%), 34 were oval (34%), and 4 were lobulated (4%), while 53 were irregular in shape (53%). For benign lesions with a mass configuration, out of 9 lesions, 3 were oval (33.3%), 2 were lobulated (22.2%), and 4 were irregular in shape (44.4%).

Of the malignant lesions with mass enhancement, 13 (11.9%) were homogeneously enhancing, 76 (69.7%) were heterogeneously enhancing, 1 (0.9%) showed dark internal septations, and 10 (9.2%) exhibited rim enhancement. For benign lesions, 2 (18.2%) were homogeneously enhancing, 6 (54.5%) were heterogeneously enhanced, and 1 (9.1%) had rim enhancement.

In malignant lesions, 1 lesion (10%) exhibited focal enhancement, 7 lesions (70%) showed segmental non-mass enhancement, and 2 lesions (20%) exhibited regional non-mass enhancement. For benign lesions, 1 lesion (50%) exhibited segmental non-mass enhancement and 1 lesion (50%) exhibited regional non-mass enhancement. The MRI findings are summarized in Table 1.

The pathological types and percentages of the 109 malignant lesions identified in this study are as follows: invasive lobular carcinoma accounted for 8.3%, tubular carcinoma for 2.8%, mucinous carcinoma for 0.9%, and infiltrating ductal carcinoma for the majority (Figures 1, 2), constituting 88.0% of the cases. These findings underscore the predominance of infiltrating ductal carcinoma among the malignant lesions studied, highlighting its significant presence in the cohort. The distribution of these pathological types provides valuable insights into the breast cancer subtype spectrum observed in the analyzed population. Among the identified benign lesions, there were 2 cases of fat necrosis (14.3%), 1 case of granulomatous mastitis (7.1%), 2 cases of fibrocystic changes (14.3%), 1 case of benign phyllodes tumor (7.1%) (Figure 3), 3 cases of fibroadenoma (21.4%), 1 case of radial scar (7.1%), and 1 case of intraductal papillomatosis (7.1%) (Figure 4). Inter-group

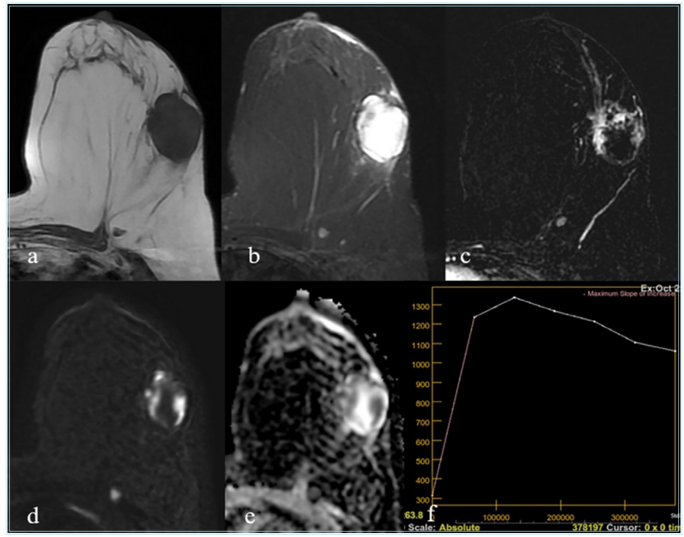

Figure 1. A 49-year-old female patient presented with a palpable mass. The mass appeared hypointense on T1-weighted imaging (a) and hyperintense on T2-weighted imaging (b), with lobulated contours and an oval shape. There is diffusion restriction in DWI (d, e), and the mass shows peripheral enhancement (c) and washout in the dynamic series (f). Histopathological diagnosis of invasive ductal carcinoma

Table 1. Magnetic resonance imaging findings

		Malignant lesions n (%)	Benign lesions n (%)
The breast parenchymal pattern (n=120)	A	10 (9.2)	1 (9.1)
	B	27 (24.8)	2 (18.2)
	C	36 (33)	2 (18.2)
	D	36 (33)	6 (54.5)
Basal enhancement (n=120)	Minimal	2 (1.8)	3 (27.3)
	Mild	49 (45)	0
	Moderate	33 (30.3)	5 (45.4)
	Marked	25 (22.9)	3 (27.3)
T2 signal characteristics (n=120)	Hypointense and isointense words	61 (56)	4 (36.4)
	Hyperintense	48 (44)	7 (63.6)
Lesion type (n=120)	Focus	1 (0.9)	0
	Non-mass enhancement	9 (8.3)	2 (18.2)
	Mass configuration	99 (90.8)	9 (81.8)
Kinetic curve type (n=113)	Persistent	2 (1.96)	3 (27.3)
	Plateau	16 (15.7)	3 (27.3)
	Washout	84 (82.3)	5 (45.5)
Mass shape (n=109)	Round	9 (9)	0
	Oval	34 (34)	3 (33.3)
	Lobulated	4 (4)	2 (22.2)
	Irregular	53 (53)	4 (44.4)
Mass enhancement (n=109)	Homogeneously	13 (11.9)	2 (18.2)
	Heterogeneously	76 (69.7)	6 (54.5)
	Dark internal septa	1 (0.9)	
	Rim	10 (9.2)	1 (9.1)
Non-mass distrubition (n=12)	Segmental	7 (70)	1 (50)
	Regional	2 (20)	1 (50)
	Focal	1 (10)	0

comparison could not be statistically performed because of the low number of benign lesions.

Discussion

MRI has significant advantages in breast imaging because of its high soft-tissue resolution for morphological assessment and dynamic evaluation capabilities, which help determine pathological features associated with tumor angiogenesis.[4] In our study, most malignant lesions exhibited heterogeneous enhancement patterns and were typically hypointense on T2-weighted signals. Specifically, 56% of the malignant lesions appeared hypointense and 44% appeared hyperintense on T2-weighted signals. This finding reflects differences in water content and cellular density in malignant lesions. In benign lesions, higher rates of hyperintense structures were observed on T2-weighted signals.[5]

A washout pattern was observed in 82.3% of malignant lesions, indicating angiogenesis specific to malignancy and rapid proliferation of tumor cells. In contrast, benign lesions more commonly exhibited homogeneous enhancement patterns. Notably, the washout kinetic model observed in many malignant lesions has been identified as an important indicator for assessing malignancy potential.[7] Our findings are consistent with the characteristic differences between malignant and benign lesions reported in the literature.[5,8]

It was found that the majority of malignant lesions had a mass configuration, with 53% having an irregular shape. This finding reflects the invasive and aggressive nature of malignant lesions, which is consistent with the literature.[2]

Our findings highlight the critical role of MRI in the early diagnosis of breast cancer and in determining appropriate treatment. It was

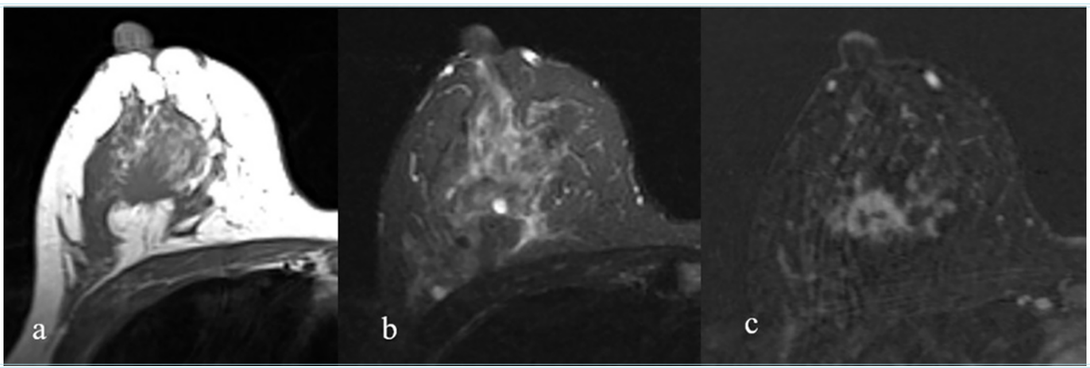

Figure 2. A 43-year-old female patient presented with a palpable mass. The mass appeared hypointense on both T1-weighted and T2-weighted magnetic resonance imaging images (a, b) and showed ring enhancement with spiculated contours on post-contrast images (c). Histopathological diagnosis of invasive ductal carcinoma

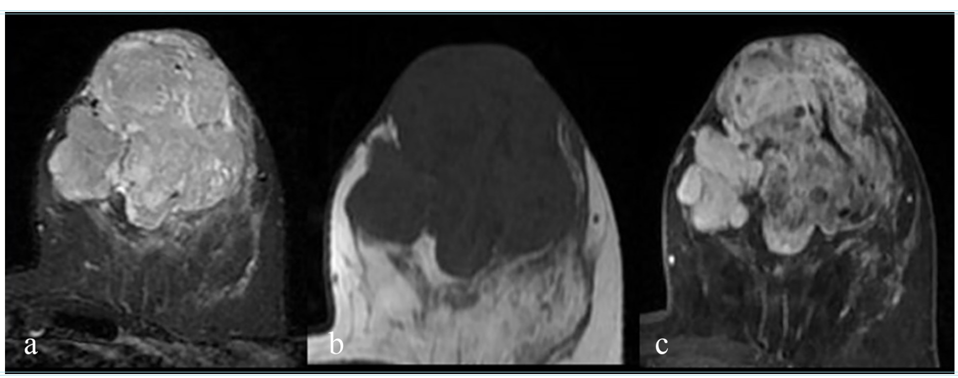

Figure 3. A 40-year-old patient presented with an 8-cm palpable mass in the left breast that caused nipple retraction and skin thickening. The mass appears hypointense on STIR sequence (a), hypointense on T1-weighted imaging (b), and shows heterogeneous enhancement on post-contrast images (c). Histopathologically, the lesion was a low-grade phyllode tumor

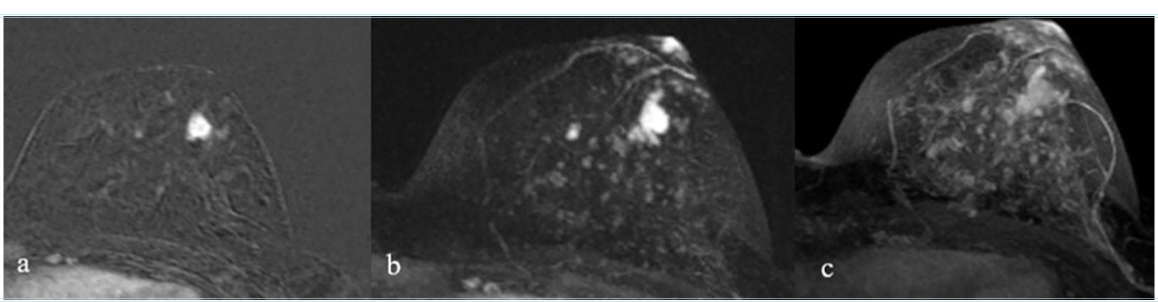

Figure 4. A 45-year-old female patient presented with an irregularly shaped, homogeneously enhancing solid lesion on post-contrast images (a). Dynamic imaging shows washout in both early and late phase MIP images (b, c). Histopathological diagnosis was intraductal papilloma

observed that the majority of lesions classified under BI-RADS 5 were malignant, and their morphological and dynamic characteristics were instrumental in diagnosis.[1,4,9]

Study Limitations

The main limitation of our study was the relatively small number of benign lesions included in the analysis. This limitation restricted our ability to perform robust statistical comparisons between benign and malignant BI-RADS 5 lesions. Future studies with larger sample sizes of benign lesions are needed to provide more definitive results.

Conclusion

In conclusion, the high-resolution images and dynamic contrast-enhanced examination methods offered by MRI have once again proven to be crucial tools for accurately classifying lesions and for surgical planning. These findings support the broader and standardized use of MRI in clinical practice. Future larger-scale studies will further validate the diagnostic accuracy and clinical utility of MRI.

Ethics

Ethics Committee Approval: This study was approved by the Medical Research Ethics Committee of Bolu Abant University Faculty of Medicine (decision no: 2024:144, date: 25.03.2024).

Informed Consent: Since the study was a retrospective study, informed consent was not required by the ethics committee.

Authorship Contributions

Surgical and Medical Practices: Z.C., E.D., Concept: Z.C., E.D., Design: Z.C., E.D., Data Collection or Processing: Z.C., Analysis or Interpretation: Z.C., Literature Search: Z.C., Writing: Z.C., E.D.

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References

1. Morris EA. Diagnostic breast MR imaging: current status and future directions. Radiol Clin North Am. 2007;45:863-80.
2. Liberman L. Clinical management issues in percutaneous core breast biopsy. Radiol Clin North Am. 2000;38:791-807.
3. Ding W, Fan Z, Xu Y, et al. Magnetic resonance imaging in screening women at high risk of breast cancer: A meta-analysis. Medicine (Baltimore). 2023;102:e33146.
4. Kuhl C. The current status of breast MR imaging. Part I. Choice of technique, image interpretation, diagnostic accuracy, and transfer to clinical practice. Radiology. 2007;244:356-78.
5. Schnall MD, Blume J, Bluemke DA, et al. Diagnostic architectural and dynamic features at breast MR imaging: multicenter study. Radiology. 2006;238:42-53.
6. Mann RM, Hoogeveen YL, Blickman JG, Boetes C. MRI compared to conventional diagnostic work-up in the detection and evaluation of invasive lobular carcinoma of the breast: a review of existing literature. Breast Cancer Res Treat. 2008;107:1-14.
7. Fischer U, Zachariae O, Baum F, von Heyden D, Funke M, Liersch T. The influence of preoperative MRI of the breasts on recurrence rate in patients with breast cancer. Eur Radiol. 2004;14:1725-31.
8. Bluemke DA, Gatsonis CA, Chen MH, et al. Magnetic resonance imaging of the breast prior to biopsy. JAMA. 2004;292:2735-42.
9. Orel S. Who should have breast magnetic resonance imaging evaluation? J Clin Oncol. 2008;26:703-11.