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Comparative Analysis of Abbreviated and Full Protocol MRI in Detecting Axillary Lymph Node Metastasis in Patients with Known Breast Cancer

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ABSTRACT

Background: Accurate axillary lymph node staging is crucial for breast cancer prognosis and treatment planning. This study compares the diagnostic efficacy of abbreviated MRI (AB-MRI) protocols with limited sequences and reduced time, against full-diagnostic MRI (FD-MRI) in staging axillary lymph node metastasis of breast cancer patients.

Methods: This was a retrospective cross-sectional diagnostic-accuracy study of 88 women with breast cancer who underwent MRI for axillary lymph node staging. MRI protocols included FD-MRI, non-contrast T1 sequence, and contrast-enhanced T1 sequence. Imaging findings, interpreted by two radiologists blinded to histopathological results, were correlated with findings from sentinel lymph node biopsy or axillary lymph node dissection as the gold standard. Data analysis comprised diagnostic performance parameters (sensitivity and specificity) and inter-protocol agreement using the kappa statistic.

Results: No statistically significant differences were detected among the three protocols (all McNemar's p-values > 0.05). The non-contrast abbreviated MRI protocol demonstrated a sensitivity of 84.9% (95% CI: 72.4%-93.3%) and a specificity of 85.7% (95% CI: 69.7%-95.2%). Unweighted Cohen's Kappa demonstrated strong concordance between the non-contrast and contrast-enhanced AB-MRI protocols ($\kappa = 0.931$; 95% CI: 0.855–1.00), between the non-contrast AB-MRI protocol and the FD-MRI ($\kappa = 0.930$; 95% CI: 0.852–1.00), and between the contrast-enhanced AB-MRI protocol and the FD-MRI ($\kappa = 0.907$; 95% CI: 0.819–0.995), respectively.

Conclusion: Non-contrast AB-MRI provides a less invasive, cost-effective alternative to FD-MRI for staging axillary lymph nodes in breast cancer, with shorter scan times and fewer procedural risks. Further studies are needed for validation in larger cohorts.

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INTRODUCTION

Breast cancer is known as the most frequently diagnosed malignancy among women globally, which affected 2.3 million patients in 2024.[1] Proper care and the use of optimal methods to determine the need for invasive interventions in patients are some of

the most important factors in improving outcomes in these patients. The use of biopsy for detecting lymph node metastasis in patients with primary breast tumors plays an important role in tumor staging, prognosis, and overall survival outcomes.[2]

Historically, assessing axillary lymph node status required patients to undergo complete axillary lymph node dissection (ALND) for both diagnostic and therapeutic purposes. In the last 15 years, sentinel lymph node biopsy (SLNB) has become the primary alternative to ALND for the classification of breast cancer patients with a negative clinical node, and it is suggested that if there is a positive finding in the patients' SLNB, in the next step, they should go for a complete ALND.[3]

Current findings from the Z0011 clinical trial indicate that the indication for ALND is no longer based only on distinguishing between negative (N0) and positive (<N1) metastasis. Instead, the decision now differentiates between the absence or presence of non-significant metastasis (N0–N1 and 0–3 positive nodes) versus significant lymph node metastasis (≥N2 and ≥4 positive nodes). In addition, those who have tumors with T1 and T2 stages can also skip ALND.[4]

Although SLNB as the first stage is a less invasive method than ALND, it is associated with complications such as lymphedema, paresthesia and possibly permanent impairment of arm muscle movement.[5] As a result, in recent years, non-invasive methods such as ultrasonography and PET-CT have been suggested to evaluate the axilla in the first stage.[5] Compared to other imaging methods for lymph node evaluation, MRI offers benefits including the absence of ionizing radiation and superior inter- and intra-observer reliability.[6,7]

Performing breast MRI with contrast injection and taking several hundred images can take between 30 and 40 minutes. The time required to generate a report by the radiologist should also be considered. Abbreviated MRI (AB-MRI) is a shortened version of the standard full diagnostic protocol in breast MRI (FD-MRI), which was introduced as a diagnostic and screening tool. Compared to FD-MRI, AB-MRI requires less scanning time, is associated with reduced costs, and therefore is more practical, especially in high patient volume centers and in centers with limited MR slots.[6,8] Contrast enhancement in lymph nodes, which occurs regardless of malignancy, complicates the diagnostic challenge of distinguishing metastatic from non-metastatic disease.. Moreover, the intrinsic challenge of differentiating lymph nodes from adjacent adipose tissue requires the implementation of a specialized pulse sequence. A complete staging approach, incorporating pre-contrast imaging, is vital for precise evaluation.[4] Limited studies have focused on the use and effectiveness of AB-MRI in the investigation of axillary lymph node metastasis, comparing it with the standard FD-MRI protocol, and so far, most of them have focused on the use of this method in the diagnosis of breast cancer. This study aims to compare the accuracy of AB-MRI with and without contrast and FD-MRI in the diagnosis and staging of axillary lymph node metastasis in breast cancer.

METHODS

Patient selection

This was a retrospective cross-sectional diagnostic-accuracy study that included 88 women with a mean age of 46.56 years who underwent MRI for axillary lymph node staging between 2022 and 2024 at Imam Khomeini Hospital Complex. The primary goal was to compare the diagnostic performance of AB-MRI protocols (with and without contrast) and FD-MRI in the diagnosis of axillary lymph node metastasis. The study was approved by the research ethics committee. All patients provided written informed consent prospectively for the routine clinical MRI acquisition. For this retrospective analysis utilizing de-identified data, a waiver of additional consent was granted by the institutional ethics committee. This study was conducted and reported in accordance with the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) reporting guideline. The completed checklist is provided in the Supplementary Material.

Patient data including MRI images, biopsy results, surgical reports and patients' demographic information were collected from the database of our hospital. A cohort of patients was selected based on a strict set of criteria: (a) Patients diagnosed with breast cancer (stages I-III); (b) Patients who underwent FD-MRI with contrast injection and AB-MRI with and without contrast injection all performed in our institution; (c) Subsequent surgical evaluation (SLND/ALND) after imaging; and (d) complete clinical data. Patients were excluded from the study based on the following criteria: a history of prior surgery, radiotherapy, chemotherapy for breast cancer and stage IV patients (metastatic breast cancer); contraindications for MRI or claustrophobia; and the unavailability of all necessary MRI sequences or images of inadequate quality for analysis. Inclusion and exclusion criteria were approved by an expert radiologist. Patients with stage IV breast cancer were excluded, as the primary aim was to assess staging accuracy prior to knowledge of systemic disease, thereby informing locoregional treatment decisions. All potentially eligible cases were first screened against the predefined inclusion

and exclusion criteria by the study coordinator, using clinical records. Cases with ambiguous eligibility were subsequently reviewed by an experienced breast radiologist, who made the final decision on inclusion or exclusion.

MRI imaging protocols

A bilateral breast MRI was conducted with the patient in a prone position following a standardized protocol[9] on a 1.5 T Achieva system (Philips Medical System) using a four-channel bilateral breast coil (In vivo, Gainesville, FL, USA). The FD-MRI consisted of axial, and coronal turbo-spin echo (TSE) fat-saturated T2-weighted sequences; axial TSE T1-weighted sequences; and axial diffusion-weighted imaging (DWI). Dynamic contrast-enhanced (DCE) imaging was conducted with a fat-suppressed axial 3D T1-weighted spoiled gradient-echo sequence subsequent to the intravenous administration of 0.2 mmol/kg gadolinium-DTPA (Dotarem, Guerbet), accompanied by a 15 mL saline flush. The imaging parameters comprised a TR/TE of 9/4 ms, a bandwidth of 31.25 Hz/pixel, a field of view (FOV) of 320 mm, a slice thickness of 2.0 mm, a matrix size of 352 × 288, a flip angle of 30°, and a number of excitations (NEX) of 1. Maximum intensity projection (MIP) and subtraction images were generated for each post-contrast phase.[10] DWI was conducted with an axial echo-planar sequence with spatial fat suppression, 10 minutes following contrast administration. The DWI settings were a TR/TE of 7700/89 ms, a FOV of 380 mm, a flip angle of 90°, a matrix size of 192 × 192, a slice thickness of 5 mm, a NEX of 4, and b-values of 0, 400, and 800 s/mm². The sequences used for the abbreviated protocol were extracted from the full breast MRI examination. This approach enabled direct, head-to-head comparison of different protocols within the same imaging session and minimized biases associated with comparing separate examinations, including potential differences in acquisition parameters, disease evolution, and imaging artifacts. We used an abbreviated breast protocol comprising two separate T1-weighted acquisitions. The initial was an abbreviated non-contrast method, encompassing axial and coronal T1-weighted images. This was followed by a contrast-enhanced protocol, comprising axial and coronal dynamic T1-weighted series with fat suppression. Throughout this manuscript, the term *abbreviated protocol* refers specifically to this defined combination of sequences. All abbreviated sequences were obtained using the system's built-in body coil, which, although primarily designed for transmitting radiofrequency pulses, was also employed as the receiver coil instead of the standard local surface coils, such as the dedicated breast coil typically used for breast MRI. All MRI examinations were performed within standard preoperative staging timelines (<4 weeks prior to surgery), minimizing potential disease progression bias.

MRI interpretation

Patient data were extracted from the hospital dataset by two independent investigators, with discrepancies resolved by cross-checking to ensure quality and consistency. The images were independently reviewed by two expert radiologists with 8 and 10 years of experience. All radiologists were blinded to histopathological results and to each other's interpretations. Reciprocally, the pathologists who assessed the specimens were blinded to all imaging findings, ensuring a dual-blinding strategy to minimize interpretation bias. Discrepancies in readers' initial evaluations were later resolved through a collaborative consensus discussion to determine the final decision for each case. The two radiologists used these discussions to perform a joint reassessment, meticulously analyzing key imaging characteristics against established radiological criteria for lymph node evaluation. The criteria for classifying lymph nodes as metastatic included their short axis size more than 10 mm; morphology (such as round shape, cortical thickening more than 3mm and loss of fatty hilus), and their signal intensity on T1-weighted imaging.[11] All patients' MRI images were first analyzed using non-contrast AB-MRI, subsequently assessed using contrast-enhanced AB-MRI, and finally evaluated with FD-MRI. A one-month delay was established between each set of MRI image interpretations to mitigate any potential for recall bias. Histopathologic information was obtained from clinical reports. All patients with breast cancer were histologically evaluated using either core needle biopsy or vacuum-assisted biopsy. Information derived from biopsy specimens included the histopathologic subtype, Ki-67 index, and the levels of estrogen receptors (ER), progesterone receptors (PR), and HER2.

Data analysis

Surgical and pathological findings were the gold standard to confirm the presence of axillary lymph node metastasis, and correlation of imaging findings with histopathological results was checked to calculate the diagnostic accuracy of each MRI protocol. True positives (TP) denote instances where the MRI protocol accurately detected a metastatic lymph node confirmed by histology;

Table 1. Patient demographics and characteristics of invasive breast cancer based on axillary lymph node status. IDC=invasive ductal carcinoma, ILC=invasive lobular carcinoma, DCIS=ductal carcinoma in situ, SD=standard deviation, BPE=background parenchymal enhancement

Variable	Lymph Node Positive N (%) Total = 53	Lymph Node Negative N (%) Total = 35
Age		
≤50-year	33 (54.1%)	28 (45.9%)
>50-year	20 (74.1%)	7 (25.9%)
Grade		
1	8 (53.3%)	7 (46.7%)
2	30 (66.7%)	15 (33.3%)
3	12 (66.7%)	6 (33.3%)
Missing data	10	
Cancer Type		
DCIS	0 (0.0%)	4 (100.0%)
IDC	45 (62.5%)	27 (37.5%)
ILC	7 (63.6%)	4 (36.4%)
Missing data	1	
Breast Cancer Subtype		
HER2 Enriched	3 (42.9%)	4 (57.1%)
Luminal A	34 (68.0%)	16 (32.0%)
Luminal B	10 (62.5%)	6 (37.5%)
Triple Negative	5 (45.5%)	6 (54.5%)
Missing data	4	
Tumor Size (cm)		
≤2	13 (50.0%)	13 (50.0%)
2-5	28 (71.8%)	11 (28.2%)
5<	6 (60.0%)	4 (40.0%)
Missing data	13	
ER Status		
Negative	8 (44.4%)	10 (55.6%)
Positive	44 (63.8%)	25 (36.2%)
Missing data	1	
PR Status		
Negative	17 (60.7%)	11 (39.3%)
Positive	35 (60.3%)	23 (39.7%)
Missing data	2	
HER2 Status		
Negative	39 (63.9%)	22 (36.1%)
Positive	13 (56.5%)	10 (43.5%)
Missing data	4	
Ki-67 Status		
Negative	15 (60.0%)	10 (40.0%)
Positive	37 (61.7%)	23 (38.3%)
	3	
Fibroglandular		
A	3 (60.0%)	2 (40.0%)
B	14 (63.6%)	8 (36.4%)
C	21 (58.3%)	15 (41.7%)
D	15 (62.5%)	9 (37.5%)
Missing data	1	
Focality		
Multifocal	21 (75.05)	7 (25.0%)
Unifocal	27 (52.9%)	24 (47.1%)
	9	
Missing data		
Tumor Centers		
Multicenter	5 (100.0%)	0 (0.0%)
Single center	30 (58.8%)	21 (41.2%)
Missing data	32	

false positives (FP) imply cases where the MRI protocol erroneously indicated a metastatic lymph node not verified by histology; false negatives (FN) refer to situations where the MRI protocol overlooked a metastatic lymph node present in the histological findings; and true negatives (TN) indicate instances where the MRI protocol correctly identified the benign lymph node, as confirmed by histology. Diagnostic performance metrics, including sensitivity, specificity, positive and negative likelihood ratios (PLR/NLR), and accuracy were calculated on a per-patient basis. The sample size was calculated using the formulas for diagnostic accuracy studies: $n = \frac{Z^2_{1-\alpha/2} \times Se \times (1-Se)}{d^2 \times Prevalence}$ for sensitivity, and $n = \frac{Z^2_{1-\alpha/2} \times Sp \times (1-Sp)}{d^2 \times (1-Prevalence)}$ for specificity. Assuming expected sensitivity and specificity of 0.80, Z = 1.96 (95% confidence), precision $d = 0.12$, and prevalence $\approx$ 0.50, the required sample size for each metric is approximately 85. Our sample of 88 patients therefore provided adequate precision for both sensitivity and specificity estimation. McNemar's test was employed for pairwise comparisons of diagnostic performance between the three MRI protocols, inherently accounting for within-subject correlation in this paired design. Bonferroni correction was applied across the three comparisons. The data obtained from all three groups were analyzed using SPSS 26.0 software. Absolute frequency (N) and percentage (%) were employed to represent qualitative statistics. Continuous variables were assessed for normality using the Shapiro-Wilk test. Normally distributed data were presented as mean ± SD, and non-normal data as median (IQR). Unweighted Cohen's kappa tests were employed to assess inter-protocol concordance for nominal data (poor < 0.20; fair = 0.21–0.40; moderate = 0.41–0.60; good = 0.61–0.80; very good = 0.81–0.99; perfect = 1.00).[12] Statistical significance was set at P < 0.05.

RESULTS

Pre-operative MRI was evaluated against surgical pathology in a cohort of 88 women with breast cancer. The mean age of patients was 46.5 ± 9.4 years and the mean size of lymph nodes was 30.5 ± 19.2mm. The patient's demographic and tumor characteristics are presented in Table 1.All 88 patients underwent pre-contrast T1-weighted coronal sequence breast MRI. Axillary lymph node (ALN) involvement was detected in 50 patients in non-contrast AB-MRI. The distribution of involvement by anatomical level was as follows: 38 patients (76% of the patients with ALN) were observed to have only level I involvement, 4 patients (8% of the patients with ALN) to have only level II involvement, 4 patients (8% of the patients with ALN) to have both levels I and II involvement, and 4 patients (8% of the total) to have levels I, II, and III involvement (Figure 1a, Figure 2a). In the remaining 38 patients, no ALN involvement was detected on FD-MRI. Pathology results were available for these patients. Of the 50 patients with ALN involvement on MRI, 45 cases were histopathologically positive. Of the 38 patients without ALN involvement on MRI, 30 were proven negative in histopathology.

Table 2. Diagnostic value of different protocols in evaluation of lymph node involvement. PLR: positive likelihood ratio, NLR: negative likelihood ratio, AB-MRI: abbreviated MRI protocol, FD-MRI: full diagnostic MRI protocol

	Sensitivity (95% CI)	Specificity (95% CI)	PLR (95% CI)	NLR (95% CI)	Accuracy (95% CI)
AB-MRI non-contrast	84.9% (72.4%-93.3%)	85.7% (69.7%-95.2%)	5.94 (2.62-13.4)	0.18 (0.09-0.34)	85.2% (76.1%-91.9%)
AB-MRI with contrast-enhancement	81.1% (68.0%-90.6%)	82.9% (66.4%-93.4%)	4.73 (2.26-9.92)	0.23 (0.13-0.41)	81.8% (72.2%-89.2%)
FD-MRI	88.7% (77.0%-95.7%)	82.9% (66.4%-93.4%)	5.17 (2.48-10.7)	0.14 (0.06-0.29)	86.4% (77.4%-92.8%)

Contrast-enhanced AB-MRI reported 49 cases of positive lymph involvement and 39 cases of negative involvement among 88 patients. Among 49 patients, 37 cases (75.4%) had level 1 lymph node involvement, 4 cases (8.2%) with level 2 lymph node, 4 patients (8.2%) with level 1 and 2 lymph nodes and 4 cases (8.2%) had involvement of all three levels (Figure 1b, Figure 2b). Also, 43 cases out of the 49 patients with ALN involvement on MRI were proven positive in pathology. Of the 39 patients without ALN involvement on MRI, 29 had a negative histopathology.

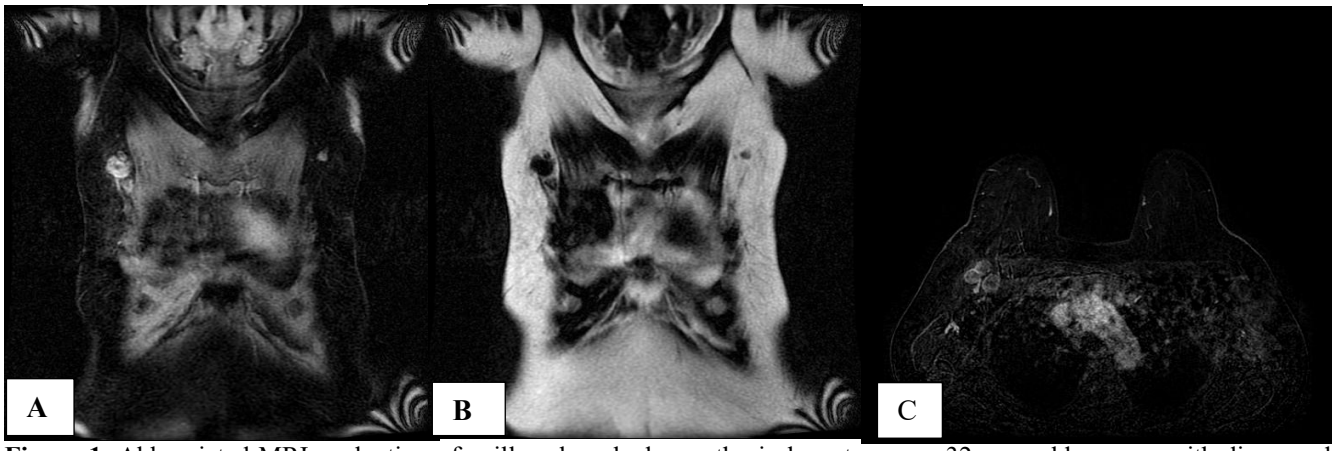
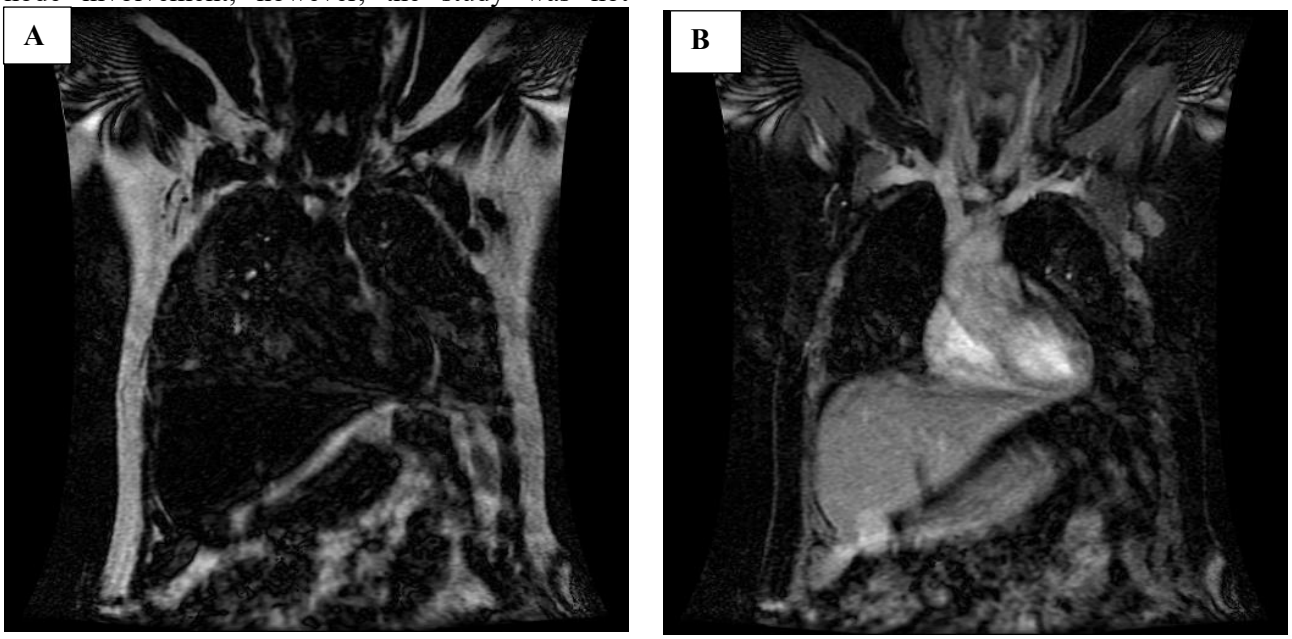


Figure 1. Abbreviated MRI evaluation of axillary lymphadenopathy in breast cancer: 32-year-old woman with diagnosed invasive ductal carcinoma of the right breast. (a): T1-weighted coronal image without fat saturation and contrast demonstrates a hypointense lymph node in the right axilla. (b): T1-weighted coronal image with contrast and fat saturation highlights the lymph node with increased signal intensity. (c): T1-weighted axial image with contrast further enhances visualization of the pathological lymph node. (d): Axial diffusion-weighted imaging (DWI) reveals restricted diffusion, consistent with metastatic involvement.

Among the 88 patients who underwent a FD-MRI, 53 cases showed axillary lymph node involvement, while 35 cases did not. Out of the 53 patients, 40 cases (75.6%) had level one lymph node involvement, 4 cases (7.5%) had level 2 lymph node involvement, 5 patients (9.4%) had involvement in both levels 1 and 2, and 4 cases (7.5%) had involvement across all three levels (Figure 1c, Figure 2c). Histopathology results were positive in 47 of the 53 patients with lymph node involvement and negative in 29 of the 35 patients without it. Sensitivity, specificity, PLR, NLR and accuracy of the three protocols evaluated in this study for detection of lymph node involvement are summarized in Table 2, 3, 4, and 5. McNemar's test showed no statistically significant difference among the three protocols in the detection of axillary lymph node involvement; however, the study was not powered for equivalence (all p-values > 0.05) (Figure 1d, Figure 2d). Moreover, the high unweighted Cohen's kappa confirmed high agreement among the various MRI protocols for the detection of lymph node involvement. The comparison between the non-contrast AB-MRI and the contrast-enhanced AB-MRI protocols yielded a kappa value of 0.931 (95% CI = 0.855-1.00), indicating very good agreement. Similarly, the contrast-enhanced AB-MRI showed substantial agreement with the FD-MRI, with a kappa of 0.907 (95% CI = 0.819-0.995). The agreement between the non-contrast T1-weighted and the FD-MRI was also very good, with a kappa value of 0.930 (95% CI = 0.852-1.00). All kappa values were statistically significant, with p-values < 0.001.



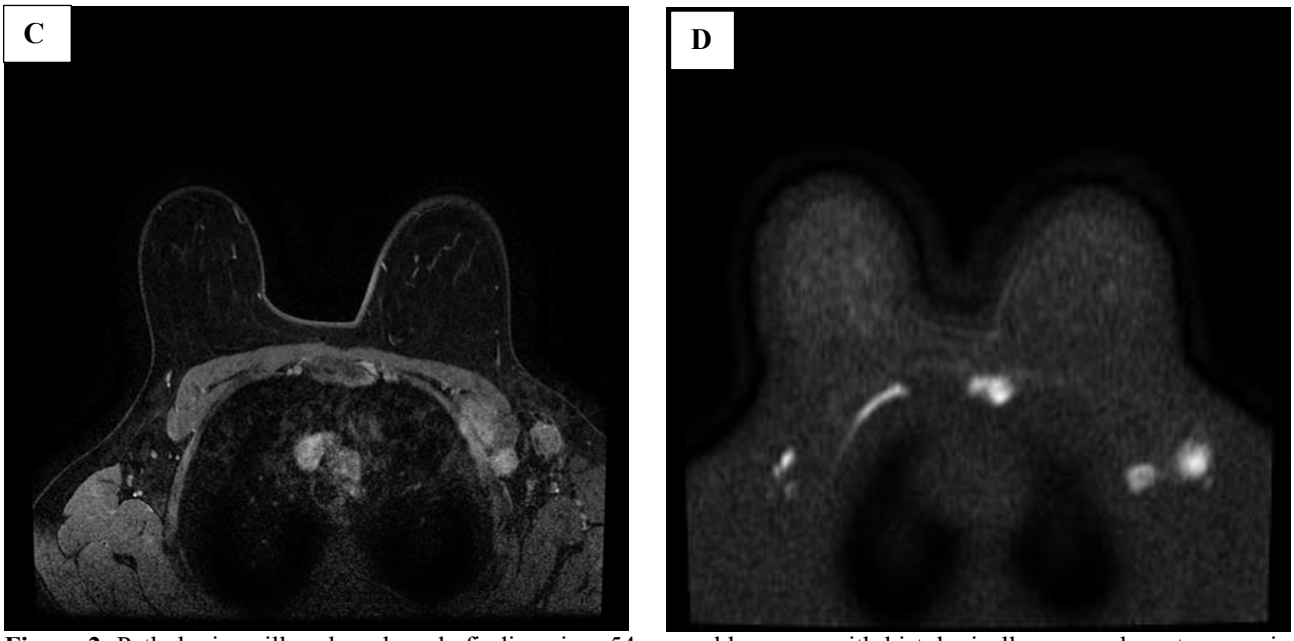


Figure 2. Pathologic axillary lymph node findings in a 54-year-old woman with histologically proven breast cancer in the left breast. (a): T1-weighted coronal image without fat saturation and contrast shows a left hypointense axillary lymph node. (b): T1-weighted coronal image with contrast and fat saturation demonstrates the lymph node with increased signal intensity. (c): T1-weighted axial image with contrast further enhances visualization of the pathological lymph node. (d): Axial diffusion-weighted imaging (DWI) reveals restricted diffusion, consistent with metastatic involvement.

Table 3. Sensitivity and specificity of T1 coronal without contrast: TP= true positive=false negative,FP=false positive,TN=true negative

T1-W/O cont. / *Lymph*	+	-
+	*TP: 45*	*FN: 8*
-	*FP: 5*	*TN: 30*

Sensitivity: 0.849; Specificity: 0.857; NPV: 0.79; PPV: 0.9; Accuracy: 0.852; Kappa: 0.696, p-value: <0.001

Table 4. Sensitivity and specificity of T1 coronal fat sat with contrast. TP= true positive=false negative,FP=false positive,TN=true negative

T1-W cont. / *Lymph*	+	-
+	*TP: 43*	*FN: 10*
-	*FP: 6*	*TN: 29*

Sensitivity: 0.811; Specificity: 0.829; NPV: 0.744; PPV: 0.878
Accuracy: 0.818; Kappa: 0.628, p-value: <0.001

Table 5. Sensitivity and specificity of full protocol MRI. TP= true positive=false negative,FP=false positive,TN=true negative

Full-MRI / *Lymph*	+	-
+	*TP: 47*	*FN: 6*
-	*FP: 6*	*TN: 29*

Sensitivity: 0.887; Specificity: 0.829; NPV: 0.829; PPV: 0.887
Accuracy: 0.864; Kappa: 0.715, p-value: <0.001

DISCUSSION

Implementing AB-MRI offers substantial workflow benefits through reduced acquisition time (3-10 minutes vs. 30+ minutes for full diagnostic MRI), enabling higher throughput in busy centers and addressing limited MRI slots. Cost savings from shorter scans and simplified reading (often <3 minutes) make AB-MRI feasible for broader screening, particularly in high-volume or resource-limited settings, while avoiding gadolinium in contraindicated patients via unenhanced protocols. This study highlights the non-inferior performance of a T1-weighted pulse sequence, acquired using the system's built-in body coil, into the standard preoperative breast MRI protocol in comparison to full protocol MRI. This modification significantly improves the discovery of axillary lymph node involvement, demonstrating a high positive predictive value. Historically, prior to the advent of SLNB, all patients diagnosed with invasive breast cancer underwent complete axillary lymph node dissection ALND for both diagnostic and therapeutic goals.[13] To mitigate the considerable morbidity associated with ALND, SLNB was introduced as a less invasive alternative.[14] However, before the ACOSOG Z0011 study, patients with positive SLNB findings were still required to undergo complete ALND. The results of the aforementioned study led to a paradigm shift, allowing women with invasive breast tumors up to 5 cm in size, no clinically palpable

axillary or parasternal lymph nodes, and 1–2 positive SLNB nodes to avoid axilla dissection.[15]

The final confirmation of lymph node metastasis is performed by invasive methods, and finding methods to identify lymph node metastasis preoperatively and with less invasiveness is one of the current goals. Ultrasound remains the primary modality for this purpose owing to its accessibility, real-time assessment, and capability for image-guided sampling. Nonetheless, its performance may be limited by operator dependency, restricted coverage, and reduced sensitivity for small or deep-seated metastases.[16,17] In this context, our study investigated the potential of an abbreviated non-contrast MRI protocol as a complementary tool in specific clinical scenarios. This approach would be particularly relevant if non-contrast techniques like diffusion-weighted imaging advance sufficiently to become reliable standalone methods for screening or staging.

Because of its limited ability to provide complete visualization of the axilla region, MRI currently plays a minor role in imaging this region. Although protocols specific to the axilla region have increased sensitivity, specificity, positive and negative predictive value, these protocols require more time and are currently not very useful in the clinic.[5] The acquisition of a standard full MRI protocol, which includes multiple sequences, is traditionally a lengthier process, while the abbreviated protocol is performed by omitting certain sequences and reducing the time required for imaging.[18] Many studies have demonstrated the potential of abbreviated MRI in the diagnosis and characterization of a variety of cancers, such as prostate, breast, cervix, and hepatocellular carcinoma.[19-22] Nevertheless, the abbreviated protocol's diagnostic accuracy for the detection of axillary lymph node invasion in breast cancer has not yet been fully assessed in the literature. While MRI showed exceptional performance in detecting and characterizing primary breast cancer using different established scoring systems[23], assessing axillary lymph nodes remains a challenge. This is mainly because all lymph nodes, regardless of metastatic involvement, display contrast enhancement after the administration of contrast material. Additionally, since the enhancement pattern of lymph nodes may resemble that of the surrounding fat tissue, a pulse sequence for lymph node staging is acquired prior to contrast agent injection to improve diagnostic accuracy.[5] The coronal plane is particularly beneficial for visualizing parasternal, infraclavicular, and supraclavicular lymph nodes, offering a more comprehensive anatomical assessment while requiring fewer imaging sections compared to axial imaging.[4]

Our study showed that the non-contrast T1 sequence has the same performance as FD-MRI, with no significant difference in sensitivity and specificity. This similar performance was also supported by our inter-protocol agreement analysis, which showed that all three protocols can be used interchangeably as indicated by consistent “very good” pair-wise kappa values. With its high positive and negative likelihood ratios for detecting axillary lymph node involvement, non-contrast AB-MRI shows strong potential for integration into routine clinical practice. An abbreviated, non-contrast MRI methodology provides a more cost-effective and safer method for assessing axillary lymph node involvement. This approach markedly diminishes patient exposure to the potential concerns of contrast agents, including nephrogenic systemic fibrosis, gadolinium tissue deposition, allergic reactions, and pregnancy-related concerns. Refraining from contrast administration is particularly advantageous for patients with renal insufficiency or those requiring many imaging procedures, since it alleviates the burden of contrast exposure while maintaining diagnostic efficacy. Abbreviated MRI could also enhance access to MRI in low-resource environments, where contrast agents may be few or inaccessible. It would also decrease scan duration and total examination expenses.[20] Nonetheless, contrast-enhanced MRI remains indispensable for comprehensive evaluation and accurate staging of breast disease, as the abbreviated non-contrast protocol cannot delineate the full extent of tumor involvement. Accordingly, this protocol should be regarded as a complementary adjunct applicable in selected clinical scenarios rather than a replacement for standard contrast-enhanced imaging in complete disease assessment.

In the study by Kadioglu *et al*., 3 different types of abbreviated protocol (AP) were extracted from the full MRI protocol. In AP1, T2-weighted and diffusion-weighted axial images were acquired, whereas in AP2, axial T1-weighted fat-saturated images were attained two minutes after contrast administration. In AP3, both AP2 and diffusion-weighted images were analyzed. For each protocol, the lesion's location, number, size, and the presence of axillary lymphadenopathy were assessed separately. In this study, in all types of protocols, the evaluation time was shorter than the full protocol, and the best diagnostic correlation in all the investigated factors, including axillary lymphadenopathy (κ=0.842) occurred in the AP3 protocol.[24]

Bode *et al.* investigated regional lymph nodes and reported that the addition of a short coronal T1-weighted MRI sequence was effective in identifying

patients with clinically significant lymph node metastasis (≥N2), achieving a high negative predictive value (98.8%). However, the positive predictive value was relatively low (50.6%), likely because the MRI observers were only asked to report the presence or absence of lymph node metastasis, without considering the number of metastatic nodes, which defines clinically significant involvement. This limitation may have reduced the ability to correctly identify patients with ≥N2 metastasis, resulting in a lower PPV.[4] Also, Pesapane *et al.* meta-analysis aligns with our sensitivity findings (AB-MRI 86% vs. full MRI 95%), emphasizing comparable specificity and practical advantages for dense breasts.[20]

Our study faced several limitations: 1) The study was retrospective, which presents inherent concerns of selection bias and unmeasured confounding. Despite the available research on this topic, further generalizable multicenter prospective investigations with large sample sizes are needed on whether abbreviated T1-weighted imaging with and without contrast can reliably stage axillary lymph nodes in breast cancer patients compared to the traditional FD-MRI. 2) The research does not assess inter-reader agreement among radiologists, which may indicate inconsistencies in interpretation and impact the reliability of the results and reproducibility in other settings.

CONCLUSION

Abbreviated T1-weighted MRI protocols present a promising alternative to FD-MRI, especially in time-sensitive resource-constrained settings or in a subset of patients with contraindication to contrast. Although they may not fully match the sensitivity of FD-MRI protocols for accurate detection of lymph node metastases, they provide a reliable and efficient option for detecting axillary lymph node metastasis. In clinical practice, abbreviated MRI protocols could be strategically implemented to complement traditional diagnostic pathways, reducing scan times and costs while maintaining diagnostic accuracy. Moreover, unenhanced T1-weighted MRI sequences may hold diagnostic value in lymph node assessment, especially if future developments in non-contrast MRI—primarily diffusion-weighted imaging—enable their use as standalone protocols for screening or disease extent evaluation.

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None.

CONFLICT OF INTERESTS

The authors declare no financial or non-financial conflict of interest.

ETHICAL CONSIDERATIONS

This study was approved by the research ethics committee (IR.TUMS.IKHC.REC.1403.536) and written informed consent was obtained from patients. The patients in this manuscript gave written informed consent for the publication of their case details.

DATA AVAILABILITY

The datasets generated or analyzed during the study are available from the corresponding author upon request.

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Not Applicable.

AI DISCLOSURE

Artificial intelligence tools were used only to assist with language editing. The authors take full responsibility for the content of the manuscript.

AUTHOR CONTRIBUTION

Conceptualization: [Fahimeh Zeinalkhani]; Formal analysis: [Fatemeh Mahdavi Sabet]; Investigation: [Maryam Movahedi]; Methodology: [Fahimeh Zeinalkhani]; Project administration: [Fahimeh Zeinalkhani], [Maryam Movahedi]; Resources: [Peyman Kamali Hakim], [Hadise Zeinalkhani], [Elahe Baban Taher], [Simin Hashemi], [Afrooz Moradkhani], [Mahdiyeh Movahedi]; Supervision: [Fahimeh Zeinalkhani]; Validation: [Maryam Movahedi]; Writing-original draft: [Maryam Movahedi]; Writing-review & editing: [Saeed Mohammadzadeh], [Maryam Movahedi], [Mahdiyeh Movahedi]

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