

Original Research Article

Utilization of breast magnetic resonance imaging in the pre-operative setting and its ability to better predict local staging in non-metastatic breast cancer patients

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ABSTRACT

Background: Breast cancer can be difficult to stage using ultrasound (USS) and mammography (MMG) alone. The use of MRI in the pre-operative setting has been increasingly incorporated to aid in treatment planning. However, the indications for breast magnetic resonance imaging (MRI) are not universally agreed upon, and its direct impact on patient care requires further research. This paper aims to assess pre-operative non-metastatic breast cancer patients to determine whether breast MRI led to changes in management and to evaluate its accuracy in predicting tissue staging when compared to ultrasound and mammography.

Method: This is a retrospective study of 44 patients diagnosed with non-metastatic breast cancer who underwent upfront surgery and received pre-operative breast MRI between March 1, 2022, and March 1, 2024. Patient demographics, pre-operative imaging (including USS, MMG, and MRI), and final tissue histology were reviewed. The findings from breast MRI and its impact on pre-operative planning, as well as its concordance with final tissue histological staging, were assessed.

Results: Of the 44 patients who underwent pre-operative breast MRI, 12 experienced a change in management, and 11 required additional investigations. This was largely due to an upstaging of the disease, leading to mastectomy instead of the previously planned breast-conserving surgery. Furthermore, breast MRI demonstrated better concordance with final histological staging at 69.4% compared to USS/MMG alone at 52.7%.

Conclusion: Breast MRI is a valuable tool in pre-operative planning for newly diagnosed breast cancer patients. It can significantly affect surgical management in a substantial proportion of patients and has been shown to be more accurate in estimating disease burden.

Keywords: Breast cancer, Ductal carcinoma in situ, Magnetic resonance imaging, Staging, Histology

INTRODUCTION

Breast magnetic resonance imaging (MRI) has been increasingly used to aid diagnosis of breast cancer. It was first introduced in the 1980's by Heywang and Kaiser et al.^{1,2} Gadolinium enhanced breast MRI can assess permeability of blood vessels by measuring T1 shortening. Leaky vessels from neo-angiogenesis in breast cancer will therefore cause rapid local

enhancement, contrast extravasation, and ultimately higher signal on T1-weighted images.^{3,4} Breast MRI is now routinely used as a screening tool in high-risk breast cancer patients. However, indications for preoperative evaluation in patients with known breast cancer have not been clearly established. American College of Radiology (ACR) practice guidelines 2018 simply stated that MRI is useful for determining extent of tumour, its relation to deep fascia, and screening of contralateral breast, while

European union society of breast imaging (EUSOBI) 2008 recommended breast MRI in patients with dense breast, invasive lobular carcinoma, and screening of contralateral breast.⁵ Currently research have been able to demonstrate that breast MRI have greater sensitivity than mammography in detecting additional lesions, both malignant and benign.^{6,7} However, this increased sensitivity can often lead to additional investigation and cost, patient anxiety, and potential delay in surgery.⁸

Currently in Australia, Medicare Benefit Schedule (MBS) provides rebates for MRI breast in asymptomatic patients younger than 60 who identified as high-risk breast cancer patients. High risk due to presence of one or more of the follow factor, high risk breast cancer gene mutation in patient or first degree relative, having patient's first/second degree relative who was diagnosed with cancer before age of 45 and another first/second degree relative on the same side of family diagnosed with bone/soft tissue sarcoma before age of 45, personal history of breast cancer before age of 50, personal history of mantle radiation therapy, and lifetime risk estimation greater than 30% or a 10 year absolute risk estimation greater than 5% using risk evaluation algorithm. Our study aims to investigate the utility of breast MRI in the pre-operative assessment of newly diagnosed breast cancer and surgical planning, as well as to determine whether breast MRI is more concordant than conventional imaging in assessing the extent of disease.

METHODS

Between March 1, 2022, and March 1, 2024, patients diagnosed with non-metastatic breast cancer at a moderately sized secondary metropolitan hospital were included in this retrospective study. Patient demographics, imaging and tissue results, as well as operative details, were retrospectively retrieved from electronic operative records, multidisciplinary meeting records, and hospital electronic medical records.

Inclusion criteria

Inclusion criteria comprised all patients diagnosed with non-metastatic breast cancer during this period who underwent a breast MRI as part of their initial workup.

Exclusion criteria

Patients who did not have a breast MRI scan or who received neoadjuvant treatment were excluded from the study.

Data collection

Pre-operative and post-operative data collected included age at diagnosis, method of diagnosis, initial ultrasound (USS) and mammography (MMG) results, initial biopsy results, breast MRI findings, final surgical specimen histology, and any subsequent management undertaken

for the patient. Each patient's data was reviewed by a breast surgeon to determine whether the addition of breast MRI resulted in a change in patient management. Furthermore, size of the index lesion on both USS/MMG and MRI was assigned a grade based on the TMN staging classification (T1=<20 mm, T2=20-50 mm, T3=>50 mm). This grading was subsequently compared to the final histological grade to assess which imaging modality was more concordant in estimating disease burden. Patients with unmeasurable index lesion on USS/MMG or MRI were excluded from the analysis.

RESULTS

Baseline patient demographics are presented in Table 1. Forty-four patients met the inclusion criteria for the study, with a mean age of 61 years (range: 33-79). Among these patients, 43% had their cancer detected through breast screening.

Table 1: Patient demographics (n=44).

Total patients	
Mean age at diagnosis (age range)	61.2 (33-79)
Method of diagnosis	
Breast screen	43.2%
Self-detected	56.8%
Breast cancer type	
DCIS only	7 (15.9%)
IC (± DCIS)	25 (56.8%)
ILC (± LCIS)	12 (27.3%)

Table 2: MRI led investigation and change in patient management.

Further investigation due to MRI breast	11
Benign	100%
Ipsilateral imaging	4
Ipsilateral biopsy	3
Contralateral imaging	3
Contralateral biopsy	1
Change in management due to MRI breast	7 (27.3%)
Avoided further biopsy	3
BCS to Mx due to upsizing	8
Contralateral surgery	1

Table 3: Histological staging comparison with MRI finding (n=36).

Total patient (excluding multifocal disease)	
Histological stage	
T1	19
T2	9
T3	8
Final histology concordant with imaging	
USS/MMG	19 (52.7%)
MRI	25 (69.4%)
Final histology upstaged despite imaging	10 (30.3%)
Final histology downstage despite imaging	1 (3.0%)

The majority of breast cancer cases were classified as invasive carcinoma of no special type, with or without surrounding ductal carcinoma in situ (DCIS), accounting for 56%. Additionally, 27% of patients had invasive lobular carcinoma, with or without lobular carcinoma in situ (LCIS).

Management of patient post-breast MRI was reviewed, and the results can be found in Table 2. In 11 out of 44 patients, further investigations were organized due to MRI findings, 7 underwent additional radiological imaging studies, and 4 had further biopsies, all of which resulted in benign conclusions. In 12 out of 44 patients, breast MRI was deemed significant in altering surgical management, 3 patients avoided further biopsies, 8 underwent total mastectomies (Mx) instead of breast-conserving surgery (BCS), and 1 patient had an additional contralateral excisional biopsy.

Final histological tissue stages are detailed in Table 3. Thirty-six patients were included in this part of the study (8 patients were excluded due to non-measurable masses on imaging studies). Final histology was reviewed and compared with pre-operative radiological findings. In 19 out of 36 patients, the final histological tissue stage matched the ultrasound (USS) and mammography (MMG) findings, compared to 25 out of 36 patients when taking into account MRI findings.

DISCUSSION

Ultrasound (USS) and mammography (MMG) can sometimes be insufficient in estimating tumour burden in certain patients. Breast MRI can therefore be a valuable tool in obtaining additional information during the pre-operative stage. Breast MRI's dynamic approach by assessing non-mass enhancement provides valuable information in determining disease burden. In our study, the utilization of breast MRI changed the surgical management for 12 out of 44 patients (27.3%). Majority of the patient underwent total mastectomy instead of BCS due to upsizing of lesions as a direct result of MRI breast finding. A small portion of patient avoided further biopsy of suspicious lesions identified on initial USS and/or MMG as a result of further evaluation with MRI breast.

Doyle et al, demonstrated that MRI is more concordant with ductal carcinoma in situ (DCIS) and enhances mammography's ability to accurately predict the extent of DCIS, often resulting in reliable upstaging.⁹ With this additional information, clinicians can make more informed decisions regarding patients' surgical management, decreasing risks of involved margin that require further operations. Our study found that MRI results were correlated with final histological findings in 25 of 36 patients, compared to only 19 of 36 patients with USS/MMG results. This suggests that MRI is more accurate in assessing disease burden when compared to USS/MMG alone.

MRI's improved sensitivity has been shown to often detect additional lesions, both malignant and benign. DeMartini et al. demonstrated that breast MRI identified contralateral breast cancer in 30 of 969 patients that was occult on mammography, 18 of whom had invasive breast cancer. This conclusion was drawn from additional biopsies on 121 patients based on their MRI findings, majority of which yielded benign results.^{9,10}

Similarly, Bilimoria et al. reported that pre-operative breast MRI found 124 additional suspicious lesions in 73 out of 155 patients, leading to changes in surgical management for 36 patients (20 of which were beneficial).⁷ In our study, 12 out of 44 patients required additional investigations in the form of imaging or biopsies, all of which resulted in benign findings. This outcome may be attributed to our smaller sample size; nonetheless, it resulted in additional costs, delays in surgical treatment, and increased patient anxiety. While these delays may not impact overall survival, they can contribute to heightened anxiety and negative psychological consequences for patients.⁸

Our retrospective study is limited by relatively small sample size with heterogenous breast cancer type.

CONCLUSION

Our study demonstrated that pre-operative breast MRI in patient receiving up-front surgical management if able to change management in a large proportion of patients. However, additional benign lesions were also detected on MRI requiring further investigations and potential delay in treatment. Further research is required in determining which patients are more likely to benefit from pre-operative breast MRI.

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