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Influence of Preoperative Magnetic Resonance Imaging in Surgical Planning for Breast Cancer

Sara Besharat[1], Mojgan Kalantary[1], Azadeh Julaee[2] and Nasser Malekpour[2,*]

[1]Department of Radiology, School of Medicine, Shahid Beheshti University of Medical Sciences, Tehran, Iran
[2]Department of General Surgery, School of Medicine, Shahid Beheshti University of Medical Sciences, Tehran, Iran

[*]*Corresponding author*: Department of General Surgery, School of Medicine, Modarres Hospital, Shahid Beheshti University of Medical Sciences, Tehran, Iran. Tel: +98-2122069355, Email: nassermalekpour@gmail.com

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Abstract

Background: Assessment of efficacy of preoperative magnetic resonance imaging (pMRI) is important to improve the diagnosis and treatment results in patients with breast cancer (BC).
Objectives: We designed this study to determine the role of pMRI in surgical planning for patients suffering from BC.
Methods: We, cross sectionally, observed 98 women with BC referring to an educational hospital in Tehran from January 2014 to December 2015. Data pertaining age, pathological type of BC, preoperative imaging findings, and surgical planning were gathered. The frequency of plan alteration was determined according to pMRI findings and analyzed, using appropriate statistical analyses (descriptive statistics, independent *t*-test, Chi-square, and Fisher's exact tests).
Results: Initial surgical plan of 23 patients (23.47%) was changed. Pathological diagnosis of BC (P = 0.460), size of lesion (P = 0.696), laterality (P = 0.139), and lymph node involvement (P = 0.094) did not seem to alter the surgical plan. On the contrary, younger age (P = 0.049), more lesions (P = 0.002), pMRI enhancement curve washout pattern (P = 0.020), and multifocality (P < 0.001) of lesions in pMRI seemed to change surgical treatment plan. Yet, neither ultrasonography nor mammography findings did alter the plan (P > 0.050).
Conclusions: pMRI findings, including multiple lesions and multifocal involvement showing enhancement pattern suggestive for malignancy, may change surgical planning in about a quarter of women suffering from BC, particularly the younger ones, but MRI is not mere criterion for determining and usage of it should be limited to necessary subjects because when it is done without strict parameters, it will cause over diagnosis and over treatment.

Keywords: Magnetic Resonance Imaging, Breast Cancer, Surgical Procedure

1. Background

Breast cancer (BC), as a multifactorial disease, is the most prevalent cancer in women affecting about 1 out of 4 women, worldwide. The prevalence is lower in developing countries such as Iran, although the trend is rising. Studies showed patients suffering from BC have lower general and mental health and impaired quality of life. Thus, prevention, early diagnosis, and treatment can dramatically decrease the burden of BC (1-3). Notably, BC is mostly detected at advanced stages in Iranian patients due to public unawareness about BC symptoms and screening and inappropriate national screening strategies. In addition, Iranian women with BC are found to be younger than western patients, i.e., about 25% of Iranian patients with BC are under 40 (3-5).

It is challenging to detect BC in younger females because of its lower prevalence and the higher density of young breast's tissue, which limits the reliability of imaging (mammography and ultrasonography) (6). On the other hand, imaging is indispensable for preoperative assessment of breast lesions (size, multifocality, and laterality) in order to choose the appropriate surgical plan (7-9). Regarding diagnosis and management of BC, ultrasonography and mammography are routinely used as inexpensive and feasible imaging methods, both pre- and post-operatively. Magnetic resonance imaging (MRI) has been shown to have higher sensitivity for diagnosis of BC and can be used to confirm ultrasonographic and mammographic findings. Preoperative loco regional staging, evaluation of tumor extent and assessment of multifocal and multicentric tumors are major indications for MRI (Role of MRI in the planning of BC treatment strategies: Comparison with conventional imaging techniques). Yet, MRI is not considered a specific diagnostic tool for BC due to its high false positive rate leading to unnecessary and avoidable mastectomies and it is not being used as a routine preoperative investigation (magnetic resonance imaging in the preoperative evaluation of breast cancer patients and diagnostic value of nineteen different imaging methods for patients with breast cancer: A network meta-analysis) (8-11).

Concerning the improvement of diagnostic and therapeutic approaches and surgical outcomes in Iranian patients with BC, we aimed at determining the frequency distribution of preoperative MRI (pMRI) findings in patients with BC and evaluating the impact of pMRI on changes in surgical treatment plan (from breast conservative surgery (BCS) to modified radical mastectomy (MRM)) for those patients. Findings will be helpful in choosing the appropriate preoperative imaging for patients with BC.

2. Methods

It is a cross sectional descriptive observation on 98 eligible patients, whose BC was pathologically confirmed in an educational hospital in Tehran from January 2014 to December 2015. Routine mammographic and ultrasonographic investigation were performed for all patients. In all cases, an expert pathologist spotted the diagnosis of BC and its type through examination of breast tissue specimens provided by an experienced surgeon, using Tru-Cut biopsy. Between the date of BC suspicion and the date of surgery, patients were undergone preoperative T2 weighted MRI of both breasts by a blinded radiologist, using 1.5 Tesla MRI scan before and after injection of 0.2 mL/kg Gadolinium. Suspicious or complicated pMRI scans were examined by a second radiologist.

During medical records review, data pertaining age, type of BC (invasive ductal carcinoma (IDC), ductal carcinoma in situ (DCIS), Other), preoperative imaging (size of lesion, multifocality, laterality, lymph node involvement), and surgical approach (initial and alternative) were gathered, using MS Office Excel (Microsoft, Redmond, USA).

We used descriptive statistics, including frequency distribution, mean, and standard deviation to report the findings. Kappa measurement was calculated to assess the agreement between pMRI, ultrasonography, and mammography. Independent *t*-test was used to compare the continuous variables (age, lesion count, and size) between patients, whose surgical plan altered and patients whose not. Comparing the plan alteration rate in categorical variables, we used Chi-square and Fisher's exact tests. Type I error was considered 0.05. All analyses were conducted, using SPSS V. 22 (IBM Corp., Armonk, USA).

2.1. Ethical Considerations

All identity revealing information is kept encoded and secure. No harms were imposed to subjects. Researchers in this project are committed to the principles of the Declaration of Helsinki and have no conflict of interest. The ethical approval for the study was obtained from the Institutional Review Board at Shahid Beheshti University of Medical Sciences IR.SBMU.MSP.REC.1394.104.

3. Results

We studied 98 Iranian female patients with mean age (± standard deviation) of 45.56 (± 11.28) years, who had breast lesions with an average count of 1.47 (± 0.90) and the average size of 31.71 mm (± 20.94). According to pathological findings, 91 patients (92.86%) had IDC, 5 (5.10%) had DCIS, and 2 (2.04%) had other pathological types of BC.

Preoperative mammography revealed mass in 93.88% of the subjects (count = 92). pMRI detected multifocal (28 patients, 28.57%) and bilateral (6 patients, 6.12%) breast lesions more than routine ultrasonography (count = 8, 8.16% and = 1, 1.02%, respectively) and mammography (count = 4, 4.08% and = 1, 1.02%, respectively). The agreement between pMRI and ultrasonography or mammography on detection of bilateral breast lesions (with ultrasonography and with mammography: Kappa = 27.3%, P = 0.061) and on diagnosis of multifocal ones (with ultrasonography: Kappa = 30.0%, P = 0.002; with mammography: Kappa = 19.2%, P = 0.006) was weak.

As demonstrated in Figure 1, contrast imaging showed enhancement in 37 subjects (37.75%) and the most common enhancement pattern (count = 31, 31.63%) was type III (washout) curve. In addition, pMRI showed lymph node involvement in 47 subjects (47.96%).

Regarding preoperative findings, initial surgical plan (BCS) of 23 patients (23.47%) was changed to MRM. Pathological diagnosis of BC did not seem to alter the surgical plan (P = 0.460) (Table 1). Independent *t*-test showed that patients, whose surgical plan was changed, were slightly significantly younger than ones, whose initial plan was not altered (40.90 ± 9.72 years vs. 46.34 ± 11.59 years, P = 0.049) and had more lesions (2.33 ± 1.39 vs. 1.24 ± 0.53, P = 0.002). Yet, the average size of lesions was not significantly different between two groups of patients (27.10 ± 10.86 mm vs. 32.93 ± 22.79 mm, P = 0.696).

As demonstrated in Table 2, enhancement curve pattern (P = 0.020) and multifocality (P < 0.001) of lesions

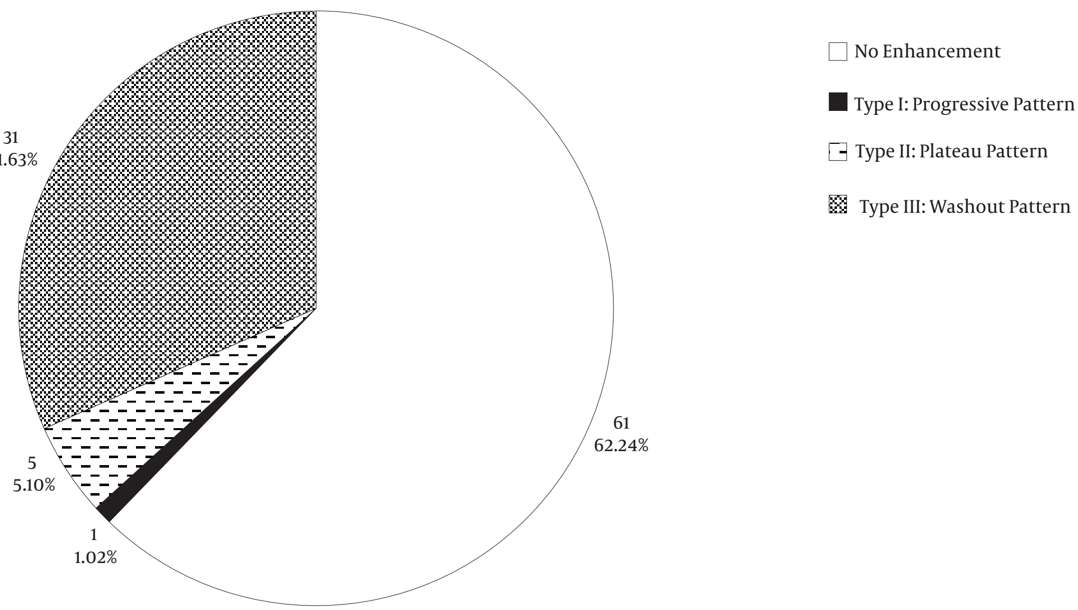

Figure 1. Preoperative contrast MRI enhancement curve pattern's frequency distribution in 98 women with breast cancer

Table 1. Comparison of Surgery Planning Change Rates in Different Subtypes of Breast Cancer in 98 Patients

	Pathological Type of Breast Cancer[a]			P Value[b]
	IDC	DCIS	Other	
Surgical Plan Changed				0.460
No (n = 75)	68 (74.72)	5 (100.0)	2 (100.0)	
Yes (n = 23)	23 (25.28)	0 (0.0)	0 (0.0)	
Total (n = 98)	91 (100.0)	5 (100.0)	2 (100.0)	

Abbreviations: DCIS, ductal carcinoma in situ; IDC, invasive ductal carcinoma.
[a]Values are expressed as No. (%).
[b]Chi-square and Fisher's exact tests.

in pMRI were associated with changes in surgical treatment plan, unlike laterality (P = 0.139) and involvement of lymph nodes (P = 0.094). Yet, neither ultrasonography nor mammography findings altered the plan, significantly (P > 0.050) (Table 3).

4. Discussion

The studied Iranian patients with BC had a mean age of 45.56 (± 11.28) years, so observed in similar studies (3-5). In line with other studies most subjects had IDC (92.86%) (4, 8, 10). In comparison with routine imaging, pMRI showed more multifocal and bilateral breast lesions. Although the strongest agreement was observed between pMRI and ultrasonography on the diagnosis of multifocal lesions (kappa = 30.0%), pMRI was weakly in agreement with ultrasonography or mammography on detection of breast lesions, so reported previous studies (12, 13).

The initial conservative surgical plan for treatment of BC was changed to MRM in 23.47%, so reported previous studies (14, 15). Subjects whose surgical plan altered were younger (P = 0.049) and had more breast lesions in pMRI (P = 0.002) compared with patients, whose plan was not changed. According to Gruber and colleagues' study, the histopathological subtype of BC should be considered for planning surgery, particularly for estimation of lesion size

Table 2. Comparison of Surgery Planning Change Rates According to Preoperative MRI Findings in 98 Patients with Breast Cancer[a]

Preoperative MRI Findings	Surgical Plan Changed		Total	P Value[b]
	No	Yes		
Enhancement curve pattern				0.020
No enhancement	52 (85.25)	9 (14.75)	61 (100.0)	
I[c]	1 (100.0)	0 (0.0)	1 (100.0)	
II[d]	4 (80.00)	1 (20.00)	5 (100.0)	
III[e]	18 (58.06)	13 (41.94)	31 (100.0)	
Multifocal lesion				< 0.001
Negative	64 (91.43)	6 (8.57)	70 (100.0)	
Positive	11 (39.29)	17 (60.71)	28 (100.0)	
Bilateral lesion				0.139
Negative	72 (78.26)	20 (21.74)	92 (100.0)	
Positive	3 (50.00)	3 (50.00)	6 (100.0)	
Lymph node involvement				0.094
Negative	43 (84.31)	8 (15.69)	51 (100.0)	
Positive	32 (68.08)	15 (31.92)	47 (100.0)	
Overall	75 (76.53)	23 (23.47)	98 (100.0)	

Abbreviation: MRI, magnetic resonance imaging.
[a]Values are expressed as No. (%).
[b]Chi-square and Fisher's exact tests.
[c]Progressive pattern.
[d]Plateau pattern.
[e]Washout pattern.

(10) while we found BC subtype not altering the surgical plan (P = 0.460). Despite our findings, a study concluded lymph node involvement can predict an MRI-triggered change in surgical plan (16).

In spite of prior studies concluding that including MRI in preoperative imaging is unnecessary for planning breast surgery (6, 9, 11, 17) and in line with the other ones, (12, 18-20) we found if pMRI is used based on rational necessity before operation, it can alter surgical plan, while routine ultrasonography and mammography did not seem to change the initial plan, significantly. If MRI is done without strict parameters, it will cause over diagnosis and over treatment (21). Plan alteration was more frequent in the presence of multifocal lesions compared with unifocal ones in pMRI (60.71% vs. 8.57%; P < 0.001) and in the presence of preoperative contrast MRI "washout" enhancement, a pattern is suggestive for malignancy (41.94%, P = 0.020).

4.1. Conclusions

pMRI findings may change the surgical treatment plan for about a quarter of women suffering from BC. If MRI is done without strict parameters, it will cause over diagnosis and over treatment (21), but we had already decided about method of treatment based on many factors and, then, we did MRI to confirm diagnosis. It means that MRI was not mere criterion for determining, and usage of it should be limited to necessary subjects. Multiple lesions and multifocal involvement showing preoperative contrast MRI enhancement pattern suggestive for malignancy (type III curve) can alter the surgical planning in younger women. Physicians and patients should consider these findings when making surgical decisions based on pMRI findings. Further longitudinal studies with larger sample size are required to corroborate these findings.

4.2. Limitations

Selection bias and data reliability were challenges in this study. Small sample size might limit the accuracy.

Table 3. Comparison of Surgery Planning Change Rates According to Routine Preoperative Mammography and Ultrasonography Findings in 98 Patients with Breast Cancer

Preoperative Imaging, Findings	Plan Change		Total	P Value[a]
	No	Yes		
Mammography				
Multifocal lesion				0.234
Negative	73 (77.66%)	21 (22.34%)	94 (100.0%)	
Positive	2 (50.0%)	2 (50.0%)	4 (100.0%)	
Bilateral lesion				0.765
Negative	74 (76.29%)	23 (23.71%)	97 (100.0%)	
Positive	1 (100.0%)	0 (0.0%)	1 (100.0%)	
Mass				0.139
Negative	3 (50.00%)	3 (50.00%)	6 (100.0%)	
Positive	72 (78.26%)	20 (21.74%)	92 (100.0%)	
Ultrasonography				
Multifocal lesion				0.676
Negative	68 (75.65%)	22 (24.45%)	90 (100.0%)	
Positive	7 (87.50%)	1 (12.50%)	8 (100.0%)	
Bilateral lesion				0.765
Negative	74 (76.29%)	23 (23.71%)	97 (100.0%)	
Positive	1 (100.0%)	0 (0.0%)	1 (100.0%)	
Overall	75 (76.53%)	23 (23.47%)	98 (100.0%)	

[a] Chi-square and Fisher's exact tests.

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Footnotes

Authors' Contribution: None declared.

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