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Role of Breast Magnetic Resonance Imaging in Early Stage Breast Cancer

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ABSTRACT

Background: globally, breast cancer is the most frequently diagnosed cancer and the leading cause of cancer death in women. The surgical management of patients with early stage operable breast cancer is the main step of treatment and addresses both the primary tumor and regional lymphatics.

Objectives: this study aims at highlighting the role of preoperative dynamic contrast enhanced breast MRI in early stage breast cancer and its impact on surgical management.

Patients and Methods: this study was carried out over the period from March 2015 to October 2017 in Radiodiagnosis Department of Mansoura University Hospitals and Nasser Institute. The study was conducted on 29 female their ages ranging from 30 to 59 years old the study was approved by our Institution's Ethics Committee, and all patients gave their informed consent before inclusion in the study.

Results: in our study, MRI was requested for different causes varying between dense breast which may obscure lesions (51.7%), multifocal lobular carcinoma (13.7%), exclude multicentric lesion (10. 3%) and in (24%) of patients MRI was requested as preoperative routine check. In our study, we found that in 10 patients (34.5%), MRI revealed additional lesions that were not seen on conventional imaging by mammography and ultrasound.Six lesions (20.7%) of those additional occult lesions were identified as malignant and all were ipsilateral. Our study reported that six patients (20. 7%) who had unsuspected abnormalities identified on MRI had changes in treatment based on MRI findings.

Conclusion: the results of this study confirm previous reports that preoperative MRI of the breast alters clinical management and detects otherwise occult carcinoma in a substantial number of patients with early breast cancer.

Keywords: Breast Magnetic Resonance Imaging, Early Stage Breast Cancer.

INTRODUCTION

Globally, breast cancer is the most frequently diagnosed cancer and the leading cause of cancer death in women [(1)]. In Egypt, according to the results of the National Population Based Cancer Registry Program, breast cancer is the most common female cancer. It comprised 32% of malignancies in female [(2)].

The surgical management of patients with early stage operable breast cancer is the main step of treatment and addresses both the primary tumor and regional lymphatics. The primary tumor may be managed by mastectomy or (lumpectomy with postoperative radiation therapy), and the nodal regions may be surgically addressed by lymph node dissection or sentinel node biopsy which mean either breast conservation therapy (lumpectomy and radiation therapy) or modified radical mastectomy [(3)].The major change in the surgical treatment of primary breast cancer has been the shift towards breast conservation treatment that started over 30 years ago [(4)].

Mammography remained the modality of choice as a primary imaging for surgical decision either breast conservation therapy (BCT) with breast conserving surgery (BCS) and definitive breast irradiation or mastectomy [(5)].

Breast magnetic resonance imaging (MRI) was shown to be a more sensitive preoperative staging technique for detecting invasive breast cancer than mammography and/or breast ultrasound [(6)].

Although there is no consensus on whether preoperative MRI in women with breast cancer (BC) benefits surgical treatment, MRI continues to be used preoperatively in practice [(7)].

The use of preoperative breast magnetic resonance imaging (MRI) in patients with breast cancer (BC) remains a controversial issue. Despite a decade of evidence suggesting a lack of clinical benefit, counterbalanced by evidence that MRI detects additional disease not seen with conventional imaging in the cancerous breast [(8)].

Also breast MRI may be able to better differentiate between dense breast tissue and actual breast cancers especially in young women compared to routine mammography and breast ultrasound based on the tumor enhancement characteristics [(9)].

In young women with breast cancer, breast MRI alters surgical management in a significant proportion of patients. Finally, multiple studies have advocated the use of preoperative MRI to detect occult multicentricity in the ipsilateral breast and occult cancer in the contralateral breast, although this could be helpful information for preoperative planning and staging, it simultaneously carries the risk of additional procedures, potentially increasing mastectomy rates [(10)].

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AIM OF THE WORK

The aim of the study is to evaluate impact of Magnetic resonance imaging on surgical decision in early stage breast cancer.

PATIENTS AND METHODS

Patients (Subjects):

This study was carried out over the period from March 2015 to October 2017 in Radiodiagnosis Department of Mansoura University Hospitals and Nasser Institute. The study was conducted on 29 female, their ages ranging from 30 to 59 years old.

The study was approved by our Institution's Ethics Committee, and all patients gave their informed consent before inclusion in the study.

Eligibility criteria

- Only female patients.
- Any age.
- Patients with histologically confirmed breast cancer.
- Stage 0, stage I and stage II disease.

Exclusion criteria included:

- Male patients.
- Patients with locally advanced disease or stage VI breast cancer.
- Any past history for breast surgery.
- Preoperative (Neoadjuvant) chemotherapy.

All patients underwent the following:

(1) ***Thorough history taking:***

- Onset, course and duration of the present illness.
- Past history of breast cancer.
- K2Family history of breast cancer.

(2) ***Clinical examination including:***

- Local breast examination.
- Axillary lymph nodes examination.

(3) Mammography, ultrasound and MRI examination

Each case was reviewed and the following data were registered in excel sheet followed by statistical analysis.

1. **Patient's data:**
   - Age.
   - Menopausal status.
   - Symptoms at presentation.
2. **Disease criteria:**
   - Surgical decision before and after breast MRI.
   - Surgical details.
   - Histopathology details:
     - Microscopic data.
     - Grade: grade one to three.
3. **Radiological Data:**
   - Details of preoperative mammography.
   - Details of preoperative U/S.
   - Details of preoperative breast MRI.

Methods:

(1) Mammography

Cranio-caudal (CC) and medio- lateral (ML) views were done for 29 patients ***(N=29),*** then these views were analyzed regarding the breast composition, masses, calcification, architectural distortion, asymmetries, intramammary LNS, skin lesion, solitary dilated duct, associated features (skin retraction, nipple retraction, skin thickening, trabecular thickening, axillary adenopathy, calcification and location of lesion (laterality, quadrant, depth, distance from nipple).

(2) Ultrasound

Breast ultrasound was done for all patients using high frequency probe (215 MHz) and we comment upon; tissue composition, masses (shape, orientation, margin, echo pattern, posterior features), calcification (in mass, outside mass, Intraductal), axillary LNs and associated features (architectural distortion, duct changes, edema, vascularity).

(3) MRI examination:

Bilateral breast examination was done for all patients using 1 5 T system (Siemens, Magnetom Symphony).

- ***Patients preparation:***

1- Before entering the examination room, the patient was instructed to remove all metallic objects and all clothes containing metal.

2- The patient was informed about the examination time and the value of remaining motionless during examination.

3- Insertion of intravenous line for contrast injection by mechanical injector, so that injection can be done without movement of the patient.

- ***Patient position:***

1. It is usually done in prone position to minimize motion artifact due to respiration.

2. The breast in the coil should be as deep and centered as possible with the nipple-facing straight down.

3. Light compression is applied from lateral and medial aspects of the breast for decreasing the motion blurring and other artifacts. However, strong compression can affect the kinetic of contrast within the tumor.

4. Patient raises her arms above her head and the head is turned to one side.

- ***Breast coils:*** Patients are supported above the table so that her breasts are pendent. The patient lies with her breasts in well so that the coil wraps around her breasts. Double breast coil is used to allow the assessment of breast symmetry as at mammography and allow the examination of both breasts together in half the time.

- **Image acquisition:**

A- Localizing sagittal protocol (scout view).

B- T1-weighted pulse sequence: Using FSE with the following imaging parameters: TR 512 ms, TE 8 ms, slice thickness 3 mm, field of view (FOV) 400-500 mm and matrix was 256× 256 to obtain axial non-fat saturated T1WI.

C- Short T1 inversion recovery (STIR): The following parameters: TR 4000 ms, TE 70 ms and inversion time (TI) was 175 ms, slice thickness was 3 mm with inter slice gap 1mm, field of view (FOV) 400-500 mm and the matrix was 256×256 were used to obtain STIR images .

D- T2-weighted pulse sequence: Using FSE with the following imaging parameters TR 2000 ms, TE 8 ms, slice thickness 80 mm, field of view (FOV) 400-500 mm and matrix was 256× 256, filp angel 90 degree to obtain axial non-fat saturated T2WI.

- **For dynamic MRI**
- **Kinetic curves**
- **Image post-processing*:***

A- Image subtraction.

B- Maximum intensity projection (MIP).

C- Morphological analysis:

- **Mass**
- **Non-mass enhancement**
- **Distribution**
- **Internal enhancement pattern**
- **Focus**

Statistical methods

Data management and statistical analysis was performed using Statistical Package for Social Sciences (SPSS) vs P-values < 0 05 was considered significant. Data were presented as number and percentage.

RESULTS

Table (1): Patient characteristics

Variable	Grouping	
Age	Group I: 30-39 Group II: 40-49 Group III: 50-59 Mean age Median Range	7 (24%) 9 (31%) 13 (45%) 45 .83 45 (30-57)
Menopausal Status	Pre menopausal Peri menopausal Post menopausal	16 (55%) 6 (21%) 7 (24%)
Side	Rt breast Lt breast	12 (41%) 17 (59%)

Table (2): Histopathologic diagnosis of the index lesions (n=29)

	Number of lesions	%
Tumor type (N=29)		
- DCIS	3	10. 3%
- Invasive ductal	23	79. 4%
- Invasive lobular	3	10. 3%
Pt stage (N=29)		
- PT_{is}	3	10. 3%
- PT_1	2	6. 9%
- PT_2	21	72. 4%
- PT_3	3	10. 3%
Grading (N=29)		
- I	3	10. 3%
- II	15	51. 8%
- III	11	37. 9%

The sample included 3 types of index lesions: ductal carcinoma in situ, invasive lobular and the majority was invasive ductal (79%) The patients were classified based on grading from GI to GIII and PT staging from PT_{is} to PT_3 In 28 of the 29 patients (96 5%), we classified the primary tumor correctly according to the definite pathologic diagnosis based on MRI findings.

Table (3): Histopathologic characteristics of malignant and benign tumors detected by MRI

Malignant	DCIS	1	3. 4%
	Invasive ductal	4	13 8%
	Invasive lobular	1	3. 4%
	Total	6	20. 7%
Benign	Fibro adenoma	2	6. 9%
	Fibrocystic ds	1[a]	3. 4%
	Fibro adenosis	1	3. 4%
	Total	**4[a]**	13. 8%

a: one patient with bilateral additional benign lesions

Table (4): Extent and histopathologic characteristics of the five additional MRI detected tumors with corresponding index lesions

Age (year)	**Histopathologic diagnosis of indexed lesion**	**Histopathologic diagnosis of additional lesion**	**Ipsilateral/ contralateral**
35	IDC	IDC (32mm) +IDC (10mm)	Ipsilateral
35	IDC	IDC (43mm)	Ipsilateral
44	IDC	IDC (multiple < 17mm)	Ipsilateral
49	No index lesions (both mammogram and U S were free)	DCIS (85mm)	Ipsilateral
44	IDC	IDC	Ipsilateral
37	ILC	ILC	Ipsilateral

Table (5): The impact of preoperative breast MRI on surgical management

No Impact		**22/29**	**75. 9%**
With Impact	Positive impact	5/29	17. 2%
	Negative impact	2/29	6 .9%

No impact in 22 patients (75. 9%) (group 1), with impact in 7 patients (24. 1%) (group2); positive impact in 5 patients (17. 2%) and negative impact in 2 patients (6. 9%) .

DISCUSSION

This retrospective study was done to evaluate the role of preoperative breast MRI in early stage breast cancer and its impact on surgical management.

For patients with newly diagnosed breast cancer, MRI is more accurate for determining true tumor size and extent compared with mammography and ultrasound. MRI depicts additional areas of malignancy that are occult with other imaging techniques [(11)].

National and international guidelines as well as the European society of breast cancer specialists (EUSOMA) recommended the use of preoperative MRI for selected patients with primary breast cancer (multifocal disease, lobular carcinoma, high breast density, large DCIS, and occult primary tumor [(12)].

In our study, MRI was requested for different causes varying between dense breast which may obscure lesions (51. 7%), multifocal lobular carcinoma (13. 7%), exclude multicentric lesion (10. 3%) and in (24%) of patients MRI was requested as preoperative routine check.

In our study, we found that in 10 patients (34. 5%), MRI revealed additional lesions that were not seen on conventional imaging by mammography and ultrasound. This rate is higher than the rate of (31. 2%) reported by ***Manuel et al.*** [(12)].

Six lesions (20. 7%) of those additional occult lesions were identified as malignant. .This rate is matching with the rate of 20. 2% reported by ***Manuel et al.*** [(12)].

The six malignant lesions were ipsilateral to the index lesion with a rate of (20. 7%) This result is matching with other studies and provide support for the use of preoperative screening breast MRI outside the investigational settings. These studies reported that the rate of detection of additional ipsilateral malignant tumors have ranged between (6% and 27%) [(13, 14)].

Without the use of MRI, these additional lesions would have been left undetected resulting in six unresected lesions (20. 7%).

Detection of additional disease by preoperative breast MRI is clinically important only if it is translated into improved outcomes, including decreased rates of reexcision and ipsilateral tumor recurrence and an increased disease –free survival rate [(11)].

Detection of additional occult tumor foci may influence the therapeutic strategy by performing wider excisions, mastectomies instead of breast conserving therapy in cases of multicentric disease or excision of lesions in contralateral breast. The goal of the planned surgery is to achieve tumor free margins after surgery. It is matter of fact that spread of invasive tumor occurs also in some distance from the index tumor, and remaining tumor cells may develop into recurrent disease with unfavorable prognosis [(12)].

A metanalysis by ***Clarke et al.*** [(15)] demonstrated that for every four avoided local recurrences, about one breast cancer death over the next 15 years might be prevented (the 4-to-1 rule). Assuming, six patients of our study populations (20. 7%) might have been spared a recurrence preventing approximately one patient (5. 2%) from breast cancer related death, thus precise planning of surgery and accurate removal of tumor foci is of outmost importance.

Our study reported that patients who had unsuspected abnormalities identified on MRI had changes in treatment based on MRI findings with a rate of (20. 7%). These findings matched with the studies of ***Schelfout et al.*** [(16)] that reported changes in treatment based on MRI findings in (11-31%), but higher than the rate of (9. 1%) reported by ***Meagan et al.*** [(17)].

In our study, the surgical decision changed from conservative surgery to mastectomy in 5 patients (17. 2%) and wider excision in one patient (3. 4%) with the evidence of multicentricity, multifocality or the evidence of wide extent of disease detected by preoperative MRI.

Our study demonstrated a significant yield of additional malignant findings in patients with invasive ductal histologic subtypes with a rate of (13. 8%) followed by DCIS and invasive lobular histologic subtypes (each 3. 4%) resulting in changing the surgical management in those patients to mastectomy or wider excision based on MRI findings .

Other studies reported the potential benefit of MRI in patients with invasive lobular histologic subtypes ***Manuel et al.*** [(12)] reported a significant yield of additional malignant findings in patients with invasive lobular carcinoma . These data are not in agreement with our study. In our study, MRI was of no benefit for patients with invasive lobular carcinoma (n=3) (10. 3%).

Among 3 patients with ILC in our study, MRI was equal to mammography with no change in surgical management in two patients, while detected multifocality in one patient leading to conversion to wider excision, however that change was unfavorable for the patient as MRI underestimated the index lesion so, the surgeon performed only WLE based on MRI findings, but the final pathology revealed positive margins for malignancy (ILC and LCIS) prompting the surgeon to do reexcision of the lesion and perform post- WLE mastectomy. The residual resected mass was measuring about 7 cm.

CONCLUSION

The results of this study confirm previous reports that preoperative MRI of the breast alters clinical management and detects otherwise occult carcinoma in a substantial number of patients with early breast cancer.

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