The Impact of Breast Magnetic Resonance Imaging (MRI) On the Therapeutic Planning in Women Newly Diagnosed with Breast Cancer

Hesham E. Elsheikh [a], Gamal E. Saleh [b]. Shorouk Z. Abdel Aziz [a], Asmaa M. Abdel Samad [a]

[a] Department of Radiology, Faculty of Medicine, Benha University, Egypt.
[b] Department of General Surgery, Faculty of Medicine Benha University, Egypt.

Correspondence to: Eman Ibrahim, Department of Radiology, Faculty of Medicine Benha University, Egypt.

Email:

asmaa_saso19@yahoo.com

Received: 21 October 2019

Accepted: 25 March 2021

Abstract:

Objective: to determine the effect of preoperative MRI on the treatment plan in women newly diagnosed with breast cancer. **Subjects:** the study included 40 patients newly diagnosed with breast cancer that did not have any type of treatment or underwent any type of operation. **Methods:** This prospective controlled study included 40 patients newly diagnosed with breast cancer who did not receive any type of treatment or underwent any type of operation the plan of the therapy was compared before and after MRI examination to document the impact of MRI on the plan of therapy. **Results:** Only 10 patients of the included cases had the therapeutic plan significantly changed after MRI examination while the other 30 patients had the same therapeutic plan pre and post MRI examination. **Conclusion:** Breast MRI proved to be the best imaging modality for pre-operative evaluation of breast cancer for proper determination of the therapeutic plan in patients newly diagnosed with breast cancer.

Key words: breast cancer; MRI; therapeutic plan.

Introduction:

Breast cancer is the most common cancer among women in Arab countries with 50 years or even younger age at presentation. Locally advanced disease is very common and modified radical mastectomy is the most commonly performed surgery. Breast MRI can alter treatment planning for many patients with newly diagnosed breast cancer (*1*).

MRI represents a highly sensitive diagnostic method with the ability to detect small tumors in dense breasts (*2*). It can

demonstrate the extension of the disease by estimating both the in-situ and invasive components of the disease [(3)]. It can detect multifocality and occult contralateral breast cancer as well [(2)].

Although breast MRI is not a standard diagnostic tool in primary breast cancer staging but it can serve as a complement workup of complex cases with inconclusive mammography and ultrasonography, MRI is also an adjunct in evaluating neo-adjuvant treatment response [(4)]**.** The use of magnetic contrast agent is helpful in the evaluation of the breast lesions depending on the analysis of the uptake, and pattern of enhancement [(5)].

Because of this greater accuracy, it is expected that breast MRI would increase the rates of complete resection, reduce the number of reoperations, and improve the prognosis for such patients [(6)].

Although MRI has distinct advantages over mammography, it also has potential limitations, for example, false positive findings can pose a significant problem in the interpretation of breast MRI. The role of false positives varies generally in the literature as the reported specificity ranges from 37% to 100%, another disadvantage is that it has historically been unable to identify calcifications or tiny calcium deposits that can indicate breast cancer [(7)]**.**

Subjects and methods

Patients:

This prospective controlled study was conducted in the period between January 2018 and June 2019 at the radiology department, Benha University with approval of the ethical committee of the institute. It included 40 patients. Their ages ranged from 36-70 years

Inclusion criteria:

- Female patients newly diagnosed with suspicious breast mass.
- Histopathologically proven breast cancer.
- Revised treatment planning pre & post MRI examination.
- Patients who did not receive any type of treatment for breast cancer surgical or medical.

Exclusion criteria:

1. Patients with contraindication of MRI examination such as
   - Metallic implants as orthopedic patients non MRI compatible.
   - Patients with cardiac pace makers.
   - Inability to lie prone.
   - Extremely large breasts.

- Claustrophobia.

2. Patients with contraindication for contrast injection such as
   - Previous severe allergic reaction to contrast.
   - Patients with severe renal disease (GFR less than 30 ml /min/1.73m2) or acutely deteriorating renal function.
   - Pregnancy.
3. Patients refused to do MRI.
4. Patients not histopathologically proven as breast cancer.
5. Patients underwent any type of treatment for breast cancer.

Methodology:

We assessed all the patients who had been diagnosed with breast cancer and undergone MRI for determination of preoperative treatment planning at our hospital.

All the cases underwent breast MRI on a 1.5 tesla MRI(Siemens area MRI device).The conventional breast MRI protocol was performed using a standard breast coil in prone position .The field of view was 300mm, pre contrast and dynamic post contrast images were obtained .

A T1- weighted fast low angel shot (FLASH) three-dimensional sequence was performed. Vascular access was obtained with antecubital needle for the administration of the contrast material. In the dynamic study, a T1 weighted 3D fast low angel shot (FLASH) sequence was performed following the contrast injection.

The image sequence was repeated six times with 60 seconds interval, and the images were obtained in the axial plane. The contrast material such as gadolinium, was injected intravenous at a dose of 0.1mmol/kg.

For the dynamic images, a standard subtraction program was performed by subtracting the pre-contrast images from the post-contrast images on a pixel basis. Subtracted series aided in the visualization of the contrast enhanced images. The images had be transferred to a workstation, and the time signal intensity curves of the lesion were drawn from the dynamic contrast enhanced images. After image processing, the MRI examinations were evaluated with respect to the patients' histories and prior studies as mammography and ultrasonography, using the BIRADS (breast imaging and reporting data system) recommended by the American college of radiology.

Statistical analysis:

The collected data was analyzed using SPSS software. Categorical data was expressed as number and percentage while continuous data was expressed as mean + SD. Suitable statistical tests of significance were calculated**. P** value less than 0.05 were considered significant.

Results:

This study was conducted in radiology department in Banha university hospital on 40 females with newly diagnosed breast cancer who will undergo breast MRI.

Mean age of the study population was 52 years with standard deviation of ±8 years. 50% of patients had right sided lesions and 50% had left sided lesions. 40% of patients had multicentric lesions while both unifocal and multifocal lesions represented 30% for each (Table 1).

The most frequent site affected was upper outer quadrant (65.0%) followed by retro areolar (30.0%). MRI showed new findings that were not seen by mammogram in 45.0% of patients (Table 2). Mammography showed mass in 65.0% of patients. Micro calcifications were found in 15.0% of patients (table 3). Mammography detected lymph nodes in only 5.0% of patients. Ultrasound detected lymph nodes in 60.0% of patients while MRI detected lymph nodes in 75.0% of patients (Tables 4,5). Therapy plan was changed in 25.0% of patients (table 6, fig.1)

Enhancement showed borderline significant association with therapy change (P value = 0.054). Mass enhancement was borderline significantly higher in patients changed therapy (80.0%) compared to patients with no therapy change (25.0%) (Table 7).

Table (1) General characteristics in the whole study population

General characteristics		
Age	Mean ±SD	52 ±8
Side	Right n (%)	20 (50.0)
	Left n (%)	20 (50.0)
Number of lesions	Unifocal n (%)	12 (30.0)
	Multifocal n (%)	12 (30.0)
	Multicentric n (%)	16 (40.0)

Table (2) Distribution of site affected

	n (%)
Upper outer quadrant	26 (65.0)
Upper inner quadrant	8 (20.0)
Lower outer quadrant	8 (20.0)
Lower inner quadrant	2 (5.0)
Retro areolar	12 (30.0)
Central	8 (20.0)

Table (3) Distribution of mammography findings

	n (%)
Mass	26 (65.0)
Micro-calcification	6 (15.0)
Others	10 (25.0)

Table (4) Distribution of MRI findings

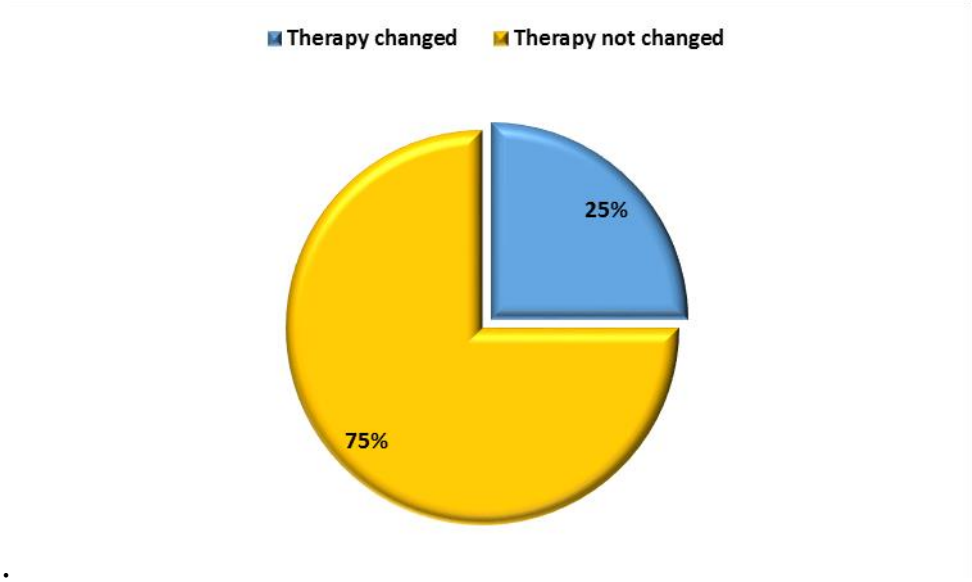
		n (%)
Enhancement	Mass	26 (65.0)
	Non mass	12 (30.0)
	Mass and non-mass	2 (5.0)
Kinetic curve	I	2 (5.0)
	II	12 (30.0)
	III	10 (25.0)
	II & III	16 (40.0)
New findings by MRI	Yes	18 (45.0)

Table (5) Lymph node detection by different modalities

	n (%)
LN detected by mammography	2 (5.0)
LN detected by ultrasound	24 (60.0)
LN detected by MRI	30 (75.0)

Table (6) Therapy change in the whole study population

	n (%)
Therapy changed	10 (25.0)



.

Figure (1) Therapy change after MRI

Table (7) Association between MRI findings and therapy change in patients with new findings

		Therapy changed				
		Yes (n = 10)		No (n = 8)		
		N	%	N	%	P value
LNs	Yes	8	80.0	8	100.0	0.477
Enhancement	Mass	8	80.0	2	25.0	0.054
	Non mass	2	20.0	6	75.0	
Kinetic curve II	Yes	4	40.0	4	50.0	1.0
Kinetic curve III	Yes	4	40.0	2	25.0	0.638

Data management and statistical analysis were done using SPSS vs.25. (IBM, Armonk, New York, United states).

Numerical data was summarized as means and standard deviations. Categorical data was summarized as numbers and percentages.

Performance of MRI in detection of LNs was compared to performance of mammography and ultrasound using McNemar test.

MRI findings were compared as regard therapy change using Fisher's exact test.

All P values were two sided. P values less than 0.05 were considered significant.

Case presentation:

Sixty years old female patients with multicentric breast cancer came for preoperative MRI evaluation.

U/S & mammography showed: Left breast showed multiple lesions of mixed density occupying upper & lower outer quadrants corresponding by ultrasound to multiple small well defined hypoechoic lesions seen at 5 o'clock, 1 o'clock & axillary tail. Right breast showed few sub-centimetric cysts the largest seen at 10 o'clock measuring (0.5x0.6cm).

Preoperative MRI showed: Left breast showed multiple speculated heterogeneously enhancing lesions with non-enhancing areas of breaking down seen in the retro areolar, upper outer, lower outer and axilla with intra-ductal extension, skin, nipple and areola invasion. On plotting time intensity curves, they showed type 2/3 curves (plateau/washout curves). Right breast showed an irregular shaped small enhancing mass lesion measuring about 1 cm seen at 10-11 o'clock on plotting time intensity curve it showed type 3washout curve.

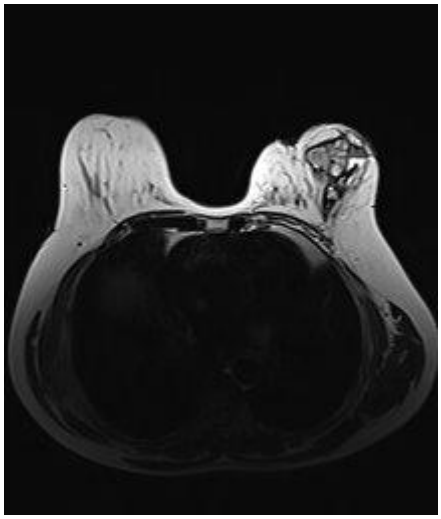


Figure (2): MRI T2 showing heterogenous left sided multicenteric lesion with nipple & skin infiltration.

Figure (3): DCE – MRI showing left multicentric lesion with heterogeneous contrast uptake

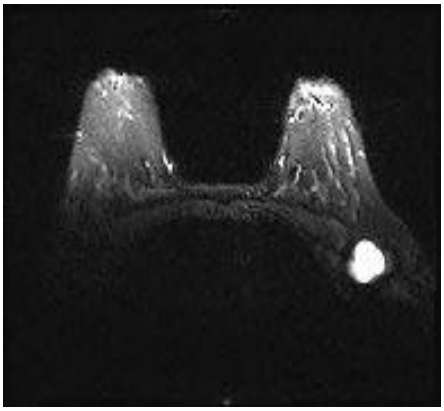


Figure (4): MRI diffusion showing metastatic axillary lymph node.

Treatment plan before MRI: Left MRM with POCT and hormonal treatment.

Treatment plan after MRI: Left MRM, right BCS with POCT, hormonal therapy and right PORT.

Discussion:

Breast cancer is one of the most common leading causes of women deaths all over the world especially over 40 years. Mammography is still the standard breast imaging modality while MRI is not used as a routine examination for breast imaging it can exploit the difference in vascular supply between normal and neoplastic tissue to visualize cancer through gadolinium-based contrast administration, the fact that make

MRI more accurate and that helpful in the management plan[8,9,10].

A study which was conducted in 2018, and included 98 Iranian females with mean age 45.56 (±11.28SD) years, who had breast cancer, their diagnostic sono-mammography revealed unilateral malignant mass in 93.88%. The MRI discovered concurrent bilateral disease in 6.12% of patients where they showed kinetic curve was type III (wash out curve) as the most common type. MRI showed lymph nodes involvement in 47.95% of patients [11].

In our study, we included 40 Egyptian women with their mean age 52 (±8 SD) years. Primitive sono-mammography revealed unilateral malignant mass in 90%of cases while MRI detected contralateral associated disease in 10% and showed kinetic curves both type II and III (plateau and wash out curves) as the most common types of time intensity curves in (40%). MRI showed lymph node involvement in 75% of patients.

The study conducted in 2014 showed new findings by MRI not seen by sono-mammography in 38% of patients. However in our study, breast MRI showed additional findings not seen in sono-mammography in 45% of patients [2].

In the study conducted in 2014 pretreatment MRI depicted contralateral cancer not seen sono-mammographically in five of 174 (3%), while our study depicted contralateral breast cancer in 4 of 40 (10%) [12].

Another large study from 2007-revealed additional occult disease in the contralateral breast in 3% of patients newly diagnosed with breast cancer that underwent preoperative MRI [13].

According to the research done in 2009, MRI detected additional suspicious lesions in approximately 19% of cases, with synchronous contralateral breast malignancy in approximately 4% of cases [13].

Our study showed significant therapeutic plan changes in 25% of patients after MRI examination compared to the initial plan designed according to sono-mammographic findings only.

In the other study done previously in 2005, the therapeutic plan was changed in 25.0% of patients of the whole study population [14].

Another study performed in 2014, claimed that patients primarily scheduled for BCS (breast conserving surgery) showed significantly higher rate of conversion to MRM (modified radical mastectomy) as final treatment after MRI examination [2].

Regarding preoperative findings it was proved that the initial surgical plan for BCS was changed to MRM in 23 (23.47%) of the patients [(11)].

These different percentages between our study and others may be due to our smaller sample size compared to others; however, they are still compatible to each other, concluding that, in spite of prior studies said that including MRI in the preoperative imaging is un-necessary for planning breast surgery [(13)].

We found that pre-treatment MRI if used based on rational necessity before operation, can alter the entire therapeutic plan compared to routine sonography and mammography [(11)].

Conclusion:

Breast MRI proved to be the best study for breast cancer accurate management planning**.**

References:

1. **Kelli P, swatske ME and Gao F:** The impact of MRI on surgical decision making. 2014 journal of surgical oncology.2009Dec 1; 100(7):553-8.
2. **Virginia G, Sandelin K, Aberg W , Anders Karlsson, Wiveca A ˚berg, Lars L, Gabriela I, Staffan E and Brita A**: preoperative MRI of the breast influences the primary treatment. World J surg. 2014 Jul;38(7):1685-93**.**
3. **Luciana K, Lira F, Almir G Vieira B T, Cynthia A, Bueno d.T, , Luciana G, Camila S.G., Juliana A. S & Elvira F. M:** Tumor size assessment of invasive breast cancers :which pathological feature affect MRI-pathology agreement?. Applied Cancer Research **volume 38**, Article number: 2 (2018) 0055-y.
4. **Atkins JJ, Fisher CS, Appleton CM, Feng G and Julie A.M:** Which imaging modality is superior for prediction of response to neoadjuvant chemotherapy in patients with triple negative breast cancer ? J oncology 2013:964863/2013**.**
5. **Nouha Salibi, Marianne Vorbuchner and Jan Ruff:** MR Spectroscopy of the Breast at 1.5T and at 3T, American Journal of Roentgenology 07.3521 magneton flash 1/2006
6. **Trunbull L, Brown S and Harvey I** (2010) comparative effectiveness of MRI in breast cancer (COMICE) trial: a randomized controlled trial. Lancet 375:563-571.
7. **Elizabeth A. Morris:** Review of breast MRI : indications and limitations, department of radiology, Weil medical college of Cornell University, seminars in Roentgenology, volume 36, issue 3, July 2001, 226-237.
8. **Lobbes MB, Lalji UC, Nelemans PJ, Houben I, Smidt ML, Heuts E, de Vries B, Wildberger JE and Beets-Tan RG.** The quality of tumor size assessment by contrast-enhanced spectral mammography and the benefit of additional breast MRI. *J Cancer*. 2015 Jan 5;6(2):144-50.
9. **Lourenco AP and Mainiero MP** Incorporating imaging into the locoregional management of breast cancer**.** *Semin Radiat Oncol.* 2016 Jan; 26(1):17-24.

10. **Yang T, Liang H, Chouc C Huang J and Pan H .**Adjunctive Digital Breast Tomosynthesis in Diagnosis of Breast Cancer. *Biomed Res Int.* 2013; 2013: 597253.
11. **Sara besharat, Mojgan Kalantary, Azadeh Julaee and Nasser Malekpour.** Influence of preoperative magnetic resonance imaging in surgical planning for breast cancer. Cancer manag.2018 December ;11(12):e81459.
12. **Sujata patil, Elizabeth Morris, Kimberly van zee**. Preoperative breast MRI for early stage breast cancer: effect on surgical and long term outcomes. American journal of roentgen ology. June 2014 :10.2214 13.11.355
13. **Houssami N, Hayes DF.** Review of preoperative magnetic resonance imaging (MRI) in breast cancer: should MRI be performed for all women with newly diagnosed early stage breast cancer ? CA cancer J clin 2009;59(5):290-302.
14. **Lehman C.D., Blume Jd, and Thickman D**. Screening women at high risk for breast cancer with mammography and magnetic resonance imaging. cancer . 2005 May 1;103(9):1898-905.

To cite this article: Hesham E. Elsheikh, Gamal E. Saleh, Shorouk Z. Abdel Aziz, Asmaa M. Abdel Samad. The Impact of Breast Magnetic Resonance Imaging (MRI) On the Therapeutic Planning in Women Newly Diagnosed with Breast Cancer. BMFJ 2022; 39 (Radiology):315-325. DOI: 10.21608/bmfj.2022.18520.1120