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ORIGINAL ARTICLE

Role of dynamic contrast enhanced MRI in evaluation of post-operative breast lesions

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KEYWORDS

DCE-MRI;
Post-operative;
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Abstract *Purpose:* To evaluate the role of dynamic contrast enhanced magnetic resonance imaging in differentiation between benign postoperative changes and recurrent malignant tumor.
Patients & methods: This study was performed during the time from August 2014 till August 2015. Enrolled in this study were 50 female patients and all of them were breast cancer patients that had been candidates for breast conserving surgery, modified radical mastectomy and reconstructive surgery using autologous tissue reconstruction; DCE-MRI was done for all patients.
Results: In this study, 12 patients (24%) were with recurrent malignant tumor, 7 patients (14%) with postoperative fat necrosis, 10 patients (20%) with postoperative seroma, 10 patients (20%) with diffuse skin thickening and edema, and 6 patients (12%) with postoperative scar tissue; the remaining 5 patients (10%) were normal. Dynamic contrast enhanced MRI has sensitivity of 85.7%, specificity of 100%, PPV of 100%, NPV of 93.3% and accuracy of 95.6% in differentiation between benign postoperative changes and recurrent malignant tumors.

1. Introduction

Preventing local recurrence in women who undergo breast conserving therapy or mastectomy is important because local recurrence is associated with increased cost, psychological distress, and potentially worse prognosis of the disease (1).

Presence of cancer cells in the vicinity of the primary tumor after resection in period between 3 and 12 months is more likely a residual tumor. Most doctors consider cancer to be recurrence if there were no signs of cancer for at least 2 years (2).

Architectural distortion and increased density at the lumpectomy site as well as post-treatment edema may impair accurate detection of recurrence at mammography and ultrasonography (US) (3).

Dynamic contrast-enhanced magnetic resonance imaging (DCE-MR) has been shown to aid significantly in detection and characterization of primary and recurrent breast cancers (4). The most important factor is that MRI can assess both lesion morphology and enhancement kinetics (5).

The sensitivity of breast MR imaging for detection of residual and recurrent tumor in the post-breast conservative therapy (BCT) is over 90% (6). Breast MR imaging has been

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shown to be useful in differentiating scar tissue from tumor recurrence; in particular, non-enhancing areas have a high negative predictive value for malignancy (88–96%) (7,8).

The aim of the study was to evaluate the role of dynamic contrast enhanced magnetic resonance imaging in differentiation between benign postoperative changes and recurrent malignant tumors.

2. Patients & methods

This study was performed during the time from August 2013 till August 2015. Enrolled in this study were 50 female patients who underwent prior surgery for malignant breast lesions and are suspected to have local regional recurrence. 25 patients underwent breast conserving surgery (lumpectomy versus quadrantectomy), 12 patients underwent modified radical mastectomy and 13 patients underwent reconstructive surgery using autologous tissue reconstruction.

Their age range was 30–70 years with a mean age of 50.98 years. The indication for referral to our MRI unit in Mansoura university hospital was diffuse breast enlargement in 15 patients, palpable lump in 24 patients, and routine post-operative follow-up (6 months up to 2 years post-surgery) in 11 patients.

Exclusion criteria were as follows:

Patients who have contraindications to do MRI as patients with cardiac pacemaker, and patients with cochlear implant and ocular foreign body.

3. Methods

All patients underwent full history taking, general and local examination.

3.1. Mammography and complementary ultrasound examination

Mammography was performed for 38 patients, including both Cranio caudal (CC) and medio lateral (ML) views. Cases with modified radical mastectomy could not handle breast compression elicited during mammography examination.

High resolution conventional ultrasound was performed for 50 patients by 8–12 MHz linear array transducer.

3.2. MR imaging

In 50 patients, MRI of the breast was performed on superconducting 1.5 T MR imaging unit (Philips Ingenia). All patients were examined in the prone position using dedicated breast coil.

4. MRI protocol

The following protocol was applied for all patients.

A. Localizing sagittal protocol (scout view)
B. T1-weighted pulse sequence

Axial non-fat saturated TIWI was obtained by FSE with the following imaging parameters: TR 450 ms, TE 14 ms, slice thickness 3 mm, field of view (FOV) 300–360 mm and matrix was 307 × 512.

C. T2-weighted pulse sequence

Axial non-fat-suppressed T2-weighted turbo spin-echo was obtained with the following parameters TR 4500, TE 97, matrix 384 × 512 and slice thickness 3 mm.

D. Short TI inversion recovery (STIR)

Axial STIR was obtained with the following parameters: TR 7000–9000 ms, TE 70 ms and inversion time (TI) was 150 ms, slice thickness was 3–4 mm with inter-slice gap 1 mm, field of view (FOV) 300–360 mm and the matrix was 307 × 512.

E. Dynamic study

All dynamic studies were made in the axial plane with fat suppression by applying fat saturated pulse. The sequence used was FLASH 3-D GRE-T1WI with the following parameters: TR 4–8 ms, TE 2 ms, flip angle 20–25°, slice thickness 2 mm with no inter-slice gap, FOV 300–360 mm and the matrix was 307 × 512. Dynamic contrast enhanced MRI was performed after injection of a bolus of gadopentetate dimeglumine, in a dose of 0.2 m-mol/kg using an automated injector at a rate of 3–5 ml/s through a 18–20 gauge intravenous cannula inserted in an ante-cubital vein. This was followed by a bolus injection of saline (total of 20 ml at 3–5 ml/s).

Dynamic study consists of one pre-contrast and 5 post-contrast series, each of them took about 1.16 min with a break between the pre-contrast and post-contrast study about 20 s.

5. Image post-processing

Image post-processing includes image subtraction which was obtained by subtracting each of the pre-contrast images from each post-contrast series images, creation of time to signal intensity curve for suspicious enhancing lesions and maximum intensity projection (MIP) views obtained through each orthogonal plane, producing sagittal, coronal and axial projection.

5.1. Image analysis

STIR images were first examined to detect edema, postoperative seroma and hematoma. T1WI was also examined to detect fat within the lesion.

6. Morphological analysis

Lesions were classified as a mass, an area of non-mass-like enhancement or a focus.

6.1. Mass

A mass is a three-dimensional, space-occupying lesion. It is usually visible on pre-contrast T1 or T2 weighted images.

Masses were described in terms of shape, margin, and internal enhancement characteristics.

6.2. Non-mass-like enhancement

Non-mass-like enhancement refers to enhancement of an area that was neither a mass nor a focus. Non-mass-like enhancement was categorized by distribution, internal enhancement pattern, and symmetric or asymmetric enhancement.

7. Analysis of enhancement kinetics

Considering the contrast enhancement pattern during the dynamic series, three different phases were distinguished.

(1) The early phase (between contrast injection and the second post-contrast phase).
(2) The post-initial phase (3rd to 4th post-contrast phase).
(3) The late phase (later than the 4th post-contrast phase).

Types of curve were defined according to delayed phase enhancement as persistent Type I curve (Diagram A) (continuous increase in signal intensity on each successive contrast enhanced images), plateau Type II curve (Diagram B) (initial increase in signal intensity is followed by a flattening of the enhancement curve), and washout Type III curve (Diagram C) (initial increase and subsequent decrease in signal intensity).

8. Standard of reference

The possible pathology suggested by MR imaging to be residual malignancy had been correlated with biopsy. For suggested benign post-operative changes, regressive course and/or complete resolution of the condition after follow-up every three months for two years duration by sonomammography and dynamic contrast enhanced MRI was the standard of reference.

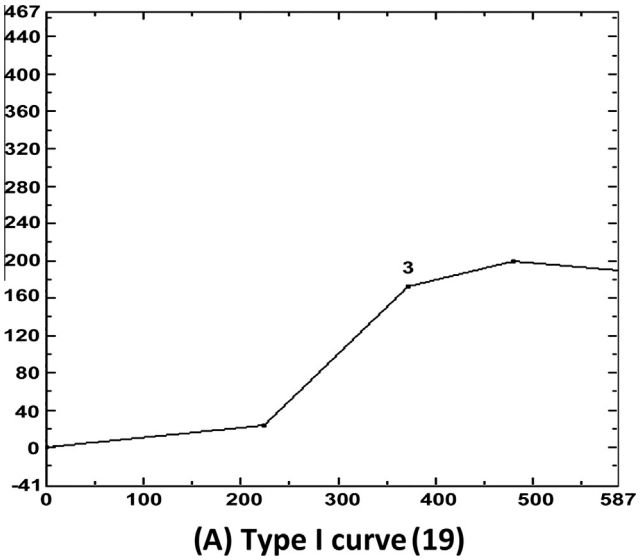

Diagram A Type I curve (19).

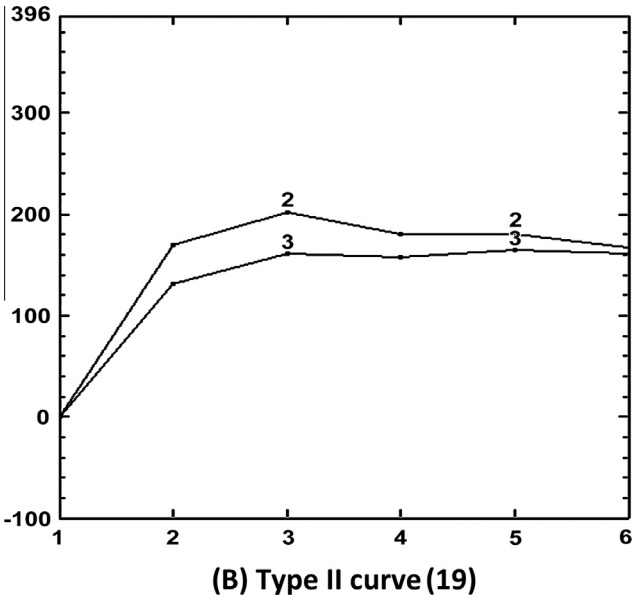

Diagram B Type II curve (19).

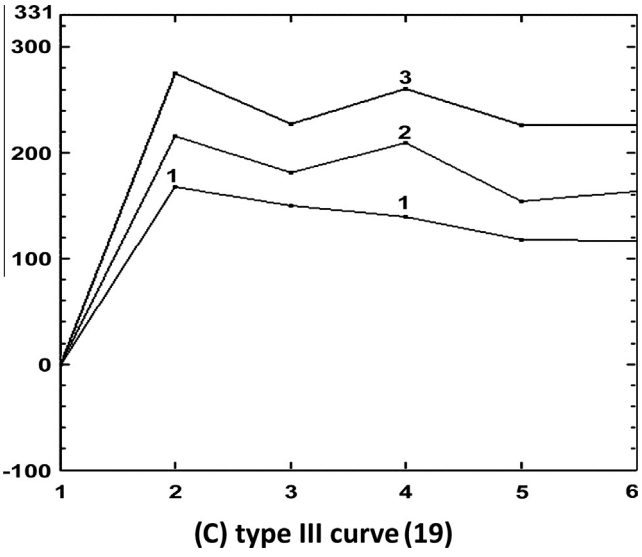

Diagram C Type III curve (19).

9. Statistical analysis

Inter-group comparison of categorical data was performed by using chi-square test (X^2-value). The sensitivity, specificity, positive predictive value, negative predictive value and accuracy of MRI were calculated to differentiate between benign postoperative changes and recurrent malignant lesions. Data were analyzed using the computer program SPSS (Statistical package for social science) version 17.0. A P value <0.05 was considered statistically significant. P value of <0.0001 was considered highly significant in all analyses.

10. Case presentation

10.1. Case No: 1

Female patient aged 40 years with history of left breast cancer and underwent lumpectomy, now presented by palpable lump (see Figs. 1a–1e).

MRI findings are consistent with postoperative fat necrosis. Truecut biopsy revealed postoperative fat necrosis.

10.2. Case No: 2

Female patient aged 43 years with history of left breast cancer underwent lumpectomy and presented by palpable mass in the left breast (see Figs. 2a–2d).

This case was categorized by MRI as BI-RADS 5 proved to be recurrent grade III infiltrating duct carcinoma.

10.3. Case No: 3

Female patient aged 42 years with history of right breast intraductal carcinoma, presented by palpable lump (see Figs. 3a–3d).

MRI findings of this case are consistent with post-operative seroma and categorized as BI-RADS 2. By follow-up of this case total resolution of seroma was observed after 6 months.

10.4. Case No: 4

Female patient aged 40 years with history of invasive duct carcinoma underwent lumpectomy and now presented by diffuse breast enlargement (see Figs. 4a–4d).

This case was categorized by MRI as BI-RADS 4C and biopsy revealed recurrent ductal carcinoma.

11. Results

Fifty female patients with prior surgery for breast cancer were enrolled in this prospective study with age range of 30–70 years (mean age of 50.98 years).

Concerning the type of surgery, 25 patients have had breast conserving surgery (lumpectomy and quadrantectomy), 12 patients had modified radical mastectomy and 13 patients had reconstructive surgery using autologous tissue reconstruction.

The indication for referral to our MRI unit in Mansoura university hospital was diffuse breast enlargement in 15 patients, palpable lump in 24 patients, and routine postopera-

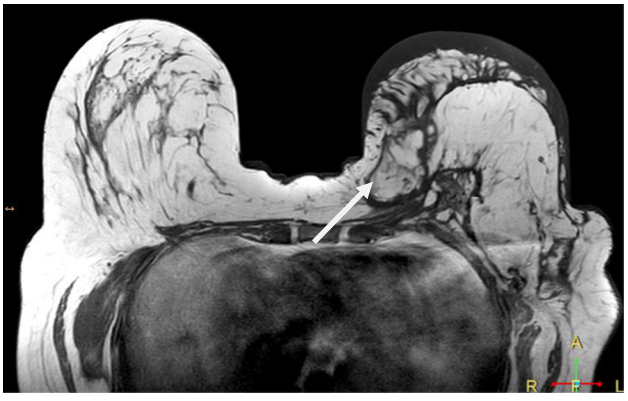

Fig. 1a Axial T1WI showing lesion of high signal intensity in the lower inner quadrant of the left breast.

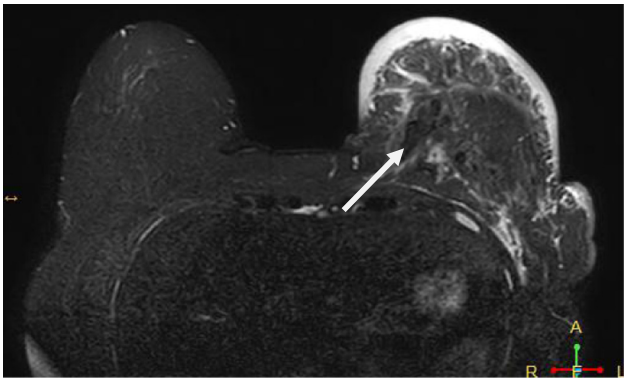

Fig. 1b Axial STIR image showing diffuse skin thickening of the left breast, mild interstitial edema and lesion of low signal intensity in the lower inner quadrant of the left breast.

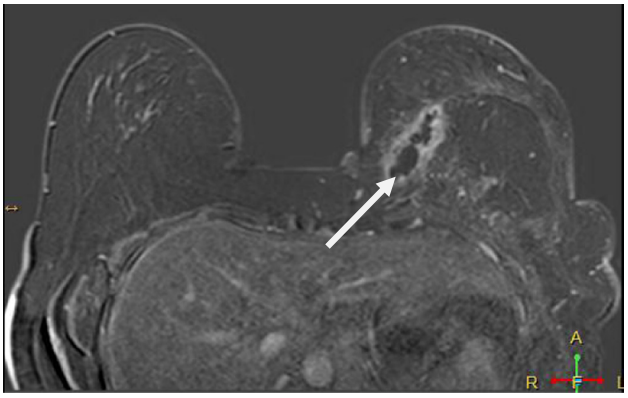

Fig. 1c Axial 2nd minute post-contrast subtraction image showing heterogeneously enhancing lesion in the lower inner quadrant of the left breast.

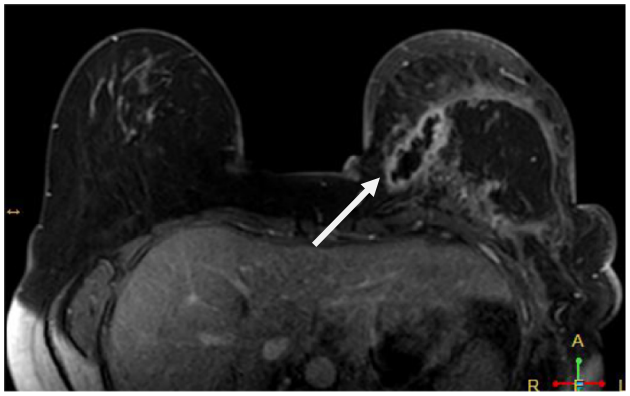

Fig. 1d Axial 4th minute post-contrast subtraction image shows progressive pattern of enhancement (persistent time signal intensity curve).

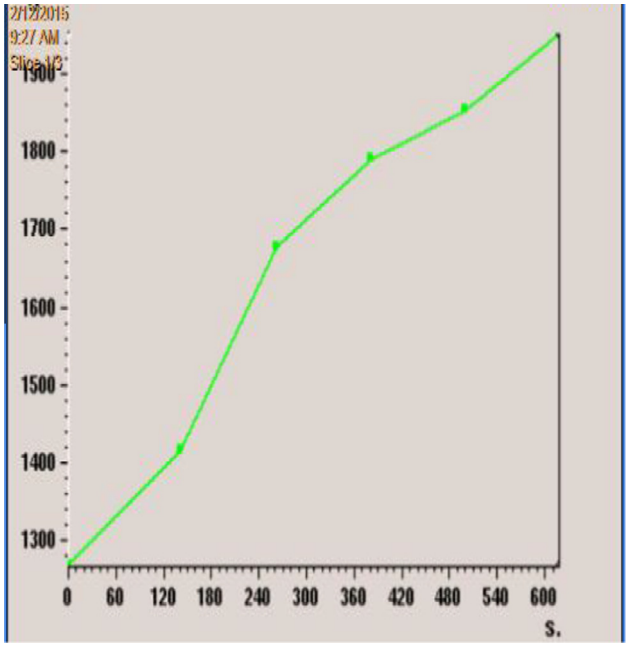

Fig. 1e Time intensity curve showing mild initial enhancement with progressive pattern of enhancement (Type I curve).

tive follow-up (6 months up to 2 years post-surgery) in 11 patients (Table 6).

Mammography was done for 38 patients, and the remaining 12 patients had previous modified radical mastectomy and therefore couldn't handle breast compression elicited during mammography examination. Complementary ultrasound was done for all patients.

In this study, 12 patients (24%) were with recurrent malignant tumor, 7 patients (14%) with postoperative fat necrosis, 10 patients (20%) with postoperative seroma, 10 patients (20%) with diffuse skin thickening and edema, and 6 patients (12%) with postoperative scar tissue; the remaining 5 patients (10%) were normal. Our results were confirmed by histopathology for suspicious malignant lesions by MRI and

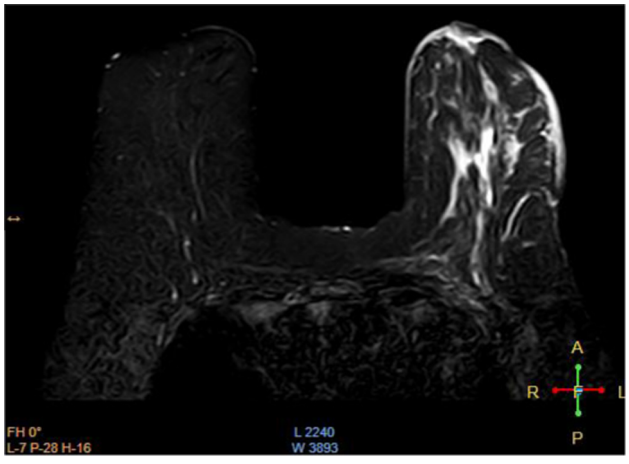

Fig. 2a Axial STIR MRI image shows increased skin thickness and edema of the left breast.

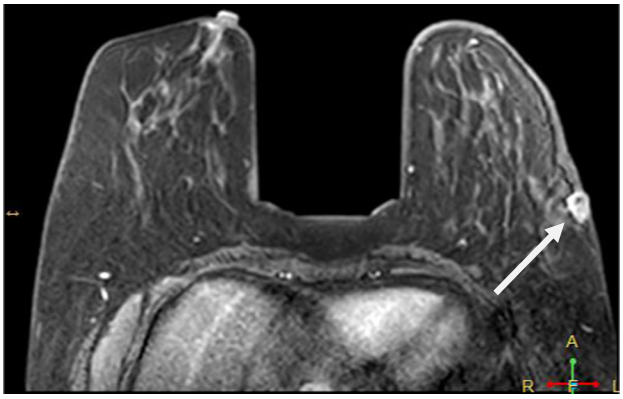

Fig. 2b Axial early 2nd minute post-contrast subtraction images showing the spiculated mass in the lower outer quadrant of the left breast infiltrating the skin, and it shows initial rapid degree of heterogeneous enhancement.

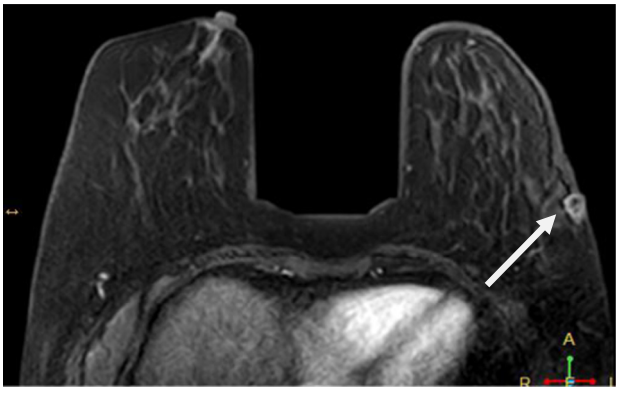

Fig. 2c Axial 4th minute post-contrast subtraction image showing washout pattern of enhancement (washout time signal intensity curve).

regular follow-up every three months for suspected benign lesions.

Dynamic contrast enhanced MRI was performed for 50 patients, and both lesion morphology and enhancement kinetics were assessed to differentiate between benign postoperative changes and recurrent malignant tumor.

Thirty patients had mass lesions on dynamic contrast enhanced MRI and according to the margins of the lesion (Table 1), eleven patients had masses with speculated margins and six out of them were proved pathologically to have recurrent malignant tumors while the remaining five patients proved to have postoperative scarring, so the spiculated margin has 50% sensitivity and 89% specificity for detection of malignant lesions and it is considered statistically highly significant difference between benign and malignant lesions with P value 0.0001. Eleven patients had masses with regular smooth margins, nine of them were proved to have postoperative seroma and the other two patients were proved to have postoperative fat necrosis, so regular smooth margin has 100% sensitivity and 100% specificity for detection of benign lesions. Irregular margins were found in eight patients, five of them were proved to have postoperative fat necrosis, one patient proved pathologically to have postoperative fibrosis, while the remaining

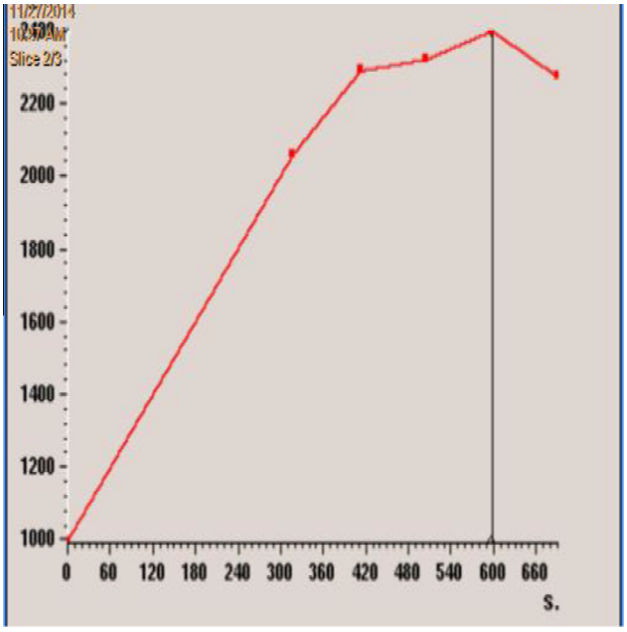

Fig. 2d Time intensity curve showing initial rapid enhancement of the lesion with subsequent washout (Type III curve).

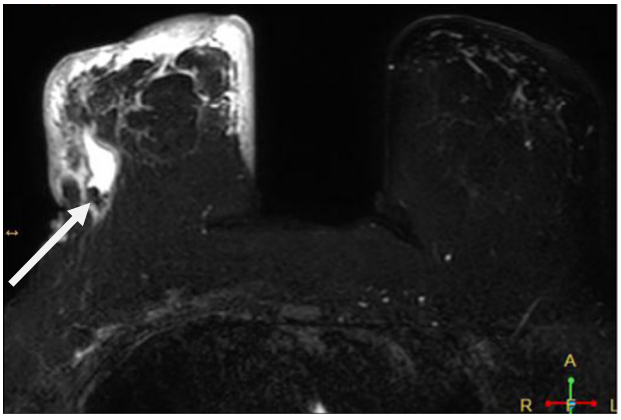

Fig. 3a Axial STIR MRI image shows increased skin thickness and edema of the right breast with a well defined lesion of high signal intensity in the lower outer quadrant of the right breast.

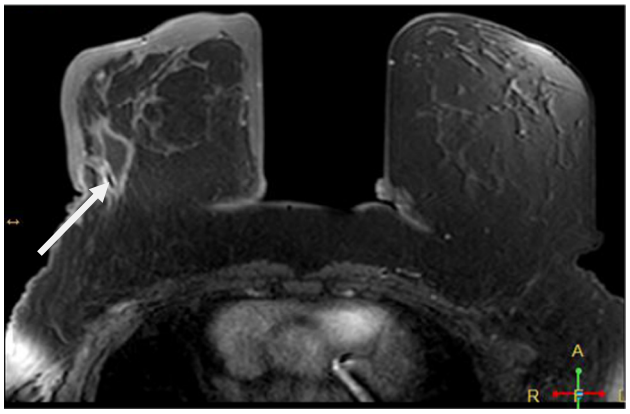

Fig. 3b Axial 2nd minute post-contrast T1WI with fat suppression showing thin rim of enhancement (< 5 mm).

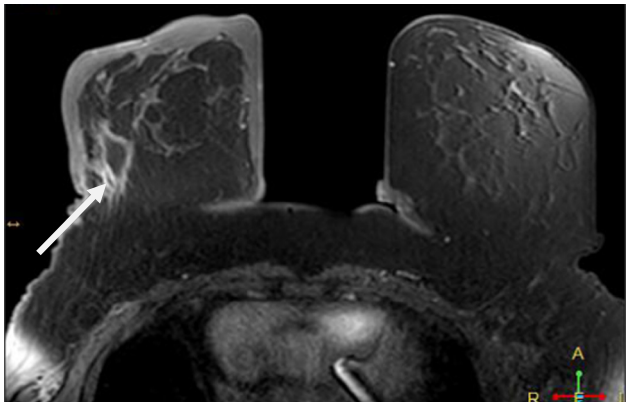

Fig. 3c Axial 4th minute post-contrast T1WI with fat suppression showing progressive pattern of enhancement (Type I time signal intensity curve).

two patients were proved to have recurrent malignant tumors, so irregular margins have 60% sensitivity and 87.5% specificity for detection of malignant lesions.

Thirty-one patients showed contrast enhancement on dynamic MRI study, according to the pattern of enhancement (Table 2), and 11 patients have masses with smooth marginal enhancement, 9 of them were proved to have postoperative seroma and the other 2 patients were proved to have postoperative fat necrosis, so smooth marginal enhancement has 100% sensitivity and 100% specificity for detection of benign lesions. Heterogeneous enhancement was found in 15 patients, 8 of them were proved to have recurrent malignant tumors, 2 patients were proved pathologically to have postoperative fibrosis, while the remaining 5 patients were proved to have postoperative fat necrosis, so heterogeneous enhancement has 66.6% sensitivity and 83.3% specificity for detection of malignant lesions and it is considered statistically significant difference between benign and malignant lesions with *P* value 0.0.02. 19 patients have no enhancing lesions; all of them were proved to be free from recurrent malignant tumors, MRI study for 5 of them was totally normal, 10 patients have diffuse skin thickness and edema, and the remaining 4 patients were proved pathologically to have postoperative scar, so non-enhancing lesions have 100% sensitivity and 100% specificity for detection of benign lesions. Five patients had non-mass like enhancement, and one of them showed small focal area of non-mass-like enhancement at the lumpectomy site. By follow-up of this patient for 1 year by dynamic contrast enhanced MRI no mass was developed and the non-mass-like enhancement shows stationary course along this year. The MRI study for remaining 4 patients shows area of clumped non-mass-like enhancement and biopsy from these lesions revealed recurrent ductal carcinoma.

According to the presence of fat on T1WI (Table 3), 7 patients were proved pathologically to have fat necrosis, all of them have high signal intensity on T1WI.

According to the type of kinetic curve (Table 4), Type I curve was noted in 15 patients and all of them were benign postoperative changes as postoperative seroma and fat necrosis, so Type I curve has sensitivity and specificity of 100% for

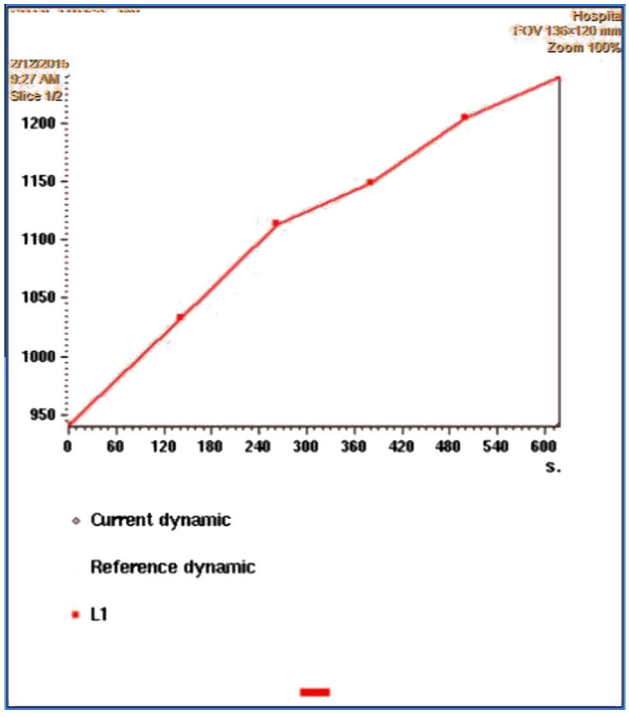

Fig. 3d Time intensity curve showing mild initial enhancement with progressive pattern of enhancement (Type I curve).

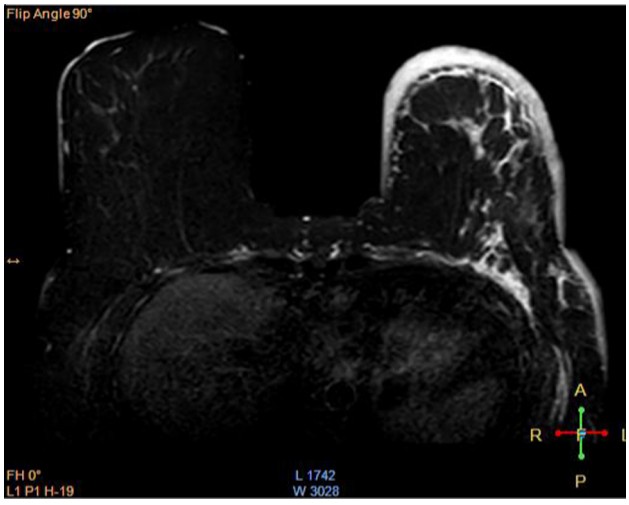

Fig. 4a Axial STIR MRI image shows increased skin thickness and edema of the left breast.

benign lesions. Type II curve was noted in 6 patients; 3 of them had benign postoperative changes (postoperative fat necrosis and fibrosis), while the remaining 3 patients were recurrent malignant tumor, so Type II curve has 25% sensitivity and 72% specificity for detection of malignant lesions. Type III curve was noted in 10 patients, 9 of them were proved to be recurrent malignant tumor and the remaining 1 patient was proved to have postoperative fibrosis, so Type III curve has 75% sensitivity and 97% specificity for detection of malignant lesions and it is considered statistically highly significant differ-

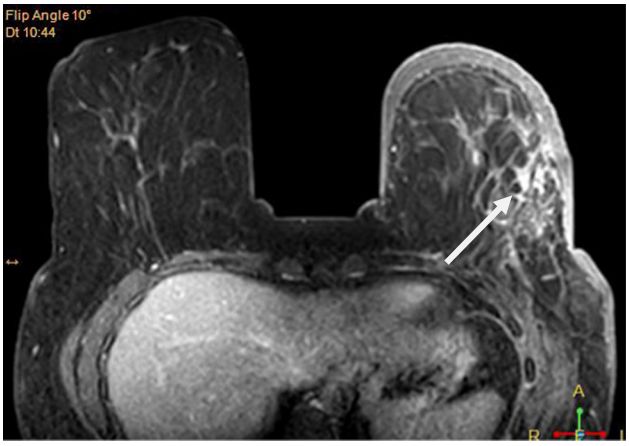

Fig. 4b Axial post-contrast T1WI with fat suppression showing area of clumped non-mass-like enhancement seen in the lower outer quadrant of the left breast.

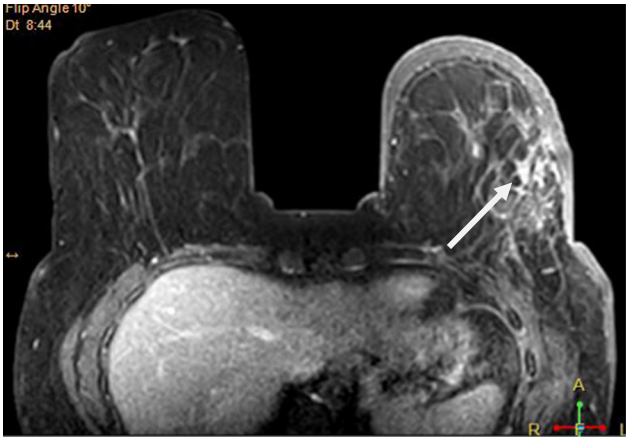

Fig. 4c Axial 4th minute post-contrast T1WI with fat suppression shows washout pattern of enhancement.

ence between benign and malignant lesions with *P* value 0.0001.

The most sensitive and specific parameters for detection of recurrent malignant tumors are heterogeneous enhancement and Type III curve.

The most sensitive and specific parameters for detection of benign postoperative changes as scar tissue and fat necrosis are the absence of enhancement and presence of fat on T1WI.

Finally dynamic contrast enhanced MRI has sensitivity of 85.7%, specificity of 100%, PPV of 100%, NPV of 93.3% and accuracy of 95.6% in differentiation between benign postoperative changes and recurrent malignant tumors (Table 5).

12. Discussion

MR imaging is useful in evaluation of the postoperative breast, as distortion of normal breast architecture can confound the physical examination and the mammographic assessment of the breast. This leads to difficulty in distinguishing between normal postsurgical changes and locally recurrent breast cancer (9).

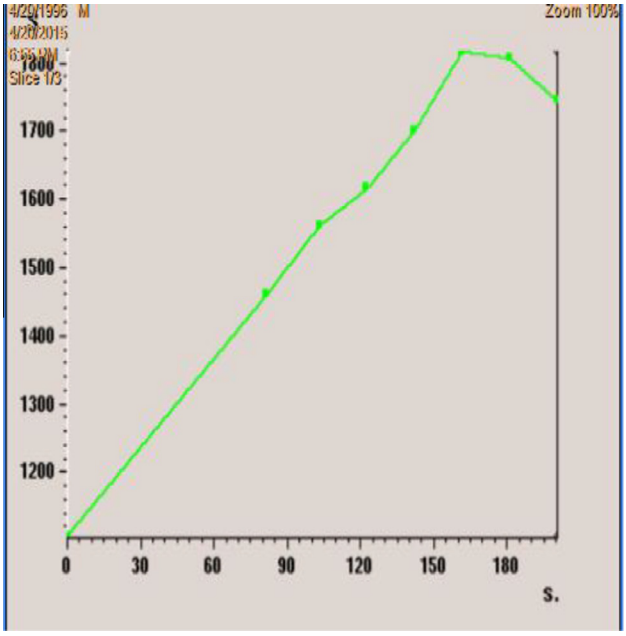

Fig. 4d Time intensity curve showing initial rapid enhancement of the lesion with subsequent washout (Type III curve).

MR imaging has been used successfully to differentiate between benign postoperative findings and recurrent breast cancer (3). The most important factor of MR imaging in differentiation between neoplasia and post-treatment changes is the integration of lesion morphology and enhancement kinetics following administration of gadolinium contrast material (10). Breast cancers, whether primary or recurrent, will typically demonstrate early and rapid contrast enhancement kinetics, often with delayed washout. Benign postoperative changes, such as fibrosis or fat necrosis, will generally demonstrate more gradual uptake of contrast material (11).

Postoperative seromas are common following breast surgery; in this study MRI for 10 patients (20%) showed postoperative seromas, all of them have high signal on STIR images, regular smooth margins, showing thin smooth marginal enhancement and Type I time signal intensity curve and this is in agreement with several studies (3,9) which stated that postoperative seromas have high signal intensity (fluid signal) on T2-weighted images and Smooth, thin ($\leqslant$5 mm) rim enhancement.

Fat necrosis is a common and challenging pitfall in interpretation of post-breast conservative surgery and MR imaging. However, when identified appropriately, this finding can be placed in the BI-RADS 2 or BI-RADS 3 category. The margins and the enhancement pattern of fat necrosis may be indistinguishable from recurrent malignant tumor. The clue for the diagnosis of postoperative fat necrosis is the presence of fat on T1WI (3,12).

In 2015 Mansour and Behairy (13), performed prospective study about the role of diffusion weighted MRI (DWI) in postoperative breast and they declared that the application of precontrast non-fat saturation T1WI had a very important role in the assessment of postoperative breast lesions mimicking malignant lesions (fat necrosis or fat engulfed scar tissue). In our work high signal on T1WI (fat signal intensity) was present in 7 cases which were proved pathologically to be fat necrosis.

Fibrosis is a common sequela of radiation therapy in the breast. Fibrotic masses can be irregular in appearance, often with spiculated margins (14). Distortion of the surrounding breast architecture can also be seen. These findings overlap with those of cicatrizing tumors. One of the challenges in evaluating the postoperative breast is therefore the differentiation between postoperative or post-radiation therapy scarring and tumor recurrence (9).

Previous studies (3,9) stated that MR imaging has been shown to be useful in differentiating scar tissue from tumor recurrence; in particular, non-enhancing areas have a high negative predictive value for malignancy (88–96%). In our study 6 cases were proved pathologically to be postoperative scarring; in 4 of them, MRI showed an area of architectural distortion and no enhancement was observed on dynamic post-contrast study, and the remaining 2 cases were misdiagnosed by MRI to be recurrent malignant tumor as one of them showed spiculated margin, heterogeneous enhancement and Type II time signal intensity curve, and the other case showed irregular margin, heterogeneous enhancement and Type III time signal intensity curve.

In the current study we had 5 patients with non-mass-like enhancement, and one of them showed small focal area of non-mass-like enhancement at the lumpectomy site with Type

Table 1 Shows correlation between the margins of the lesion and detection of recurrent malignant tumor.

Margin of the lesions		Groups			Total	*P*	X^2	*P*
		Normal	Benign	Malignant				
Irregular	No	0	6	2	8	0.37	31.5	< 0.0001
	%	0.0%	18.2%	16.6%	16.0%			
Regular	No	0	11	0	11	0.075		
	%	0.0%	33.0%	0.0%	22.0%			
Spiculated	No	0	5	6	11	0.001		
	%	0.0%	15.2%	50.0%	22.0%			
Total	No	5	33	12	50			
	%	100.0%	100.0%	100.0%	100.0%			

X^2-value is chi-square test used for inter-group comparison of categorical data.
P value is probability factor value.

Table 2 Shows correlation between the pattern of enhancement and detection of recurrent malignant tumor.

Pattern of enhancement		Groups			Total	*P*	X^2	*P*
		Normal	Benign	Malignant				
Heterogeneous enhancement	No	0	7	8	15	0.028	30.3	< 0.0001
	%	0.0%	21.2%	66.7%	30.0%			
Marginal enhancement	No	0	11	0	11	0.075		
	%	0.0%	33.0%	0.0%	22.0%			
No enhancing lesions	No	5	14	0	19	0.027		
	%	100.0%	42.2%	0.0%	38.0%			
Non-mass-like enhancement	No	0	1	4	5	0.16		
	%	0.0%	3.0%	33.3%	10.0%			
Total	No	5	33	12	50			
	%	100.0%	100.0%	100.0%	100.0%			

X^2-value is chi-square test used for inter-group comparison of categorical data.
P value is probability factor value.

Table 3 Shows correlation between the presence of fat on T1WI and detection of recurrent malignant tumor.

Presence of fat on T1WI		Groups			Total
		Normal	Benign	Malignant	
Absent	No	5	26	12	43
	%	100.0%	78.8%	100.0%	86.0%
Present	No	0	7	0	7
	%	0.0%	21.2%	0.0%	14.0%
Total	No	5	33	12	50
	%	100.0%	100.0%	100.0%	100.0%

I time signal intensity curve. Follow-up of this patient for 2 years by dynamic contrast enhanced MRI revealed that no cancer was developed and the non-mass-like enhancement shows stationary course along this year. Several references (3,15) stated that a minimal or small focal area of enhancement or thin linear non-mass-like enhancement (NMLE) can be seen for up to 18 months (in some cases even longer) without nodularity or an associated mass and they consider it probably benign and appropriate for 6-month MR imaging follow-up.

Table 5 Shows sensitivity, specificity, PPV, NPP and accuracy of dynamic contrast enhanced MRI in detection of recurrent malignant tumors.

	Sensitivity	Specificity	PPV	NPV	Accuracy
MRI	85.7	100.0	100.0	93.3	95.6

In the current study, 4 patients had area of clumped non-mass-like enhancement at MRI, 2 of them showed Type II time signal intensity curve and the remaining 2 cases showed Type III time signal intensity curve. Biopsy from these lesions revealed recurrent ductal carcinoma. Several publications (3,9,12) reported that ductal and clumped non-mass-like enhancement has high positive predictive values for malignancy of up to 85% and 60%, respectively.

Petralia (2011) and Drukteinis (2012) (3,16) stated that recurrent malignant lesions showed rapid enhancement following administration of gadolinium contrast material. Other features, such as heterogeneous enhancement and spiculated margins increase the likelihood of malignancy, comparable with our results; 8 patients proved pathologically to have recurrent breast cancer, their MRI study showed masses with

Table 4 Shows correlation between type of kinetic curve and detection of recurrent malignant tumor.

Kinetic curve assessment		Groups			Total	*P*	X^2	*P*
		Normal	Benign	Malignant				
Type I	No	0	15	0	15	0.02	50.57	< 0.0001
	%	0.0%	45.4%	0.0%	30.0%			
Type II	No	0	3	3	6	0.2		
	%	0.0%	9.0%	25.0%	12.0%			
Type III	No	0	1	9	10	< 0.0001		
	%	0.0%	3.0%	75.0%	20.0%			
Total	No	5	33	12	50			
	%	100.0%	100.0%	100.0%	100.0%			

X^2-value is chi square test used for inter-group comparison of categorical data.
P value is probability factor value.

Table 6 Shows correlation between clinical findings and final diagnosis in fifty female patients included in study.

Clinical finding		Final diagnosis						
		Fat necrosis	Seroma	Recurrent malignant tumor	Diffuse skin thickening and edema	Postoperative scar	Normal	Total
Diffuse breast enlargement	No %		1 6.6%	3 20%	10 66.66%	1 6.6%		15
Palpable lump	No %	7 29.16%	9 37.5%	7 29.16%		1 4.16%		24
Postoperative follow-up	No %			2 18.18%		4 36.36%	5 45.45%	11

speculated margins and heterogeneous enhancement, 7 of them showed Type III time signal intensity curve and 1 case showed Type II time signal intensity curve.

In our work DCE-MRI yielded sensitivity (85.7%), specificity (100%) and accuracy (95.6%) in diagnosis of recurrent malignant tumor. There is a large series of papers in the literature (3,9,15,17,18) stated that breast MRI has a high sensitivity in the detection of breast cancer and, in particular, a high sensitivity and specificity in differentiating scar from recurrent tumor.

13. Conclusion

Dynamic contrast enhanced MRI is a valuable tool in evaluation of postoperative breast as it has high sensitivity and specificity in differentiation between benign postoperative changes and recurrent malignant tumor. Breast MRI minimizes unnecessary intervention and optimizes diagnosis of recurrence in its early stages.

Conflict of interest

The authors declared that there is no conflict of interest.

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