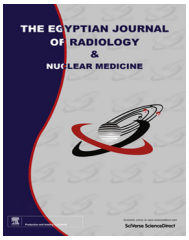
The Egyptian Journal of Radiology and Nuclear Medicine (2015) **46**, 225–234

Egyptian Society of Radiology and Nuclear Medicine

The Egyptian Journal of Radiology and Nuclear Medicine

www.elsevier.com/locate/ejrnm
www.sciencedirect.com



ORIGINAL ARTICLE

Residual breast cancer or post operative changes: Can Diffusion-weighted magnetic resonance imaging solve the case?

Sahar M. Mansour *, **Noha Behairy**

Radiology Department, Faculty of Medicine, Cairo University, Egypt

Received 13 September 2014; accepted 24 November 2014
Available online 16 December 2014

KEYWORDS

Diffusion imaging;
MRI;
Post operative;
Breast cancer

Abstract *Objective:* To evaluate the ability of Diffusion weighted MR imaging (DWI), as a non-invasive sequence to differentiate between accepted post operative sequel and residual malignancy in breast cancer patients following different surgical procedures.

Patients and methods: DWI in addition to the routine post contrast MRI was performed for follow up of 170 post operative breasts (6–24 months). DWI acquired using *b* values: 0, 850, 1000 and 1500. Analysis considered signal intensity (SI) at *b* 1000 and the ADC map and the mean ADC values.

Results: Post operative changes were: Edema (n = 17, 10%), skin thickening (n = 25, 15.9%), seroma (n = 17, 10%), hematoma (n = 5, 3%), fat necrosis (n = 13, 7.6%), fibrosis (n = 8, 4.7%), and combined (n = 83, 48.8%). Residual malignancy found in 16.5% (n = 28) of cases.

No significant difference was noted between DWI SI at *b* 850 versus 1000 and *b* 1000 versus 1500 ($P > 0.05$). Also no difference ($P > 0.05$) was noted between the mean ADC values of residual malignant masses and post operative sequel of fibrosis and fat necrosis. ADC map showed low SI in 30% of cases. Statistical analysis yielded sensitivity, specificity and accuracy of 92.8%, 75.6% and 78% for contrast MRI and 92.8%, 82.6% and 83.4% for DWI respectively.

Conclusion: DWI enhanced the diagnostic performance of MRI in differentiating residual malignancy from post operative changes.

1. Introduction

The importance of preventing local recurrence in women who undergo breast-conserving therapy (BCT) for early-stage breast cancer is underscored by the fact that local recurrence is associated with increased cost, psychosocial distress for the patient, and potentially worse distant disease-free and overall survival (1).

* Corresponding author at: Radiology Department (Women's imaging unit), Faculty of Medicine, Cairo University, Kasr ElAiny Hospital, Egypt. Tel.: +20 1006029047.
E-mail address: sahar_mnsr@yahoo.com (S.M. Mansour).

Peer review under responsibility of Egyptian Society of Radiology and Nuclear Medicine.

http://dx.doi.org/10.1016/j.ejrnm.2014.11.017

For many years DCE-MRI has been used for breast imaging with variable applications starting from lesion characterization and staging of known carcinomas, passing by silicone and non-silicone breast augmentation, screening of high-risk patients and contralateral breast examination in patients with breast malignancy, up to breast examination for postoperative tissue reconstruction, detection of residual tumor or recurrence of breast cancer (2).

The most important factor in the ability of MR imaging to allow differentiation between neoplasia and posttreatment changes is the integration of lesion morphology and enhancement kinetics (3).

After breast conservative therapy, the incidence of ipsilateral breast tumor recurrence (IBTR) is about 1% per year for invasive breast cancer and is slightly less for ductal carcinoma in situ (DCIS). Women who are at the greatest risk for failure include those who are under 35 years old, women with high-grade DCIS, women with DCIS measuring 2.5 cm or greater in diameter, women treated for infiltrating ductal carcinoma with a large DCIS component, and women with multifocal disease (4).

Moreover, following TRAM flap reconstruction, the uses of MR imaging include (a) confirming a benign imaging impression as demonstrated at mammography and US, (b) reinforcing radiologic suspicion of tumor recurrence as based on conventional imaging modalities, or (c) documenting the full extent of disease in cases of biopsy-proved recurrence (5).

Breast MRI is important in the postoperative work-up of breast cancers. High sensitivity and specificity have been reported for the diagnosis of recurrence; however, pitfalls such as liponecrosis and changes after radiation therapy have to be carefully considered. Dynamic contrast-enhanced MR and Diffusion weighted-MRI have shown potential for improving the early assessment of tumor response to therapy and the assessment of residual tumor after the end of therapy (6).

The purpose of this work was to assess the ability of Diffusion weighted MR imaging, being a non-invasive cost-effective option compared to post contrast MRI, to solve the dilemma of accepted post operative sequel vs residual malignancy during follow up of breast cancer patients.

2. Patients and methods

2.1. Patients

The current work was a prospective analysis approved by the Faculty of Medicine Ethics committee of the Cairo University; cases were supplied by the Kasr ElAiny Hospital and have given informed consent for their used data.

Diffusion-weighted MR scanning in addition to the routine dynamic contrast-enhanced MRI protocol was done to 170 female patients.

The study cases were breast cancer patients that had been candidates for; breast-conserving surgery (lumpectomy vs quadrantectomy, $n = 69$), modified radical mastectomy ($n = 47$) and reconstructive surgery (using silicone/saline implants, $n = 10$ or autologous tissue reconstruction, $n = 44$).

MRI was requested to further assess operative bed residual malignancy.

The majority of cases ($n = 103$) were scanned for MR at our institute as a routine post operative follow up (6 months up to 2 years post surgery). The indication for MR imaging in 67 cases (39.4%) was the presence of palpable abnormality or pain at the site of the operative bed.

Findings were evaluated for analysis from March 2013 to July 2014.

2.2. Methods

High-resolution conventional ultrasound was performed for all cases by 8–12 MHz linear array transducer (General Electric (GE), Logic 7 machine). Full field digital mammography was performed using GE Senograph 2000 Machine for 99 cases. Forty-seven cases with modified radical mastectomy and another 24 cases with post operative inflammatory complications could not handle breast compression elicited during mammography examination.

2.2.1. Magnetic resonance imaging

Diffusion-weighted MR imaging was done to make use of its capacity in discriminating benign post operative changes from residual malignancy. Abnormalities scanned using the b values: zero, 850, 1000 and 1500 s/mm^2.

MRI was performed for all cases using a 1.5-T magnet (Gyroscan INTERA, Philips medical systems, Netherland). Cases were imaged in the prone position using a dedicated breast coil with eight channels.

The examination was first performed by precontrast sequences: Axial T1-weighted sequence spinecho (SE)-(TR/TE 500/5.3 ms), sagittal and axial T2-weighted sequences SE (TR/TE 120/4.9 ms) and axial T2-weighted inversion recovery (IR)-(TR/TE 80/6.5 ms). For all the aforementioned sequences slice thickness = 4 mm, matrix = 512×192, flip angle = 90° and FVO = 34–37 cm.

We performed DW sequences for all the cases with the following parameters: TR/TE = 5000/77 ms; slice thickness = 5 mm and 1 mm interslice gap; matrix = 124×100, b-values (0, 850, 1000, 1500 s/mm^2); and the diffusion image was supplied from "Spectral Adiabatic Inversion Recovery" (SPAIR) MR sequence.

Sequentional post contrast MR examination was applied for 166 cases; four cases had renal failure and consequently contrast injection was contradicted.

Dynamic post contrast acquisition performed using six series of 3D "T1 High Resolution Isotropic Volumetric Examination" THRIVE acquisition – 1 before & 5 after power injection of 0.1 mmol/kg BW of contrast (Gd-DTPA) with the parameters (TR/TE 2.8/9 ms) and slice thickness = 1.5 mm.

2.3. Image analysis

MR image interpretation and quantitative analysis were performed by qualified consultants of radiology, M.D. certified (M.S. and B.N.) – 12 and 8 years experience in breast MR imaging respectively.

The authors were blinded about the pathology results at the time of initial evaluation. Also they were blinded about each other's MRI analysis. At the stage of final evaluation, there was multidisciplinary discussion of cases between the radiology and breast surgeon consultants.