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ORIGINAL ARTICLE

The role of conventional and functional MRI in diagnosis of breast masses

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KEYWORDS

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Abstract *Objective:* To evaluate the role of conventional and functional MRI in diagnosis of breast masses.

Patients and methods: This study included 34 female patients who presented clinically by breast mass and/or had abnormal sonomammographic findings and referred from General surgery Department for MRI assessment. The MRI results were correlated with pathological results for all cases.

Results: Those 34 patients were classified pathologically into 21 patients with benign breast lesion (21/34) (61.8%), 10 patients with malignant lesion (29.4%) and 3 patients with high risk lesion (8.8%). The type III intensity curve was the most depicted type in the malignant breast lesion (60%), while type Ia curve was the most depicted type in the benign lesions (61.8%). Out of 25 patients without restricted diffusion; 19 patients showed benign lesions (76%) and out of 9 patients with restricted diffusion; 6 patients showed malignant lesion (66.7%). Out of 17 patients with choline trace; 9 patients were malignant, 5 were benign and 3 were with high risk lesion.

Conclusion: DCE-MRI of the breast had a higher sensitivity for breast cancer detection and more accurate in delineation of the disease extension. The breast MRI with three parameters (DCE-MRI, DWI, and MRS) increased the diagnostic accuracy of the breast cancer.

1. Introduction

Breast cancer is a major health problem. Unlike many other forms of cancers, awareness among women of the risks associated with the breast cancer is high and derives from many sources including health education programs, extensive media coverage and firsthand knowledge from friends and relatives.

Abbreviations: ACR, American College of Radiology; ADC, apparent diffusion coefficient; AUC, area under curve; BI-RADS, Breast Imaging Reporting And Data System; DCE, dynamic contrast enhanced; DWI, diffusion weighted imaging; MRM, magnetic resonance mammography; TIC, time intensity curve; MRS, magnetic resonance spectroscopy; SE-EPI, single excitation echo planar imaging; VOI, volume of interest; tChol, choline trace

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Despite this public awareness, the best screening tool is mammography, which has a false negative rate of 10–25%. Furthermore, mammography has limitations in its ability to accurately establish the extent of the disease in the breast cancer for some subsets of women undergoing treatment. It may underestimate the extent of lobular carcinoma up to 25% of cases. That's why interest has focused on MRI as an adjunct to mammography (1).

Dynamic contrast enhancement MRI (DCE-MRI) of the breast has a high sensitivity for breast cancer detection and has recently been shown to be the most sensitive breast screening technique for women at high risk. DCE-MRI is also more accurate than mammography or U/S. for delineation of the extent of the disease in patient with recent diagnosis of cancer. The high sensitivity of clinical breast DCE-MRI is due to its differential enhancement between normal and malignant tissue on TIWI (2).

Researches on new MRI technique are being conducted to further increase the specificity of breast MRI. Diffusion weighted imaging (DWI) was recently integrated into the standard breast MRI examination for this purpose. It is a non-invasive technique that measures the random motion of free water protons (Brownian motion) and characterizes the tissue with a mechanism that is different from T1 and T2 relaxation. The motion of water protons in the tissue is affected by fluid viscosity, membrane permeability, blood flow and cellularity of the tissue, for quantification of this motion, Apparent Diffusion Coefficient (ADC) values are used (3).

Diffusion weighted MR imaging detects early changes in the morphology and physiology of tissues, such as changes in the permeability of membrane, cell swelling and/or cell lysis (4,5). Since 2002 many studies revealed the usefulness of DWI in differentiation of malignant from benign tumor of the breast. In these studies, sensitivity in the range of 80–96% and specificity in the range of 46–91% were reported (6,7). Moreover, DWI has a potential role for characterization of breast masses and treatment monitoring after chemotherapy (8,9).

Promising findings from the preliminary DWI studies of the breast have shown significantly lower ADC measures for breast carcinoma than for benign breast lesion or normal tissue. The lower ADC in malignancy is primarily attributed to higher cell density causing increased restriction of extracellular matrix and increased fraction of signal coming from intracellular water. A recent study reported high accuracy for characterizing enhancing breast masses through multivariate combination of DWI and DCE-MRI (10).

In addition to morphologic and kinetic analyses, molecular information has been expected to be useful for diagnosis of the breast disease. In vivo proton (H) Magnetic Resonance Spectroscopy (MRS) of the breast which provides molecular information obtained in non-invasive manner, has shown that the choline is generally not detectable in normal breast tissue. In several studies performed on 1.5 T MR imagers, investigators have reported sensitivities of 70–100% and of 67–100% specificities for breast MRS (11).

2. Patients and methods

This study was carried out on 34 female patients who presented clinically by breast mass and/or abnormal sono-mammographic findings. Those patients were referred to Radio-diagnosis and Medical Imaging Department from wards and clinics of the surgery department for MRI evaluation and assessment.

This study was performed at the period from November 2012 to November 2013. Approval of Research Ethics Committee (REC) of Tanta University and informed written consent were obtained from all participants in the study after full explanation of the benefits and risks of the procedure. Privacy and confidentiality of all patient data were guaranteed. All data provision were monitored and used for scientific purpose only.

All patients of our study were subjected to the followings:

I-Full history taking.

II-Clinical examination: General examination and local breast examination and examination of the ipsilateral and contralateral axillary, cervical and supraclavicular lymph nodes.

III-MRI Examination:

*Studies were obtained using a closed MRI machine – 1.5-T MRI system (Signa; GE Medical Systems, Milwaukee, USA) equipped with bilateral dedicated breast coils.

*Patients were placed on top of specialized phased array breast coil in the prone position to allow both breasts to naturally hang inside the loop of coil. We ensured that both breasts fitted entirely within the coil, positioning pads and cushions were used to eliminate skin folds within the coil near axilla and under the breast.

*Premenopausal women underwent the examination ideally on day 6–13 of the menstrual cycle in order to reduce the risk of false positives except for some urgent cases.

*Transverse, sagittal and coronal plane localization scans were done and the following sequences were taken.

i-Fast spin echo (FSE)T1WI (TR; 500 ms, TE; 15 ms).
ii-T2WI with fat suppression (TR; 5600 ms, TE; 59 ms) in the transverse plane; slice thickness; 4 mm, spacing; 1 mm, image matrix; 320 × 314; 4 NEX.

*After confirmation of the lesion location in T2WI, DWI of the entire breast was performed in the transverse plane with a single excitation echo planner imaging (SE-EPI) sequence. A diffusion sensitive gradient was applied along the X-, Y- and Z-axes. The main parameters of DWI were; TR; 8400 ms TE; 98 ms, Slice thickness; 4 mm, spacing; 1 mm, image matrix; 174 × 349, 2 NEX; field of vision (FOV); 33 × 30 cm; b values were 50, 400, and 800 s/mm^2. DWI was always performed prior to contrast enhancement to avoid the effect of contrast material.

*Dynamic contrast MRI was performed by two dimensional fast spoiled gradient recalled echo with fat suppression in T1WI (TR; 4.3 ms TE; 1.3 ms, flip angle; 80 axial scan, FOV 34 × 34 cm, image matrix 448 × 322, 1 NEX, slice thickness; 1 mm, spacing; 1 mm). T1WI were obtained in the transverse plane before, and immediately after bolus injection of 0.2 mmol Gadopentate dimeglumine/kg of body weight at a rate of 4 ml/s, followed by 20 ml saline flush using an automatic injector. Five phase dynamic images were obtained 1, 2, 3, 4, 5 min. respectively. Dynamic analysis was performed through generation of percent enhancement versus time curves performed through positioning of ROI at least for all identified enhancing lesion with a diameter > 5 mm and mass-like morphology according to MR Breast Imaging Reporting And Data System(BI-RADS) classification.