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ORIGINAL ARTICLE

Role of diffusion weighted imaging and dynamic contrast enhanced magnetic resonance imaging in breast tumors

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KEYWORDS

Breast;
Diffusion-weighted imaging (DWI);
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Breast MRI

Abstract *Purpose:* To evaluate the role of diffusion weighted imaging and dynamic contrast enhanced magnetic resonance imaging in characterization of breast tumors and comparing the results with the histological finding.

Patients and methods: From January 2011 to January 2015, 71 patients with 74 suspicious breast lesions had performed breast DCE-MRI combined with DWI and the results were compared with the histopathological examination which was used as the standard diagnostic method.

Results: The study included 71 patients with 74 suspicious breast lesions, there were 38 benign lesions ((51.35%) and 36 malignant lesions (48.65%)).

DCE-MRI proved to have a sensitivity of 91.7%, and a specificity of 84.2%. ADC cutoff value to differentiate between benign and malignant lesions was 1.32×10^3 mm^2/s ($P < 0.001$). The diffusion weighted MRI proved to have a sensitivity of 94.4%, and a specificity of 92.1%.

The combined MRI protocol of DCEMRI and DWI proved to increase the sensitivity and specificity of breast MRI.

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Conclusion: DWI had a higher sensitivity and specificity than DCE-MRI. The combined MRI protocol of DCEMRI and DWI proved to increase sensitivity and specificity of MRI in diagnosis and differential diagnosis of breast lesions.

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1. Introduction

Breast cancer is the commonest female cancer. It is the 2nd leading cause of death among female after lung cancer (1). Improvements in diagnosis of breast cancer are largely responsible for increasing rate of survival among breast cancer women (2).

Techniques of Magnetic resonance imaging (MRI) such as dynamic contrast-enhanced MRI (DCE MRI) and diffusion-weighted (DW) techniques are among those of interest, as they allow noninvasive digital biomarker measurements of tissue properties that are highly valuable for assessment of tumor progression (3).

Dynamic contrast-enhanced MRI (DCE MRI) sensitivity in diagnosis of breast cancer is relatively high ranging from 88% to 100% for invasive breast malignancies (4,5). However the reported specificity of DCE MR imaging has been largely variable, ranging from 37% to 97% (6).

DCE MRI specificity is variable depending on lesion criteria that used in differentiation between benign and malignant breast tumors (7).

The commonly used lesion criteria used for characterization of breast lesions by DCE MRI are lesions morphology and enhancement kinetics (8,9).

According to BIRAD MRI lexicon, morphological evaluation of breast lesions is done by evaluating its shape, margins, and enhancement characteristics, enhancement distribution, and internal enhancement pattern. Kinetic evaluation is done by detecting the initial and post-initial enhancement of the breast lesion (10).

In order to increase breast MRI specificity, diffusion-weighted imaging (DWI) was designed (10).

Diffusion-weighted imaging (DWI) is a noninvasive technique which measures the free water protons random motion and evaluates the exchange (diffusion) of water molecules among compartments of breast tissues. Rate of diffusion is varying between pathologic and nonpathologic breast tissues (11).

The quantitative value of water molecules diffusion between tissue components is expressed by apparent diffusion coefficient (ADC) value. This value is proved to be different between benign and malignant breast lesions (11).

From 2002, a lot of studies (12–19) have revealed the usefulness of breast DWI in differentiation of benign from malignant lesions of the breast. These studies proved that the sensitivity of breast DWI was in the range of 80–96% and its specificity was in the range of 46–91%. Yabuuchi et al. (20) concluded 92% sensitivity and 86% specificity and also Partridge et al. (21) concluded that there is 10% improvement in the PPV when combining DWI with dynamic contrast-enhanced MRI (DCE-MRI) in the differentiation of breast masses (7,8).

2. Patients and methods

2.1. Patients

This prospective study was carried out in the period between January 2011 and January 2015 in diagnostic radiology department of Mansoura University Hospitals. The study comprised 71 women (age range, 28–75 years; mean age 46.6 years) with 74 suspicious breast lesions based on physical examination, mammography and ultra-sonography.

2.1.1. Inclusion criteria

1. Patient with suspicious breast lesion at mammography or breast ultrasound or with suspicious clinical findings.
2. Patients who are suspected to have local regional recurrence after resection of malignant breast lesion.
3. Patients who are suspected to have tumor residual following chemotherapy or radiotherapy sessions.

2.1.2. Exclusion criteria

1. Patients with history of breast biopsy within 1 month.
2. Patients without a detectable lesion on MRI corresponding to clinically or mammographically defined lesion.
3. Patients without histopathologic confirmation of the lesion.
4. Contraindication to perform MRI examination (cardiac pacemaker, or metallic aneurysm clips).

All the patients underwent full history taking, general and local examination. All patients underwent diffusion weighted MRI and dynamic contrast enhanced MRI examination and the results of breast MRI were compared with the histopathological results that were used as the standard diagnostic method.

2.2. MR imaging protocol

All patients were examined using a 1.5-T magnetic resonance machine. All patients were examined in the prone position using dedicated breast coil. MR Imaging was done within 7–14 days of menstrual cycle in premenopausal women. Examination included image acquisition followed by image post-processing.

2.3. Image acquisition

The conventional MRI protocol included Localizing sagittal view (scout view), axial nonfat saturated T1WI obtained by FSE with the following imaging parameters: TR 450 ms, TE

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