



ORIGINAL ARTICLE

Role of quantitative diffusion weighted imaging in characterization of breast masses



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Apparent diffusion coefficient (ADC);
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Abstract Purpose: To evaluate the diagnostic accuracy of diffusion-weighted imaging (DWI) in differentiating benign from malignant breast lesions.

Patients and methods: Forty patients with positive diagnoses at mammography or breast ultrasound were included in this study. Patients were imaged with dynamic contrast enhanced MRI and DWI before biopsy of their breast tumors. Apparent diffusion coefficient (ADC) map was utilized to select the region of interest (ROI) for ADC calculation. DWI was performed using three sets of *b* value (0, 400, and 800 s/mm²).

Results: The final analysis comprised 40 breast lesions, 18 of which were malignant and 22 were benign. Significant results were obtained between ADC values of benign and malignant lesions (*p* < 0.001). The cut-off ADC value for benign and malignant lesions was 1.25×10^{-3} mm²/s.

Conclusion: The present study provides consistent evidence to support DWI as a diagnostic tool for breast lesion characterization and as a useful adjunct to standard breast MRI protocols in aiding the diagnosis of breast cancer.

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1. Introduction

Conventional MRI of the breast is mainly based on the combined analysis of the morphological data and enhancement kinetics of the lesions. This gives information about tumor

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physics, vascularity, and vascular permeability. It provides high sensitivity yet with moderate specificity for breast cancer (1), with overlap between benign and malignant lesions (2–6).

Due to the low specificity of the conventional MRI, an additional feature is needed to characterize suspicious lesions in order to decrease the number of invasive breast procedures. Prior studies with breast MRI and DWI have already addressed this question and show promising results (7–9).

Diffusion weighted imaging is a novel technique in magnetic resonance imaging and has a high sensitivity in the detection of changes in local biological environment. A significant advantage of diffusion weighted MR imaging is its high

sensitivity to changes in microscope cellular environment without the need for intravenous contrast material injection (10).

The diffusion of water in tissue is quantified by the apparent diffusion coefficient (ADC). Based on the diffusion-weighted images, an ADC map can be calculated which shows the ADC value of each voxel in every slice. Restricted water movement in tumors with high cellularity leads to smaller ADC values (7).

The objective of this study was to evaluate the role of DWI with ADC value measurement in differentiating benign from malignant breast lesions.

2. Patients and methods

Forty patients with positive diagnoses at mammography or breast ultrasound were included in this study which was conducted over a period of 10 months. Patients were imaged with dynamic contrast enhanced magnetic resonance imaging (DCE-MRI) and diffusion weighted imaging (DWI) before biopsy of their breast tumors. Lesions greater than 1 cm in size were selected for this study because smaller lesions are hardly identifiable on the DWI images. Lesions less than 1 cm in size or purely cystic lesions were excluded as the latter show no diffusion restriction. Approval for the study was obtained from

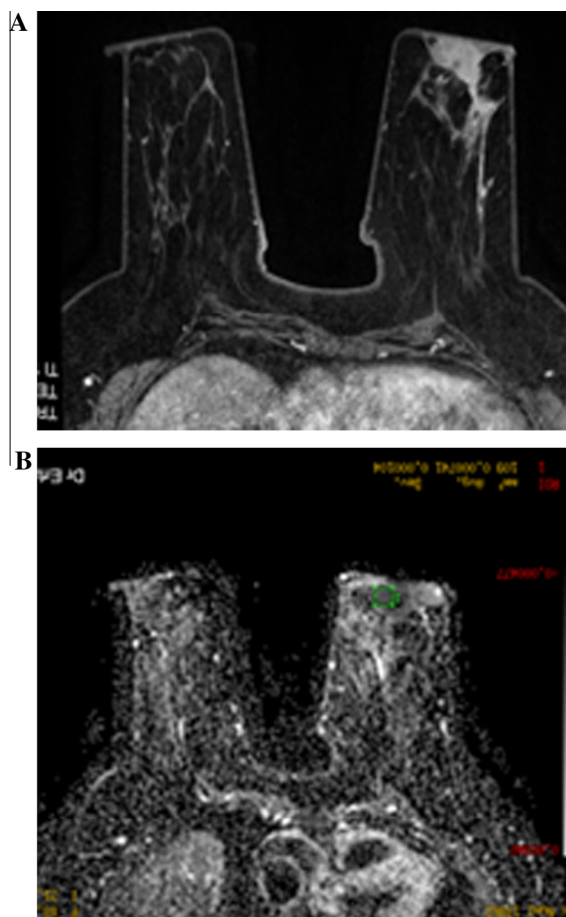


Fig. 1 A – DCE-MRI shows an inhomogeneously enhancing retroareolar mass lesion with spiculated margins. B – ADC map revealed restricted diffusion with a low mean ADC value of $0.7 \times 10^{-3} \text{ mm}^2/\text{s}$.

the local ethical committee and informed consent was obtained from all the study subjects. In all patients, MRI was performed bilaterally, and results were correlated with histopathology. The age of the patients ranged from 12 to 50 years (mean age 36.5 ± 9.6).

2.1. MRI protocol

All patients were examined using a 1.5-T MR unit (Achieva, Philips Medical Systems, Best, The Netherlands) and a dedicated double breast coil. Imaging was performed within days 7–14 of the menstrual cycle for premenopausal women. Patients were placed in the prone position.

The conventional MRI protocol included the following:

- T2W axial sequence (TR/TE: 4800/120), number of excitation (NEX): 1, slice thickness: 3 mm with no gap, and field of view (FOV): ranged from 280 to 340 mm depending on the breast size, matrix = 256×160 or 256×192 .

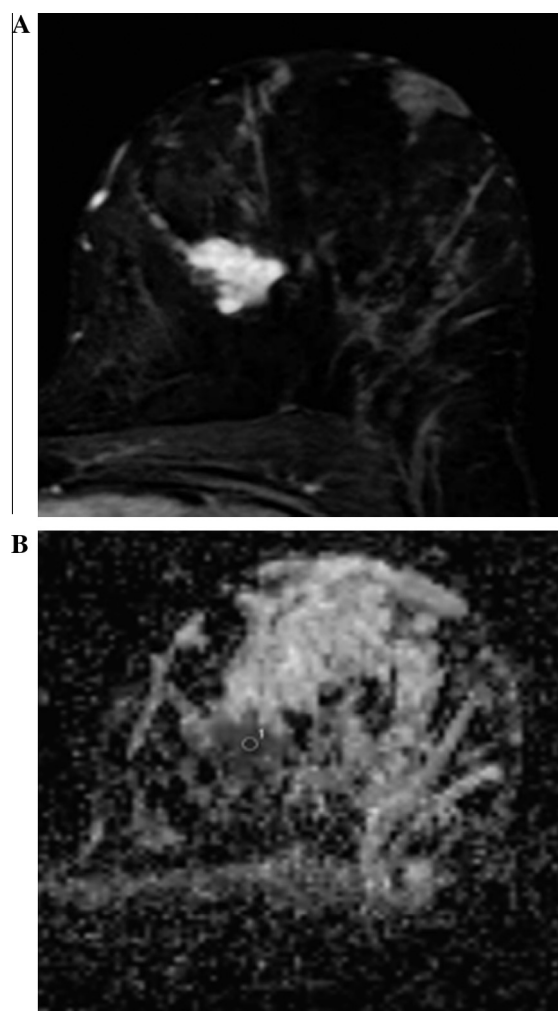


Fig. 2 A – DCE-MRI shows an intensely enhancing irregularly outlined mass lesion in the upper inner quadrant of the left breast with a curvilinear tail of abnormally enhancing tissue seen directed anteromedially. B – ADC map revealed restricted diffusion with a low mean ADC value of $0.81 \times 10^{-3} \text{ mm}^2/\text{s}$.

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