Comparison of the value of DWI based on monoexponential and stretched exponential model in differential diagnosis between benign and malignant lesions of breastΨ

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Introduction

It is well known that conventional mammography is the basic method used for screening breast cancer, but it has only a sensibility of 69-90%, and if the breast parenchyma is very dense, the sensibility may be decreased by 48%. MRI has been widely used in the diagnosis of breast disease. Diffusion-weighted imaging is a non contrast-enhanced type of MRI which is most simply performed with 2 b values, such as 0 and 800s/mm^2. In vivo, microscopic motion of water molecules detected by DWI is influenced not only by diffusion of water molecules, affected by the structures of the tissue, but also by microcirculation of blood in the capillary network[1]. Accordingly, the signal attenuation on monoexponential DWI sometimes does not represent a linear relationship and it is difficult to calculate the accurate ADC value. Now we use intravoxel incoherent motion (IVIM) which is first described by Le Bihan *et al*[2] to compare the application value of monoexponential apparent diffusion coefficient with single b-factor range and stretched exponential apparent diffusion coefficient with extender b-factor range in differential diagnosis of benign and malignant lesions of breast.

Material and method

A total of 64 patients with breast tumor underwent DWI with single b-factor range (b-factors were 0, 800s/mm^2）and DWI with extended b-factor range (b-factors were 0, 20, 50, 100, 200, 400, 800, 1200 s/mm^2). MRI was performed on a GE 3.0T Discovery 750 scanner. After exclusion of 13 patients, the 51 patients remaining were analyzed. Among them, benign lesions were found in 30 cases (benign group), while malignant lesions were found in 21 cases (malignant group). Contralateral normal glandular tissues of the same patients were used as control (47 glandular tissues, control group). The value of apparent diffusion coefficient (ADC), distributed diffusion coefficients (DDC), and alpha (α) were measured on GE Advantage Windows 4.5 workstation. These quantitative parameters of three groups were compared using one-way analysis of variance and were compared each other using LSD method. These threshold values of ADC, DDC and α for identifying malignant lesions were determined using a receiver operating characteristic curve analysis, the performance of the monoexponential model parameter and stretched exponential model parameters in identifying malignant lesions were also compared.

Results and Discussion

The mean ADC, DDC and α were (1.46±0.30) ×10-3 mm^2/s, (1.44±0.44) ×10-3 mm^2/s, and (81.47±10.01)% in benign group; the mean ADC, DDC and α were (1.04±0.18) ×10^{-3} mm^2/s, (0.91±0.24)×10^{-3} mm^2/s, and (79.40±6.44)% in malignant group (Fig. 1); and the mean ADC, DDC and α were (1.74±0.33)×10^{-3} mm^2/s, (1.74±0.49) ×10^{-3} mm^2/s, and (85.98±9.86)% in control group. There were significant differences between benign group and malignant group, benign group and control group, malignant group and control group in ADC and DDC; There were significant differences between benign group and control group, malignant group and control group in α, but there were no significant differences between benign group and malignant group inα;. The areas under the ROC curve (AUC) of ADC, DDC and α were 0.87, 0.84 and 0.64 (Fig. 2). The sensitivity of ADC, DDC and α were 95.2%, 90.5%, 66.7% and the specificity of ADC, DDC and α were 76.7%, 83.3%, 70.0% for the differential diagnosis of benign and malignant lesions of breast if taken the maximum Youden's index as cut-off. IVIM model could be a supplement of standard ADC .The differential diagnosis of benign and malignant breast lesions by ADC of monoexponential model and DDC of stretched exponential model is applicable and show high diagnostic efficacy.
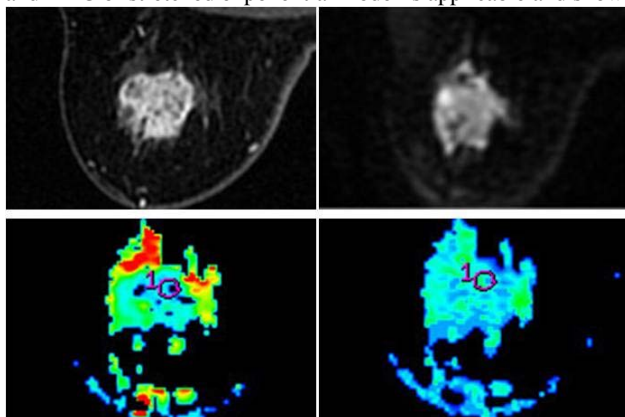

Fig 1. Example axial contrast material-enhanced MR image, DWI image, DDC map and α map of invasive carcinoma in a 50-year-old woman, respectively.
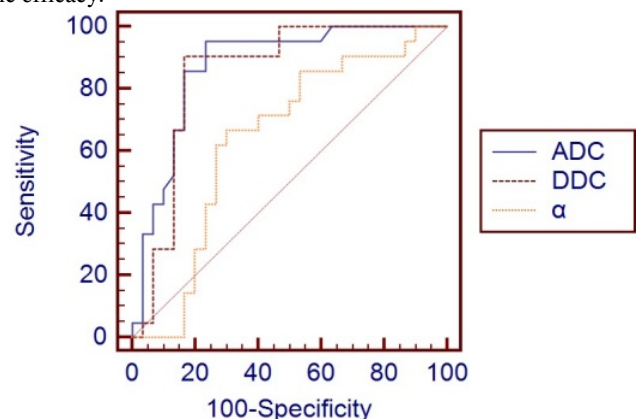

Fig 2. The areas under the ROC curve (AUC) of ADC, DDC and α were 0.87, 0.84 and 0.64.

References

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