Preoperative Differentiation of Intracranial Dural Metastases and Meningioma Using Quantitative Diffusion MR Imaging

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Introduction

Cerebral metastases may occasionally present as a focal meningeal mass, mimicking meningioma [1-2]. Frequently, radiographic results are inconclusive, and a biopsy or surgical resection of the lesion is needed [3]. Preoperative differentiation between dural-based metastases and meningioma is important in selection of surgical approach or oncological management [4]. The aim of this study was to evaluate the feasibility of using apparent diffusion coefficients (ADCs) and diffusion anisotropy indices (DAI) in discriminating dural metastases from meningiomas.

Materials and Methods

58 patients (30 men, 28 women, mean age 52.4 years) with extra-axial dural-based intracranial mass lesions were selected for a prospective study during an 18-month period from October 2001 to March 2003. Histopathology revealed that there were 53 meningiomas (50 benign, two atypical, one malignant) and five dural metastases (two breast carcinoma, one lung carcinoma, one colon carcinoma, and one unknown primary). MR imaging was performed using a 1.5-T MR imager equipped with high-speed gradients. After T1-weighted, T2-weighted, and contrast-enhanced T1-weighted images had been acquired, transaxial diffusion-weighted images (DWI) with diffusion-sensitizing gradient along x-, y- and z- axes were acquired using EPI-diffusion pulse sequence with b values of 0 and 1000 s/mm^2. ADC and DAI values were computed and compared between meningiomas and dural metastases using a two-tailed Student's t-test.

Results

83% of meningiomas (n=44) appeared hyperintense or isointense to white matter on DWI (Fig.1) and 17% (n=9) appeared hypointense or mildly hypointense to white matter on DWI. All dural metastases (n=5) were predominantly hypointense to white matter on DWI (Fig.2). The mean ADC and DAI values were $(0.812 \pm 0.178) \times 10^{-3}$ mm^{2}s^{-1} and 0.235 ± 0.078 in meningiomas, and $(1.788 \pm 0.252) \times 10^{-3}$ mm^{2}s^{-1} and 0.083 ± 0.016 in dural metastases respectively. The mean ADCs of meningiomas were significantly lower than those of dural metastases ($p < 0.005$) while the DAI values of meningiomas were significantly higher than those of dural metastases ($p < 0.005$). There were no overlap between the ADC and DAI values of the meningiomas and dural metastases (Fig.3).

Discussion

Histologically, meningiomas are composed of firm fibrous tissues and characterized by high tumor cellularity, which account for their relatively low apparent diffusion coefficients and high diffusion anisotropy indices [5]. Other researchers found that the ADCs in contrast enhancing areas within cerebral metastases were significantly higher than those in other types of brain tumors [6]. Our preliminary results indicate that combined utilization of apparent diffusion coefficients and diffusion anisotropy indices may be able to provide reliable differentiation between dural metastases and meningiomas.

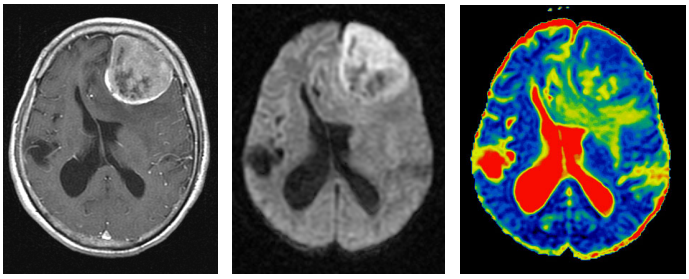

Figure 1. Meningioma

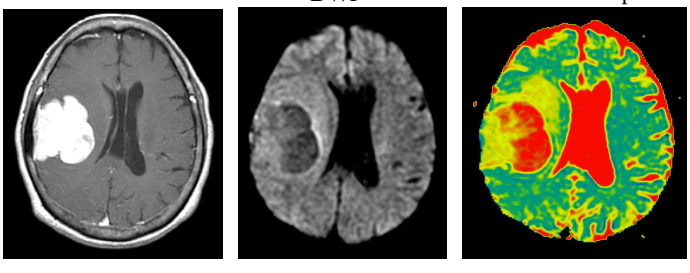

Figure 2 Dural metastases

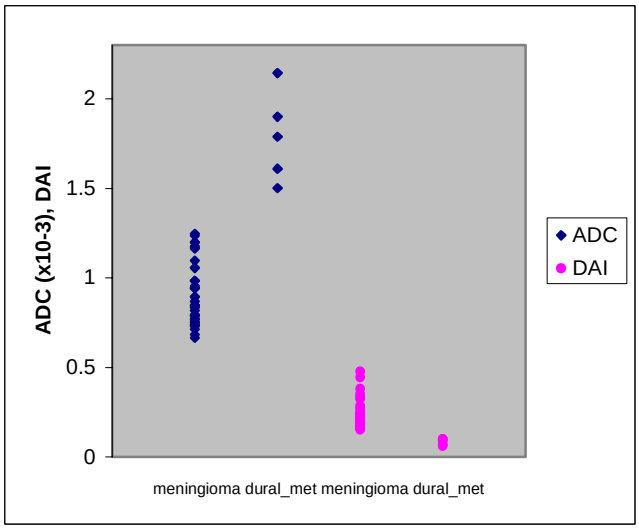

Figure 3. Plots of ADC and DAI values for meningiomas and dural metastases.

References

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