Diffusion-weighted MR Imaging for Pretreatment Prediction and Early Monitoring of primary rectal cancer Response to chemoradiation Therapy

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Introduction

A tumor's response to treatment cannot be reliably predicted and early monitoring, but the capacity might be of considerable clinical benefit. Diffusion-weighted magnetic resonance imaging (DW-MRI) enables noninvasive characterization of biologic tissues on the basis of their water diffusion properties. The Purpose of this study is to evaluate the predictive and early monitoring value of DW-MRI on therapy outcome of combined chemoradiation in patients with primary carcinoma of the rectum.

Materials and Methods

Fifteen patients with primary rectal carcinoma (cT3) undergoing preoperative chemoradiation were recruited in the study. Diffusion weighted echo planar imaging was performed weekly on all 15 patients during the course of therapy using a GE 1.5T MR scanner with an 8-channel body phase-array coil. The imaging parameters are: TE/TR：minimum/6000 msec, FOV：36cm, Matrix：128x128 Slicethick：5mm, Nex：8. Two motion-probing gradients (b=0 and b=1000 sec/mm^2) were employed to obtain the diffusion –weighted images. And SENSE (ASSET) technology was also used to reduce the distortion of EPI. The mean ADC values of the tumor region was calculated at before and 1st, 2nd, 4th week of therapy compared with the postsurgical histopathologic results.

Results

Patients were divided into two groups according to the postsurgical histopathologic results: with 9 patients in responder group and 6 patients in non-responder group. The mean ADC (10^{-3} mm^2/s) value in non-responder group (1.36 ± 0.13) was higher compared to that in responder group (1.11 ± 0.14) before onset of chemoradiation therapy(t=3.158,p<0.05). The mean ADC values between the groups are significantly different (Fig.1,2)(week1:F=4.84,p<0.05; week2:F=14.71,p<0.01; week4:F=2.07,p>0.05). Responder group showed a significant increase of mean ADC value at the course of treatment. In the nonresponder group, no initial increase of ADC value was observed or a decrease was found.

Discussion and Conclusion

In quantitative diffusion-weighted imaging, the magnetic resonance signal arises from both intracellular and extracellular components, and the result is given in terms of the apparent diffusion coefficient (ADC), which is a weighted sum of these contributions. The ADC is a measure of restrictions to diffusion of molecules by structures such as cell membranes, and can reflect microstructure of the cellular environment. Hence, DW-MRI should be sensitive to several physiologic and morphologic characteristics of tissue that are associated with difference and variance of slow and fast diffusion water molecules[1, 2]. This study has shown the mean ADC value in non-responder group was higher than that in non-responder group before chemoradiation therapy, responder group showed a significant increase of mean ADC value and that was decrease in the non-responder group at the early treatment. So, DW-MRI is able to detect difference and individual changes of tumor ADC values during the course of chemoradiation, reflect biological difference and changes within the tumor tissue, and has shown the potential for pretreatment Prediction and early monitoring of primary rectal cancer response to chemoradiation therapy.

Key words

rectum, neoplasm, magnetic resonance imaging, diffusion –weighted imaging, apparent diffusion coefficient

Reference

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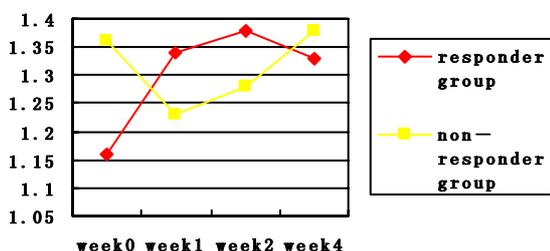2. Dzik-Jurasz A et al. Lancet 2002; 360:307–30*8.*

Fig.1 the figure shows non-responder group has a significant increase of mean ADC value at the course of treatment, and the responder group has a decrease.
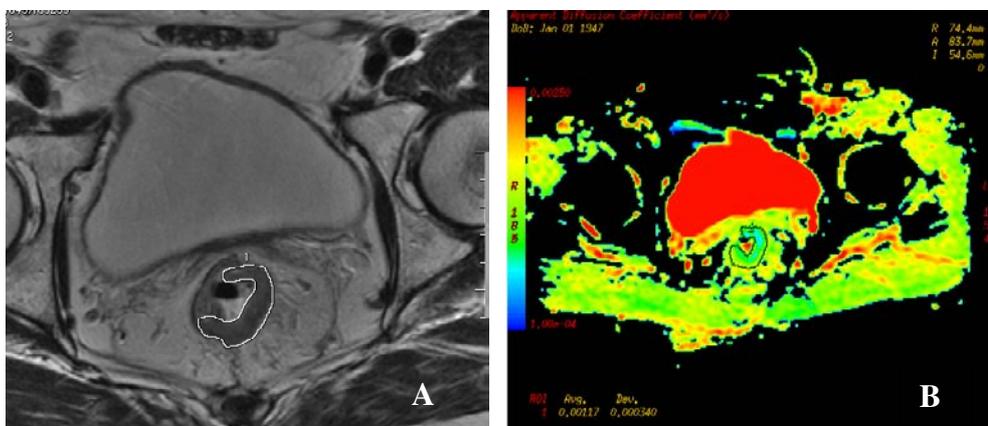

Fig,2 a) Typical T2-weighted transaxial FSE (fast spin-echo) image through the pelvis of the patient. b) Corresponding ADC (apparent diffusion coefficient) map obtained from the diffusion-weighted images. The tumor outline is shown as a solid line.