Diffusion weighted imaging (DWI) of the prostate cancer at 3 T; comparative study with DWI at 1.5 T

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Purpose

To evaluate the apparent diffusion coefficient (ADC) value, image quality and diagnostic performance of diffusion-weighted imaging (DWI) of the prostate at 3 T compared with those at 1.5 T.

Materials and methods

This study was approved by the institutional review board, and informed consent was obtained from all patients. Between June 2006 and March 2008, 40 patients suspected of having prostate cancer (mean age 64.1 years) underwent MR examination with both a 3-T unit (Signa EXCITE HD 3.0T, GE Healthcare) and a 1.5-T unit (Signa EXCITE HD, GE Healthcare) on the same day. In 19 of the 40 patients, prostate cancer was confirmed by TRUS-guided needle biopsy. Axial diffusion-weighted images were obtained using the single-shot echo planar imaging technique at two b values (0 and 2000 s/mm^2) using the tetrahedral gradient technique. The imaging parameters of DWI were as follows: TR/TE = 5000/61 mesc (3 T), 5000/67 mesc (1.5 T); slew rate = 150 mT/m/ms (3 T), 120 mT/m/ms (1.5 T); slice thickness = 5 mm; interslice gap = 1 mm; matrix = 128 × 128; FOV = 36 cm; number of excitations = 3; reduction factor = 2. Regions of interest (ROI) were drown on the normal central zone (CZ) and the normal peripheral zone (PZ) on both of the b = 0 s/mm^2 images and b = 2000 s/mm^2 images. In the 19 patients with prostate cancer, ROI was also drawn on the cancer if it was depicted clearly. ADC values were calculated both on 3 T images and 1.5 T images in the same region for CZ, PZ and cancer using following equation;

$$ADC = \frac{-\log(S_2 - S_1)}{b_2 - b_1}(mm^2/s)$$ [S_1 is the signal intensity at $b_1(=0)$, S_2 is the signal intensity at $b_2(=2000)$]

Two experienced abdominal radiologists independently evaluated image qualities of DWI using a five-point rating system in terms of signal homogeneity, amount of noise, image distortion and overall image quality. They also assigned their confidence level regarding the presence of the prostate cancer. The paired-t test and Peason's correlation coefficient test were used for the evaluation of ADC values, and Wilcoxon signed-ranks test was used for the qualitative evaluation. Receiver operating characteristic (ROC) curve analysis was performed to compare the diagnostic performance.

Results

Table 1 shows the mean ADC values at 3 T and 1.5 T for the CZ, PZ and cancer. The differences were not statistically significant between 3 T and 1.5 T ($P > 0.2$, > 0.7, > 0.6). The ADC values at 3 T was significantly correlated with those at 1.5 T ($r = 0.91$, $P < 1\times10^{-35}$) (Fig. 1). Image quality at 3 T was significantly superior to that at 1.5 T in terms of signal homogeneity, amount of noise and overall image quality ($P < 0.01$). The sensitivity and the Az value for the images at 3 T was higher than those at 1.5 T, but the differences were not significant ($P > 0.08$) (Table 2).

Conclusion

The ADC values at 3 T were almost equivalent to those at 1.5 T. Image quality of DWI at 3 T was superior to that at 1.5 T, and diagnostic performance of DWI would be improved by using 3-T units.

References

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2) Gibbs P, Pickles MD, Turnbull LW. Diffusion imaging of the prostate at 3.0 tesla. Invest Radiol. 2006; 41(2):185-8.

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Table 1. Mean ADC values (mean ± SD) of the CZ, PZ and cancer at 3 T and 1.5 T.

	3 T	1.5 T
CZ	1.10 ± 0.07	1.07 ± 0.08
PZ	1.41 ± 0.18	1.39 ± 0.18
cancer	0.88 ± 0.17	0.87 ± 0.19

All ADC values × 10^{-3}mm^2/s

Table 2. Mean sensitivity, specificity and Az for DWI at 3 T and 1.5 T.

	3 T	1.5 T
Sensitivity	0.48	0.21
Specificity	0.88	0.95
Az	0.62	0.48

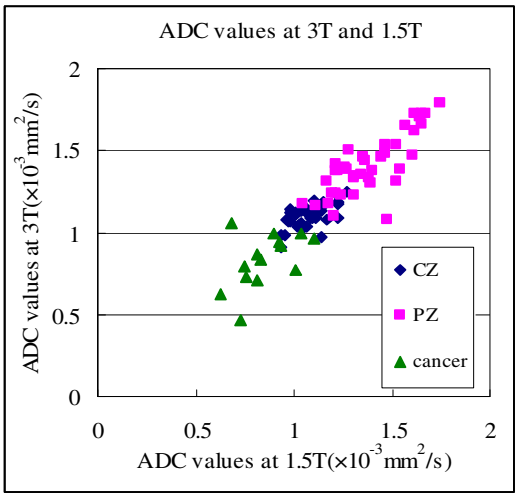

Fig. 1. The ADC values at 3 T were significantly correlated with those at 1.5 T.