Role of Quantitative MRI Biomarkers for Evaluating Prostatic Transition Zone Tumors

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Purpose: To evaluate the efficacy of apparent diffusion coefficient (ADC) maps combined with T2-weighted (T2w) methods in quantitatively assessing the detection of malignant nodules in the prostatic transition zone (TZ).

Materials and Methods: This was a prospective single-center study. Seventy eligible cases were included in the study. Patients underwent conventional magnetic resonance imaging (MRI) examination and functional diffusion-weighted imaging (DWI) examinations. The T2w or DWI results showed the nodules in the prostatic TZ. All seventy patients were suggested to undergo transrectal ultrasound-guided (TRUS-guided) prostate needle biopsy with the MRI information and biopsy results were used for the reference standard.

Results: Fifty-four (77.1%) of seventy patients were verified as having prostatic TZ benign prostatic hyperplasia (BPH) and sixteen (22.9%) patients had malignant nodules by biopsy examination. The ADC values of the benign and malignant nodules were $(1.352 \pm 0.0885) \times 10^{-3}$ mm$^2 \cdot$s^{-1} and $(0.931 \pm 0.0795) \times 10^{-3}$ mm$^2 \cdot$s^{-1}, respectively. The ADC values of malignant nodules were significantly lower than those of benign nodules ($P = 0.05$). The area under the ROC curve (AUC) of T2w combined with ADC data (0.993, 95%CI: 0.935~0.995) was greater than that of T2w images alone (0.896, 95%CI: 0.800~0.956, where CI is confidence intervals, $P < 0.05$). T2w plus DWI had higher sensitivity, specificity, accuracy than Tw2 or DWI alone for predicting prostate cancer detection.

Conclusion: Quantitative MRI biomarkers play very important roles in the differential diagnosis of cancer and BPH in prostatic TZ. In particular, T2w combined with ADC improves the clinical diagnosis of cancer in the prostatic TZ.
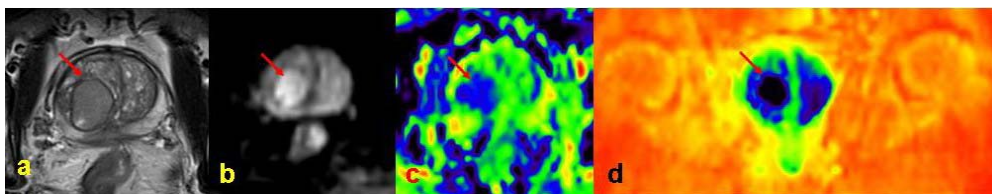
Fig 1 PCa in TZ, 1a T2WI shows an iso-intensity nodule in TZ; 1b the nodule shows high intensity at DWI; 1c the nodule shows low intensity on ADC map; 1d coronal PET-like (arrows)
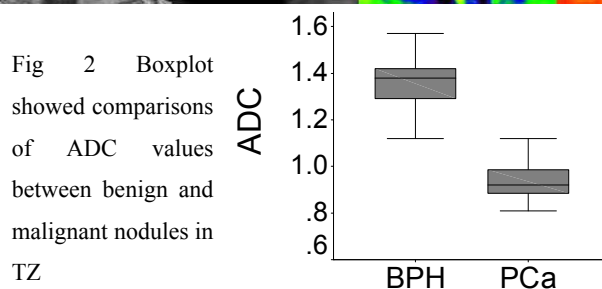

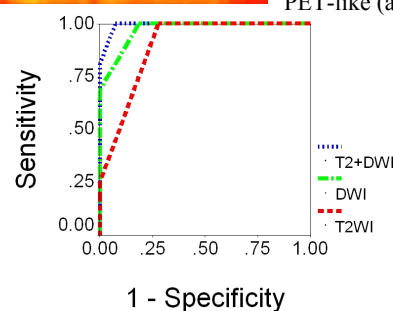Fig 2 Boxplot showed comparisons of ADC values between benign and malignant nodules in TZ

Fig 3 ROC curves for prostate cancer detection

Table 1: Comparison of Three Data Sets (Tw2 alone, DWI alone and T2w combined with DWI) for Prostate Cancer Detection

		Cut Point1	Cut Point 2	Cut Point3	Cut Point 4
T2WI	sensitivity	100%	25%	18.75%	6.25%
	specificity	72.22%	100%	100%	100%
DWI	sensitivity	100%	100%	68.75%	31.25%
	specificity	44.44%	81.48%	100%	100%
T2WI +DWI	sensitivity	100%	100%	81.25%	50%
	specificity	74.07%	92.59%	100%	100%