Diffusion Tensor Imaging of Prostate Cancer: Comparison with Systemic Prostate Biopsy

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Introduction: Diffusion tensor imaging (DTI) has been used primarily to demonstrate microstructure and identify abnormalities in the neurology, and has only recently begun to be investigated for discriminating cancer. DTI uses additional gradients to plot the relative degree of diffusion in multiple dimensions. The use of multiple diffusion gradient directions allows gradient summation, resulting in stronger applied gradients and shorter TE values. Several studies have recently reported the values of measuring diffusion anisotropy to correlate with histologic findings of disease extent in prostate cancer. The purpose of our study was direct comparison between DTI parameters and systemic 12-core biopsy.

Methods: Thirty-one patients with suspected prostate cancer underwent MR imaging and DTI. The men ranged in age from 47 to 72 years (mean, 56 years). DTI was performed at 1.5T MR scanner (GE Signa Excite HD) with an 8-channel phased array coil prior to transrectal ultraound guided systemic 12-core biopsy. We used single-shot spin-echo EPI sequence using the following parameters: TR/TE = 4000/6 ms, FOV = 27 cm, slice thickness =5 mm, no gap, matrix 192 x 192, 4 NEX and ASSET factor = 2. The acquisition time was 2 minutes and b-factors were 0 and 500 s/mm^2 with the diffusion gradients applied in 6 different directions. We prospectively calculated apparent diffusion coefficient (ADC) and fractional anisotropy (FA) value in each corresponding systemic biopsy site using an Advantage Windows workstation (GE Fungtool 2.6.6i). Then, we obtained 12 biopsy cores at the levels of apex, middle, and base in both peripheral zones and classified biopsy cores into “positive” or “negative” for carcinoma.

Results and Discussion: Twenty-three of 31 patients were histopathologically proven adenocarcinoma. Among 276 biopsy cores of 23 patients with prostate cancer, 109 cores showed positive results (39%). ADC and FA value of positive cores were 1.31 ± 0.34 x 10^{-3} mm^2/s and 0.63 ± 0.07 and those of negative cores were 1.74 ± 0.45 x 10^{-3} mm^2/s and 0.48 ± 0.09, respectively. Eight (96 biopsy cores) patients without carcinoma showed ADC value of 1.83 ± 0.26 x 10^{-3} mm^2/s and FA value of 0.42 ± 0.07. ADC and FA value of positive cores were significantly lower than those of negative cores and cancer-free patients ($P < 0.05$) (Fig. 1.). However, there were no significant differences between negative cores and cancer-free patients in both ADC and FA values ($P > 0.05$).

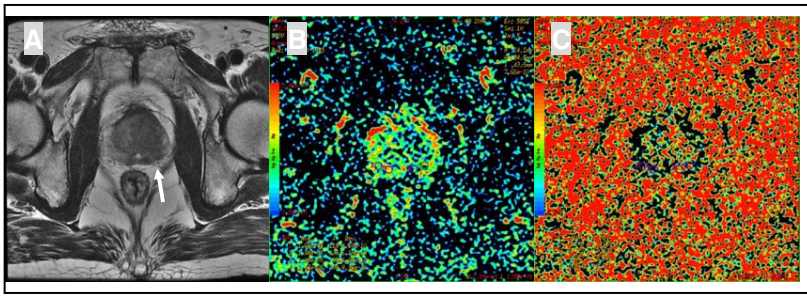

Figure 1. T2-weighted image (A) shows low signal intensity (arrow) of left peripheral zone in accordance with a positive biopsy result. ADC (B) and FA (C) value showing corresponding decrease in the same regions.

Conclusion: ADC and FA value using DTI may provide useful diagnostic information in differentiation of cancerous tissues in patients with prostate cancer, although there is overlap in some cases.

References

[1] Le Bihan D, et al. J magn Reson Imaging 2001;13:534-546. [2] Sinha S, et al. Magn Reson Med 2004;52:530-537. [3] Haker SJ, et al. Proc. Intl. Soc. Mag. Med. 2005. [4] Kozlowski P, et al. J magn Reson Imaging 2006;24:108-113. [5] Sato C, et al. J magn Reson Imaging 2005;21:258-262.