Relative Conspicuity of Prostate Cancer: Apparent Diffusion Coefficient Versus Dynamic Contrast Enhancement

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BACKGROUND: Prostate magnetic resonance imaging has been shown to be sensitive and specific for localization of prostate cancer *in situ* when combining T2 weighted imaging (T2WI) with spectroscopy, but spectroscopy is not reimbursed and is technically demanding. Diffusion-weighted imaging (DWI) and dynamic contrast enhancement (DCE) modeling have emerged as adjuncts which also appear sensitive and specific for *in situ* prostate cancer, but it is unclear if one is superior to the other in terms of lesion conspicuity.

PURPOSE: Compare dynamic contrast enhancement parameters (K^{trans}, K_{ep}, and V_e), Apparent Diffusion Coefficient (ADC) maps from diffusion-weighted imaging (DWI), and T2-weighted imaging (T2WI) of the prostate with pathology and compare the quantitative parameters of the area of highest grade adenocarcinoma (Ca) with the contralateral prostate on the same image to determine relative conspicuity.

MATERIALS AND METHODS: With IRB approval, the reports of 45 sequential patients referred for MRS and MRI of the prostate who subsequently underwent surgical (robot-assisted) prostatectomy were reviewed, of which 20 were excluded because they did not receive intravenous contrast, and an additional 2 we excluded for technically inadequate contrast imaging. Dynamic contrast-enhanced (TWIST, TR 6.8 TE 2.86 ms, 1.5 mm, matrix 320 x 225, 28 x 30 cm FOV, 14 acquisitions every 15 s, 15-20 ml Magnevist after 2nd acquisition) and T2WI (TSE, TR 3800-5040 TE 101 ms, ETL 13, 3 mm, no gap, matrix 256 x 205, 14 x 14 cm FOV) and DWI with ADC (EPI; b = 0, 50, 400 mm/s2; TR 1600-2300 TE 75-90 ms, 5 gap 1.65 mm, 256 x 154 matrix, FOV 35 x 26 cm) was performed on a Siemens Magnetom Avanto 1.5 Tesla magnet using combined external phased array and endorectal coil. Pathology slides were specifically reviewed to determine the location of highest tumor burden, and highest tumor grade, by sextant location (right versus left, base versus midgland versus apex). Regions of interest (ROI) were then calculated at the location of highest grade disease (10-50 mm^2) with comparison ROI of the same area on the opposite side of the same image also calculated. Dynamic contrast enhancement was also carried out using commercial software (MIStar, Apollo Medical Imaging Technologies) with the 1999 Tofts-Brix model, with average K^{trans}, K_{ep}, and V_e calculated using ROI as close to those for T2WI/ADC analysis as possible. For comparison, a unitless variable, the "conspicuity ratio," was calculated as the difference of the values derived from the ROI for the lesion and the contralateral side, divided by the average of these values: $^{(X-N)}/_{(X+N)/2}$. This allows for comparison between disparate units.

FINDINGS: A focal lesion was apparent on ADC and T2WI and to some extent on dynamic contrast imaging in all 20 patients, based on the pathologic description. The means and standard deviations are given below. Paired T-test analysis comparing the lesions to the contralateral side were highly significant ($p<0.01$) for all but V_e.

Average±St. Dev.	T2 signal intensity	ADC (10^{-3} mm/s^2)	K^{trans}	K_{ep}	V_e
Lesion	187±53	0.976±0.190	947±585	3347±1391	299±127
Contralateral	233±97	1.366±0.219	570±386	1892±1067	359±210
Conspicuity Ratio	0.179±0.220	0.334±0.250	0.520±0.422	0.568±0.402	0.088±0.500

The mean values for the lesion and contralateral prostate did overlap within patients, on 5 patients for T2WI, 3 for ADC, and one for DCE. The conspicuity of ADC compared with T2WI was significantly greater based on paired t-test ($p=0.002$) and both K^{trans} and K_{ep} were significantly more conspicuous than ADC ($p=0.05$ and 0.02 respectively) but there was not significant difference between the conspicuity of K^{trans} and K_{ep}. However, neither did ADC nor any DCE value correlate with the Gleason score in this small patient series; only 3 patients were low grade (Gleason 3+3=6), all the rest were Gleason 3+4 or higher.

CONCLUSION: Prostate cancer is more conspicuous on DWI ADC maps and on DCE than on T2WI, and more conspicuous on DCE than on ADC, but K^{trans} and K_{ep} are not significantly different in terms of conspicuity.