Multiparametric Comparison of Magnetic Resonance Spectroscopy and Dynamic Contrast Enhanced Magnetic Resonance Imaging With Surgical Pathology

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BACKGROUND: Prostate magnetic resonance spectroscopy (MRS) and imaging with dynamic contrast enhancement (DCE) is gaining favor as method for staging prostate cancer. Newer minimally invasive therapies, including intensity-modulated and image-guided radiotherapy, high-intensity focused ultrasound, and irreversible electroporation, necessitate localization of disease within the prostate.

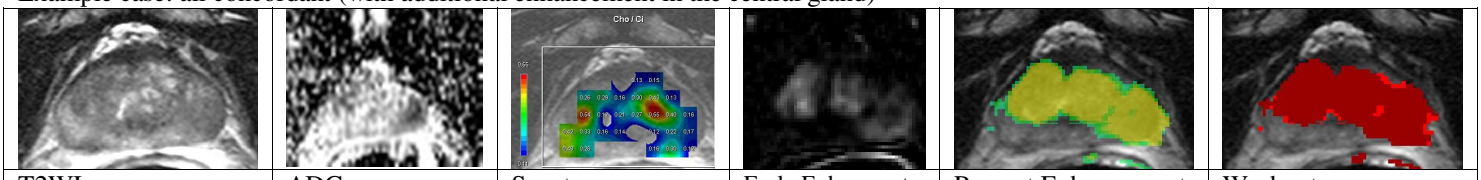
PURPOSE: Comparison of T2-weighted imaging (T2WI), apparent diffusion coefficient (ADC), MRS, and components of DCE with prostatectomy specimens, to determine how accurate each component is at localizing disease

MATERIALS AND METHODS: With IRB approval, the reports of 35 sequential patients referred for MRS and MRI of the prostate who subsequently underwent surgical (robot-assisted) prostatectomy were reviewed, of which six were excluded because they were deferred from receiving contrast. 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 in addition to MRS. 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). For spectroscopy, T2WI, and ADC findings, the radiological reports were reviewed; the reports are routinely structured to report our each sextant location. The DCE data were reviewed for both percent enhancement (PE) and washout (WO), as well as for subjective early enhancement (EI) and de-enhancement (DE). Concordance for imaging and pathology was recorded only when abnormal areas on imaging included all sextant areas of disease by pathology. “Specific concordance” was defined as concordance with no more than 2 other sextant regions positive by imaging.

FINDINGS: Of the 45 patients, 14 were excluded as contrast was not administered, and an additional two were excluded because the pathology was unclear upon second review. One additional patient could not be graded secondary to neoadjuvant therapy. Of the remaining 29 patients, 23 had MRS. Gleason scores were given as 3+3 (3 patients), 3+4 (18), 4+3 (6), 4+4 (1) and 4+5 (1). By pathology, 6 patients had the greatest burden in 1 sextant location, and 17 in two locations, with the rest in 3 or 4 locations, and 17 had the highest grade of disease in 1 sextant location. Spectroscopy was relatively better at localizing higher grade, with accuracy up to 67% for specimens with two sextant areas of disease. The percent enhancement and washout imaging was most likely to overestimate disease, with up to 75% of cases having abnormality corresponding to more than 2 additional sextant areas. Combining T2, WO, and ADC resuted in 86% accuracy by grade, although specific concordance was best for T2WI and PE.

Imaging	T2WI	ADC	Spectro-scopy	PE	WO	EI	DE	T2WI+ PE	T2WI+ WO	T2+PE +ADC	T2+WO +ADC
Concordance, Burden %	43	25	26	54	50	39	29	71	75	75	79
Concordance, Grade %	61	43	30	64	57	54	43	79	82	82	86
Specific Concordance, Burden %	32	18	26	32	25	29	21	50	50	50	50
Specific Concordance, Grade %	39	32	30	29	14	29	21	61	50	61	50

Example case: all concordant (with additional enhancement in the central gland)



T2WI	ADC	Spectroscopy	Early Enhancemt.	Percent Enhancement	Washout

CONCLUSION: No one imaging technique was sufficiently accurate to localize disease, but by combining T2WI, ADC, and DCE, 82% of the highest grade of disease can be localized.