Luminal water imaging of prostate cancer: quantitative comparison with diffusion-weighted imaging for characterization of cancer aggressiveness

Stefanie Hectors PhD[1,2], Daniela Said MD[1,2], Jeffrey Gnerre MD[1,2], Ashutosh Tewari MD[3], Bachir Taouli MD[1,2]

Affiliations:
1 Translational and Molecular Imaging Institute, Icahn School of Medicine at Mount Sinai, New York, NY, United States
2 Department of Radiology, Icahn School of Medicine at Mount Sinai, New York, NY, United States
3 Department of Urology, Icahn School of Medicine at Mount Sinai, New York, NY, United States

Background
Luminal water imaging (LWI), a recently introduced MRI method that employs multicomponent modeling of T2 mapping data, has shown to be promising for the detection and grading of prostate cancer (PCa). While these initial results are promising, it has not yet been established whether this technique is of additional value compared to diffusion-weighted imaging (DWI). Apparent diffusion coefficient (ADC) quantification is already routinely used in prostate MRI and has shown to be valuable for the diagnosis and characterization of PCa, although there is substantial overlap of ADC values between histopathological grades. It would therefore be of substantial clinical value if LWI could provide improved differentiation between histopathological PCa grades. The goals of our study were (1) quantify LWI and ADC parameters in PCa and benign peripheral zone tissues of PCa patients undergoing prostatectomy and (2) evaluate the diagnostic performance of LWI and ADC for differentiation between low- and high-grade PCa lesions.

Methods
Twenty-six PCa patients scheduled to undergo prostatectomy were recruited prospectively in this ongoing study (mean age 59 years, range 46-72 years). Multiparametric MRI at 3.0T was performed, including DWI and LWI T_2 mapping. LWI and ADC parameters were quantified in index tumors and PZ tissue. Differences in MRI parameters between PCa and PZ were assessed using Wilcoxon signed tests. Spearman correlation of pathological grade group (GG) with the MRI parameters (LWI, ADC and PI-RADS) was evaluated. Utility of each of the parameters for differentiation between low-grade (GG≤2) and high-grade (GG≥3) PCa was determined by Mann-Whitney U tests and ROC analyses.

Results
Twenty-six index lesions were analyzed [mean size 1.7±0.8 cm, GG: 1 (n=1; 4%), 2 (n=14, 54%), 3 (n=8, 31%), 5 (n=3, 12%)]. LWI and ADC both showed high diagnostic performance for differentiation between PZ and PCa [highest AUC for LWI parameter $T_{2,short}$ (AUC=0.98, P<0.001)]. LWI parameters luminal water fraction (LWF) and amplitude of long T_2 component A_{long} were the only parameters that significantly correlated with GG (r range -0.441 - -0.414, P<0.036). These parameters also showed significant differences between low-grade and high-grade PCa (P<0.029, AUC 0.758 - 0.776). Maximum diagnostic performance for discrimination of high-grade PCa was found with combined LWI parameters (AUC 0.891).

Conclusions
Our initial results suggest that LWI parameters, in particular in combination, have superior diagnostic performance for differentiation between low-grade and high-grade PCa compared to ADC and PI-RADS assessment.

Conflict of Interest
Dr. Tewari serves as an advisor for Promaxo.

Funding acknowledgement
Stefanie Hectors is supported by the 2017 Judy and Ronald Baron Prostate Cancer Foundation Young Investigator Award.