

## Diffusion-weighted imaging for detection and staging of urothelial neoplasms

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### Introduction

Urothelial carcinoma is the most common urinary tract cancer, and accounts for over 90% of bladder neoplasms [1]. Prognosis relies on local staging, and a reliable diagnosis of early urothelial cancer is essential in improving the outcome [1]. Diffusion-weighted imaging (DWI) has been shown to improve tumor detection through increased lesion conspicuity in the liver [2], and tumor apparent diffusion coefficient (ADC) has been shown to correlate with tumor cellularity and grade [3]. The purpose of this study is to investigate the performance of DWI for the detection and staging of urothelial neoplasms.

### Methods

We retrospectively identified 18 patients (16 men, 2 women, mean age 74.2 y) with pathology proven urothelial neoplasms referred for MR urography (MRU). Patients were evaluated at 1.5 T with a routine MRU protocol and breath-hold, tridirectional SSEPI DWI using  $b=0$ , 400-500, 800-1000 sec/mm<sup>2</sup> in the axial plane (n=9) and coronal plane (n=9). Two readers evaluated DWI signal intensity of tumor for each b-value and measured ADC of detected urothelial neoplasms and urine/kidney (used as reference). ADC values were compared between tumor and reference tissues. In addition, ADC and rADC (relative ADC=ADC tumor/ADC urine) were correlated to pathologic tumor stage for operated patients (n=15).

### Results

18 lesions were evaluated in 18 patients. There were 13 bladder neoplasms [11 transitional cell carcinomas (TCC), 1 TCC with squamous differentiation, 1 TCC with foci of small cell carcinoma], 4 renal TCCs, and 1 ureteral TCC, all confirmed histologically. 83% and 100% of lesions were hyperintense to reference organs on intermediate b-values (400-500 sec/mm<sup>2</sup>) and high b-values (800-1000 sec/mm<sup>2</sup>), respectively. Mean ADC ( $\times 10^{-3}$  mm<sup>2</sup>/sec) of tumor was  $1.42 \pm 0.42$  (range, 0.78 – 2.31), and was significantly lower than ADC of urine (mean ADC  $3.04 \pm 0.51$ ,  $p < 0.0001$ ) and kidney (mean ADC  $2.16 \pm 0.03$ ,  $p=0.0001$ ) (Fig.). Tumor stage was available for 15 lesions, stage 0a (n=3), stage I (n=2), stage II (n=2), stage III (n=5), stage IV (n=3). ADC showed moderate but significant correlation with tumor stage ( $r = -0.525$ ,  $p=0.045$ ), while rADC demonstrated strong correlation with tumor stage ( $r=-0.706$ ,  $p=0.003$ ). Sensitivity, specificity, PPV, NPV and accuracy for prediction of stage 3-4 tumors are listed in the table. We obtained maximum performance in predicting stage III-IV using rADC.

	ADC (< 1.3)	rADC (< 0.48)
Sens.	0.88	1.00
Spec.	0.86	1.00
PPV	0.88	1.00
NPV	0.86	1.00
Accuracy	0.87	1.00

Performance of ADC for diagnosis of stage III-IV urothelial tumors

### Discussion

ADC has been shown to correlate with tumor cellularity in brain and breast neoplasms [4]. However, data on the utility of DWI in urothelial tumors is extremely limited [5]. Our results demonstrate that urothelial neoplasms have restricted diffusion and can be easily detected on DWI. In addition, we established the utility of the relative ADC ratio (rADC) which correlated better with tumor stage than ADC and had 100% accuracy in predicting non-organ confined tumors (stage III-IV), which show significantly higher recurrence rates and worse survival than those with organ-confined tumors [6].

### Conclusion

These preliminary results demonstrate the potential utility of DWI in detecting and predicting stage of urothelial neoplasms, which has an important prognostic value. The addition of DWI to conventional MRI has the potential to include new applications such as better targeting of biopsies and monitoring of disease after treatment.

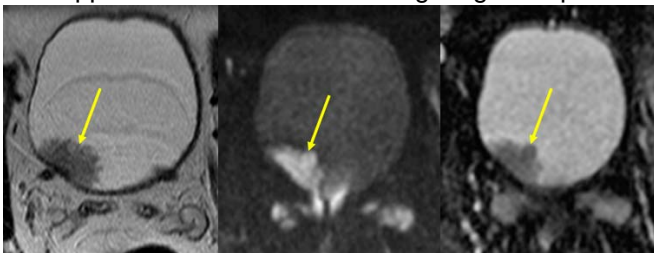


Fig.: Urothelial carcinoma adjacent to the right UVJ demonstrates low signal on T2 (left), high signal on DWI for  $b=500$  (middle) and low ADC (right).

### References

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