Renal lesions: added value of diffusion MRI

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In recent years Diffusion-weighted MRI (DW-MRI) has gaining increasing importance in imaging of the urogenital tract including its application to transplanted and native kidneys with focus on feasibility studies and assessment of diffuse and focal renal disease (1, 2, 3).

The main clinical challenge in evaluating focal renal lesions is the limitation of CT and conventional MRI in differentiating complicated renal cysts from cystic renal cell carcinomas and from abscesses in selected cases as well as solid benign and malignant renal lesions (e.g. oncocytomas and renal cell carcinomas), or between different subtypes of renal cell carcinomas (RCC).

One of the first studies investigating the ability of DW-MRI to evaluate focal renal lesions in a small number of patients (n=25; 26 tumors, 11 benign cysts) reported significantly lower median ADC values in renal tumors compared to benign cysts and necrotic tumor areas, whereas the latter showed lower ADC values compared to simple cysts (4). When renal lesions were stratified by T1 signal characteristics, T1 hyperintense lesions had lower ADC values compared to their hypointense counterparts, and overlap decreased. In another study of 41 patients with 64 non-fat-containing, T1 hyperintense renal lesions, mean ADC values for RCC were significantly lower than those for haemorrhagic or proteinaceous cysts (5). In a further study performed in 42 patients with 69 focal renal lesions, the ADC values of 7 cystic RCCs were significantly lower (p <.001) than those of 31 simple cysts (6). Another study failed to confirm these findings, since no difference between benign cysts and cystic areas of RCC was observed (7). In that study, moreover, ADC values of renal oncocytomas were significantly higher (p=.0097) than those of solid RCCs. All these studies, however, included only a limited number of patients and the reported ADC values showed a non-negligible overlap, although the difference in ADC values between benign and malignant cystic renal lesions was statistically significant. Therefore, the ability of ADC values to discriminate benign from malignant lesions is still limited in everyday clinical practice, where decisions have to be taken on the individual patient.
DW-MRI has also been investigated in an attempt to differentiate the various RCC subtypes, which is critical for both prognostication and selection of appropriate systemic therapies for patients with metastatic disease (8). Contrasting results have been reported in the literature. In a study including 83 patients with 85 tumors (9), applying $b$-values of 0 and 800 sec/mm$^2$ mean ADC values of 49 clear-cell RCCs were significantly higher ($p < .001$) than those of 22 papillary RCCs and 14 chromophobic RCCs, whereas in another study including 32 patients (10) using $b$-values of 0, 300 and 1000 sec/mm$^2$ significantly lower ADC values ($p = .0004$) were reported for clear-cell RCC compared to non-clear-cell RCC. No significant difference between mean ADC values of clear cell RCCs and those of non-clear cell RCC was found in another study including 17 malignant lesions (6). A possible explanation for this discrepancy could be related to differences in image analysis (e.g., delineation of region of interest including necrotic areas leading to higher ADC values) and limited sample size for sub-group analysis.