Specialty area:

RE Course: Added Value of DWI for Your Clinical Practice

Renal Lesions: Added Value of Diffusion MRI

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Highlights:

- Diffusion-weighted MRI (DWI) can improve characterization of renal lesions when combined with conventional MRI
- DWI may be especially useful in patients where the use of intravenous contrast agents are contraindicated

Target audience: Clinicians and clinical scientists interested in improving renal lesion characterization using DWI including IVIM.

Learning objectives: Through discussion of relevant clinical examples compared to the published literature and from clinical practice, course attendees will learn about the use of DWI in combination with conventional MRI for the differentiation of benign from malignant solid and cystic renal lesions, and learn about the potential to differentiate renal cell carcinoma (RCC) subtypes.

Background and motivation: Conventional CT and MRI are limited in their ability to differentiate renal lesions. DWI provides additional functional information over conventional imaging which lends insight into tissue diffusion and perfusion characteristics on a microstructural level, helping to differentiate renal cysts and abscesses from cystic RCC, solid benign from solid malignant lesions, and between RCC subtypes. The purpose of this talk is to demonstrate the use of DWI in improving characterization of renal lesions (1).

Examples from the literature: One of the first studies investigating the ability of DWI to evaluate focal renal lesions in a small number of patients 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 (2). 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 (3). 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 (4). Another study failed to confirm these findings, since no difference between benign cysts and cystic areas of RCC was observed (5). 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.

DWI 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 (6). Contrasting results have been reported in the literature. In a study including 83 patients with 85 tumors (6), 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 a another study including 32 patients (7) 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 (4). 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.

Relevance to clinical practice: DWI combined with morphological images improves characterization of solid and cystic focal renal lesions. This technique in combination with IVIM may be particularly helpful in patients where the use of contrast agents is contraindicated due to renal dysfunction.

References:

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