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Renal Lesions: Added Value of Diffusion MRI

Outline

1. Introduction to DWI:

Diffusion weighted imaging (DWI) is sensitive to thermally induced motion of water molecules known as Brownian motion in tissues. Restriction to water motion or diffusion can be qualitatively or quantitatively evaluated. DWI is easy to perform, does not require gadolinium injection, and provides information about local microenvironment. Hence, this novel technique is generating considerable interest in evaluation of renal lesions.

DWI is most simply performed with 2 or 3b values in the kidneys, such as 0, 400, and 800 sec/mm2; the exponential decay of signals is approximated using a monoexponential fit to arrive at a decay constant, referred to as the apparent diffusion coefficient (ADC).

2. DWI Application:

2.1 Detection and characterization of renal lesion (qualitative and quantitative evaluation):

- Studies have shown more restricted diffusion and lower ADC in the malignant masses compared to the benign lesions (1, 2) presumably due to higher cellularity or complex architecture of the neoplastic lesions (3, 4).

2.2 Differentiating renal cell cancer (RCC) subtypes on the basis of quantitative ADC evaluation

- Papillary and chromophobe subtypes have lower ADC compared to clear cell subtype (5). High nuclear grade clear cell RCC have lower ADC compared to low grade tumors (6).

2.3 Treatment response

- In advanced RCC undergoing targeted chemotherapy, change in ADC may be a sensitive marker of treatment response

3. Novel Emerging Trends:

- Multi-b DWI: The biexponential IVIM model of diffusion-weighted imaging can be used to derive perfusion/microcirculation as well as tissue diffusion parameters (7). These parameters may be useful as alternative biomarkers of malignancy to standard gadolinium chelate contrast agent, or may be more specific quantitative marker for malignancy or treatment response. These potential applications of multi-b DWI need to be investigated.

References:
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