Renal mass characterization with MRI
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Objectives
1. Review an optimized protocol for renal MRI
2. Review major indications and results of renal MRI in adult patients for renal mass characterization

Introduction
Accurate characterization of complex renal lesions relies primarily on the presence or absence of enhancement (1) on contrast-enhanced (CE) CT or MR imaging, which, when present, is generally diagnostic of renal cell carcinoma (RCC), excluding angiomyolipomas (AMLs) and oncocytomas (1-3). With MRI, enhancement can be assessed by measuring signal intensity changes (4) or visually without or with image subtraction (5). However, in view of the recently described concerns of the development of nephrogenic systemic fibrosis in patients with renal insufficiency who have undergone (CE) MRI (6-8), and given the risk of contrast-induced nephropathy with CE CT (9, 10), there is an increasing interest in exploring methods not requiring contrast administration which might be useful in characterizing renal lesions.

Suggested renal protocol
• Axial T1 GRE in- and out of phase: to assess for microscopic fat and differentiate hemorrhagic cysts from AMLs
• Axial and coronal SS FSE T2: to diagnose cysts and hydronephrosis
• SS EPI diffusion-weighted imaging (DWI)-using b0-400-800: helps renal mass characterization
• Axial T1 3D fat suppressed GRE pre and post-contrast (3 time points): essential for diagnosis of renal neoplasm
• Optional (for preoperative planning-renal donors):
  – Coronal 3D T1 GRE MRA: for vascular supply and diagnosis of renal artery stenosis
  – MR Urogram

Role of image subtraction for renal mass characterization
Image subtraction has excellent accuracy for the assessment of enhancement of renal lesions, especially in T1 hyperintense renal lesions, in order to differentiate hemorrhagic or proteinaceous cysts from RCCs (11, 12). Subtraction is limited however by the risk of misregistration artifacts.

Role of diffusion-weighted MRI (DWI) for renal mass characterization
DWI measures water diffusion and capillary perfusion in the kidneys and renal masses, and can help characterize tumors based on their cellularity. There is limited data on the use of DWI for renal lesion characterization (13-16). Prior studies have demonstrated lower ADC of RCCs and solid renal lesions compared to that of simple renal cysts. For example, a prior study (17) based on a total of 109 renal lesions (mean size 4.2 ± 2.5 cm) in 64 patients showed good to excellent performance of DWI in differentiating benign from malignant renal lesions. Mean and SD of ADC (x 10^{-3} mm^2/sec) of RCCs were significantly lower than those of benign lesions: 1.41 ± 0.61 vs. 2.23 ± 0.87 (p <0.0001). AUC, sensitivity and specificity of DWI for diagnosis of RCC were 0.865, 85.7% and 84.6% (when excluding AMLs and oncocytomas), using cutoff ADC ≤ 1.80 or 1.92 x 10^{-3} mm^2/sec.
Conclusion
MRI can be used as a problem solving tool for indeterminate renal lesions on CT or ultrasound, or as a primary modality given its excellent accuracy.

References