Diffusion-weighted MR imaging for characterization of renal masses: preliminary results

R. K. Thakur[1], G. M. Israel[1], V. S. Lee[1], E. M. Hecht[1], B. Taouli[1]
[1]Radiology, NYU Medical Center, New York, NY, United States

Introduction

Contrast enhanced computed tomography (CT) and magnetic resonance (MR) imaging are established methods for preoperative diagnosis and staging of renal masses. While improving the early detection of cancers, advances in imaging technology have also led to the detection of many indeterminate or diagnostically challenging lesions, such as complex cysts. Diffusion-weighted imaging (DWI) has the potential to help characterize these indeterminate renal masses. Previous studies have evaluated renal ADC values (1-3), but to our knowledge only one study has investigated DWI for characterization of focal renal lesions (4). The objective of this study is to describe ADC values of focal renal lesions (simple cysts, complex cysts, and renal neoplasms) and determine whether these can be used to differentiate surgical from nonsurgical lesions.

Methods

Seventeen patients referred for clinical MR evaluation of known or suspected renal masses were evaluated with MR imaging at 1.5 T. In addition to the routine protocol (including coronal T2 HASTE, axial in-phase and out-of-phase T1, and 3D gadolinium-enhanced GRE sequence), 3 breath-hold, pulse triggered, echoplanar diffusion-weighted sequences (b=0, 400; b=0, 800; and b=0-400-800 sec/mm2) were performed using TR/TE 2300/60 (b=400), 68 (b=800), FOV 338x450 mm, matrix 192x256, slice thickness/gap 7/1.4 mm, number of acquisitions 2. Pixel-by-pixel ADC maps were obtained using commercial software. Based on conventional MR imaging characteristics, lesions were categorized as nonsurgical (Bosniak category 1, 2 and 2F) or surgical (Bosniak categories 3, 4 and non fat-containing solid masses) by consensus read of two radiologists. A third radiologist measured the ADC values on focal renal lesions and on normal cortex and medulla.

Results (see table)

Thirty-two lesions were evaluated in 17 patients. Based on routine imaging, 23 lesions were characterized as nonsurgical and 9 as surgical. Statistically significant ADC differences were observed between surgical and nonsurgical lesions at all b-values. Significantly different ADCs were also observed between renal cortex and renal medulla in 16 patients (cortex/medulla ADCs were not calculated in one patient with polycystic kidney disease.).

*ADC= value x 10^{-3} mm^2/sec; **Wilcoxon test; ***Wilcoxon matched-pairs signed-ranks test

	ADC* b=0,400	ADC b=0,800	ADC b=0,400,800
Nonsurgical lesions (23 lesions)	3.10 ± 0.23	2.81 ± 0.15	2.79 ± 0.14
Surgical lesions (9 lesions)	2.08 ± 0.27	1.65 ± 0.21	1.77 ± 0.18
Surgical vs. nonsurgical	*p < 0.006*	*p < 0.002*	*p < 0.005*
Normal renal cortex (16 patients)	2.98 ± 0.15	2.46 ± 0.10	2.51 ± 0.11
Normal renal medulla (16	2.49 ± 0.13	2.11 ± 0.09	2.11 ± 0.10
*Cortex vs. medulla****	*p < 0.001*	*p < 0.001*	*p < 0.001*

Discussion

These preliminary results data demonstrate the potential utility of DWI for evaluation of renal masses. Surgical lesions have significantly lower ADC values, indicating more restricted diffusion, when compared to nonsurgical cystic masses. However, further evaluation is needed to determine if DWI can be used to differentiate benign renal neoplasms (such as oncocytomas and angiomyolipomas) from renal cell carcinoma. These data also demonstrate significantly different ADC values of renal cortex and medulla, in agreement with previously published data (1,3).

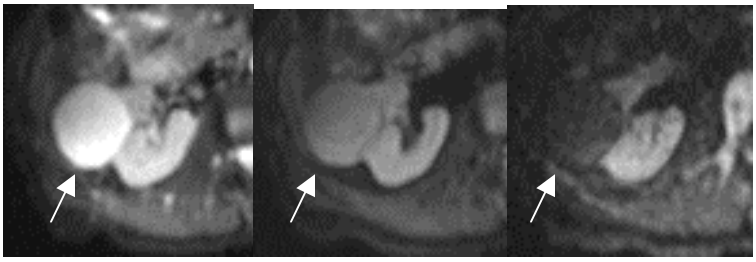

Fig. 1

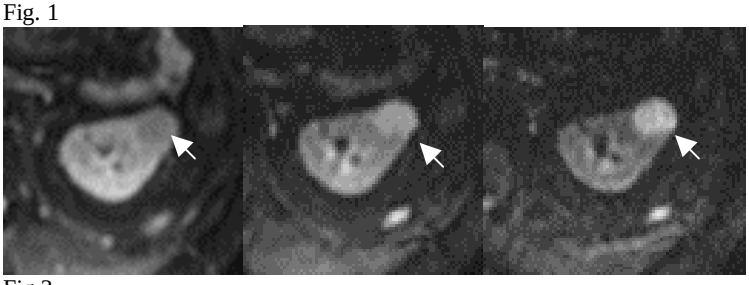

Fig 2

From left to right, DWI b=0, DWI b=400 and b=800.
Fig. 1: Simple renal cyst of right kidney. There is signal attenuation (stronger for b=800) of the cyst content, indicating free water diffusion.
Fig. 2: Papillary renal cell carcinoma of left kidney. There is no signal attenuation of the mass, which appears bright relative to renal parenchyma, indicating restricted diffusion.

References
1.Namimoto T, et al. Measurement of the apparent diffusion coefficient in diffuse renal disease by diffusion-weighted echo-planar MR imaging. JMRI 1999; 9:832-837
2.Fukuda Y, et al. Anisotropic diffusion in kidney: apparent diffusion coefficient measurements for clinical use. JMRI 2000;11:156-160.
3.Ries M, et al. Diffusion tensor MRI of the human kidney. J Magn Reson Imaging. 2001;14:42-49.
4.Cova M, et al. Diffusion-weighted MRI in the evaluation of renal lesions: preliminary results. Br J Radiol 2004;77:851-857