

## Focal Nodular Enhancement on 3D MRI of Cystic Renal Lesions Predicts Malignancy

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**Purpose:** Improvements in imaging, primarily through technological advancement, have increased detection and characterization of renal lesions dramatically. Complex cystic renal lesions are a difficult problem for radiologists and urologists. The Bosniak classification, based completely on CT findings, helps guide clinical decision-making<sup>1</sup>. Despite an increasing use of magnetic resonance imaging (MRI) for evaluating renal lesions, the Bosniak system is still in the process of being verified for MRI of complex renal cysts<sup>2</sup>. The exquisite soft tissue contrast and sensitivity to contrast media with MRI allows small enhancing components in cystic lesions to be seen. We examined the positive predictive value (PPV) for malignancy of focal nodular enhancement in renal cysts seen on breath hold three dimensional (3D) MRI.

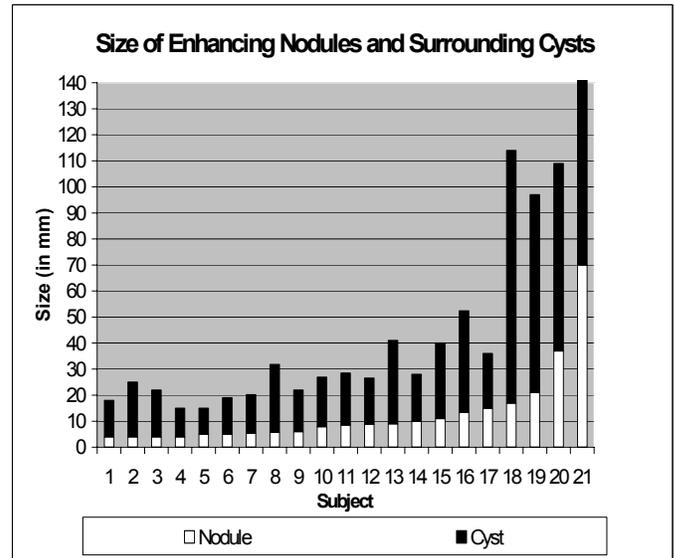
**Materials and Methods:** A surgical database was reviewed to identify all patients having both a pre-operative 3D renal MRI and a radical or partial nephrectomy from January 2000 thorough April 2004. Both the MRI and the surgery had to be performed at our hospital. From among those cases with MRI prior to partial or radical nephrectomy, 21 patients were identified with focal nodular enhancement within cystic renal lesions on 3D fat suppressed T1-weighted gradient echo acquisitions (TR=4.2, TE= 1.7, flip angle 12, thickness 3 mm, matrix 256-320 x 128-190) in the coronal and sagittal planes. Pathologic correlation was made in each case.

**Results:** 286 nephrectomies were performed during the study period, of which 159 (56%) patients had pre-operative MRI studies. There were 21/159 (13%) patients with complex cystic lesions that displayed focal nodular enhancement (Figures 1 and 2), 14 (67%) of which measured  $\leq 10$ mm. Twenty (95%) of the 21 lesions were renal cell carcinoma. The single benign lesion was a cystic nephroma. Fuhrman Grade 1 or Grade 2 cancers were found in the majority of patients (80%), and there were no Grade 4 cancers.

**Conclusions:** High resolution contrast enhanced 3D MRI is critical for cystic renal lesion characterization. The demonstration of solid enhancing nodular components provides excellent PPV for diagnosing neoplastic cystic renal lesions, including a large percentage  $\leq 10$ mm in size. Our experience suggests a 95% likelihood that cystic renal lesions with focal nodular enhancement are malignant.

### References:

1. Bosniak MA. The current radiological approach to renal cysts. *Radiology* 1986;158(1):1-10.
2. Israel GM, Hindman N, Bosniak MA. Evaluation of cystic renal masses: comparison of CT and MR imaging by using the Bosniak classification system. *Radiology* 2004;231(2):365-371.



**Figure 1.** Size distribution of focal enhancing nodules and surrounding cysts in ascending order of nodule size for the 21 patient cohort. 14 nodules (67%) measured  $\leq 10$ mm and 7 nodules (33%) measured  $\leq 5$ mm.



**Figure 2.** Coronal gadolinium-enhanced subtracted (post-contrast minus pre-contrast) 3D T1-weighted SPGR image showing cystic lesion in the lower pole of the the left kidney. A 5mm focal enhancing nodule (arrow) has high signal intensity, as do thin enhancing septae, compared to the non-enhancing fluid contents within this cystic lesion. Grade II clear cell RCC was determined at pathology.