

Characterization of renal masses: Is there a threshold for differentiating noise from true enhancement on subtraction imaging?

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Introduction

Soft tissue enhancement is the most important characteristic diagnostic for a renal neoplasm. Postprocessing image subtraction has been used successfully in MR in characterizing and evaluating enhancement of renal lesions. However, image noise is a potential pitfall in MR subtraction imaging. Our objective was to evaluate if there is a threshold signal-to-noise ratio of subtraction images for distinguishing nonenhancing from enhancing renal lesions.

Methods

The retrospective study and a waiver of patient consent were approved by our institutional review board. Subtracted data set using voxel-by-voxel subtraction of precontrast images from the postcontrast images was retrospectively created from initial MR dataset of 52 renal lesions from 18 patients (13 men, 5 women, mean age 67 y) that included 17 simple cysts and 19 T1 hyperintense cysts with documented stability of at least one year and 16 renal neoplasms (15 renal cell carcinomas, 1 oncocytoma) for which pathologic correlation was available. Images for analyses of renal mass enhancement were performed at 1.5T by using a breath-hold T1 weighted 3D fat suppressed GRE sequence (VIBE) (TR/TE/FA 3.4/1.3/12°, matrix 104-177x256, 30-45 cm FOV, parallel imaging GRAPPA factor 2). Images were obtained before and after the administration of 19mL gadolinium DTPA at 0, 70, and 180 seconds.

Voxel-by-voxel subtraction of unenhanced from contrast enhanced images at 180 seconds was performed using standard software (Syngo, Siemens). Circular regions of interest (ROIs) measuring approximately 20 pixels were drawn within the lesion of interest and within the background air adjacent to the patient ipsilateral to the lesion to calculate an approximate SNR (aSNR) = mean internal lesion signal / standard deviation of background air noise. The Tukey honestly significant difference procedure was used to assess for differences among the subtraction-to-noise ratios of simple cysts, T1 hyperintense cysts, and renal neoplasms.

Results

The mean (\pm sd) aSNR for renal masses was 27.67 ± 14.75 , for simple cysts was 2.18 ± 1.38 , and for T1 hyperintense cysts was 2.56 ± 2.48 . The aSNRs for simple cysts and T1 hyperintense cysts were not significantly different ($p=.990$) and the aSNRs for cysts (simple and T1 hyperintense) were significantly lower compared with renal masses ($p<.001$). In addition, a cutoff aSNR value of 10 would achieve a 100% specificity and sensitivity in distinguishing nonenhancing from enhancing renal lesions (Figure 1).

Discussion

Our preliminary data shows that SNR estimate can be used to distinguish image noise from true enhancement in image subtraction of a renal lesion, with a cutoff aSNR value of 10 achieving a 100% specificity and sensitivity.

References

1. Hecht E, et al. *Radiology* 2004; 232:373-378.
2. Ho V, et al. *Radiology* 2002; 224:695-700.

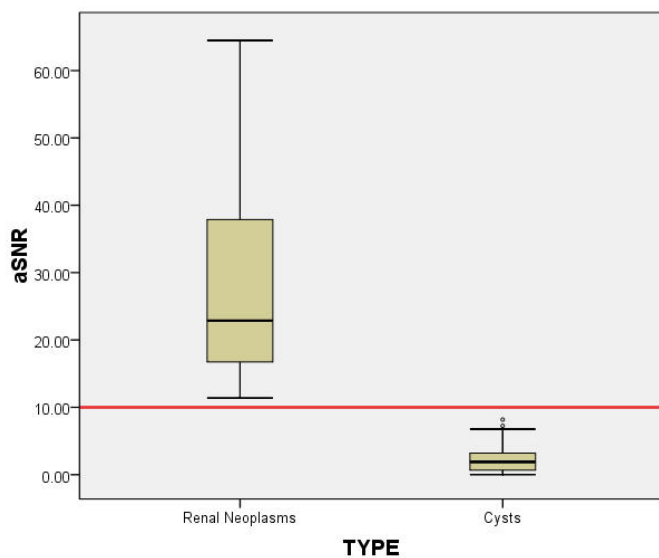


Figure 1. Boxplot of the aSNRs of renal neoplasms and renal cysts.

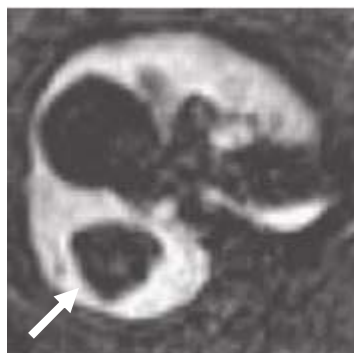


Figure 2. Signal attenuation within a simple renal cyst (arrow) of a subtraction image secondary to image noise with an aSNR of 7.2.



Figure 3. Enhancement within a subtraction image of a pathology proven papillary renal cell carcinoma (arrow) with an aSNR of 12.3.