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A novel approach for identifying aggressive cystic renal cell carcinoma using solid volume score and enhancement

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INTRODUCTION AND OBJECTIVES: Bosniak classification of renal cysts provides radiographic prediction of malignant histology but does not address tumor aggressiveness. Limited evidence suggests cystic renal cell carcinoma (RCC) tumors may be indolent, challenging whether resection is routinely warranted, however oncologic outcomes remain poorly characterized. Here we provide the largest study to our knowledge characterizing tumor histology and metastasis rates for cystic RCC patients, while identifying radiographic features predicting aggressive biology.

METHODS: Cross-sectional imaging was reviewed for 864 consecutive RCC patients undergoing partial or radical nephrectomy at a single National Comprehensive Cancer Network cancer center from 2006-2013. Patients with cystic RCC tumors defined as $\geq$70% cystic (solid composition $\leq$30%) were identified. For each, an estimated solid volume (ESV) score was calculated as the product of tumor volume ($^4/_3\Pi r^3$) and radiographically estimated solid percentage (0-30%); the solid component was further classified as hypo- (<40 net HU) vs. hyperenhancing (>40 net HU). Cyst features were correlated with high grade histology and postoperative metastasis.

RESULTS: 50 cystic RCC lesions from 49 patients were identified. Median cystic percentage was 90% and median ESV score was 5 cc (range 0-595 cc). Histologic subtypes included 32 clear cell, 17 papillary and 1 unclassified. 13 (26%) tumors had high grade histology. With a median follow up of 24 months, 6 (12%) patients developed metastasis. High grade and/or metastatic cases (N=14) could be split into two groups: 1) hyperenhancing/clear cell RCC with a high ESV score, 2) hypoenchancing/papillary or unclassified RCC. Among cysts with hyperenhancement (all clear cell RCC), a threshold ESV of $\geq$70 cc was 100% sensitive and 83% specific for high grade and/or metastasis. In contrast, cysts with solid hypoenhancement (all papillary or unclassified RCC) were frequently associated with high grade histology and metastasis at even low ESV scores (range 3-108 cc).

CONCLUSIONS: ESV score and enhancement level can help identify aggressive variants of cystic RCC. Hyperenhancement indicates clear cell histology and suggests indolent biology when ESV is low. Conversely, cystic RCC with solid hypoenhancement suggests papillary histology which may be aggressive even with low ESV. Surgery is advisable for lesions with high ESV and for all hypoenhancing cystic RCC lesions regardless of ESV, while hyperenhancing cystic lesions with low ESV may be good surveillance candidates.

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