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Original article

Pathological characteristics and radiographic correlates of complex renal cysts

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Abstract

Objectives: To characterize pathological and cancer-specific outcomes of surgically resected cystic renal tumors and to identify clinical or radiographic features associated with these outcomes.

Methods and materials: All patients at our institution who underwent radical or partial nephrectomy for complex renal cystic masses between 2004 and 2011 with available computed tomographic imaging were included. The Bosniak score was determined, as were 10 specific radiographic characteristics of renal cysts in patients with preoperative imaging available for review. These characteristics were correlated with cystic mass histopathology. Recurrence-free survival after surgery was determined.

Results: Overall, 133 patients underwent renal surgery for complex cystic lesions, 89 (67%) of whom had malignant lesions. Malignancy risk increased with Bosniak score ($P \leq 0.01$) and presence of mural nodules ($P = 0.01$). Most (63%) malignancies demonstrated clear cell histology. The papillary renal cell carcinomas (25%) exhibited lower enhancement levels ($P = 0.04$) and were less often septated ($P < 0.01$). Of the malignancies, 79% were low stage (pT1), and 73% were Fuhrman grade 1 or 2. Large cyst size was associated with advanced tumor stage ($P = 0.05$). Neither Bosniak score nor any other radiographic parameter was associated with Fuhrman grade. In 70 patients with a median follow-up of 43 months, only 1 (1.4%) developed disease recurrence.

Conclusions: Most cystic renal malignancies are low-stage, low-grade lesions. Papillary renal cell carcinomas account for nearly a quarter of cystic renal malignancies and have unique radiographic characteristics. Disease recurrence after surgical resection is rare. These findings suggest an indolent behavior for cystic renal tumors, and these lesions may be amenable to active surveillance.

Keywords: Kidney; Renal cell carcinoma; Cysts; X-ray computed tomography

1. Introduction

The incidence of renal cell carcinoma (RCC) has increased in the last decade [1]. This increased incidence is partially due to the widespread use of abdominal cross-sectional imaging leading to the frequent detection of asymptomatic renal masses. Although the majority of these masses are solid lesions, approximately 6% of these incidentally detected masses are cystic renal cancers [2].

Although the pathological and cancer-specific outcomes for solid renal masses have been studied extensively [3–5], these characteristics for cystic masses are less well characterized [6]. Given the paucity of data regarding cystic renal masses, counseling patients with asymptomatic cystic renal lesions can be difficult. The Bosniak score is well established in characterizing the malignant potential of cystic renal lesions [7,8]; however, it is unclear whether there is an association between Bosniak score and other pathological outcomes such as histologic subtype, pathological stage,

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and Fuhrman grade. It is also unclear which specific radiographic characteristics of cystic renal lesions are most strongly associated with the risk of malignancy and other pathologic outcomes, which may be particularly important given the uncertainties inherent in percutaneous biopsy of cystic renal lesions.

A growing body of literature supports active surveillance as an initial management strategy for small renal masses, especially those thought to have relatively indolent behavior with minimal potential for metastases [9]. Identification of clinical or radiographic characteristics associated with indolent behavior of cystic renal lesions would allow the clinician to better differentiate lesions that can be managed expectantly from those with greater malignant potential that warrant immediate intervention.

In the current study, we aimed to describe the pathological characteristics and cancer-specific outcomes of cystic renal lesions removed owing to concern for malignancy. Furthermore, we sought to retrospectively identify clinical or radiographic characteristics associated with these specific pathological outcomes.

2. Materials and methods

2.1. Study cohort

A retrospective analysis of our institutional kidney cancer database was performed to identify subjects who underwent either radical or partial nephrectomy for a cystic renal lesion concerning for malignancy between 2004 and 2011. Study approval was obtained by our institutional review board. Patients with known hereditary renal tumor syndromes, polycystic kidney disease, and renal failure–associated renal cystic disease were excluded. A total of 133 patients were identified. Of these, 49 (36.8%) had detailed 3- or 4-phase preoperative computed tomographic (CT) imaging (precontrast as well as early and delayed post–intravenous contrast phases) available for rereview.

For patients with available preoperative imaging, scans were rereviewed by a single body imaging fellowship–trained CT attending radiologist (P.T.J.) blinded to diagnosis, who confirmed the presence of a cystic lesion, defined as a renal lesion with a wall surrounding some degree of fluid components. At the discretion of the radiologist, lesions that appeared to be solid lesions with large areas of necrosis were excluded. Each case was assigned a Bosniak score, performed by consensus between the same radiologist and a highly experienced attending radiologist (E.K.F.) for equivocal cases [8]. For patients in whom preoperative imaging was not available for rereview, the Bosniak score was determined by the radiology report or by the clinician's interpretation of the imaging at the time of the original clinic visit.

In patients with available preoperative imaging, CT images were rereviewed for the following 10 detailed radiographic characteristics: percent of lesion cystic vs. solid, presence of septations, character (thick vs. thin) of septations, presence of a mural nodule, presence of necrosis, presence of calcifications, 3-dimensional size of cyst, 3-dimensional size of mural nodule, maximum wall thickness, and density of any cystic or solid components on precontrast and arterial phase (i.e., lesion enhancement). These characteristics were not assessed in the subset of patients in whom preoperative imaging was not available for rereview.

2.2. Pathological analysis

Pathological characteristics after either partial or radical nephrectomy were determined by chart review. These characteristics included tumor histologic subtype, pathological stage, and Fuhrman grade. Per convention, Fuhrman grade was not determined for chromophobe RCC [10].

Univariate associations of demographic characteristics and clinical parameters with pathological outcomes were then determined using the chi-squared test. Associations between Bosniak score and pathological outcomes were similarly determined.

In the subset of patients with available preoperative imaging, the chi-squared test was used to determine univariate associations between the 10 detailed radiographic characteristics and pathological outcomes. Several patients did not have a full 3-phase renal protocol CT performed preoperatively, as not all of the scans were performed at our institution. Thus, certain radiographic parameters could not be assessed in all patients, precluding a multivariable analysis investigating associations between radiographic characteristics and pathological outcomes.

2.3. Survival analysis

Tumor recurrence data were ascertained from the Johns Hopkins Hospital and Johns Hopkins Bayview Medical Center cancer registries, which prospectively collect annual oncological follow-up data on all patients with cancer treated at these institutions. Recurrence was defined as detection of a nodal or distant metastasis. Recurrence-free survival was determined for patients with $\geq$6 months of available follow-up data.

3. Results

Overall, 133 patients met the study inclusion criteria; all had pathology reviewed at our institution (100%), and 49 (37%) had preoperative CT imaging available for institutional radiologic rereview. Patient demographic characteristics are summarized in Table 1. There were 80 men (60%) and 53 women (40%). Median patient age was 57.0 years (interquartile range = 19.3 y). Of the 133 lesions, 44 (33%) were benign and 89 (67%) were malignant. Of the 44 benign lesions, there were 40 (91%) simple cysts and 4 (9%) mixed epithelial and stromal tumors. These