A Clinical View of Simple and Complex Renal Cysts

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ABSTRACT
The availability and use of abdominal diagnostic ultrasonography or computed tomography has led to the frequent detection of asymptomatic renal cysts. The vast majority of these are simple cysts that are usually unilateral and solitary with well-defined structural and imaging features and whose occurrence, number, and bilaterality increase with age. Simple cysts are asymptomatic, except when complications such as hemorrhage, infection, or rupture lead to the development of complex cysts with calcification, demarcation irregularities, and multilobularity. The diagnostic challenges that cysts present are in the differentiation of the less common complicated complex cysts from those associated with malignancy and when numerous the possible heralding of genetic or acquired multicystic diseases of the kidney.


Cysts are the most common space-occupying lesions of the kidney. Whereas their presence is mentioned in the older literature and their pathogenesis discussed as far back as the 19th century, it is only with the arrival of noninvasive methods of abdominal imaging over the past 50 yr that their clinical importance has grown. Technical advances in imaging, accrued expertise in their use and interpretation, and the expanding but varied populations studied over the years make it difficult to compare adequately published reports over time.

A turning point in this evolution was a 1964 classification of renal cystic diseases on the basis of microdissection of kidneys that localized cysts to specific nephron segments and classified them broadly as hereditary, nonhereditary, or acquired.1 Subsequent nosologic refinements coupled with clinical, morphologic, and radiologic observations have clarified and expanded the field of renal cystic diseases.2–4 Major advances in understanding inherited forms of cystic disease, particularly autosomal dominant polycystic kidney disease, provide compelling evidence for the role of genetics and epithelial cilia in the formation of cysts.5–6 The nonhereditary forms of cystic lesions have received less attention at a time when widespread use of abdominal imaging has increased their detection and refined their diagnosis in general, particularly the simple cyst. Much of the attention on the latter has focused on their radiologic diagnosis and indications for surgical intervention. Recent evidence suggests additional linkages and problems such as their association with hypertension, kidney size, and renal function.7–11

Simple cysts are usually unilateral and solitary lesions with well-defined features.2–4 Their importance stems from their increased detection in aging populations with widespread use of abdominal ultrasonography and computed tomography (CT). The diagnostic challenges they present is their differentiation from the atypical features of the far less common complex cysts associated with malignancy and, when present in increased numbers, their evaluation as an early manifestation of a genetic or acquired multicystic disorder.

A distinct characteristic of simple cysts is their increased occurrence with aging. Early autopsy studies reported almost half of individuals older than 50 yr have one or more renal cysts.12 Cross-sectional imaging studies since then substantiate their increased prevalence with age (Figure 1) and hence their being considered “acquired.” Acquired they may be, but their pathogenesis remains unknown. One perpetuated notion from microdissection is they originate from diverticulae of the distal convoluted tubules and collecting ducts and increase with age.13 This remains an unexplored and unsubstantiated area.

Simple cysts may be present at birth. Ultrasonography on approximately 30,000 fetuses in succession revealed an incidence of 0.09%, in most of whom the cysts resolved by birth.14 Only two of them persisted as simple benign cysts and in a third case heralded a unilateral multicystic dysplastic kidney. Between birth and 20 yr of age, the occurrence of new cysts is very rare but thereafter begins to increase in frequency, with an increased male-to-female ratio of approximately 2:1 in some studies.7–11 The reported overall prevalence of simple
Stage Cyst Wall Septae Calcification Enhancement

<table>
<thead>
<tr>
<th>Stage</th>
<th>Cyst Wall</th>
<th>Septae</th>
<th>Calcification</th>
<th>Enhancement</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Hairline thin</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>II</td>
<td>Minimal regular thickening</td>
<td>Few, hairline thin</td>
<td>Smooth, hairline thin</td>
<td>No</td>
</tr>
<tr>
<td>IIIF*</td>
<td>Minimal regular thickening</td>
<td>Multiple, minimal smooth thickening</td>
<td>Thick, nodular</td>
<td>No</td>
</tr>
<tr>
<td>III</td>
<td>Irregular thickening</td>
<td>Measurably thick, irregular</td>
<td>Thick, nodular, irregular</td>
<td>Yes</td>
</tr>
<tr>
<td>IV</td>
<td>Gross irregular thickening</td>
<td>Irregular gross thickening</td>
<td>Thick, nodular, irregular</td>
<td>Yes, tissue and cyst</td>
</tr>
</tbody>
</table>

*F in IIIF is for follow-up. Cyst size of >3 cm in diameter is another criterion for follow-up and by extension inclusion in class IIIF.
Alternatively, this is one situation in which cyst puncture and aspiration can be diagnostic and either circumvent the need for surgery or limit it to drainage of an infected cyst.\(^4\,16\)

A classification of renal cysts on the basis of their appearance and enhancement on CT was introduced by Bosniak in 1986 and refined in 2003 (Table 1)\(^17\) and is accepted by urologists and radiologists for the diagnosis, evaluation, and management of cystic lesions. Technical adequacy, high-quality imaging, operator skill, interpretive expertise, and the population studied affect the variable results in the literature. It is important to note that the classification criteria are based on CT and only retrospectively extended to ultrasonography for the diagnosis of a simple cyst.

Whether labeled simple or complex or however reported radiologically, the terms used all are descriptive. Whenever concern of their association with neoplasms exists, a final diagnosis can be made only with histologic examination. Approximately 40 to 60% of class III and 85 to 100% of class IV cysts prove to be malignant\(^2\,4\). Nevertheless, imaging findings can be diagnostic and circumvent unnecessary surgery. As a rule, sharply defined cysts with well-transmitted sound waves and absence of any echoes on ultrasonography define a simple cyst. Any complexity that deviates from this should be further evaluated by CT. The features of note on CT that are associated with increased risk for malignancy are the presence of calcification, septae, loculation, wall thickening or nodularity, and increased density or enhancement after dye injection. It is the cumulative complexity of these features that determine the Bosniak classification (Table 1). Magnetic resistance imaging has better contrast resolution than CT and can be useful in indeterminate class II and III cases but is not necessary for routine evaluation.\(^2\,4\)

Taken together, lobularity, irregularity, calcification, and measurable dye enhancement (increased attenuation of \(>10\) to 15 HU) of a cyst determine its current classification and approach (Table 1). Although there are no evidence-based guidelines, the available literature suggests that\(^2\,4\) class IV cysts and definite class III features should be considered surgical. Class IIF and indeterminate class III should be followed by CT at 3, 6, and 12 mo and annually thereafter. Class I and II cysts are benign but may need periodic evaluation by ultrasonography for the first 2 to 3 yr, especially in younger patients with cyst diameters of \(>3\) cm. Renal neoplasms originating from a simple cyst wall were observed in two of 61 patients followed for 10 yr.\(^8\) As such, periodic evaluation at progressively longer intervals of enlarging or symptomatic cysts would be prudent. The role of therapeutic shrinkage of enlarging cysts is questionable.\(^2\,4\)

**References**