

SOLICITED REVIEW / *Genitourinary imaging*

# Simple and complex renal cysts in adults: Classification system for renal cystic masses<sup>☆</sup>

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## KEYWORDS

Kidney;  
Renal cyst;  
Cystic tumor;  
Ultrasound;  
Bosniak classification

**Abstract** Ultrasound and slice imaging are currently the key modalities for diagnosing simple renal cysts. Benign simple renal cysts are defined by a set of strict criteria. Any cystic lesions that do not meet these criteria should be classified as "atypical" or "complex" and considered as suspicious. For over three decades, the Bosniak classification has been the central tool for diagnosing renal cystic masses larger than 1 cm. The Bosniak classification is based upon the results of a well-established pre- and post-contrast computed tomography (CT) protocol. Lesions that are difficult to classify or that remain indeterminate after CT can benefit from a multimodal diagnostic approach combining CT, non-contrast-enhanced and contrast-enhanced ultrasound, and magnetic resonance imaging.

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Simple renal cysts are defined as non-tumor lesions of the parenchyma, with an epithelial origin, and consisting of a thin-walled, completely fluid-filled renal mass. This definition excludes numerous cystic masses of the renal parenchyma; including those caused by dysplastic, dystrophic, or inherited conditions, or those acquired in chronic dialysis patients. Cystic tumors, various infectious, inflammatory lesions, and lesions of the excretory renal system can be difficult to differentiate from complicated benign cysts. When a cystic renal mass does not meet all the necessary criteria to be classified as a simple cyst, it is referred to as a complex or atypical cyst. If it seems suspicious, it is referred to as an atypical, cystic "lesion" or "mass". The Morton Bosniak classification system is the central tool for diagnosing renal cystic masses using CT for the three last decades [1]. It is comprised of five lesion categories. These categories are used to predict the risk of malignancy as well as standardize the management of cystic renal lesions.

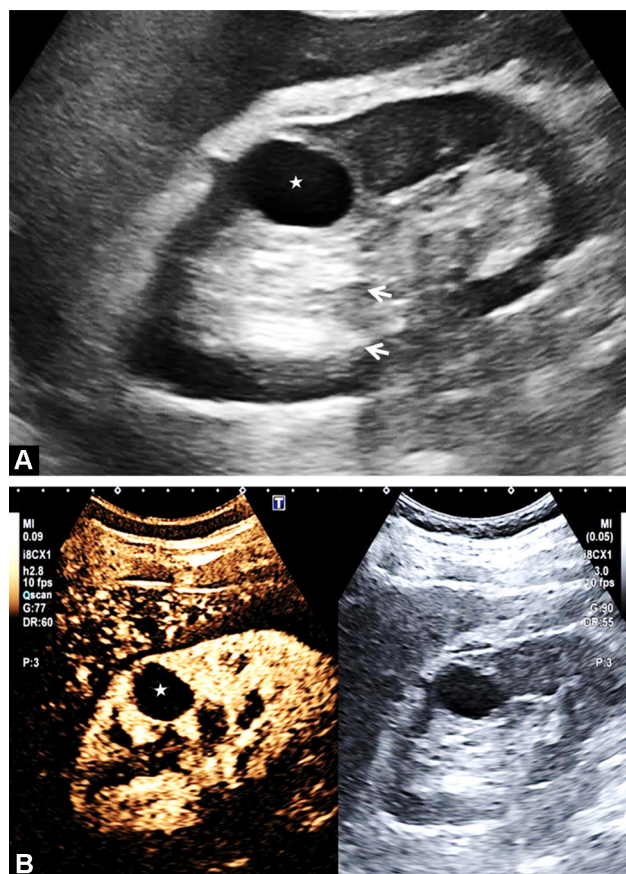
## Diagnosis of a simple cyst

Typical simple cysts are typically discovered incidentally and are easily diagnosed upon cross-sectional imaging. Such cysts are often detected during a renal or abdominal ultrasound, and can generally be diagnosed with certainty using this modality. Intravenous iodine or gadolinium contrast-enhanced computed tomography (CT) or magnetic resonance imaging (MRI) also generally results in definitive diagnosis. Simple cysts are classified as Bosniak category I within the Bosniak classification system.

## Ultrasound

A simple cyst is defined by ultrasound as a rounded or oval mass of homogeneous anechoic content. The cyst must also exhibit marked posterior enhancement, smooth well-delimited margins, and an imperceptible sub-millimeter wall (Fig. 1A). The borders between the cyst and the surrounding structures should form a simple interface, and no wall should be visible around the lesion. When all the previous criteria are met, the reliability of ultrasound (US) is approximately 100% [2]; however, this should be balanced with the operator- and device-dependency of the method. The now widespread use of tissue harmonic imaging has resulted in increased diagnostic confidence and more stable performance due to improvement of cystic lesion analysis.

Color Doppler generally provides no further advantage for the diagnosis of a simple cyst. Some bilobar-shaped cysts that display a central septation may contain an artery that runs along the septation. Such features reflect the presence of two side-by-side cysts separated by a narrow band of kidney parenchyma. Similarly, simple renal sinus cysts can contain a segmental artery which originates on the periphery and runs deep within the cyst. The absence of vessels within a complex fluid-filled lesion does not allow an operator to suggest that the cyst is benign in nature. In this case, further imaging, such as CT or MRI, should be planned.



**Figure 1.** (A) Typical simple cyst. B-mode ultrasound. (B) Anechoic, round mass showing marked posterior enhancement, homogeneous, well-delimited, imperceptible wall on contrast-enhanced ultrasound. Image obtained 40 seconds after injection of 1.2 mL of contrast agent (SonoVue®). Note the anechoic, round, well-delimited, smooth mass showing no signs of internal or peripheral enhancement after injection of contrast medium (star).

## Contrast-enhanced ultrasound

Current low-mechanical index, real-time techniques which use the latest generation of contrast agents can be used to diagnose cystic lesions. These techniques provide excellent sensitivity for microbubble detection, and help resolve challenging cases in which cystic lesion diagnosis is difficult [3–8]. Following intravenous administration of microbubble contrast agents, simple cysts remain uniformly anechoic, devoid of signal, and show smooth margins (Fig. 1B).

### Key points

Criteria to classify a cyst as "simple" using ultrasound

- Anechoic.
- Homogeneous content.
- Posterior enhancement.
- Imperceptible wall.

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