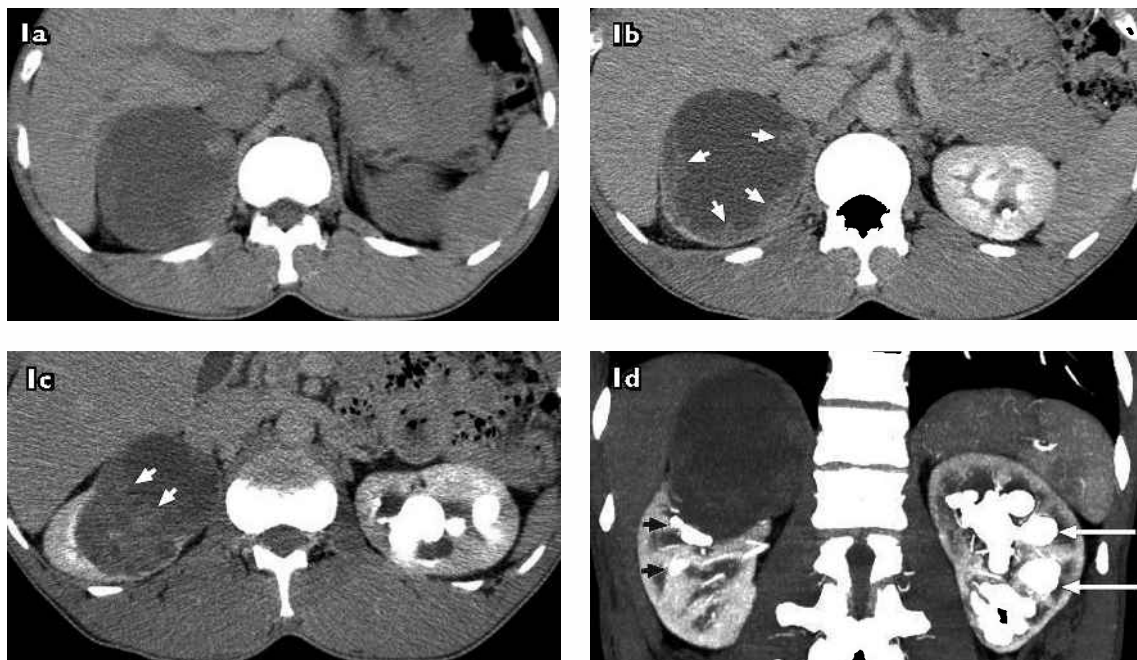


**CME Article**

# Clinics in diagnostic imaging (I35)

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**Fig. 1** (a) Axial unenhanced; (b & c) delayed excretory phase enhanced CT images; and (d) reformatted coronal arterial phase enhanced CT images of both kidneys.

## CASE PRESENTATION

A 45-year-old man presented at our hospital with right flank pain and haematuria for one month. Abdominal radiography and ultrasonography showed bilateral renal stones and a mass in the right kidney. He had a history of right nephrolithotomy ten years ago. Physical examination revealed no abnormal findings. His blood pressure was 110/70 mm Hg and body temperature was 37°C.

Laboratory investigations revealed serum haemoglobin level 13.8 g/dL, haematocrit 40.9%, white blood cell count  $7.1 \times 10^9$ /dL, blood urea nitrogen 23 (normal range 8–20) mg/dL and creatinine 1.4 (normal range 0.7–1.5) mg/dL. Urinalysis revealed 30–50 red blood cells and 30–50 white blood cells per high power field. What do the unenhanced and enhanced computed tomography (CT) images of the kidneys show (Figs. 1a–d)? What is the diagnosis?

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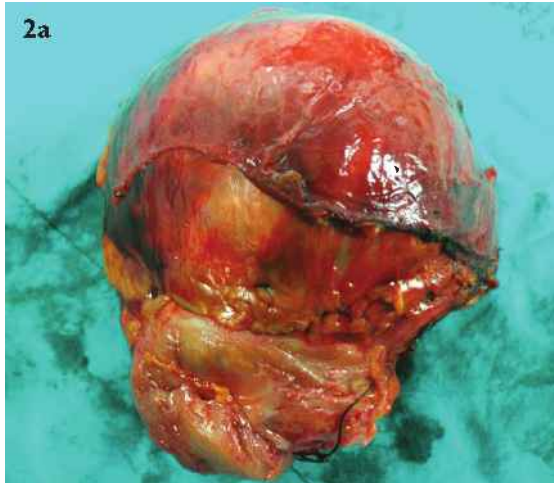
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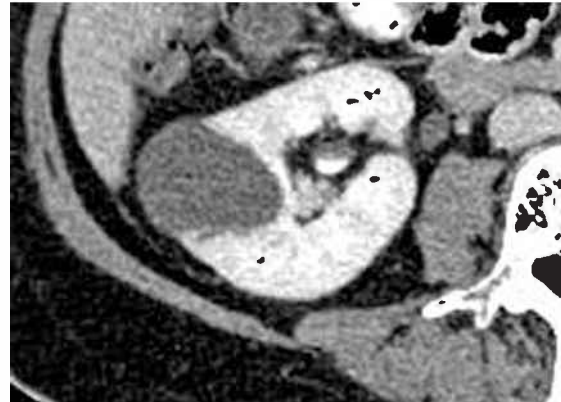
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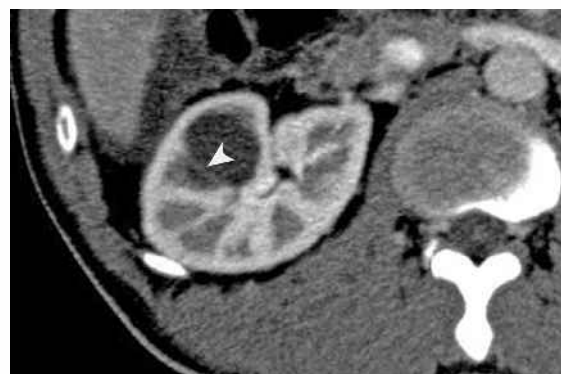
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**Fig. 2** (a) Specimen photograph of the removed tumour shows a well-capsulated mass. (b) Cut section of the mass shows a well-capsulated solid-cystic mass with focal papillary proliferation.



**Fig. 3** Category I cyst. Axial contrast-enhanced CT image shows a 3-cm well-circumscribed, unilocular homogeneous water-dense cyst with no wall enhancement or calcification in the right kidney.



**Fig. 4** Category II cyst. Axial contrast-enhanced CT image shows a 2.5-cm well-circumscribed cyst with a smooth thin septum (arrowhead) in the right kidney.

### IMAGE INTERPRETATION

Axial unenhanced (Fig. 1a) and delayed excretory phase enhanced CT images of the upper abdomen (Figs. 1b & c) show a 7.7 cm × 6.8 cm well-circumscribed, inhomogeneous hypoattenuated mass in the right suprarenal area. On the more caudal image (Fig. 1c), there was concavity of a renal contour with renal parenchyma cupping this mass or a “claw” sign, which indicated that the mass was renal in origin. The lesion was exophytic, extending superiorly to displace the right adrenal gland superiorly (not shown). Enhancement of the irregular thickened wall was observed, particularly at the posterior wall (arrowheads). Reformatted coronal arterial phase enhanced CT image of both kidneys (Fig. 1d) revealed a large, well-circumscribed exophytic complex cystic mass, with enhanced irregular thickened walls arising from the upper pole of the right kidney, the upper calyceal stones (arrowheads) of the right kidney and a staghorn stone (white arrows) of the left kidney, with moderate dilatation of the left pelvocalyceal system.

### DIAGNOSIS

Cystic renal cell carcinoma (RCC).

### CLINICAL COURSE

The patient underwent right partial nephrectomy with removal of the right renal stones (Fig. 2). Histopathological examination revealed papillary cell carcinoma confined within the kidney. He made good postoperative recovery and was discharged seven days after the operation.

### DISCUSSION

Most renal cysts are benign and pose no diagnostic problem on imaging studies. Approximately half of patients aged > 50 years have renal cysts.<sup>(1)</sup> The criteria for a simple renal cyst on CT include an imperceptible cyst wall, a smooth interface with the renal parenchyma, a round or ovoid cyst wall, absence of mural enhancement after contrast material administration and a simple fluid content.<sup>(2,3)</sup> Cysts that do not meet the strict imaging criteria for a simple cyst can be problematic. Since renal cysts often undergo pathological changes, e.g. haemorrhage and infection, differentiating them from RCC presenting as a complex cystic renal lesion may be difficult.<sup>(4)</sup>

In 1986, Bosniak developed a classification system of renal cysts to help evaluate cystic renal masses and decide on the course of clinical management.<sup>(2)</sup> The Bosniak

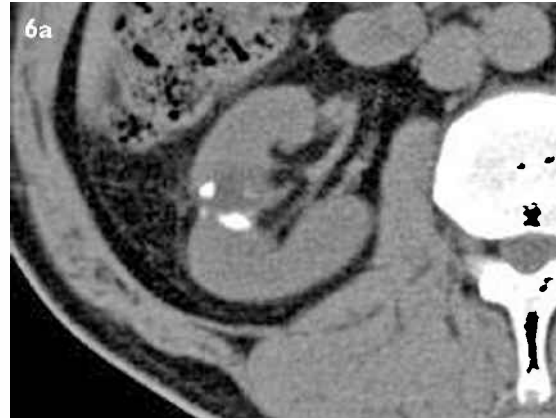


**Fig. 5** Category III cyst. Axial contrast-enhanced CT image shows a large, well-circumscribed multilocular cystic lesion with uniform enhanced thickened wall and septa (arrowheads) in the left kidney. Multilocular cystic nephroma was proven by histopathology.

system classifies renal cysts into four categories on the basis of CT appearances:

- Category I: Cystic masses have well-defined margins, are homogeneous and have water density, with no wall thickening, calcification or contrast enhancements (Fig. 3).
- Category II: Cystic masses show a thin septa (<1 mm) or fine calcifications, or appear as hyperdense cysts. The lesion must be  $\leq 3$  cm in diameter, have one-quarter of its wall extending outside the kidney so that the wall can be assessed, and be non-enhancing after contrast material is administered (Fig. 4).
- Category III: Cystic masses show more extensive thickened and irregular calcifications, uniform wall thickening, as well as thickened and irregular or multilocular nature, with multiple enhancing septa (> 1 mm) (Fig. 5). Hyperdense lesions that do not fulfill category II criteria are included in this category.
- Category IV: Cystic masses with non-uniform or enhancing thick walls, enhancing or large nodules in the wall, or clearly solid components in the cystic lesion. Enhancement is considered present when lesion components increase by at least 10 HU.

Category I and II cystic masses are considered benign and do not require treatment. Surgical resection is recommended for category III and IV lesions. This classification system has been accepted worldwide as a way of assessing cystic renal lesions. Most of the category I and IV lesions are easily categorised. The main difficulty lies in the distinction between category II (non-surgical) and category III (surgical) lesions, as their recommended management is different.<sup>(5-8)</sup> Category II and III lesions present the most difficulty in diagnosis and have the most interobserver variations.<sup>(8)</sup>



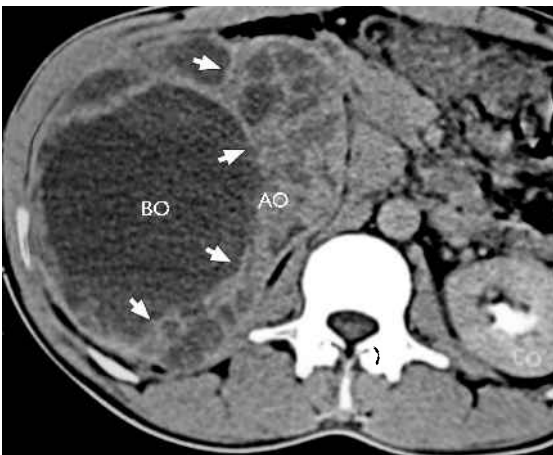
**Fig. 6** Category intermediate IIF cyst. Axial (a) unenhanced and (b) contrast-enhanced CT images show a 2-cm well-circumscribed cyst with irregular thickened calcifications (arrowheads) along the wall.

In 1993, Bosniak revised the classification system to include an intermediate IIF category (F = follow-up) of lesions.<sup>(9)</sup> These lesions have imaging features that are slightly more complicated than those of a standard category II lesion, and are managed by close follow-up rather than through surgery. Category IIF comprises minimally-complicated cysts that do not fall neatly into category II. These lesions may contain an increased number of hairline-thin septa. Minimal hairline-thin smooth septum or wall can be seen, and there may be minimal thickening of the septa or wall. The cyst may contain calcification that may be thick and nodular, but no contrast enhancement is present. There are no enhancing soft-tissue components. Totally intrarenal non-enhancing, high-attenuation renal lesions  $\geq 3$  cm are also included in this category. These lesions are generally well marginated (Fig. 6).

Curry et al<sup>(6)</sup> and Siegel et al<sup>(8)</sup> have demonstrated 0% malignancy in category I, 0%–13% in category II, 45%–59% in category III, and 90%–100% in category IV. Our presented case had category IV cystic lesions, which caused no problem in diagnosis and management. Approximately 15% of RCC cases referred to the



**Fig. 7** Clear cell-type renal cell carcinoma with central necrosis in the left kidney. Axial contrast-enhanced CT image shows a large, inhomogeneous enhancing mass with central necrosis in the left kidney. There is enhancing tumour thrombus in the expanded left renal vein (arrow).



**Fig. 8** Category IV cyst. Axial contrast-enhanced CT image shows a large well-circumscribed, multilocular cystic mass with non-uniform, irregular enhanced thickened wall and septa (arrowheads) in the right kidney. Multilocular cystic renal cell carcinoma of the right kidney was proven by right radical nephrectomy.

Armed Forces Institute of Pathology are cystic.<sup>(10)</sup> The demographical and clinical features of cystic RCC are similar to those that are solid. Men are affected more often than women, and the tumour usually occurs in middle-aged and older patients. The prognosis of cystic RCC is excellent.<sup>(11-14)</sup> There are three radiological patterns of cystic RCC: a unilocular cystic mass; a multiloculated cystic mass; or a discrete mural tumour nodule in a large fluid-filled mass.<sup>(10)</sup> Approximately 50% of cystic RCCs present as a unilocular cystic mass, which could be cystadenocarcinoma or extensive cystic necrosis of a previously solid RCC (Fig. 7). A multiloculated cystic mass presents in approximately 30% of cases of cystic RCC (Fig. 8). A discrete mural tumour nodule within a cystic mass is seen in less than 20% of cases. Microscopically, tumour cells line the cyst wall in cystadenocarcinoma, and no epithelial lining is seen in the cystic tumour necrosis. In a multiloculated cystic RCC, locules are lined by tumour cells. Our patient presented with a unilocular cystic mass with tumour cells lining the cyst wall. Since cystic RCC

has a better prognosis than solid RCC, patients with cystic RCC may benefit from nephron-sparing surgery. Our patient had associated bilateral renal stones with moderate hydronephrosis; hence, nephron-sparing surgery was the operation of choice.

## ABSTRACT

**A 45-year-old man presented with right flank pain and haematuria for one month. Computed tomography showed a large, well-circumscribed exophytic complex cystic mass with enhanced, irregular thickened walls arising from the upper pole of the right kidney, which was associated with bilateral renal stones. Partial right nephrectomy with removal of the right renal stones was performed. Histopathology revealed papillary cell carcinoma confined to the kidney. The patient made good postoperative recovery. The Bosniak classification system of renal cystic lesions and cystic renal cell carcinoma are discussed. Various cases of renal cystic lesions and cystic renal cell carcinoma are shown.**

**Keywords:** cystic renal cell carcinoma, kidney, renal cell carcinoma, renal cysts

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**SINGAPORE MEDICAL COUNCIL CATEGORY 3B CME PROGRAMME**  
**Multiple Choice Questions (Code SMJ 201105B)**

- |   | True                     | False                    |
|---|--------------------------|--------------------------|
| <b>Question 1.</b> Concerning renal cyst:   |                          |                          |
| (a) Renal cystic lesions are mostly benign.   | <input type="checkbox"/> | <input type="checkbox"/> |
| (b) They commonly occur in adolescence.   | <input type="checkbox"/> | <input type="checkbox"/> |
| (c) Renal cysts with haemorrhage or infection may mimic renal cell carcinoma.                                   | <input type="checkbox"/> | <input type="checkbox"/> |
| (d) An increased density by at least 10 HU represents the presence of enhancement.                              | <input type="checkbox"/> | <input type="checkbox"/> |
| <br><b>Question 2.</b> Concerning cystic renal cell carcinoma (RCC):  |                          |                          |
| (a) Cystic RCC usually occurs in middle-aged and older patients.  | <input type="checkbox"/> | <input type="checkbox"/> |
| (b) Approximately 15% of RCC are cystic.  | <input type="checkbox"/> | <input type="checkbox"/> |
| (c) Cystic RCC has better prognosis than the solid type.  | <input type="checkbox"/> | <input type="checkbox"/> |
| (d) The most common radiological pattern of cystic RCC is cystic mass with a discrete mural nodule.             | <input type="checkbox"/> | <input type="checkbox"/> |
| <br><b>Question 3.</b> Concerning Bosniak classification system category IIF:                                   |                          |                          |
| (a) A 2-cm unilocular, thin-walled cyst with no calcification or enhancement.                                   | <input type="checkbox"/> | <input type="checkbox"/> |
| (b) A 4-cm intrarenal, non-enhanced high-attenuation cyst.  | <input type="checkbox"/> | <input type="checkbox"/> |
| (c) A 3-cm cyst with a few hairline-thin septa.   | <input type="checkbox"/> | <input type="checkbox"/> |
| (d) A 4-cm multilocular cyst with irregular, thickened septa.   | <input type="checkbox"/> | <input type="checkbox"/> |
| <br><b>Question 4.</b> The criteria used for the Bosniak classification system of renal cystic lesions include: |                          |                          |
| (a) Number of cysts.  | <input type="checkbox"/> | <input type="checkbox"/> |
| (b) Wall-thickness.   | <input type="checkbox"/> | <input type="checkbox"/> |
| (c) Presence of calcification.  | <input type="checkbox"/> | <input type="checkbox"/> |
| (d) Contrast enhancement characteristics.   | <input type="checkbox"/> | <input type="checkbox"/> |
| <br><b>Question 5.</b> Concerning the Bosniak classification system:  |                          |                          |
| (a) Simple cyst is classified as category I.  | <input type="checkbox"/> | <input type="checkbox"/> |
| (b) Almost all cystic RCCs are classified as category IV.   | <input type="checkbox"/> | <input type="checkbox"/> |
| (c) The proper management of category III is surgery.   | <input type="checkbox"/> | <input type="checkbox"/> |
| (d) This classification is based on ultrasonographic appearance.  | <input type="checkbox"/> | <input type="checkbox"/> |

**Doctor's particulars:**

Name in full: \_\_\_\_\_

MCR number: \_\_\_\_\_ Specialty: \_\_\_\_\_

Email address: \_\_\_\_\_

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**RESULTS:**

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