

## Peer Reviewed Article of Interest

# A PICTORIAL PRESENTATION OF CT KIDNEY LESIONS IN ADULTS, PARTICULARLY KIDNEY CANCER: PART 2

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### ABSTRACT

There are many pathologies that affect the kidneys. The focus of this paper is computed tomography of kidney cancer. Other imaging modalities for kidney pathologies are briefly discussed. A few examples of benign tumours and masses are presented. The bulk of the paper is a pictorial presentation of kidney cancer and its spread to other organs and bones. A range of unenhanced and enhanced CT images are included for self-assessment.

**Keywords:** renal cell carcinoma, lymphadenopathy, oncocytoma, imaging modalities

### LAY ABSTRACT

Imaging of the kidneys is done to find out whether a mass in a kidney may be a benign tumour, cyst or cancer. If it is a cancer then it is important to check whether there is spread to other organs. Examples of computed tomography (CT) are used to describe the different patterns of benign and cancer lesions.

## 5. KIDNEY CANCER: RISK FACTORS AND TREATMENT

Kidney cancer is often an incidental finding at an abdominal ultrasound or CT examination for other reasons. RCC accounts for 80-85% of kidney cancers.<sup>[25]</sup> Renal masses are either cystic or solid in terms of imaging criteria.<sup>[25]</sup> Enhanced CT is used to differentiate malignant masses from benign ones. Literature reports potential risks factors such as genetic factors, family history of kidney cancer, obesity, hypertension, smoking, and occupational exposure, for example, asbestosis.<sup>[25-27]</sup> The spread of RCC may be by direct extension or by the lymphatics or intra-renal veins to other organs and the skeleton.

Treatment may be minimally invasive techniques such as percutaneous radiofrequency ablation and laparoscopic removal, or a more invasive total nephrectomy (see 12 below). The overall survival from RCC is poor.<sup>[27]</sup>

### 5.1 Benign tumours vs RCC

- Oncocytoma which may mimic RCC on imaging.

- Angiomyolipoma is a mesenchymal tumour composed of blood vessels, smooth muscle, and adipose tissue.

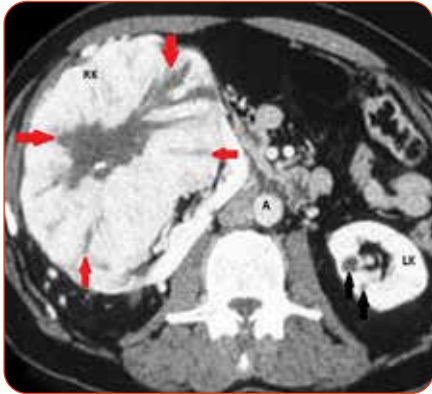
#### 5.1.1 Oncocytoma

Oncocytoma is a benign epithelial tumour of the kidney which often makes it difficult to distinguish from RCC, especially chromophobe RCC.<sup>[28]</sup> It makes up 5% - 7% of renal tumours<sup>[29]</sup> and is considered to be at the benign end of the spectrum is a chromophobe RCC. CT imaging with i.v. contrast media is the preferred imaging modality for

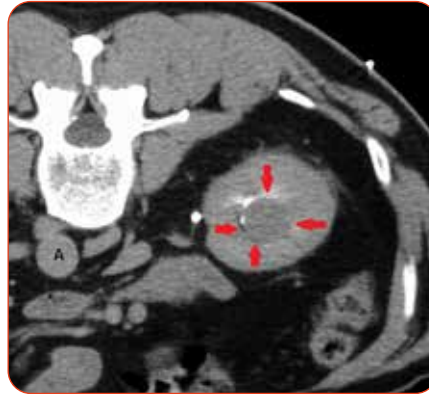
evaluation of solid renal tumours. Oncocytoma tends to be hypovascular and shows less contrast enhancement in all CT multiphases when compared with the renal cortex.<sup>[30]</sup> It usually presents as a solid tumour (Figure 5.1.1a). In 60% of cases a central star-shaped scar is present (Figure 5.1.1b). But this may not be a specific oncocytoma finding.<sup>[29]</sup> Differentiation of oncocytoma and RCC usually requires a biopsy. The characteristics of oncocytoma and RCC may be similar on CT imaging thus a definitive diagnosis is usually by biopsy.<sup>[30]</sup> See Figures 5.1.1c and d.



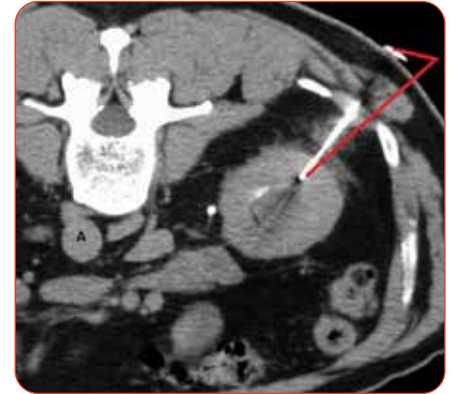
**Figure 5.1.1a.** Enhanced axial CT scan showing solid tumour (black circle) in the right kidney (RK). IVC = inferior vena cava. A = aorta. LK = left kidney. Left renal vein (black arrow). Proven oncocytoma. (Courtesy of Professor PJ Pickhart, University of Wisconsin).



**Figure 5.1.1b.** Enhanced axial CT scan showing a solid tumour in the right kidney (RK) with a central star-shaped scar (red arrows). A = Aorta, LK = left kidney. Proven oncocytoma. (Courtesy of Professor PJ Pickhart, University of Wisconsin).



**Figure 5.1.1c.** Prone axial CT scan showing lesion in left kidney (red arrows). A = aorta. (Courtesy of Professor PJ Pickhart, University of Wisconsin).



**Figure 5.1.1d.** Prone axial CT scan of patient in 6a. Red lines = biopsy needle. A = aorta. Oncocytoma proven on histology. (Courtesy of Professor PJ Pickhart, University of Wisconsin).

### 5.1.2 Angiomyolipoma (AML)

This is a common solid benign neoplasm consisting of smooth muscle and fatty tissue and is more common in females between 30 to 50 years old. AML may be subdivided into: classic AML, and AML with minimal fat. The diagnosis of classic AML is not difficult to make as there is abundant fat present hence will have marked hyperechogenicity on ultrasound screening. On unenhanced CT scans the attenuation value is usually  $< -10$  HU. However, if there is minimal fat present then a problem may arise in differentiating it from RCC since both may contain too little fat to be detected on unenhanced CT.<sup>[28]</sup> Examples of AML are presented in the discussion of unenhanced CT for visualisation of renal lesions.

## 6. RENAL LESIONS: CT OF THE ABDOMEN

Since the introduction of CT screening of the abdomen there has been an increase in the number of renal lesions detected. These vary from congenital such as 'horseshoe kidney' to benign and malignant lesions. In a study by O'Connor et al<sup>[31]</sup> of 3000 unenhanced scans performed for CT colonography 14% of the cases had incidental renal masses  $> 1$ cm.

Imaging will help in differentiating benign from malignant lesions as 20% of small renal masses which are solid

will be benign. Therefore i.v. contrast media enhanced CT is essential in differentiating benign from malignant renal lesions. This may well be followed by other imaging modalities, such as ultrasonography (US), magnetic resonance imaging (MRI), and nuclear medicine studies.

Two benign lesions, oncocytoma (3-7%) and angiomyolipoma (3%) of CT examinations that show renal masses may simulate carcinoma and need to be excluded.<sup>[31]</sup>

### 6.1 Malignant renal tumours

Renal cell carcinoma (RCC) accounts for 90% of malignant renal tumours. It is subdivided into categories depending their histological features. The tumours arise from the renal parenchyma and renal pelvis. The histology of RCC is as follows.<sup>[22]</sup>

- 75% are clear cell
- 7% - 15% are papillary
- 5% chromophobe

The other 10% of renal cancers include sarcomas, neuroendocrine, lymphoid, and germ-cell tumours.

### 6.2 Role of unenhanced CT for visualisation of renal lesions

Pooler et al<sup>[32]</sup> retrospectively analysed a series of pathologically proven renal cell carcinoma (RCC) detected on unenhanced CT scans of the abdomen.

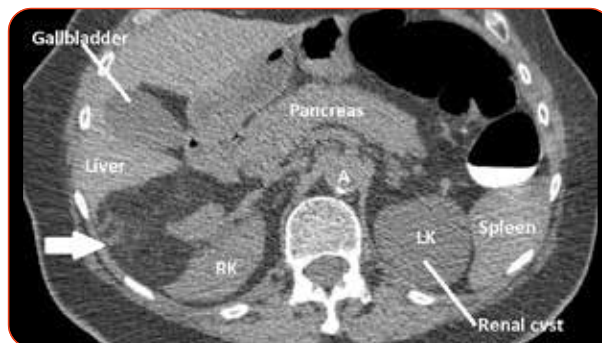
They made some important deductions based on the size of a lesion, its homogenous or heterogeneous appearance, and mainly the value of the region of interest (ROI) in measuring densities of renal masses. They defined a homogeneous lesion as a tumour which appeared uniform in composition when soft-tissue window settings were used. Their definition of a heterogeneous lesion is one that contains a complex internal structure with septations, mural nodules, calcification, and visible attenuation differences. They underscored that a lesion that was in the 'danger zone' of between 20-70 HU should raise suspicion for malignancy on unenhanced scans. Using 20 to 70 HU measurements resulted in 72% of all RCC cases being diagnosed.<sup>[32]</sup>

Cases where the ROI may fall below 20 or greater than 70 HU, especially in dealing with heterogeneous tumours, will require further imaging studies. If a homogeneous lesion measured less than 20 HU then a benign cyst should be considered.<sup>[32]</sup> One exception would be an angiomyolipoma (a benign condition) where the macroscopic fat measurement is  $< 0$  HU. Figures 6.2a and b are two examples of angiomyolipomas.

In CT colonography if an angiomyolipoma is visualised it should be reported as an extracolonic finding (ECF) of moderate clinical importance: E3.<sup>[33]</sup>



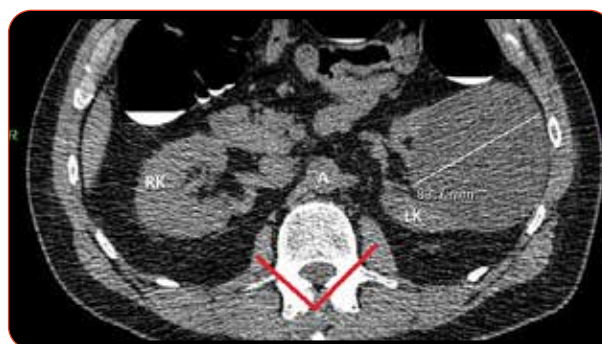
**Figure 6.2a.** Unenhanced axial CT scan showing right kidney (RK) and left kidney (LK) with an angiomyolipoma (red arrow).



**Figure 6.2b.** Unenhanced axial CT scan. Right kidney (RK) and left kidney (LK). Angiomyolipoma (white arrow) showing a 'rat eaten appearance' due to invasion by fatty tissue. There is a cyst in the LK.



**Figure 6.2c.** Unenhanced axial CT scan showing bilateral renal cysts (open black arrows). Right kidney (RK), left kidney (LK), liver (L), pancreas (P), spleen (S) and aorta (A). Psoas muscles (red lines).



**Figure 6.2d.** Unenhanced axial CT scan showing 8.37 cm renal cyst in left kidney (LK). Right kidney (RK) and aorta (A). Psoas muscles (red lines).

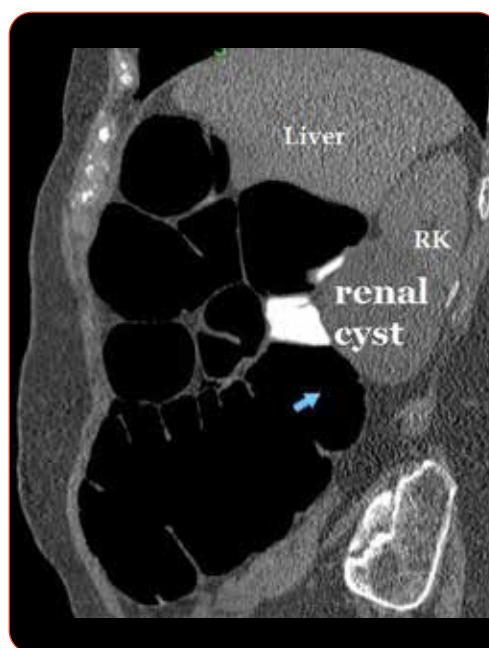
The most serious complication of an angiomyolipoma is haemorrhage which tends to occur if the lesion is > 4cms in size.<sup>[34]</sup>

According to Silverman et al<sup>[35]</sup> on an unenhanced CT scan a homogeneous, hyperdense kidney lesion of at least 70 HU means that there is a 99.9% probability that it is a benign lesion. Homogeneous lesions which measure >70 HU would thus represent high attenuation benign cysts. Figures 6.2c to e are examples of renal cysts visualised on unenhanced CT scans.

O'Connor et al<sup>[31]</sup> found in their study of unenhanced screening CT colonography cases that all lesions outside the 20-70 HU range were benign. Based on their findings they concluded that mean attenuation values alone seem to be reliable in terms of determining which renal masses on unenhanced CT need further evaluation.

**REFERENCES**

See Part 5.



**Figure 6.2e.** Unenhanced sagittal CT scan showing renal cyst in lower pole of right kidney (RK).