

## “Role of Contrast Enhanced Computed Tomography in Evaluation of Renal lesions.”

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### **Aims & Objectives :-**

- To characterize renal imaging findings renal mass lesion on CECT.
- To evaluate the accuracy of CECT in the preoperative evaluation of malignant lesions.

### **Material and Methods:**

- The study included 40 patients presenting with renal complaints such as flank pain, flank mass, hematuria, weight loss and showed a renal mass, cystic or solid lesion on USG.
- They were evaluated through history, physical examination, USG and CECT.
- The machine used was Philips 16-slice CT machine.

### **Inclusion criteria: -**

- Patient with renal complaints and positive findings on the screening ultrasonography.

### **Exclusion criteria :-**

- Patients not willing to participate in the study.

### **Result –**

Contrast enhanced CT was significantly superior to ultrasound in the evaluation of the renal tumour and in preoperative evaluation in terms of its extension, vascular invasion, detection of lymph nodes and adjacent organ involvement. In our study we came across renal cell carcinoma in 28% of cases, Wilms' tumor in 2.5%, renal lymphoma in 5%, angiomyolipoma in 23% and oncocytoma in 2.5% cases in all the cases. Rest of the cases were benign lesions including infective lesions, hematoma and pseudotumour.

**Overall accuracy of preoperative evaluation of renal tumour (Renal cell carcinoma) on the basis on capsular, perinephric and vascular invasion and involvement of adjacent organ and lymph nodes by CECT was 80% in average.**

### **Conclusion -**

- CT with and without intravenous contrast, is the primary imaging modality for characterization and staging of renal masses.
- Good accuracy of CECT in preoperative evaluation of renal tumour (Renal cell carcinoma) on the basis on capsular, perinephric and vascular invasion and involvement of adjacent organ and lymph nodes by CECT was 80% in average.

**Keywords:** computed tomography (CT); magnetic resonance imaging (MRI); renal cell carcinoma; renal mass; ultrasound

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### **I. Introduction**

The detection of a renal mass is a relatively frequent occurrence in the daily practice of any Radiology Department. The diagnostic approaches depend on whether the lesion is cystic or solid. Cystic lesions can be managed using the Bosniak classification, while management of solid lesions depends on whether the lesion is well-defined or infiltrative. The approach to well-defined lesions focuses mainly on the differentiation between renal cancer and benign tumors such as angiomyolipoma (AML) and oncocytoma. Differential diagnosis of infiltrative lesions is wider, including primary and secondary malignancies and inflammatory disease, and

knowledge of the patient history is essential. Radiologists may establish a possible differential diagnosis based on the imaging features of the renal masses and the clinical history. The aim of this review is to present the contribution of the different imaging techniques and image guided biopsies in the diagnostic management of cystic and solid renal lesions.

Contrast enhanced CT scan technique (CECT) of the kidney and other organs. With the advent of newer techniques of CT scanning, evaluation of renal tumors is becoming more accurate. For correct preoperative evaluation of renal tumors, the clinician expects an accurate assessment of the morphology of renal tumors, perinephric space, regional lymph nodes, major vessels and adjacent organs, so that he can correctly choose the correct treatment from the available options; viz. surgical resection, interventional techniques like arterial embolisation, chemotherapy, radiotherapy or combinations. The purpose of our study was to detect mass lesions in the kidneys, their morphology and correlate CT study findings with operative and histopathological findings wherever possible.

## STATISTICAL ANALYSIS

Descriptive statistics like mean and percentages were used to interpret the data.

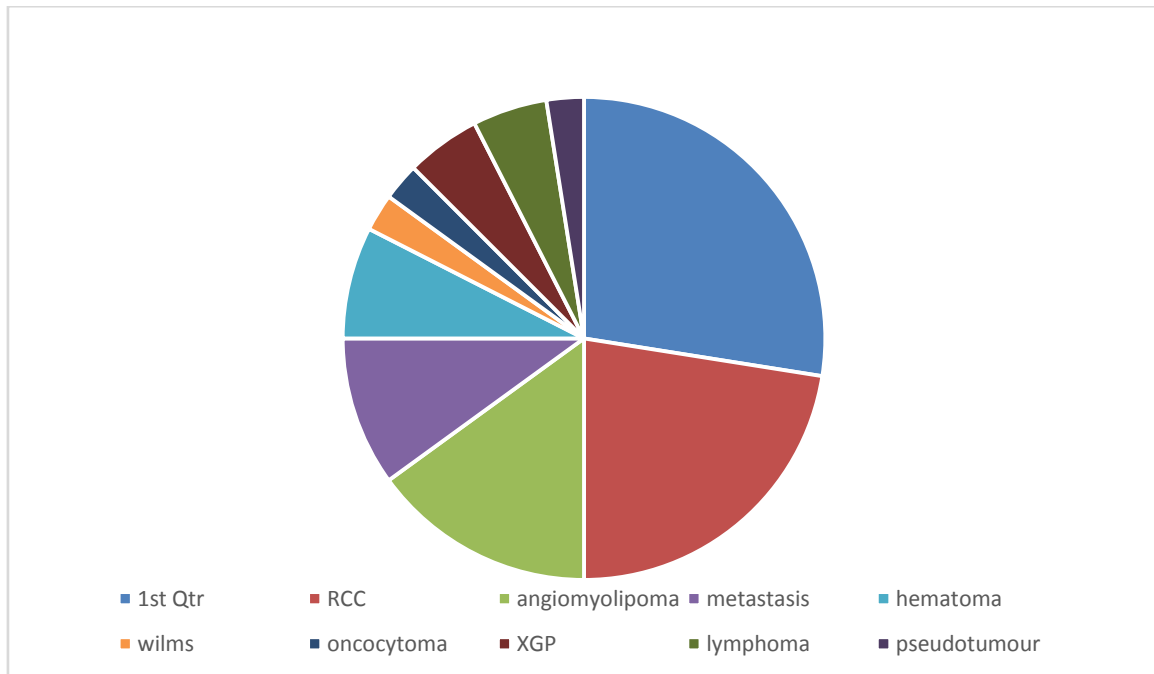
## II. Result

Renal cell carcinoma was the most common primary renal parenchymal tumor with an incidence of 40% among all the neoplastic lesions, followed by angiomyolipoma with an incidence of 32%. Wilms' tumor was the most common primary malignant renal parenchymal tumor in childhood with 3.5 % incidence amongst all the tumours.

As regards to sex predilection Renal tumors were more common in males than in females. Renal cell carcinoma was more common in males. Wilms' tumor detected in only one patient that was a male child. Angiomyolipoma was found more in females. There was equal incidence of lymphoma in both sexes.

**TABLE 1.**  
**Details of descriptive data of study participants**

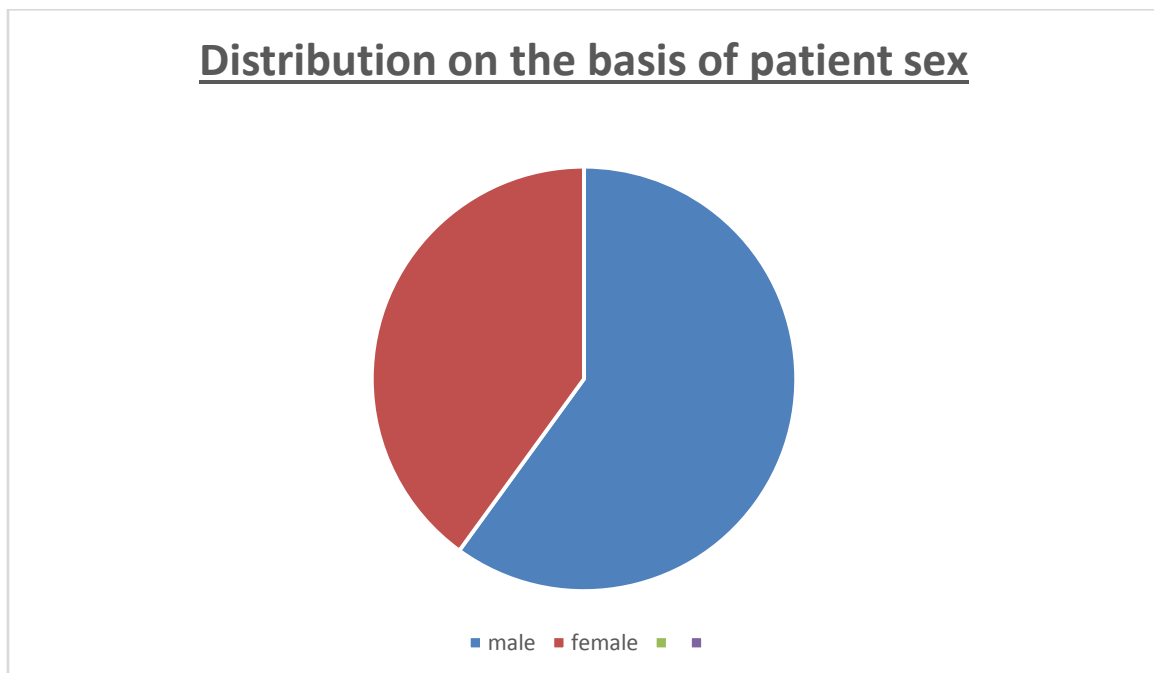
<i>Diagnosis</i>	<i>No of cases (40)</i>
<i>RCC</i>	<i>11</i>
<i>Renal angiomyolipoma</i>	<i>9</i>
<i>Renal abscess</i>	<i>6</i>
<i>Renal metastasis</i>	<i>4</i>
<i>Renal hematoma</i>	<i>3</i>
<i>Wilms tumour</i>	<i>1</i>
<i>Renal oncocytoma</i>	<i>1</i>
<i>Xanthogranulomaotus pyelonephritis</i>	<i>2</i>
<i>Renal lymphoma</i>	<i>2</i>
<i>Renal pseudotumour</i>	<i>1</i>



**TABLE 2 .  
Distribution on the basis of patient sex**

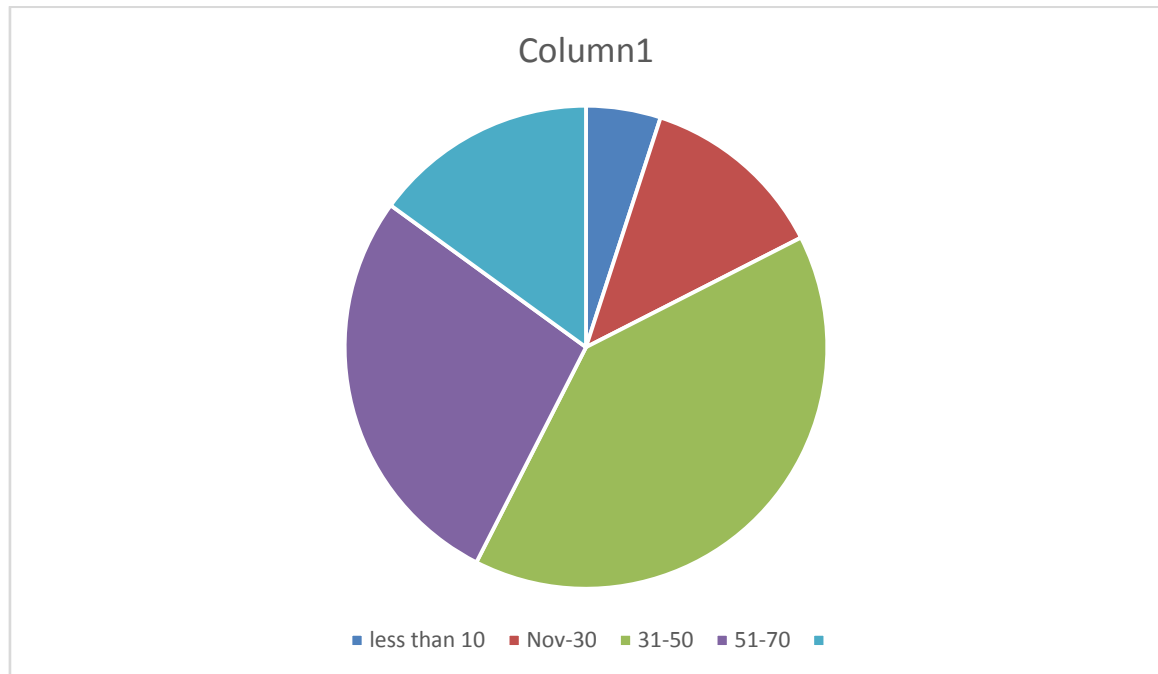
Sex	Number of patients
Male	24
Female	16

**Distribution on the basis of patient sex**



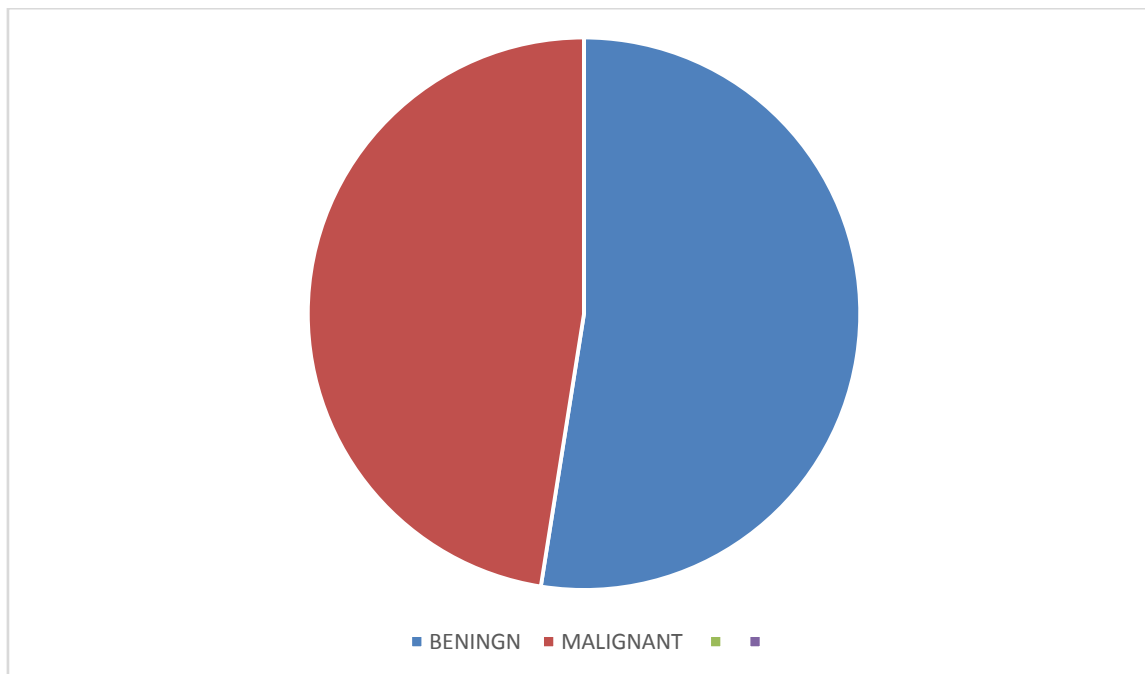
**TABLE 3 AGE WISE DISTRIBUTION OF THE PATIENTS**

Age of the patient ( in years)	Number of pateints
Less than 10	2
11-30	5
31-50	16
51-70	11
More than 70	6
total	40



**TABLE 4  
DISTRUBUTION ON BASIS OF BENINGN AND MALIGANANT**

	NUMBER OF PATIENTS
BENINGN LESIONS	21
MALIGNANT LESIONS	19



**TABLE 5**  
**Accuracy of CT in the Pre operative and treatment evaluation**

Sr No	Tumour involvement	False positive	False negative	Sensitivity	Specificity	Overall accuracy
1.	Confined to renal capsule	1	1	85	75	81
2.	Invasion of perinpheric fat	2	1	75	71	72
3.	Vessel invasion	1	0	100	75	81
4.	Regional L,N or adjacent organ	2	0	100	71	81

### III. Discussion

CT is a relatively easy, simple and accurate modality and is relatively free of complications, except for those which may arise secondary to use of intravenous contrast medium for contrast enhancement. Calcifications are easily seen and the nature of the renal masses can be determined by CT scanning. (2)

#### Renal cell Carcinoma

Renal cell carcinoma was the most common tumor in our study with median age distribution of 40 years which is similar to the studies of Crojan et al.(3)

Perinephric extension and capsular invasion are the most troublesome areas in CT diagnosis accounting for majority of staging errors(4) In this study, sensitivity of 75% and specificity of 71% respectively was recorded for perinephric extension at CT scanning. We encountered two false positive cases in which perinephric soft tissue extension reported on CT turned out to be fibrous tissue at histopathology. There was one false negative case seen where tumor appeared to be confined within renal capsule at CT scanning, but microscopic extensions were seen at histopathology. These false positive and false negative results of capsular invasion and perinephric extension have resulted in difficulties in differentiating stage-I disease from stage-II disease. Similar difficulty was also faced by Richiet al and Weyman et al.

#### Wilms' Tumor

Wilms' tumor was found in 2.5% cases and there was male preponderance in our study. These findings are similar to the study of Currarino et al.(5)

No Wilms' tumor was present in adult patient if present, Renal cell carcinoma and multilocular cystic nephroma should be considered as differentials in the diagnosis of adult Wilms' tumor. Renal cell carcinoma appears as a solid mass, smaller than Wilms' tumor and is hyper vascular at angiography. Multilocular cystic nephromas

benign and occurs more in young adult females than males. It is well capsulated and shows multiple non-communicating cysts and is hypo vascular on angiography. Calcification was seen in this case.

CT provided correct information about the location and extent of the tumor inside the kidney. However, due to lack of retroperitoneal fat evaluation of perinephric region, renal vein and inferior vena cava caused difficulties. (3)

### **Renal Lymphomas**

Primary renal lymphomas are rare as kidneys normally do not contain lymphoid tissue. Secondary involvement occurs due to disseminated disease or direct contiguous extension of retroperitoneal disease. (6) In this study we came across two cases of renal lymphoma constituting (5%) of all the renal lesions of this study. Non-Hodgkin's lymphoma is commoner than Hodgkin's lymphoma, but the disease pattern remains same in both the conditions. In this study both the cases were proved to be non-Hodgkin's lymphoma at histopathology. Singer et al stated that CT findings of renal lymphoma are nonspecific and can be seen in other conditions also. (7) Our study also revealed similar features.

### **Angiomyolipoma**

In this study we came across nine cases of renal angiomyolipoma. 66% of the patients were females. All the lesions were unilateral except one which was bilateral involvement of the kidneys. One of the patients presented with classical Vogt's triad of tuberous sclerosis and showed bilateral small renal angiomyolipoma and with stigmata of tuberous sclerosis. Renal angiomyolipoma has to be differentiated from renal lipoma, retroperitoneal liposarcoma and renal cell carcinoma at CT. Presence of fat in the renal tumor is a sure indicator of renal angiomyolipoma; however, presence of solid density component causes diagnostic difficulties with renal cell carcinoma (8).

### **THE BOSNIAK CLASSIFICATION FOR RENAL CYSTS.**

<b>Category</b>	<b>CT findings</b>	<b>Diagnosis</b>
Cat I	Water attenuation -5 to +15 HU	Simple cyst
	Homogeneous	
	Smooth margins without perceptible wall	
	Lack of enhancement (variation < +10 HU)	
Cat II	Few thin septa (1 to 3 septa) no perceptible wall	Complicated cyst
	Fine calcification (wall or septum)	
	Lack of enhancement (variation < +10 HU) or minimal (perceptible) enhancement of septa	
Cat IIF	More than a few thin septa	Complicated cyst
	Minimum wall thickening ( $\leq 1$ mm) not measurable	Multilocular cyst
	Thick or irregular calcification	Cystic tumor (cystic carcinoma or cystic nephroma)
	Hyperdense cyst <sup>a</sup> except for size $\geq 4$ cm or intraparenchymal location	
	Lack of enhancement (variation < +10 HU) or minimal enhancement (septa, wall)	
Cat III	Numerous thick septa	Complicated cyst
	Uniform grossly thick wall	Multilocular cyst
	Slightly irregular thick wall	Cystic tumor (cystic carcinoma, cystic nephroma)
	Thick or irregular calcification	
	Enhancement (septa and/or wall)	
Cat IV	Grossly thick and irregular wall	Cystic carcinoma
	Mural nodules or solid tissue component	Pseudocystic necrotic RCC
	Enhancement of the soft tissue elements	

The most important step in evaluation of renal masses is to determine whether the mass is benign or malignant or in itself a pseudotumor as it has important role in treatment planning and to decide whether patient needs surgery.

In our study 40 patients with renal pathologies were studied by modality of contrast enhanced CT. Amongst 40 cases, 15 cases underwent surgical procedures that were tagged as a neoplastic likely malignant lesion on the CT.

In our present study, the mean age was 40 years and the most commonly affected age group was 30-50 years.

The three most important things that were noted for assessment of Renal masses in our study were

1. Origin of mass
2. Characterization of mass
3. Classification of mass as either benign or malignant.
4. preoperative staging if malignant.

#### RENAL CELL CARCINOMA

Renal cell carcinoma (RCC) is a typical ball-type lesion.

50% of RCCs are incidental findings on imaging studies performed for non-urinary tract symptoms. Peak incidence of RCC is between 60 and 70 years. RCC is associated with hereditary syndromes, such as von Hippel-Lindau, tuberous sclerosis and Birt-Hogg-Dubé. The most common subtype of RCC is clear cell carcinoma, followed by papillary and chromophobe RCC. Renal medullary carcinoma is very uncommon and occurs almost exclusively in patients with sickle cell trait.(9)

Clear cell tumours arise from the renal cortex and are often expansive.

It is a hyper vascular lesion, frequently heterogeneous due to necrosis, haemorrhage, cystic components or calcifications. A typical feature of clear cell carcinoma is strong enhancement in the corticomedullary phase. The nephrogenic phase is the most sensitive phase for the detection of these lesions, as the renal parenchyma enhances homogeneously and more intensely than the tumour(9)

Papillary RCC accounts for 10-15% of all RCCs. These lesions are typically homogeneous and hypo vascular and can therefore mimic cysts. In contrast to clear cell carcinoma, the enhancement of papillary renal cell carcinoma can be very subtle, up to only 10-20 HU difference between unenhanced and enhanced images.(10)

Chromophobe RCC can be seen in patients with Birt-Hogg-Dubé syndrome.

These patients have small papular skin lesions called fibrofolliculomas, lung cysts with spontaneous pneumothorax. They can have a central scar or spoke-wheel pattern of contrast enhancement, similar to oncocytomas. It is not possible to differentiate chromophobe RCC from an oncocytoma on imaging.(10)



PLAIN

ARTERIAL

VENOUS

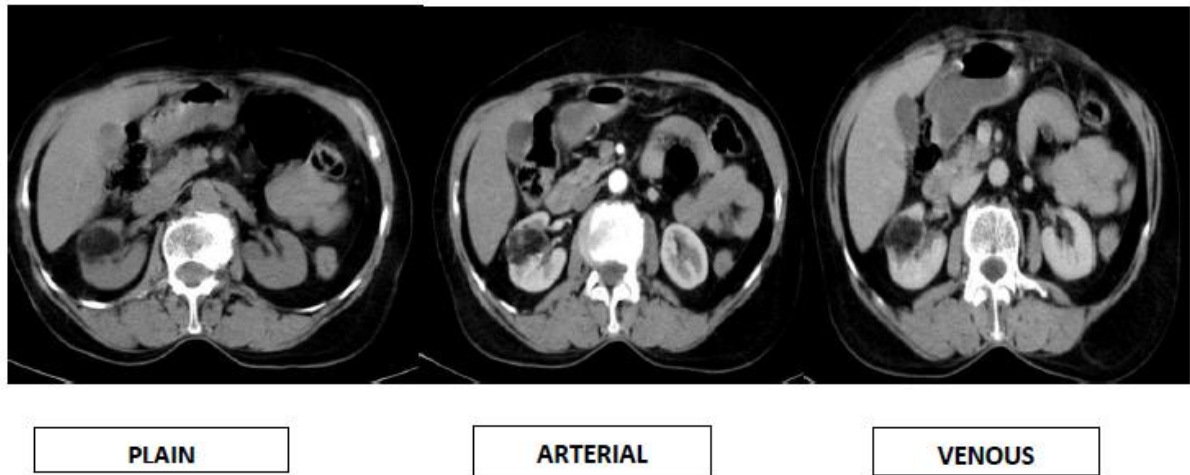
**Axial CT shows a well-defined, lobulated, heterogeneous predominantly iso-hypodense lesion involving upper and mid pole of right kidney.**

#### ANGIOMYOLIPOMA

Angiomyolipoma (AML) is the most common benign solid renal mass. It is composed of angiomatous tissue, smooth muscle and fat. If a lesion contains macroscopic fat on CT, the diagnosis of AML can be made. On CT an AML is usually a well-defined, heterogeneous tumor, located in the renal cortex and containing areas of fat density of -20 HU or less (11). Calcification or necrosis within the tumor is rare.

The presence of both fat and calcifications should raise the suspicion of a RCC. Enhancement is seen in the vascular and smooth muscle portions of the lesion.(12)

Sporadic AML is typically small, unilateral and asymptomatic, usually seen as an incidental finding. In 10-20% of cases angiomyolipomas are multiple and bilateral. This is mainly seen in patients with tuberous sclerosis(13)

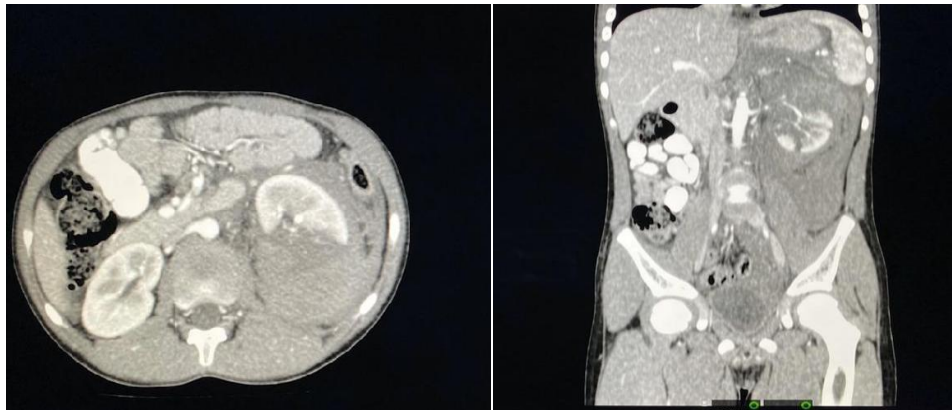


**Axial CECT shows inhomogenous enhancement of the lesion. The findings are suggestive of with fat density to suggests Angiomyolipoma.**

#### **INTRAPARENCHYMAL HEMATOMA**

Renal hematoma can occur due to number of causes including

1. trauma, important in assessing renal trauma grading
2. post procedural, e.g. extracorporeal shock-wave lithotripsy (ESWL).
3. spontaneous - spontaneous subcapsular perirenal hematoma.
4. due to an underlying associated lesion like Renal cell carcinoma or renal angiomyolipoma (14,15)



**Ill defined non enhancing heterogenous predominantly hyperdense areas (HU 40-60) in parenchyma of upper pole of left kidney following trauma suggests Intraparenchymal Hematoma.**

#### **CROSSED FUSED ECTOPIA**

**Crossed fused renal ectopia** refers to an anomaly where the kidneys are fused and located on the same side of the midline. The estimated incidence is around 1 out of 1000 births. There is a recognized male predilection with a 2:1 male to female ratio (16). More than 90% of crossed renal ectopia results in fusion. It results as a consequence of abnormal renal ascent in embryogenesis with the fusion of the kidneys within the pelvis. It is thought to occur in the first trimester, at around 4<sup>th</sup>-8<sup>th</sup> week of fetal life (in a normal situation the kidney reaches its appropriate position at the L2 level at the end of the 2<sup>nd</sup> month).(17)





SAGITTAL

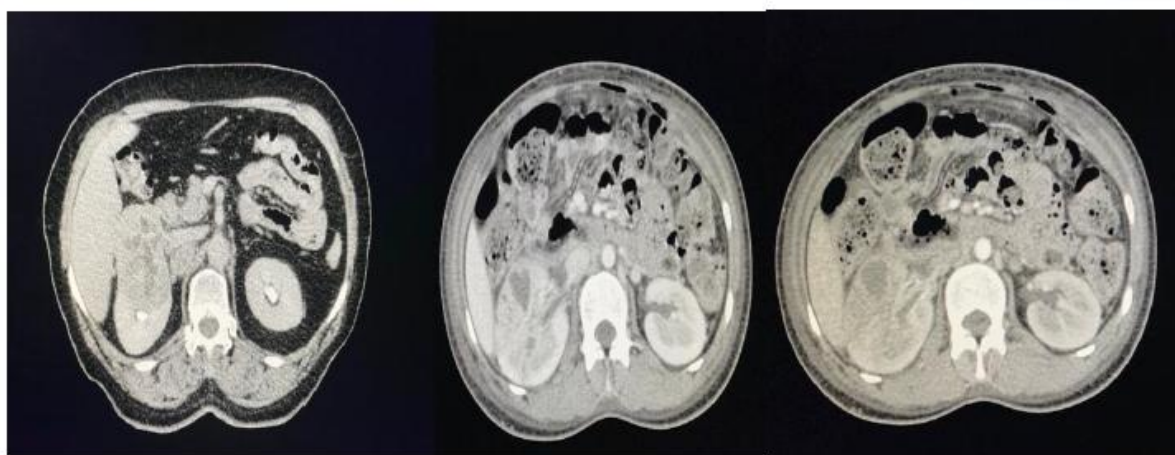


CORONAL

Empty right renal fossa with both kidneys on left side suggestive of Cross Fused Renal Ectopia.

#### MULTIPLE RENAL ABSCESS

**Renal abscess** is a collection of infective fluid in the kidney. It is usually a sequela of acute pyelonephritis, where severe vasospasm and inflammation may occasionally result in liquefactive necrosis and abscess formation. It can affect all ages and has no recognized gender predilection. The predisposing factors includes diabetes mellitus, renal calculi and ureteral obstruction.



PLAIN

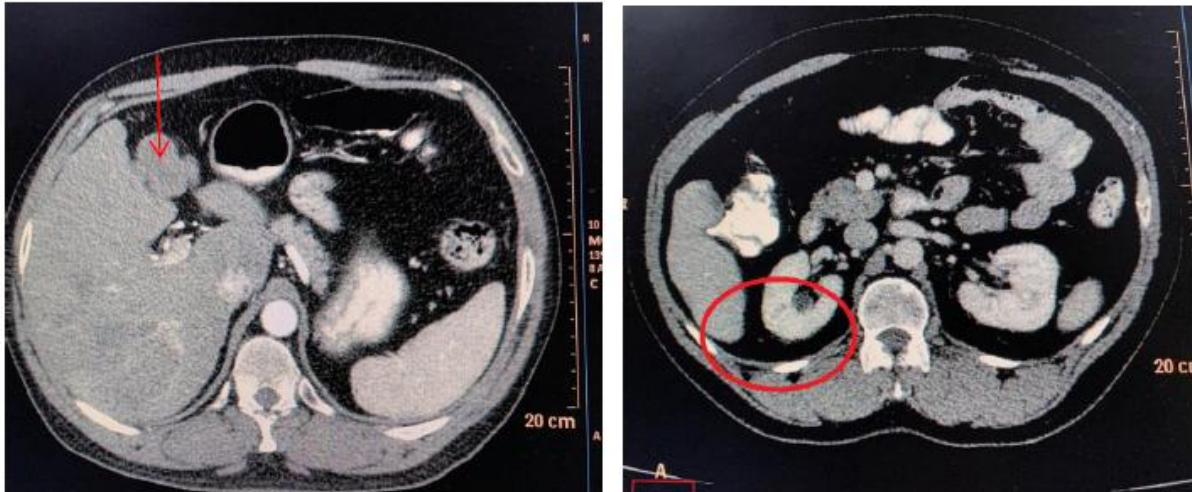
ARTERIAL

VENOUS

Axial CECT shows multiple well defined peripherally enhancing hypodense lesion in right kidney Multiple Renal Abscess

#### RENAL METASTATIC LESION

The most common tumour to metastasize to the kidney is carcinoma of the lung. Renal metastases may be multiple and bilateral and frequently are associated with metastases to other organs. Although they have nonspecific CT and MRI features, renal metastases commonly demonstrate infiltrative growth patterns. When the clinical history is available, the diagnosis may be obvious. In a patient with a history of malignancy without other metastases and a solitary renal mass, the renal mass is more likely to represent a renal cell carcinoma and not a metastasis.



Axial CECT shows minimally enhancing hypodense lesion in mid pole of right kidney (red circle) – METASTASIS in a known case of leiomyosarcoma (Red arrow).

#### **HYPERTROPHIED COLUMN OF BERTIN (PSEUDOTUMOUR)**

**Columns of Bertin** represent the extension of renal cortical tissue which separates the pyramids, and as such are normal structures. They become of radiographic importance when they are unusually enlarged and may be mistaken for a renal mass (renal pseudotumor). Ideally, the term **hypertrophied column of Bertin** or **prominent column of Bertin** should be used to avoid confusion.

On non-contrast CT they appear isodense to normal parenchyma and, following administration of contrast, enhance uniformly with renal cortex, and remain isodense to normal parenchyma on delayed images.



USG showing intermedullary solid isoechoic lesion without internal vascularity. On CT the lesion is isodense to the rest of the cortex in the corticomedullary phase strongly suggesting it to be a pseudotumour.

#### **IV. Conclusion -**

- CT with and without intravenous contrast, is the primary imaging modality for characterization and staging of renal masses.
- The enhancement value of renal masses on contrast enhanced CT in nephrogenic and corticomedullary phase determines the vascularity of the mass and hence determines the nature of the lesion.
- Pattern of enhancement of benign masses depends on the etiology.
- Renal neoplasms show greater enhancement with or without involvement of renal vein in the nephrogenic phase compared with that in corticomedullary phase.
- Though Ultrasound is considered as the initial modality for Imaging of renal masses but CT scan includes accurate characterization of the lesion and its staging, assistance with treatment planning, and evaluation of treatment response.

- Good accuracy of CECT in preoperative evaluation of renal tumour ( Renal cell carcinoma) on the basis on capsular, perinephric and vascular invasion and involvement of adjacent organ and lymph nodes by CECT was 80% in average.

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