

## CT EVALUATION AND CHARACTERIZATION OF RENAL MASSES

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**ABSTRACT: CONTEXT/BACKGROUND:** The detection rate of renal masses has increased in the last decades owing to the widespread use of CT and MRI.<sup>[1]</sup> Therefore, an accurate characterization of renal masses is essential to ensure appropriate case management. This study was done to evaluate and characterize renal masses on CT for early and prompt management.

**AIMS:** To detect the presence of solid renal masses on CT and to characterize them into benign and malignant masses with histopathological correlation.

To assess the diagnostic accuracy of CT in distinguishing between benign and malignant lesions.

**SETTINGS AND DESIGN:** A prospective study of 60 subjects was carried out from those referred to the Department of Radiodiagnosis for CT evaluation and characterization of renal masses after being clinically suspected or incidentally detected on other imaging studies.

**METHODS AND MATERIAL:** The patients were subjected to contrast enhanced helical CT. The CT findings were correlated with the surgical or histological findings or the therapeutic response in the case of inflammatory lesions.

**STATISTICAL ANALYSIS:** It was done using sensitivity, specificity positive predictive value and negative predictive value. CT diagnosis was compared with histopathological diagnosis, which was considered as the gold standard.

**RESULTS:** Neoplastic lesions were observed in 42 cases (70%) cases and inflammatory lesions in 9 cases (15%). Renal cell carcinoma was observed in 27 cases, Wilm's tumour in 6, oncocytoma in 3 cases and angiomyolipoma in 6 patients. The inflammatory renal lesions observed were focal pyelonephritis in 4, renal abscesses in 4 and emphysematous pyelonephritis in 1.

**CONCLUSION:** This study concludes that contrast enhanced spiral CT is sensitive as well as specific not only to diagnose neoplastic renal mass lesions but also to diagnose other non-neoplastic renal mass lesions.

**KEYWORDS:** Renal Mass, CT Characterization, Renal Cell Carcinoma.

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**INTRODUCTION: OBJECTIVES:** To detect the presence of solid renal masses on CT and to characterize them into benign and malignant masses with histopathological correlation. To assess the diagnostic accuracy of CT in distinguishing between benign and malignant lesions.

**MATERIAL AND METHODS:** This study was carried out at Shrimati Kashibai Navale Medical College, Narhe Pune. Sixty consecutive patients of renal mass lesions clinically suspected or incidentally detected on other imaging studies referred for CT evaluation were included. Renal masses that adhered to the criteria of simple cyst were not included in this study. The institutional ethical and the evaluation committee cleared the study.

Helical CT was performed on Siemens Somatom Spirit. Oral, rectal, and intravenous contrast was given to each patient. A topogram was acquired with the patient supine in a state of suspended respiration. Initial plain scans were obtained to determine the location of the mass and pertinent vascular structures.

There after, in adults 70ml of non-ionic contrast was injected manually as a single bolus through 18-gauge catheter and in children around 1.5ml/kg was given. Spiral CT scans with collimation of 10mm and table speed of 15mm per second, i.e., a pitch of 1.8 was done. Images were reconstructed at 10mm intervals. Thinner images were reconstructed at 4mm wherever indicated. Reconstructed images were viewed in detail. Axial CT images so obtained were studied in detail on soft tissue and bone window. The morphology, size, shape, enhancement pattern, calcification if any, local or distant spread of the mass was studied. The CT staging of the malignant mass lesions was done according to Robson's classification. The CT findings were correlated with the surgical or histological findings or the therapeutic response in the case of inflammatory lesions.

**Review of Literature:** Benign renal masses are more common as compared to malignant masses. The commonest benign lesion is a simple cyst with an incidence of 25% to 50% after the age of 50 years.<sup>(1)</sup> Renal cell carcinoma is the most common malignant tumor of the kidney comprising 3% of all malignancies found in adults.<sup>(2)</sup> Majority of solid renal masses in patients presenting with hematuria are primary renal cell carcinoma.<sup>(3)</sup> As this cancer is usually unresponsive to chemotherapy or radiotherapy, surgical resection of early stage disease is the only option with possibility of cure. However, small renal masses are now commonly detected incidentally during US, CT, or MRI examinations for non-urologic indications. A significant proportion of these smaller masses are benign.

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CT and MR can differentiate between benign and malignant lesions in some cases, such as angiomyolipomas containing fat.<sup>(4)</sup> Until recently, percutaneous biopsy was considered inaccurate enough for diagnosis. Therefore, masses that were not definitively benign on imaging were surgically resected without a confirmed diagnosis of malignancy due to high likelihood of renal carcinoma.

Recent radiological and pathologic advances have increased the accuracy of image-guided percutaneous biopsy. Therefore percutaneous biopsy has a role to play in the diagnosis and management of small renal masses, and has the potential to spare many unnecessary and potentially morbid surgical procedures.

Simple renal cysts are common in the general population and if these are detected incidentally by ultrasound, CT or MRI, no further diagnostic imaging is necessary.<sup>(5)</sup> The presence of fat in a renal mass which can be detected by ultrasound, CT or MRI, implies that the lesion is an angiomyolipoma.

CT is helpful to differentiate Bosniak category I, III and IV cysts (Table 1). Depending on the size and location, it is critical to differentiate between complicated cysts of categories II and III.<sup>(6)</sup> There is a pitfall of CT called pseudoenhancement, which is actually an artificial elevation of the Hounsfield unit measurements of a renal cyst measured on the contrast-enhanced CT images. It occurs as a result of image reconstruction algorithm used to adjust for beam-hardening effects.

Class I	Simple benign cysts. These lesions are round or oval in shape, are unilocular with the uniform density of water, have no perceptible wall and exhibit no enhancement on radiographs taken after the administration of contrast medium.
Class II	Probable benign simple cystic lesions that are minimally complicated These lesions include septated cysts, minimally calcified cysts, infected cysts and high-density cysts.
Class III	More complicated cystic lesions. These lesions exhibit some findings seen in malignancy, such as thick, irregular calcifications, irregular borders, multilocular form, thickened or enhancing septa, uniform wall thickening or small nonenhancing nodules.
Class IV	Clearly malignant cystic masses. The appearance of these lesions results from necrosis and liquefaction of a solid tumor or a tumor growing in the wall. These lesions are heterogeneous, with a shaggy appearance, thickened walls or enhancing nodules.

**Table 1: Bosniak's Classification of Cystic Renal Masses**

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This pseudo enhancement of small intraparenchymal cysts can lead to an upgraded Bosniak cyst classification and difficulty in prognosis. Also calcification and high-density fluid of cysts can complicate the differentiation between Bosniak II and III cysts.

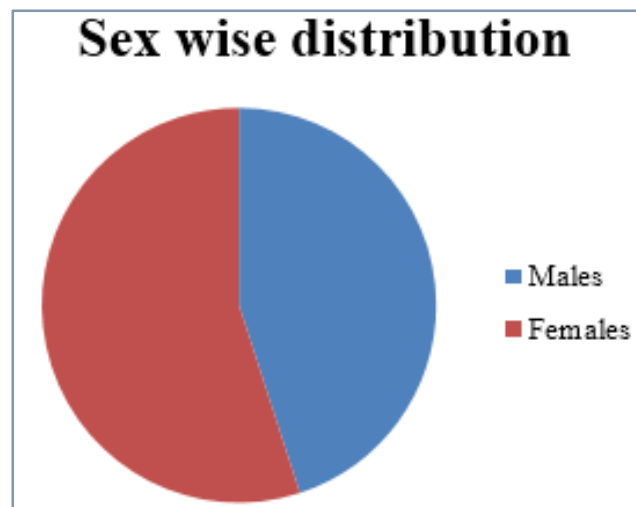
**STATISTICS:** The statistical analysis was done using sensitivity, specificity, positive predictive value, negative predictive value. The CT features were compared with the histopathological findings, which were considered as the gold standard.

**OBSERVATIONS:** In our study, the pattern of renal mass lesions was compared on CT and the final clinical and histological diagnosis was done. The vast majority of masses in our study were renal cell carcinoma. The next common mass was infective inflammatory.

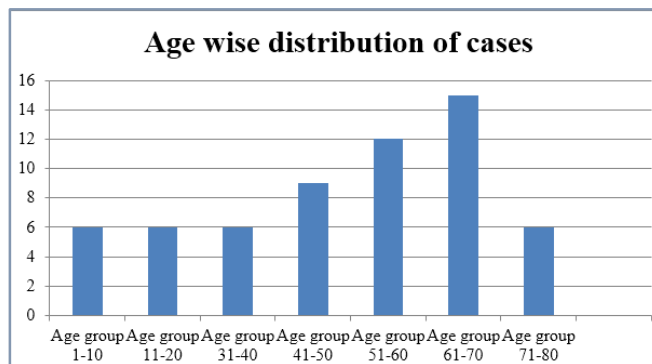
The present study included 60 patients – 27 males and 33 females – in the age range of 1 year to 70 years with a mean age of 35.5 years.

More than 70% of the cases had neoplastic renal lesions and about 1/5th were of inflammatory in nature.

A patient with suspected neoplastic etiology came out to be infective with no malignant cells seen. A suprarenal mass closely abutting the upper pole was wrongly diagnosed as renal mass, but histopathologically turned out to be schwannoma. A concomitant malignancy of the GB and renal cell carcinoma was found in one patient.



**Table 2: Sex-wise distribution of cases, shows Male: Female ratio is 0.81:1**



**Table 3: Age wise distribution of cases**

Type	Soft Tissue Attenuation	Fat Component	Cystic Component	Calcification	Post Contrast Enhancement
Renal cell carcinoma	Heterogeneous	+/-	+	+	Moderate
Wilms' tumor	Iso to hypodense	+/-	+	+	Heterogeneous
Oncocytoma	Homogenous (<3 cm) /heterogeneous (>3 cm)	-	-	+	Homogenous with central non-enhancing scar
Angiomyolipoma	Hyperdense	++	-	-	
Inflammatory/ Infective	Homogenous, cystic	-	++	+	Peripheral

**Table 4: Characterisation of renal mass lesions**

Types	No. of Cases
Renal cell carcinoma	27
Wilms' tumor	6
Oncocytoma	3
Angiomyolipoma	6
Inflammatory/Infective	9
Others	9

**Table 5: Types of Tumors**

Group	CT Diagnosis	Sensitivity and Specificity of CT
Neoplastic	Renal cell carcinoma 27	Sensitivity 93.1% Specificity 94.29%
	Wilms' tumor 06	Sensitivity 100 % Specificity 98.08%
	Angiomyolipoma 06	Sensitivity 100% Specificity 98.18%
	Oncocytoma 03	Sensitivity 100% Specificity 98.28 %
Infective/Inflammatory	Focal PN 04	Sensitivity 90 % Specificity 96.23 %
	Emphysematous PN 01	
	Renal abscess 04	
Others	Adrenal adenoma 4	Sensitivity 100 % Specificity 94.44 %
	Neuroblastoma 2	
	Schwannoma 3	

**Table 6: Sensitivity and specificity of CT in evaluation of renal masses. (Histopathological diagnosis was considered the gold standard and CT was compared with it)**

**DISCUSSION:** In sixty patients diagnosed as renal mass lesions, the mean age of presentation was 35.5 years. The range of age presentation is 1 year to 70 years. The maximum cases were in age group of 61-70 years (27%); 71% cases belong to age group between 51 to 60 years. These observations of present study correspond with following studies. According to Bajwa RPS, Sandhu P et al., the range of age presentation is from age 4 to 84 years.

In the present study out of 60 patients with renal mass lesions, females (55%) were more predominantly involved than males (45%). Male to female ratio of patients with renal mass lesions was 0.8:1.

Renal masses with a diameter of <4 cm are defined as small renal masses. The smaller the mass is, the greater the chance that it is benign.<sup>[1]</sup> In our study, 75% were large lesions and only 25% were small lesions. In a report by Massachusetts General Hospital, 46% masses that were less than 1 cm in diameter were benign as were 22% of those that were 1 to 2.9 cm in diameter and 20% of those that were 3 to 3.9 cm in diameter.<sup>[3]</sup>

Out of 60 cases of renal mass lesions, 27 cases were diagnosed as renal cell carcinoma (RCC) on CT, while histopathological diagnosis showed 25 cases of RCC. There were two false positives, which came out to be inflammatory mass in one and oncocytoma in the other.

Thus CT showed a sensitivity of 93.1% and specificity of 94.29% in detecting renal cell carcinoma. H/P diagnosis was considered as gold standard in all the cases. This study is consistent with the study conducted by Bajwa RPS, Sandhu P et al.

CT enhancing masses are classified as solid or complex cystic. Eighty-five percent of expansive solid masses are malignant.<sup>[7]</sup> Therefore, a solid enhancing mass must be considered malignant unless proven otherwise. Renal cell carcinoma (RCC) is the most common malignant tumour with a rising incidence of about 3% per year since 1975. The most common subtype of RCC is the clear cell RCC (Conventional RCC) with 65% of renal cortical tumours. Further subtypes are papillary (basophilic and eosinophilic) and chromophobe RCCs with about 25% of renal cortical

tumours. Clear-cell RCC causes 90% of metastases of all renal malignancies.<sup>[8,9]</sup>

Other malignant masses include transitional cell carcinoma (TCC), lymphoma (Primary and more frequent secondary), metastases from carcinoma and primary/secondary sarcoma. Primary tumours of the lung, breast and gastrointestinal tract are the most common sources of renal metastases.<sup>[10]</sup>

Ninety percent of clear cell RCCs are hypervascular with a heterogeneous enhancing pattern of mixed enhancing solid soft tissue components and low attenuation necrotic or cystic areas.<sup>[11,12]</sup> Clear cell carcinomas can be predominantly cystic. Renal vein tumour thrombus can be seen with aggressive higher stage tumours. Seventy-five percent of papillary RCCs are hypovascular, and 90% of all papillary tumours demonstrate a homogeneous or peripheral enhancement pattern. Chromophobe tumours often demonstrate a moderate degree of enhancement.

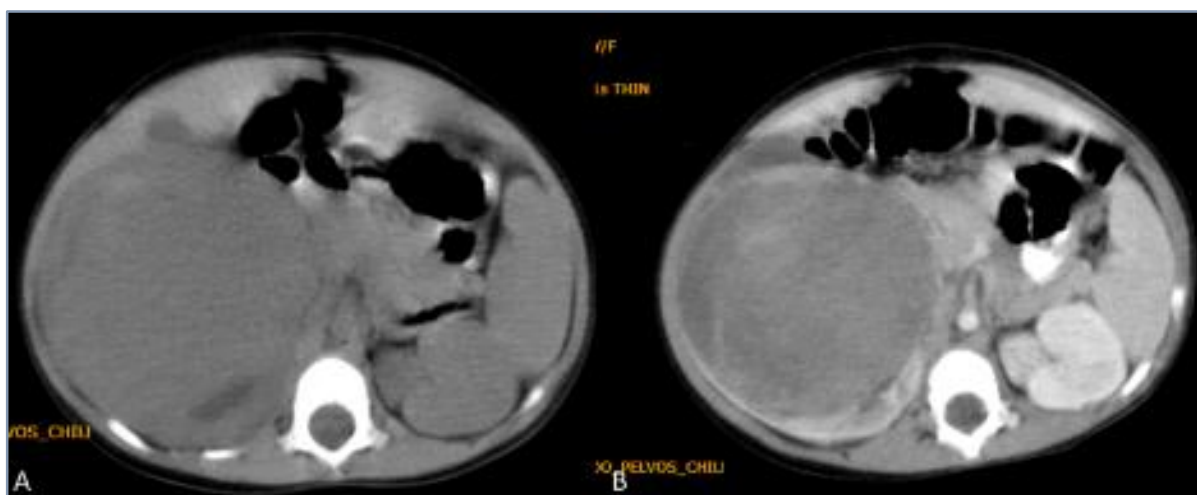
**CONCLUSION:** In the present study we found a sensitivity of 100%, specificity of 98% for determining the presence of neoplastic lesions excluding renal cell carcinoma and sensitivity of 93%, specificity of 94.3% for renal cell carcinomas and sensitivity 90% specificity 96.23% for diagnosing renal inflammatory mass lesions. Thus this study concludes that contrast enhanced spiral CT is sensitive as well as specific not only to diagnose neoplastic renal mass lesions, but also to diagnose other non-neoplastic renal mass lesions.

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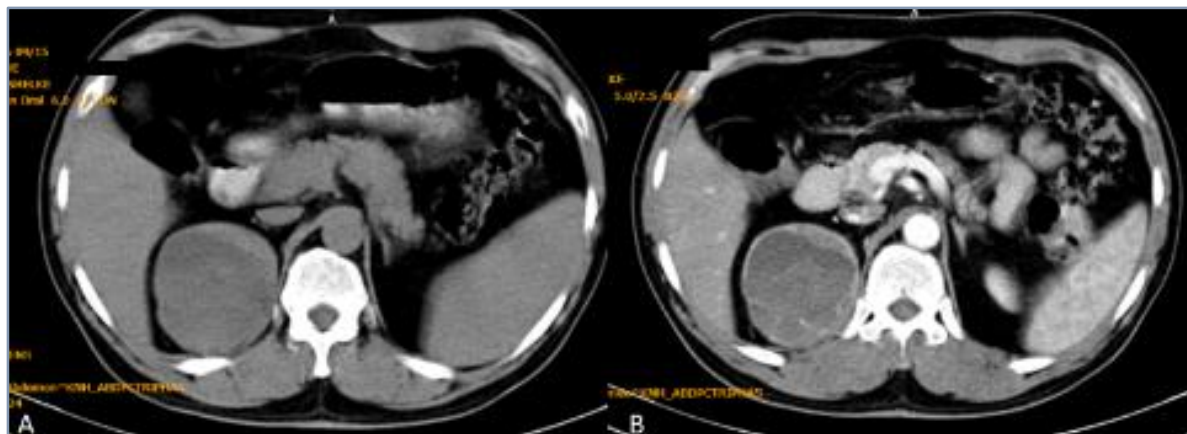
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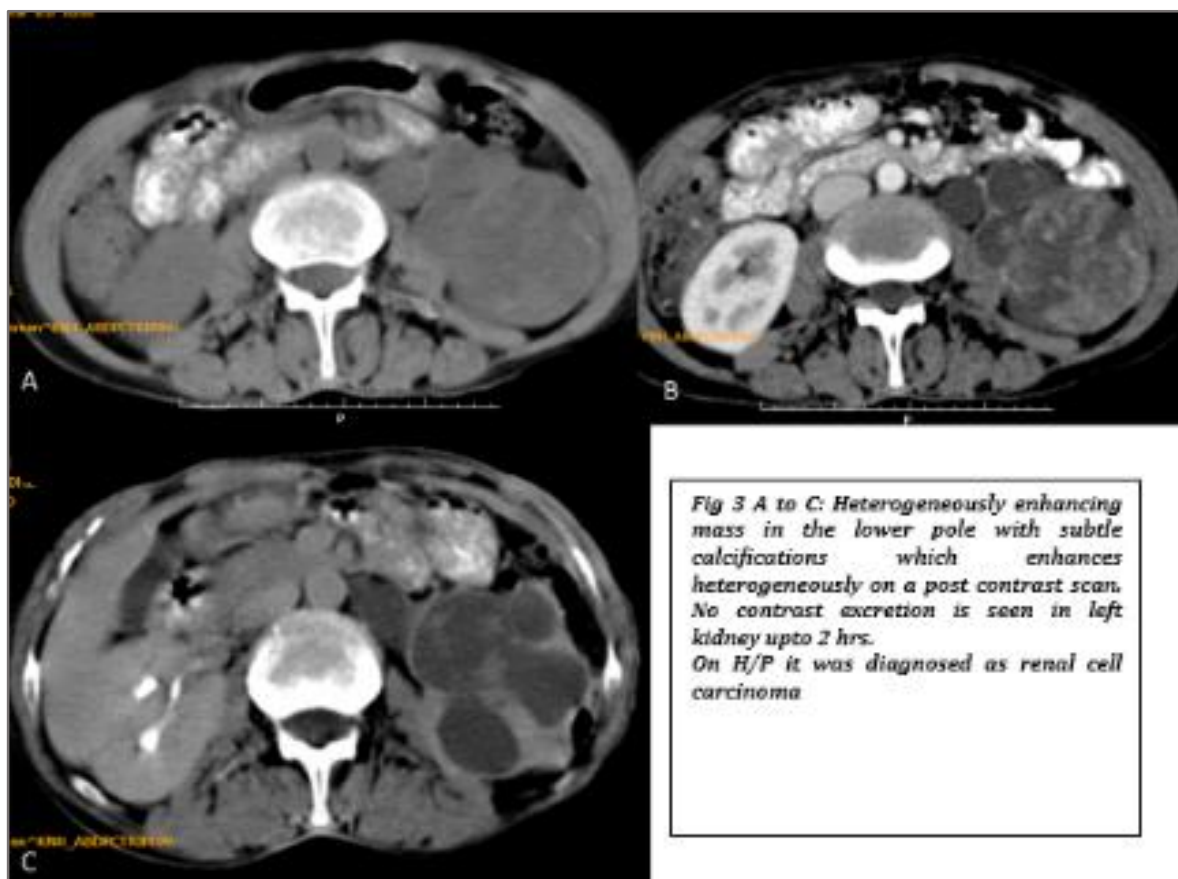
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**Fig. 1 A and B:** Large well defined hypodense mass is noted arising from the upper and midpole of right kidney with thin peripheral enhancement. On H/P it was confirmed as Wilms tumor.



**Fig. 2 A and B:** A well-defined hypodense mass arising from the upper pole of right kidney showing thin enhancing wall and internal septae with large non-enhancing component. CT diagnosis was kept as neoplastic etiology. On H/P it was found to be infective pathology with no malignant cells seen.



**Fig. 3 A to C:** Heterogeneously enhancing mass in the lower pole with subtle calcifications which enhances heterogeneously on a post contrast scan. No contrast excretion is seen in left kidney upto 2 hrs. On H/P it was diagnosed as renal cell carcinoma.