

## Study of Computed Tomography (CT) in Assessment in Characterization of Renal Masses at a Tertiary Hospital

Pandey Kumar Abhishek Rajan Harihar Prasad<sup>1</sup>, Suresh Kumar Toppo<sup>2</sup>,  
<sup>3</sup>Rajeev Ranjan

<sup>1</sup>Senior Resident, Department of Radiology, RIMS, Ranchi, India.

<sup>2</sup>Professor, Department of Radiology, RIMS, Ranchi, India.

<sup>3</sup>Associate Professor, Department of Radiology RIMS, Ranchi, India.

Received Date: 20/08/2023

Acceptance Date: 23/09/2023

### Abstract

**Background:** The incidence of renal masses has risen significantly over the past years with the increasing use of radiological imaging modalities. For various treatment modalities of renal masses correct preoperative evaluation of renal tumors is very important. Present study was aimed to study of computed tomography (CT) in assessment in characterization of renal masses at a tertiary hospital. **Material and Methods:** Present study was single-center, prospective, observational study, conducted patients of either gender, with diagnosed renal masses on ultrasound, underwent biopsy/surgery & histopathological diagnosis was available. Multi detector computed tomography was performed using 64 slice MDCT scanner. **Results:** 38 patients of renal mass were studied, majority patients were from 51-60 years (23.68 %), 61-70 years age group (28.95 %), were male (65.79 %) & left sided (52.63 %). Mean age was  $55.9 \pm 11.2$  years. Common complaints were pain in abdomen (60.53 %), Hematuria (28.95 %), Mass per abdomen (23.68 %) & nonspecific complaints (63.16 %). In present study, Renal Cell Carcinoma (39.47 %), Renal abscess 15.79 %), Xanthogranulomatous pyelonephritis (XGPN) (7.89 %), Multi-locular cystic nephroma (MLCN) (7.89 %), Bosniak type Cyst (7.89 %).& Lymphoma (5.26 %) were common CT diagnosis. 36 CT diagnosis were correlating with histopathology report, 2 CT diagnosis were not correlating to histopathology diagnosis as Bosniak type cyst was a case of renal cell carcinoma & renal cell carcinoma was a case of renal metastasis of unknown primary. **Conclusion:** Computed Tomography is the imaging modality of choice for further evaluation and characterization & enables excellent detection of renal masses and differentiation between cystic, complex cystic and solid masses.

**Keywords:** Computed Tomography, renal masses, renal cell carcinoma, radiodiagnosis.

**Corresponding Author:** Dr. Suresh Kumar Toppo, Professor, Department of Radiology, RIMS, Ranchi, India.

**Email:** [rddrsuresh2205@gmail.com](mailto:rddrsuresh2205@gmail.com)

### Introduction

The incidence of renal masses has risen significantly over the past years with the increasing use of radiological imaging modalities. Early detection of renal masses is essential for appropriate case management, differentiating benign from malignant renal masses and also identifying masses which need surgical intervention.<sup>1,2</sup>

The wide range of radiological investigations in evaluation of the renal lesions varies from the plain abdominal radiograph, excretory urography (Intravenous Pyelography and Retrograde Urethrography / Micturating Cysto - urethrography), ultrasonography,

radionuclide imaging, angiography, computed tomography (CT) and magnetic resonance imaging (MRI).<sup>3</sup> Imaging methods play a relevant role in the diagnosis of RCCs, determining a tendency toward the diagnosis of tumors at earlier stages, besides being essential for staging and therapeutic planning.<sup>4</sup>

For various treatment modalities of renal masses (surgical resection, interventional techniques like arterial embolisation, chemotherapy, radiotherapy or combinations) correct preoperative evaluation of renal tumors is very important. Accurate assessment of the morphology of renal tumors, perinephric space, regional lymph nodes, major vessels and adjacent organs can guide clinician to correct treatment from the available options.<sup>5</sup> Present study was aimed to study of computed tomography (CT) in assessment in characterization of renal masses at a tertiary hospital.

### Material And Methods

Present study was single-center, prospective, observational study, conducted in department of radiology in association with department of urology and Nephrology, at XXX medical college & hospital, XXX, India. Study duration was of 2 years (January 2020 to December 2021). Study approval was obtained from institutional ethical committee.

#### Inclusion criteria

- Patients of either gender, with diagnosed renal masses on ultrasound, underwent biopsy/surgery & histopathological diagnosis was available, willing to participate in present study

#### Exclusion Criteria

- Pregnant and lactating patients
- Any contraindication to CT
- Patients with history of allergic reaction to contrast medium
- Patient with deranged renal function tests (RFTs) (S. creatinine > 1.6 mg / dl)
- Patients not willing to give consent.

Study was explained to patients in local language & written consent was taken for participation & study. All patients underwent clinical history taking, all laboratory investigations, examination findings were noted in the proforma. All patients underwent primary USG assessment (Philips IU 22 ultrasound machine) using probe frequencies ranging from 2.5 to 4 MHZ, lying in supine position, oblique and lateral decubitus positions and findings were noted.

Multi detector computed tomography was performed using 64 slice MDCT scanner (Philips scanner, Netherlands). A noncontrast and multiphase post contrast MDCT examination was performed on all subjects of the study. In unenhanced phase scanning was performed from diaphragm down to symphysis pubis and in post contrast phases scanning was performed from diaphragm to iliac crest. The unenhanced phase was performed at 5mm thickness and at a speed of 15mm rotation. Ultravist (300mg/ml) a low osmolar non ionic contrast medium was administered for all cases at 2ml/kg body weight at a rate of 4ml/s and 150mmhg using automatic injector. Scanning started immediately using automatic bolus tracking and was triggered 5 seconds after a threshold of 150 HU in the region of interest was reached. All patients underwent scanning during unenhanced phase, cortico medullary phase, Nephrographic phase and Excretory phase.

CT features assessed were diameter, pattern of enhancement, invasion, presence or absence of calcification, spreading patterns, including perinephric change, venous invasion and lymphadenopathy. After biopsy/surgery histopathological diagnosis was noted in proforma.

Data was collected and compiled using Microsoft Excel, analysed using SPSS 23.0

version. Statistical analysis was done using descriptive statistics.

### Results

38 patients of renal mass were studied, majority patients were from 51-60 years (23.68 %), 61-70 years age group (28.95 %), were male (65.79 %) & left sided (52.63 %). Mean age was  $55.9 \pm 11.2$  years. Common complaints were pain in abdomen (60.53 %), Hematuria (28.95 %), Mass per abdomen (23.68 %) & nonspecific complaints (63.16 %).

**Table 1: General characteristics**

Characteristics	No. of patients	Percentage
Age groups (in years)		
21-30	5	13.16%
31-40	4	10.53%
41-50	5	13.16%
51-60	9	23.68%
61-70	11	28.95%
>70	4	10.53%
Mean age (mean $\pm$ SD)	$55.9 \pm 11.2$	
Gender		
Male	25	65.79%
Female	13	34.21%
Complaints		
Pain abdomen	23	60.53%
Hematuria	11	28.95%
Mass per abdomen	9	23.68%
Nonspecific complaints	24	63.16%
Laterality of renal masses		
Right	17	44.74%
Left	20	52.63%
Bilateral	1	2.63%

In present study, Renal Cell Carcinoma (39.47 %), Renal abscess 15.79 %), Xanthogranulomatous pyelonephritis (XGPN) (7.89 %), Multi-locular cystic nephroma (MLCN) (7.89 %), Bosniak type Cyst (7.89 %). & Lymphoma (5.26 %) were common CT diagnosis.

**Table 2: CT diagnosis**

CT diagnosis	No. of patients	Percentage
Renal Cell Carcinoma	15	39.47%
Renal abscess	6	15.79%
Xanthogranulomatous pyelonephritis (XGPN)	3	7.89%
Multi-locular cystic nephroma (MLCN)	3	7.89%
Lymphoma	2	5.26%
Bosniak type Cyst	3	7.89%
Wilms tumor	2	5.26%
Renal Angiomyolipoma	2	5.26%
Transitional cell carcinoma	1	2.63%
Oncocytoma	1	2.63%

36 CT diagnosis were correlating with histopathology report, 2 CT diagnosis were not correlating to histopathology diagnosis as Bosniak type cyst was a case of renal cell carcinoma & renal cell carcinoma was a case of renal metastasis of unknown primary,

**Table 3: CT diagnosis & Histopathological correlation**

No of cases	CT diagnosis	Pathological diagnosis
14 (36.84 %)	renal cell carcinoma	renal cell carcinoma
6 (15.79 %)	Renal abscess	Renal abscess
3 (7.89 %)	Xanthogranulomatous pyelonephritis (XGPN)	Xanthogranulomatous pyelonephritis( XGPN)
3 (7.89 %)	Multi-locular cystic nephroma (MLCN)	Multi-locular cystic nephroma (MLCN)
2 (5.26 %)	Lymphoma	AML
2 (5.26 %)	Bosniak type Cyst	Bosniak type Cyst
2 (5.26 %)	Wilms tumor	Wilms tumor
2 (5.26 %)	Renal Angiomyolipoma	Renal Angiomyolipoma
1 (2.63 %)	Transitional cell carcinoma	Transitional cell carcinoma
1 (2.63 %)	Oncocytoma	Oncocytoma
1 (2.63 %)	Bosniak type cyst	renal cell carcinoma
1 (2.63 %)	renal cell carcinoma	Renal metastasis – unknown primary

## Discussion

Improvement in software, hardware, image acquisition and processing, X-ray tubes, detector arrays along with the operational experience gained in last few decades has lead to a dramatic improvement in image quality and the Contrast enhanced CT scan technique (CECT) of the kidneys and other organs.

Ultrasound (US), contrast-enhanced US (CEUS), computed tomography (CT), and magnetic resonance imaging (MRI) are the most common imaging techniques used to differentiate between benign and malignant lesions and to establish an appropriate management. CT is a relatively easy, simple and accurate modality which is independent of renal function and is relatively free of complications, except for those which may arise secondary to use of intravenous contrast medium for contrast enhancement.

Kuchhal A et al.,<sup>6</sup> noted that renal cell carcinoma (RCC) was the most common renal mass (48 %) followed by renal cyst (30 %). The most common presenting symptom of RCC was haematuria (91.6 %) followed by flank pain (58.3 %). Renal cyst was a fairly common lesion with majority (93.3 %) being BOSNIAK - I category. RCC most commonly showed malignant extension via lymph nodes (83.3 %) while transitional cell cancer (TCC) most commonly spread via ureteric extension (75 %). Inferior vena cava (IVC) extension, even though seen only in a small fraction of cases (4 %), was only associated with RCC. On correlation with histopathological findings, a sensitivity of 95.8 %, specificity of 96.15 % and a diagnostic accuracy of 96 % was found, for diagnosing RCC.

Gomalavalli R et al.,<sup>7</sup> noted that Grey Level Co-Occurrence Matrix (GLCM) parameters are crucial tool for the determination of the solid mass composition of tumour. (entropy, energy, sum average, sum variance, inertia and low gray level emphasis) were found to be statistically significant which helps the clinician to differentiate the benign from the malignant renal masses. This obviates the need for an invasive procedure like Ultrasound or a CT guided biopsy of the mass.

In study by Madhuri A,<sup>8</sup> mean age of the study sample was 36.5 years, majority of patients were males. Palpable abdominal mass, flank pain and hematuria were the most frequent

presenting complaints. Renal cell carcinoma was the most common lesion followed by cyst. CT scan comes to an accurate diagnosis of renal mass and staging of a renal neoplasm. sensitivity and specificity of CT scan as a reliable diagnostic modality for diagnosis is 96% and 80%.

In study by Rohini A et al.,<sup>9</sup> clear cell RCC was the most common (75%) tumor subtype with smaller size of the lesion at presentation, heterogeneous enhancement, and cystic degeneration, hypervascularity with post-contrast HU of >100 in corticomedullary phase. The tumor had various patterns of spread and the tumor to aorta enhancement ratio was >0.3. The papillary RCC (pRCC) was 17%, smaller lesions, and hypovascular with post-contrast HU of <100. The tumor-to-aorta enhancement ratio was <0.23. Single case of translocation type RCC (4%) and chromophobe RCC (4%) were observed which presented with intermediate features and tumor-to-aorta enhancement ratio was 0.3 and 0.23-0.3, respectively. Chromophobe RCC showed calcification and high-attenuation values. Excepting pRCC, other subtypes were observed more in females.

Abhang A et al.,<sup>10</sup> studied 43 patients. mean age was  $51.6 \pm 11.4$  years. 27 patients were male and 16 were females and mean longest diameter of renal mass was  $5.7 \pm 1.9$  cms with range of 3.8 – 8.7 cms. Most of renal masses were malignant (86.84 %) while benign lesions were less (13.16 %). Renal cell carcinoma (74.42 %) was most common diagnosis of renal mass in present study. Other diagnosis were renal angiomyolipoma (9.3 %), transitional cell carcinoma (4.65 %), Wilms tumor (4.65 %), metastasis (4.65 %) and Bosniak II cyst (2.33 %). Out of 38 malignant lesions, common local extent noted were beyond perirenal fascia (28.95 %), perinephric extension (23.68 %) and pelvicalyceal involvement (13.16 %). Other less common local extent were regional lymphadenopathy (13.16%), renal vein thrombus (10.53%), IVC thrombus (7.89 %) and ipsilateral adrenal involvement (5.26 %).

In study by NVK Sundeeep et al.,<sup>11</sup> 28 were diagnosed to be malignant (70%) and 12 cases were diagnosed benign (30%). The most common renal mass was renal cell carcinoma accounting for 60% of all the renal masses and 85% of the malignant renal masses. Overall there were male to female ratio was 1.85:1. MDCT was able to differentiate a benign from malignant lesion with Sensitivity of 100%, Specificity of 85.71%, Positive predictive value of 92.85% and Negative predictive value of 100% was achieved. The characteristics of malignant renal masses such as perinephric extension, invasion of gerotas fascia, renal vein / IVC, lymphnodal extension, extension to adjacent organs and distant metastases can be exactly identified by MDCT with various reconstructions which is very useful for staging of lesions.

The Society of Abdominal Radiology RCC Disease-Focused Panel<sup>12</sup> recommends that the renal CT image acquisition protocol includes precontrast imaging and nephrographic phase imaging (100–120 seconds) at 3-mm section thickness with weight-based dosing of intravenous iodinated contrast material, with optional imaging in the corticomedullary phase (40–70 seconds) and/ or excretory phase (7–10 min). The excretory phase is recommended if the imaging is performed for preprocedural planning.

### Conclusion

Computed Tomography is the imaging modality of choice for further evaluation and characterization & enables excellent detection of renal masses and differentiation between cystic, complex cystic and solid masses. Incidental renal masses with heterogenous enhancement, necrosis, and calcifications are suggestive of renal cell carcinoma.

**Conflict of Interest:** None to declare

**Source of funding:** Nil

**References**

1. Hollingsworth JM, Miller DC, Daignault S, Hollenbeck BK. Rising incidence of small renal masses: a need to reassess treatment effect. *J Natl Cancer Inst.* 2006;98:1331–1334
2. Vincent G. Bird and Victoria Y. Bird (2011). *Radiologic Imaging of Renal Masses, Renal Cell Carcinoma*, Dr. Hendrik Van Poppel (Ed.), ISBN: 978-953-307-844-1.
3. Tsili AC, Argyropoulou MI. Advances of multidetector computed tomography in the characterization and staging of renal cell carcinoma. *World J Radiol.* 2015;7(6):110-27.
4. Catalano C, Fraioli F, Laghi A, Napoli A, Pediconi F, Danti M, et al. High resolution multidetector CT in the preoperative evaluation of patients with renal cell carcinoma. *AJR Am J Roentgenol* 2003;180:1271-7.
5. Abhang Apte, Vinod Attarde, Parag Patil, Devidas Dahiphale. Role of computed tomography in characterization of renal masses at a tertiary center. *MedPulse International Journal of Radiology.* May 2021; 18(2): 52-55.
6. Kuchhal A, Sethi S, Gupta R, et al. Multidetector computed tomography in the evaluation of renal masses - a prospective study from Ambala, India. *J Evolution Med Dent Sci* 2021;10(21):1583-1587,
7. Gomalavalli Ramesh, Sriram Krishnamoorthy, Muttan Sourirajan, Venkata Sai, Assessment of Primary Solid Renal Mass using Texture Analysis of CT Images of Kidney by Active Contour Method: A Novel Method, *Journal of Clinical and Diagnostic Research.* 2018 Jul, Vol-12(7): TC05-TC09.
8. Madhuri Atluri, Vamsi Krishna S.V.N. Role of CT in the characterization of renal masses. *International Journal of Contemporary Medicine Surgery and Radiology.* 2020;5(1):A128-A133.
9. Rohini A, Bhargavi V, Kala P. Multiple Detector Computed Tomography Evaluation of Subtypes of Renal Cell Carcinoma. *Int J Sci Stud* 2017;5(5):41-47.
10. Abhang Apte, Vinod Attarde, Parag Patil, Devidas Dahiphale. Role of computed tomography in characterization of renal masses at a tertiary center. *MedPulse International Journal of Radiology.* May 2021; 18(2): 52-55.
11. NVK Sundeep, M Venkatesh, P Suneetha. Role of computed tomography (plain and contrast) in the evaluation of renal masses. *International Journal of Contemporary Medicine Surgery and Radiology.* 2018;3(3):C39-C43.
12. Wang ZJ, Davenport MS, Silverman SG, et al. <https://abdominalradiology.org/wp-content/uploads/2020/11/RCC.CTprotocolsfinal-7-15-17.pdf>. CT renal mass protocols v1.0. 2018 5/9/2018. Accessed February 1, 2021.