

Role of ultrasound and contrast-enhanced computed tomography in the diagnosis and assessment of renal masses with histopathological correlation

Authors:

Dr. Anjaneya Singh¹, Dr. Tanya Aggarwal², Dr. Ashna Garg³, Dr. Hemant Kumar Mishra⁴
Resident 2. Resident 3. Resident 4. Professor and head

Department of Radiodiagnosis

Mahatma Gandhi University of Medical Sciences and Technology, Jaipur, Rajasthan, India Pincode- 302022

Corresponding Author:

Dr. Tanya Aggarwal

Resident, Mahatma Gandhi University of Medical Sciences and Technology, Jaipur, Rajasthan, India

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ABSTRACT:

Aim: The aim of the present study was to examine the roles of ultrasound and contrast-enhanced computed tomography in the diagnosis and assessment of renal masses. **Methods:** The study was carried out in the Department of Radiodiagnosis. Patients were referred from the departments of nephrology, urology, pediatrics, and surgery. The study was carried out in the department and included 60 patients with suspicion of renal masses coming to the department. **Results:** The majority of the cases presented with renal masses belonged to the age group of 61–70 years (38.3%), followed by 41–50 years and 51–60 years, which represent 9 cases (15%). The majority of the cases presented with suspected renal mass were males (81.7%). Out of 60 cases, 45 (75%) were detected as malignant on histopathology, and 15 (25%) were benign. In our study, pain was the most common symptom (75%), followed by hematuria (53.3%). 41.7% of renal masses were seen in the right kidney, 43.3% were in the left kidney, and 15% were bilateral. **Conclusion:** Due to its low cost, simplicity of use, and lack of radiation exposure, ultrasound is the first imaging modality of choice in cases of renal masses. The imaging technique of choice for additional assessment and characterization is contrast-enhanced computed tomography. Due to its capacity to show perinephric and vascular extension, CT offers undeniable advantages over US in the preoperative staging of renal cell carcinoma.

Keywords: contrast-enhanced computed tomography; ultrasound; renal cell carcinoma

INTRODUCTION:

Renal cancer (RCC) is the most common primary malignant tumor of the kidney, accounting for 80% to 90% of primary malignant tumors of the kidney. In recent years, the incidence of kidney cancer has increased significantly. Most patients with kidney cancer lack typical clinical symptoms and signs at an early stage. One-third of RCC cases were reported to have metastasis by the time of diagnosis.⁴ Therefore, there is a need for an effective kidney cancer imaging diagnosis method.

Ultrasonography is useful for children, pregnant women, people with poor renal function, and people who are sensitive to iodinated contrast media since it is simple, cost-effective, and without the risk of radiation and contrast media. Pulsed Doppler USG and color Doppler flow imaging (CDFI) have recently demonstrated potential for distinguishing between various renal

masses by intralésional blood flow patterns as well as the intralésional extent of the tumor.⁷

CT has a high definition and spatial resolution and can determine the type of lesions such as cystic, fat, and calcific.¹⁰ However, a contrast-enhanced CT scan (CECT) using an iodine-contrast agent can perform better for differential diagnosis because it is frequently challenging to ascertain the kind of RCC with a plain CT scan. For the diagnosis, staging, and follow-up of RCC, contrast-enhanced CT (CECT) represents the gold standard of cross-sectional imaging, particularly in light of recent advancements in CT scanner technology. It is an effective preoperative planning tool in the era of minimally invasive procedures.¹¹

MATERIAL AND METHODS:

The study was carried out in the Department of Radiodiagnosis, and patients were referred from various IPDs and OPDs with suspicion of renal

mass. Pregnant patients were not included in this study. Permission from the institutional ethical committee was obtained prior to the study. Written and informed consent was obtained from all participants before enrollment in the study. The patients underwent abdominal US to determine the nature, shape, and location of any mass in the kidneys and other organs using real-time ultrasound. Patients underwent CT to confirm the mass and its extension using pre-contrast and post-contrast examinations. Results of the histopathological examination of the tissue were obtained and were compared with histopathological studies. The collected data was entered in Microsoft Excel. Data were analyzed and statistically evaluated using SPSS-PC-25.

OBSERVATION:

The majority of the cases presented with renal masses belonged to the age group of 61–70 years (38.3%); the mean age was 55.45–16.73 years. The majority of the cases presented with renal masses were males (81.7%) 81.7% of cases were males, and 18.3% were females. 75% of the patients presented with complaints of Pain, 25% of the patients presented with hematuria, and 11.7% with tenderness, which were the main presenting symptoms. 43.3% of the renal masses. The left kidney was involved in 41.7% , the right kidney was involved in 41.7%, and 15% of cases were bilateral. On CECT, 42 (93.33%) malignancies out of 45 cases, while 3 cases were misidentified as benign masses. CECT was able to identify 14 (93.33%) of the 15 benign mass cases and 1 case was misclassified as malignant. On USG, malignant pathology was found in 37 (61.7%) cases. In one case, USG was unable to detect any pathology and detected that case as normal.

Table 3: Final diagnosis made by histopathology or FNAC in study subjects

Final diagnosis	No.	Percent
Benign		
Angiomyolipoma	1	1.7 %
Chronic interstitial nephritis	2	3.3%
Chronic pyelonephritis	9	15%
Haemorrhage	1	1.7%
Low grade spindle cell tumors	1	1.7%
Ovarian fibroma	1	1.7%
Malignant		
Clear cell RCC	42	70%
Transitional cell RCC	2	3.3%
Papillary RCC	1	1.7%

The most common type of malignant tumor in renal masses was clear cell carcinoma (70%), followed by transitional cell carcinoma (3.3%), and papillary cell RCC (1.7%). Benign masses were chronic pyelonephritis in 9 cases (15%), chronic interstitial nephritis in 2 cases, and 1-1 case each of angiomyolipoma, hemorrhage, low-grade spindle cell tumor, and ovarian fibroma. Perinephric involvement was seen in 25 (55.6%) of the 45 malignant cases. Out of 45 malignant cases, vascular involvement was present in 13 (28.9%) cases. Out of 45 malignant cases, retroperitoneal lymphadenopathy was present in 10 (22.2%) cases. Out of 45 malignant cases, there were distant metastases in 11 (24.4%) cases. Out of 45 cases, USG detected 36 (80%) cases of malignancy, while nine cases were falsely labeled as benign masses. Among 15 cases of benign masses, USG was able to detect 14 (93.33%), and 1 case was falsely labeled as malignant. Out of 45 cases, CECT detected 42 (93.33%) cases of malignancy, while 3 cases were falsely labeled

as benign masses. Among 15 cases of benign masses, CECT was able to detect 14 (93.33%), and 1 case was falsely labeled as malignant. Sensitivity, specificity, PPV, and NPV of USG in differentiating benign and malignant renal masses were 80%, 93.33%, 97.3%, and 60.87%, respectively. The sensitivity, specificity, PPV, and NPV of CECT in differentiating benign and malignant renal masses were 93.33%, 93.33%, 97.67%, and 82.35%, respectively.

DISCUSSION:

In our study, age groups 61–70 years (38.3%), 41–50 years(15%), 51–70 years (13.3%), and 31–40 years (8.1%) were the ones with the greatest proportion of cases presenting with renal mass. Up to 20 years old and 21 to 30 years old represent roughly equal percentages of instances or 5%. The average age was 55.45 (16.73). Males made up the majority of cases (81.7%) and females (18.3%) of probable renal masses. It

demonstrates a definite masculine preference for cases of renal mass. The study cohort's median age in Vogel DWT et al.'s 2013 study was 63 years (range 36–91 years). Of the 48 individuals, 30 (62.5%) were men and 18 (37.5%) were women. In order to clinically connect the results with further diagnostic techniques, we evaluated the clinical presentation of the study individuals. In our investigation, hematuria (53.3%), tenderness (11.7%), and fever (6.7%) were the next most prevalent symptoms after abdominal pain (75%) and tenderness (11.7%). In the Karthikeyan MA et al. 14 investigation, hematuria was the most prevalent (18/35 = 51.42%) presenting symptom, followed by abdominal pain (12/35 = 34.28%) and palpable abdominal mass (8/35 = 22.85%). Other symptoms included weight loss and vertigo.

In the present study, out of 60 instances, 15 (or 25%) were benign, and 45 (or 75%) were found to be malignant by histology. Clear cell carcinoma was the most prevalent kind of malignant tumor in renal masses (n = 42, 70%), followed by transitional cell Ca (n = 2, 3.3%) and papillary cell RCC (n = 1; 1.7%). The histopathological findings of research by Jin L. et al. (15) revealed that out of 191 individuals, 148 had malignant lesions and 43 had benign lesions. The histopathological findings in 43 patients were suggestive of benign tumors, including angiomyolipoma (n = 30) and oncocytomas (n = 12). Our study's findings were supported by a study by Karthikeyan MA et al.14, in which 21 patients (or 60%) had renal cell carcinoma, making it the most frequent renal mass seen.

In the current study, 11 (24.4%) of the 45 malignant cases had distant metastases. The most frequently affected organs by metastasis in patients with RCC were the liver and the lungs (3 cases each). In our investigation, the pleura and the bones were infrequent locations for metastasis. The findings of our

investigation were supported by a study by Adke S et al. (16), in which 23% of patients had distant metastases at the time of presentation. Malignant pathology was discovered on USG in 37 (61.7%) instances in our study. In one instance, USG failed to find any pathology and identified the condition as normal. In 13 (21.7%) patients, benign pathology was found; particularly, complex hemorrhagic cysts, complex renal cysts, simple cysts, abscesses, and urinoma/focal caliectasis were all found. Clear cell carcinoma was the most prevalent kind of malignant tumor found in renal masses on CT scans (n = 40, 66.7%), followed by transitional cell carcinoma (n = 3, 5%). In 10 cases (16.7%) of benign masses, chronic pyelonephritis, chronic interstitial nephritis, angiomyolipoma, and hemorrhage were present. RCC was the primary malignancy detected by CECT, followed by papillary carcinoma. These findings were in agreement with research by Fang L. et al. (17).

In our study, out of 45 instances, the USG found 36 (80%) cases of cancer, while the remaining 9 cases were mistakenly classified as benign tumors. Among 15 benign mass cases, USG was able to identify 14 (93.33%), whereas CECT correctly identified 42 (93.33%) malignancies out of 45 cases, while 3 cases were misidentified as benign masses. CECT was able to identify 14 (93.33%) of the 15 benign mass cases and 1 case was misclassified as malignant. In research by Mohi JK et al.7, CT found 28 cases of RCC, while USG accurately identified 26 cases (true positives).

In our study, the sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) of CECT in differentiating benign from malignant renal masses were 93.33%, 93.33%, 97.67%, and 82.35%, respectively, while the sensitivity, specificity, PPV, and NPV of USG were 80%, 93.33%, 97.3%, and 60.87%, respectively.

Figure 1: Diagnostic value of USG in differentiating benign and malignant renal masses

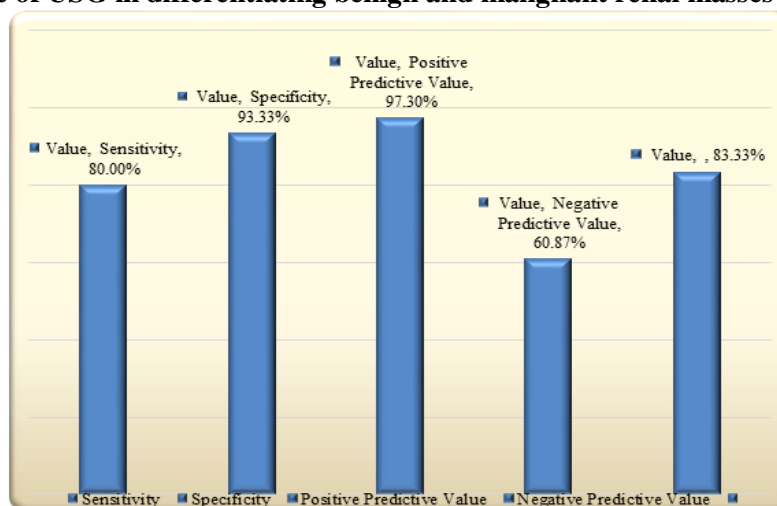


Figure 2: Diagnostic value of CECT in differentiating benign and malignant renal masses

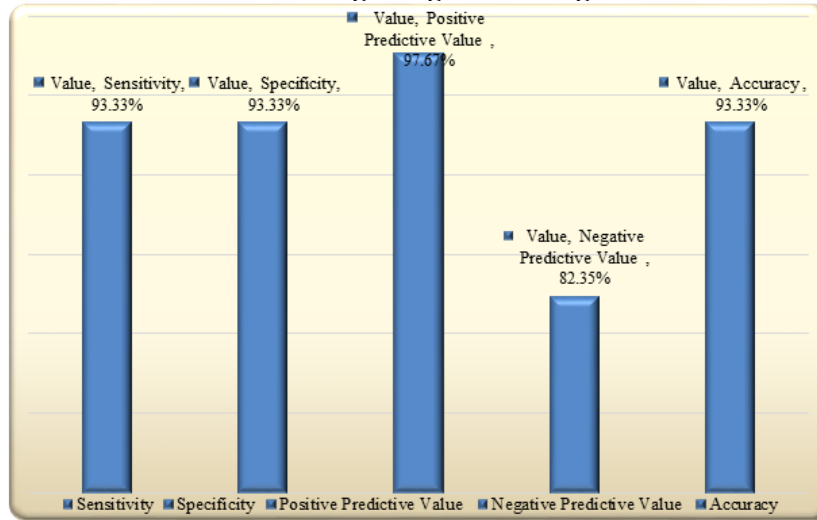


Fig 3: Axial and coronal CECT of abdomen shows a large lobulated mass lesion with large abnormal internal tumor vessels and intralesional aneurysms involving upper pole and interpolar region of right kidney with extension into anterior perinephric space. The lesion shows internal areas of enhancement and necrosis with small foci of calcification

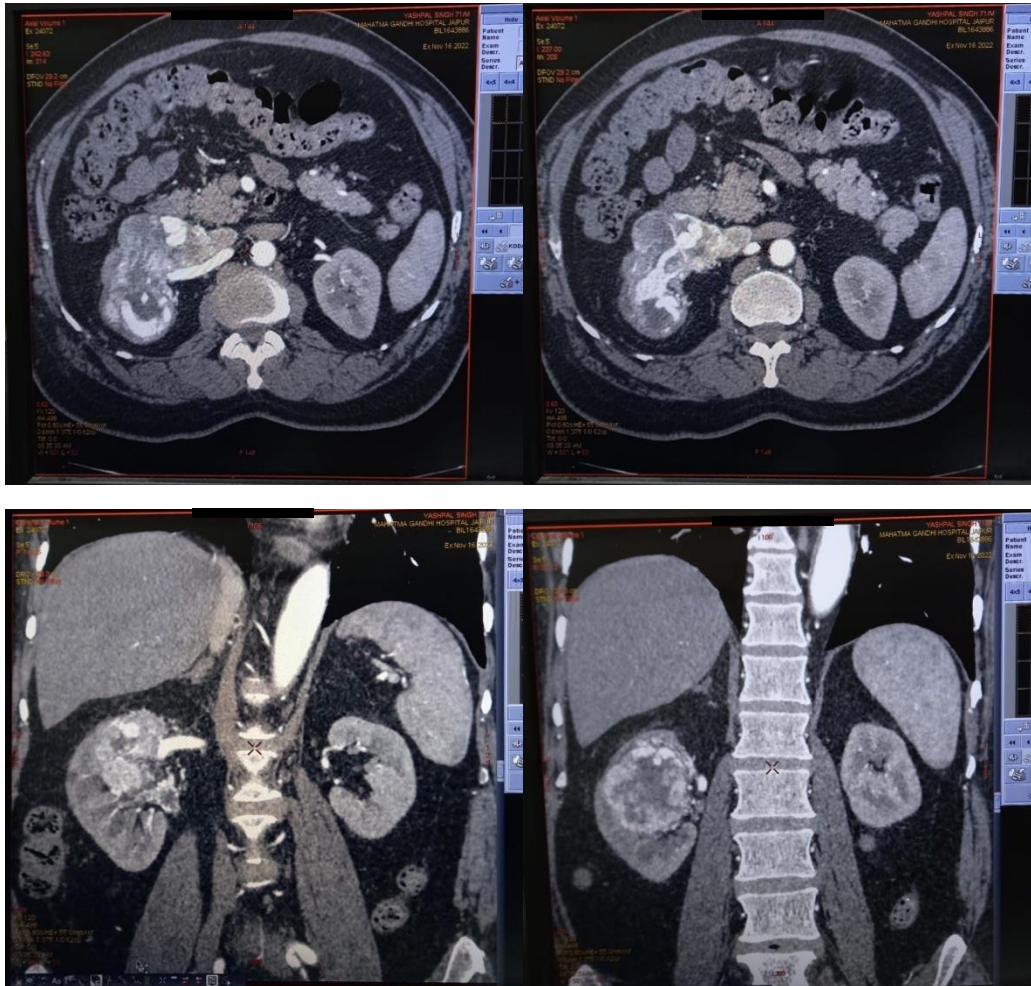
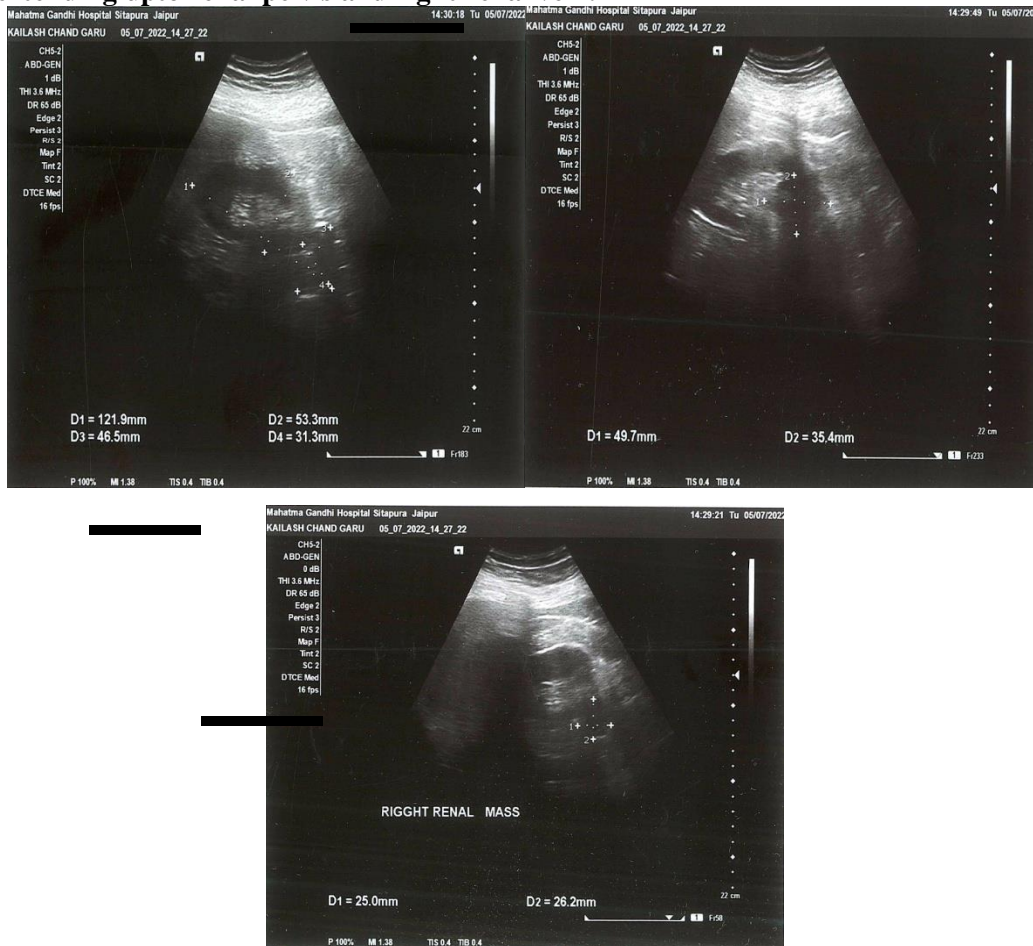


Fig 4: Ultrasonography shows round to oval mass lesion with heterogenous echotexture and internal vascularity in the lower pole, extending upto renal pelvis and right renal vein.



CONCLUSION:

In our study, pain was the most common symptom (75%), followed by hematuria (53.3%). On USG, malignant pathology was found in 37 (61.7%) cases. In one case, USG was unable to detect any pathology and detected that case as normal.

Due to its low cost, simplicity of use, and lack of radiation exposure, ultrasound is the first imaging modality of choice in cases of renal masses. The imaging technique of choice for additional assessment and characterization is contrast-enhanced computed tomography. Due to its capacity to show Perinephric extension, renal fascia invasion, assess the central retroperitoneum, and find distant metastases, CT offers undeniable advantages over the US in the preoperative staging of renal tumors.

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