Journal of Cardiovascular Disease Research

ISSN: 0975-3583, 0976-2833 VOL15, ISSUE 01, 2024

EVALUATING THE ROLE OF THE MDCT IN DETECTION OF THE RENAL MASSES IN CANCER INSTITUTE

Dr. Sandeep Kumar[1]*, Dr. Madhukar Dayal[2] , Dr. Sachidanand[3]

1*. M.B.B.S, M.D- Community Medicine & M.D-Radiodiagnosis, Resident, Department of Radiology, Mahavir Cancer Institute and Research Centre (MCSRC), Patna

2. M.B.B.S, M.D(AIIMS, Delhi) , DNB (Radiodiagnosis), Senior Consultant and HOD, Department of Radiology, Mahavir Cancer Institute and Research Centre (MCSRC), Patna

3. M.B.B.S, M.D- Community Medicine, Assistant Professor & HOD, UNS, ASMC, Jaunpur

Corresponding Author:-Dr. Sandeep Kumar

Email ID**:-** sandeepdoc.pmch@gmail.com

ABSTRACT

Background: With the advances in the diagnostic parameters, CT with the use of various software allowing manipulation and increase in the spatial resolutions lead to a considerable reduction in time needed for scanning.

Aims: This study was conducted to study the attenuation and enhancement pattern of renal masses during different phases (Cortico-medullary, nephrographic, and unenhanced phases). To evaluate renal parenchymal enhancement characteristics during these above-mentioned phases.Also, comparison of findings from CT and histopathological diagnosis was being made.

Methods: For enhancement pattern and attenuation values of renal masses during various phases namely nephrographic, corticomedullary, and unenhanced phase multidetector CT was used for better assessment. Subjects with the complaint of flank pain/fullness, and/or hematuria, and also subjects having renal masses on ultrasound were referred for CT abdomen. 20 subjects with confirmed presence of renal masses on CT were finally included.

Results: Mean size of the masses detected in the kidney was found to be 6.4 ± 4 cm with the range of 2cm to 20 cms. 8 lesions were benign whereas 12 lesions detected were found to be malignant. For margins of the tumors, well-defined margins were seen in 7 of the benign lesion, and only 1 benign lesions had ill-defined margins. In malignant lesions, only 2 lesions had well-defined margins and ill-defined margins were seen in the rest 10 lesions. This difference in the margins of the benign and malignant tumors was statistically significant. For enhancement pattern, it was homogenous in 5 whereas, heterogeneous in remaining 3 in benign lesion. Among 11 malignant lesions, only 1 lesion was homogenous and 11 lesions were heterogeneous. In the corticomedullary phase and nephrographic phase, HU values for malignant renal masses respectively were 94,00 and 72.41. Enhancement was lower in the nephrographic phase compared to the corticomedullary phase.

Conclusion: For differentiating benign tumors from malignant tumors, their characterization, attenuation values, and the enhancement patterns serve as an important tool in this regard. Regarding enhancement patterns of benign tumors, no statistically significant difference was seen nephrographic and corticomedullary phases. For malignant renal masses, enhancement was greater in the corticomedullary phase compared to the nephrographic phase. The present study

ISSN: 0975-3583, 0976-2833 VOL15, ISSUE 01, 2024

concludes that renal masses should be evaluated in all phases including unenhanced, corticomedullary, and nephrographic phases for appropriate characterization and detection of the renal masses.

Keywords: CT, Renal masses, Attenuation, Benign, enhancement pattern, malignant.

Keynote: Reduction in the rotation time and acquisition of thin slices in MDCT as compared to conventional CT results in faster scanning and better assessment of renal masses. As slices are in 3 D allowing better visualization and treatment planning., various thin slices can lead to a better assessment of the renal masses to be detected. With the advances in the diagnostic parameters, CT with the use of various software allowing manipulation and increase in the spatial resolutions lead to a considerable reduction in time needed for scanning.

INTRODUCTION

In India renal tumours especially RCC is a serious public health problem and the prevalence is about 2/100,000 in men population and among women it is about 1/100,000 population [1]. Incidence is expected to rise in India due to increasing life expectancy, rising awareness, better diagnostic facilities like MRI and CT and growing prevalence of risk factors such as obesity[2]. The accurate detection radiographically is an important aspect to ensure proper management of the renal masses. The renal masses usually seen can be divided into two usual types including solid lesions and cystic lesions. Cystic lesions comprise the maximum types in approximately 27% of the detected subjects and are usually seen in subjects of more than 60 years of age.[3]

Renal masses detected from MRI or CT are classified into complex cystic and solid type. 85% of solid masses detected are found to be malignant. Hence, solid masses detected are considered malignant unless they are found to be benign. The most common malignant tumor seen in kidneys is Renal Cell carcinoma with an increase of 3% seen with every passing year. The most common subtype of renal cell carcinoma is clear cell carcinoma followed by papillary carcinoma.[4]

Other lesions (malignant) seen in the kidney are lymphoma, transitional cell carcinoma, secondary sarcomas, and metastatic lesions. Metastases in the kidney are usually seen from the tumors associated with the breast, gastrointestinal tract, and lungs. The benign tumors seen are approximately 20% of all lesions, were most commonly seen solid tumor is oncocytoma.[5]

Among non-cancerous masses detected in the kidney, commonly seen are inflammatory pseudotumors associated with or without the pus, hematomas, infarction of the kidney, and lipomatosis. Due to an increase in the incidence of renal masses, their detection and treatment have become an important aspect to be taken care of in the recent past.[6]

With the advances in the diagnostic parameters, CT with the use of various software allowing manipulation and increase in the spatial resolutions lead to a considerable reduction in time needed for scanning. Reduction in the rotation time for multidetector CT compared to conventional CT results in faster scanning and results. Also, various thin slices can lead to a better assessment of the renal masses to be detected, where these slices are in 3 D allowing better visualization and treatment planning.[7]

Multidetector CT has the advantages of increased coverage of volume, better temporal resolution, faster scan, and improvement in spatial resolution. Renal Cell Carcinoma is the most common tumor of the epithelial cells of the kidney, which accounts for >90% of all the malignancies detected in the renal system, and is the most lethal among all cancers detected in the urologic

ISSN: 0975-3583, 0976-2833 VOL15, ISSUE 01, 2024

system. Only 20% of five-year survival is seen in subjects with renal cell carcinoma and lymph node metastases.[8]

Owing to the increase in incidence, and advances in the detection and diagnosis there is a need for accurate detection and treatment. As some detected lesions are benign with a few of them turning out to be malignant, which need to be removed using the surgical method.[9] The present clinical study was conducted to study enhancement pattern and attenuation pattern of renal masses during different phases (Cortico-medullary, nephrogenic, and unenhanced phases, and to evaluate renal parenchymal enhancement characteristics during these phases, Also, comparison of findings from CT and pathological diagnosis was done.

MATERIAL & METHODS

The present prospective observational study was conducted to study the enhancement and attenuation pattern of renal masses during different phases (Cortico-medullary, nephrographic, and unenhanced phases) and to evaluate renal parenchymal enhancement characteristics during these phases, Also, comparison of findings from CT and pathological diagnosis was done. The study included 20 subjects with the age range of 32-54 years. The patients included were males as well as females.

In all 20 included subjects, the renal mass was detected on multidetector CT. The study was conducted from 1/04/2023 to 31/10/2023 at MCSRC, Patna**.** For enhancement pattern and attenuation values of real masses during various phases namely nephrographic, corticomedullary, and unenhanced phase multidetector CT was used for better assessment. Subjects with the complaint of flank pain/fullness, and/or hematuria, and also subjects with the incidental detection of renal masses ultrasonographically and were referred for CT abdomen. 20 subjects with confirmed presence of renal masses on CT were finally included.

Informed consent was taken from all the included subjects. The study was approved by the Ethical Committee of the Institute. Bosniak criteria were used for characterizing the renal cysts. Cysts were classified into benign and malignant types. The following subjects were excluded from the study: Traumatic injury to the kidney and subjects with simple renal cysts seen on ultrasonography. The collected data were subjected to the statistical evaluation, with a clinical significance level of $p<0.05$.

RESULTS

The present study was conducted to study the enhancement and attenuation pattern of renal masses during different phases (Cortico-medullary, nephrogenic, and unenhanced phases) and to evaluate renal parenchymal enhancement characteristics during these phases. Also, the comparison of findings from CT and pathological diagnosis was done. The study included 20 subjects with the age range of 32-54 years with a mean age of 41.7 years. The demographic characteristics of the study subjects are listed in Table 1.

On evaluation, it was seen that the mean size of the masses detected in the kidney was found to be 6.423± 4 with the range of 2cm to 20 cms. Radiological features of both benign and malignant tumors were assessed and categorized. Among the total 20 subjects, 8 lesions were benign whereas 12 lesions detected were found to be malignant. The characteristics of renal masses are depicted in Table 2.

Concerning the enhancement pattern, it was seen that the enhancement pattern was homogenous in 5 of the benign lesions, whereas, heterogeneity was seen in the remaining 3 benign lesions.

ISSN: 0975-3583, 0976-2833 VOL15, ISSUE 01, 2024

Among 12 malignant lesions, only 1 lesion was homogenous and 11 lesions were heterogeneous in enhancement pattern. The differences in the enhancement patterns and heterogeneity in malignant and benign lesions were statistically significant with the p-value of <0.05. For margins of the tumors, well-defined margins were seen in 7 of the benign lesion, and only 1 benign lesion had ill-defined margins. In malignant lesions, only 2 lesions had well-defined margins and ill-defined margins were seen in the rest 10 lesions. This difference in the margins of the benign and malignant tumor was statistically significant with a p-value of <0.05.

Calcification was seen in 2 of the benign lesions whereas 1 of the malignant lesion showed evidence of calcification. Attenuation pattern for benign and malignant lesion showed that in the unenhanced phase, HU value for benign and malignant lesion was seen as 9.25 and 34.58 respectively. In the corticomedullary phase and nephrographic phase, HU values for malignant renal masses respectively were 94.00 and 72.4 (Table 3). Enhancement was lower in the nephrographic phase compared to the corticomedullary phase. The difference in enhancement between benign and malignant tumors was also statistically significant with a p-value of <0.05.

DISCUSSION

Characterization and diagnosis of the renal masses are largely determined with accuracy using multidetector CT. With the advances in the display and data recording, there is a large scope of MDCT in the detection and managing the renal masses. The present clinical study was conducted to study the enhancement pattern and attenuation pattern of renal masses during different phases. The precise assessment of the renal masses is important to plan adequate treatment and patients counseling.

Out of 20 included subjects, 8 subjects had benign tumors, whereas, 12 were malignant masses. This is probably due to specialized tertiary centre for cancer. Renal Cell Carcinoma was the most common tumor detected with a percentage of 55% among all the tumors. In the present study, the mean size of the tumor was 6.4 ± 4. These findings were consistent with the studies by Shetty et al[10] in 2004 where lesion size raged from 2.4cm to 14 cm. Another study by Welch et al[11] also reported the mean sizes of renal masses as 7cm.

Regarding enhancement pattern, In the unenhanced phase, HU for the benign and malignant tumor was 9.25±19.55 and 34.58±3.654 respectively with a p-value of 0.008. During the corticomedullary phase, these findings respectively were 16.62±27.097 and 94.00±10.171 with a p-value of 0.000. For the nephrographic phase, the values for benign and malignant tumors respectively were 18.37±27.90 and 72.41±10.714. These values were all statistically non-significant. These findings also contrasted with the studies by Cohan et al[12] and Szolar et al[13] where higher attenuation was seen in the corticomedullary phase compared to the neurogenic phase and these findings were non-significant.

The homogeneous pattern was distributed in a benign tumor in 5 cases, whereas, 3 cases had heterogeneous distribution. For malignant tumors, 11 cases had heterogeneous distribution, and 1 mass had homogeneous distribution. These findings were in agreement with the study of Birnbaum et al where progressive enhancement radiographically was reported.

In the present study, the most common presenting symptoms were pain (n=3) and fever (n=2) in benign lesions, whereas, in malignant cases, the same findings were seen. These results were in contrast with the findings by Jayson et al[14] and Amendola et al[15] where hematuria and flank pain was the most common presenting symptom shown by the 131 subjects studied.

ISSN: 0975-3583, 0976-2833 VOL15, ISSUE 01, 2024

CONCLUSION

In the present study, all the masses were visible in both nephrographic phases and corticomedullary phases. For differentiating benign tumors from malignant tumors, and their characterization, attenuation values, and the enhancement patterns played an important tool. Regarding enhancement patterns of benign tumors, no statistically significant difference was seen in nephrographic and corticomedullary phases. For malignant renal masses, enhancement was greater in the corticomedullary phase compared to the nephrographic phase. The present study concludes that renal masses should be evaluated in all phases including unenhanced, corticomedullary, and nephrographic phases for appropriate characterization and detection of the renal masses. Although, the present study had few limitations including a smaller sample size , short monitoring period.

REFERENCES

1. Abraham G, Cherian T, Mahadevan P, Avinash T, George D, Manuel E. Detailed [2] study of survival of patients with renal cell carcinoma in India. Indian J Cancer. 2016;53:572-74
2. Pallagani L, Choudhary GR, Himanshu P, Madduri VKS, Singh M, Gupta P, Shrivastava N, Baid G, Meenakshi R, Aasma N, Pareek P, Sanjeev M. Epidemiology and Clinicopathological Profile of Renal Cell Carcinoma: A Review from Tertiary Care Referral Centre. J Kidney Cancer VHL. 2021 Jan 20;8(1):1-6. doi: 10.15586/jkcvhl.2021.154. PMID: 33552876; PMCID: PMC7827726
3. van Oostenbrugge TJ, Fütterer JJ, Mulders PFA. Diagnostic imaging for solid renal tumors: a pictorial review. Kidney Cancer. 2018;2:79–93.
4. Agnello F., Albano D., Micci G., Buono G.D., Agru-sa A., Salvaggio G., et al. CT and MR imaging of cystic renal lesions. Insights. Imaging. 2020;11:5.
5. A.D. Karaosmanoglu, M.R. Onur, M. Karcaaltincaba, D. Akata, M.N. Ozmen**Secondary tumors of the urinary system: an imaging conundrum.** Korean J. Radiol., 19 (2018), pp. 742-751,
6. Pallwein-Prettner L, Flöry D, Rotter CR, et al. Assessment and characterization of common renal masses with CT and MRI. Insights Imaging2011; 2:543–56.
7. Dorbala S, Ananthasubramaniam K, Armstrong IS et al. Single Photon Emission Computed Tomography (SPECT) Myocardial Perfusion Imaging Guidelines: Instrumentation, Acquisition, Processing, and Interpretation. J Nucl Cardiol 2018;25:1784–1846.
8. Kang EJ. Clinical applications of wide-detector CT scanners for cardiothoracic imaging: an update. *Korean J Radiol,* 2019;20:1583–96.
9. Connolly JLSS, Wang HH, Longtine JA, Dvorak A, Dvorak HF. Role of the Surgical Pathologist in the Diagnosis and Management of the Cancer Patient. In: Kufe DWPR, Weichselbaum RR, et al., editors. Holland-Frei Cancer Medicine. BC Decker; Hamilton (ON): 2003.
10. Shetty C, Lakhar B, Devi B, Lakshmi B. Dual-phase helical CT of the kidney: Comparison of corticomedullary and nephrographic phases in detection and characterization of renal masses. Indian J Radiol Imaging [Internet]. 2004;14:285–90.

ISSN: 0975-3583, 0976-2833 VOL15, ISSUE 01, 2024

11. Welch TJ, LeRoy AJ. Helical and electron beam CT scanning in the evaluation of renal vein involvement in patients with renal cell carcinoma. J Comput Assist Tomogr. 1997;21:467–71.

12. Cohan RH, LS S, M K, JC B, IR F. Renal masses: assessment of corticomedullary-phase and nephrographic-phase CT scans. Radiology. 1995;96:445–51.

13. Szolar D, Kammerhuber F, Aliziebler S, Al E. Multiphasic helical CT of the kidney: increased conspicuity for detection and characterization of small (_3 cm)renal masses. Radiology. 1997;202:211–7.

14. Jayson M, Sanders H. Increased incidence of serendipitously discovered renal cell carcinoma. *Urology.*1998;51:203-205.

15. Amendola MA, Bree RL, Pollack HM, et al. Small renal cell carcinomas: resolving a diagnostic dilemma. Radiology 1988;166:637–41.

TABLES

Demographic Characteristic	Value
Total Subjects	20
Mean Age (in years)	41.7± 6.69
Age Range	32-54 years
Males	12
Females	8

Table 1: Demographic Characteristics of study subjects

Renal Mass Characteristic	Number	Percentage	SD
Size	6.4(cm)		4.0
Frequency			
Right	10	50	
Left	7	35	
Bilateral	3	15	
CT Diagnosis			
Renal Cell Carcinoma	11	55	
Transitional Cell Carcinoma	1	5	
Angiomyolipoma	2	10	
Renal Abscess	1	5	
Oncocytoma	1	5	
Bosniak Type II	2	10	
Bosniak Type III	1	5	
Bosniak Type IV	1	5	

Table 2: Characteristics of Renal Masses in study subjects

Parameter	Benign (n=8)	Malignant (n=12)	p-value
Presenting Symptom			
Fever	2	3	0.077
Pain	3	4	0.574
Lump	1	2	0.413

ISSN: 0975-3583, 0976-2833 VOL15, ISSUE 01, 2024

Haematuria	1	2	0.85
Weight Loss	1	1	0.005
Tumor Margins			
Well-defined	7	2	
Ill-defined	1	10	0.002
Enhancement Pattern			
Heterogeneous	3	11	0.01
Homogeneous	5	1	
Attenuation			
Hyperdense	0	1	0.76
Hypodense	7	10	
Isodense	1	1	
Hounsfield Unit			
Unenhanced Phase	9.25±19.55	34.58±3.654	0.008
Corticomedullary Phase	16.62±27.097	94.00±10.171	0.000
Nephrographic phase	18.37±27.90	72.41±10.714	0.001

Table 3: Comparison of Benign and Malignant Renal Masses in study subjects

ATLUS

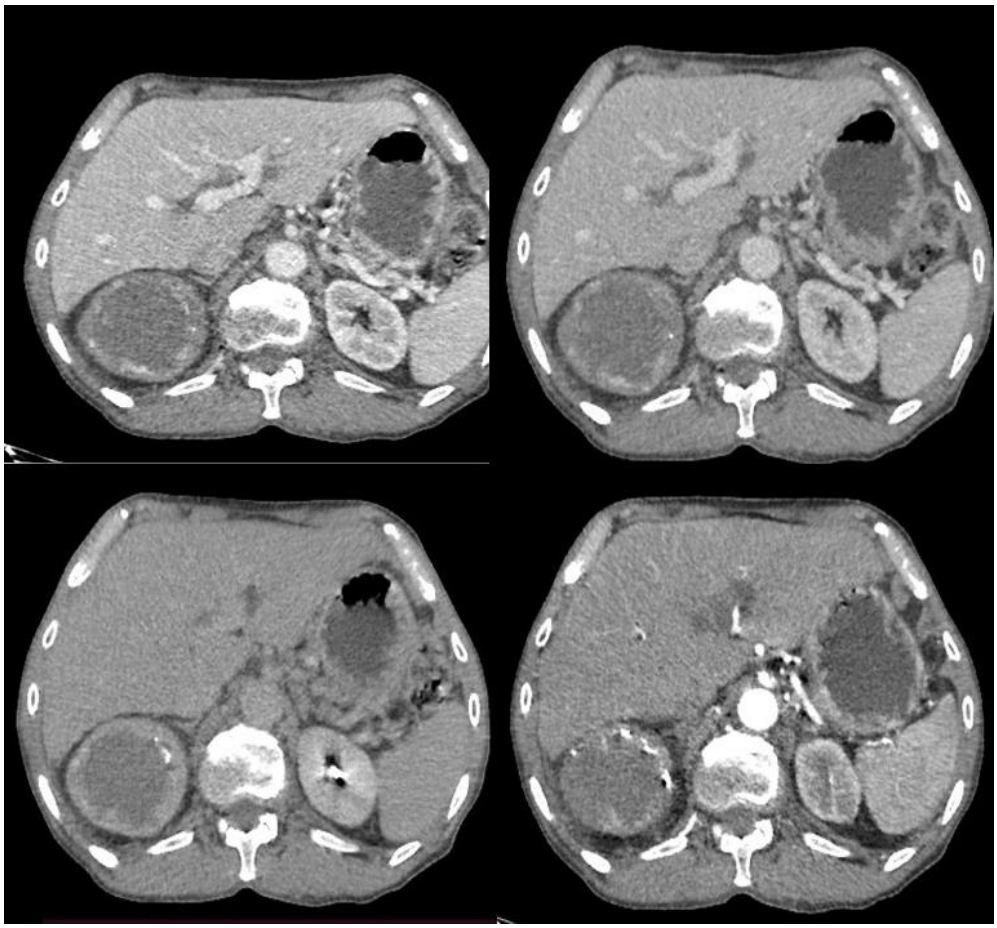

Fig:1- RCC of right in different phases

ISSN: 0975-3583, 0976-2833 VOL15, ISSUE 01, 2024

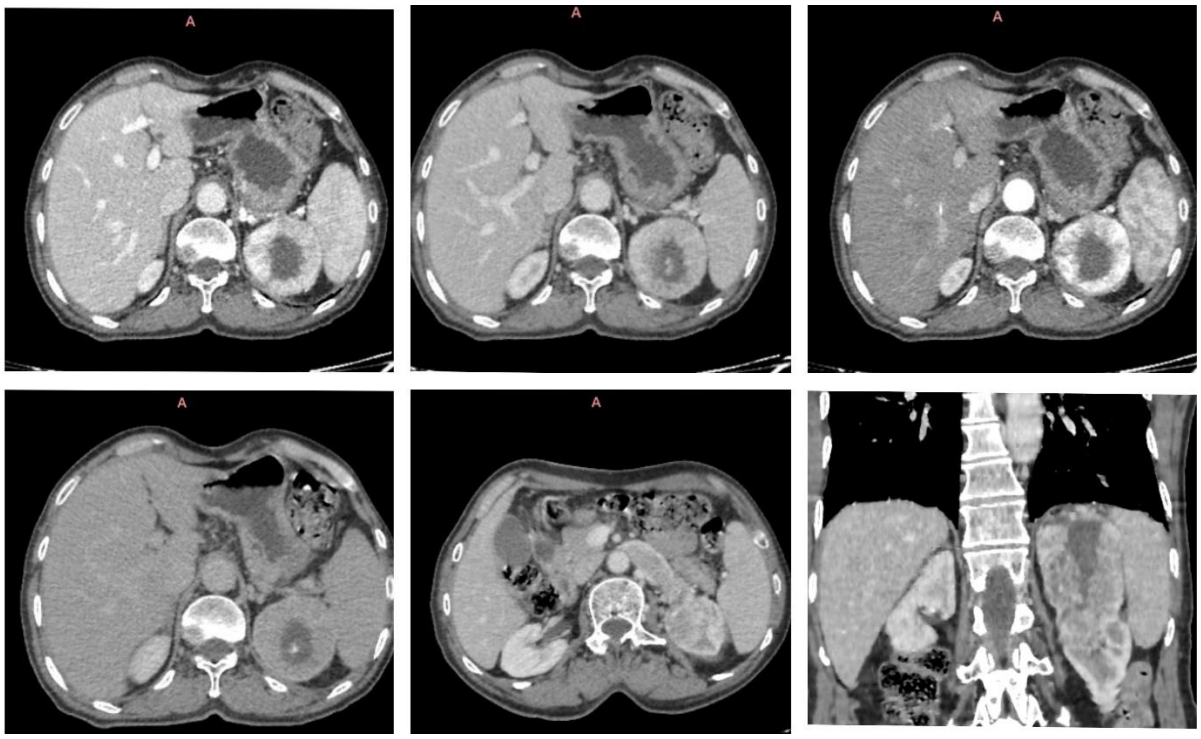

Fig2:- RCC of left kidney in different phases with left renal vein tumoral thrombosis