Section: Radiodiagnosis

Original Research Article

EVALUATION OF ENHANCEMENT AND ATTENUATION PATTERN OF RENAL MASS IN DIFFERENT PHASES USING MDCT

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Abstract

Background: The world of diagnostic tool is dynamic, especially in imaging science. The continuously updating software adds to accuracy and saves time. The facility to manipulate and enhance spatial resolutions in multidetector CT (MDCT) is a paradigm shift. **Aim:** The world of diagnostic tool is dynamic, especially in imaging science. The continuously updating software adds to accuracy and saves time. The facility to manipulate and enhance spatial resolutions in multidetector CT (MDCT) is a paradigm shift **Materials and Methods:** 40 subjects were studied. Subjects with detected renal masses on USG were evaluated using MDCT. The enhancement and attenuation pattern of renal masses were assessed during various phases. **Results:** The malignant renal masses showed higher enhancement in corticomedullary phase compared to nephrographic phase. The benign renal masses showed no statistically significant difference by enhancement patterns for nephrographic and corticomedullary phases. **Conclusion:** Enhancement pattern and attenuation value is an important diagnostic tool for differentiation and characterization of benign tumors and malignant tumors. Renal masses can be evaluated and characterized in all phases using MDCT with reliability.

INTRODUCTION

In the recent decades, the easy availability and access of MRI and CT facility together with its increased use has increased the detection of renal masses many folds. The accurate radiographic detection of these masses is the key to timely and successful management of the renal masses. These renal masses broadly are classified as two types including solid lesions and cystic lesions. Cystic lesions are commonly found in elderly (more than 60 years of age) and comprise around 27% of the detected renal mass.[1]

Based on MRI or CT imaging, the detected Renal masses are again classified as complex cystic and solid type. As high as 85% of the detected solid masses are malignant. Henceforth, the detected solid masses are considered malignant unless or until proven benign. The most common type of malignancy found in kidney is renal cell carcinoma. The prevalence of renal cell carcinoma is reported to be increasing by 3% every year. Clear cell carcinoma is the most common variant of renal cell carcinoma, and this is followed by papillary carcinoma.[2]

The other malignant lesions (comparatively less prevalent) found in the kidneys include lymphoma, transitional cell carcinoma, secondary sarcomas, as well as metastatic lesions. Metastases to kidney are frequently related to tumors of breast, gastrointestinal tract, and lungs origin. The benign tumors include about 20% of all lesions. The most commonly seen benign solid tumor is oncocytoma.[3]

The non-malignant masses of kidney, commonly include inflammatory pseudo-tumors. These pseudo-tumors may or may not be associated with pus, hematomas, infarction and lipomatosis. The incidence of renal masses in recent past warrants early detection and timely comprehensive treatment.[4]

Recently, the advancement in CT diagnostic parameters, together with software as an adjunct permit multiple manipulation and enhance spatial resolutions. This progress has significantly reduced the scanning time. The fast moving multidetector CT provides faster scanning and results compared to the conventional CT. Also, the thin CT slices facilitates better assessment of renal masses.

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Further, thin slice enables better visualization and treatment planning in 3 D.[5] The advantages of Multidetector CT includes increased coverage, better temporal resolution, faster scan, and improvement in spatial resolution.[6 -7]

The present observational study was conducted to evaluate the enhancement and attenuation pattern of renal masses in different phases using MDCT.

MATERIALS AND METHODS

Study Design

This prospective, descriptive , unicentric study was conducted in the department of radio diagnosis, at Bhagwan Mahavir Institute of Medical Sciences and Hospital, Pawapuri. The study was conducted over a period of 1 year from October 2021 to September 2022. The study was approved by the institutional research and ethical committee. All the study participants were informed about the study and a written and informed consent was obtained after explaining about the study.

Study Sample

Subjects with the complaint of flank pain/fullness, and/or hematuria, as well as subjects with the incidental detection of renal masses on USG and were referred for CT abdomen. The study sample included 40 subjects in the age range of 30-60 years with renal mass detected on multidetector CT. The patients included were both males as well as females. Subjects with traumatic kidney injury, renal masses with kidney parenchyma invasion, and simple renal cysts diagnosed by USG, were not included in this study.

Procedure

To study the enhancement pattern and attenuation pattern of renal masses during different phases (Cortico-medullary, nephrographic, and unenhanced phases. The values of renal masses (viz; nephrographic, corticomedullary), and unenhanced phase multidetector CT was used for enhancement pattern and attenuation as well as for assessment. Bosniak criteria for characterizing the renal cysts were followed. The cysts were categorized into benign and malignant types.

Statistical Analysis

The collected data were subjected to the statistical evaluation, with a clinical significance level of $p<0.05$.

RESULTS

The current study assessed the enhancement and attenuation pattern of renal masses during different phases. A total of 40 subjects in the age range of 30-60 years (mean age of 42.5 years) participated towards the success of this study. The demographic characteristics of the study subjects is shown in. [Table 1]

Table 1: Demographic Characteristics of study subjects. (n=40)

Demographic Characteristic	Number
Total Subjects	40
Mean Age (in years)	44.5 ± 3.17
Age Range	30-60 years
Males	22
Females	18

The distribution of males and females is shown in [figure 1.]

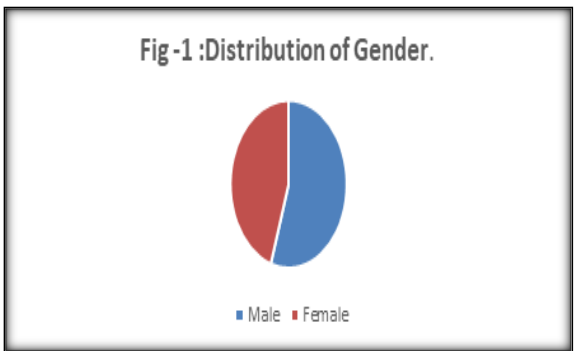

Figure 1: Distribution of Gender

On imaging it was observed that, the size of detected renal masses ranged from 2cm to 19cms with a mean size of 5.4 ± 3.5 cm. The radiological features were assessed and categorized into benign and malignant tumors. Among the 40 subjects, 22 lesions were found to be benign, in contrast only 18 lesions were detected to be malignant. The radiological characteristics of imaged renal mass is illustrated in Table 2.

Table 2: Radiological characteristics of imaged renal masses

Renal Mass Characteristic	N	%	p-value
Size	5.4		3.5
Frequency			
Right	20	50	
Left	18	45	
Bilateral	2	5	
CT Diagnosis			

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Renal Cell Carcinoma	24	60	
Transitional Cell Carcinoma	2	5	
Acute Myeloid Lymphoma	2	5	
Renal Abscess	2	5	
Oncocytoma	2	5	
Bosniak Type II	4	10	
Bosniak Type III	2	5	
Bosniak Type IV	2	5	

The enhancement pattern was found to be homogenous in 12 of the benign lesions, on the other hand heterogeneity was found in 10 benign lesions. In contrast, of the 9 malignant lesions, 2 lesions were homogenous whereas 7 lesions were found to be heterogeneous in enhancement pattern. The differences of enhancement patterns and heterogeneity between the malignant and benign lesions were statistically significant ($p < 0.05$). While evaluating the margins of the lesion, it was observed that, 9 of the benign lesion had well-defined margins but only 2 benign lesions revealed ill-defined margins. On the other hand, of the malignant lesions, 2 had well-defined margins and 7 showed ill-defined margins. This difference of the benign and malignant tumor margins were statistically significant ($p < 0.05$). No malignant lesion showed any evidence of calcification, while it was evident in 2 of the benign lesions. In unenhanced phase, the benign and malignant lesion have 9.32 HU and 35.16 HU values respectively. The same for corticomedullary phase and nephrographic phase for malignant was 96.64 HU and 73.26 HU respectively. In the nephrographic phase enhancement was lower compared to corticomedullary phase. This difference in enhancement was statistically significant ($p < 0.05$). (Table 3).

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

Parameter	**Benign (n=22)**	**Malignant (n=18)**	**p-value**
Presenting Symptom			
Fever	6	6	0.077
Pain	8	6	0.574
Lump	4	2	0.413
Haematuria	2	4	0.85
Weight Loss	2	2	0.005
Tumor Margins			
Well-defined	18	4	0.027
Ill-defined	4	14	0.029
Enhancement Pattern			
Heterogeneous	10	14	0.035
Homogeneous	12	4	
Attenuation			
Hyperdense	0	2	-
Hypodense	20	14	
Isodense	2	2	
Hounsfield Unit			
Unenhanced Phase	9.32±21.465	35.16±3.545	0.001
Corticomedullary Phase	14.34±26.426	96.64±13.012	0.001
Nephrographic phase	16.16±27.314	73.26±10.224	0

DISCUSSION

Renal masses are diagnosed with accuracy and are characterized with efficacy by the use of multidetector CT. The facility of advanced display concurrent with data recording, enhances the large scope of MDCT in the detection and managing the renal masses.

A detailed evaluation of the renal masses is utmost important for patients counselling and adequate treatment plan. The current study evaluated the enhancement and attenuation pattern of renal masses in Cortico-medullary, nephrographic, and unenhanced phases.

A total of 40 subjects were assessed, 22 subjects were found to have benign tumors, while 18 subjects had malignant masses. The most common tumor detected was Renal Cell Carcinoma with a prevalence of 60 % amongst all the tumors. In the current study, the mean tumor size was found to be 5.4 ± 3.5 cm. This finding was in accordance with the previously reported study of Shetty et al.[8] In contrast, Welch et al reported a comparatively bigger (7cm) mean renal masses in their study.[9]

In the present study, in unenhanced phase, the calcification value for the benign and malignant tumor was found to be 9.32±21.465 HU and 35.16±3.545 HU respectively. This difference was highly statistically significant ($p<0.001$). During corticomedullary phase, the calcification value was found to be 14.34±26.426 HU and 96.64±13.012 HU respectively with a p-value of 0.001.

While for nephrographic phase, it was 16.16±27.314 HU and 73.26±10.224 HU for benign and malignant tumors respectively. This difference was statistically non-significant. The observations of our study was in contrast with the studies observations of Cohan et al and Szolar et al, who reported higher but non-

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significant attenuation value for corticomedullary phase compared to nephrogenic phase.[11-12]

A homogeneous pattern was observed in 12 subjects with benign tumor while the remaining 10 subjects showed heterogeneous distribution. In subjects with malignant tumors, 7 had heterogeneous distribution, while 2 had homogeneous distribution. These findings of our study was in consonance with the previous study reports where a progressive radiographic enhancement was reported.

The study findings show, flank pain and fever as the most common presenting symptom in both benign and malignant lesion subjects with renal masses. On the other hand the study reports of Jayson et al and Amendola et al presented flank pain and hematuria as the most common presenting symptom.[13-14]

CONCLUSION

Renal masses are visible on MDCT in both nephrographic phases and corticomedullary phases. Attenuation value and enhancement pattern are very important tool and shows promising efficacy in differentiation and characterization of benign tumors and malignant tumors. Renal masses can be evaluated and characterized in all phases using MDCT with reliability.

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