Original Research Article

Accuracy and Reliability of the CT for Detection of The Renal Masses

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Received: 10-08-2021 / Revised: 05-09-2021 / Accepted: 15-10-2021

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 & Objectives:**The present observational study was conducted to learn the enhancement pattern 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. **Materials and Methods:** 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. **Results:** Mean size of the masses detected in the kidney was found to be 5.423±3.4877 with the range of 2cm to 19cms. 11 lesions were benign whereas 9 lesions detected were found to be malignant. For enhancement pattern, it was homogenous in 6 whereas, heterogeneous in remaining 5. Among 9 malignant lesions, only 2 lesions were homogenous and 7 lesions were heterogeneous. For margins of the tumors, well-defined margins were seen in 9 of the benign lesion, and only 2 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 7 lesions. This difference in the margins of the benign and malignant tumors was statistically significant. In the corticomedullary phase and nephrographic phase, HU values for malignant renal masses respectively were 96.64 and 73.26. Enhancement was lower in the nephrographic phase compared to the corticomedullary phase.**Conclusion:**For differentiating benign tumors from malignant tumors, and 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 trial 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: Attenuation, Benign,CT, enhancement pattern, malignant,Renal masses.

Introduction

With the more use and availability of MRI and CT in clinical practices, the detection of renal masses has increased by large numbers in the recent past. 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 [1].

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 [2].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 [3].

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 [4].

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 CTcompared 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 [5].

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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 system. Only 20% of five-year survival is seen in subjects with renal cell carcinoma and lymph node metastases [6].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 [7]. The present observational study was conducted to learn 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 and methods

The present observational study was conducted to learn the enhancement pattern 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 trial included 20 subjects with the age range of 32-54 years with a mean age of 44.2 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 January 2021 to august 2021 atSri Shankaracharya Institute of Medical Sciences, Bhilai, Chhattisgarh, India.

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 andmalignant types. The following subjects were excluded from the study: Traumatic injury to the kidney, renal masses having invasion into the parenchymal structures of 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 clinical trial was conducted to study the 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, the comparison of findings from CT and pathological diagnosis was done. The trial included 20 subjects with the age range of 32-54 years with a mean age of 38.2 years. The demographic characteristics of the study subjects are listed in Table 1.

Table 1: Demographic Characteristics of study subjects

Demographic Characteristic	Value
Total Subjects	20
Mean Age (in years)	44.2± 4.17
Age Range	32-54 years
Males	11
Females	9

On evaluation, it was seen that the mean size of the masses detected in the kidney was found to be 5.423±3.4877 with the range of 2cm to 19cms. Radiological features of both benign and malignant tumors were assessed and categorized. Among the total 20 subjects, 11 lesions were benign whereas 9 lesions detected were found to be malignant. The characteristics of renal massesare depicted in Table 2.

Table 2: Characteristics of Renal Masses in study subjects

Renal Mass Characteristic	N	%	p-value
Size	5.423		3.4877
Frequency			
Right	10	50	
Left	9	45	
Bilateral	1	5	
CT Diagnosis			
Renal Cell Carcinoma	12	60	
Transitional Cell Carcinoma	1	5	
Acute Myeloid Lymphoma	1	5	
Renal Abscess	1	5	
Oncocytoma	1	5	
Bosniak Type II	2	10	
Bosniak Type III	1	5	
Bosniak Type IV	1	5	

Concerning the enhancement pattern, it was seen that the enhancement pattern was homogenous in 6 of the benign lesions, whereas, heterogeneity was seen in the remaining 5 benign lesions. Among 9 malignant lesions, only 2 lesions were homogenous and 7 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 9 of the benign lesion, and only 2 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 7 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 no malignant lesion showed any 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 9.32 and 35.16 respectively. In the corticomedullary phase and nephrographic phase, HU values for malignant renal masses respectively were 96.64 and 73.26 (Table 3).

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

Parameter	Benign (n=11)	Malignant (n=9)	p-value
Presenting Symptom			
Fever	3	2	0.077
Pain	4	3	0.574
Lump	2	1	0.413
Haematuria	1	2	0.85
Weight Loss	1	1	0.005
Tumor Margins			
Well-defined	9	2	0.027
Ill-defined	2	7	0.029
Enhancement Pattern			
Heterogeneous	5	7	0.035
Homogeneous	6	2	
Attenuation			
Hyperdense	0	1	-
Hypodense	10	7	
Isodense	1	1	
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

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 trial was conducted to study the enhancement pattern 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, the comparison of findings from CT and pathological diagnosis was done. The precise assessment of the renal masses is important to plan adequate treatment and patients counseling.

Out of 20 included subjects, 11 subjects had benign tumors, whereas, 9 malignant masses. Renal Cell Carcinoma was the most common tumor detected with a percentage of 60% among all the tumors. In the present trial, the mean size of the tumor was 5.423±3.4877. These findings were consistent with the studies by Shetty et al [8]. in 2004 where lesion size raged from 2.4cm to 14 cm. Another study by Welch et al [9]. 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 9.32±21.465 and 35.16±3.545 respectively with a p-value of 0.001. During the corticomedullary phase, these findings respectively were 14.34±26.426 and 96.64±13.012 with a p-value of 0.001. For the nephrographic phase, the values for benign and malignant tumors respectively were 16.16±27.314 and 73.26±10.224. These values were all statistically non-significant.These findings also contrasted with the studies by Cohan et al [10] and Szolar et al [11].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 6 cases, whereas, 5 cases had heterogeneous distribution. For malignant tumors, 7 cases had heterogeneous distribution, and 2 masses had homogeneous distribution. These findings were in agreement with the study of Birnbaum et al where progressive enhancement radiographically was reported.In the present trial, the most common presenting symptom was a pain (n=4) and fever (n=3) I benign lesions, whereas, in malignant cases, the same findings were seen. These results were in contrast with the findings by Jayson et al [12] and Amendola et al [13]. where hematuria and flank pain was the most common presenting symptom shown by the 131 subjects studied.

Conclusion

In the present clinical trial, 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 serves 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 trial 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 trial had few limitations including a smaller sample size and short monitoring period.

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Conflict of Interest: Nil Source of support: Nil