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ROLE OF MULTI-DETECTOR COMPUTED TOMOGRAPHY (MDCT) IN EVALUATION OF RENAL MASSES ASSUMING HISTOPATHOLOGY AS GOLD STANDARD

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ABSTRACT:

Aim: To study role of MDCT in evaluation of renal masses, characterization of Benign and malignant lesions and to find out the Sensitivity, Specificity and Accuracy to differentiate a benign from malignant lesion.

Material & methods: 48 patients having 50 renal masses from Nephrology, Urology and Pediatrics department were included in this hospital based descriptive type of observational study. All patient underwent MDCT and Histopathological examination. MDCT was performed on Philips Ingenia 128 slice multi detector scanner and the final diagnosis was made by histopathology. Statistical analysis was applied to find out the sensitivity, specificity, PPV, NPV and Accuracy. P-value < 0.05 was taken as significant.

Results: In our study out of total 48 cases with 50 renal masses (in 2 cases masses were bilateral accounting 4 masses in them) among 31 males and 17 females (age range from 3 to 69 years), there were 46 (92%) malignant and 4 (8%) benign renal masses. Renal cell carcinoma (n=31) accounted for 62% of all renal masses and 67.3% of malignant renal masses, Transitional cell carcinoma (n=02), Wilm's tumor (n=07), Metastases (n=03), lymphoma (n=03), Angiomyolipoma (n=03) and Oncocytoma (n=01). The most common calcified renal mass was renal cell carcinoma. Calcification was seen in 7 out of 31 cases of RCC (22.5%). Malignant renal masses showed more amount of necrosis when compared to the benign renal masses (58% in RCC and 100% in Wilms' tumor).Renal vein invasion was seen in 35.4% cases of RCC and in 2 out of 7 (28.7%) cases of Wilms' tumor whereas none of the benign renal masses showed renal vein invasion. 2 out of 31 (6.5%) cases of RCC showed inferior vena caval thrombosis. MDCT was able to differentiate a benign from malignant lesion with Sensitivity of 100%, Specificity of 80%, and Accuracy of 98%.

Conclusion: MDCT with good reformatting techniques has excellent accuracy in the detection and characterization of renal masses and to differentiate a benign from malignant lesion.

Keywords: Multi-detector computed tomography (MDCT), Masses, Renal cell carcinoma (RCC).

INTRODUCTION:

Detection of malignant renal masses and their differentiation from their benign counterparts is extremely important, especially when these masses are small. Despite recent advances, most renal adenocarcinomas are relatively unresponsive to chemotherapy and radiation therapy. Surgery of early stage lesions remains the only hope for long term survival or cure.

Computed Tomography (CT) scanner is the most sensitive imaging modality for detection of renal masses, additionally it has been suggested that CT can play an effective role in characterizing renal masses as solid lesions, simple cysts, or

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complex cysts, further differentiating the last group into six categories based on the likelihood of a complex cyst being malignant. Accordingly, CT is used daily to aid the radiologist in deciding whether to recommend that a renal mass be surgically removed, followed with additional imaging studies, or ignored.

Although the effectiveness of conventional axial renal CT is well established, a variety of problems can be encountered. Variations in patient respiration can cause motion artifacts or gaps in scanning. The former may substantially compromise image quality, and the latter may lead to failure to image portions of the kidneys and masses within these portions. Partial voluming of renal masses with surrounding normal renal parenchyma or with perinephric fat can result in inaccurate attenuation measurements, particularly if a small lesion (less than twice the image collimation) is not centered perfectly within in image. Partial voluming can also hinder evaluation of subtle features within cystic lesions. Such as minimal wall thickening, thin septations, or tiny areas of nodularity. Lastly, the duration of a conventional scanning sequence is relatively long, with scan times usually lasting 2 seconds and inter scan delays of 3.5 to 8 seconds. Even under ideal circumstances, more than a minute is required to image the kidneys entirely. Therefore, selective imaging entirely during the earliest (cortical) phase of renal enhancement, during which time renal cortical enhancement is maximal, is not possible.

Helical CT on the other hand has many potential advantages over conventional axial CT. Rapid and continuous scanning allows an entire sequence to be obtained during a single breath hold. At the most commonly used pitch (ratio of table speed to image collimation) of 1:1; most kidneys can be scanned using narrow (5 mm) image collimation in less than 30 seconds. Scanning during a single breath hold also prevents misregistration, eliminating the chance that portions of the kidneys (and therefore renal masses) might not be imaged. The ability to retrospectively shift the level of reconstruction is an additional major advantage of helical CT. Although collimation and pitch must be determined at the time that scans are acquired, raw data can be reconstructed at any level. This allows the technologist to reconstruct an axial image at that level which precisely includes the center of a detected renal mass. Such positioning improves the accuracy of range of interest measurements and the imager's ability to characterize a lesion by minimizing partial volume effects. The rapid scanning time of helical CT also permits renal imaging during any of the three phases of renal parenchymal contrast material enhancement: the cortical phase, nephrographic phase, or excretory phase.

This study assessed the role of MDCT in evaluation of renal masses, characterization of Benign and malignant lesions and find out the Sensitivity, Specificity and Accuracy of MDCT to differentiate a benign from malignant lesion.

MATERIAL AND METHODS

This Hospital based Descriptive type of Observational Study was conducted in the Department of Radio-diagnosis and Modern imaging of S.M.S. Medical College, Jaipur from March 2015 to April 2016 after approval from institutional Research Review Board.

Sample size of 48 patients having 50 renal masses from Nephrology, Urology and Pediatrics department were included in study following appropriate consent.

INCLUSION CRITERIA:-

1. All patients clinically and USG suspected renal masses referred to the department of Radio-diagnosis for MDCT examination.
2. Both male and female patients.
3. Patients who gave appropriate informed and written consent.

EXCLUSION CRITERIA:-

1. Simple renal cysts.
2. Extra renal masses involving renal parenchyma.
3. Uncooperative or unstable patients.
4. Patients sensitive to iodine contrast material.
5. Patients who were managed conservatively.
6. Serum creatinine > 1.5 mg/dl
7. Pregnant women

METHOD OF DATA COLLECTION

All patients underwent MDCT examination.

MDCT PROTOCOL:-

CT machine: Philips Ingenia 128 slice multi detector scanner. Position of patient: supine & gantry vertical. Patients were kept nil by mouth 4 hours prior to CT scan to avoid complications while administrating contrast media. Risks of contrast administration was explained to the patient and informed written consent was obtained prior to the study. Routine antero-posterior plain tomograms of abdomen was initially taken in all the patients in the supine position with the breath hold. Axial plain sections of 5 mm thickness was taken from the level of bases of lung to ischial tuberosities. In all cases plain scans were followed by intravenous contrast scan in suspended inspiration. Sections were taken in cortico-medullary (40-60s), nephrographic (80-120s) and excretory phases (180s) in cranio-caudal direction from the upper pole to the lower pole of kidneys. Post study reconstructions were done at 2.5 mm interval. Sagittal and coronal reconstructions were also made wherever necessary. Newer techniques of multi slice CT like curved planar reformatting, volume rendering, maximum and minimum intensity projections were also be done as and when necessary. The magnification mode commonly employed, and the scans were reviewed on a direct display console at multiple window settings (i.e. abdomen window at 320/40; lung window at 1400/-600 & bone window of 2400/200).

The pathological lesions were evaluated with respect to pre and post contrast attenuation values, the size, location of the mass, presence of calcification, hemorrhage, necrosis, presence of fat, and extension in to the adjoining structures. Statistical analysis was applied to find out the sensitivity, specificity, PPV, NPV and Accuracy. P-value < 0.05 was taken as significant.

RESULTS

In our study out of total 48 cases with 50 renal masses (in 2 cases masses were bilateral accounting 4 masses in them) among 31 males and 17 females (age range from 3 to 69 years), there were 46 (92%) malignant and 4 (8%) benign renal masses. Renal cell carcinoma (n=31) accounted for 62% of all renal masses and 67.3% of malignant renal masses, Transitional cell carcinoma (n=02), Wilm's tumor (n=07), Metastases (n=03), lymphoma (n=03), Angiomyolipoma (n=03) and Oncocytoma (n=01). 21 out of 31 patients (67.8%) of renal cell carcinoma were in the age range of 60-69 years, the youngest patient with RCC was 41 years old male patient and the oldest was 69 years old female patient. The mean age for RCC was 60.7 years. 7 out of 7 patients (100%) with Wilms' tumor were < 10 years, the youngest was 3 year old male patient and oldest was 9 years old male patient the mean age was 5.1 years. 2 cases out of 3 of Angiomyolipoma were seen in the age group of 40-49 years. All 3 cases of metastases were in the age group of >60 years and both were seen in male patients with lung carcinoma. 2 out of 3 cases lymphoma were in females (66.7%) and 1 in male 33.3%). 1 out of 2 cases of TCC in male and one in female (50%). 1 case of Oncocytoma seen in male.

The most common calcified renal mass in our study was renal cell carcinoma. Calcification was seen in 7 out of 31 cases of RCC (22.5%). Renal transitional carcinoma when located in the renal pelvis and ureter was associated with hydronephrosis (50%). Malignant renal masses showed more amount of necrosis when compared to the benign renal masses (58% in RCC and 100% in Wilms' tumour). Renal vein invasion was seen in 35.5% cases of RCC and in 28.5% cases of Wilms' tumor, both the malignant masses, whereas none of the benign renal masses showed renal vein invasion. 2 out of 31 (6.45%) cases of RCC showed inferior vena caval thrombosis. The common site of metastases from renal cell carcinoma was to Lymph nodes (48.3%), Lungs (13%) and to Appendicular skeleton (6.4%). The common site of metastases from Wilms' tumor was to lymph nodes (42.2%) and liver (28.3%). Involvement of renal vein, adrenals, lungs and appendicular skeleton was not seen in benign masses.

Table 1: Distribution of Individual Renal Masses with Respect to Location

Renal Masses	Right	Left	Total
Renal Cell Carcinoma	20 (64.5%)	11 (35.5%)	31 (100%)
Wilm's Tumor	04 (59.2%)	03 (42.8%)	07 (100%)
Metastases	02 (66.7%)	01 (33.3%)	03 (100%)
Lymphoma	02 (66.7%)	01 (33.3%)	03 (100%)
Renal Pelvic TCC	01 (50.0%)	01 (50.0%)	02 (100%)
Angiomyolipoma	02 (66.7%)	01 (33.3%)	03 (100%)
Oncocytoma	01 (100%)	00 (00.0%)	01 (100%)
Total	**32 (64%)**	**18 (36%)**	**50 (100%)**

Table 2: Attenuation Characteristics of Individual Renal Mass on Pre and Post Contrast Scans

Diagnosis (MDCT)	UE HU	CMP HU	NP HU	CMP - UE HU	NP - UE HU	CMP - NP HU	Total
Renal Cell Carcinoma	28.96	63.87	83.71	31.8	54.74	22.87	31
Wilm's Tumor	25	48	54	23	29	06	07
Metastasis	26.5	43	65.5	17.5	39	21.5	03
Lymphoma	32.4	58.23	67.87	25.8	35.4	9.6	03
Renal Pelvic TCC	11	15	17.5	4	6.5	2.5	02
Oncocytoma	29	60	85	31	56	25	01
Angiomyolipoma	-22	4.5	12.6	26.5	34.6	8.1	03

Table 3: Sensitivity and Specificity of MDCT for Renal Masses

Final Diagnosis (Histopathology)	True Positive	False Positive	False Positive	True Positive	Total
Renal Cell Carcinoma	30	1	0	19	50
Wilm's Tumor	7	0	0	43	50
Metastases	3	0	0	47	50
Lymphoma	3	0	0	47	50
Renal Pelvic TCC	2	0	0	48	50
Oncocytoma	1	0	0	49	50
Angiomyolipoma	3	0	0	47	50

Diagnosis	Sensitivity	Specificity	PPV	NPV	Accuracy	P value
Renal Cell Carcinoma	100	95	97	100	98	<0.001**
Wilm's Tumor	100	100	100	100	100	<0.001**
Metastases	100	100	100	100	100	<0.001**
Lymphoma	100	100	100	100	100	<0.001**
Renal Pelvic TCC	100	100	100	100	100	<0.001**
Oncocytoma	100	100	100	100	100	<0.001**
Angiomyolipoma	100	100	100	100	100	<0.001**

DISCUSSION

In our study out of total 48 cases with 50 masses (in 2 cases masses were bilateral accounting 4 masses in them) and 31 males and 17 females (age range from 3 to 69 years), there were 46 (92%) malignant and 04 (8%) benign renal masses. Renal cell carcinoma (n=31) accounted for 62% of all renal masses and 67.3% of malignant renal masses, Transitional cell carcinoma (n=02), Wilm's tumor (n=07), Metastases (n=03), Lymphoma (n=03) Angiomyolipoma (n=03) and Oncocytoma (n=01).Regarding age distribution of renal masses; in our study, the maximum percentage of patients were in the age range of 60 to 69 years (52%). Out of 50 masses 46 were diagnosed as malignant (92%) and 04 cases were diagnosed as benign (8%). The most common renal mass was renal cell carcinoma accounting for 62% of all the renal masses and 67.39% of the malignant renal masses. Overall masses were in 31 (62%) males and 19 (38%) females, the male to female ratio was 1.6:1. Thus renal neoplasms are seen more commonly in males.

MDCT was able to differentiate a benign from malignant lesion with Sensitivity of 100, Specificity of 80%, and Accuracy of 98% when the images were assessed in unenhanced, corticomedullary and nephrographic phases. Renal cell carcinomas showed a heterogeneous contrast enhancement with an increase of more than 20 HU. Renal vein and inferior vena caval invasion was highly specific for malignancy. The difference in the density was maximum in the unenhanced and nephrographic group, when compared to unenhanced and corticomedullary group, indicating that malignant renal masses being very vascular would show significant enhancement in the nephrographic phase.

The advantages of MDCT include : (a) the use of contiguous single breath hold data acquisition, thereby decreasing or eliminating respiratory motion artifacts (b) the ability to perform thin section scanning with small interval reconstruction, which decreased partial volume artifacts and increased sensitivity of lesion detection and (c) excretory phases and perform three-dimensional SSD, MIP, VRT and curved planar reformatting.

The minor limitations noted in the current study are limited number of cases evaluated, resulting in reduction (80% v/s 95% and 100%) in achieving the higher specificity. This is in addition contributed by the deficiency in the technique of contrast administration viz. injection of contrast agent using pressure injector which would have enabled as to keep the rate of contrast injection and timing the different phases of enhancement at a constant and standard rate.

CONCLUSION

MDCT with good reformatting techniques has excellent accuracy in the detection and characterization of renal masses and to differentiate a benign from malignant lesion.

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