Original Article

Computed Tomographic Evaluation of Renal Mass with Histopathological Correlation

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Abstract

Renal cell carcinoma (RCC) is the seventh most common cancer and the most common primary renal malignant neoplasm in adults. Computed Tomography (CT) is of a great value in differentiating malignant from benign masses of RCC. This cross-sectional study was conducted among 61 clinically suspected cases of renal mass at Sir Salimullah Medical College and Mitford Hospital (SSMC and Mitford Hospital) in the Department of Radiology and Imaging in collaboration with the Department of Urology and Pathology, from July '2011 to June' 2013. However, in 05 cases, histopathological reports were not available and 07 patients refused surgery after enrolling. Finally, histopathology reports were collected from 49 patients and they were considered as study subjects. Aim of the study was to evaluate the accuracy of CT scan findings in compere with the histopathological report for the diagnosis of renal mass and to differentiate its benign and malignant forms. The age range of the patients was 2 to 73 years, where more than two-third (69.38%) were male and rest of them were female. Maximum number of malignant cases observed in the age range of 50-59 years. In comparison, inflammatory and benign conditions dominate in early age group, mostly before 40 years. Among 49 cases, 41 (83.68%) cases were diagnosed as malignant renal mass by CT scan, 01 (2.04) case was missed, which was confirmed by histopathology. Rest 07 (14.28%) patients were diagnosed as benign both in CT scan and histopathology. The sensitivity of CT for malignant renal mass was found 97.62% and specificity was 100%. The positive and negative predictive values of CT were 87.5% and 97.59% respectively. Computed tomography is a valid diagnostic modality for differentiating benign and malignant renal mass.

Keywords: *Renal mass, computed tomography, histopathology, malignant, benign.*

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INTRODUCTION

Renal masses may be single or multiple or may be benign or malignant. Renal cysts are the most common mass lesions in the kidney. With ultrasonography 80% of detected renal masses are characterized as simple cysts thus ending their diagnostic evaluation. The remaining 20% of renal masses require further study with Computed tomography (CT) or Magnetic Resonance (MR) imaging.[1]

Renal cell carcinoma (RCC) is the seventh most common cancer as mentioned by Siddiqui et al (2005) and the most common primary renal malignant neoplasm in adults.[2] It accounts for approximately 90% of renal tumors and 2% of all adult malignancies. RCC is more common in men than in women (ratio, 1.6:1), and it most often occurs in patients aged 55-84 years.[3]

Approximately 87% of solid renal neoplasms in children are Wilms' tumors; Wilms' tumor is the most common primary pediatric malignant abdominal neoplasm; it is the third most common malignancy in children, after leukemia and brain tumors. It also is the third most common of all renal masses in childhood, after hydronephrosis and multicystic dysplastic kidney. Wilms' tumor occurs equally in males and females and occurs within 3 years.[4]

The accurate diagnosis of a renal mass is dependent on many factors, including the clinical history, the nature of the imaging findings, the experience of the radiologist, the quality of the examination, and the exclusion of conditions that can mimic a renal neoplasm.[5]

Ultrasonography (USG) is the first method in the diagnosis of renal malignancies. But staging is not possible with this modality. Multi detector Computed Tomography (MDCT) has ability to detect small renal lesions and to complete the examination a single breath hold. So Computed tomography have a great role in the evaluation of renal mass and also provide some clinical information regarding the lymphadenopathy & or the presence of metastatic lesion in the liver.[6]

High-resolution MDCT is accurate in the preoperative evaluation of patients with renal cell carcinoma. CT is the modality of choice for evaluating indeterminate renal lesions that are suspicious for Malignancy.[6]

USG has an advantage over CT in detection of nature of the lesion (solid/cystic) and evaluation of renal vein invasion by the lesion. CT including pattern of enhancement after contrast administration, presence of calcification and necrosis, perinephric extension, infiltration of adjacent organs, presence of thrombus in renal vein and inferior vena cava (IVC), retroperitoneal lymphadenopathy and distant metastasis. In addition, staging was done in patients with renal cell carcinoma according to Robson's staging criteria.

Although a variety of examinations (USG, MRI, and angiography) can be used in the workup of patients with suspected RCC, the preferred method of imaging these patients is dedicated renal computed tomography (CT). In most cases, this single examination can be used to detect and stage RCC and to provide information for surgical planning without additional imaging.[5]

MRI is comparable to helical CT for detection, diagnosis, and staging of renal masses. However, CT has the advantages of widespread availability, shorter examination time, and lower cost in comparison with MRI.[1]

The current use of CT scan and ultra-sonography for a wide variety of indications has led to the frequent incidental discovery of small (1.5-3.0 cm) and very small (< 1.5 cm) lesions in the renal parenchyma. These lesions are usually small benign cysts, complicated cysts, or small neoplasms.[7] CT is the most useful staging technique with accuracy ranging between 72% and 90%.[8] The present work has been carried out to assess the diagnostic accuracy of CT to evaluate renal mass.

MATERIALS AND METHODS

This cross sectional observational study was carried out in the Department of Radiology & Imaging, SSMC & Mitford Hospital, Dhaka in collaboration with the Department of Urology and Pathology to evaluate the diagnostic accuracy of computed tomography scan in the diagnosis of renal mass enrolling 61 patients who were referred by Urology department of SSMC & Mitford Hospital, Dhaka, as clinically suspected cases of renal mass for CT scan of whole abdomen. This study was conducted during July 2011 to June 2013. CT scan of abdomen was performed in all patients and after surgery specimen of renal masses were sent for histopathological diagnosis. Histopathological reports were collected and correlated with CT findings. However, in 5 cases, histopathological reports were not available and seven patients refused surgery after enrolling into the study. Finally, histopathology reports were collected from 49 patients and they were considered as study subjects. After taking informed consent, data was collected in a pre-tested questionnaire by taking history, examining the patients clinically, the finding and interpretation of the CT scan and histopathological reports. The data was expressed as frequency, percentage, mean (±SD) and range. For the validity of the study outcome sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV) and accuracy were calculated for CT scan using histopathological diagnosis as a gold standard of diagnostic criteria.

Results

Table I shows distribution of clinically suspected cases of renal mass; from total 61 clinically suspected cases of renal mass 49 patients were detected as renal tumors (benign and malignant conditions) and others 12 were normal condition.

Table I: Distribution of renal tumors and normal condition from clinically suspected cases of renal mass (N= 61)

No of patients with renal mass (clinically suspected)	Renal tumors (study subject)	Excluded cases from study	
		Refused surgery after enrolling	Histopathology report was not found
61	49	7	5

Table II contains the distribution of renal tumors (benign and malignant conditions) in different age groups; age range of the patients was 2 to 73 years. The distribution of benign condition was 16.32% and malignant condition was 83.68%. Among 49 patients with a renal tumors; 79.55% was in age group 40 ≥ 60 years, 12.24% was in age group 10-39 years and other 10.21% was in age group 2-9 years. Benign conditions were found 8.16% equally in both age group 10-39 years and 40 ≥ 60 years and no patient was found in age group 2-9 years. Malignant conditions were found 69.39% in age group 40 ≥ 60 years, 10.21% in age group 2-9 years, 4.08% in age group 30-39 years and no patients was found in age group 10-29 years.

Table II: Distribution of benign and malignant conditions according in different age groups (N=49)

Age group	Benign		Malignant		Benign + Malignant	
	No of patients	%	No of patients	%	No of total patients	%
2-9 Years	0	0	5	10.21	5	10.21
10-19 Years	2	4.08	0	0	2	4.08
20-29 Years	1	2.04	0	0	1	2.04
30-39 Years	1	2.04	2	4.08	3	6.12
40-49 Years	2	4.08	6	12.24	8	16.32
50-59 Years	1	2.04	16	32.66	17	34.70
≥ 60 Years	1	2.04	12	24.49	13	28.53
Total	8	16.32	41	83.68	49	100

Table III displays that 30.61% of patients were female and 69.36% were male. The male to female ratio was 2.27:1.

Table III: Distribution of patients by sex (N=49)

Gender	Number of Patients	Percentage	Male to female Ratio
Male	34	69.38	2.27:1
Female	15	30.62	

Table IV states the comparison of benign and malignant tumors of CT scan and histopathological examination. Here 35 (71.43%), 1 (2.04%) and 5 (10.21%) malignant tumors were detected as RCC, TCC and Wilms' Tumor respectively by CT scan; where 36 (73.45%), 1 (2.04%) and 5 (10.21%) were detected as RCC, TCC and Wilms' Tumor respectively by histopathological examination. Similarly 2 (4.08%), 4 (8.16%) and 2 (4.08%) benign tumors were detected as AML, Inflammatory and Cyst respectively by CT scan; on the other hand 3 (6.12%), 3 (6.12%) and 1 (2.04%) benign tumors were detected as AML, Inflammatory and Cyst respectively by histopathological examination.

Table IV: The distribution of different diagnosis of the renal mass made by CT scan and Histopathology (N=49)

	CT scan	Histopathology
Malignant		
Renal Cell carcinoma (RCC)	35 (71.43%)	36 (73.45%)
Transitional cell carcinoma (TCC)	1 (2.04%)	1 (2.04%)
Wilms' Tumor	5 (10.21%)	5 (10.21%)
Benign		
AML	2 (4.08%)	3 (6.12%)
Inflammatory	4 (8.16%)	3 (6.12%)
Cyst	2 (4.08%)	1 (2.04%)

Table V shows the comparison of CT-scan and histopathological diagnoses; 41 patients were both malignant on CT-scan and histopathology. In a CT scan of 42 patients with malignancy, 01 was found to have benign condition.

Table V: Comparison of CT scan with Histopathological Diagnosis of Malignant Renal Mass (N=49)

	Histopathological diagnosis		Total
CT scan	Malignant	Benign	
Malignant	41	0	41
Benign	1	7	8
Total	42	7	49

Table VI shows the comparison of CT-scan and histopathological diagnosis of benign renal tumor. CT scan detected 08 benign cases, of which 01 was histopathologically confirmed to be malignant.

Table VI: Comparison of CT scan with histopathological diagnosis of benign renal mass (N=49)

	Histopathological diagnosis		Total
CT diagnosis	Benign	Malignant	
Benign	7	1	08
Malignant	0	41	41
Total	7	42	49

Table VII shows comparison of CT-scan with histopathological diagnosis of inflammatory renal mass. Out of 04 inflammatory mass which are revealed on CT-scan, 03 were histo-pathologically detected.

Table VII: Comparison of CT scan with histopathological diagnosis of inflammatory renal mass (N=49)

CT scan	Histopathology		Total
	Inflammatory renal mass	Non-Inflammatory renal mass	
Inflammatory renal mass	3	1	4
Non-Inflammatory renal mass	0	45	45
Total	3	46	49

Table VIII shows that, out of 02 fat containing lesion which were detected by CT-scan, all were histopathologically same.

Table VIII: Comparison of CT scan with histopathological diagnosis of Fat containing lesion (N=49)

CT scan	Histopathology		Total
	Fat containing lesion	Non-fat containing lesion	
Fat containing lesion	2	0	2
Non-fat containing lesion	1	46	47
Total	3	46	49

Table IX shows margins of any lesion either well defined or ill-defined (for helps to diagnose type of pathology).

Table IX: Margin of lesion determined by CT scan (N=49)

Margin	Frequency	Percentage
Well defined	8	16.32
Ill defined	41	83.68

Table X shows density of the lesions by which characteristics of the lesion can be described. Mixed density, Hypo-dense, Iso-dense and Hyper-dense lesions were found in 48.98%, 42.86%, 6.12% and 2.04% of masses.

Table X: Distribution of patients by density of lesion in NECT (n=49)

Density	Frequency	Percentage
Iso-dense	3	6.12
Hypo-dense	21	42.86
Mixed density	24	48.98
Hyper-dense	1	2.04

Table XI shows the well-established indicator of benign and malignant lesion; pattern of enhancement (after IV contrast) in CT scan. Here 42 (85.71%) show minimal to moderate contrast enhancement. Large solid lesion with enhancement ranges between mild to moderate showed heterogeneous enhancements, where homogenous and no enhancement were 02 (4.09%) and 05 (10.20%).

Table XI: Distribution of patients by pattern of enhancement (N=49)

Enhancement	Frequency	Percentage
Heterogeneous	42	85.71
Homogenous	2	4.09
No enhancement	5	10.20

Table XII shows tumor characteristics staging of the lesions, especially malignant case. Presence of calcification, renal vein or IVC involvement, lymph node involvement, invasion of adjacent viscera and distant metastasis were found in 02 (4.08%), 03 (6.12%), 04 (8.16%), 03 (6.12%) and 01 (2.04%).

Table XII: Distribution of patients by presence of calcification, renal vein or IVC involvement (N=49)

Tumor characteristics	Frequency	Percentage
Calcification	2	4.08
Renal vein or IVC involvement	3	6.12
Lymph node involvement	4	8.16
Invasion of adjacent viscera	3	6.12
Distant metastasis	1	2.04

Table XIII contains the frequency of benign or malignant mass lesions by CT diagnosis. Benign mass like angiomyolipoma and other benign mass were found in 02 (4.08%) and 06 (12.24%) masses. Malignant mass like Renal cell carcinoma, Wilms' tumor and TCC were found in 35 (71.43%), 05 (10.21%). and 01 (2.04%) masses.

Table XIII: Distributions of patients by type of renal mass by CT diagnosis (N=49)

Type		Frequency	Percentage
Benign mass			
	Angiomyolipoma	2	4.08
	Other Benign mass	6	12.24
	Renal cell carcinoma (RCC)	35	71.43
Malignant mass			
	Wilms' tumor	5	10.20
	Transitional cell carcinoma (TCC)	1	2.04

DISCUSSION

The study was conducted among 61 clinically suspected cases of renal mass from where 49 patients were detected as renal tumors (benign and malignant conditions) and others 12 were normal condition. These 49 patients were selected as study subjects. The age range of 49 patients with renal masses was 2 to 73 years. Malignant lesion were found mostly on the 5th and 6th decades and thereafter, with malignant lesion seen most frequently during 5th decade. Wilms' tumor was found between 0 to 5 years. Benign lesions were found in earlier ages i.e. before 40 years. In this study, 30 (61.22%) patients aged 50 years or more and 17 (34.69%) patients were in between 50 to 59 years, while 13 (26.53%) patients were aged more than 60 years. The peak incidence of malignant lesions was found in the age group of 50 years and older. Sutton D (2003) reported that Renal cell carcinoma most commonly after 40 years of age and most cases arise spontaneously from 5th to 7th decade of life, as presented by Grainger RG (2008).[9,10]Helenon et al (2002) in a series of 125 cases of renal masses, found highest incidence in the age group of 50 years and older.[11] Deborah A, 2011 found RCC most often occurs in patients aged 55-84 years. Their observation was similar to our study.[6]

In this present study it was observed that male was predominant, where male and female patients were found 69.38% and 30.61% respectively with a male to female ratio of 2.27:1. Sutton D (2003) reported that RCC has a male to female predominance of 2.5:1.[9]

Asymptomatic renal tumors are increasingly detected incidentally (more than 50%) with the routine use of CT scanning evaluation of nonspecific findings. A manifestation of classically triad of gross hematuria, flank pain and a palpable mass occurs only 7-10% of patients.[12] We found 10 patients (20.40%) presented with abdominal pain and hematuria and 10 patients (20.40%) presented with abdominal pain and lump, 3 patients (6.12%) presented with symptoms of uraemia. The reliable symptoms, "classical triad" (pain, hematuria and flank mass was found in few cases (5 cases = 10.2%) and it generally indicates advanced diseases, Helenon et al (2002) found the percentage of classical triad (10%) which was almost close to our study.[11]

In our study most of the lesions (83.68%) showed ill-defined or poorly defined margin. Benign lesion (16.32%) showed well defined margin that correlates with the findings of Zagoria et al, 1990.[13]

In this study, Sensitivity and specificity, PPV, NPV and accuracy of CT scan diagnosing malignant renal mass were 97.62%, 100%, 100%, 87.5%, 97.59%. Sensitivity and specificity, PPV, NPV and accuracy of CT scan diagnosing renal cell carcinoma were 97.22%, 100%, 100.00 %, 92.86%, 97.59%. Sensitivity and specificity, PPV, NPV and accuracy of CT scan diagnosing benign renal mass were 100.00%, 97.62%, 87.5%, 100.00 %, 97.59%. Sensitivity and specificity, PPV, NPV and accuracy of CT scan diagnosing inflammatory renal mass were 100.00%, 97.83%, 75.00%, 100.0%, 97.59%.These findings are more or less closer to the findings of Silvermann SG (1994) the sensitivity and specificity of spiral CT in detecting renal mass less than 3 cm in size was 78% and 86% and Biswas NP (2007), sensitivity,specificity and accuracy of CT scan in the diagnosis of renal tumors were 100%,66.66% and 97.43% respectively.[1,14] Sensitivity and specificity, PPV, NPV and accuracy of CT scan diagnosing fat containing lesion were 66.67%, 100%, 100.0%, 97.87%, 97.57%. This study was conducted in only one tertiary care hospital at Dhaka, using non probability sampling technique (purposive sampling), which might not represent the whole country scenario. So, further study with large sample size involving multiple centers is recommended.

CONCLUSIONS

CT scan is useful diagnostic modality in pre-operative discrimination of renal mass and it should be worthy to note here that CT can help the patients and doctors in the rational approach of patient management. CT has definite value in the diagnosis of renal mass and can be regarded as a sensitive and specific imaging modality for pre-operative discrimination of the tumor.

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