Original Research Article

Efficacy of Computed Tomography in Diagnosing Renal Masses Correctly

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Abstract

Background: Early detection, accurate staging of malignant renal masses and their differentiation from their benign counterparts is extremely important.
Materials and methods: Retrospectively 50 MDCT abdomens were studied with renal masses in a hospital setup. Renal mass protocols were followed in the included exams. CT scans were done on 64 and 128 slice canners.
Results: In my study, out of total 50 cases studied, 30 were males and 20 were females (age range from 4 to 77 years), there were 32 (64%) malignant and 18 (36%) benign renal masses. Renal cell carcinoma (n: 25) accounted for 50% of all renal masses and 78% of malignant renal masses. There was male preponderance (67%) in case of RCC when compared to females (37%). Other renal lesions showed no significant difference in gender distribution. In my study CT scan was found to have a 100% Sensitivity, 83% Specificity, 91.4% Positive predictive value and 100% negative predictive value in differentiating malignant renal masses from benign masses.
Conclusion: MDCT with correct protocols and technique has excellent sensitivity and specificity in the detection, characterization and staging of renal masses.

Key words

Multidetector Computed Tomography (MDCT), Renal cell carcinoma (RCC), Renal Transitional cell carcinoma (TCC), Wilm's tumour, Metastases, Angiomyolipoma (AML), Oncocytoma and other uncharacterized benign slid lesions, Complex cysts, infectious-inflammatory masses.

Introduction

Early detection, accurate staging of malignant renal masses and their differentiation from their benign counterparts is extremely important. Despite recent advances, most renal adenocarcinomas are relatively unresponsive to chemotherapy and radiation therapy. So early detection and surgical options remain the main stay of treatment.

There are different studies available regarding the evaluation of renal masses, some using the conventional CT and some using the MDCT with advanced techniques [1-6]. However, there are only few studies which use proper 4 phase protocols. Protocols are further being updated.

Ambros J. Beer, et al. in 2006 evaluated 28 patients with kidney lesions. Both MDCT and MRI were performed. Classification of lesions as surgical or non-surgical was done. Sensitivity and specificity values were 92.3% and 96.3% for MDCT and 92.3% and 91.3% for MRI [1].

Materials and methods

Inclusion criteria: Retrospectively CT scans done for renal masses over a period of 1 year in Rajiv Gandhi Cancer Institute.

Exclusion criteria: Simple cysts and extrarenal masses invading the renal parenchyma were excluded from the study.

CT technique – Renal mass protocol was followed strictly, which includes a non-contrast exam, post contrast corticomedullary phase at 70 seconds, nephrogenic phase at 90 seconds and excretory phase at 5 minutes. Contrast injection rate was at 3-5 ml/sec and about 70-90 ml contrast injected depending on patient weight and IV canula size.

Statistical analysis

Data analysis was done using ratios, averages of different diagnosis. Outcome of sensitivity, specificity, positive predictive value and negative predictive values were computed and tabulated.

Results

Hospital based retrospective study, to find the efficiency of computed tomography (plain and contrast) in evaluation and characterization of renal masses. In our study, the maximum percentage of patients were in the age range of 60-69 years (37.5%) followed by 50 to 59 years (22.5%). There was a male preponderance (65%) when compared to females (35%).

As per **Table – 1**, in our study, out of total 50 cases studied, 30 were males and 20 were females (age range from 4 to 77 years), there were 32 (64%) malignant and 18 (36%) benign renal masses. Renal cell carcinoma (n: 25) accounted for 50% of all renal masses and 78% of malignant renal masses. The other lesions include Transitional cell carcinoma (n: 02), Wilm's tumor (n: 02), Metastases (n: 03), Angiomyolipoma (n: 04), Oncocytoma and other uncharacterized benign slid lesions (n: 04), Complex cysts (n: 05), infectious-inflammatory masses like abscess (n: 5).

Table - 1: Age Distribution of renal masses.

Diagnosis	0-9 years	10-29 years	30-49 years	50-69 years	70 years and above	Total
Renal cell carcinoma	0	0	3	16	6	25
Wilm's tumor	2	0	0	0	0	2
Renal TCC	0	0	0	1	1	2
Metastases	0			1	2	3
Angiomyolipoma	0	2	2	0	0	4
Other benign solid lesions	0		1	1	2	4
Complex cyst	0		1	2	2	5
Infection-inflammatory masses	0		2	2	1	5

In our study, the maximum percentage of patients were in the age range of 50 to 69 years (44%). 16 out of 25 patients (64%) of renal cell carcinomas were in the age range of 50 – 69 years, the youngest patient with RCC was 42 years old male patient and the oldest was 76 years old male patient. The mean age was 59 years.

Verhoest G, et al. [2] in their study have found that the incidence of renal cell carcinoma was 6% in < 40 years, 38.5% in 40-60 years, 52.3% in 60-80 years and 3.2% in > 80 years. Our findings were comparable to the study of Verhoest G, et al. [2] where the maximum percentage of patients was seen in 60-69 years.

There was male preponderance (67%) in case of RCC when compared to females (37%). Male: female ratio is 2.03:1. Other renal lesions showed no significant difference in gender distribution.

As per **Table – 2**, on CT evaluation most of the RCC cases had calcifications (32%), necrosis (64%), renal or IVC invasion (40%) and retroperitoneal lymph node enlargement (64%). In two Wilm's tumors 1 had calcification, both had necrosis and lymph node enlargement. Out of two transitional carcinoma cases none had calcification or necrosis. Necrosis and calcification were also associated with abscesses and focal nephritis cases. Fat density was mostly associated with angiomyolipomas.

Table - 2: CT characteristics of individual pathologies.

Diagnosis	Calcifications	Necrosis	Veinous invasion	Lymph nodes	Fat	Hemorrhage	Central fibrous scar
Renal cell carcinoma	8	16	10	16	6	6	-
Wilm's tumor	1	2	-	2	-	-	-
Renal TCC	-	-	-	1	-	-	-
Metastases	-	-	-	3	-	-	-
Angiomyolipoma	1	1	-	-	4	-	-
Other benign solid lesions	-	-	-	-	-	-	1
Complex cyst	1	-	-	-	-	1	-
Infection-inflammatory mass	2	3	-	3	-	-	-

Table - 3: True positive, false positive, false negative, true negative values of MDCT for renal masses.

Diagnosis	Actual case number	True positive	False positive	False negative	True negative	Total
Renal cell carcinoma	25	25	3	0	22	50
Wilm's tumor	2	2	0	0	48	50
Renal TCC	2	2	0	0	48	50
Metastases	3	3	0	0	47	50
Angiomyolipoma	4	4	0	0	46	50
Other benign solid lesions	4	2	0	2	46	50
Complex cyst	5	4	0	1	45	50
Infection-inflammatory mass	5	5	0	0	43	50

Out of three wrongly diagnosed (false positive) renal cell carcinomas, two were found to be benign lesions (oncocytoma and a scar from endometriosis after surgery) and 1 was a complex cyst on follow up (**Table – 3**).

In our study, most malignant renal masses showed soft tissue attenuation (20-70 HU) on the precontrast scans, and showed a mean attenuation value of 110.5 ± 45.5 HU in the corticomedullary phase and 50.5 ± 35.0HU in the nephrographic phase, whereas the benign lesions

(n: 12) showed a mean attenuation of 50.0 ± 20.5HU in corticomedullary phase and 40.0 ± 15.0HU in nephrographic phases. In our study all the clear cell carcinomas displayed the attenuation of 120±25.5 HU and 60.5±10.5 HU on corticomedullary phase and nephrographic phase respectively.

In the study by Jinzaki, et al.; 37 patients were scanned by MDCT, they have demonstrated that RCC being very vascular tumor shows significant enhancement (>20 HU). Attenuation in corticomedullary phase was 165 ± 45 and in nephrographic phase was 85.5 ±13.4 [3].

Statistical confidence of CT scan in diagnosing malignant renal masses was 100% Sensitivity, 83% Specificity, 91.4% Positive predictive value and 100% negative predictive value (**Table – 4**).

Statistical confidence of CT scan in diagnosing benign renal masses was 83.3% Sensitivity, 100% Specificity, 100% Positive predictive value and 91.4% negative predictive value.

Table - 4: Sensitivity, specificity, positive predictive value, negative predictive value of MDCT for renal masses.

Diagnosis	Sensitivity	Specificity	Positive Predictive Value	Negative Predictive Value
Renal cell carcinoma	100.0	88.00	89.3	100.0
Wilms tumor	100.0	100.0	100.0	100.0
Renal pelvic TCC	100.0	100.0	100.0	100.0
Metastases	100.0	100.0	100.0	100.0
Angiomyolipoma	100.0	100.0	100.0	100.0
Other benign	50.0	100.0	100.0	95.8
Complex cyst	80.0	100	100.0	97.8
Infection-inflammation	100	100.0	100.0	100.0

Conclusion

MDCT with proper protocoling and good reformatting techniques has excellent sensitivity and specificity in the detection, characterization and staging of renal masses. However, it has the limitation in ruling out some benign lesions like oncocytoma, fat poor AML and some complex cystic lesions and scars and diagnosing some malignant lesions like fat containing RCC, Papillary RCC with high confidence.

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