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Evaluating the Accuracy of Computed Tomography in the Diagnosis of Renal Masses

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Abstract
Objectives: *To evaluate the accuracy of Computed Tomography in differentiation of benign and malignant renal masses.*
Methodology: *Aprospective study was conducted in the Department of Radio diagnosis, Govt. Medical College, Kottayam over a period of 18 months from May 2015 to November 2016. Study population included 46 patients who were referred for CT scan of abdomen with clinical suspicion of renal mass.*
Results: *Of the 46 cases studied, majority (73.9%) were malignant renal masses among which Renal Cell Carcinoma was the predominant diagnosis (50%). The diagnostic accuracy of multiphasic Computed Tomography was found to be 86.9% for differentiation of benign and malignant renal masses with a sensitivity of 94%, specificity of 66.6%, Positive Predictive Value of 88.9% and Negative Predictive Value of 80%.*
Some of the CT parameters were found to have statistically significant association with various renal masses. Irregular shape and ill defined parenchymal interface of renal masses on CT were found to have statistically significant association with malignancies and RCCs. Exophytic growth pattern, heterogenous and early washout enhancement pattern & presence of perilesional collaterals were also found to be associated with RCCs. Intrarenal location of lesion along with renal pelvic / ureteric involvement was found to be significantly associated with TCC.
Conclusion: *Computed Tomography is an accurate imaging modality for the evaluation of renal masses and thus an important prerequisite for proper patient management.*
Keywords: *Computed Tomography; Renal masses; Renal Cell Carcinoma.*

Introduction

Owing to the widespread use of abdominal imaging studies the detection rate of solid renal masses has increased, and an accurate characterization of imaging features of renal masses has become more essential for case management. Renal masses can be divided into cystic and solid lesions. The most common are cysts in up to 27% of patients over 50 years [1]. When a solid renal mass is encountered, numerous causes are possible, but the main one is the presence of a malignant lesion, such as renal cell

carcinoma (RCC) (clear cell, papillary, and chromophobe subtypes), metastasis, or lymphoma, or of a benign lesion, such as oncocytoma, angiomyolipoma, granuloma, or an inflammatory lesion [2].

Renal cell carcinoma (RCC) is the most common malignant tumor of the kidney, accounting for 85–90% of adult renal malignancies, and 1–2% of all malignancies[3]. The classical presentation of RCC with hematuria, flank pain and palpable flank mass is relatively uncommon (5-10% of cases). Incidentally detected tumors in asymptomatic individuals have been steadily increasing with the dissemination of imaging techniques [4].

The challenges of renal tumoral imaging include not only reliable differentiation between benign and malignant lesions but also accurate delineation of the extent of the disease to ensure optimal treatment planning. Spiral computed tomography (CT) has significantly improved imaging of renal masses by decreasing volume averaging artifacts and respiratory misregistration artifacts and allowing image acquisition during optimal contrast enhancement [5].

MDCT is today the most important imaging technique for diagnosis, staging and prognostic evaluation of renal mass lesions because of its high spatial resolution and faster image acquisition. MDCT provides the imaging to evaluate tumor size, location, organ involvement; to predict the presence and extent of inferior vena cava [IVC] thrombus; invasion of adjacent organs, lymph nodes and metastasis[3].

Although radical surgery remains the only efficient & curative treatment in both localized & advanced RCC, surgical techniques have evolved over the years. Currently less invasive surgical techniques like laparoscopic & nephron sparing surgery are used in the treatment of renal tumors. Therefore, detailed preoperative imaging and exact renal tumor staging are important for planning surgical approach and strategy, and for providing accurate prognostic information for the patient[3].

Aim

- To evaluate the accuracy of Computed Tomography in the diagnosis of renal mass lesions.

Materials & Methods

The study was conducted in a total number of 46 patients referred for CT scan of abdomen to the department of Radio diagnosis at Government Medical College, Kottayam with clinical suspicion of renal mass during a period of 18 months from May 2015 to November 2016.

Patients of renal trauma and patients in whom histopathological findings were not available for correlation were excluded from the study.

Clinical details of all cases were recorded. All scans were done using TOSHIBA ASTEION 4 – slice CT with 120 KVp, 150 mAs, 5 mm slice thickness and 0.75 second gantry rotation. Patients were kept nil orally for at least 4 hours prior to the CT scan to avoid complications during contrast administration. Risks of contrast administration were explained to the patient and consent obtained prior to the study. Scanning protocol consisted of unenhanced and triphasic contrast enhanced scans. 90-100 ml of 300mg/ml non ionic iodinated contrast was injected in a large antecubital vein at the rate of 4ml/second. Start delay was 40 seconds for corticomedullary phase, 90 seconds for nephrographic phase and 180 seconds for excretory phase; imaged from the diaphragm to the biacetabular line. Images were reconstructed with 3 mm slice thickness and reformatted in sagittal and coronal planes for analysis.

CT images thus obtained were studied in detail in multiple window settings (Soft tissue window of 320/40, Bone window of 2400/400, Lung window of 1400/-600). The magnification mode was commonly employed. The lesions were characterized based on their location, size, shape, contour, internal characteristics, calcifications, adipose component, attenuation value and degree of contrast enhancement.

Location, size, shape and parenchymal interface of the lesions were determined in the

nephrographic phase. Tumor attenuation and the degree of enhancement were quantitatively assessed. Attenuation values were measured in the unenhanced, corticomedullary & nephrographic phases. For homogeneous lesions, a round or elliptic region of interest was placed in the center of the lesion. For heterogeneous lesions, the region of interest was placed in the area that had the greatest degree of enhancement in the corticomedullary or nephrographic phase. The regions of interest measured were consistent in size and location on images obtained during all three scanning passes. The amount of tumor enhancement in the corticomedullary and nephrographic phases was measured by calculation of the difference between tumor attenuation and the values noted on the unenhanced scans. In cases of complex cystic lesions, maximum attenuation of septa / wall / soft tissue components during various phases was assessed.

The time-course enhancement pattern was classified as follows according to criteria used in previous studies. An early washout pattern was considered present when a tumor had peak enhancement in the corticomedullary phase and washout of at least 20 HU in the nephrographic phase. A gradual enhancement pattern was considered present when the tumor attenuation in the nephrographic phase was at least 20 HU greater than that in the corticomedullary phase. A prolonged enhancement pattern was considered present when the difference in tumor attenuation between the corticomedullary and nephrographic phases ranged from –20 to 20 HU.[2]

Perinephric space was assessed for presence of fat strandings, soft tissue nodules/ masses. Tumoral extension into perinephric space was considered to be present when the soft tissue mass measured atleast 1 cm.

Extension of tumor into renal sinus, presence of invasion of Gerota's fascia / adjacent structures were also looked for in post contrast images.

Presence of renal vein thrombosis was determined with corticomedullary phase images. IVC thrombosis and regional lymphadenopathy were assessed in nephrographic phase. Renal PCS and ureteric involvement were assessed in the excretory phase images. Rest of the abdominal organs, visualiesd lung fields and bones were also assessed for any significant abnormalities.

RCCs were staged according to the Revised TNM (7^{th} edition) staging system.

For characterization of cystic renal lesions, Bosniak criteria was used.

All CT diagnosis were obtained by a consensus of two senior radiologists.

CT diagnosis were later compared with results of Histopathological examination of the biopsy/postsurgical specimen.

The data was entered in Microsoft excel and further statistical analysis was done using SPSS software.

Results

In our study group of 46 patients with renal masses, the age of presentation ranged from 2 to 86 years. The mean age was 54 years. The maximum cases were in the age group 41 – 60 years which was followed by the age group 61 – 80 years. Males constituted the majority, 26 in number (56.5%). Majority of the malignant lesions were found in males (66.7%) whereas most of the benign lesions were found in females (69.2%).

Majority of the patients were symptomatic. Abdominal Pain which was present in 24 (51%) patients was the most frequent symptom. It was either solitary or in combination with other symptoms like hematuria, mass per abdomen or fever. Hematuria was the major solitary symptom {11 (23.4%)} followed by abdominal pain. 2 children presented with history of abdominal mass alone.

Twelve of the patients were asymptomatic with incidentally detected renal mass lesions on ultrasonography.

CT Diagnosis of Renal Masses

40 patients had solitary lesions while 3 had 2 or

more similar lesions in the same kidney and 3 had multiple lesions in both kidneys. In case of multiple lesions with similar enhancement characteristics, the largest lesion was assessed in detail and included in the study.

Cystic lesions confirming to Bosniak type 1 and 2 could not be included in the study as they could not be followed up and lacked histological correlation. Hence, majority, 41 (89%), of the renal masses in the study were solid in nature. Complex cysts constituted the rest 11%.

Size: minimum size was 2 cm and maximum 20 cm. Mean size was 6.9 cms. Majority (~ 45.7%) of the lesions had a size </= 4 cm. However large lesions measuring >10cm constituted about 21.7%.

Location: Most lesions were those involving the Right mid and lower pole {8(17.4%) . This was closely followed by lesions involving left upper and mid poles {7(15.2%)}.

Shape: Most of the lesions, 28(61%) had an irregular shape.10 (22%) of the lesions were rounded whereas 8 (17%) were ovoid.

Growth pattern: Majority of the lesions, 26 (56.5%), had an exophytic component whereas 20 (43.5%) of the lesions were totally intrarenal.

Majority of the lesions, 24 (52.2%) had an ill defined interface with adjacent normal renal parenchyma. 22 (47.8%) were well defined lesions, some showing pseudocapsule also.

CT Attenuation and enhancement

Majority of the lesions, 36 (78.3%), were heterodense and showed heterogenous enhancement. 6 (13%) of the lesions showed areas of calcification. Focal fat density areas were present in 3 of the cases.

On unenhanced scans, renal masses showed an attenuation of 29+/-6 HU. Renal masses showed an average enhancement of 62+/-38 HU in the corticomedullary phase and 38 +/- 28 HU in the nephrographic phase.

Table 1: Attenuation of Renal Masses in Various CT Phases

NECT attenuation	29 +/- 6 HU
CMP attenuation	92+/-43 HU
NPH attenuation	70+/-30 HU
CMP enhancement	62+/-38 HU
NPH enhancement	38 +/-28 HU

Table 2: Enhancement Pattern of Renal Masses

Enhancement pattern	Frequency
Early Washout	21 (45.7%)
Prolonged	25 (54.3%)

Table 3: Frequency of Other CT Parameters

Other CT Parameters	Frequency
Collaterals	8 (17.4%)
Perinephric events	32 (69.56%)
Gerota's fascia invasion	6 (13.04%)
Renal sinus involvement	14 (30.4%)
Ipsilateral adrenal involvement	5 (10.8%)
Renal vein involvement	6 (13.04%)
IVC involvement	4 (8.7%)
Regional nodes	8 (17.3%)
Ureteric / renal pelvic involvement	4 (8.7%)
Metastasis	2 (4.3%)

Majority of the renal masses, 36 of the total 46 were diagnosed to be malignant lesions on CT

Evaluation of Association between Various CT Parameters and Histopathological Results

Table 4: Shape of Lesion versus Malignancy

Shape	Malignant	Benign
Round	4 12.1%	6 46.2%
Ovoid	5 15.2%	3 23.1%
Irregular	24 72.7%	4 30.8%

Table 5: Nature of Lesion versus Malignancy

	Malignant (% within malignant)	Benign (% within benign)
Solid	30 90.9%	11 84.6%
Cystic	4 9.1%	1 15.4%

Table 6 Parenchymal Interface versus Malignancy

Interface	Malignant	Benign
Well defined	11 33.3%	11 84.6%
Ill defined	22 66.7%	2 15.4%

Table 7: Growth Patternversus Malignancy

Growth pattern	Malignant	Benign
Totally intrarenal	14 42.4%	6 46.2%
Exophytic component	19 57.6%	7 53.8%

Table 8: Heterogeneity of Lesion versus Malignancy

	Malignant	Benign
Heterogenous	27 81.8%	9 69.2%
Homogenous	6 18.2%	4 30.8%

Table 9: Enhancement Pattern versus Malignancy

Enhancement pattern	Malignant	Benign
Early Washout	14 42.4%	7 53.8%
Prolonged	19 57.6%	6 46.2%

Table 10: Peripheral Enhancement versus Infective/Inflammatory Lesions

Peripheral enhancement	Infective/inflammatory % within infective/inflammatory	Others
Present	2 40%	0 0%
Absent	3 60%	41 100%

Table 11: Presence of Calcification versus Malignancy

Calcification	Malignant	Benign
Present	6 15.2%	0 0%
Absent	28 84.8%	12 100%

Table 12: Presence of Collaterals versus Malignancy

Collaterals	Malignant	Benign
Present	8 23.5%	0 0%
Absent	26 76.5%	12 100%

Table 13: Perinephric Involvement on CT Versus Malignancy

Perinephric involvement on CT	Malignant	Benign
Fat strandings	10 30.3%	5 38.5%
Soft tissue mass/nodules	14 42.4%	3 23.1%
Absent	9 27.3%	5 38.5%

Table 14: Invasion of Gerota's Fascia (CT) Versus Malignancy

Gerota's invasion	Malignant	Benign
Present	6 17.6%	0 0%
Absent	28 82.3%	12 100%

Table 15: Presence of Regional Nodes (CT) Versus Malignancy

	Malignant	Benign
Nodes +	8 24.2%	0 0%
Nodes -	25 75.8%	13 100%

Table 16: Renal Vein Involvement (CT) versus RCC

Renal vein involvement	RCC	Others
Present	6 35.3%	0 0%
Absent	11 64.7%	29 100%

Table 17: Presence of Renal Pelvis/Ureteric Involvement versus TCC

Pelvic/ureteric involvement	TCC	Others
Present	3 75%	1 2.4%
Absent	1 25%	41 97.6%

Table 18: Other statistically Significant CT Parameters for Various Renal Masses

CT Parameters	P Value	Pearson Chi – Square χ^2
Fat density & AML	<0.001	26.316
Central scar & Oncocytoma	0.003	8.55
Intrarenal Location & TCC	0.017	5.695
Ureteric/renal pelvic involvement & TCC	<0.001	24.258
Peripheral enhancement & infective / inflammatory lesion	<0.001	17.145
Multiplicity & Metastasis	0.017	8.136
Multiplicity & Lymphoma	0.038	6.525

Table 19: Frequency of Various CT Diagnosis

Diagnosis	Frequency
AML	3 (6.5%)
Infective/Inflammatory	3 (6.5%)
ComplexCyst	4 (8.7%)
Oncocytoma	3 (6.5%)
RCC	23 (50%)
TCC	4 (8.7%)
Lymphoma	1 (2.2%)
Nephroblastoma	2 (4.3%)
Metastasis	3 (6.5%)
Total	46

Table 20: Classification of Renal Masses According to Histopathological Examination

Type of lesions	Frequency
Malignant	34 (73.9%)
Benign	12 (26.1%)
Total	46

Table 21 Frequency of Various Histopathological Diagnoses

Diagnosis	Frequency
AML	5 (10.9%)
Infective/inflammatory	5 (10.9%)
Complexcyst	4 (8.7%)
Oncocytoma	4 (8.7%)
RCC	17 (37%)
TCC	4 (8.7%)
Lymphoma	2 (4.3%)
Nephroblastoma	2 (4.3%)
Metastasis	3
Total	46

CT Diagnosis versus Pathological Diagnosis

Table 22: CT Diagnosis versus HP Diagnosis

	HP Malignant	HP Benign	Total
CT Malignant	32	4	36
CT Benign	2	8	10
Total	34	12	46

Sensitivity = True Positive/ True Positive + False Negative x 100 = 32 / 34 x 100 = 94 %

Specificity = True Negative/ True Negative + False Positive x 100 = 8 / 12 x 100 = 66.6 %

Positive Predictive Value = True positive / True positive + False Positive x 100 = 32 / 36 x 100 = 88.9 %

Negative Predictive Value = True Negative / True Negative + False Negative X 100 = 8 / 10 x 100 = 80%

LR+ = Sensitivity / 1 – Specificity = 0.94 / 1 – 0.66 = 0.94 / 0.34 = 2.76

LR- = 1 – Sensitivity / Specificity = 1 – 0.94 / 0.66 = 0.06 / 0.66 = 0.09

Diagnostic Accuracy = True Positive + True Negative / True Positive + True Negative + False Positive + False Negative x 100 = 32 + 8 / 32 + 8 + 4 + 2 x 100 = 40 / 46 x 100 = 86.9 %

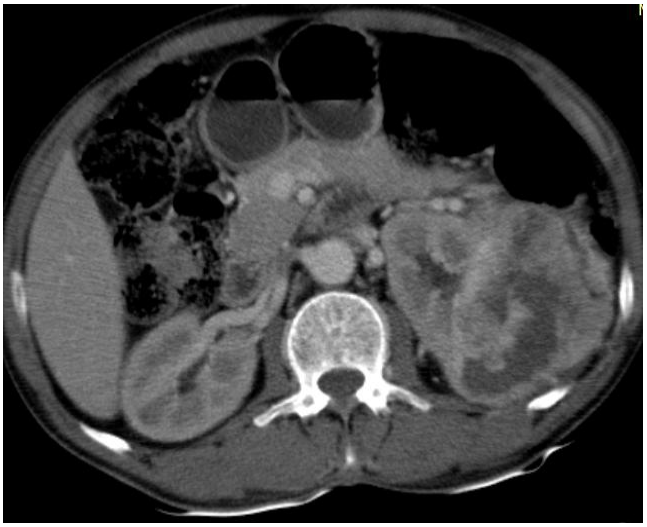
Table 23: Accuracy of CT in Detection of Various Types of Renal Masses (A)

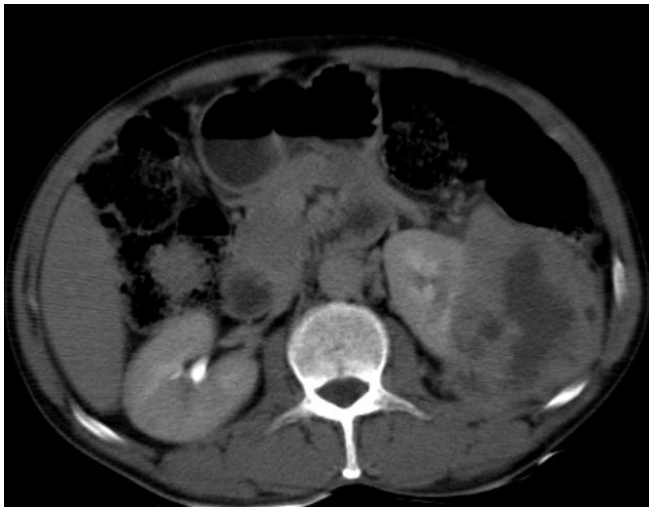
No of lesions	CT Diagnosis	HP Diagnosis
17	Renal Cell Carcinoma	Renal Cell Carcinoma
1	Renal Cell Carcinoma	Transitional Cell Carcinoma
1	Renal Cell Carcinoma	Metastasis
1	Renal Cell Carcinoma	Lipid Poor AML
1	Renal Cell Carcinoma	Focal Pyelonephritis
1	Renal Cell Carcinoma	Oncocytoma
1	Renal Cell Carcinoma	Lymphoma
3	Transitional cell Carcinoma	Transitional Cell Carcinoma
1	Transitional Cell Carcinoma	Focal pyelonephritis
2	Metastasis	Metastasis
1	Metastasis	Lipid poor AML
1	Lymphoma	Lymphoma
2	Nephroblastoma	Nephroblastoma
3	Oncocytoma	Oncocytoma
3	Angiomyolipoma	Angiomyolipoma
3	Infective/Inflammatory lesions	Infective/Inflammatory lesions
4	Complex cysts	Complex cysts

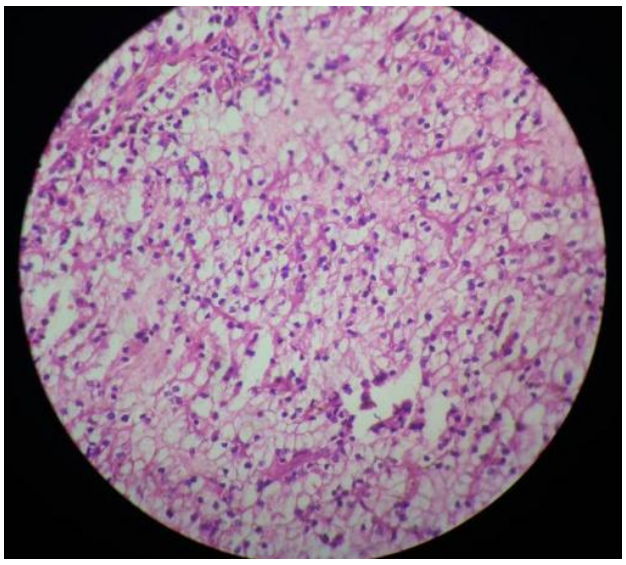
Table 24: Accuracy of CT in Detection of Various Types of Renal Masses (B)

CT Diagnosis	CT Sensitivity & Specificity
Renal Cell Carcinoma	Sensitivity – 94.1 % Specificity – 79.3 %
Transitional Cell Carcinoma	Sensitivity – 75 % Specificity – 97.6 %
Nephroblastoma	Sensitivity – 100 % Specificity – 100 %
Renal Metastasis	Sensitivity – 66.7 % Specificity – 97.7 %
Renal Lymphoma	Sensitivity – 50 % Specificity – 100 %
Oncocytoma	Sensitivity – 75 % Specificity – 100 %
Angiomyolipoma	Sensitivity – 60 % Specificity – 100 %
Infective/Inflammatory	Sensitivity – 60 % Specificity – 100 %
Complex Cyst	Sensitivity – 100 % Specificity – 100 %

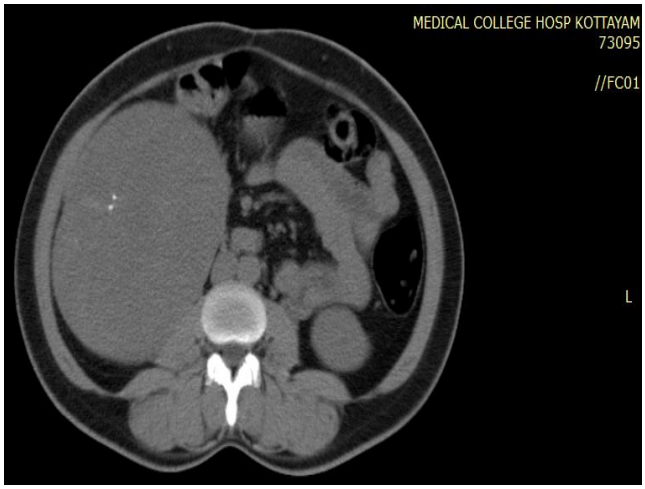
Illustrative cases

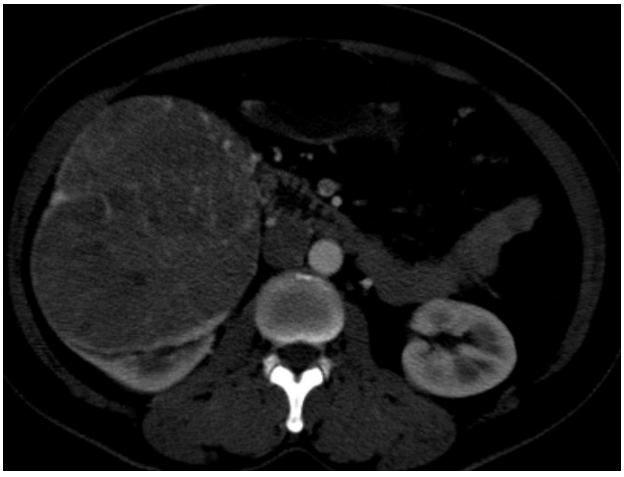


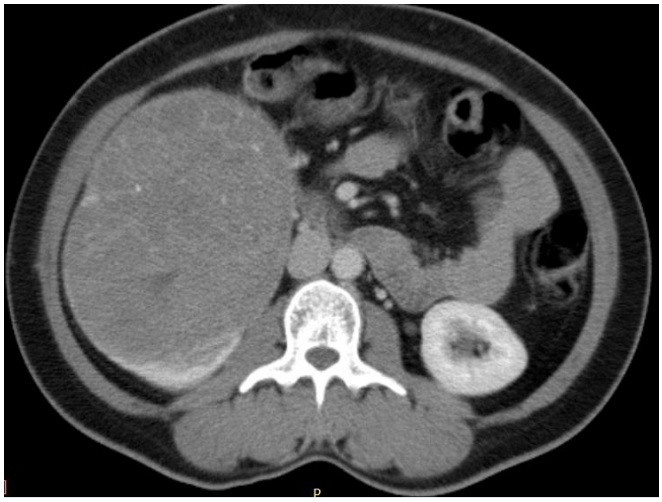




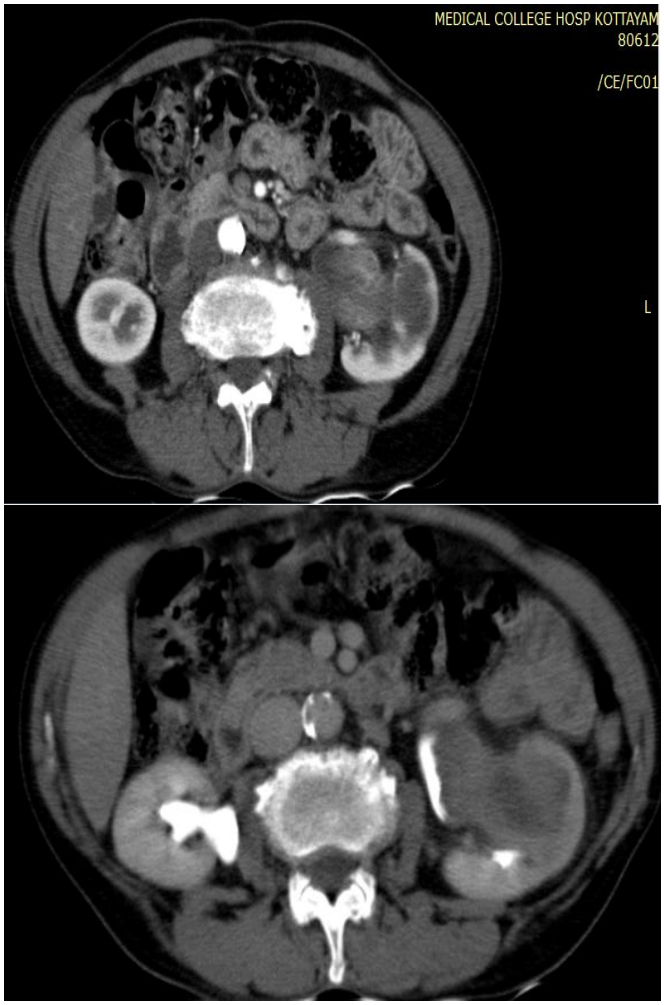
Case 1 : Case of Clear Cell RCC : Contrast enhanced CT during corticomedullary and nephrographic phases showing large irregular heterogeneously enhancing mass lesion involving left kidney with an early washout pattern of enhancement and multiple perilesional collaterals. HP Slide showing large uniform cells with abundant clear cytoplasm







Case 2: A case of chromophobe type of RCC: Plain & Contrast enhanced CT scans during corticomedullary & nephrographic phases showing a large well defined, predominantly exophyticmass lesion with calcific foci & a pseudocapsule involving Right kidney. It shows a progressive type of enhancement pattern.



Case 3: A case of upper tract TCC: CECT scans in corticomedullary and excretory phases showing irregular enhancing soft tissue lesion involving Left renal pelvis and calyces with adjacent parenchymal infiltration.

Discussion

In our study group of 46 patients with renal masses, the age of presentation ranged from 2 to 86 years. The mean age was 54 years. The maximum cases were in the age group 41 – 60 years which was followed by the age group 61 – 80 years. This was slightly different from the studies in the literature.

In the study conducted by Bajwa et al[5]., the range of age presentation was from 4 to 84 years and mean age was 48.5 years.

Dongre et al[6]studied 60 patients whose age ranged from 1 year to 70 years. Mean age was 35.5. The maximum cases were in age group of 61-70 years (27%); 71% cases belong to age group between 51 to 60 years.

Our study included 26 (56.5%) males and 20 (43.5%) females.

Male to female ratio = 1.29.

In the study conducted by Bajwa et al[5], of the total 70 patients, 44 (62.8%) were males. Females constituted only 37.1 %. Male to female ratio was 1.69

In the study conducted by Dongre et al [6] females 33(55%) were more predominantly involved than males 27(45%). Male to female ratio of patients with renal mass lesions was 0.8:1.

Majority of the patients were symptomatic. Abdominal Pain which was present in 24 (51%) patients was the most frequent symptom. It was either solitary or in combination with other symptoms like hematuria, mass per abdomen or fever. Hematuria was the major solitary symptom {11 (23.4%)} followed by abdominal pain. 2 children presented with history of abdominal mass alone. 4 patients presented with the classic triad of abdominal / flank pain,mass and hematuria. Twelve (26.1 %) of the patients were asymptomatic with incidentally detected renal mass lesions on ultrasonography

CT Diagnosis of Renal Masses

40 patients had solitary lesions while 3 had 2 or more similar lesions in the same kidney and 3 had multiple lesions in both kidneys. In case of multiple lesions with similar enhancement characteristics, the largest lesion was assessed in detail and included in the study.

Cystic lesions confirming to Bosniak type 1 and 2 could not be included in the study as they could not be followed up and lacked histological correlation. Hence, majority, 41 (89%), of the renal masses in the study were solid in nature. Complex cysts constituted the rest 11%.

Location: Most lesions were those involving the Right mid and lower pole {8(17.4%) . This was closely followed by lesions involving left upper and mid poles{7(15.2%)}.

Size: minimum size was 2 cm and maximum 20 cm. Mean size was 6.9 cm. Majority (~ 46%) of the lesions had a size </= 4 cm. However large lesions measuring >10cm constituted about 11%.

Shape: Most of the lesions,28 (61%) had an irregular shape.10 (22%) of the lesions were rounded whereas 8 (17%) were ovoid. Irregular shape was found to have a statistically significant association with Malignancy (P value of 0.007 & Chi-square value of 9.937).

Growth pattern and parenchymal interface: Majority of the lesions, 26 (56.5%), had an exophytic component whereas 20 (43.5%) of the lesions were totally intrarenal.

Presence of exophytic component showed statistically significant association with RCC (P value of 0.007 , Chi – square value of 7.322) whereas Totally intrarenal location was found to be associated with TCC (P value of 0.017 & Chi - square value of 5.695).

This was contrary to the study conducted by Millet et al[2]In their study, there was no significant association between CT growth pattern (ball versus bean) and the benign or malignant nature of the lesion.

Majority of the lesions, 24 (52.2%) had an ill defined interface with adjacent normal renal parenchyma. 22 (47.8%) were well defined lesions, some showing pseudocapsule also. Ill-defined interface with normal parenchyma was found to have a statistically significant association with malignancy (P value of 0.004 and Chi – square value of 8.203) as well as RCC (P value – 0.05 and Chi- square value of 3.664)

CT Attenuation and enhancement:

Majority of the lesions, 36 (78.3%), were heterodense and showed heterogenous enhancement.

6 (13%) of the lesions showed areas of calcification. All of them were malignant, majority being RCC.

Focal fat density areas were present in 3 of the cases and all of them were benign angiomyolipoma. (Chi square value – 26.316)

On unenhanced scans, renal masses showed an attenuation of 29 +/- 6 HU. Renal masses showed an average enhancement of 62 +/- 38 HU in the corticomedullary phase and 38 +/- 28 HU in the nephrographic phase.

Majority of the lesions, 25 of the total 46, showed a prolonged enhancement pattern. Rest 21 masses showed an early washout pattern with peak enhancement in the corticomedullary phase and washout of at least 20 HU in the nephrographic phase.

Majority of RCCs showed an early washout pattern. Chi – square test showed a P value of 0.006 suggestive of statistically significant association.

This finding corresponded with the study conducted by Songib et al[7] in which the highest enhancement of malignant tumors was achieved in the CMP with washout seen in the nephrographic phase.

However, there are discrepancies with other studies in literature.

In the study conducted by Millet et al[2], there was significant difference between malignant and benign tumors in terms of enhancement parameters with a higher rate of progressive enhancement (tumor attenuation in the nephrographic phase was at least 20 HU greater

than that in the corticomedullary phase) in benign tumors.

Both cases of renal abscesses in our study showed typical peripheral enhancement pattern. 8 of the cases showed perilesional collaterals and all of them were proved to be RCC on histopathological evaluation. (Chi square value – 16.52)

Renal sinus involvement, renal vein & IVC involvement, Gerota's fascia invasion & ipsilateral adrenal involvement were the other CT features which were found to have statistically significant association with RCC, P values being 0.0011 , 0.001, 0.001 & 0.002 respectively.

Renal pelvic / proximal ureteric involvement was seen in majority of the TCC cases (Chi square – 24.258) which along with intrarenal location of lesion &ill defined interface with normal parenchyma were helpful in correct preoperative diagnosis of upper tract TCC.

Diagnosis

Majority of the renal masses, 36 of the total 46 were diagnosed to be malignant lesions on CT . However, Histopathological examination revealed that 4 of these were benign. Of the 32 true positive cases, majority of the malignant renal lesions was constituted by RCC.

Among the 23 cases diagnosed as RCC on CT, only 17 were true positive. A case of upper tract TCC with parenchymal infiltration, a solitary renal metastasis, a case of NHL with heterogenously enhancing solitary renal mass, a case of lipid poor angiomyolipoma and an oncocytoma were misdiagnosed as RCC.

Majority (75%) of TCC were correctly diagnosed on CT. However a case of focal pyelonephritis was misdiagnosed as TCC.

2 cases of metastasis were rightly diagnosed by CT. However, a case of lipid poor angiomyolipoma was misdiagnosed as renal metastasis in a patient with known history of GIST.

60 % of AML cases with fat density were rightly diagnosed as AML. However, patients underwent surgery due to the large size or known case of primary & clinical suspicion of metastasis. 75% of oncocytoma,, 60 % of infective/inflammatory lesions and 50% of lymphoma cases were correctly diagnosed by CT.

All cases of nephroblastoma and complex cysts were rightly diagnosed.

Table 26: Accuracy of CT in Distinguishing Benign and Malignant Renal Mass Lesions

Sensitivity	94 %
Specificity	66.6%
Positive Predictive Value	88.9%
Negative Predictive Value	80%
Likelihood Ratio Positive	2.76
Likelihood Ratio Negative	0.09
Diagnostic Test Accuracy	86.9%

There is disparity between the results of the present study and the previous studies in literature. Dongre et al[6] in their study found out that contrast enhanced CT has a sensitivity of 100%, specificity of 98% for determining the presence of neoplastic lesions excluding renal cell carcinoma and sensitivity of 93%, specificity of 94.3% for renal cell carcinomas and sensitivity 90% specificity 96.23% for diagnosing renal inflammatory mass lesions.

In the study by Bajwa et al[5], the sensitivity of helical CT for accurate diagnosis of renal masses was found to be 98.5% .One upper pole renal cell carcinoma (RCC) was misdiagnosed to be an adrenal tumour on CT.

Conclusion

This study was a prospective study conducted in the department of Radio diagnosis, Medical College, Kottayam for a period of 18 months from May 2015 to November 2016. The study aimed at characterizing renal masses and evaluating the accuracy of Computed Tomography in differentiation of benign and malignant masses and in staging of malignant renal masses.

The diagnostic accuracy of multiphasic Computed Tomography was found to be 86.9% for differentiation of benign and malignant renal masses with a sensitivity of 94%, specificity of

66.6%, Positive Predictive Value of 88.9% and Negative Predictive Value of 80%.

Some of the CT parameters were found to have statistically significant association with various renal masses. Irregular shape and ill defined parenchymal interface of renal masses on CT were found to have statistically significant association with malignancies and RCCs. Exophytic growth pattern, heterogenous and early washout enhancement pattern & presence of perilesional collaterals were also found to be associated with RCCs. Intrarenal location of lesion along with renal pelvic / ureteric involvement was found to be significantly associated with TCC. Central scar was found to be significantly associated with Oncocytoma and intralesional fat density with AML. Multiplicity of lesions was found to be significantly associated with Metastasis as well as Lymphoma.

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