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Role of Computed Tomography in Evaluation of Renal Masses

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ABSTRACT

At present there are various ways to recognize and evaluate kidney mass. A systematic methodological approach is needed to ensure a complete assessment of the suspected kidney mass, because each x-ray modality has relative strengths and weaknesses for an accurate diagnosis. Despite the lack of sensitivity and specificity, intravenous pyelography (IVP) remains the original diagnostic method in many cases because it plays a role in the assessment of hematuria. Intravenous pyelography with or without nephrotomography can detect a lot of kidney mass and provide information about kidney function. As the modality of imaging has expanded extensively, the measurement of adverse renal mass has improved significantly. The heterogeneous development, necrosis or calcification of such a by-of renal cell carcinoma is strongly suggestive. This research describes early-stage accidental renal cell carcinoma as correlated with symptoms of patients with renal cell carcinoma. It has significant implications on therapeutic strategies such as partial nephrectomy, etc. and increases the recovery of premature lesions. It suggests that the renal mass requires monitoring at age over 40 and high-risk classes such as the background of renal cell carcinoma, VHL, etc. The most common and successful modality for the measurement and characterisation of renal weight remains computational multidetector tomography (MDCT). The diagnostic efficiency of RCC in characterising and predicting the severity of disease is vastly enhanced by MDCT scans with an increase in spatial resolution and the potential to provide multiplanar and 3D recreations.

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INTRODUCTION

Background

The bilateral kidneys are retroperitoneal organs that are normally situated anteriorly between the transverse processes of T12-L3 vertebrae. Frequently several renal pathologies are encountered in routine clinical practice. Improvement in imaging modalities ensures its impact on the diagnosis and treatment of solid renal masses. Due to rapid pace in development of imaging techniques and increasing number of investigations being done, more number of renal masses are discovered incidentally during evaluation of unrelated or non-specific symptoms. Hence, it is vital to differentiate neoplastic and non-neoplastic masses (Catalano *et al.*, 2003).

Among the neoplastic masses, there is a need to further characterize them so that appropriate treatment strategies like nephron-sparing surgery, radio frequency ablation etc. can be planned at an early stage and also unnecessary radical treatments can be avoided (Tsili, 2015). Earlier all solid

renal masses showing enhancement were treated as instances of renal cell carcinoma (RCC), although proof generally was obtained only after radical nephrectomy (Hallscheidt *et al.*, 2004). Various types of renal masses, which are encountered are enlisted in Table 1 and Figure 1.

Diagnosis Methods

Plain X-Rays

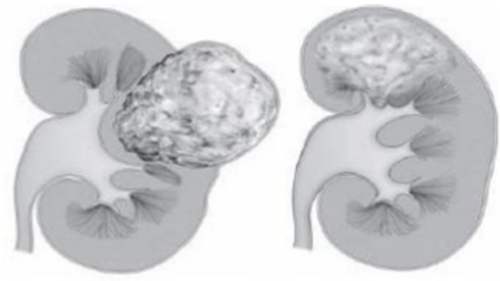
They have limited role in identifying renal mass and may be identified as large soft tissue densities with displacement of fat and calcification within it.

Intravenous Pyelography

It is one of the first radiological methods to demonstrate renal tumors through distortion of renal calyces or renal pelvis. However, it has limited role in identifying renal tumors and often used for evaluation of renal function.

Ultrasound

Though ultrasound can detect renal mass, it has limitations in characterization and differentiation of renal masses.



Ball Type	Bean Type
Renal cell carcinoma (RCC)	Transitional carcinoma
Angiomyolipoma	lymphoma
Oncocytoma	Metastasis
Metastasis	RCC (infiltrative)
Lymphoma	Medullary carcinoma

Figure 1: Ball type vs Bean type lesions

Computerized Tomography

Computerized tomography (CT) plays a major role in evaluation and characterization of renal masses (Joshi *et al.*, 2004). CT protocol for evaluation of the kidneys consists of non-enhanced (plain) and contrast-enhanced scans. Overall diagnostic accuracy of properly performed CT scanning for separating renal cysts from neoplasm is particularly high. MRI: Gadolinium-enhanced renal MRI is an attractive alternative to other techniques for evaluation of native and transplanted kidneys Dynamic gadolinium-enhanced gradient echo imaging achieves coverage of the entire kidney during breath-holding, thereby reducing respiration-induced phase artifacts (Ng *et al.*, 2008; Willatt *et al.*, 2014). Gadolinium-enhanced fat suppressed T1-weighted spin echo technique, images the kidneys with significantly fewer artifacts than does conventional spin echo imaging (Dyer *et al.*, 2001; Kim *et al.*, 2013).

Problem Statement

The explanation for differing oncocytoma imaging patterns is due to variations in cellularity including stroma that influence the extent of tumor improvement as well as the prominent pattern of individual oncocytomas amplification. Renal oncocytomas thus show different results for the scanning. It may be difficult not just to discriminate against oncocytoma from RCC, as well as have oncocytoma with subsequent RCC can be a therapeutic issue. Therefore, a typical pattern of enhancement was not generally recognized for renal oncocytomas.

Research Objectives

To study the Role of Multidetector Computed Tomography (MDCT) in Evaluation of Renal Mass. Moreover, the objective also focusses to characterize the image morphology of Renal Mass lesion on Computed Tomography. Yet it also aims to analyze the study imaging findings of Computed Tomography with operative and/or Histopathological findings. To study the accuracy of Computed Tomography in diagnosis of Renal Mass lesions.

LITERATURE REVIEW

The segmental enhancement inversion is described as a kidney lesion, with two different repair areas, showing an inverse pattern between the corticomedullal (30–40 seconds) and the early (120–180 seconds) eradication phases. In a zone the corticomedullal stage is hyperboosted, and in the initial removal process then transforms into a hypo amplification. The other phase in cortico-medulla is hypointensified and in its initial removal processit hyperintensifies (Patel *et al.*, 2009; Powell *et al.*, 1951).

Millet et al. (Kim *et al.*, 2009) , by comparison, have observed no reversals to the oncocytoma or RCC sector and reported that low, strong, fat free kidney lesions have been strengthened. It is not possible to differentiate between benign as well as malignant lesion by a single CT criteria.

O'Malley et al. (Millet *et al.*, 2011) reported that the reversal of segmentary magnification is not a typical finding or function in oncocytoma. In order to boost the RCC repair trends (transparent RCC cell or chromophobic RCC). The heterogenous strengthening

Table 1: Various Renal Masses

Neoplastic	
Benign	Malignant
Oncocytoma, Angiomyolipoma Cystic nephroma	Renal cell carcinoma, Transitional carcinoma, Squamous cell carcinoma, Wilms tumor, Renal sarcoma, Lymphoma, Metastasis
Non-Neoplastic	
Cyst Abscess and pyonephrosis Hematoma Pseudotumour	Malakoplakia Hydatid disease Vascular malformation Xanthogranulomatous Pyelonephritis

amount, which in the late phase is homogens, was clarified by McGahan et al. (O'Malley *et al.*, 2012) in 2011 by the most specific characteristic of the oncocytomas, (< 4 cm).

In 2011, McGahan et al (McGahan *et al.*, 2011) found that in CT scans, the average RCC diameter of the pathological test had been 5.6 cm (range, 2.8-15 cm). In 20 of 29 RCCs with 83% flexibility, 95% positive forecasting interest, 80% precision, 50% negative predicting interest including 83% overall reliability, MDCT allowing renal pseudokapsule identification. Pseudocapsula identification has been found to be more effective by the portal as well as nephrographic transitions of coronal and sagittal renaissance (p < 0,05).

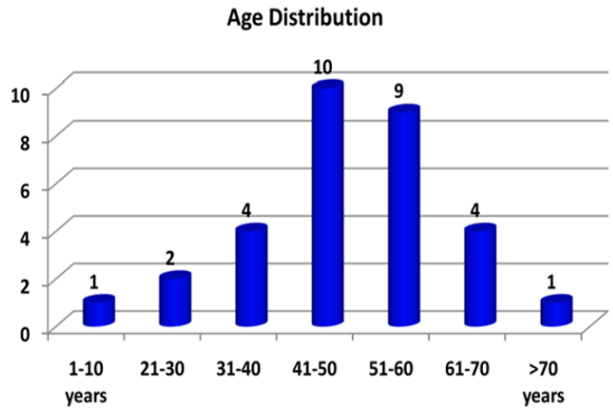


Figure 2: Age Distribution of study subjects

MATERIALS AND METHODS

Study Design

The study was conducted in the Department of Radio-diagnosis at Krishna Hospital after obtaining ethical committee clearance. The patients included in the study were referred from the various clinical departments of Krishna Hospital.

Study Design- Descriptive Cross-sectional Study.

Sample Size- 31 patients

Study Duration – November 2016 to November 2018.

Methodology

Informed consent was taken from the patient/attendant/legally acceptable representative for inclusion in the study as per the proforma attached.

Clinical evaluation

A detailed history was taken with complete physical and systemic examination of the patient. Relevant biochemical investigations were done wherever required. USG. Ultrasound abdomen of patient was performed as an initial modality in patients with suspected renal mass. Ultrasound was performed using 3 MHz convex transducer on ACUSON X300 Ultrasound (Siemens). Acoustic gel was used for skin transducer coupling. Computed Tomography.

CT was performed on 16 slice Multi-detector CT Siemens Somatom Emotion machine. A plain tomogram was taken as a guide/reference from diaphragm to pelvis. Images were acquired with 5mm collimation, 0.5mm reconstruction interval, gantry rotation speed of 0.6 second, pitch of 1.375:1, 120 Kv and 200mA. CT protocol for evaluation of the kidneys consists of both non enhanced and contrast-enhanced CT scans obtained in suspended respiration, to overcome the motion artifact. To avoid artifactual differences in attenuation values, the same peak kilo voltage, milliampere-second setting, section thickness, and field-of-view were used for both pre contrast and post contrast scans (Jinzaki *et al.*, 2014).

Renal angiomyolipoma

Angiomyolipomas are most commonly isolated sporadic tumors or present in association with tuberous sclerosis (TS). Sporadic AMLs without TS are generally detected during the fifth to seventh decade

Table 2: Distribution of age among patients

Age Group	No of Patients	Percentage
1-10	1	3.22%
11-20	0	0
21-30	2	6.45%
31-40	4	12.90%
41-50	10	32.25%
51-60	9	29.03%
61-70	4	12.90%
>70 years	1	3.22%
Grand Total	31	100%

Table 3: Sex distribution of renal mass

Gender	No of Patients	Percentage
Males	19	61.29%
Females	12	38.70%
Total	31	100%

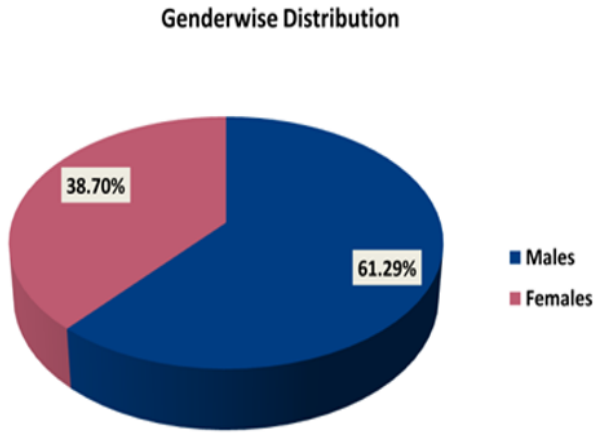


Figure 3: Distribution of cases according to diagnosis

in females or later and are more often larger and solitary than those found associated with syndromes. Angiomyolipomas may be rarely associated with neurofibromatosis-1, von Hippel-Lindau (VHL), or ADPKD. CT being the most accurate imaging technique for detection and characterization of angiomyolipomas. The lesions usually show low attenuation owing to fat component and hence presence of gross fat which is characteristic for these lesions.

The ROIs of these lesions are typically less than -10 HU. Thin slices are essential to demonstrate fat in small AMLs because of volume averaging. Higher specificity can be obtained using threshold measurements of -15° to -30° HU. On CT, the fat attenuation of an AML may be interposed with solid components. A subset of lesions will not meet fat attenuation criteria because of volume averaging or intratumoral hemorrhage.

Renal cell carcinoma

Renal cell carcinoma (RCC) is the eighth most common malignancy. It accounts for approximately 3% of newly diagnosed cancers and has been reported to occur in 11 out of 100000 individuals. There appears to be a true increase in the incidence of RCC attributable to the increased number detected by abdominal cross-sectional imaging. This increase has been accompanied by improved 5-year survival as the tumors detected by imaging are diagnosed at an earlier stage when they are still resectable. With a reported accuracy of 91%, CT remains the most widely available and single most effective modality for staging renal cell carcinoma (Catalano *et al.*, 2003).

RESULTS AND DISCUSSION

The present study was carried out in the Department of Radiodiagnosis, Krishna Hospital, Karad, among a total of 31 cases suspected of having renal masses on the basis of clinical profile, prior imaging profile underwent CT examination.

Demographic Characteristics

In the present study, we observed cases with suspected renal mass. Various cases belonged to different age group and gender. Hence, in order to study their age distribution and gender wise distribution. We assessed their demographic characteristics.

Age Distribution

In our study, we observed that majority of the cases presented with suspected renal mass based on clinical findings, belonged to age group of 41-50 years (n=10, 32.25%), followed by 51-60 years which represents 9 cases (29%), age groups 31-40 years and 61-70 years represents similar proportion of cases, i.e. 4 (12.90%)

In the present study we observed only one pediatric case of age 5 years (3.22%) and one case above 70 years of age (3.22%) in Table 2 and Figure 2.

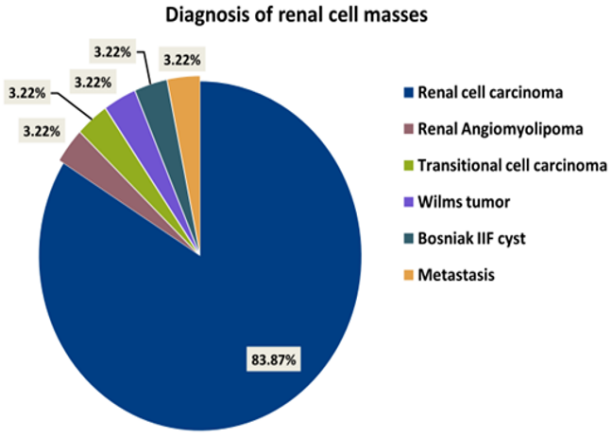


Figure 4: Distribution of Cases of Renal Mass in Our Study

Sex Distribution

In the given study, we studied the gender-wise distribution of the study subject with suspected renal mass. We observed that majority of the cases presented with suspected renal mass were males (n=19, 61.29%), followed by females (n=12, 38.70%). It shows clear male predominance of cases with renal mass in Table 3 and Figure 3.

In the present study, all the cases with suspected renal mass were subjected to a computed tomography examination. We reported that majority of the cases of renal mass found to be a renal cell carcinoma (n=26, 83.87%).

Other cases were Renal Angiomyolipoma, Transitional cell carcinoma, Wilms tumor, Bosniak II cyst and Metastasis (One case each, see Table 4 and Figure 4).

Renal Cell Carcinoma

Age group: In our study, we analyzed age distribution of cases of renal cell carcinoma among the cases of renal mass. It was observed that majority of the cases of RCC belonged to age group of 41-50 years (n=9, 34.61%), followed by 51-60 years (n=7, 26.92%) & 31-40 years (n=4, 15.38%) and so on. (Table 5).

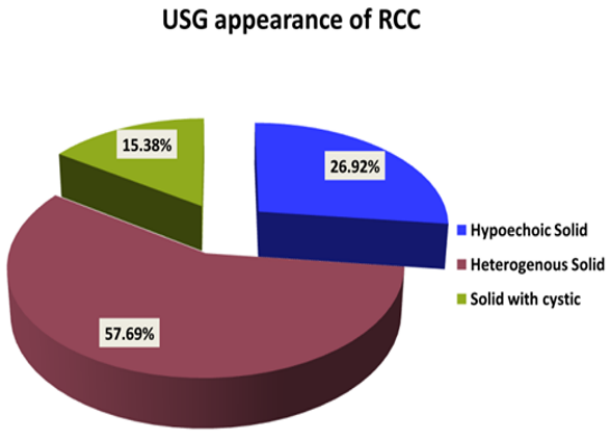


Figure 5: USG Features of RCC lesions

Ultrasound Appearance

In the present study, we initially subjected all the cases suspected of having renal mass to ultrasound examination. It was observed that majority of the cases reported heterogeneous solid appearance (n=15, 57.69%), followed by 7 cases with hypoechoic solid appearance and 4 cases with heterogeneous solid with cystic appearance (Table 6 and Figure 5).

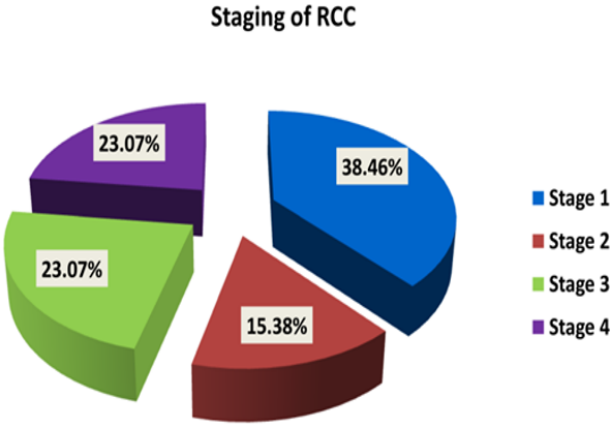


Figure 6: Staging of Renal Cell Carcinoma in Our Study

Characteristics in CT

In this current study, we assessed the computed tomography characteristics of renal the cell carcinoma lesions. It was reported that majority of the cases showed heterogenous enhancement (n=24, 92.30%), 5 cases reported calcifications and 2 cases reported homogenous enhancement (see Table 7).

In the present study, we categorized various cases of RCC according to their TNM staging. In T staging, majority of the cases belonged to the stage T1b (n=7, 26.92%), followed by T4 (n=6, 23.07%) and T1a, T2a, T3a (3 cases in each), followed by T3b (2 cases).

Table 4: Distribution of Cases of Renal Mass in Our Study

Diagnosis on CT	Number of cases	Percentage
Renal cell carcinoma	26	83.87%
Renal Angiomyolipoma	1	3.22%
Transitional cell carcinoma	1	3.22%
Wilms tumor	1	3.22%
Bosniak IIF cyst	1	3.22%
Metastasis	1	3.22%

Table 5: Age Wise Distribution of Renal Cell Carcinoma

Age Group	No of Patients	Percentage
21-30	2	7.69%
31-40	4	15.38%
41-50	9	34.61%
51-60	7	26.92%
61-70	3	11.53%
71-80	1	3.84%
Grand Total	26	100%

Table 6: USG Features of RCC lesions

USG Appearance		No of Patients	Percentage
Hypoechoic	Solid	7	26.92%
Heterogenous	Solid	15	57.69%
	Solid with cystic	4	15.38%

Table 7: Distribution of Characteristics in Renal Cell Carcinoma

RCC Characteristics	Number of cases	Percentage
Calcification	5	19.23%
Fat attenuation	0	0
Heterogeneous enhancement	24	92.30%
Homogenous enhancement	2	7.69%

Comparison of "T", "N", "M"

In N staging, only 3 cases showed lymph nodal involvement, and 5 cases of metastasis (M staging), (see Table 8 and Figure 6).

The objectives of the present study were to characterize image morphology of renal mass lesion on CT in Figure 7, and hence to study findings of CT with HPR, to evaluate the accuracy of CT scan in diagnosis of renal mass lesions. The present study began after the approval of institutional ethical committee. According to the inclusion criteria of the present study, 31 cases of suspected renal mass were selected, based on random sampling methods. All the 31 cases were subjected for ultrasound examination. Those who were positive for renal mass in USG and those patients with incidentally detected mass in any of the radiological investigation was further evaluated with multidetector computed tomography. Followed by CT scanning the findings were recorded and all the subjected were then subjected to histopathological examinations in order to confirm the diagnosis. Radiologic work remains the key tool for determining renal mass in kidneys as the associated retroperitoneal organ. Ultrasound is the initial imaging tool and preferred method, as it is cheap, easy to conduct and free of exposure to radiation. According to Using USG, kidney lesions are either solid or cystic. CT is done in four phases viz., unenhanced, corticomedullary, nephrographic and excretory phase especially in cases of malignancy while benign conditions like angiomy-

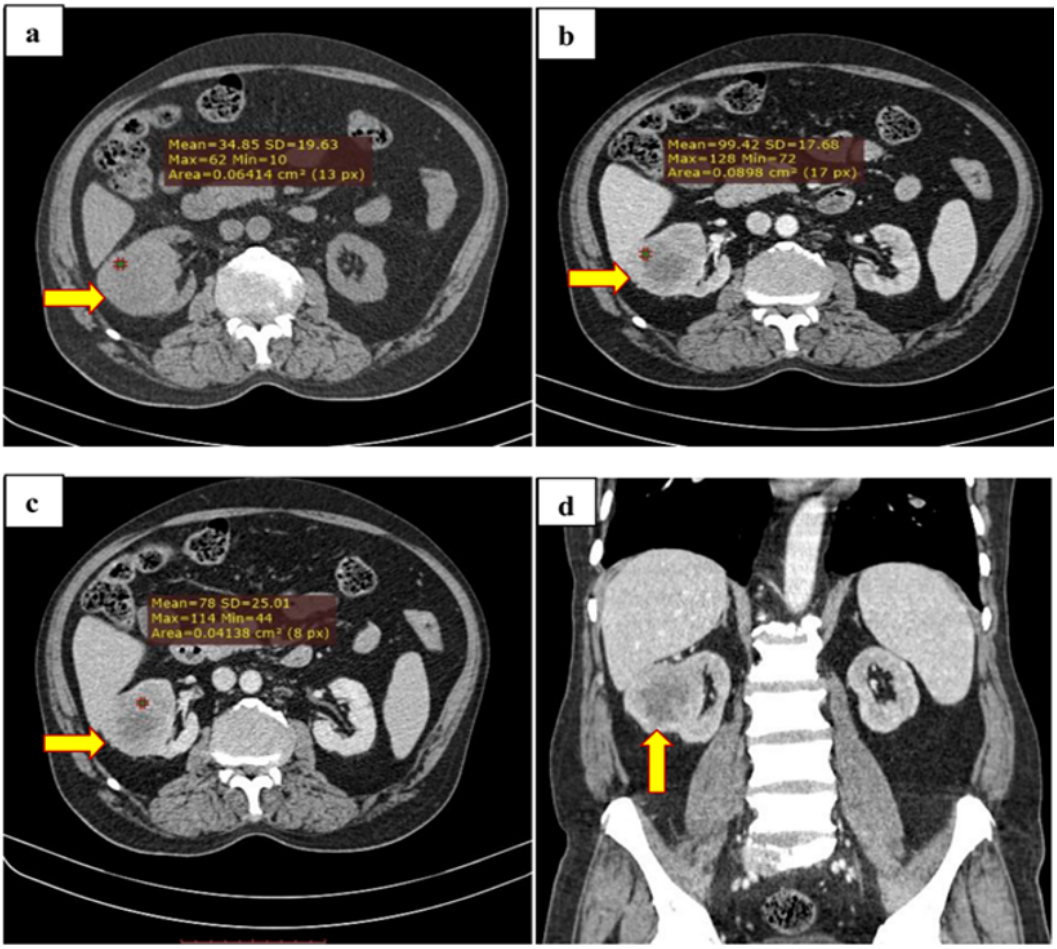


Figure 7: Case of renal cell carcinoma of ball type lesion in middle aged male patient a)Axial unenhanced CT showing iso to hyperdense mass. (b) and (c) CMP & NP showing heterogenous enhancement. (d) Coronal MPR image is helpful in evaluation of contour, location & extent.

Table 8: TNM of Renal Cell Carcinoma in Our Study

T Stage	No	% of T Stage	No of N 1	No of M1
T1a	3	11.53%	0	0
T1b	7	26.92%	0	0
T2a	3	11.53%	0	0
T2b	1	3.84%	0	0
T3a	3	11.53%	1	0
T3b	2	7.69%	0	0
T3c	1	3.84%	1	1
T4	6	23.07%	1	4
Total	26	100%	3	5

olipoma, abscess evaluation with unenhanced and single phase post contrast in Porto-venous phase is sufficient. Presence of macroscopic fat attenuation in the lesion confidently allows to make diagnosis of angiomyolipoma. Presence of Ball or bean type of lesion based on whether it alters the renal contour or not respectively helps to narrow the differential diagnosis. MDCT is the imaging modality of choice for further local extension and staging of renal lesion. Further MDCT provides preoperative renal vascular status viz, renal artery anatomy, accessory arteries, normal variants, renal vein/IVC invasion and for evaluating the hyper enhancing metastasis in corticomedullary phase.

CONCLUSIONS

However, the disadvantages of MDCT is that some benign masses like oncocytoma, lipid poor angiomyolipoma, metastases show solid enhancements similar to Renal cell carcinoma and unable to differentiate form RCC which needs further research and evaluation. However, histopathology still-remains the gold standard for diagnosis of RCC but with advancement in imaging modalities like MDCT evaluation of renal mass helps in further management of patient.

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NIL

Conflict of Interest

I hereby declare that there is no conflict of interest related to this manuscript.

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