ORIGINAL RESEARCH ARTICLE

Assessment of the Masses of the Urinary System with Contrast Enhanced CT

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A B S T R A C T

Introduction: CT is considered the gold standard for the characterization of renal and urothelial tumors. As it is superior to USG and MRI is not easily available, CT is often the first choice of imaging modality for the proper evaluation of a tumor of urinary system. Due to increased use of abdominal imaging there is an increase in the number of small renal incidentaloma in recent decades. Study aimed at Characterization of masses of urinary system using contrast enhanced CT.

Material and methods: This was a prospective study done in the department of Radiodiagnosis, Rohilkhand medical college and hospital, Bareilly over a period of six months from November 2019 to April 2020.

Results: In our study most of the patient with urinary system masses were diagnosed incidentally while USG was being done for some other complaint followed by assessment of patients for hematuria. On MDCT, the lesions and their extent of spread were easily detected in its early phase of disease. Hence, CT has a major role in early detection of mass of urinary system.

Conclusion: MDCT plays an important role in early diagnosis of benign and malignant urinary system masses as well as its location and spread.

Keywords: Renal Masses, Characterization of Renal Masses , Renal Tumor on CT

INTRODUCTION

The diagnosis of urinary system masses has increased in the lastdecades due to widespread use of computed tomography. Masses of urinary system are renal mass, ureteral mass, bladder mass and pediatric renal mass like wilms' tumour. Renal masses are divided into solid, cystic, and complex cystic lesions. Benign tumors account for 15–20% of all solid renal cortical tumors, and renal oncocytoma is the most common solid tumor type**,** known for mimicking RCC on imaging.[4] The second most common benign tumor is an angiomyolipoma.[5] Sometimes it is associated with tuberous sclerosis. Acquired renal cysts have the risk of developing renal carcinoma. Renal cell carcinoma (RCC) accounts for 3% of all adult cancer and 85% of all kidney tumors.[6] RCC is considered to be the malignancy of 6–7th decade of life, however, now a days in India it shows predisposition at a younger age.[7]

Therefore, a solid, enhancing mass must be considered malignant unless proven otherwise. Of the malignant renal tumors, 90% are renal cell carcinomas.[8] Renal carcinoma are sometimes associated with genetic disease like von Hippel Lindau syndrome.[9,10]

Ct is also very helpful in diagnosing ureteric and urinary bladder tumor like renal mass. Benign tumors of the ureter are not commonly seen as malignant ones. They involve the lower third of the ureter, as a rule. Transitional cell neoplasm may occur anywhere along the course of the upper tract collecting system but they most frequently occur in the distal ureter.[11]

About 90% of bladder tumors originate from the urothelium hence are called transitional cell carcinoma. Superficial tumors are mostly papillary and other are high-grade carcinoma in situ.The bladder is by far the most common site of transitional cell carcinomas. These tumors are usually small at diagnosis, grow slowly, and follow a relatively benign course.

Wilms tumor (nephroblastoma) most common renal malignancy in children and the fourth most common childhood cancer.[12,13]

Aim & objectives

- Characterization of masses of urinary system using contrast enhanced CT
- Differentiation of lesions into benign & mailgnant
- Characterization of extent of spread of tumor in malignant lesions

MATERIAL AND METHODS

The study was conducted in the department of Radiodiagnosis,

Rohilkhand medical college and hospital, Bareilly over a period of 6 months from November 2019 to April 2020.A total of 30 patients presenting in the OPD complaining for hematuria, lump in renal fossa or incidentally got diagnosed for renal tumor went for CECT after preliminary investigations were included in the study.

Evaluation modalities for masses

The study was performed on GE Brightspeed multidetector computed tomography and CT guided biopsy were done in all the patients.

CT protocol for urinary system masses

Contrast enhanced scan was followed by non enhanced scan. No oral contrast was given. Images were acquired with 1- to 3-mm collimation, scan time of 10s-12s, and a pitch of1.5: 1 to allow coverage of the area of interest in a single breath hold.

Scans were obtained in the following phases.

Corticomedullary Phase: The corticomedullary phase scans were taken between 25 and 50 seconds after the start of contrast administration.

Nephrographic Phase - The nephrographic phase scans were taken between 80 seconds to 120 seconds after the start of injection.

Excretory Phase - Early excretory scans were taken at 5 min whereas delayed scans were taken at 15 mins.

RESULTS

Out of 30 patients**,** 26 were males (86%) and four were females (14%).

There were 13 patients (43%) diagnosed with renal mass in which only two masses (15%) were confined to the kidney.

10 patients (33%) were diagnosed with bladder mass whereas 07 patients (23%) were diagnosed with ureteric mass. Among renal, bladder and ureteric masses most of them were seen

Extension	Bladder mass 10	Renal mass 13	Ureteric mass 07	Percent
Confined to kidney	-	02	-	6.6%
Parenchymal thinning		02	-	6.6%
Confined to bladder	02			6.6%
VUJ	08			26%
Extending to ureter			05	16.6%
Other organ like spleen , liver, pancreas	01	01	-	6.6%
Metastasis Lungs and liver	04	02	-	23%
B/l adrenal		01	-	(3%)
Vessels involvement	01 (encasing internal iliac vein)		-	3%
Lymph node(para aortic and iliac retro-peritoneal)	04	08	-	40%
Peri nephric space	05	05	-	33%
Peri-vesical space	01 (invade wall of UB extending to left kidney		-	3%

Table-1: Extent of spread of solid/cystic lesion with enhancement in arterial phase on MDCT

Male	Female
26 (86%)	04 (14%)

Table-2: Sex wise distribution of renal mass

Age in years	Benign	Malignant
1-10	1 (3%)	-
11-20	1(3%)	-
21-30	1(3%)	1 (3%)
31-40	-	2 (6%)
41-50	3(9%)	8(26%)
51-60	2(6%)	7(23%)
61-70	-	4(13%)

Table-3: Age wise distribution of renal masses

Benign	Malignant
8 (26%)	22 (73%)

Table-4: Histologically proven differentiation of renal mass:

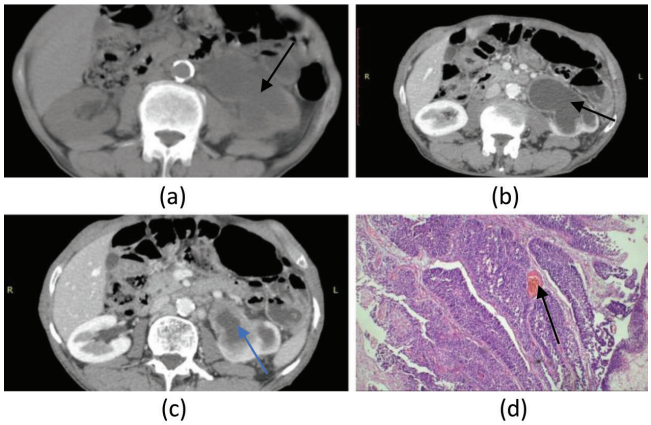

Figure-1: (a) Axial NCCT abdomen shows a polypoidal mass lesion at left PUJ ,(b) on contrast shows enhancement with irregular margins, and marked thinning of the left renal parenchyma.(c)Circumferential enhancing irregular wall thickening in the region of left PUJ causing luminal narrowing , (d)This was a proven case of invasive high grade papillary urothelial carcinoma on hisopathology.

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to extend to vesicoureteric junction. Among overall urinary system masses 08 masses were benign(26%) and 22 masses were (74%) malignant. 12 masses (40%) were involving para-aortic , iliac or retro-peritoneal lymph nodes.11 masses (36%) were seen extending to perivesical and peri-nephric space. 01 mass (3%) was noted extending to liver and spleen while one mass (3%) was extending upto tail of pancreas. A rare scenario was also noted in a mass that was infiltrating bilateral adrenals. Metastasis were seen in lungs and liver in 06 patients (23%). One mass was encasing internal iliac vein while another bladder mass was seen invading wall of UB and extending to left kidney.

We have also noticed gender differences in mass of urinary system as it was male predominant. We also reached to a conclusion that urinary system masses are a disease of late onset. It was mainly found in elderly age group as there were 11 patients (42%) aged more than 50 yrs while 11 patients (35%) were in their fourty decades. In early onset urinary system masses, we also noticed genetic predisposition and association with other disease. There was amass also seen in a neonate presented with distended abdomen and excessive cry and diagnosed as wilms' tumour confirmed with biopsy result.

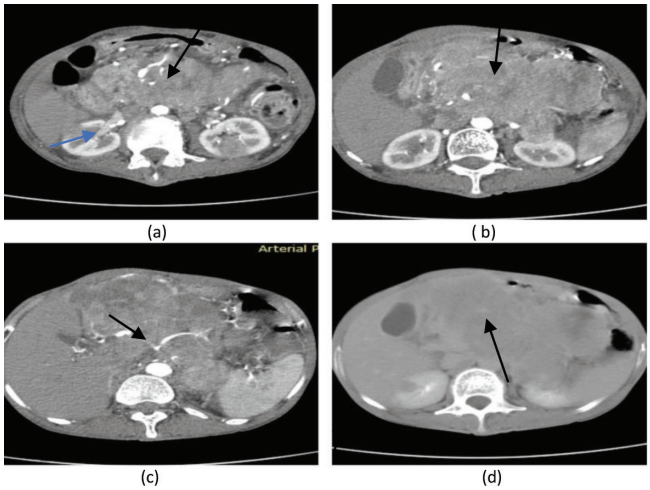

Figure-2: CECT abdomen shows soft tissue attenuation heterogeneously enhancing hyper-vascular mass lesion (6a, long arrow) with washout in delayed phase (d long arrow) is noted involving pancreas (a, b long arrow). Enhancement pattern suggests neuro-endocrine origin. Two soft tissue attenuation enhancing lesion is noted in right and left kidney suggestive of renal cell carcinoma (6a blue arrow). The lesions were encasing the celiac-axis and its branches, SMA, portal vein and splenic vein(c, short arrow). Occlusion of lumen of splenic vein was also seen. This was a case of renal cell carcinoma with neuro-endocrine tumour of pancreas suggesting syndromic association with von-Hippel-Lindau syndrome.

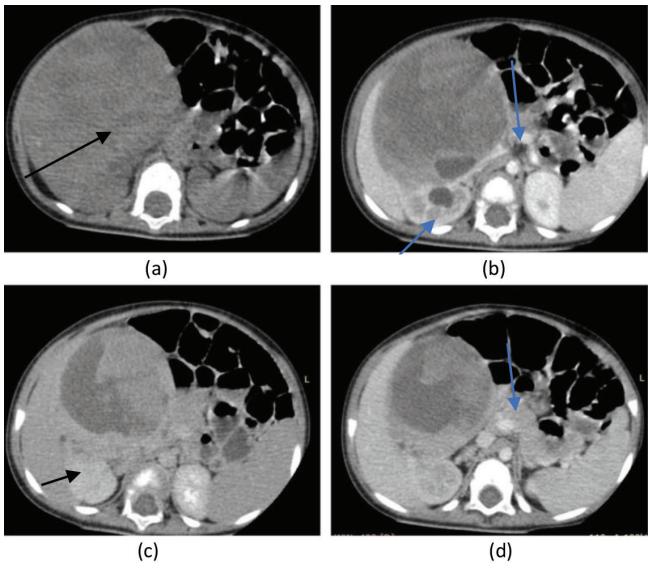

Figure-3: CECT lower abdomen shows large hypodense heterogeneously enhancing mass lesion arising from inter-polar region of right kidney(a). Small central non enhancing area is seen in the mass with small area of fat attenuation (b short arrow). Few small enhancing para-aortic nodes are noted (b long arrow). Mass is seen to abut inferior surface of liver and gall bladder (c, small arrow). Mass is seen to reach up-to midline (d) but does not cross the midline. This was a proven case of wilm's tumour.

DISCUSSION

CT features of different types of urinary tract masses:
imaging parameter of renal masses

These imaging parameters play an important role in differentiation and characterization of renal masses as cystic and solid lesions.

1. Size, shape and contour: Renal masses that have a diameter of <4 cm are defined as small renal masses. The smaller the mass there is less chance of malignancy.[3]
2. Growth rate: Growth rate of small renal masses is typically low (2 to 4 mm per year).
3. Tissue consistency: Renal mass having areas of macroscopic fat within it usually signify of being angiomyolipoma. In rare cases the evidence of calcification in a fat-containing lesion can point a malignant condition.[15,16]

Clear cell RCC

On imaging, clear cell carcinoma is typically highly vascular. The lesion may show necrosis, cystic degeneration, hemorrhage,calcification, and ossification.

Clear cell RCC has a worse prognosis when compared with chromophobe or papillary subtypes.[17,18]

Papillary RCC

On imaging, papillary RCCs are hypovascular .

Seventy-five percent of papillary RCCs are hypovascular, and 90% of all papillary tumours show homogeneous or peripheral enhancement pattern.[19]

Chromophobe RCC – On imaging, these tumors are hypovascular and demonstrate homogeneous enhancement. These lesions mayy show central scar or necrosis. The enhancement characteristics fall in between those of clear cell and papillary RCC.[20] Raman *et al*. in their study showed that the tumor-to-cortex ratios for chromophobe RCCs were 0.59, 0.48, and 0.50 in the corticomedullary, nephrographic, and excretory phases,respectively.[21]

Simple Cyst	No enhancement
Complex Cyst	Septal enhancement
RCC Clear cell	Hyperenhancement, heterogeneous pattern
RCC Papillary	Hypoenhancement , heterogeneous pattern
TCC	Hypoenhancement , heterogeneous pattern
Lymphoma	Hypoenhancement, heterogeneous pattern
Oncocytoma	Hyper/hypoenhancement, heterogeneous pattern

Primary renal lymphoma is rare, and non-Hodgkin's lymphoma is much more common than Hodgkin's.[22] It shows multiple masses that are poorly enhancing or retroperitoneal lymph nodes that directly invades the kidneys.

Angiomyolipomas are hamartomas that contain smooth muscle , varying proportions of fat, and thick-walled blood vessels. Tumours larger than 4 cm have an increased risk of potentially life-threatening haemorrhage (Wunderlich syndrome), which has been reported in up to 10% of these patients. Lipid-containing angiomyolipoma can be easily detected with CT. However, angiomyolipoma may contain very small quantities of fat, which can be overlooked if the mass is not carefully evaluated. When a small amount of fat is suspected in a renal mass, an unenhanced CT examination with thin sections and, if necessary, a pixel analysis, is the most sensitive test. Lipid-poor angiomyolipoma presents a diagnostic dilemma and cannot be differentiated from RCC. Zhang et al[23] described a homogeneous pattern and a moderate enhancement of lipid-poor angiomyolipomas .AML rarely shows calcification.[24]

Bladder transitional cell carcinomas appear as either focal regions of thickening of the bladder wall, or as masses protruding into the bladder lumen, or in advanced cases, extending into adjacent tissues. The masses are of soft tissue attenuation and may show small calcifications. Although CT is unable to distinguish between T1, T2 and T3a (microscopic extravesical spread), CT is able to distinguish T3b tumors (stranding/nodules in perivesical fat) and T4 tumors (direct extension into adjacent structures/loss of normal fat plane). Nodal metastases are common, seen in 30% of T2 tumors and 60% of T3 and T4 tumors .

VHL: Patients may develop some or all of the various lesions which include renal lesions in the form of renal cell carcinomas (RCCs) usually of the clear cell type and frequently bilateral.[25] It can also present with renal cyst that may be single or multiple may be associated with renal angiomyolipoma.

Tuberous sclerosis

The most common radiographic manifestations are cortical or subependymal tubers and white matter abnormalities, renal angiomyolipomas and cardiac rhabdomyoma. Although rates of renal cell carcinoma are the same as in the general population, in patients with tuberous sclerosis, renal cell carcinoma tends to occur at a younger age.[26,27]

CONCLUSION

MDCT plays an important role in early diagnosis of benign and malignant urinary system masses as well as its location and spread. When lesion is greater than 2cm ;tumor detection rate of CT is as comparable as MR. The technical advancements in CT and MRI in the last decade provided an excellent detection rate of renal masses. Contrast-enhanced CT allow differentiation between cystic and solid renal lesions. Complex cystic and solid lesions can be characterised further on CT and MRI. Percutaneous biopsy should be done before starting treatment and it significantly decreases the number of unnecessary surgeries for benign disease and help the urologist in clinical decision-making and proper management especially in elderly who are unfit and possible candidates for active surveillance and/or minimally invasive ablative therapies.

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