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Role of ultrasound and CT scan in evaluation of Renal Masses

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Abstract

Background: *The term renal "mass" includes a large variant of expansile entities which are aggregates of non functioning renal parenchyma. The non neoplastic renal masses can be grouped as renal cystic disease, inflammatory masses, vascular masses, angiomyolipomas and others. The neoplastic masses can be either benign which includes adenoma, hemangiomaetc or malignant like renal cell carcinoma, renal pelvic carcinoma and Wilm's tumour.[1]*

The ultrasonography (US) and computed tomography (CT) in diagnostic imaging, the accuracy in renal mass detection has approached close to 100%.CT is to be superior to intravenous urography, ultrasonography and angiography for detection of renal and retroperitoneal details and in staging of renal neoplasms.[02] On the other hand, ultrasound combined with cyst aspiration has an important role to play in these cyst-like renal masses which are indeterminate on CT.[03]

Materials and Methods: *The study had been carried out in the Department of Radiodiagnosis, Rajiv Gandhi Cancer Institute and Research Centre in the period March 2012 to July 2013.*

A total number of fifty (50) patients with suspected renal mass were studied, irrespective of age and sex. In all the patients taken up for the study, a detailed clinical history was taken with emphasis on duration of symptoms and specific complaints like fever, pain abdomen and hematuria. The patients were examined for any palpable lump abdomen. Routine and other relevant laboratory investigations were done e.g. Blood Urea, Serum Creatinine, Urine routine, microscopic examination, Culture and for malignant cells.

All patients with renal symptoms like hematuria, flank pain, clinically palpable renal lump or with renal mass in ultrasound, CT fulfilling the specified inclusion and exclusion criteria from March 2012 to May 2013 were enrolled into this study.

Inclusion Criteria: *Patients with renal lesion on USG, CT and on other imaging modalities.*

Exclusion Criteria:

a. *Pregnant females*
b. *History of contrast hypersensitivity.*
c. *Impaired renal functions.*
d. *Bosniak category I cysts*

Results: *Out of 50 cases, eight were diagnosed radiologically & HPE was not required. 42 cases underwent HPE, out of these 37 cases were correctly diagnosed radiologically as malignant & remaining five cases were either misdiagnosed or radiologically diagnosed as indeterminate masses. Radiological*

correlation with HPE was done to see the nature of the lesion (Benign versus Malignant).In our study out of 50 cases, 10 cases were Benign & 40 were Malignant. Ten Benign cases include Oncocytoma (1), Abcess (1), APKD (3), Parapelvic cyst (1), Angiomyolipoma (1), Psuedo tumour (2) and Bosniak type (II) cyst (1). Eight (8) cases were correctly diagnosed radilogically as Benign and HPE was not carried out whereas two cases who were underwent HPE were proved to be Oncocytoma & abcess. Out of the 10 cases, one case was falsenegatively diagnosed as RCC which proved to be Oncocytoma on HPE. In our study specificity was found to be 90% (Table no. 20).%In our study 37 cases were diagnosed radiologically as malignant lesions out 40 malignant cases, sensitivity of imaging was formed to be 94.8.

Statistical Analysis: *Statistical testing was conducted with the statistical package for the Social Science System Version SPSS 17.0. Nominal categorical data between the groups were compared using Chi-squared test or Fisher's exact test as appropriate*

Conclusion: *Ultrasound remains the modality of choice for initial screening in cases of Adult Polycystic Kidney disease, Parapelvic cyst. CT is indicated only when an associated renal complication such as intra cyst haemorrhage, infection or tumour is suspected. Ultrasound has a definite role in determining the nature of renal cell carcinomas.*

US is equally sensitive to CT in detecting venous invasion into renal vein or inferior venacava, in cases of renal cell carcinoma.

Keyword: *Renal masses, Ultrasonography, CT scan.*

Introduction

By definition, the term renal "mass" includes a large variant of expansile entities which are aggregates of non functioning renal parenchyma. The non neoplastic renal masses can be grouped as renal cystic disease, inflammatory masses, vascular masses, angiomyolipomas and others. The neoplastic masses can be either benign which includes adenoma, hemangiomaetc or malignant like renal cell carcinoma, renal pelvic carcinoma and Wilm's tumour.[1]

The ultrasonography (US) and computed tomography (CT) in diagnostic imaging, the accuracy in renal mass detection has approached close to 100%.[1] CT is to be superior to intravenous urography, ultrasonography and angiography for detection of renal and retroperitoneal details and in staging of renal neoplasms.[02] On the other hand, ultrasound combined with cyst aspiration has an important role to play in these cyst-like renal masses which are indeterminate on CT.[03]

The incidence of benign histology is higher in young women as well as in older patients.[4,5] Tumors less than 3 cm may be more likely to be benign [4,6] and the aggressive potential of RCC increases dramatically beyond this size.[7] Magnetic resonance imaging (MRI) may be reserved for the clinical settings of locally advanced malignancy, possible venous involvement, renal insufficiency or allergy to intravenous contrast. Ultrasound can identify three categories of mass lesions: cystic, indeterminate and solid. It has a number of convincing advantages: Firstly, it can differentiate cystic from solid masses with a high degree of accuracy. Secondly, it requires neither ionizing radiation nor intravenous contrast media so it is particularly useful for children, pregnant women and those who have impaired renal function or sensitivity to iodinated contrast. Thirdly, it is the most economical and easily available modality.[8,9]CT have a role not only in evaluation of cases in which urographic results are questionable or positive but also in confirmation of apparently negative urographic or US findings when clinical suspicion of a lesion is high.[10]

CT has proved to be an extremely accurate method of differentiating a renal cyst from a neoplasm based on (a) attenuation value of the mass and whether it increased on giving intravenous contrast (b) demarcation of the mass from the normal renal parenchyma and (c) the thickness of the wall of the mass.[11] CT had become an essential imaging tool for the evaluation of the kidney and perirenal space as

well. The use of intravenous contrast material simplified the detection and evaluation of renal masses and was essential for the staging of the renal carcinomas.[12]

Bosniak (1986)[13] proposed a useful classification of cysts and cystic renal masses in an attempt to define precisely the radiological findings for lesions not requiring further evaluation and for those that should be explored surgically, he proposed the following CT criteria for a benign hypodense cyst.

1) The lesion must be perfectly smooth, round, sharply marginated and homogenous.
2) The lesion must not enhance on IV contrast administration and its configuration must remain unchanged.
3) The lesion must be 3cm or less in size.

Aims and Objectives

1. To study the role of ultrasound and computed tomography in defining the nature and extent of renal masses.
2. To correlate radiological findings of the lesions with surgical/pathological diagnosis.

Material & Methods

The study had been carried out in the Department of Radiodiagnosis, Rajiv Gandhi Cancer Institute and Research Centre in the period March 2012 to july 2013.

A total number of fifty (50) patients with suspected renal mass were studied, irrespective of age and sex. In all the patients taken up for the study, a detailed clinical history was taken with emphasis on duration of symptoms and specific complaints like fever, pain abdomen and hematuria. The patients were examined for any palpable lump abdomen. Routine and other relevant laboratory investigations were done e.g. Blood Urea, Serum Creatinine, Urine routine, microscopic examination, Culture and for malignant cells.

All patients with renal symptoms like hematuria, flank pain, clinically palpable renal lump or with renal mass in ultrasound, CT fulfilling the specified inclusion and exclusion criteria from March 2012 to May 2013 were enrolled into this study**.**

Inclusion criteria: Patients with renal lesion on USG, CT and on other imaging modalities.

Exclusion Criteria

e. Pregnant females
f. History of contrast hypersensitivity.
g. Impaired renal functions.
h. Bosniak category I cysts

Scanning Protocol

Equipment

1. Combined PET – CT in-line system (Siemens Biograph 40) integrates a PET scanner (Lutetium Oxyorthosilicate (LSO) scintillator) with a 40 slice helical CT scanner. Dedicated CT scanner Somatom Emotion Duo (Siemens).
2. Ultrasonography was done on Philips Supersonic HD-11 XE and Sonocite Micromax portable.

Patient preparation

Patient preparation for USG: US scan of patient would be acquired on full urinary bladder.

1. Patient preparation for CECT: CT scan of patient would be acquired after 6 hour fasting and patient will be given plain water as oral negative contrast approximately 1000 ml for 1½ at interval of 15-20 minutes.

Procedure

1. **Ultrasonography**

Ultrasonographic examination of right kidney - the patient was examined in supine position using liver as acoustic window. The transducer was placed along the lateral abdominal wall and scans were obtained in both longitudinal and transverse orientation. Depending upon the position of right kidney and the amount of intestinal gas present, it was often necessary to examine right kidney in left lateral decubitus position. In this position, the

renal vein is best seen in a transverse plane by locating the hilum of the kidney and connecting the renal vein to the inferior venacava.

Ultrasonographic examination of left kidney - is more difficult because of overlying gas in the stomach and splenic flexure, thereby obscuring the anterior or anterolateral approach. Also, there is a lack of an acoustic window as the normal sized spleen will not serve the function that the liver serves on right side. The right lateral decubitus is the best position with the transducer on the lateral abdominal wall. Long axis of the kidney was examined moving the plane of section both anteriorly and posteriorly to sweep the entire kidney. The plane of section was also moved superiorly and inferiorly to see the upper and lower poles. The fluid filled stomach serves as an acoustic window to image upper pole of kidney and left renal vein with patient in erect or semi erect position.

Prone position was also utilized to evaluate cortical abnormalities which are posteriorly located e.g. complex cysts or neoplasms.

2. C**omputed tomography**

Procedure: CT is performed with the patient in supine position. For proper positioning, a computed radiograph (scanogram or scout view) is made in order to localize the ideal scan level and to help in repositioning. Continuous 10mm slices were taken. Pre contrast scans were obtained to detect any parenchymal calcification or renal/ Perirenal hemorrhage. 500ml water is given orally 1 hr prior to the examination. At the time of scan, 70-100 ml intravenous injection of non-ionic contrast is given at the rate of 3 ml\sec. Main indications for intravenous use of contrast is to differentiate normal from anomalous vascular structures, to define pathologic vessels, to estimate the vascularity of a mass and to detect thrombus in a vein.

Statistical Analysis

Statistical testing was conducted with the statistical package for the Social Science System Version SPSS 17.0. Nominal categorical data between the groups were compared using Chi-squared test or Fisher's exact test as appropriate.

Observations and Results

Fifty (50) patients with suspected renal masses were studied and evaluated radiologically by ultrasonography and computed tomography. Role of US & CT was studied in defining the nature and extent of the lesions. The radiological findings were correlated with histopathological diagnosis.

Table 1: Type of Renal Masses Studied

Type Of Lesions	No. Of Cases	Percentage
Neoplastic		
Renal cell carcinoma	24	48
Wilm's tumour	12	24
Transitional Cell Carcinoma	1	2
Squamous cell carcinoma	2	4
Lymphoma	1	2
Angiomyolipoma	1	2
Oncocytoma	1	2
Bosniak type II cyst	1	2
Non neoplastic		
Parapelvic cyst	1	2
Adult polycystic kidney disease	3	6
Renal Abscess	1	2
Pseudo tumour	2	4
Total	**50**	**100**

Simple cortical cysts (Bosniak type I), the commonest renal masses have been excluded from the study.80% of cases studied were malignant renal neoplasms. The majority of cases were those of renal cell carcinoma (48%).

Table 2: Demographic profile of studied subjects

Residency	Numbers	Percentage
Rural	34	68
Urban	16	32
Total	50	100

34 (68%) patients in our study were from rural background & 16 (32 %) were from urban dwelling.

Table 3: Age Group Distribution of Patients

Age (Years)	**Patient**	**Percentage**
0 - 10	12	24
11 – 20	0	0
21 – 30	0	0
31 – 40	2	4
41 – 50	9	18
51 – 60	16	32
61 – 70	5	10
71 – 80	6	12
Total	50	100
Mean ± SD	43.73 ± 25.34	

The youngest patient in our study was a 6 months old child and the oldest was an 80 year old woman. This wide range had two peaks – one in the age group 0-10 years and the other in the age group of 41 – 60 years.

Table -4: Age Wise Distribution of Lesions

Type of lesion	0-10	11-20	21-30	31-40	41-50	51-60	61-70	71-80
Adult polycystic kidney disease(3)	0	0	0	1	2	0	0	0
Parapelvic cyst (1)	0	0	0	0	0	0	0	1
Renal cell carcinoma (24)	0	0	0	1	5	12	2	4
Wilm's tumour (12)	12		0	0	0	0	0	0
Squamous cell carcinoma(2)	0	0	0	0	1	0	1	0
Transitional cell carcinoma(1)	0	0	0	0	0	0	0	**1**
Lymphoma(1)	0	0	0	0	0	**1**	0	0
Angiomyolipoma(1)	0	0	0	0	0	0	**1**	0
Oncocytoma(1)	0	0	0	0	0	**1**	0	0
Renal abscess(1)	0	0	0	0	**1**	0	0	0
Bosniak type II cyst(1)	0	0	0	0	0	**1**	0	0
Pseudotumor (2)	0	0	0	0	1	1	0	0
Total (50)	**12**	**0**	**0**	**2**	**10**	**16**	**4**	**6**

All the patients of adult polycystic kidney disease presented between 30 and 50 years of age.

75% of renal cell carcinomas were seen in patients above the age of 50 years.

100% of Wilm's tumour cases were below 5 years of age.

Table 5: Sex Distribution of Patients

TYPE	MALE	FEMALE	TOTAL
Adult polycystic kidney disease	2	1	3
Parapelvic cyst	1	0	1
Renal cell carcinoma	14	10	24
Wilm's tumour	8	4	12
Squamous cell carcinoma	2	0	2
]==Transitional cell carcinoma	1	0	1
Lymphoma	1	0	1
Angiomyolipoma	1	0	1
Oncocytoma		1	1
Renal abscess	1	0	1
Bosniak type II cyst	1	0	1
Pseudo tumour	1	1	2
TOTAL	**33**	**17**	**50**

There was a male preponderance in each group, except in case of oncocytoma where the only one female patient was diagnosed.

Table: 6 Signs and Symptoms in Patients With Renal Masses

TYPE of Renal mass	Pain Abdomen	Hematuria	Fever	Weight Loss	Hypertension	Palpable Lump
Adult polycystic kidney disease(3)	3	2	0	0	2	2
Parapelvic cyst (1)	1	0	0	0	0	0
Renal cell carcinoma(24)	22	14	6	24	6	22
Wilm's tumour(12)	4	2	10	4	0	12
Squamous cell carcinoma(2)	2	0	0	2	0	2
Transitional Cell Carcinoma(1)	1	1	0	1	0	1
Lymphoma(1)	1	0	0	1	0	1
Angiomyolipoma(1)	Asymptomatic	Incidental finding				
Oncocytoma(1)	1	0	0	0	0	1
Renal abscess(1)	1	0	1	0	0	0
Bosniak type IV cyst(1)	Asymptomatic	Incidental finding				
Pseudo tumour(1)	Asymptomatic	Incidental finding				

Table shows sign and symptoms associated with different types of renal masses.

Table 7: Ultrasound in Renal Masses (Side, Site and Size of Lesions)

Renal mass	Side			Site			Size (cms)		
	Rt.	Lt.	Bilat.	Upp.	Low.	Whole	<4	4 – 7	>7
Adult polycystic kidney disease (3)	0	0	3	0	0	3	0	0	0
Parapelvic cyst (1)	0	1	0	0 *	0	0	0	1	
Renal Cell carcinoma (24)	18	6	0	10	6	8	0	7	17
Wilm's tumour(12)	4	8	0	2	2	8	0	0	12
Squamous cell carcinoma(2)	2	0	0	0	0	2	0	0	1
Transitional Cell Carcinoma(1)	1	0	0	0	1	0	0	0	1
Lymphoma(1)	1	0	0	0	0	1	0	0	1
Angiomyolipoma (1)	0	1	0	0	1	0	0	1	
Oncocytoma(1)	1	0	0	0	1	0	0	0	1
Renal abscess(1)	1	0	0	1	0	0	0	0	1
Bosniak type II cyst(1)	0	1	0	1	0	0	1	0	0
Pseudotumor (2)	0	2	0	1	1	0	0	0	0
TOTAL(50)=	**28 + 19 + 3**								

Rt. – Right kidney, Lt. – Left kidney, Bilat. – Bilateral, Upp. – Upper pole, Low. – Lower pole. * Cyst arising from renal hilum

56% of renal masses were seen in right kidney, 38% were in left kidney, 6% were bilateral (Adult Polycystic Kidney disease).Majority of renal cell carcinoma 70.8% (17/24), were more than 7 cms in size. While in Wilm's 100% (12/12) tumours were more than 7 cms in size.

Table 8: Ultrasonographic Characteristics of Renal Masses

Renal mass	Solid	Cystic	Mixed/heterogenous	Calculi/calcification
Adult polycystic kidney disease (3)	0	3	0	0
Parapelvic cyst (1)	0	1	0	0
Renal Cell carcinoma (24)	9	1	14	10
Wilm's tumour(12)	10	0	2	0
Squamous cell carcinoma(2)	0	0	2	2
Transitional Cell Carcinoma (1)	0	0	1	0
Lymphoma (1)	1	0	0	0
Angiomyolipoma (1)	1	0	0	0
Oncocytoma (1)	1	0	0	0
Renal abscess (1)	0	0	1	0
Bosniak type II cyst (1)	0	0	1	0
Pseudotumor (2)	2	0	0	0

58.8% (14/24) of renal cell carcinomas, two of Wilm's tumour, transitional cell carcinoma and both squamous cell carcinoma appeared heterogenous on US. One renal cell carcinoma appeared as a well defined cystic mass with internal echoes and calculus. 83.3% (10/12) of Wilm's tumour appeared predominantly solid. Calculi / Calcification were seen in 41.6% (10/24) cases of renal cell carcinoma. Calculi were seen in both the cases of squamous cell carcinoma.

Table 9: Ultrasonographic Findings – Tumour Extent

Renal mass	Venous invasion		Lymph nodes		Distant metastases
	Renal vein	IVC	Regional	Distant	
Renal Cell carcinoma (24)	3	3	2	0	2 (liver)
Wilm's tumour (12)	0	0	0	0	2 (liver)
Squamous cell carcinoma (2)	0	0	0	0	0
Transitional Cell Carcinoma	0	0	0	0	0
Lymphoma	0	0	0	0	0
Angiomyolipoma	0	0	0	0	0
Oncocytoma	0	0	0	0	0

US detected inferior venacaval and renal vein invasion in 3 cases of renal cell carcinoma. Echocardiography and MRI, in one of patient showed extension of IVC thrombus into the right atrium. Large ipsilateral paraaortic lymph nodes were detected by US in two case of renal cell carcinoma. US detected liver metastases in two patients each of Wilm's tumour and renal cell carcinoma.

Table 10: CT Characteristics of Renal Masses

Characteristics	APKD (03)	PC (01)	RCC (24)	Wilm's (12)	SCC (02)	ONC (1)	TCC (01)	AML (01)	LYMP (01)	RA (01)	BS II (01)
SIZE											
Less than 4cm	0	0	0	0	0	0	0	0	0	0	01
4-7 cms	0	1	07	0	0	0	0	01	0	01	0
More than 7cms	3 (Kidney Size)	0	17	12	01	01	01	0	01	0	0
DENSITY											
Predominantly solid	0	0	06	06	0	01	0	01	01	0	0
Predominantly cystic	3	1	03*	0	0		01	0	0	01	01
Solid with necrosis	0	0	15	06	2	0	0	0	0	0	0
TEXTURE											
Homogenous	0	1	04	06	0	0	0		0	0	0
Non Homogenous	3	0	20	06	2	01	01	01	01	01	01
MARGINS											
Smooth	0	1	08	06	0	01	0	01	0	01	01
Irregular	3 (lobulated)	0	16	06	2		01		01	0	0

APKD – Adult polycystic kidney disease, PC – Parapelvic Cyst, RCC – Renal cell carcinoma, SCC – Squamous cell carcinoma. TCC – transitional cell carcinoma, AML – angiomyolipoma, ONC – oncocytoma, LYMP – lymphoma, RA – Renal abscess, BS II – Bosniak type II cyst.

*One of the cystic renal cell carcinoma appeared as a solid nodule in a simple cyst, while it had appeared as a mass of mixed echotexture on US.

62.5% (15/24) of renal cell carcinoma, 50% (6/12), Wilm's tumour and both squamous cell carcinoma appeared as solid masses with areas of necrosis on CT.

Table 11: CT Findings – Contrast Enhancement in Renal Masses

Renal mass	Contrast enhancement			
	Homogenous	Nonhomogenous	Peripheral	Absent
Adult polycystic kidney disease (3)	0	0	0	3*
Parapelvic cyst (1)	0	0	0	1
Renal Cell carcinoma (24)	1**	23	0	0
Wilm's tumour(12)	6	6	0	0
Squamous cell carcinoma (2)	0	2	0	0
Transitional Cell Carcinoma(1)	0	1	0	0
Lymphoma(1)	0	1	0	0
Angiomyolipoma(1)	0	1	0	0
Oncocytoma(1)	0	1	0	0
Renal abscess(1)	0	1	0	0
Bosniak type II cyst(1)	0	1	0	0
Pseudo tumour(2)	2	0	0	0

*The cysts in adult polycystic kidney disease did not enhance on Contrast CT.

**There was moderate homogenous enhancement of a solid nodule in a simple cyst. The cyst did not enhance on Contrast CT.

95.8% (23/24) of renal cell carcinomas showed non homogenous contrast enhancement. 50% (6/12) of Wilm's tumour showed homogenous enhancement.

Table 12: CT Findings – Tumour Extent

Extent	Lymphoma	Renal cell carcinoma	Wilm's tumour	Squamous cell carcinoma	TCC	AML	Oncocytoma
tumour confined to renal capsule	01	10	06	0	1	01	01
Perinephric extension	0	14	06	2	0	0	0
Renal vein involvement	0	3	0	0	0	0	0
Inferior venacaval invasion	0	3	0	0	0	0	0
Regional lymph nodes	0	4	0	0	0	0	0
Direct invasion through Gerota's fascia into adj. structures	0	2	0	0	0	0	0
Distant metastases	0	4 (2 liver, 2 lung)	2 (liver, lung)	0	0	0	0
Distant lymph nodes	Multiple nodes in abdomen and chest	0	0	0	0	0	0
Bilateral tumours	0	0	0	0	0	0	0

66.6% (16/24) tumour of renal cell carcinoma showed perinephric extension on CT, while 33.3% (8/24) tumours were confined to the renal capsule. In 16.6% (4/24) tumours, direct invasion through Gerota's fascia was observed. 50% (6/12) Wilm's tumours were confined to renal capsule.

CT detected IVC and renal vein invasion by the tumours which were also detected by USG in three cases of renal cell carcinoma. CT detected regional lymph node enlargement (ipsilateral paraaortic and retroperitoneal group) in four cases. Metastases to liver in two case of renal cell carcinoma and two cases of Wilm's tumour were detected on CT. Chest CT detected metastasis to lung in one case of renal cell carcinoma.

Table 13: TNM CT Staging in Renal Cell Carcinoma

Stage	No. Of Cases On CT Staging	No. Of Cases On Surgical Staging
I	08	10
II	12	10
III	0	0
IV	4	NOT OPERATED
	24	20

Total number of cases surgically explored – 20/24. Four patients had advanced disease with distant metastases to liver and lungs and therefore were not subjected to surgery.

In one case, the tumour confined to renal capsule was misinterpreted as stage II on CT, where the size of the tumour was quite large.

Accuracy of CT in staging of renal cell carcinoma in the present study was 90%.

Table No. 14: Comparison between Ultrasound & Computed Tomography (Renal Mass Characteristics)

Renal Mass	Ultrasound				Computed Tomography				
	Solid	Cystic	Mixed	Calcif. /Calculus	Pred. Solid	Pred. Cystic	Solid with necrotic areas	calc ulus	Calcif.
Adult polycystic kidney disease (3)	0	3	0	0	0	3	0	0	0
Parapelvic cyst (1)	0	1	0	0	0	1	0	0	0
Renal cell carcinoma (24)	9	1	14*	10	6	3*	15	4	3
Wilm's tumour12	10	0	2	0	6	0	6	0	1**
Squamous cell carcinoma (2)	0	0	2	2	0	0	2	2	0
Transitional Cell Carcinoma(1)	0	0	1	0	0	1	0	0	0

Lymphoma(1)	1	0	0	0	1	0	0	0	0
Angiomyolipoma(1)	1	0	0	0	1	0	0	0	0
Oncocytoma(1)	1	0	0	0	1	0	0	0	0
Renal abscess(1)	0	0	1	0	0	1	0	0	0
Bosniak type II cyst(1)	0	1	0	0	0	1	0	0	0
Pseudo tumour(2)	2				Normal	Renal	tissue		

Calcif. – Calcification, Pred. – Predominantly

* One case of renal cell carcinoma appeared as a mass of mixed echotexture on US, while on CT a solid nodule was seen inside a simple renal cyst.

**CT detected small, anterior, curvilinear calcification in one case of Wilm's tumour which was not seen on US.

Table 15: Comparison between US and CT Evaluation of Tumour Extent

R – Regional, D – Distant, RV – Renal vein, DI – Direct invasion adjacent structures, DM – Distant metastases, MN – Multiple

Renal Mass	**Ultrasound**						**Computed tomography**					
	Venous invasion		Lymph nodes		DM	Perinephric Extension	Venous Invasion		Lymph nodes		DI	DM
	RV	IVC	R	D			RV	IVC	R	D		
RCC (24)	3	3	2	0	2	8	3	3	4*	0	2	4**
Wilm's (6)	0	0	0	0	2	6	0	0	0	0	0	2
SCC (2)	0	0	0	0	0	2	0	0	0	0	0	0
Transitional Cell Carcinoma(1)	0	0	0	0	0	0	0	0	0	0	0	0
Lymphoma	0	0	0	0	0	0	0	0	MN	0	0	0
Angiomyolipoma(1)	0	0	0	0	0	0	0	0	0	0	0	0
Oncocytoma(1)	0	0	0	0	0	0	0	0	0	0	0	0
Parapelvic cyst(1)	0	0	0	0	0	0	0	0	0	0	0	0
Renal abscess(1)	0	0	0	0	0	0	0	0	0	0	0	0
Bosniak type II cyst(1)	0	0	0	0	0	0	0	0	0	0	0	0
Pseudo tumour(2)	0	0	0	0	0	0	0	0	0	0	0	0

retroperitoneal lymph nodes.

*CT detected retroperitoneal lymph node involvement in two case of RCC which were not detected by US. CT detected perinephric extension and direct invasion through Gerota's fascia in renal cell carcinoma, which could not be appreciated on US. ** Chest CT detected metastasis to lung in one case of RCC.

Table 16: Fine Needle Aspiration Cytology (FNAC) In Renal Masses

Final diagnosis	US guided FNAC (No. of patients)	Tissue conclusive	Diagnosis inconclusive
Renal cell carcinoma (24)	4	3	1
Wilm's tumour (12)	2	1	1
Squamous cell carcinoma(2)	2	1	1
Transitional Cell Carcinoma(1)	1	0	1
Lymphoma(1)	1	1	0

FNAC was done in those patients in whom a definite radiological diagnosis could not be established.

U.S/CT guided FNAC was done in 10/50 (20%) such indeterminate masses, in the present study. Tissue diagnosis was conclusive in 6/10 (60%) of cases.

Table 17: Correlation between Radiological, FNAC and Histopathological Diagnosis
(In 10 cases in which US guided FNAC was done).

Radiological Indeterminate diagnosis	FNAC diagnosis	Histopathological diagnosis
1. Neuroblastoma	Wilm's tumour	Wilm's tumour
2. Indeterminate cystic mass	Malignant cells	Unilocular cystic renal cell carcinoma
3. Pyonephrosis with stag horn calculus	Well differentiated squamous cell carcinoma	Squamous cell carcinoma.
4. Pyonephrosis with calculi	Inconclusive	Squamous cell carcinoma
5. Cystic renal * Cancer	Inconclusive	Cystic renal cell carcinoma (tumour nodule in a simple cyst)
6.Renal lymphoma	NHL	NHL
7Renal mass	RCC	RCC-clear cell carcinoma
8 cystic renal carcinoma	Inconclusive	TCC
9 Renal malignancy	Inconclusive	Wilm's tumour
10 Renal malignancy	RCC	RCC-clear cell carcinoma

FNAC was conclusive in 6/10 (60%) cases. In 4 cases, FNAC was inconclusive and diagnosis was established only after post operative histopathology.

Table 19

Sensitivity: True Positive / True Positive + False Negative = 37/37+2= 94.8%.
Specificity: True Negative / True Negative + False Positive = 9/9+1=90.0%

TP – All those cases which were diagnosed as Malignant Radiologically where Malignant .
TN – All those cases which were Benign.
FP – All those cases which were Benign but were diagnosed as Malignant Radiologically.
FN – All cases which were Malignant but were diagnosed Benign radiologically.

Discussion

In the present study, 50 cases of renal masses were investigated radiologically using modalities, ultrasonography and computed tomography. The patients selected were either symptomatic having renal symptoms or having symptoms unrelated to urinary tract but a renal mass was detected incidentally on investigation. An US/CT guided Fine Needle Aspiration Cytology (FNAC) was performed in cases where a definite radiological diagnosis could not be made.

This study was an attempt to understand and know the role of US and CT in renal masses. Here, we will be discussing each pathological entity separately.

Adult Polycystic Kidney disease

It is the most prevalent hereditary renal disorder, adult polycystic kidney disease (APKD) is seen in one individual per thousand. We encountered 3 cases (6%) of APKD in our study of 50 renal masses. However, we had excluded simple renal cyst from the study. All the patients were between 30 & 50 years of age. Similiar age relation has also been observed by other workers like Bosniak & Ambos[13], Madewellet al[14].

According to Madewellet al[14] and Goldman and Hartman[15]there is no sex predilection in APKD. Whereas in our study the M: F ratio was 2: 1. 66.6% (2/3) patients were hypertensive at the time of presentation, while one patient was normotensive. The incidence of hypertension in APKD has been observed to be 71% by Brash and Schacht[16].

US can detect associated cysts in liver (33%), pancreas (10%) and rarely in spleen Madewell et al[14]. One of our three cases showed associated cysts in pancreas on US.

On CT in all 3 patients, the kidneys were enlarged with lobulated contours, with distortion of collecting system and replacement of renal parenchyma by multiple cysts of varying sizes. Love et al[17], Dunnick & Reed[18], Lipuma[19] observed similar findings on CT in cases of

APKD. Acute haemorrhage into a few cysts was seen in one patient (33.3%), as hyperdense cysts on unenhanced CT scan. These high density cysts are common and reported to be 75% of APKD patients, by Levine & Grantham[20].

Parapelvic Cyst

We came across only one parapelvic cyst (2%) during our period of study. This finding had been made by Jordon[21] and lately by Amis [22] who stated that most renal sinus cysts occur in fifth or sixth decades and are detected as an incidental radiographic finding. On CT, the parapelvic cyst had an attenuation value of 11 on pre contrast scan. This observation has been made by other workers like Hidalgo et al [23] and Lipuma[19].

Renal Cell Carcinoma

In the present series, 24 cases were studied. The age range of patients was between 36 years to 80 years, with 50% of the cases seen in the age group of 51 to 60 yrs. This age relation has also been observed by Subramanayam & Bosniak[24]. According to them, renal cell carcinoma occurs in people over 40 yrs of age and is most common in their fifties and sixties.

The above workers found that in all cases of renal cell carcinoma, haematuria is seen in 56%, pain abdomen in 18%, a flank mass in 36% and weight loss seen in 27% of patients. While in our study, 58.3% patients had painless haematuria, 91.6% complained of pain abdomen and a palpable lump was seen in 91.6% and all patients complained of weight loss.

The classical triad of renal cell carcinoma is flank pain, gross haematuria and a palpable lump. It is seen in 4-9% of patients at presentation Skinner et al [25] with metastases in 47% of these patients. This classical triad was seen in 50% of patients in the present study of which 33.3% had advanced disease with distant metastases.

According to Charbonneau et al [26] the majority of renal cell carcinomas are primarily solid masses and about 40% may show cystic areas representing necrosis and haemorrhage, where as in our study, 58.3% of tumours showed necrosis.

In our study, all the nine solid renal cell carcinomas appeared predominantly isoechoic on US as compared with renal cortex. This was in accordance with Coleman et al[27] findings who observed that about 86% of renal cell carcinomas are isoechoic.

In the present study, 8.3% tumours were diagnosed as cystic renal carcinomas, of which only one appeared cystic on US. According to Pollack et al[28] about 5% of renal cell carcinomas are cystic.

In our study US in one case detected the direct extension of IVC thrombus into the right atria on echocardiography and on MRI. This extension of tumour into the right atrium and also right ventricle and pulmonary artery has been reported by Schechter & Vogel.[29]

US detected a large ipsilateral paraaortic lymph node in two cases of left sided renal cell carcinoma. However, it could not detect retroperitoneal lymph nodes in another two case, which were detected by CT. Levine et al[20] also found this limitation of US, they stated that intestinal gas often obscures the central retroperitoneum, making it difficult to evaluate tumour extension to the retroperitoneal lymph nodes, ipsilateral renal vein or infrahepatic segment of IVC in 50% of patients.

US detected liver metastasis in two case (8.3%). Bennington & Beckwith[30] the incidence of liver metastasis in RCC is reported to be 33%.

In our two cases of cystic renal cell carcinomas, one tumour appeared as a large, well defined unilocular cystic mass with calculus on precontrast CT. The precontrast value, of the mass was 25 H. U. After injection of contrast, there was slight enhancement of the wall with interspersed enhancing areas inside the mass. The mass being quite well defined, cystic but with CT value more than 20 H., definite diagnosis could not be arrived at and an US guided FNAC was performed. Balfe et al[32] too recommended puncture in such an indeterminate mass which resembles a cyst on CT but has attenuation value of more than 20 H. FNAC was of significant value, showing malignant cells.

In the present study, 33.3% of renal cell carcinomas were confined to the renal capsule as seen on CT. In 66.6% tumours, perinephric extension beyond renal capsule was observed. In 16.6% cases, the tumour had spread through the renal fascia with direct invasion of abdominal wall in one case. Levine et al [20] and Weyman et al[33] had observed similar results .

In our study, CT staging according to TNM was done. The accuracy of CT staging in renal cell carcinoma in the present study was 90%. This was in accordance with the findings of other workers like Weyman et al[33] and Johnson et al[34] who found CT staging accuracy of about 84% to 91% compared with surgical and pathological staging.

Wilm's tumour

Wilm's tumour represents 22% of all abdominal masses occurring after new born period. In our study of renal masses, we encountered 24% (12/50) cases of Wilm's tumour. All of 12 patients were below 5 years of age. According to Belasco et al [36] the main incidence of Wilm's tumour is between 1 & 5 years of age.

Ultrasound was diagnostic in 10 of our cases. It detected the gross morphology of the tumour, local or distant (liver) metastasis and condition of the contralateral kidney. 83.3% of tumours were predominantly solid on US with a homogenous appearance. One of the tumour was huge with extensive areas of liquefaction and necrosis. In this case, a diagnosis of Wilm's could be made tumours are large and predominantly solid. Our findings were in accordance with this in 10/12 cases.

Reiman et al [37] in their study on Wilm's tumour in children, found CT more sensitive than US in detecting tumour necrosis. In the present study, CT only on US guided FNAC. According to Jaffe et al[36] there is a spectrum of sonographic appearances in Wilm's tumour. Most of detected areas of necrosis in 4 such tumours which had appeared predominantly solid on US, corresponding to Reimanet al[37] observation.

Brasch et al [16] had stated that CT is reliable in evaluation of liver and chest for metastases. Pulmonary metastasis is seen in 8-15% of children at the time of diagnosis. In our study only two patient (16.6%) had lung metastases which could be satisfactorily seen on plain chest skiagram. The same patient had liver metastasis which were detected by US and CT.

Squamous cell carcinoma

Blacher et al [38] these are rare lesions comprising 0.5% of all renal neoplasms and 6.2% of renal pelvic tumours. We studied 2 cases of squamous cell carcinoma during our period of study. Both the patients in our study, were males and above 40 yrs of age. The male to female ratio has been described as equal by Blacher et al [38].

On US, the entire kidney in both the cases, was converted into a mass of heterogenous echotexture with calculi within it. The mass was echogenic with areas of pus and necrosis. The US picture was indistinguishable from pyonephrosis or xanthogranulomatous pyelonephritis. This observ-ation has also been made by Wimbish et al [39].

The CT appearance in both the cases was indistinguishable from pyonephrosis or xanthogranulomatous pyelonephritis. On CT, the involved kidney was enlarged with multiple low density areas suggesting pus and necrosis.. Similar CT findings in squamous cell carcinoma have been discussed by Narumi et al [40].According to Levine[20], there is no role for routine aspiration of solid renal masses. However it is useful in cases where the nature of the mass remains indeterminate despite . In our study, we have performed needle aspiration in patients where a firm radiological diagnosis could not be made. We performed FNAC's in 10 such indeterminate masses.

Transitional Cell Carcinoma (TCC)

TCC accounts for 90% of all cancers of renal pelvis while squamous cell carcinoma and adenocarcinoma comprise 9% and 1% respectively. Papillary types are the most common

(85%) variety among TCC .In our study, the only case of TCC was of Papillary variety proven by HPE in 80 year old male who presented with hematuria, pain right flank and weight loss. As per literature, the average age of patient with the TCC at the time of presentation is 65 years and approximately 70% of patients are older than 60 years at the time of diagnosis with a range of 32 to 88 years and male to female ratio of 4:1 (Letham & Kay[41]. Rubenstein & Waltz[42] stated that most common symptom in patients with TCC is hematuria being seen in 75% of cases in his study.

Angiomyolipoma (AML)

In our study, the only patient was a 63 year old male who was detected incidentally on abdominal USG. Benington and Beckwith[30] described that patients of symptomatic angiomyolipoma have flank pain (75%), flank mass (41%), hematuria (30%) and hypotension. In our study, the patient was symptomatic and had hematuria.

The size of angiomyolipoma ranges from several centimetres to more than 20 cm with a mean diameter of 9.4 cm in a study conducted by Hajdu & Foote, [43]. In our study the size of the lesion was 5.3 cm on histopathological examination.

Oncocytoma

A 56 year old female was a single case of Oncocytoma in our study, who exhibited classical features of this entity on CT & USG. The mass was well defined & homogenous in echo-texture with central echogenic stellate scar & central calcification. Quinn & Hartman[44] have also described that calcification is not commonly seen in Oncocytoma.On CECT the mass was well defined, lobulated, and homogenous with central hyperdense radiating stellate scar and calcification showing homogenous marked enhancement on CECT.

Renal Abscess

In our study of 50 cases only one case of renal abscess was seen who presented with pain abdomen, fever and palpable lump.USG examination performed showed enlarged right kidney with large hypoechoic mass with internal echoes in it. There was strong acoustic with posterior shadowing from a calculus in the renal pelvis. Contrast enhanced CT demonstrated enlarged right kidney which was replaced by a homogenous hypodense mass measuring 4.8×4.5 cm and density of +24 HU with thick septae-in-between (with density of +75 HU to +80 HU) surrounded by thin irregular enhancing rim of renal parenchyma. A large hyper-dense calculus was also seen in the right renal pelvis. The hypodense areas within the mass were dilated calyces with thick pus in the calyceal system. These typical findings have also been described by Levine[20]. These CT findings are consistent with literature by Levine[20] and Sulen[45] where in it is described that in obstructed cases, pyonephrosis develops secondary to calcularhydronephrosis. Patient was later on subjected to Pyelolithotomy.

Conclusions & Recommendations: Ultrasound remains the modality of choice for initial screening in cases of Adult Polycystic Kidney disease. CT is indicated only when an associated renal complication such as intra cysthaemorrhage, infection or tumor is suspected. Parapelvic cysts are satisfactorily diagnosed by ultrasound. However, contrast CT has a definite role in distinguishing these cysts from dilatation of renal pelvis.

Ultrasound has a definite role in determining the nature of renal cell carcinomas. However, sonography has its limitations in determining the extent of the tumor.

US is equally sensitive to CT in detecting venous invasion into renal vein or inferior venacava, in cases of renal cell carcinoma. CT has definite advantages over US in preoperative staging of renal cell carcinoma, due to its ability in demonstrating Perinephric extension, invasion or renal fascia, evaluation of central retroperitoneum and detection of distant metastases.

In cases of squamous cell carcinomas, it may be difficult to give a definite diagnosis based on US

and CT findings. Both ultrasound and computed tomography are useful in determining the nature and extent of Wilm`s tumor with CT having few advantages over US in detection of necrosis, calcification and perinephric extension of the tumor

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