www.jmscr.igmpublication.org
Impact Factor (SJIF): 6.379
Index Copernicus Value: 79.54
ISSN (e)-2347-176x ISSN (p) 2455-0450
crossrefDOI: https://dx.doi.org/10.18535/jmscr/v7i1.76

IGM Publication
Journal Of Medical Science And Clinical Research
An Official Publication Of IGM Publication

Comparative Study of Ultrasonography- Doppler and Computed Tomography in Cases of Renal Mass

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Abstract
Introduction: *Ultrasound, Color Doppler and computerized Tomography can reliably diagnose benign and malignant mass lesions affecting kidneys. The common benign renal lesions include simple renal cyst, angiomyolipoma, oncocytoma, cystic nephroma and inflammatory lesions like renal abscess. The common malignant renal lesions include renal cell carcinoma in adults and wilms tumor in pediatric age group. Though the imaging can be useful in diagnosis final diagnosis is dependent upon histopathology particularly in malignant lesions such as renal cell carcinoma and Wilms tumor. We conducted this study to compare Ultrasonography-Doppler and Computed Tomography as imaging modality in the diagnosis of renal masses and to correlate the Ultrasonography-Doppler and Computed Tomography findings of renal masses with Histopathology wherever possible.*
Materials and Methods: *This was a prospective cohort study conducted in the department of radiology of a tertiary care medical college situated in an urban area. One hundred and two (102) patients of all age groups and both sexes and diagnosed to be having renal mass on the basis of imaging in either ultrasound or CT were included in this study on the basis of a predefined inclusion and exclusion criteria. Ultrasound and Doppler examination and CT scan was done in all the cases. USG- Doppler and CT scan findings were compared with histopathology diagnosis. The sensitivity, specificity, positive predictive value and negative predictive value of the various modalities were determined.*
Results: *Out of 102 cases included in this study there were 63 (61.76%) males and 39 (38.24%) females with a M:F ratio of 1:0.61 and most of the patients belonged to the age group of 40-49 years (27.45%). The most common lesion found in the patients was renal cyst (40.20%) followed by renal cell carcinoma (27.45%) and abscess (9.80%). RCC was the most common malignant renal mass (28 out of 40 i.e. 70%). The accuracy of USG doppler for diagnosis of RCC and AML was 98.07%. The accuracy of CT scan for diagnosis of abscess, AML, simple cyst, cystic nephroma, renal lymphoma, RCC, TCC and Wilms tumor was 100%. There were two false negative cases of SCC on CT scan. The analysis of CT characteristics for pre-operative evaluation of RCC showed that Computerized tomography was having sensitivity of 75% for determination of adjacent organ involvement. For all other parameters CT was found to be 100% sensitive.*
Conclusion: *For the diagnosis of renal masses both USG-Doppler and CT scan were found to be equally accurate except in cases of angiomyolipoma, renal cell carcinoma and squamous cell carcinoma where CT was found to be more accurate for diagnosis. On the basis of imaging features of various renal masses on USG-Doppler and CT scan, it is possible to differentiate and diagnose most of the renal masses thus aiding in their management.*
Keywords: *Renal Masses, Ultrasound, Doppler, Computerized Tomography, Positive Predictive Value.*

Introduction

The great majority of renal masses are detected by imaging modalities like USG- Doppler and CT scan. The various mass lesions in kidney include benign lesions like simple cyst, angiomyolipoma, oncocytoma, cystic lesions in autosomal dominant polycystic kidney disease, cystic nephroma; inflammatory lesions like renal abscess and malignant lesions like renal cell carcinoma, Wilm's tumor, lymphoma, transitional cell carcinoma, squamous cell carcinoma etc[1]. Majority of these lesions turn out to be simple renal cysts not requiring any kind of intervention. However, solid and complex cystic renal masses are also discovered, many of which are clearly malignant and need to be surgically removed, while others may not require surgical intervention. The role of ultrasound in cases of renal masses is unique as it is usually the first modality used which picks up any mass in kidney. USG describes mass lesions as solid, cystic, mixed; hyperechoic, hypoechoic, heterogeneous. It also shows the vascularity within the lesion on color Doppler. Dedicated investigations are done so as to characterize the mass lesion. The USG has an advantage over CT in delineating tumor extension into the retrohepátic segment of inferior vena cava and right atrium[2].

The role of computed tomography (CT) in the evaluation of renal lesions is very well-known. CT is widely accepted as the preferred imaging technique for suspected renal tumors and also has an important role in tumor staging. Benign renal processes, including cystic disease, renal infection, and benign tumors may simulate malignant renal tumors, and could be defined correctly by CT. The improvements in CT technique and increased use of cross-sectional imaging have facilitated the detection of small or previously undiagnosed renal masses[3].

It is important to detect fat, calcifications and vascularity within the lesion and features such as vascular invasion, invasion into other adjacent organs, lymph nodal involvement for characterization and staging of the mass lesion. For example, the angiomyolipoma has fat, with attenuation values less than – 40 HU at the non-enhanced scan. The most important renal mass is renal cell carcinoma (RCC). It is the third most common and the most lethal of all genitourinary malignancies[4]. It accounts for 1.5% of all malignancies in India. There are approximately 200 thousand new cases of renal cell carcinoma diagnosed worldwide every year. There has been a steady rise in the incidence of RCC at the rate of 2.3 -4.3% annually over the past 30 years partly due to a general increase in life expectancy and increased detection consequent upon the widespread use of abdominal imaging[5]. The peak incidence of RCC is in the 7thdecade and there is a male preponderance in the ratio of 1.5:1[6]. In pediatric age group Wilms tumor is an important neoplastic lesion affecting 1 child per 10,000 worldwide. RCCs are extremely uncommon in children and constitute 2.3-6.6% of all childhood renal tumors. In children, the mean age at diagnosis is 8-9 years with an equal incidence in both sexes[7].

We conducted this study compare Ultrasonography-Doppler and Computed Tomography as imaging modality in the diagnosis of renal masses and to correlate the Ultrasonography-Doppler and Computed Tomography findings of renal masses with Histopathology wherever possible.

Materials and Methods

This was a prospective cohort study conducted in the department of radiology of a tertiary care medical college situated in an urban area. One hundred and two (102) patients of all age groups and both sexes admitted various departments and who are referred for Ultrasonography-Doppler or Computed Tomography of abdomen and diagnosed to be having renal mass on the basis of imaging in either of the two modalities during the study period were included in this study on the basis of a predefined inclusion and exclusion criteria. Patients without clinical suspicion of

renal masses, but incidentally diagnosed on USG and CT were also included in the study.

A detailed clinical history was taken and findings of clinical examinations were noted. Imaging findings were reviewed. Final diagnosis was reached in consensus with biopsy (wherever applicable) or clinical or laboratory findings and follow up. For ultrasound and Doppler PHILIPS HD11 XE USG MACHINE with convex abdominal probe for deeper structures, linear probe for superficial structures was used. Focal lesions were evaluated under the features of size, site, definition, echogenicity, morphology, calcification, calculus, perinephric extension, involvement of adjacent organs. Color flow in the lesions was determined as present or absent on color doppler. Fluid collection in the Morrison's pouch was also determined by use of this position. Perinephric lymph nodes if present were noted. Lymph nodes were considered enlarged if the diameter is more than 1.0 cm. Renal veins and IVC were evaluated by gray scale and color Doppler method for detection of thrombus. As for right kidney, left kidney was also evaluated for presence of any focal lesions. Renal vein of this side was also evaluated as with right side. By placing the transducer in supra-pubic location, and obtaining sagittal and transverse sections urinary bladder, prostate, uterus and adnexa are evaluated. Next the transducer is placed in right iliac fossa for the evaluation of appendix, ilium and caecum.

For computerized tomography CT scan machine-Siemens Somatum Definition Ast 65983 mmwp-70527 (64x2) Slice multi-detector CT scan machine. For contrast enhancement Intravenous nonionic water soluble contrast agent Iopamidol 300 was used. CT sections were obtained from the level of dome of diaphragms, including both the kidneys including region of interest within the scan field. Each scan was done in suspended respiration. Contrast was given in the forms of calculated dosage; intravenously through antecubital vein using intra-cath by automatic pressure injector.Post-contrast scans were obtained in a similar fashion immediately. Each lesion was observed for location, shape, definition, size, density, and calcification, calculus, patterns of enhancement, involvement of adjacent organs, renal vein, inferior vena cava, regional lymph nodes and distant metastases. The cases were followed up for their histological diagnosis wherever possible. The tissue specimen was obtained by biopsy or during operation. The findings at CT scanning were correlated with the operative findings and histopathological diagnosis. Data analysis was performed by using SPSS (statistical package for social sciences) version 20.0.Qualitative data variables were expressed by using frequency and percentage (%).To correlate USG- Doppler and CT scan findings with histopathology diagnosis we have used sensitivity, specificity, positive predictive value and negative predictive value.

Inclusion Criteria

1. Patients of all age groups referred to our department and found to have renal mass.
2. Patients who gave informed consent to be part of study.

Exclusion criteria

1. Patients unwilling to give consent.
2. Claustrophobic patients
3. Patients allergic to contrast agents.
4. Patients with serum creatinine level >1.5mg/dl
5. Pregnant females.

Results

Out of 102 cases included in this study there were 63 (61.76%) males and 39 (38.24%) females with a M:F ratio of 1:0.61.

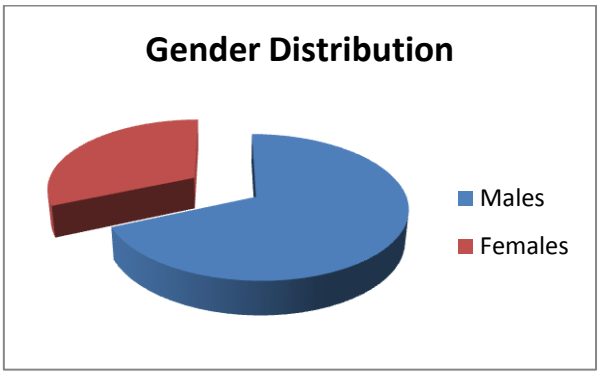

Figure 1: Gender Distribution of the studied cases

The analysis of the age groups of the patients showed that most of the patients belonged to the age group of 40-49 years (27.45%) followed by 50-59 years (26.47%) and 60-69 years (19.61%). Only 8 (7.84%) patients belonged to pediatric age group.

Table 1: Age groups of the studied cases

Age group (years)	No of Patients	Percentage
0-9	8	7.84%
10-19	0	0.00%
20-29	3	2.94%
30-39	13	12.75%
40-49	28	27.45%
50-59	27	26.47%
60-69	20	19.61%
70 and above	03	2.94%
Total	102	100%

The renal masses were diagnosed on the basis of ultrasound, Doppler and computerized tomography. The confirmation of diagnosis was done on the basis of histopathology (whenever it was indicated) On the basis of investigations the most common renal lesion in the studied cases was found to be simple cyst (40.20%) followed by renal cell carcinoma (27.45%) and renal abscess (09.80%).

The most common lesion found in the patients was renal cyst (40.20%) followed by renal cell carcinoma (27.45%) and abscess (9.80%). RCC was the most common malignant renal mass (28 out of 40 i.e. 70%).

Table 2: Distribution of Renal Masses

Diagnosis.	Patients	Percentage
Abscess	10	9.80%
ADPKD	6	5.88%
Angiomyolipoma	4	3.92%
Simple Cyst	41	40.20%
Cystic Nephroma	1	0.98%
Lymphoma	3	2.94%
Renal cell carcinoma	28	27.45%
Squamous cell carcinoma	2	1.96%
Transitional cell carcinoma	2	1.96%
Wilms tumor	5	4.90%
Total	102	100%

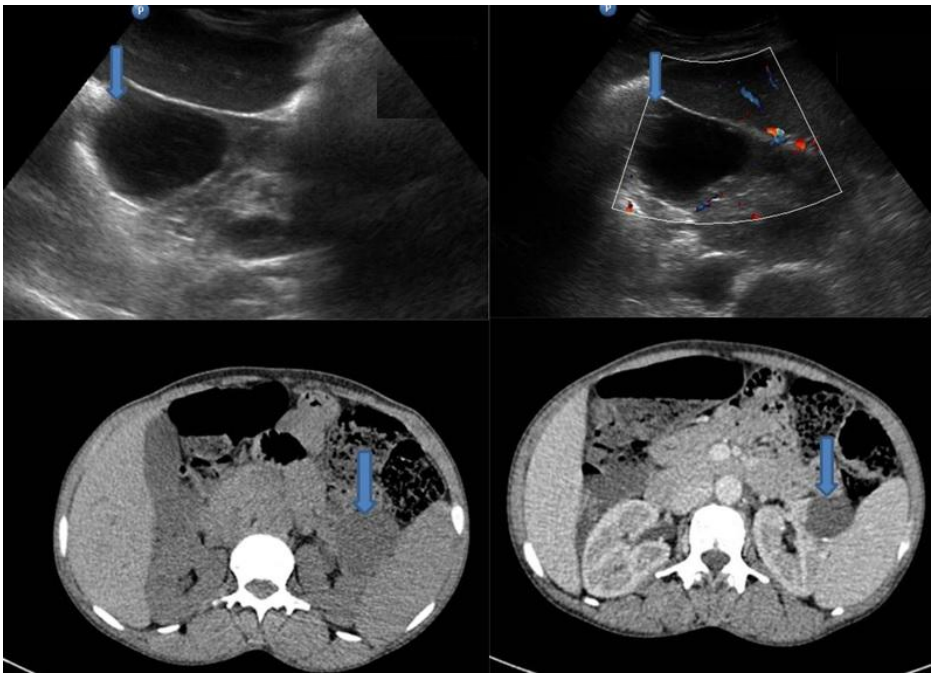

Figure 2: Simple Cyst: well-defined thin walled anechoic lesion involving upper pole of left kidney. Color Doppler showing no internal vascularity. NECT and CECT images showing non-enhancing thin walled fluid density lesion in left kidney

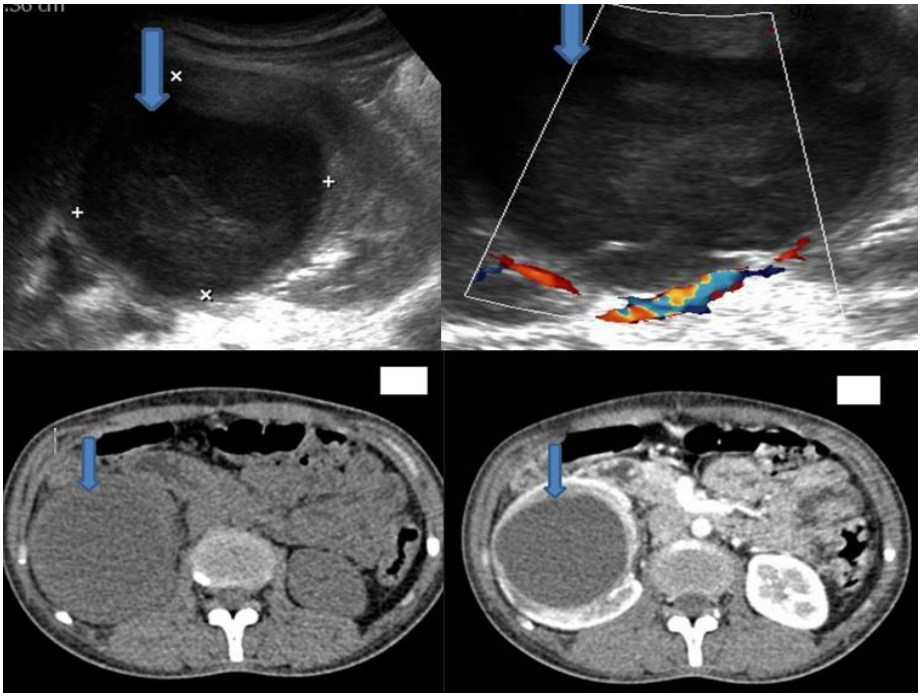

Figure 3: Abscess: Well defined cystic lesion with internal echoes no vascularity on Doppler. On CT appearing hypodense with peripheral contrast enhancement

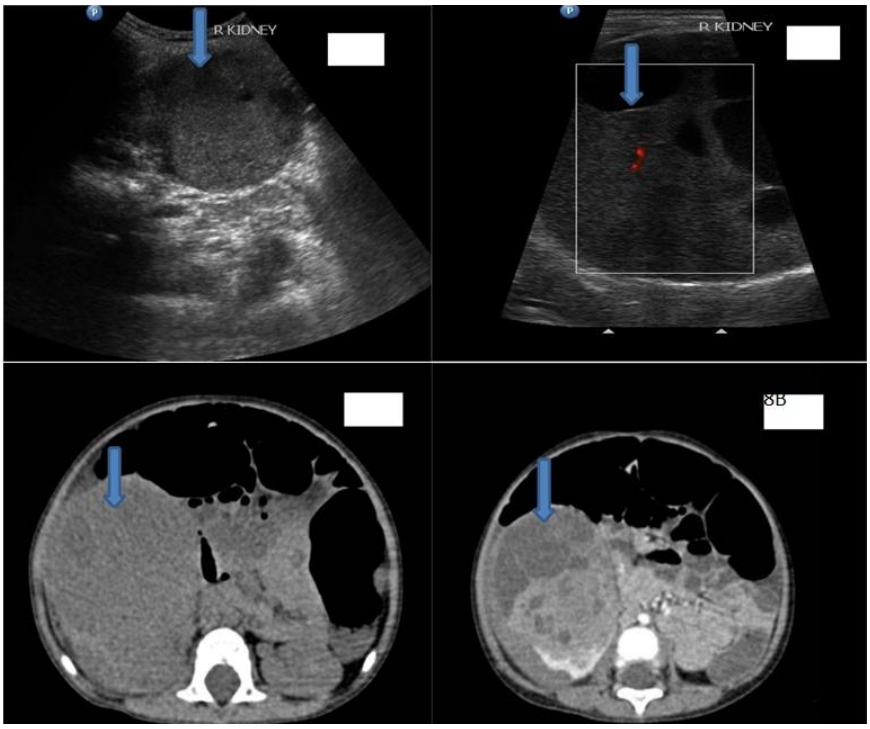

Figure 4: Wilms Tumor: well-defined solid cystic lesion involving lower pole of right kidney. Color Doppler showing vascularity within the lesion. NECT and CECTshowing heterogeneously enhancing lesion in lower pole of right kidney with areas of necrosis.

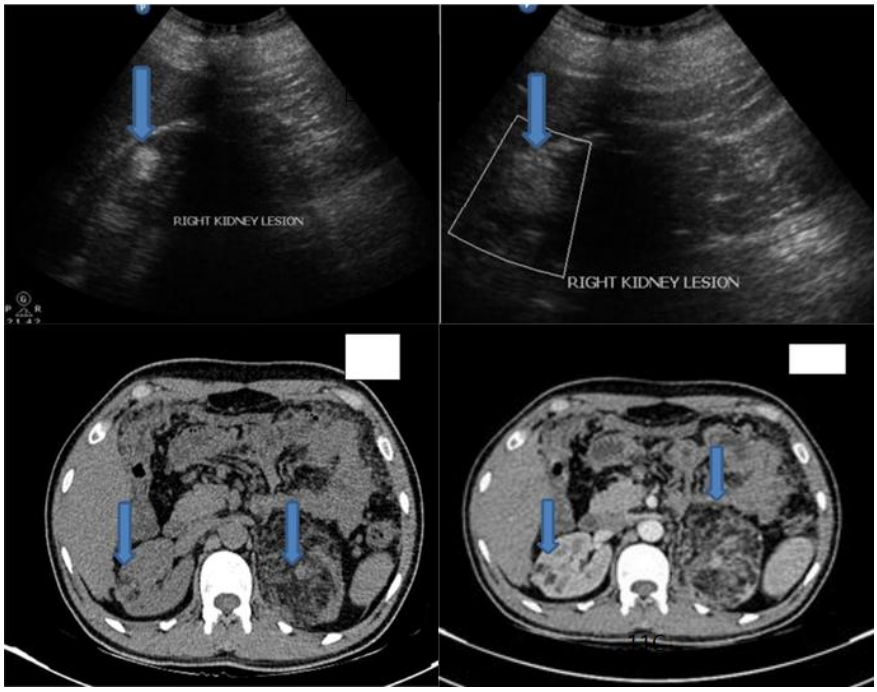

Figure 5: Angiomyolipoma: well-defined hyper-echoic lesion in upper pole of right kidney. On color Doppler, no internal vascularity is seen. NECT and CECT scan showing heterogeneously enhancing lesions in both kidneys with fat density areas within them.

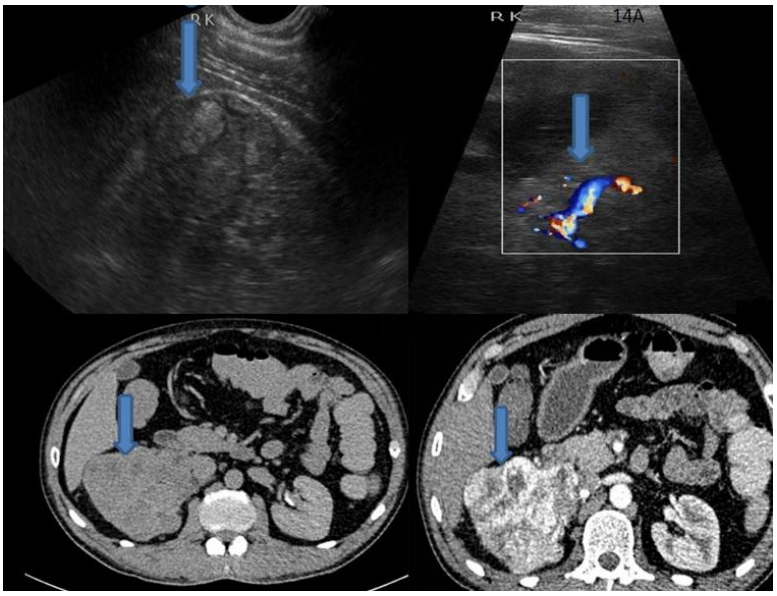

Figure 6: Ill-defined heterogeneous lesion involving right kidney. Color Doppler showing internal vascularity. NECT and CECT images showing heterogeneously enhancing lesion in right kidney showing areas of necrosis.

Overall renal masses were more common in male (61.76%).RCC; Wilms tumor and renal lymphoma were more common in male.AML was more common in female. RCC was more common in right kidney. Lesions in ADPKD and Lymphoma are seen in both kidneys. Most of the renal masses were medium in size (1.0 – 7.0 cm) that is 76.47%.Lesions less than 1.0 cm in size were seen in simple cyst and renal lymphoma. All the lesions in RCC, SCC and Wilms tumor were single. Multiple cysts were seen in all the cases of ADPKD.

Table 3: Gender distribution, size, number and side of the lesions

	Gender		Size			Number		Side		
	Males	Females	<1cm	1-7cm	>7cm	Single	Multiple	Right	Left	Bilateral
Abscess	03	07	00	09	01	01	09	04	03	03
ADPKD	04	02	00	06	00	00	06	00	00	06
Angiomyolipoma	01	03	00	03	01	03	01	02	01	01
Simple Cyst	26	15	04	35	02	18	23	16	11	14
Cystic Nephroma	00	01	00	01	00	00	01	01	00	00
Lymphoma	02	01	01	02	00	00	03	00	00	03
RCC	20	08	00	18	10	28	00	18	10	00
Squamous cell Ca	02	00	00	00	02	02	00	02	00	00
Transitional cell Ca	02	00	00	02	00	01	01	02	00	00
Wilms tumor	03	02	00	02	03	05	00	03	02	00
Total	63	39	05	78	19	58	44	48	27	27

All the lesions in AML were hyperechoic on USG. Most of the lesions of RCC (71.43%) were isochoric. All the lesions in Wilms tumor, SCC and TCC were isochoric. All the lesions in renal lymphoma and abscess were hypoechoic. All the lesions in Cystic Nephroma, simple cyst and ADPKD were anechoic. Both the lesions in SCC had ill-defined margins. Most of the lesions of RCC were solid on USG.60% lesions of abscess were cystic with internal echoes on USG. All the lesions in cystic nephroma, simple cyst and ADPKD were cystic on USG. All the lesions of AML, renal lymphoma and TCC were solid on USG. Lesions in abscess, ADPKD, AML, simple cyst, Cystic nephroma, renal lymphoma, SCC and Wilms tumor did not show any calcification. Calcification was seen in 35.71% lesions of RCC on USG. Renal calculus was seen in both the cases of SCC and in one case of TCC (50%). Vascularity was seen in all the cases of Wilms tumor and TCC on Doppler and in 67.86% cases of RCC.

Table 4: Echogenicity, Margins, Morphology, calcification, calculus and vascularity on ultrasound

	Echogenicity				Margins		Morphology				Calcification		Calculus		Vascularity	
	Anechoic	Hyperechoic	Hypoechoic	Isoechoic	Well defined	Ill defined	cystic	Cyst with int echoes	solid	Solid cystic	No	Yes	yes	No	yes	no
Abscess	0	0	10	0	10	0	0	6	0	4	10	0	0	10	0	1
ADPKD	6	0	0	0	6	0	6	0	0	0	6	0	0	6	0	6
Angiomyolipoma	0	4	0	0	4	0	0	0	4	0	4	0	0	4	1	3
Simple Cyst	41	0	0	0	41	0	41	0	0	0	41	0	0	41	0	41
Cystic Nephroma	1	0	0	0	1	0	1	0	0	0	1	0	0	1	0	1
Lymphoma	0	0	3	0	3	0	0	0	3	0	3	0	0	3	0	3
RCC	0	1	7	20	23	5	0	0	23	5	18	10	0	28	19	9
Squamous cell Ca	0	0	0	2	0	2	0	0	0	2	2	0	2	0	0	2
Transitional cell Ca	0	0	0	2	2	0	0	0	2	0	0	2	1	1	2	0
Wilms tumor	0	0	0	5	5	0	0	0	1	4	5	0	0	5	5	0
Total	48	5	20	29	95	7	48	6	33	15	90	12	3	99	27	75

All the lesions in abscess, ADPKD, AML, simple cyst, cystic nephroma and lymphoma were hypodense. All the lesions of SCC, TCC and Wilms tumor were isodense. Most of the lesions of RCC (92.86%) were isodense. Most of the lesions of RCC (96.43%) were solid in morphology on CT scan. All the lesions of SCC were solid cystic on CT scan. Most of the lesions of Wilms tumor (80%) were solid cystic on CT scan. All the lesions of AML, TCC and renal lymphoma were solid on CT scan. Most of the renal masses had well defined margins (95.1%) on

CT scan. Both the lesions in TCC had calcification. Lesions in abscess, ADPKD, AML, simple cyst, Cystic nephroma, renal lymphoma, SCC and Wilms tumor did not show any calcification. Calcification was seen in 42.86% lesions on CT scan. All the lesions of AML contained fat density area within them. None of the lesions of abscess, ADPKD, simple cyst, cystic nephroma, renal lymphoma, RCC, SCC and TCC contained fat density within them. All the lesions of SCC, TCC, Wilms tumor and AML had heterogeneous enhancement. Most of the lesions of RCC (92.86%) showed heterogeneous enhancement. All the lesions of renal lymphoma showed minimal enhancement. Peripheral enhancement was seen in all the lesions of renal abscess. No enhancement was seen in all the cases of simple cyst, Cystic nephroma and ADPKD.

Table 5: Density, morphology, margins, calcification, fat density, necrosis and contrast enhancement on Computerized Tomography

	CT Density		Morphology			Margins		Calcification		Fat Density		Necrosis					
	Hypodense	Isodense	cystic	solid	Solid cystic	Well Defined	Ill defined	No	Yes	Yes	No	Yes	No	Hetro	minimal	Peripheral	None
Abscess	10	0	6	0	4	10	0	10	0	0	10	0	10	0	0	10	0
ADPKD	6	0	6	0	0	6	0	6	0	0	6	0	6	0	0	0	6
Angiomyolipoma	4	0	0	4	0	4	0	4	0	4	0	0	4	4	0	0	0
Simple Cyst	41	0	41	0	0	41	0	41	0	0	41	0	41	0	0	0	41
Cystic Nephroma	1	0	1	0	0	1	0	1	0	0	1	0	1	0	0	0	1
Lymphoma	3	0	0	3	0	3	0	3	0	0	3	0	3	0	3	0	0
RCC	2	26	0	27	1	25	3	16	12	0	28	15	13	26	0	2	0
Squamous cell Ca	0	2	0	0	2	0	2	2	0	0	2	2	0	2	0	0	0
Transitional cell Ca	0	2	0	2	0	2	0	0	2	0	2	0	2	2	0	0	0
Wilms tumor	0	5	0	1	4	5	0	5	0	0	5	3	2	5	0	0	0
Total	67	**35**	54	37	11	97	5	88	14	4	98	20	82	39	3	12	48

The comparison of ultrasound and CT findings of the patients showed that 1 case diagnosed as AML on USG was diagnosed as RCC on CT scan and one case diagnosed as xanthogranulomatous pyelonephritis on USG was diagnosed as complex cyst on CT scan.

Table 6: USG- Doppler diagnosis Vs CT diagnosis

USG / CT	abscess	PKD	AML	Comp Cyst	Simple cyst	Cystic nephroma	Lymphoma	RCC	TCC	Wilms	XP	Total
Abscess	10	-	-	-								10
ADPKD	-	6	-	-								6
Angiomyolipoma	-	-	4	-								4
Complex cyst				1							1	2
Renal Cyst	-	-	-	-	41							41
Cystic Nephroma	-	-	-		-	1						1
Lymphoma	-	-	-	-			3					3
RCC	-	-	1	-				27				28
Transitional cell Ca	-	-	-	-					2			2
Wilms tumor	-	-	-	-						5		5
Total	10	06	5	1	41	1	3	2	2	5	1	102

The comparison of ultrasound and Histopathology findings of the patients showed that histopathology reports were available in 52 cases of renal mass. The accuracy of USG doppler for diagnosis of RCC and AML was 98.07%.

Table 7: USG- Doppler diagnosis Vs Laboratory diagnosis

USG / LAB	abscess	AML	Complex cyst	Cyst	Cystic Nephroma	lymphoma	RCC	TCC	Wilms	XP	Total
Abscess	3	-	-	-	-	-	-	-	-	-	3
Angiomyolipoma	-	4	-	-	-	-	-	-	-	-	4
Renal Cyst	-	-	-	4	-	-	-	-	-	-	4
Cystic Nephroma	-	-	-		1	-	-	-	-	-	1
Lymphoma	-	-	-	-	-	3	-	-	-	-	3
RCC	-	1	-	-	-	-	27	-	-	-	28
Squamous cell Ca	-	-	1	-	-	-	-	-	-	1	2
Transitional cell Ca	-	-	-	-	-	-	-	2	-	-	2
Wilms tumor	-	-	-	-	-	-	-	-	5	-	5
Total	3	5	1	4	1	3	27	2	5	1	52

The Histopathology reports were found to have a 100% positive predictive value in the diagnosis of abscess, renal cyst, cystic nephroma, lymphoma, RCC,TCC and Wilms tumor. In the diagnosis of AML it was found to be 100% sensitive and 97.91% specific.

Table 8: Sensitivity, specificity, positive predictive value and negative predictive value of Histopathological exam

SN	Laboratory diagnosis	No of cases	False +ve	False -ve	Sensitivity	Specificity	PPP	NPP	Accuracy
1	ABSCESS	03	00	00	100%	100%	100%	100%	100%
2	AML	04	01	00	100%	97.91%	80%	100%	98.07%
3	SIMPLECYST	04	00	00	100%	100%	100%	100%	100%
4	CYSTIC NEPHROMA	01	00	00	100%	100%	100%	100%	100%
5	LYMPHOMA	03	00	00	100%	100%	100%	100%	100%
6	RCC	28	00	01	96.42%	100%	100%	96%	98.07%
7	SCC	02	00	02	00%	100%	00%	96.15%	96.15%
8	TCC	02	00	00	100%	100%	100%	100%	100%
9	WILMS	05	00	00	100%	100%	100%	100%	100%

The accuracy of CT scan for diagnosis of abscess, AML, simple cyst, cystic nephroma, renal lymphoma, RCC, TCC and Wilms tumor was 100%. There were two false negative cases of SCC on CT scan.

Table 9: Sensitivity, specificity, positive predictive value and negative predictive value of CT examination

CT / LAB	abscess	AML	Complex cyst	Cyst	Cystic Nephroma	lymphoma	RCC	TCC	Wilms	Total
Abscess	3	-	-	-	-	-	-	-	-	3
Angiomyolipoma	-	4	-	-	-	-	-	-	-	4
Renal Cyst	-	-	-	4	-	-	-	-	-	4
Cystic Nephroma	-	-	-		1	-	-	-	-	1
Lymphoma	-	-	-	-	-	3	-	-	-	3
RCC	-	-	-	-	-	-	28	-	-	28
Squamous cell Ca	-	-	2	-	-	-	-	-	-	2
Transitional cell Ca	-	-	-	-	-	-	-	2	-	2
Wilms tumor	-	-	-	-	-	-	-	-	5	5
Total	3	4	2	4	1	3	27	2	5	52

The comparison of CT with histopathology reports showed that there were 2 cases of squamous cell carcinoma which were initially diagnosed as complex cyst on CT.

Table 10: Computerized tomography Vs Histopathology diagnosis

CT / LAB	abscess	AML	Complex cyst	Cyst	Cystic Nephroma	lymphoma	RCC	TCC	Wilms	Total
Abscess	3	-	-	-	-	-	-	-	-	3
Angiomyolipoma	-	4	-	-	-	-	-	-	-	4
Renal Cyst	-	-	-	4	-	-	-	-	-	4
Cystic Nephroma	-	-	-		1	-	-	-	-	1
Lymphoma	-	-	-	-	-	3	-	-	-	3
RCC	-	-	-	-	-	-	28	-	-	28
Squamous cell Ca	-	-	2	-	-	-	-	-	-	2
Transitional cell Ca	-	-	-	-	-	-	-	2	-	2
Wilms tumor	-	-	-	-	-	-	-	-	5	5
Total	3	4	2	4	1	3	27	2	5	52

Preoperative evaluation of renal cell carcinoma by Ultrasound and computerized tomography showed that on CT in 7 cases the lesion was not confined to kidney whereas on ultrasound 23 lesions were reported to be confined to kidney emphasizing that ultrasound can't be relied upon for knowing the extension of the lesion beyond kidney. Similarly for other parameters such as perinephric extension, involvement of adjacent organs, renal vein thrombosis, IVC thrombosis and regional lymphnode involvement CT was more sensitive than ultrasound.

Table 11 : Pre-operative evaluation of renal cell carcinoma**.**

Characteristics	USG		CT		Histopathology		Total
	Yes	No	Yes	No	Yes	No	
Confined To kidney	23	1	17	7	17	7	24
Perinephric extension	1	23	7	17	7	17	24
Involvement of Adjacent Organs	0	24	3	21	4	20	24
Renal Vein Thrombosis	0	24	2	22	2	22	24
IVC thrombosis	0	24	2	22	2	22	24
Regional LN	0	24	3	21	1	23	24
Adrenal Involvement	0	24	0	24	0	24	24

The analysis of USG characteristics for pre-operative evaluation of RCC showed that ultrasound along with Doppler was having sensitivity of 100% and 14.28% for confinement of lesion to capsule and perinephric extension. Whereas it was not found to be sensitive for adjacent organ involvement, renal vein or IVC thrombosis and regional lymphnode involvement.

Table 12: Accuracy of USG- Doppler in preoperative evaluation of RCC

SN	USG Characterstics	False +ve	False -ve	Sensitivity	Specificity	PPP	NPP	Accuracy
1	Confined to capsule	06	00	100%	14.28%	73.19%	100%	75%
2	Perinephric extension	00	06	14.28%	100 %	100%	73.19%	75 %
3	Adjacent Organ Involvement	00	04	00%	100%	00%	93.33%	83.33%
4	Renal Vein thrombosis	00	02	00%	100%	00%	91.66%	91.66%
5	IVC thrombosis	00	02	00%	100%	00%	91.66%	91.66%
6	Regional LN	02	01	00%	100%	00%	95.83%	95.83 %

The analysis of CT characteristics for pre-operative evaluation of RCC showed that computerized tomography was having sensitivity of 75% for determination of adjacent organ involvement. For all other parameters CT was found to be 100% sensitive. CT was found to be having 100% accuracy for the diagnosis of confinement to capsule, perinephric extension, renal vein thrombosis and IVC thrombosis. CT scan was more accurate for detecting various features of RCC that are important for preoperative staging i.e perinephric extension, involvement of adjacent organs, involvement of regional lymph nodes, renal vein and IVC thrombosis.

Table 13: Accuracy of CT in preoperative evaluation of RCC

SN	CT Characteristic	False +ve	False -ve	Sensitivity	Specificity	PPP	NPP	Accuracy
1	Confined to capsule	00	00	100%	100%	100%	100%	100%
2	Perinephric extension	00	00	100%	100 %	100%	100%	100 %
3	Adjacent Organ Involvement	00	01	75%	100%	100%	95.23%	95.83%
4	Renal Vein thrombosis	00	00	100%	100%	100%	100%	100%
5	IVC thrombosis	00	00	100%	100%	100%	100%	100%
6	Regional LN	02	00	100%	91.30%	33.33%	100%	91.66 %

The analysis of histopathological reports of RCC showed that The most common histopathological subtype of RCC was clear cell carcinoma (78%) followed by papillary type (18%). Only 1 lesion was found to be belonging to oncocytic subtype.

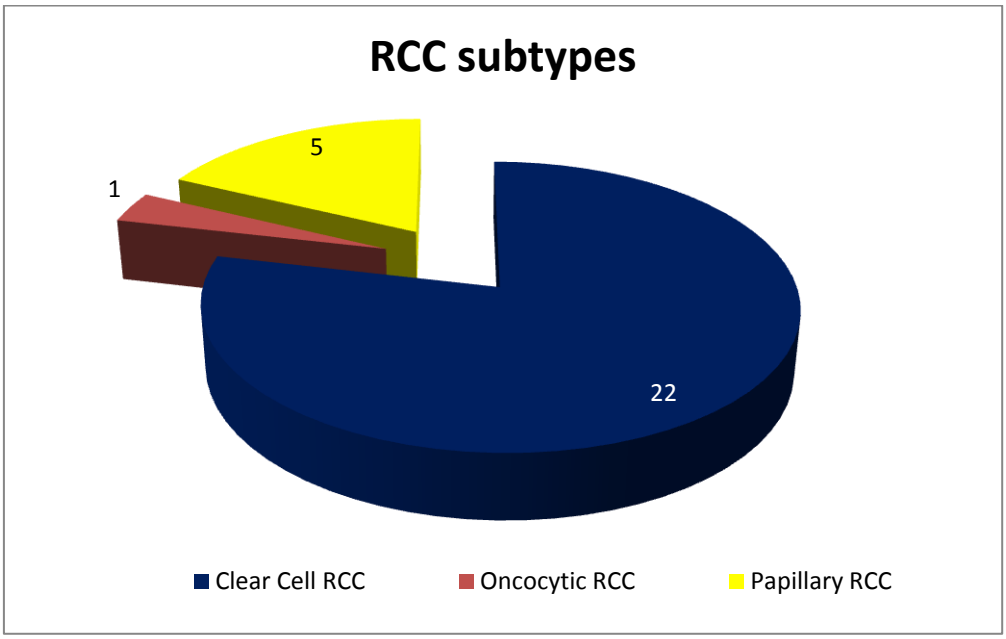

Figure 2: Histopathological subtypes of Renal cell carcinoma

Metastasis was seen in 4 cases of RCC on CT examination. Of the four cases of RCC with distant metastases on CT, there was 1 case each with lesions in bone, liver and lung. 1 case had lesions in both bone and lungs.

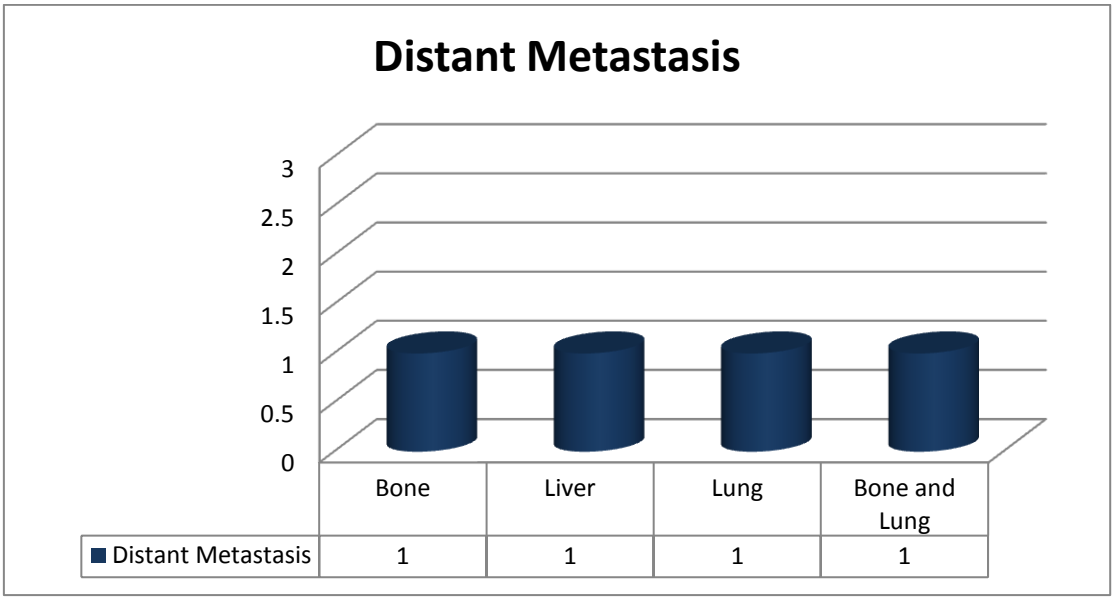

Figure 3: Distant Metastasis on CT

Discussion

Ultrasonography Doppler and CT scan are very useful in the evaluation of renal masses. CT is a reliable means of pre-operative diagnosis and staging of renal masses. Management of any renal mass depends on diagnosing it as benign and malignant. Benign renal masses like renal angiomyolipomas unless symptomatic or having developed complications like repeated hemorrhages rarely require surgery. In case of malignant renal masses resectability is mainly dependent upon whether the inferior vena cava is invaded or advanced metastases to regional lymph nodes exists[8].

In our study, 14 out of 28 cases (50%) of renal cell carcinoma were in the age group of 60-69 yrs. This was similar to Mitchel et al who stated that the peak age for RCC is 50 to 70 years[7]. Also, In a study done by William et al, out of the 102 patients of RCC, 91 % were 50 years old or older[9].In our study, there was a slightly more incidence of renal cell carcinomas on right side 18 cases out of 28 (64.28%). Spanomichos G, d'Archambeau O et al reported a case of bilateral primary synchronous renal cell carcinoma[10]. However, in all our cases, the tumor was unilateral. In our study amongst cases of RCC 20 cases (71.43%) were isoechoic, 7 cases (25%) were hypoechoic. Only one case (3.57%) was hyperechoic. The only case which was hyperechoic was 5.6 cm in size on CT scan. In our study none of the lesions were anechoic. Forman et al. had found that 77% of smaller RCCs were hyperechoic, and Yamashita et al., reported 61% cases as hyperechoic[11,12]. Our study did not correlate with these studies.

In our study, 22 cases (78.57%) were that of Clear cell type, 5 cases (17.86%) were of Papillary type and 1 case (3.57%) was Oncocytic type. This is very similar to the study done by Jeong Kon Kim et al, out of 110 patients, 76 patients (69.09%) were conventional renal carcinoma, 19 (17.17%) were papillary renal carcinoma, 13 (11.81%) were chromophobe renal carcinoma, and two (1.8%) were collecting duct renal carcinoma[13]

In our study, five cases of Wilms' tumor (4.9%) were studied. It constituted 5 out of 8 i.e. 62.5% of renal masses in the first decade of life. The mean age was 4yrs.This was consistent with Lisa H. Lowe et al, who stated that Wilms tumor (nephroblastoma) accounts for 87% of pediatric renal masses with peak incidence at 3–4 years of age[14]. Also, in the study done by Reiman et al, the mean age of diagnosis was 3.3 yrs[15]. In our study, 3 out of 5 i.e. 60% cases showed necrosis while in a study done by Richard et al, necrosis was seen in 87% cases. Lesions in all our cases had well defined margins. This was consistent with the

study done by Richard et al, 67% cases had smooth margins[16].

In our study, we came across three cases of renal lymphoma constituting (2.94%) of all the renal masses of our study. Of these two patients, two were male and one was female patient (male: female ratio 2:1). All the patients were in first decade of life, the mean age of presentation was 5.6 yrs. Bilateral renal involvement was seen in all the cases. All the three cases were of Non-Hodgkin's lymphoma. The lesions in two cases were medium (1-7cm) in size while in one case they were small (<1cm).This was similar to the study done by Neeraj B. et al in which mean age was 11.5 yrs.; The male : female ratio was 1.75:1[17].

In our study four cases of renal angiomyolipoma were studied. Three of these were females and one was male. The average age in our study was 41 yrs (range 27-55 yrs).This was similar to the study done by David et al in which all ten patients were women, with an average age of 43 years (range 18-77 yrs.)[16-126]. Also, in a series of 18 patients done by Patrice et al, there were 16 women and 2 men of 14 to 75 years of age (mean, 52.5)[18].

In our study, there were 6 patients (5.88%) of ADPKD. All of these patients had a family history of the disease. 4 patients were male and 2 were female. The average age was 46 yrs (range 35 – 56 yrs). This was consistent with Grossman H et al, who stated that, in most patients the disease becomes clinically manifested during or after the fourth decade of life[19]. diagnosis of ADPKD was given on the basis of clinical and imaging features.

In our study, there were 41 patients (40.20%) having simple renal cysts. The average age group was 49 yrs (range 28 to 75 yrs.). There were multiple cysts in 23 cases (56.10%). The lesions were in bilateral kidneys in 14 cases (34.15%). In 4, of our cases the aspiration of the lesions showed serous fluid confirming the diagnosis. In a study done by Grossman H et al, they concluded that a single cyst is more common than multiple simple cysts. The highest incidence occurs after age 30[19].

In our study, there were 10 cases (9.8%) of renal abscess. There were3 male and 7 female (M: F ratio of 1:2.3). The average age was 42.9 yrs (range 28 to 65 yrs). All the patients had high grade fever. Lesions in 9 cases were multiple and in one case was single. In the study done by Hoddick W et al, on CT, the renal abscesses characteristically appeared as well defined, low-density parenchymal lesions. Thickening of adjacent renal fascia was noted in three of the abscesses which were contiguous with perireneal fat. In their study, on USG, the abscesses appeared as either a complex fluid collection on hypoechoic mass with poor through transmission. Computed tomography seemed to be the more sensitive method of evaluating severe renal and perirenal infections[20].

Conclusion

For the diagnosis of renal masses both USG-Doppler and CT scan are equally accurate in most of the cases except in cases of angiomyolipoma, renal cell carcinoma and squamous cell carcinoma. In angiomyolipoma and renal cell carcinoma, CT is more accurate for diagnosis. CT is more accurate for detecting various features of renal cell carcinoma needed for preoperative staging like perinephric extension, invasion of adjacent organs, renal vein and IVC thrombosis.On the basis of imaging features of various renal masses on USG-Doppler and CT scan, it is possible to differentiate and diagnose most of the renal masses thus aiding in their management.

Conflict of Interest: None

References

1. Pallwein-Prettner L, Flöry D, Rotter CR, et al. Assessment and characterisation of common renal masses with CT and MRI. Insights Imaging. 2011;2(5):543-556.

2. Kay FU, Pedrosa I. Imaging of Solid Renal Masses. Radiol Clin North Am. 2016;55(2):243-258.
3. Prasad SR, Dalrymple NC, Surabhi VR. Cross-sectional imaging evaluation of renal masses. Radiol Clin North Am. 2008 Jan;46(1):95-111.
4. Landis SH, Murray T, Bolden S, Wingo PA. Cancer statistics, 1999. CA: A cancer Journal for Clinicians. 1999 Jan 1;49(1):8-31.
5. Lindblad P. Epidemiology of renal cell carcinoma. Scandinavian journal of surgery.. 2004 Jan;93:88-96.
6. Pantuck AJ, Zisman A, Belldegrun AS. The changing natural history of renal cell carcinoma. The Journal of urology. 2001 Nov 30;166(5):1611-23.
7. Breslow N, Olshan A, Beckwith JB, Green DM. Epidemiology of Wilms tumor. Medical and pediatric oncology. 1993 Jan 1;21(3):172-81.
8. Krabbe LM, Bagrodia A, Margulis V, Wood CG. Surgical management of renal cell carcinoma. Semin Intervent Radiol. 2014;31(1):27-32
9. Charboneau JW, Hattery RR, Ernst 3rd EC, James EM, Williamson Jr B, Hartman GW. Spectrum of sonographic findings in 125 renal masses other than benign simple cyst. American Journal of Roentgenology. 1983 Jan 1;140(1):87-94.
10. Spanomichos G, d'Archambeau O, Van Breusegem L, De Schepper A, Shamsi K. Bilateral primary synchronous renal cell carcinoma. Journal belge de radiologie. 1994 Jun;77(3):128-9
11. Forman HP, Middleton WD, Melson GL, McClennan BL. Hyperechoic renal cell carcinomas: increase in detection at US. Radiology. 1993 Aug;188(2):431-4.
12. Yamashita Y, Takahashi M, Watanabe O, Yoshimatsu S, Ueno S, Ishimaru S, Kan M, Takano S, Ninomiya N. Small renal cell carcinoma: pathologic and radiologic correlation. Radiology. 1992 Aug;184(2):493-8.
13. Kim JK, Kim TK, Ahn HJ, Kim CS, Kim KR, Cho KS. Differentiation of subtypes of renal cell carcinoma on helical CT scans. American Journal of Roentgenology. 2002 Jun;178(6):1499-1506.
14. Lowe LH, Isuani BH, Heller RM, Stein SM, Johnson JE, Navarro OM, Hernanz-Schulman M. Pediatric Renal Masses: Wilms Tumor and Beyond Radiographics. 2000 Nov;20(6):1585-603
15. Reiman TA, Siegel MJ, Shackelford GD. Wilms tumor in children: abdominal CT and US evaluation. Radiology. 1986 Aug;160(2):501-5.
16. Lowe RE, Cohen MD. Computed tomographic evaluation of Wilms tumor and neuroblastoma. RadioGraphics. 1984 Nov;4(6):915-28.
17. Chepuri NB, Strouse PJ, Yanik GA. CT of renal lymphoma in children. American Journal of Roentgenology. 2003 Feb;180(2):429-31.
18. Bret PM, Bretagnolle M, Gaillard D, Plauchu H, Labadie M, Lapray JF, Roullaud Y, Cooperberg P. Small, asymptomatic angiomyolipomas of the kidney. Radiology. 1985 Jan;154(1):7-10.
19. Grossman H, Rosenberg ER, Bowie JD, Ram P, Merten DF. Sonographic diagnosis of renal cystic diseases. American Journal of Roentgenology. 1983 Jan 1;140(1):81-5.
20. Hoddick W, Jeffrey RB, Goldberg HI, Federle MP, Laing FC. CT and sonography of severe renal and perirenal infections. American Journal of Roentgenology. 1983 Mar 1;140(3):517-20.