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Diagnostic Performance of Computed Tomography Scan with Core Biopsy in Assessing Paediatric Renal Tumour

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Abstract

Background: *Although abdominal ultrasound is the first choice investigation to diagnose paediatric renal mass. But computed tomography (CT) can provide all informations regarding tumour staging, infiltration to surrounding structures and distant metastasis which is required for adequate diagnosis and treatment planning.[1]*

Objective: *To compare the accuracy of CT scan with core biopsy in assessing paediatric renal growth through analysis of accuracy, sensitivity, specificity, positive predictive value and negative predictive value comparing with histopathology as the gold standard.*

Methods: *This cross sectonal study was conducted in Radiology and Imaging departments of CMH Dhaka and Dhaka Medical college and hospital, Department of pathology,Dhaka Medical college hospital and Armed forces institute of pathology and from July 2021 to June 2022 . A total of 50 pediatric patients were selected who came for CT scan with clinical suspicion of renal growth after taking informed consent. CT Image findings and core biopsy reports of paediatric renal masses were compared and correlated.*

Results: *Male female ratio was 1.17:1 with age ranging from birth to 12 years and most of the patients were between 2-3 years. In CT Wilms tumour was found in 43 patients, Mesoblastic nephroma in 02, renal cell carcinoma in 01, Multilocular cystic nephroma in 04 patients. Forty four were diagnosed as malignant by CT and among them 43 were confirmed by core biopsy. Again 07 cases are diagnosed as benign by CT and among them only 1 case was malignant in core biopsy. So, among 50 cases total 44 were confirmed malignant histopathologically. Sensitivity, accuracy and specificity of CT in diagnosis of only Wilms tumours were 97.7%, 96% and 85.7% respectively. Chi-square test showed a p-value of >0.05 which established no statistical significant difference between CT and core biopsy. In overall CT diagnosis of paediatric renal growth, similarity was found in both sensitivity and positive predictive value (97.7%) but accuracy was different (96.0%) where similarity also found between specificity and negative predictive value (83.3%).*

Conclusion: *CT is a noninvasive, ideal and reliable imaging modality for evaluating paediatric renal mass in comparison to core biopsy.*

Keywords: *CT, core biopsy, Paediatric renal mass.*

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Introduction

CT imaging causing increased incidental diagnosis of renal tumours now days. To confirm benign or malignant, it needs renal biopsy. Previously renal biopsy was not practiced so widely. But imaging alone may not predict the biological behaviour of renal tumors. There is large number of benign paediatric renal masses which does not require surgical intervention.. It was reported that biopsy could avoid unnecessary surgery in one third of incidental renal masses[2]. Benign renal masses are usually small (<4 cm) and incidence is about 30% whereas 87% of lower stage RCCs are also <4 cm[4]. With modern techniques, core biopsy and FNA of renal masses now provide adequate tissue for diagnosis in >90% of cases. Again genetic profiling may help to better differentiate renal tumours with gradings of aggressiveness and metastatic potential, and distinguish rapidly progressive tumors

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which need immediate surgery from slowly progressive tumor that might benefit from conservative management, thereby avoiding unnecessary surgery[3].

Furthermore, Helical CT guidance can help to direct the biopsy needle accurately, avoiding necrotic areas. Patient education, the availability of helical CT for biopsy guidance and the presence of a good cytopathologist are important prerequisites for success. With advances in imaging techniques it is convincing that renal mass biopsy should be considered for selected patients with small renal masses in whom it might influence the clinical management. However, young healthy patients who will not accept the ongoing uncertainty and low-level risk of renal mass biopsy should be managed proactively, preferably by partial nephrectomy which essentially represents an excisional biopsy that is both diagnostic and therapeutic.

Methodology:

This study was done both in radiology and imaging departments of CMH Dhaka and Dhaka medical college hospital and core biopsy were done both in Armed forces institute of pathology, Dhaka cantonment and Department of pathology , Dhaka medical college and hospital from July 2021 to June 2022 and was a cross sectional study. 50 paediatric patients were selected who came for CT scan with clinical suspicion of renal growth. CT Image findings and core biopsy reports of paediatric renal masses were compared and correlated. Statistical analyses of results were done by using Statistical Packages for Social Sciences (SPSS-22.0)

Detailed history was taken with special emphasis on renal system. CT scan was performed to allof those patients and radiological diagnosis was made. Sample size was 50 after exclusion and inclusion**.** The demographic and clinical findings of the patients were analyzed and their CT findings and histopathological diagnoses were compared. In this study regarding the size of thelesionssmalllesionwas1-2cm, mediumlesion3-5cmandlarge lesion>5cm. Regarding the density of non-contrast lesions, CT density<+10 HU were considered as hypodense lesions, CT density from +10to +40 HU were considered as isodense lesions and lesions with CT density>+40HU were considered as hyperdense lesions. Regarding the degree of the enhancement, Post contrast image density usually increases. An area with increased density +10 HU to+15HUwas considered as non-significant or normal, But if a post contrast image area is found more increased density from +15HUto+35HU was considered as mildly enhanced, similarly with increased density more from +35HUto+55HUwas considered as moderately enhanced and if a lesion show increased density >+55 HU was considered as intensely enhanced lesion.[4]

Method of Core Biopsy

After ultrasonographic assessment of depth of renal tumour from skin, biopsy site was marked on the corresponding posterior flank. As the sample population was paediatric age group so biopsy tissue was collected under General anaethesia. Core biopsy needle size number 20g x 10cm was used for sample collection. Post procedure analgesia was done by paracetamol suppositories. All children were monitored overnight and discharged on the next day.[5]

CT diagnostic criteria: (Karen & Catherine, 2003)[6]

Following features are considered for CT diagnosis of different paediatric renal tumors

1. *Wilms tumor:*
   Occurs upto about age 8.
   90% of paediatric renal tumors.
   Heterogenous soft tissue density mass with infrequent areas of calcification.

2. *Cystic nephroma and CPDN:*
   Occurs in paediatric males.
   Cystic with septal enhancement. Often herniates into renal pelvis.
   No nodularity or solid enhancing components.

3. *Mesoblastic nephroma*
   Congenital.
   Most common tumor under age 5 months.
   Solid, but cellular type may contain cystic components "Ring"sign seen at ultrasonogram (classic type)

4. *Clear cells sarcoma:*
   Mean age, 36 months: rare <6months
   Solid but enhance heterogenously. Often crosses midline
   Metastasizes to bone.

5. *Rhabdoid Tumor*
   Rare
   Peak Age 11 months Lobulated architecture.
   Calcification common
   Subcapsular fluid collection is characteristic.
6. *Ossifying renal tumour of infancy*
   Very Rare
   Calcification typical Resembles staghorn calculus
   Arises from papilla and grows into collecting system
7. *RCC and Angiomyolipoma*
   Younger children with tuberous sclerosis complex
   Contains fat and intensely enhancing areas.
8. *Metanephric stromal tumour*
   Mean Age2 Yrs.
   Solid, But may contain large cystic component

The main objective of the study was to evaluate the role of Computed Tomography in diagnosis of renal mass in paediatric age group (upto 12 years) and been compared with histopathology. Study was performed during the period of July 2021 to June 2022. A total of 50 patients were included in this study who were selected according to inclusion criteria and CT scan of these patients were performed. Histopathological examination was done from pathology department. The CT findings were correlated with histopathological findings. The results of the study were presented as follows in tables and figures.

Table-I shows sex, age and sites of lesion distribution. Male patients 27(54%) and female patients 23(46%). Male to female ratio was 1.17:1 and 20 (40%) patients belonged to 02-03 years and mean age 3.02 ± 1.79 years. In 22 (44%) cases lesion was found in right kidney, 25 (50%) in left kidney, 3(06%) cases lesion found in both kidneys.

Table-I

Distribution of the patients by Sex, age and sites of lesions

	Number	Percentage	Age in years	n	%	Sites of lesion	n	%
			Frombirth-1	03	06			
Sex			1-2	07	14	Right Kidney	22	44
Male	27	54	2-3	20	40			
			3-4	13	26			
			4-5	03	06			
			5-6	02	04	Left Kidney	25	50
			6-7	00	00			
			7-8	01	02			
			8-9	00	00			
Female	23	46	9-10	00	00	Both Kidney	03	06
			10-11	00	00			
			11-12	01	02			
			Mean±SD	3.02±1.79				

Table-II shows on pre-contrast CT scan 34(68%) showing large tumour. 06(12%) have calcification, 43(86%) are well defined tumour. 22 (44%) are hypodense lesion, 14 (28%) are mixed density lesions, 13(26%) isodense and only 1 (02%) had hyperdense lesions. post-contrast CT features of the patients.

On the basis of CT attenuation of HU: Non-enhance =<10 HU, Mild=10-20, Moderate=20-40, Hyperintense=>40. Mild degree of enhancement was found in 23 (46%), moderate in 20 (40%), Hyperintense in 04(08%) and no enhancement in 03(06%) cases. Heterogenous enhancement found in 26(52%), homogenous enhancement found in 21(42%) and no enhancement in 03(06%) cases. Perirenal invasion in 15(30%) cases, vascular invasion found 02 (04%) cases, lymphadenopathy found in 13(26%) and distant metastasis (in lungs, liver or bones) found in 03 (06%) cases.

Table-II

Distribution of the patients by pre and post contrast computed CT features and diagnosis

Pre-contrast CT			Post-contrast CT			CT Diagnosis		
	Number	(%)		Number	(%)		Number	(%)
Size of lesion			**Degree of enhancement**					
Small	02	04	Mild	23	46	Wilm's Tumour	43	86
Medium	14	28	Moderate	20	40			
Large	34	68	Hyperintense	04	08	Mesoblastic	02	04
			No Enhance	03	06	Nephroma (MN)		
Calcification			**Nature of enhancement**					
Present	06	12				Renal Cell Ca (RCC)	01	02
Absent	44	88						
Margin of lesion			Homogenous	21	42			
Ill defined	07	14	Heterogenous	06	52	Multilocular Cystic	04	08
Well defined	43	86	No enhance	03	06	Nephroma (MCN)		
Density			**Involvement**					
Isodense	13	26	Perirenal invasion	15	30			
Hypodense	22	44	Vascular invasion	02	04			
Hyperdense	01	02	Lymphadenopathy	13	26			
Mixed	14	28	Distant metastasis	03	06			

Table-III

Comparison between computed tomography (CT) and histopathology in diagnosis of Wilms tumour (WT), Renal cell carcinoma (RCC) and Other pediatric renal tumor. (In number):

Wilm's Tumour				Renal cell carcinoma				Other paediatric renal tumour			
	Histopathology		CT		Histopathology		CT		Histopathology		
	WT	Non WT			RCC	Non RCC		CT	Malignant	Benign	Total
WT	42	01	43	RCC	1	0	1	Malignant	43	01	44
Non WT	1	06	07	Non RCC	0	49	49	Benign	01	05	06
Total	43	07	50	Total	1	49	50	Total	44	06	50

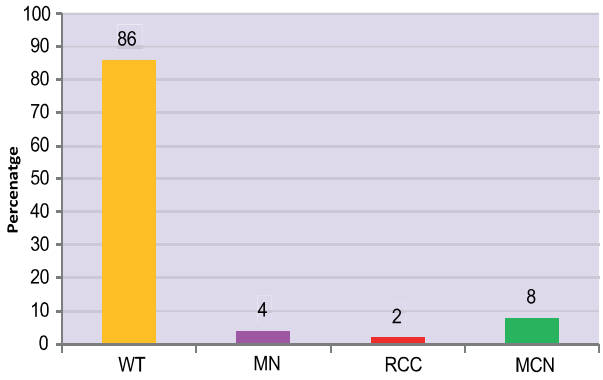


Figure-1: *Bar diagram showing percentage distribution of patients.*

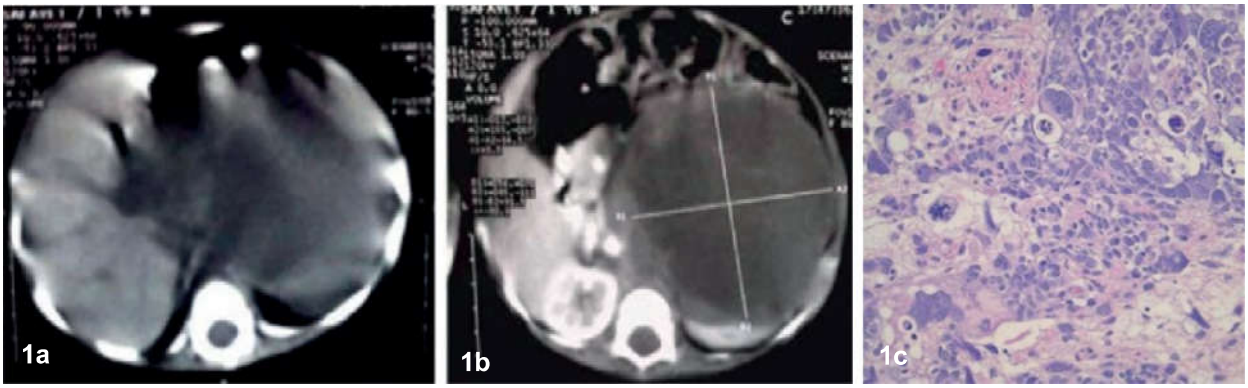
Chi-squate value for Wilm's Tumour statistics is 20243a and P value is >.05 which indicates no significant difference in CT and histopathology report. Chi square value is 32.854a and p value is < .001 and phi coefficient is .811 which indicates Benign lesion diagnosed in CT but histopathologically proven malignant in fewer cases but there is large effect of CT report on histopathology report .

Table-III shows the relationship of CT and histopathological diagnosis. Out of 50 cases 43 were diagnosed as WT by CT and among them 42 were confirmed histopathologically. They were true positive. One case was diagnosed as having

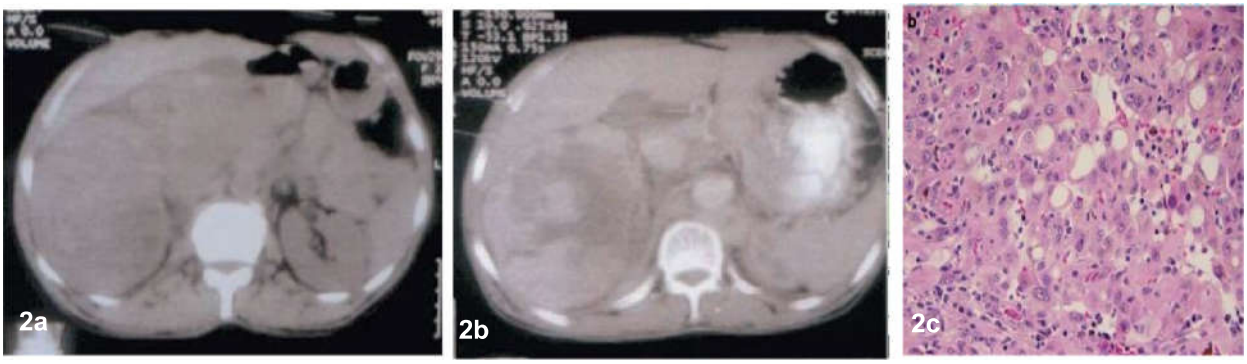
WT by CT but not confirmed histopathologically that was false positive. Out of 07 cases of non WT which was confirmed by CT, 1 was confirmed as WT and 06 were non WT histopathologically. They were false negative and true negative respectively.

Out of all cases 1 was diagnosed as RCC by CT and which was confirmed histopathologically. That was true positive. Out of 49 cases of non-RCC diagnosed by CT which were confirmed histopathologically. That were true negative.

Out of all cases 44 were diagnosed as malignant by CT and among them 43 were confirmed histopathologically. They were true positive. One case was diagnosed as malignant by CT but not confirmed histopathologically. That was false positive. Out of 06 benign cases confirmed by CT, 01 was confirmed as malignant and 05 were benign histopathologically. They were false negative and true negative respectively.



Photograph1a,b,c: CT scan of abdomen of a 4 year old child Pre and post-contrast axial sections of left kidney showing poorly enhancing mass, Claw sign confirm renal origin of mass and core biopsy sample (2c) showing unfavourable anaplastic histology , suggestive of left renal Wilms tumor.



Photograph2a, 2b: Pre and Post-contrast axial CT sections of a 10 year old child showing variable enhancement but less than normal renal tissue. Core biopsy and Hematoxylin and eosin (H&E) (2c) staining showing large eosinophilic cytoplasm, intracytoplasmic lumina, mildly pleomorphic nuclei with open chromatin, small nucleoli, and occasional groves. Hemosiderosis and lymphoplasmacytic infiltrate suggesting RCC of right kidney.

Table-IV

Sensitivity, specificity, accuracy, positive and negative predictive value of CT scan in diagnosis of Wilms Tumour (WT), RCC and paediatric renal tumour.

Test of Validity	Wilms Tumour Percentage	Renal cell carcinoma Percentage	Other paediatric renaltumour Percentage
Sensitivity	100	100	83.3
Specificity	85.7	100	96.0
Accuracy	96.0	100	97.7
Positive predictive value	97.7	100	83.3
Negative predictive value	85.7	100	97.7

Table-IV shows Sensitivity, accuracy and specificity of CT in diagnosis of only Wilms tumours were 97.7%, 96%and 85.7% respectively. In overall CT diagnosis of paediatric renal growth, similarity was found in both sensitivity and positive predictive value (97.7%) but accuracy was different (96.0%) where similarity also found between specificity and negative predictive value (83.3%).

Discussion

The histological components renal tumours are Blastema, Stroma and Epithelium and the components of nephrogenic rests and fetal kidney. Tumour that contain all three components are referred as triphasic Wilms tumour. Again CT diagnosis of RCC and Wilms tumour is tricky. Both are poorly enhancing tumour. Both have same peak age incidence that is 3 to 4 years of life and same metastatic sites that is lung, liver, lymph nodes and bone. Wilms tumour is predominantly solid but heterogeneous areas of necrosis, haemorrhage or cyst formation is seen whereas renal cell carcinoma in contrast CT shows claw sign of normal renal tissue. In case of advanced renal cell carcinoma thrombus may to be found in renal vessel, IVC and rightatrium.[7] The commonest presentation of Wilms tumour is an asymptomatic abdominal mass and is used to include infiltration of adjacent structures, extension to IVC or abdominothoracic metastases. In this study Wilms tumour is found between 3 and 4 years of age which corresponds present study. In this study most common clinical features found are lump in the abdomen, hypertension, anaemia, fever, abdominal pain, haematuria, weight loss and associated congenital anomaly i.e. Hypospadias, Most children having large sized Wilms tumour is observed in this study, Both corresponds to study done by Lowe et al (2000)[8] where a painless abdominal mass usually associated with hypertension and hematuria and large Wilms tumour can cause severe distortion of adjacent organs also. This may be due to most of the patients parent were illiterate and came from low socioeconomic condition. Usually they seek attention of a doctor in the later stage of the disease. In this study male to female ratio was 1.17:1 and paediatric renal tumors are mostly large, well defined and hypo dense which on post contrast study enhances mostly heterogeneously but mildly enhanced which is similar to study done by Loureiro et al. (2013)[9] where male to female ratio was 0.92:1 and on non-contrast study they are of low attenuating lesion and on post contrast study they enhances heterogeneously with sparing a central hypo dense area indicate areas of necrosis. Again Lonergan et al. (1998)[10] observed that in Contrast enhanced CT paediatric renaltumour enhances less than normal renal parenchyma with claw sign positive which is also similar with this study.

Present study depicts 86% paediatric renal tumours are Wilms Tumour with Perirenal invasion, intro-abdominal lymphadenopathy, intravascular invasion and metastasis in lung and /or liver which is similar to study done by White and Grossman et el(1991)[11] where Wilms tumor (nephroblastoma) accounts for 87% of paediatric renal masses and occurs in approximately1:10,000 persons.

It was observed in this present series that 43 cases were diagnosed as WT by CT, out of which 42 were confirmed histopathologically (true positive). One case was not diagnosed as WT confirmed by histopathologically (false positive). Out of 07 cases of non-WT which was confirmed by CT, 01 case was confirmed as WT (false negative) and 06 cases were non WT confirmed by histopathologically (true negative).

Miniati et al.(2008)[12] in a study found that, sensitivity, specificity, positive predictive value, and negative predictive value for CT diagnosis of WT were 92%, 55%, 84%, and 73%, respectively. In this study sensitivity, accuracy and specificity of CT in diagnosis of only Wilms tumours were 97.7%, 96% and 85.7% respectively. Diagnostic performance test of the study slightly differ from the previous study probably due to the sampling technique which was non-random purposive sampling.

In this study 02 cases were diagnosed as Mesoblastic nephroma by CT and among them 02 were confirmed histopathologically (true positive). Out of 48 cases of non-MN which was confirmed by CT, 48 were non MN histopathologically (true negative). So MN has a 100% validity result insensitivity, specificity, accuracy and both positive and negative predictive value.

In this present study RCC diagnosed by CT was only 1 which was confirmed also by histopathology (true positive). Out of 49 cases of non RCC which was confirmed by CT, 49 were non-RCC histopathologically (true negative). So, it can be

told that validity test result for RCC 100% sensitive, specific, accurate and both positively and negatively predicted by CT. This result was found different previously by Bertagna et al. (2013)[13] where Sensitivity, specificity, positive predictive value, negative predictive value and accuracy of CT were 82%, 100%, 100%,66.7% and 86.8%, respectively in the diagnosis of RCC evaluated by CT. Here the diagnostic performance test of the study also differs from the previous study. This may be due to only one case was found as RCC which hmay not be the representative sample.

Comparison between histopathology and computed tomography in diagnosis of multilocular Cystic Nephroma (MCN) it was observed that 04 cases were diagnosed as MCN by CT and among them 03 were confirmed histopathologically (true positive). One case was not confirmed histopathologically (false positive). Out of 46 cases of non-MCN which were confirmed by CT, 45 were non-MCN histopathologically (true negative) and one was confirmed MCN histopathologically (false negative).

In comparison between Core Biopsy and computed tomography, among CT diagnosed 44 Malignant cases, 43 were confirmed histopathologically (true positive). One case was not confirmed histopathologically (false positive).

Again among CT diagnosed 06 benign cases 05 were confirmed benign histopathologically (true negative). CT diagnosed 1 benign case was found malignant histopathologically (false negative).

Conclusion

So it can be concluded that computed tomography can be used as reliable diagnostic modality in pre-operative assessment and an accurate tool in validity parameters in diagnosing paediatric renal tumour along with Core biopsy.

References

1. Grover SB, Antil N, Rajani H, Grover H, Kumar R, Mandal AK et al. Approach to paediatric renal tumours: An imaging review. Abdominal radiology. 2019; 44:619–641.
2. Neuzillet Y, Lechevallier E, Andre M, Daniel L, Coulange C. Accuracy and clinical role of fine needle percutaneous biopsy with computerized tomography guidance of small (less than 4.0 cm) renal masses.
3. Vasudevan A, Davies RJ, Shannon BA, Cohen RJ. Incidental renal tumours: the frequency of benign lesions and the role of preoperative core biopsy. BJU Int. 2006; 97:946–9.
4. Dome IS, Perlman EJ, Ritchey ML, Poplack DG and Pizzo PA. In Principles and Practice of Paediatric Oncology. Philadelphia: Lippincott Williams & Wilkins. 2006:905-932.
5. Lee JS, Sanchez TR and Gorges SW. Malignant renal tumors in children. Journal of Kidney Cancer. 2015; 2(3):84-9.
6. Karen ET and Catherine MO. The Paediatric Abdomen. In Sutton DA. Text Bookof Radiology & Imaging. London: Churchill Livingstone & Imprint of Elsevier Ltd. 2003:849-84.
7. Bozlu G and Elvan Çýtak C. Evaluation of renal tumours in children. Turk J Urol. 2018; 44(3):268–273.
8. Lowe LH, Isuani BH, Heller RM, Stein SM, Johnson JE, Navarro OM et al. Paediatric Renal Masses: Wilms Tumor and Beyond. Radiographics. 2000; 20(6):1585-1603.
9. Loureiro A, Palmeiro M, Penedo JP, Conceição ES, Lisboa PT, Parede PT. Paediatric Renal Masses: A pictorial review. European Society of Radiology. 2013; 2342:01-27.
10. Lonergan GJ, Martinez-leon ML, Agrons GA, Montemarano Hand Suarez ES. Nephrogenic Resta, nephrobla stomatosis and associated lesions of the kidney. Radiographics. 1998; 18(4):947-68.
11. White KS and Grossman H. Wilms and associated renal tumours of childhood. Journal of Paediatric Radiology. 1991; 21(2):81-8.
12. Miniati D, Gay AN, Parks KV, Naik-Mathuria BJ, Hicks J, Nuchtern JG, Cass DL and Olutoye OO. Imaging accuracy and incidence of Wilmsand non-Wilms'renal tumors in children. Journal of Paediatric Surgery. 2008; 43(7):1301-7.
13. Bertagna F, Motta F, Bertoli M, Bosio G, Fisogni S, Tardanico R et al. Role of F18-FDG-PET/CT in restaging patients affected by renal carcinoma. Journal of Bulgarian, Czech, Macedonian, Polish, Romanian, Russian, Slovak, Yugoslav Societies of Nuclear Medicine and Ukrainian Society of Radiology. 2013; 16(1):3-8.