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Diagnostic accuracy of computed tomography in Wilm's tumour taking histopathology as gold standard in symptomatic renal masses at a tertiary care hospital, Karachi.

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Abstract

Background: Recent advances in imaging technology has made it possible to diagnose abdominal masses in the early stages along with accurate image-guided localization of biopsy sites. Contrast-enhanced Computed tomography (CECT) abdomen is one such imaging tool. This study aims to establish the diagnostic accuracy of CT scans in detecting Wilm's tumour.

Methodology: This descriptive cross-sectional study was conducted in the Department of Radiology, Sindh Institute of Urology and Transplantation (SIUT), Karachi, from 20-10-2018 till 04-20-2019. A total of 196 patients who were clinically suspected of renal masses were included in this research project. CECT scan abdomen was acquired. The final diagnosis was based on histopathology.

Results: Mean age in our study was 13.4±5.7 months. 104 (53.1%) were male, and 92 (46.9%) were female, respectively. Moreover, out of 196 patients, sensitivity, specificity, both the positive and negative predictive value along with diagnostic accuracy of CECT scan for diagnosis of Wilm's tumour by taking histopathology as the gold standard was found to be 93.4%, 91.8%, 95%, 89.4% and 92.8% respectively.

Conclusion: It is concluded from the study results that the Abdominal CECT scan, despite its high radiation dose, is relevant and accurate in making a diagnosis of Wilms tumour, making it significantly helpful in early disease detection in poor resource settings such as ours where patients usually present late for treatment.

Keywords

Wilm's tumour, CECT scan, Histopathology, Symptomatic Renal Mass.

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Introduction

Wilms' tumour, also known as nephroblastoma, is renal cancer that typically occurs in children and rarely in adults. It comprises 6% of all pediatric malignancies and over 95% of all childhood kidney tumors[1]. Most nephroblastomas originate in one kidney, while synchronous or metachronous bilateral masses can arise in nearly 10% of patients[2]. The peak disease presentation age is around 3-4 years with no gender predilection[3]. Its prevalence is 1 in 10,000 children, representing about 650 new cases annually[1]. Diagnosis is established usually in the 2-5 year age group[4,5]. Clinically, most children have an asymptomatic abdominal mass discovered incidentally by the mother or by healthcare workers who notice a protuberant flank. A third of the infants have intermittent abdominal pain; 20-30% of patients present with malaise and abdominal pain, while 25% of patients have microscopic or macroscopic hematuria[6,7].

Imaging plays a crucial role in the early diagnosis of Wilm's tumour to distinguish it from other causes of abdominal distention. Modern imaging techniques can be a valuable aid in the morphologic evaluation of Wilm's tumour before confirmation by histology.[7] Ritchey et al. determined the accuracy of pre-surgical imaging of bilateral Wilm's tumors[8].

Other radiological modalities (MRI ULTRASOUND AND X-RAY) can also be used, but due to certain limitations, their precise preoperative diagnostic yield is low; for example, conventional ultrasound is the most common method for initial investigation due to its non-invasiveness, affordability and availability. However, it is operator-dependent and has poor cross-sectional anatomical information. Another drawback to its use is that it is less accurate in tumour staging, which is required to effectively treat this malignancy[9]. Intravenous urography (IVU) is another such modality that can assess the functional ability of diseased kidneys without differentiating between solid and cystic lesions.

Ultrasound with Color Doppler, CECT scan and magnetic resonance imaging (MRI) are all modern imaging techniques that have proved useful for diagnosis. However, cross-sectional imaging like CT scans and MRI are proven to be far superior to ultrasonography[10,11]. CECT has been found to have an accuracy of 82% and is capable of an explicit report in 89% of all cases[12]. Dongre et al. evaluated the CECT abdomen's diagnostic accuracy for Wilm's tumour and found sensitivity and specificity to be 100% and 98.08%, respectively[13]. Significant progress has been achieved in inpatient management and overall outcome of nephroblastoma during the last two decades in developed nations, largely due to multidisciplinary approaches[14-16].

Unfortunately, in developing countries like Pakistan, outcomes remain poor due to delayed presentation with advanced disease stage, delayed referrals, socioeconomic limitations, non-compliance to treatment, and the lack of education resulting in unfavourable outcomes[14,15].

It, therefore, seems pertinent to mention here that our institute offers treatment to pediatric patients almost free of cost. Thus, increasing parents' awareness could help identify these children earlier, leading to reduced morbidity and mortality.

Methodology

This cross-sectional study was conducted in the Department of Radiology, SIUT, Karachi, for 6 months from October 2018 till April 2019. After approval from the Institutional review board, written informed consent was obtained from the parents/guardians of the patients who were referred to the radiology department for CECT Abdomen having suspected renal masses. The total number of patients was 196, and sampling was done by a non-probability consecutive method. The sample size was calculated using WHO calculator with the help of disease prevalence from literature[16,17].

We included patients with palpable abdominal masses of suspected renal origin in both genders between the ages of 1-3 years. All those patients with the co-morbid condition or recent post-surgical status were excluded from this study.

A brief history for demographic information and duration of symptoms was taken. All patients underwent CECT scan abdomen contrast followed by histopathology and were labelled positive as having Wilm's tumour based on histopathology. Patient's age, height, weight, duration of symptoms, gender, Wilms tumour confirmed by contrast CT scan abdomen (Positive/Negative) and histopathology (Positive/Negative) were recorded.

Statistical analysis was performed using SPSS Version 20.0. Mean and standard deviation was calculated for continuous variables such as age, height, weight, and duration of symptoms. Frequency and percentages were calculated for gender, Wilm's tumour confirmed by CECT scan abdomen (Positive/Negative) and histopathology (Positive/Negative). Sensitivity, specificity, positive and negative predictive values and diagnostic accuracy of the CECT scan abdomen were calculated. Stratification was done with regard to age, gender, and duration of symptoms. Post-stratification sensitivity, specificity, positive and negative predictive values, and diagnostic accuracy was calculated.

Results

A total of 196 patients visiting Department of Radiology, SIUT, Karachi. Out of 196 patients, the minimum patient age was 5 months, while the maximum patient age was 36 months. The mean age in our study was 13.4 ± 5.7 months. The mean height, weight and duration of symptoms were 40.04 ± 4.51 cm, 5.84 ± 1.22 kg and 2.21 ± 1.14.

Table 1: Descriptive Statistics.

Variable	Mean Standard Deviation	Min-Max
Age (Years)	1.12 ± 0.57	0.5 – 3
Height (cm)	40.04 ± 4.51	20 – 60
Weight (kg)	5.84 ± 1.22	2 – 10
Duration Symptoms (Month)	2.21 ± 1.14	1 – 6

The distribution frequency of tumour as determined with histopathology showed out of 196 cases of renal masses, 122 (62.2%) had Wilm's tumour while 74 (37.8%) were negative (Table 2).

Table 2: Diagnostic accuracy of CECT scan for the diagnosis of Wilms tumour taking histopathology as the gold standard in symptomatic renal masses.

CECT Scan	Histopathology		Total
	Positive	Negative	
Positive	114 (TP)*	6 (FP)**	120
Negative	8 (FN)***	68 (TN)****	76
Total	122	74	196

*TP=True positive **FP=False positive ***FN=False negative ****TN=True negative

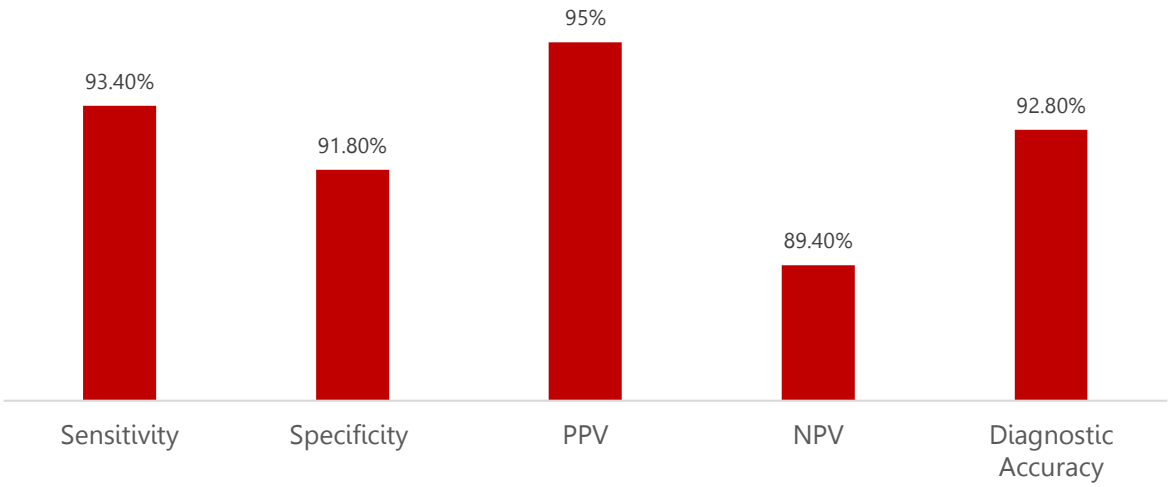

Figure 1: Diagnostic accuracy of contrast-enhanced computed tomography (CT) in detecting renal cell Carcinoma

Overall sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV) and diagnostic accuracy of CECT was 93.40%, 91.80%, 95%, 89.40% and 92.8%, respectively.

Frequency distribution of age showed that out of 196 cases of renal masses, 115 (58.7%) were in the < 24 months age group while 81 (41.3%) patients were in the > 24 months age group, respectively. The gender-based distribution showed that out of 196 with renal masses, 104 (53.1%) were male and 92 (46.9%) were female, respectively.

Table 3: Findings of CECT scan for the diagnosis of Wilms tumour taking histopathology as the gold standard in symptomatic renal masses with respect to age and gender

Variables		CECT Scan	Histopathology	
			Positive	Negative
Age	<24 years	Positive	72 (TP)	3 (FP)
		Negative	4 (FN)	36 (TN)
	>24 years	Positive	42 (TP)	3 (FP)
		Negative	4 (FN)	32 (TN)
Gender	Male	Positive	68 (TP)	2 (FP)
		Negative	6 (FN)	28 (TN)
	Female	Positive	46 (TP)	4 (FP)
		Negative	2 (FN)	40 (TN)

*TP=True positive; FP=False positive; FN=False negative; TN=True negative

Discussion

Abdominal distension in children is a source of apprehension for both parents and pediatricians. Although Wilm's tumour usually causes abdominal distension, certain less serious pathologies can also result in abdominal distension. Therefore, early diagnosis of Wilms' tumour and distinguishing it from other causes is essential. The average age of children with Wilm's tumour in this study is similar to those found in the literature[11,12].

Our study showed that the mean age was 1.12 ± 0.57 years. 104 (53.1%) were male, and 92 (46.9%) were female, respectively. Moreover, out of 196 patients, sensitivity, specificity, positive predictive value, negative predictive value and diagnostic accuracy of CT scan for diagnosis of Wilms tumour taking histopathology as the gold standard was 93.4%, 91.8%, 95%, 89.4% and 92.8% respectively.

The study conducted by Olukayode et al. included 12 children, age range of 6-96 months old underwent abdominal CECT scans as part of their clinical work-up using a General Electric (GE) Hi-speed dual CT scanner®. Pre- and post-contrast images were acquired and assessed by radiologists. Patients were operated upon, and histological confirmation of Wilm's tumour was obtained in all cases[12]. Their radiological and histopathological results were correlated. Of the 12 patients seen, nearly 75% were males, with a male to female ratio of 3:1 with an average age of 37 months. Right-sided tumours were slightly more prevalent than the left, and nearly 25% were bilateral. Approximately 17% showed punctuate calcifications. Heterogeneous contrast enhancement was seen in all the cases, vascular encasement in three and lymphadenopathy in six cases. There was no bony involvement in any of them, but 75% of the masses seen crossed the midline.

Another study identified ninety-two patients, sixty-eight had Wilm's tumour (WT), and 24 had non-Wilm's tumour (nWT). The nWT group included congenital mesoblastic nephroma (n=5), clear cell sarcoma (n=4), neuroblastoma (n=4), renal cell carcinoma (n=4), lymphoma (n=2), angiomyolipoma (n=2), teratoma (n=1), hemangioma (n=1), and renal epithelial tumour (n=1)[18]. When grouped by ages, the incidence of nWT was between 0% and 83%. Sensitivity, specificity, positive predictive value, and negative predictive value for computed tomography (CT) scan determining a diagnosis of WT were 0.92, 0.55, 0.84, and 0.73, respectively. CT reports explicitly stated a potential diagnosis in 89% of cases, with a diagnostic accuracy of 82%[19].

More patients in our study showed calcifications in the mass when compared to the study by Fishman et al. and Geller et al., where only about 13% of Wilm's tumour presented with calcifications on non-enhanced scans[20,21]. About 10% of patients exhibited poor or absent renal function of the involved kidney because of venous tumour extension, compression of the collecting system or extensive tumour infiltration throughout the kidney.

The inferior vena cava is involved by tumour thrombus in 4-10% of Wilm's tumour.[17] This is contrary to our findings, where vascular involvement was 17%. This could also be attributed to the late presentation of patients.

Our findings correlated with intraoperative findings and histological diagnosis, thus supporting the claim that CT scan is superior to IVU and ultrasonography. One limitation of this study was the unavailability of a spiral CT scan in our center. It has been shown that spiral CT improves the quality of examination and has faster image acquisition, thus reducing the sedation time, consequently lowering radiation doses.

As for morphology of renal masses, multi-slice computer tomography (MSCT) and MRI have comparable scores for diagnostic accuracy with a noteworthy concordance (k=1); particularly, the diagnostic accuracy of MSCT/MRI was 100%/100% for lesion identification, 90%/90% for lesion morphology in regards to benign or malignant nature, 97%/97% for the evaluation of lesion margins, 90%/90% for documenting lesion contrast enhancement, 93%/93% for assessing

peri-renal invasion and 96%/96% for identifying vascular encasement and invasion. It was observed that in only one out of the total three cases of oncocytoma, the above radiological imaging modalities were inaccurate in terms of wrongly categorizing lesions as probably malignant despite being benign, taking into account the absence of a central scar and the dynamic uptake of the given intravenous contrast.

CECT scan, with its high sensitivity and specificity, proved quite precise in predicting Wilms tumour in patients presenting with renal masses. In future prospective studies, High-field MRI could be considered as an alternative to MSCT for assessing renal masses, thus preventing exposures to ionizing radiations[22].

Conclusion

CT scan is an efficient imaging tool in distinguishing Wilms tumour from other indeterminate renal masses. Despite high radiation doses, it has multifold advantages making it relevant and accurate for diagnosing Wilms' tumours, aiding in early disease management in poor resource settings where patients usually present late for treatment. Finally, it is mandatory for tumour staging, overall contributing to improved patient treatment and care.

Conflicts of Interest

None.

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