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Pattern of Abdominal Masses and Evaluation of the Accuracy of Ultrasound in Pediatric Abdominal Masses

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ABSTRACT

Background: Pediatric abdominal masses encompass a range of diverse lesions, originating from various sources and carrying varying degrees of importance. Nevertheless, ultrasound has emerged as the preferred diagnostic tool for assessing these conditions. **Objective:** To determine the pattern of abdominal masses and evaluation of the accuracy of ultrasound in pediatric abdominal masses. **Study Design:** Cross-sectional study. **Settings:** This study was conducted at the Department of Radiology, Services Hospital, Lahore Pakistan. **Duration:** From August 2022 to February 2023. **Methods:** This study enrolled 182 pediatric patients who exhibited suspected abdominal masses. The data were analyzed using SPSS version 22 software, with the significance level set at $P < 0.05$. **Results:** Mean age of the study population was 6.45 ± 4.71years. There were 107 (58.79%) were male, while 75 (41.20%) were female. The most common sign or symptom at presentation was "Abdominal Swelling," which was observed in 160 cases, accounting for 97.0% of the cases. "Abdominal Pain" was reported in 52 cases (31.5%), "Weight Loss" in 48 cases (29.1%), "Fever" in 30 cases (18.2%), "Vomiting" in 4 cases (2.4%), "Hematuria" in 8 cases (4.8%), and "Others" in 23 cases (13.9%). Frequency of abdominal masses was 154(84.6%). "Tumors" were identified in 53.2% of the cases while "Organomegaly" was observed in 46.66% cases. The most common was Wilms tumor (24.18%) and Hepatomegaly (22.53%). Ultrasound showed sensitivity (93.55%), specificity (56.67%), overall accuracy was 89.92%, making it generally reliable in predictions. **Conclusion:** Ultrasonography is a dependable and sensitive tool for diagnosing abdominal masses, with a sensitivity of 93.55% and septicity 56.67% significantly enhancing our diagnostic capabilities. Ultrasonography stands as both a highly sensitive and dependable diagnostic method, known for its simplicity, cost-effectiveness, and widespread availability.

Keywords: Histopathological, Abdominal masses, Positive predictive value, Negative predictive value, Specificity, Sensitivity, Ultrasound.

INTRODUCTION

In low and middle-income countries, pediatric tumors continue to be a significant contributor to child morbidity. The presence of an uncommon abdominal mass in a young child often triggers clinical concern regarding the possibility of a tumor, whether benign or malignant.[1,2] The nature of abdominal masses varies across different age groups, with neonates often presenting with predominantly benign masses, while the likelihood of malignancy increases as children grow older. Pediatric abdominal masses vary with age, with neonates often presenting benign masses like hydronephrosis, while older children may develop malignancies like Wilms' tumor and neuroblastoma. The etiology of these masses can be diverse, including congenital anomalies, genetic factors, and acquired conditions, with specific causes varying depending on the type of mass.[3] The pathophysiology involves abnormal growth or development of abdominal structures, leading to the formation of masses. Treatment depends on the underlying cause and may include observation, surgery, or other interventions.[4]

Evaluations at the radiological, surgical, clinical, and/or levels of histology are often necessary for the

comprehensive therapy of a pediatric abdominal tumor. A low-priced imaging technology that aids in diagnosis is often sought after by medical professionals. Rapid treatment is impossible without a low-cost, broadly accessible imaging method.[5] In Pakistan, ultrasonography is the most accessible imaging method. The majority of children with apparent intra-abdominal masses have their initial imaging study performed with ultrasound.[6,7]

Reconducting this study is vital due to the current lack of country or region-specific data on the pattern of abdominal masses in pediatric patients. By analyzing the prevalence and characteristics of these masses across various regions, we can better understand regional variations and improve diagnostic accuracy using ultrasound, ultimately enhancing pediatric healthcare and patient outcomes

METHODS

After obtaining approval from the institution's Ethics and Research Committee, this cross-sectional study was conducted at the Department of Radiology, Services Hospital Lahore from August 2022 to February 2023. Our study included 182 children suspected with abdominal masses of both genders aged 18 years or younger who presented with abdominal masses. Patients displaying any other identifiable abdominal pathologies were excluded from the study. Written informed consent was acquired from the parents or guardians of all study participants.

Each child's clinical assessment at presentation included a comprehensive review of their medical history and a thorough physical examination, from which provisional diagnoses were established. Subsequently, all patients underwent ultrasonographic evaluation using a real-time 3.5–7.5MHz frequency transducer (Mindray [DC-8] ultrasound system). Ultrasonography was the primary diagnostic modality for all patients, focusing on identifying the anatomical region of the lesion, determining the organ of origin of the mass, and providing a pathological description along with a preliminary diagnosis. Accurate descriptions of the masses and presumptive diagnoses were carefully recorded.

SPSS (Statistical Package for the Social Sciences, version 22) was used for the statistical analysis. For quantitative data, their mean and standard deviation (SD) were calculated. Frequencies & percentage of qualitative data were provided.

RESULTS

Mean age of the study population was 6.45 years with a standard deviation of (SD=4.71). Regarding gender, 107 patients (58.79%) were male, while 75 patients (41.20%) were female given in table 1. The most common sign or symptom at presentation was "Abdominal Swelling," accounting for 97.0% of the cases. "Abdominal Pain" was reported in 52 cases (31.5%), "Weight Loss" in 48 cases (29.1%), "Fever" in 30 cases (18.2%), "Vomiting" in 4 cases (2.4%), "Hematuria" in 8 cases (4.8%), and "Others" in 23 cases (13.9%). When it comes to the incidence of abdominal masses, the majority of cases, specifically 154 out of 182 cases (84.6%), were associated with "Tumors/Organomegaly" as detected on ultrasound. The remaining 28 cases (15.18%) had "Other Findings." Regarding the types of masses, "Tumors" were identified in 88 cases, making up 53.2% of the cases, while "Organomegaly" was observed in 77 cases, accounting for 46.66% of the cases given in table 2. The ultrasonography diagnoses revealed a range of conditions, with the most common being Wilms tumor (24.18%) given in table 3. Overall, abdominal mass types significantly varied by age in 165 patients given in table 4.

Ultrasound showed high sensitivity (93.55%), but its specificity (56.67%) is moderate, indicating room for improvement in recognizing negatives. Overall accuracy was 89.92%, making it generally reliable in predictions.

Table 1: The demographic composition in terms of age and gender among the study (n=165)

Variables	Category	Frequency (%)
Age	Mean ± SD	6.45 ± 4.71
	< 1 year	15 (9.09%)
	1-5 years	77 (46.66%)
	≥ 5 years	73 (44.24%)
Gender	Male	96 (58.18%)
	Female	69 (41.81%)

Table 2: Details of sign, symptoms, positive abdominal masses and types of masses

Variables	Category	Frequency	Percentage
Sign / Symptom	Abdominal Swelling	160	97.0%
	Abdominal Pain	52	31.5%
	Weight Loss	48	29.1%
	Fever	30	18.2%
	Vomiting	4	2.4%
	Hematuria	8	4.8%
	Others	23	13.9%
Incidence of abdominal masses	Tumors / Organomegaly on ultrasound	154	84.6%
	Other Findings	28	15.18%
Types of masses	Tumors	88	53.2%
	Organomegaly	77	46.66%

Table 3: Ultrasonography-identified Patterns of Abdominal Masses

Ultrasonography Diagnosis	Frequency	Percentage
Wilms tumor	44	24.18%
Lymphoma	31	17.03%
Hepatomegaly	41	22.53%
Splenomegaly	31	17.03%
Hepatoblastoma	3	1.65%
Neuroblastoma	7	3.85%
Multilocular cystic nephroma	3	1.65%
Caroli disease	2	1.10%
Retroperitoneal teratoma	2	1.10%
Ovarian teratoma	5	2.75%
Primitive neuroectodermal tumor	2	1.10%
Metastasis	4	2.20%
Rhabdomyosarcoma	2	1.10%
Intussusception	3	1.65%
Tuberculoma	2	1.10%
Hepatitis	2	1.10%
Solid pseudopapillary neoplasm of the pancreas	2	1.10%
Ovarian cystadenocarcinoma	2	1.10%

Table 4: Age specific distribution of types of abdominal masses on ultrasonography

Abdominal Mass Type	≤1 year n (%)	1-5 years n (%)	>5 years n (%)	Total (%)	P-value
Renal	(22.0%)	(46.5%)	(19.5%)	53 (32.1%)	0.003
Hepatobiliary	(55.0%)	(23.0%)	(22.0%)	41 (24.8%)	0.121
Hepatobiliary and Splenic	0	(12.0%)	(21.0%)	24 (14.5%)	0.241
Splenic	(10.8%)	(6.9%)	(15.3%)	19 (11.5%)	0.321
Pelvic	0	0	(12.0%)	11 (6.7%)	0.022
Retroperitoneal	0	(3.5%)	(6.7%)	8 (4.8%)	0.765
Gastrointestinal / Mesenteric	0	(5.2%)	0	4 (2.4%)	0.221
Others	(11.0%)	(1.7%)	(3.4%)	5 (3.0%)	0.324
Total	15 (9.1%)	77 (46.7%)	73 (44.2%)	165 (100%)	—

Table 5: 2x2 Contingency table to determine diagnostic performance of ultrasound in diagnosing abdominal masses in children

Abdominal Masses on US	Abdominal Masses on Histopathology		Total
	Positive	Negative	
Positive	116 (TP)	13 (FP)	129
Negative	0 (FN)	25 (TN)	25
Total	116	38	154

Table 6: The diagnostic precision of ultrasound in the evaluation of abdominal masses among pediatric patients, using histopathology findings as the reference standard

Statistic	Formula	Value
Sensitivity	$\frac{a}{a+b}$	93.55%
Specificity	$\frac{d}{c+d}$	56.67%
Accuracy	$\frac{a+d}{a+b+c+d}$	89.92%
Positive Predictive Value	$\frac{a}{a+c}$	89.92%

DISCUSSION

"Abdominal masses in pediatric patients encompass a diverse range of conditions, each unique to different age groups. They represent a significant cause of morbidity and mortality. Imaging plays a crucial role in their diagnosis, given that relying solely on medical history and physical examination may yield unreliable results." The desirability of an investigative tool lies in its capacity to swiftly provide accurate diagnoses.

Mean age of the study population was 6.45 years with a standard deviation of (SD=4.71). Regarding gender, 96 patients (58.18%) were male, while 69 patients (41.81%) were females which are align with Lema *et al*. (2015) in Northern India, which reported comparable outcomes.[10]. Nevertheless, this contrasts with a study conducted by Nkorowo *et al*. (2015), where they observed equal male to female ratio in pediatric abdominal masses.[11]

In our study, frequency of abdominal masses was found to be 84.6%, 154 out of 182 cases. This frequency is in accordance with study of Onyango *et al*. (2019) who reported it to be to be 87.86% in his study.[12] while Adedayo *et al*. (2019) found comparatively higher frequency of abdominal masses to be 124/135 (91.9%) of patients.[13]

The most common symptom at presentation was abdominal swelling (97.0%), abdominal pain (31.5%), weight loss (29.1%), fever (18.2%), vomiting (2.4%), hematuria (4.8%) and others (13.9%), these are in line with findings of Adedayo *et al*. (2019) who found that clinical presentations in these patients were abdominal pain (17.2%), abdominal swelling (52.1%), vomiting (4.9%), incidentally detected masses (14.1%), hematuria (2.5%), weight loss (1.8%). and fever (3.1%).[13]

The pattern of abdominal masses in this study was as follows Wilms' tumor (24.18%) was the common abdominal mass and Hepatomegaly (22.53%), Lymphoma (17.03%) and Splenomegaly (17.03%) which is consistent with studies by Kirk *et al*. (2018)[15] and

Kebede *et al*. (2011).[16] In Hanif *et al*. (2004) study, neuroblastoma comprised 29.6% of all cases, with Wilms' tumor at 25.1% and non-Hodgkin's lymphomas at 15.5%.[17] Hesham *et al*. (2014) similarly reported neuroblastoma as the most prevalent cancer in early childhood.[18] In a 2016 study by Javaid *et al*., Wilms' tumor took precedence, especially among males. Hydronephrosis emerged as the leading diagnosis among all abdominal masses, constituting 37 (19.7%) of cases, with a higher incidence in infants aged 1 month to 2 years.[19]

In our study ultrasound showed high sensitivity (93.55%), but its specificity (56.67%) is moderate, overall accuracy was 89.92%, making it generally reliable in predictions. Our results are in accordance with Adedayo *et al*. (2019) who reported that ultrasound's diagnostic performance yielded an overall accuracy of 87.4%, with sensitivity and specificity rates of 87.9% and 81.8%, respectively.[13]

This aligns with findings from an Ethiopian study, where diagnostic accuracy was reported at 88.9%. In contrast, separate studies by Annuar *et al*. demonstrated slightly lower values of 78%. However, our study exhibits equally high and promising values for sensitivity, specificity, and positive predictive values compared to other research findings.[20]

CONCLUSION

Ultrasonography is a dependable and sensitive tool for diagnosing abdominal masses, with a sensitivity of 93.55% and septicity 56.67% significantly enhancing our diagnostic capabilities. Ultrasonography stands as both a highly sensitive and dependable diagnostic method, known for its simplicity, cost-effectiveness, and widespread availability.

LIMITATIONS

Study was conducted on a small sample size.

SUGGESTIONS / RECOMMENDATIONS

Let's show our support for future research on this subject.

CONFLICT OF INTEREST / DISCLOSURE

None.

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