Original Article

Diagnostic pattern with CT of pediatrics abdominal masses seen in patients admitted to St. Paul's Hospital Millennium Medical College Pediatric Surgical department, Addis Ababa, Ethiopia

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Abstract

Background: Pediatric abdominal masses represent a major diagnostic challenge and are frequently associated with malignant conditions, particularly in low- and middle-income countries. Computed tomography (CT) plays a critical role in tumor characterization, staging, and treatment planning; however, local evidence describing CT imaging patterns of pediatric abdominal masses in Ethiopia remains limited.

Objective: To assess the computed tomographic patterns of pediatric abdominal masses and their diagnostic distribution at Saint Paul's Hospital Millennium Medical College, Addis Ababa, Ethiopia.

Method: A hospital-based retrospective cross-sectional study was conducted among pediatric patients who underwent abdominal CT imaging for evaluation of abdominal masses. All eligible cases during the study period were included using a census approach. Socio-demographic data, clinical presentation, mass characteristics, anatomical origin, and radiologic patterns were extracted and analyzed using SPSS version 25.0. Descriptive statistics were used to summarize findings.

Result: A total of 133 pediatric patients were evaluated, with a mean age of 5 ± 3 years; 53.4% were male. Abdominal masses were identified in 80 patients (72.9%), predominantly of retroperitoneal origin (93.8%). Wilms' tumor was the most common radiologic diagnosis (30.0%), followed by lymphoma (28.8%) and neuroblastoma (25.0%). Most masses were solid (61.3%), showed heterogeneous contrast enhancement (81.0%), and frequently crossed the midline (70.9%). Calcification was common in neuroblastoma, while Wilms' tumors were predominantly unilateral and lacked calcification or fat.

Conclusion: Wilms' tumors remain the most common cause of pediatric abdominal masses diagnosed by CT imaging at this tertiary referral center, followed by lymphoma and neuroblastoma. CT imaging provides essential diagnostic information for tumor localization and characterization; however, radiologic–pathologic correlation remains necessary for definitive diagnosis. Strengthening access to cross-sectional imaging may facilitate earlier diagnosis and improve pediatric oncology care in resource-limited settings.

Keywords: Pediatric imaging, abdominal masses, Pediatric oncology

Introduction

Abdominal masses are defined as palpable abnormal enlargements within the abdominal cavity and are among the most common presenting signs of malignant solid tumors in children. Such masses are often first detected by family members or primary caregivers and warrant prompt medical evaluation (1, 2). The differential diagnosis of pediatric abdominal masses is strongly influenced by the child's age. For example, Wilms' tumors and neuroblastoma occur more frequently in infants and younger children, whereas leukemic or lymphomatous involvement of the liver, spleen, or retroperitoneal lymph nodes is more commonly observed in older children (3). Early identification and timely initiation of appropriate treatment play a critical role in improving prognosis and survival outcomes.

Diagnostic imaging is central to the evaluation of pediatric abdominal masses and is essential for guiding clinical decision-making before surgical intervention or medical therapy. Among available imaging modalities, computed tomography (CT) plays a pivotal role, particularly in cases with suspected malignancy, which are associated with poorer outcomes compared to benign conditions. CT imaging provides valuable information regarding the origin and characteristics of the mass, enables accurate local disease staging, facilitates detection of distant metastases, and supports monitoring of treatment response (4). Pediatric abdominal masses may arise from a wide range of conditions, including congenital anomalies, trauma, tumors, abscesses, infections, or organomegaly. Among intra-abdominal tumors in children, neuroblastoma and Wilms' tumor are the most frequently diagnosed, while lymphoma, leukemia, hepatic tumors, soft tissue sarcomas, and ovarian tumors occur less commonly (1, 4).

Wilms' tumor is recognized as the most common intra-abdominal malignancy among children in sub-Saharan Africa (5). In many cases, patient age at presentation, clinical manifestations, and characteristic imaging features may allow a presumptive diagnosis. Previous studies have reported a high sensitivity of CT imaging for detecting Wilms' tumors, reaching approximately 92%; however, specificity remains lower, particularly in differentiating renal tumors in children, with reported specificity as low as 55% (6). Although contemporary imaging techniques provide critical insights into tumor characteristics and extent, definitive diagnosis cannot be reliably established based on imaging alone in all cases. Histopathological examination, therefore, remains the gold standard for confirming tumor type and guiding definitive management (7). In low- and middle-income countries such as Ethiopia, ultrasound is typically the first-line imaging modality for evaluating pediatric abdominal masses due to its affordability, safety, and widespread availability. However, ultrasound has limitations, including operator dependence, limited visualization in the presence of bowel gas or bone, and restricted ability to fully characterize organ involvement and disease extent. Consequently, cross-sectional imaging modalities such as CT and magnetic resonance imaging (MRI) provide more comprehensive anatomical and diagnostic information and are increasingly utilized as

access to these technologies expands. Despite this growing availability, local evidence describing CT imaging patterns of pediatric abdominal masses in Ethiopia remains limited. Therefore, this study aims to assess the computed tomographic patterns of pediatric abdominal masses and their correlation with histopathological findings at Saint Paul's Hospital Millennium Medical College, Addis Ababa, Ethiopia, to contribute context-specific evidence that may support timely diagnosis and improved clinical management.

Methods

Study Area and Period

This study was conducted at the Radiologic Imaging Unit of Saint Paul's Hospital Millennium Medical College (SPHMMC), Addis Ababa, Ethiopia. SPHMMC is a tertiary-level referral and teaching hospital located in the capital city and serves as one of the national centers of excellence for undergraduate, postgraduate, and subspecialty training in medical and health sciences. The hospital provides year-round diagnostic imaging services and evaluates estimated 100–150 pediatric abdominal mass cases annually. The study included cases evaluated during the specified study period.

Study Design

A hospital-based retrospective cross-sectional study design was employed.

Source Population

The source population comprised all pediatric patients who presented to SPHMMC with a clinical diagnosis of abdominal mass and underwent abdominal CT examination at the radiology imaging unit.

Study Population

The study population included all pediatric patients who fulfilled the inclusion criteria and had complete abdominal CT imaging records during the specified study period.

Inclusion Criteria

All pediatric patients underwent abdominal CT imaging for evaluation of an abdominal mass during the study period.

Exclusion Criteria

- Abdominal CT scans performed for evaluation of known extra-abdominal primary tumors. Metastatic disease to intra-abdominal organs from an established extra-abdominal malignancy.
- Abdominal wall tumors
- Post-operative abdominal CT scans, where prior imaging was unavailable for comparison.
- Patients who received treatment before imaging and whose baseline scans were unavailable.
- Unreported or incomplete CT scans

Sample Size Estimation and Sampling Procedure

As this was a retrospective cross-sectional study, all pediatric patients who fulfilled the inclusion criteria and underwent abdominal CT imaging during the study period were included. Therefore, no formal sample size calculation

was performed, and a census approach of all eligible cases was used.

Data Collection Procedure

Data were collected retrospectively from medical records and imaging reports using a structured and pretested data extraction tool developed in English. Data collection was conducted between July 1 and July 15, 2021, by four trained nurses working in the radiology department, with the involvement of two radiology residents. The data collection process was supervised by the principal investigator to ensure consistency and completeness.

Data Quality Control

Data quality was ensured through **t**raining of data collectors on study objectives, data collection tools, confidentiality, and ethical considerations. A two-day training session was conducted by an experienced researcher from the SPHMMC Department of Public Health and the principal investigator. Pretesting of the data collection tool on 10% of the total sample size, one week before actual data collection was done. Continuous supervision by the principal investigator **and** routine review of completed data extraction forms for completeness and accuracy before data entry was also done.

Data Processing and Analysis

Data were entered, cleaned, and analyzed using Statistical Package for the Social Sciences (SPSS) version 25.0. Descriptive statistical analyses were performed, including frequency distributions and percentages, to summarize sociodemographic characteristics and radiologic findings. Results were presented using tables, charts, and narrative descriptions. Statistical significance was set at $p < 0.05$.

Operational Definitions

- **Abdominal mass:** Any abnormal growth or enlargement occurring within the abdominal cavity.
- **Non-specific symptoms:** Clinical symptoms include anorexia, nausea, fever, and weight loss.

Ethical Considerations

Ethical approval was obtained from the Ethical Review Committee of Saint Paul's Hospital Millennium Medical College (ERC approval, 2021). Informed consent was waived due to the retrospective nature of the study.

Results

Socio-Demographic Characteristics

Data were reviewed from 133 pediatric patients who underw ent abdominal CT imaging. The age of the patients ranged f rom 1 to 14 years, with a mean age of 5 ± 3 years. Of the to tal participants, 71 (53.4%) were male, and 62 (46.6%) were female (Table 1).

Table 1: Sociodemographic characteristics of pediatric patie nts with abdominal masses at SPHMMC

Variables	Frequency (n=133)	Percentage
Sex		
Male	71	53.4
Female	62	46.6

Clinical Presentation

The most common presenting symptom among the 133 pediatric patients was abdominal swelling, reported in 81 patients (60.9%), and followed by abdominal pain in 23 patients (17.3%). Other presentations included diarrhea (11 patients, 8.3%), combined abdominal pain and swelling (12 patients, 9.0%), and non-specific symptoms such as anorexia or fever in 3 patients, 2.3% (Table 2).

Table 2. Clinical presentation of pediatric patients with abdominal masses at SPHMMC

Clinical Presentation	Frequency (n=133)	per cent
Abdominal swelling	81	60.9
Abdominal pain	23	17.3
Diarrhoea	11	8.3
Nonspecific	3	2.3
Abdominal pain and swelling	12	9.0
Other	3	2.3

CT Scans Coverage and Scan Type

Most patients (123, 92.5%) underwent CT scanning of the abdomen and pelvis, while 10 patients (4.8%) had combined imaging of the abdomen, chest, and pelvis. None of the patients had a history of previous abdominal imaging. Regarding scan protocols, 114 patients (84.2%) underwent both pre- and post-contrast CT imaging, whereas 15 patients (11.2%) underwent pre-contrast imaging only, and 4 patients (3.0%) underwent post-contrast imaging only (Table 3).

Table 3: Area scanned and CT scan type among pediatric patients with abdominal masses

Variables	Frequency(n=133)	Percentage (%)
Area scanned		
Abdomen and pelvis	123	95.2
Abdomen, chest, and pelvis	10	4.8
Type of scan		
Pre-contrast and post-contrast	114	84.2
Pre-contrast only	15	11.2
Post contrast only	4	3
Previous scan	133	100

Prevalence and Anatomical Distribution of Abdominal Masses

Among the 133 pediatric patients evaluated, hydronephrosis and organomegaly accounted for 17 (17.5%) and 36 (27.0%) cases of abdominal swelling, respectively. Abdominal masses were identified in 80 patients (72.9%).

Of these 80 patients, 75 masses (93.8%) originated from the retroperitoneum, while 5 masses (6.3%) were intraperitoneal, all of which arose from the liver or biliary system. Among retroperitoneal masses, 30 (40.0%) were of renal origin.

Radiologic Characteristics of Abdominal Masses

The mean size of abdominal masses was 8.95 ± 2.7 cm. Most masses (46 patients, 57.5%) measured between 9 and 16 cm in maximum diameter. The largest mass (15 cm) was observed in a patient with lymphoma, while the smallest mass (3 cm) was noted in a case of solid pseudopapillary epithelial neoplasm of the pancreas. Regarding consistency, 49 masses (61.3%) were solid, followed by mixed and cystic lesions. Most masses (76 patients, 95.0%) involved a single organ, and 56 patients (70.9%) demonstrated midline crossing. Calcification was absent in 51 cases (63.8%).

Among patients who underwent contrast enhanced CT imaging (n = 114), 58 patients (76.3%) demonstrated contrast enhancement, of which 47 cases (81.0%) showed heterogeneous enhancement. Adjacent organ involvement was identified in 7 patients (9.0%), while 29 patients (37.7%) had vascular involvement; among these, 16 patients (55.2%) demonstrated vascular encasement. Bone involvement was rare and absent in 76 patients (96.2%). Pulmonary metastases at presentation were detected in 3 patients (3.8%), and ascites were present in 5 patients (6.3%).

Lymph Node Involvement

Among the 80 pediatric patients with abdominal masses, 38 patients (47.5%) had enlarged lymph nodes. Of these, 27 patients (71.1%) had lymph nodes measuring greater than 30 mm in size.

Radiologic Patterns and Diagnostic Distribution

Among the 80 pediatric patients with abdominal masses, Wilms' tumor was the most frequent radiologic diagnosis, identified in 24 patients (30.0%), followed by lymphoma in 23 patients (28.8%) and neuroblastoma in 20 patients (25.0%) (Figure 1). Uncommon pediatric abdominal tumors accounted for 13 cases (16.2%), including hepatoblastoma (n = 4), renal cell carcinoma (n = 3), multilocular cystic nephroma (n = 3), solid pseudopapillary epithelial neoplasm of the pancreas (n = 2), and hemangioendothelioma (n = 1). Among patients diagnosed with Wilms' tumor, 89% were aged 3-4 years, all tumors were unilateral, and all demonstrated heterogeneous enhancement. Tumor sizes ranged from 4 to 11 cm, with 58.2% crossing the midline. No cases showed internal calcification or fat. Among patients with lymphoma, 12 (52.2%) were aged 3–4 years, tumor sizes ranged from 6 to 12 cm, and 60.3% demonstrated heterogeneous enhancement without calcification or fat. Among patients with neuroblastoma, 13 patients (65.0%) were aged less than one year. Tumor sizes ranged from 3 to 15 cm, 16 cases (80.0%) showed heterogeneous enhancement and 15 cases (75.0%) demonstrated calcification, while no internal fat was identified.

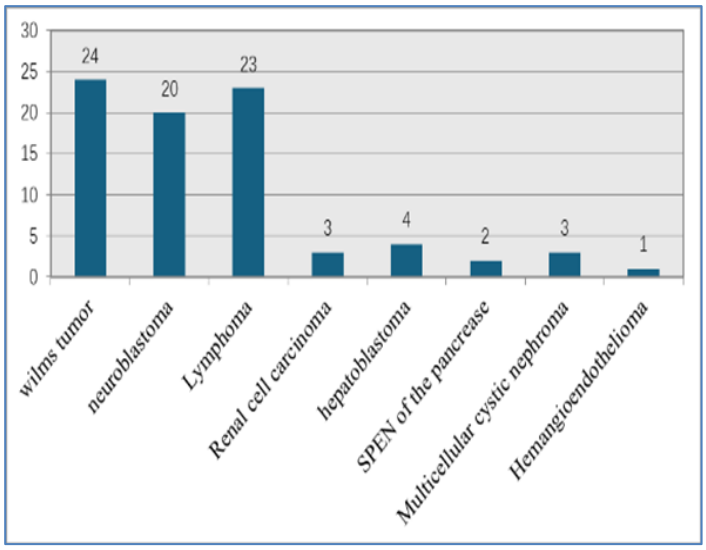

Figure 1: CT-based radiologic patterns of pediatric abdominal masses at SPHMMC

Discussion

This study examined the computed tomographic patterns of pediatric abdominal masses at a tertiary referral hospital in Ethiopia and identified Wilms' tumor as the most common radiologic diagnosis, accounting for 30% of cases. This finding underscores the continued predominance of renal malignancies among pediatric abdominal masses in sub-Saharan Africa and highlights the diagnostic value of CT imaging in this context. The proportion observed in this study is higher than that reported in a small Indian study in which Wilms' tumor accounted for only 14.2% of cases [8]. This discrepancy may be explained by differences in sample size and study settings, as the Indian study included only 21 patients, whereas the present study analyzed a substantially larger cohort.

In contrast, the current findings are consistent with other regional and international studies. A comparable study conducted in India reported Wilms' tumor in 28% of pediatric abdominal mass cases (Onyango, 2019), while a study from Nairobi, Kenya identified Wilms' tumor in 24.8% of cases. The similarity across these studies may reflect comparable demographic characteristics, disease burden, and referral patterns in tertiary care centers within low- and middle-income countries (9).

Lymphoma was identified as the second most common cause of pediatric abdominal mass in the present study, accounting for 28.8% of cases. This finding aligns with reports from India, where lymphoma has consistently ranked as the second leading cause of abdominal masses diagnosed by CT imaging (10). Similarly, a study from Nairobi reported lymphoma in 17.4% of pediatric cases. The relatively high burden of lymphoma observed across these settings may be related to age distribution, delayed presentation, and regional variations in infectious and environmental risk factors. The consistency of findings across studies further supports the reliability of CT imaging in identifying lymphomatous abdominal disease in pediatric populations.

Neuroblastoma was the third most frequent diagnosis in this study, accounting for 25% of abdominal masses. This proportion is higher than that reported in some Indian and Kenyan studies, where neuroblastoma accounted for less than 10% of cases (11). Variations in reported prevalence may reflect differences in age structure, referral practices, diagnostic availability, and disease recognition. Notably, in the present study, the majority of neuroblastoma cases occurred in children younger than one year, which is consistent with the known epidemiology of the disease and reinforces the importance of early imaging evaluation in infants presenting with abdominal masses. The radiologic characteristics observed in this study are consistent with established imaging patterns of pediatric abdominal tumors. Wilms' tumors were predominantly unilateral, heterogeneously enhancing, and frequently crossed the midline, while neuroblastomas commonly demonstrated calcification and heterogeneous enhancement.

The distribution of pediatric abdominal masses observed in this study aligns with broader global and regional evidence indicating that renal and neuroplastic tumors dominate the pediatric abdominal tumor spectrum, particularly in low- and middle-income countries. Large international analyses have consistently shown Wilms' tumor and neuroblastoma to be among the most common childhood solid malignancies, with marked regional variation influenced by health system capacity, early detection, and referral pathways (12-14). In Sub-Saharan Africa, delayed presentation and limited access to advanced diagnostic services often result in higher tumor burden at diagnosis, which may partly explain the predominance of malignant etiologies observed in tertiary referral centers (6, 7). The relatively high proportion of lymphomatous abdominal disease in this cohort further reflects the epidemiologic transition in childhood cancers in Africa, where infectious, environmental, and immunological factors continue to shape disease patterns (1, 2).

Conclusion

This study demonstrates that Wilms' tumor is the most common cause of pediatric abdominal masses diagnosed by CT imaging at Saint Paul's Hospital Millennium Medical College, followed by lymphoma and neuroblastoma. These findings are consistent with patterns reported in other low- and middle-income countries and reinforce the significant burden of malignant abdominal tumors among children in this setting. Neuroblastoma predominantly affected children younger than three years, while Wilms' tumor showed characteristic imaging features consistent with existing literature.

Given its diagnostic accuracy and ability to characterize tumor origin, extent, and associated complications, computed tomography remains a critical imaging modality for the evaluation of pediatric abdominal masses. Strengthening access to CT imaging, alongside multidisciplinary radiologic pathologic correlation, may contribute to earlier diagnosis and improved clinical decision-making. Further prospective studies incorporating histopathological confirmation are recommended to enhance diagnostic precision and guide evidence-based management strategies.

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