Tumors and Beyond: an Array of Abdominal Masses in Children

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Abstract

Aims and Objectives:

1. To provide insight into the different pediatric abdominal masses by Computed Tomography.
2. To characterize the various pediatric abdominal masses based on their imaging features.

Materials & Methods: This observational study was conducted in Department of Radio-diagnosis at S.P. Medical College & A.G. of Hospitals, Bikaner, Rajasthan. Data for the study was collected from patients of pediatric age group attending/ referred to the department of Radio-Diagnosis. An ultrasonographic examination was done in all cases using GE LOGIQ P5 USG machine. Doppler imaging was done in required cases. Non-contrast and contrast enhanced CT scan of the patients was carried out, using PHILIPS BRILLIANCE MDCT 64 SLICE CT SCAN. Scanning protocol was modified according to the age, weight of the child and the clinical situation. Imaging findings were correlated with the clinical course of disease and/or surgical/cytological findings. The results were subjected to statistical analysis and expressed as percentages.

Conclusion: The recent developments have broadened the usefulness of Computed tomography in the evaluation of pediatric abdominal masses. The advantages of single breath hold acquisition in uncooperative children, improved vessel contrast enhancement, increased detection of lesions, and multiplanar and three dimensional reconstruction may make it one of the modalities of choice in diagnosis of abdominal masses in children.

Keywords: Abdomen; Computed Tomography; Wilms'; Hepatoblastoma;

mass and presence or absence of calcific component [1]. Their role ranges from a screening process, providing non-specific information in some cases, to providing specific information in some cases, to providing a specific diagnosis in others [2]. However, children are exposed to radiations and have limited role as only four basic densities (bone or mineral, soft tissue, fat, or air) are visualized [3].

Ultrasound is a powerful imaging modality for the pediatric patients since it does not have radiation hazard. It allows imaging in multiple planes, permits repetitive examinations and requires no physiologic function for anatomic visualization [2]. It can be used in directing a location for biopsies and drainage of fluid collections [4]. It aids in localizing the tumor, looking for associated lymphadenopathy and assessment of vascularity by Colour and Duplex Doppler. Thus, USG is diagnostic in some cases while limits the differential diagnoses in others and hence, is useful as a general screening procedure. However, USG is highly operator dependent and is adversely affected by bone or gas artefacts. In addition, ultrasonography provides less precise anatomic details [4,5,6].

In recent times, computed tomography has found increasing application in the evaluation of pediatric abdominal masses [2]. The anatomic detail provided by CT is superior to any other imaging modality currently available. It obtains an entire anatomic section of tissue, which aids in determining the precise extent of disease. It is not operator dependent and permits the accurate measurement of tissue attenuation coefficient. Enhancement with contrast medium facilitates measurement of blood flow to an organ or pathologic abnormality [7,8]. However, the paucity of tilt in children makes delineation of anatomic margins in the retroperitoneum difficult [9]. In addition, conventional CT requires sedation in infants and small children, intravenous and enteric contrast medium, immobilization and alteration of environment, and is time consuming [10,11].

Thus, Multislice helical technology has expanded the usefulness of CT in evaluation of pediatric abdominal masses [12]. The advantages of single breath-hold acquisition in cooperative children, improved vascular contrast enhancement, increased detection of parenchymal lesions and multiplanar and three-

Introduction

Abdominal lumps in children include a variety of lesions of diverse origin. They may occur from the new born period through adolescence [1]. In most cases, there is absence of peculiar signs and symptoms that may aid in timely diagnosis. In many cases, the lesion is detected late after a long period of vague, non-specific symptoms. The role of radiological imaging is to identify the precise location and extension of the pathologic process using the few essential imaging techniques.

Most abdominal masses in children are initially imaged by Plain X-ray. They provide information about the location of the

dimensional reconstructions may make it one of the modalities of choice in evaluation of pediatric abdominal masses [13,14,15].

Material & Methods

This observational study was conducted in Department of Radio-diagnosis at S.P. Medical College & A.G. of Hospitals, Bikaner, Rajasthan.

Source of Data

Data for the study was collected from patients of pediatric age group attending/ referred to the department of Radio-Diagnosis.

Inclusion Criteria

All patients 0 to 14 yrs who have clinical suspicion as well as ultrasonographic evidence of mass in abdomen.

Exclusion Criteria

- Patients above the age of 14 yrs.
- Patients with bleeding diatheses.
- Patients with previous history of contrast sensitivity.

Methods

A detailed clinical history was recorded followed by relevant clinical examination. An ultrasonographic examination was done in all cases using GE LOGIQ P5 USG machine. Doppler imaging was done in required cases. Non-contrast and contrast enhanced CT scan of the patients was carried out, using PHILIPS BRILLIANCE MDCT 64 SLICE CT SCAN. Scanning protocol was modified according to the age, weight of the child and the clinical situation. Imaging findings were correlated with the clinical course of disease and/or surgical/cytological findings. The results were subjected to statistical analysis and expressed as percentages.

Results

The majority of neonatal masses are retroperitoneal in location (52%) out of which 54% are of renal origin [6]. Paediatric abdominal masses occurring after the neonatal period are still predominantly retroperitoneal; however, there is a significant increase in malignant tumours and some differences in the incidence of specific masses[2]. We studied 50 cases of paediatric abdominal masses in various age groups. Quite a large spectrum of lesions was found.

Table 1: Age Distribution

Age Group	NO. of Cases	Percentage
≤1 year	8	16
1-5 years	21	42
>5 years	21	42
Total	50	100
Maximum: More than 1yr

Chart 1: Age Distribution

Biona et. al, in 1983 and Rastogi et. al in 1988 reviewed the pattern of paediatric abdominal masses [16,17]. The age wise incidence in our series in 3 defined groups was 16% (8/50) in 0-1 years, 44% (22/50) in 1-5years and 40% (20/50) in > 5years (Table1, Chart 1). In our study, the male: female ratio was 29:21 i.e. 1.4:1 (Table2, Chart 2).

Table 2: Sex distribution

Category	Number of Cases	Percentage (%)
Male	29	58
Female	21	42
Total	50	100
Maximum: Males 58%

Chart 2: Sex distribution among the cases

Majority of the patient presented with progressively increasing abdominal lump (Table 3, Chart 3) and USG was the initial investigation requested (Table 4, Chart 4). In our study, out of 50 cases 22 (44%) were malignant and 28 (56%) were benign. This is in accordance with incidence reported by Rastogi et al where 58% masses were benign (Table 5, Chart 5). However, in Biona series, excluding hydronephrosis 18 of the 26 cases (70%) were malignant [16,17].

Table 3: Various clinical signs/symptoms of presentation

Presenting symptoms/signs	No. of cases	Percentage
Lump in abdomen/back	23	44
Pain in abdomen	19	37
Abdominal distension	15	32
Vomiting	4	9
Fever	8	11
Hematuria	2	4
Icterus	2	4

Maximum: Lump in abdomen-44%

Chart 3: Presenting signs and symptoms

Table 4: Initial investigation for which patient was referred

Investigation	No. of cases	Percentage
Plain radiograph	2	4%
Contrast study	0	0%
USG	44	88%
CT	4	8%

Maximum: USG- 88%

Initial investigation

Chart 4: Initial investigation requested

Table 5: Distribution of masses according to nature

Nature of Mass	No. of cases	Percentage
Malignant	22	44%
Benign	28	56%
Congenital	3	6%
Infective/Inflammatory	13	26%
Neoplastic	4	8%
Miscellaneous	7	14%

Chart 5: Distribution of masses according to nature

In our study, 52% (26/50) of the masses were retroperitoneal out of which 14 (54% of retroperitoneal and 28% of total) were renal (Table 6, Chart 6), an incidence quite similar to that reported by Biona et al (58% retroperitoneal and 31% renal) and Rastogi et al (53% retroperitoneal and 32% renal). Egeibor and Jabral also state that the majority of the abdominal masses occurring in childhood are retroperitoneal in location, and greater than 50% of these masses arise from the kidney [16,17,18].

Table 6: Location of masses

Location	≤1 year	1-5years	>5years	Total	Percentage
Renal	3	7	4	14	28%
Non-renal retroperitoneal	0	7	1	8	16%
Genital	0	2	4	6	12%
Gastro-intestinal/Mesentric	0	0	6	6	12%
Hepatobiliary	1	3	4	8	16%
Others	4	2	2	8	16%
Total	7	19	17	50	100%

Maximum: Renal-28%

Chart 6: Showing location of masses in various age groups

Out of the 14 renal masses, 8 were neoplastic (57%). Out of these 5 (62.5%) had Wilms' tumor (Figure 1), 1 had rhabdoid tumor of kidney and 1 had renal cell carcinoma (Table 7). In cases reported by Rastogi et al, 63% of renal lesions were neoplastic and all had Wilms' tumor while in Biona series, all the renal masses (exclusive of hydronephrosis) had Wilms' tumor [16,17,19]. (Figure 2)

Non-renal retroperitoneal masses constituted 24% (12/50) of the cases (Table 6, Chart 6). This is similar to the incidence reported by Griscom (29%), Rastogi et al (20%) and Biona et al (30%). Out of these, 6 cases were of neuroblastoma (50%) (Figure 3). In series by Griscom, neuroblastoma constituted 60% of non-renal retroperitoneal cases while in series by Rastogi et al and Biona et al, 39% and 11.8% were neuroblastomas [3,16,17].

Next category of masses included those of gastro intestinal /mesenteric origin (Table 7). These constituted 12% (6/50) of total cases as compared to 32% in Rastogi series. However, in cases illustrated by Griscom, 16% cases were of gastrointestinal/ mesenteric origin while Biona series had only 2 such cases

[6,16,17]. Out of the cases in our study, all 6 children were >5years of age. The diagnosis included mesenteric lymphangioma, chronic midgut volvulus, omphalomesenteric cyst (Figure 4).

Hepatobiliary masses contributed 8(16%) cases. Out of these, 2 cases were of hepatoblastoma (Figure 5), one of Hepatocellular carcinoma, and one of choledochal cyst (Figure 6). Cases of liver abscess and hydatid cyst were also observed (Figure 7).

Cases involving genital system were also found 6/50 (12%). Of these 1 was malignant (dysgerminoma) while others were benign and included teratoma, ovarian cysts and ovarian torsion (Figure 8).

USG and CT were done in every patient. While USG was found quite useful in majority of the cases, its accuracy was found to be consistently less as compared to CT in all aspects. While the accuracy of USG in predicting nature of the mass, its localisation, extent and exact diagnosis was 81%, 64.5%, 59% and 54.5% respectively, the accuracy of CT for same was found to be 100%, 97%, 100% and 81% respectively (Table8, Chart 7).

Figure 1 (Wilm's Tumor): Clockwise: On sagittal US image of the left kidney, a large mass can be demonstrated as a hypoechoic mass in the upper pole of the kidney. Reformatted coronal and axial contrast-enhanced CT images demonstrate a larger mass with well-defined contours in the upper pole of the left kidney. There is a nodular heterogeneous lymph node in para-aortic region.

Table 7: Percentage of masses according to diagnosis

Diagnosis	≤1 year	1-5 yrs	>5 years	Total	Percentage
Wilm's tumor	0	3	2	5	10%
Neuroblastoma	0	6	0	6	12%
Mesenteric cyst/lymphangioma	0	0	2	2	4%
Perinephric/renal abscess	1	0	1	2	4%
Abdominal wall abscess	1	0	0	1	2%
Rhabdoid tumor of kidney	0	1	0	1	2%
Renal cell carcinoma	0	0	1	1	2%
Hepatoblastoma	0	2	0	2	4%
Hepatocellular carcinoma	0	0	1	1	2%
Liver abscess	1	0	2	3	6%
Retroperitoneal yolk sac tumor	0	1	0	1	2%
Hydatid cyst	0	1	1	2	4%
Hydroureteronephrosis/ Hydronephrosis	1	1	0	2	4%
Psoas abscess	0	1	0	1	2%
Iliocaecal TB	0	0	1	1	2%
Lymphoma	0	1	1	2	4%
Midgut volvulus	0	0	1	1	2%
Multicystic dysplastic kidney	1	0	0	1	2%
Embryonal rhabdomyosarcoma	0	1	1	2	4%
Cystic nephroma of kidney	0	1	0	1	2%

Sacro-coccygeal teratoma	1	0	0	1	2%
Pelvic teratoma	0	1	1	2	4%
Choledochal cyst	0	0	1	1	2%
Ovarian cyst	0	0	2	2	4%
Ovarian torsion	0	0	1	1	2%
Heterotaxy syndrome	1	0	0	1	2%
Appendicular abscess	0	0	1	1	2%
Malignant Dysgerminoma	0	0	1	1	2%
Pseudopancreatic cyst	0	0	1	1	2%
Hemorrhagic adrenal cyst	1	0	0	1	2%
Total				50	100%

Maximum: Neuroblastoma-12%

Figure 2 (Renal abscess): Right: Transverse ultrasound image of right kidney shows avascular heterogeneous area in upper and mid zones. Left: Contrast-enhanced axial CT image shows heterogeneous lesion with multiple internal septations of varying thickness in right kidney.

Figure 3 (Neuroblastoma): Neuroblastoma; Axial CT scans shows a large soft tissue mass, with areas of necrosis, crossing the midline and encasing and anteriorly displacing the aorta and inferior vena cava

Figure 5 (Hepatoblastoma): Axial Contrast enhanced CT shows heterogeneously enhancing mass lesion in the left lobe of liver.

Figure 4 (Mesenteric cyst): Transverse ultrasound image of mid abdomen shows large anechoic cystic mass with imperceptible wall. Contrast-enhanced axial CT image shows well-circumscribed cystic mass without enhancement in mid abdomen.

Figure 6 (Choledochal cyst): CT scan of a child shows a well-defined cyst in the porta hepatis associated with dilated central hepatic ducts.

Figure 7 (Hydatid cyst of liver): Contrast-enhanced axial CT image shows well-defined cystic mass with several internal endocyst membranes.

Figure 8 (Ovarian Cyst): Axial CT shows a large ovarian cyst displacing and compressing the urinary bladder. It is typically hypodense, sharply demarcated with a smooth thin wall.

Table 8: Accuracy of CT and USG vis-à-vis surgical/cytological findings

	USG	CT
Nature of Mass	81%	100%
Localization	64.5%	97%
Extent	59%	100%
Diagnosis	54.5%	86%

Conclusion

An abdominal mass in an infant presents a challenging diagnostic problem. Preoperative study of abdominal masses is a problem of primary importance in paediatric age group [20].

In last many years, Computed Tomography has been established as the imaging modality of choice for evaluation of paediatric abdominal masses [21]. Recently the introduction of multislice multidetector helical CT has resulted in improved spatial and temporal resolution with reduction in scan acquisition and display time from minutes to seconds, while at the same time allowing acquisition of volume data [22,23].

Chart 7: Accuracy of CT and USG vis-à-vis surgical/cytological findings

While CT was found to be 100% accurate in determining the exact location as well as extent of the mass lesions, the accuracy for diagnosis was found to be 81% reflecting the inherent limitation of the imaging modality in terms of non specific findings in certain lesions. An important aspect was optimal vascular enhancement and excellent multiplanar reconstructions with CT that enabled an appropriate evaluation of the extent of the lesion as well as relation of the mass to various vessels at the same time also conclusively telling about vascular invasion, an important finding in context of various malignancies and their staging [24,25]. In context of children, the motion artifacts encountered in our study were very infrequent and in no case were they of such significance as to impede the diagnostic value of the examination.

Thus we would conclude that the recent advances have expanded the usefulness of CT in the evaluation of paediatric abdominal masses [26,27]. The advantage of single breath hold acquisition in cooperative children, improved vascular contrast enhancement, increased detection of parenchymal lesions, and multiplanar and three dimensional reconstruction may make it one of the modalities of choice in evaluation of paediatric abdominal masses.

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