EXPLORING THE PEDIATRIC ABDOMEN: A RADIOLOGICAL EVALUATION.

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ABSTRACT

To study and characterize various paediatric abdominal masses by Multidetector CT.To assess the role of Multidetector CT in imaging of various abdominal masses in paediatric age group. This hospital based study was conducted in Department of Radio-diagnosis and Modern imaging of PBM Hospital, Bikaner, Rajasthan. Data for the study was collected from patients of paediatric age group attending/ referred to the department of Radio-Diagnosis.A preliminary ultrasound scanning was done in all cases using GE LOGIQ P5 sonography machine with transducers of appropriate frequency. Color Doppler imaging was done as and when required based on gray scale characteristics.Non-contrast and contrast enhanced CT examination of the patients was carried out, using PHILLIPS BRILLIANCE MDCT 64 SLICE CT SCAN. Scanning protocol were tailored 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 as far as possible. The results were subjected to statistical analysis wherever applicable and expressed as percentages.The recent advances have expanded the usefulness of CT in the evaluation of pediatric abdominal masses. The advantage of single breath hold acquisition in cooperative children, improved vascular contrast enhancement, increased detection of parenchymal lesions, and multiplanar and three dimentional reconstruction may make it one of the modalities of choice in evaluation of pediatric abdominal masses.

***KEYWORDS*:** Pediatric; imaging; CT; Abdomen; tumor.

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INTRODUCTION

Abdominal masses in the paediatric age group include a spectrum of lesions of diverse origin and significance. They may occur at any age- from the new born period through adolescence [1]. In most cases, their common aspect is the lack of peculiar clinical features that may help in early differential diagnosis. In many cases, the mass is detected late after a long period of vague, non- specific symptoms. The role of diagnostic imaging is to identify the precise anatomic location and extent of the pathologic process with a minimal number of imaging procedures.

Most abdominal masses in children are initially imaged by abdominal radiography. Abdominal radiographs provide information as to the location of the mass and presence or absence of calcification[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.However, patients are exposed to radiation and radiographs have the intrinsic limitation in that only four basic densities (bone or mineral, soft tissue, fat, or air) are identified[3]. Ultrasonography is particularly useful imaging modality for the paediatric patients since it does not utilize radiation[2]. It allows imaging in multiple planes, permits repetitive examinations and requires no physiologic function for anatomic visualization[2]. It is also a portable means for examination of complications and does not generally require sedation. It can be used in directing a location for biopsies and drainage of fluid collections. It aids in localization of the tumor, identification of associated adenopathy and examination of adjacent vascular structures 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[4]. In addition, ultrasonography provides less precise anatomic details and smaller section areas of interest.

In recent times, computed tomography has found increasing application in the evaluation of paediatric abdominal masses[2]. It is currently one of the most powerful and versatile imaging procedure for the evaluation of abdominal masses.

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. The technique 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. Bolus injection permits visualization of vascular structures. Anatomic and physiologic information may be obtained in severely compromised organs, and structures may bevisualized despite overlying gas and bone. However, the paucity of tilt in children makes delineation of anatomic margins in the retroperitoneum difficult. In addition, conventional CT requires sedation or anaesthesia in infants and small children, intravenous and enteric contrast medium, immobilization and alteration of environment, and is time consuming.

The technical improvements, in the form of ***Multislice helical CT*** recently, have resulted in improved resolution and considerable reductions in scan acquisition and display time.

One of the most notable effects of faster scanning with present CT technology in children is the reduced need for sedation. In cases of neoplasms, ***Dual phase imaging*** of the organ concerned is important to obtain information about the vascular status. Multislice CT has improved temporal resolution into arterial and venous phases.

In certain cases, like lymphomas, CT of neck, chest, abdomen and pelvis may be necessary for staging or follow-up. With the advent of Multislice CT, the imaging time is reduced considerably. This has facilitated optimal contrast enhancement during CT of neck, chest, abdomen and pelvis using a single i.v contrast material bolus of the standard paediatric dose of contrast material. Another advantage of recent technological advancements is volume acquisition of data. This furnishes several important benefits for children. Reconstruction can be performed conveniently once the patient has left the scanner. With Multislice CT, now isotropic viewing has become a reality. Unlimited reformations are possible without any difficulty, leading to increased conspicuity.

Thus, Multislice helical technology has expanded the usefulness of CT in evaluation of paediatric abdominal masses. The advantages of single breath-hold acquisition in cooperative children, improved vascular contrast enhancement, increased detection of parenchymal lesions and multiplaner and three-dimensional reconstructions may make it one of the modalities of choice in evaluation of paediatric abdominal masses.

MATERIAL & METHODS:

This hospital based study will be conducted in Department of Radio-diagnosis and Modern imaging of PBM Hospital, Bikaner, Rajasthan.

Source of data:

Data for the study will be collected from patients of paediatric age groupattending/ referred to the department of Radio-Diagnosis, PBM Hospital, Bikaner for evaluation of abdominal mass.

Inclusion criteria:

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

Exclusion criteria:

1. Patients above the age of 14 yrs.

2. Patients with bleeding diatheses.

3. Patients with previous history of contrast sensitivity.

Methods:

The study will be carried out in the Department of Radiodiagnosis, SPMC and PBM Hospital, Bikaner on the following lines:

a. A detailed clinical history will be recorded.

b. Relevant clinical examination will be done.

c. Required lab investigations will be done.

d. Radiological Examination :-

i) A preliminary ultrasound scanning will be done in all cases using GE LOGIQ P5 sonography machine with transducers of appropriate frequency.

ii) Color Doppler imaging will be done as and when required based on gray scale characteristics.

iii) Non-contrast and contrast enhanced CT examination of the patients will be carried out, using PHILLIPS BRILLIANCE MDCT 64 SLICE CT SCAN. Scanning protocol shall be tailored according to the age, weight of the child and the clinical situation. Dual-phase imaging and angiography sequences shall be used as and when required.

iv) Other radiological investigations will also be done wherever required.

v) Ultrasound/CT guided FNAC/biopsy shall be done wherever indicated.

e. Imaging findings will be correlated with the clinical course of disease and/or surgical/cytological findings as far as possible.

Statistical Analysis

The results will be subjected to statistical analysis wherever applicable and expressed as percentages.

RESULTS:

Abdominal masses in the neonatal period are predominantly benign lesions, usually representing defects in the embryonic development[2]. 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 tumors and some differences in the incidence of specific masses[2]. We studied 50 cases of pediatric abdominal masses in various age groups. Quite a large spectrum of lesions was found.

Biona et al[24] in 1983 and Rastogi et al[25] in 1988 reviewed the pattern of pediatric abdominal masses.

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. This is quite similar to the age incidence given by Biona et al[24] of 16.4%, 51% and 32.6% respectively for the three age groups. Age wise incidence of masses(exclusive of hydronephrosis) given by Rastogi et al[25] (27% in 0-1year, 39% in 1-5years and 34% in >5years). However, the difference can be attributed to exclusiom of patients with hydronephrosis in 1-6 year age group in their study. Biona et al[24] reported that males were affected more than females (1.5:1). Rastogi et al also reported that males were affected more often than females (2.4:1). In our study, the male:female ratio was 29:21 i.e. 1.4:1.

Majority of the patient presented with progressively increasing abdominal lump and USG was the initial investigation requested.

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[25] where 58% passes were benign. However, in Biona[24] series, excluding hydronephrosis 18 of the 26 cases (70%) were malignant.

In our study, 52% (26/50) of the masses were retroperitoneal out of which 14 (54% of retroperitoneal and 28% of total) were renal, 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[23] 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.

According to Egeibor and Jabral[23], approximately 87% of solid renal neoplasms in children are Wilms' tumors; other renal tumors include clear cell sarcomas (6%), mesoblastic nephroma (2%), rhabdoid tumors (2%), lymphoma (<O.5%) and renal cell carcinoma (<0.5%). In our study, out of the 14 renal masses, 8 were neoplastic (57%). Out of these 5 (62.5%) had Wilms' tumor, 1 had rhabdoid tumor of kidney and 1 had renal cell carcinoma. 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.

Approximately 50% of children with Wilms' tumor present before 3 years, 80% before 5 years.In Biona series[24], 50% of the cases of Wilms' tumor were in 1-6years age group while 55% were in the group in Rastogi series[25]. In our study, 60% of patients presented before 5 years of age.Other renal lesions included renal cell carcinoma, rhabdoid tumor of kidney, perinephric/renal abscess and one infant with multicystic dysplastic kidney.

Non-renal retroperitoneal masses constituted 24% (12/50) of the cases.This is similar to the incidence reported by Griscom (29%)[3], Rastogi et al[25] (20%) and Biona et al[24] (30%). Out of these, 6 cases were of neuroblastoma (50%). In series by Griscom[3], neuroblastoma constituted 60% of non-renal retroperitoneal cases while in series by Rastogi et al[25] and Biona et al[24], 39% and 11.8% were neuroblastomas.

Peak age of incidence of neuroblastoma is in first 5 years of life (85 percent), with 50% in less than 2 years of age. In our study, out of 6 cases, all 6 cases were <5 years of age. The mean age of presentation was 43.4 months as compared to 31.7 months in Biona series.

Other non-renal retroperitoneal masses included one case each of psoas abscess; retroperitoneal yolk sac tumor, sacro-coccygeal and pelvic teratoma.

Next category of masses included those of gastro intestinal /mesenteric origin. These constituted 12% (6/50) of total cases as compared to 32% in Rastogi series[25]. However, in cases illustrated by Griscom[6], 16% cases were of gastrointestinal/mesenteric origin while Biona series[24] had only 2 such cases. Out of the cases in our study, all 6 children were >5years of age. The diagnosis included mesenteric lymphangioma, chronic midgut volvulus, omphalomeseneric cyst,etc.

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

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 tortion.

Eight of the case could not be ascertained to a particular category. Out of these, one case had abscess in the abdominal wall. Another interesting case was of a neonate with heterotaxy syndrome.

Plain radiographs and contrast studies were done in 10 patients. Plain radiographs were taken in five patients, out of whom 2 had Wilms' tumor, 1 case was of renal cell carcinoma, 2 had neuroblastoma, 1 had chronic midgut volvulus. Loss of renal outline with soft tissue mass was seen in all the three cases with renal tumors, thus providing aclue to the origin of the mass.

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.

Fig1: Wilms 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.

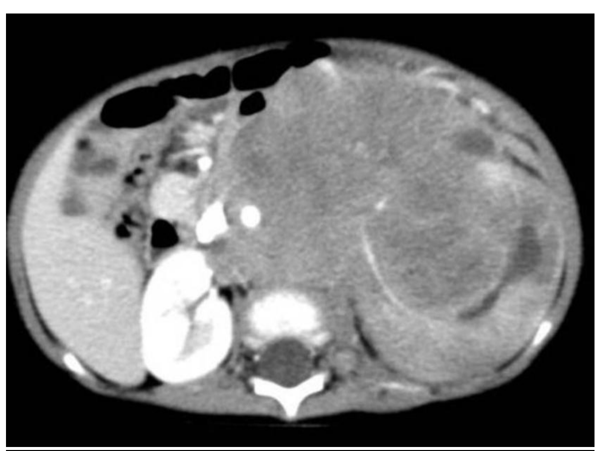


Fig. 2: Neuroblastoma; Axial CT scans shows a large soft tissue mass, with areas of necrosis, crossing the midline and encasing and anteriorly displacing the aorta and inferior vena cava.

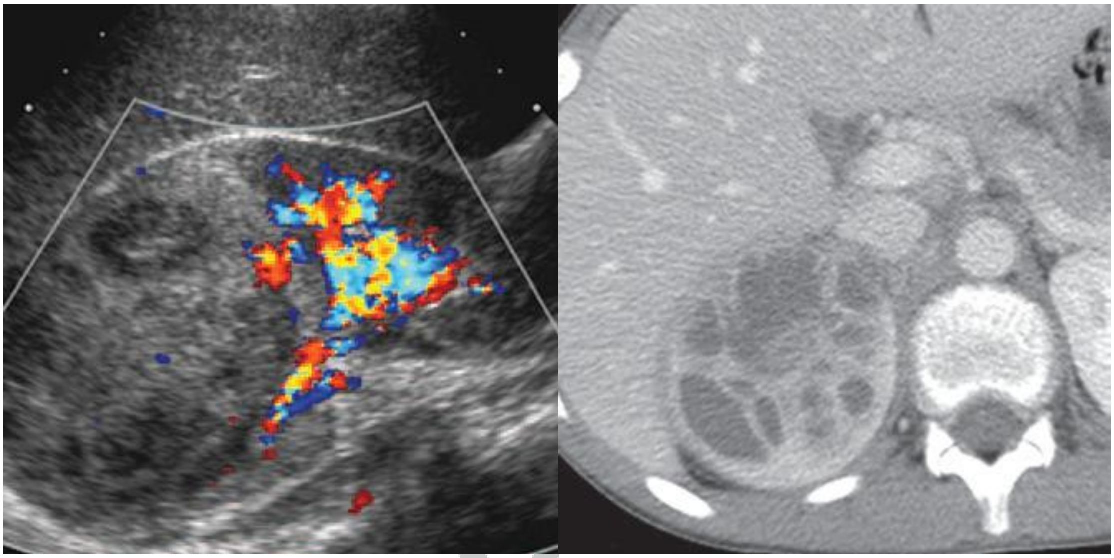


Fig. 3—Renal abscess **Right:**Transverse ultrasound image of right kidney shows avascular heterogeneous area in upper and mid zones.**Left:**Contrast-enhanced axial CT image shows heterogeneous lesion with multiple internal septations of varyingthickness in right kidney

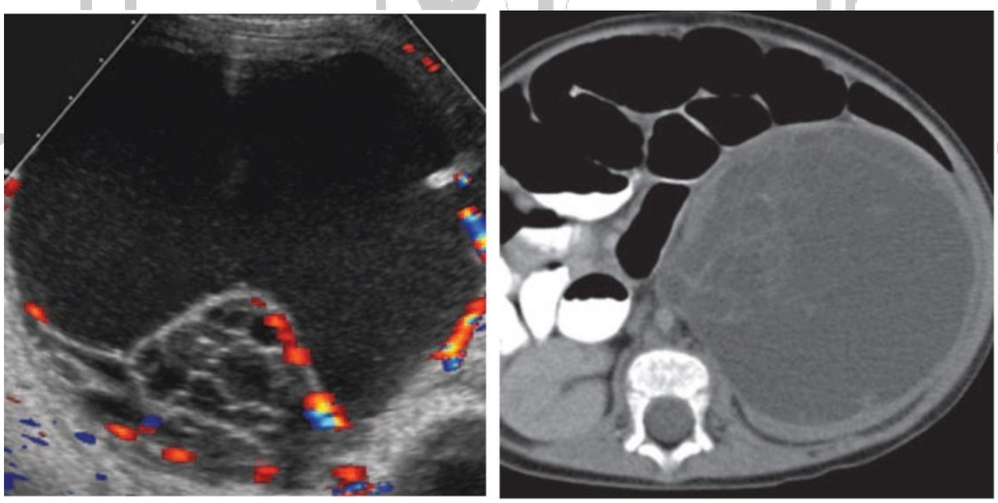


Fig 4: Multilocular cystic nephroma. **Right ,**Transverse ultrasound image of left kidney shows cystic mass with echogenic septa. Bloodflow within these echogenic septa is also seen.**Left,** Contrast-enhanced axial CT image shows largewater-attenuation mass with well circumscribedborders and mildly enhancing internal septations.

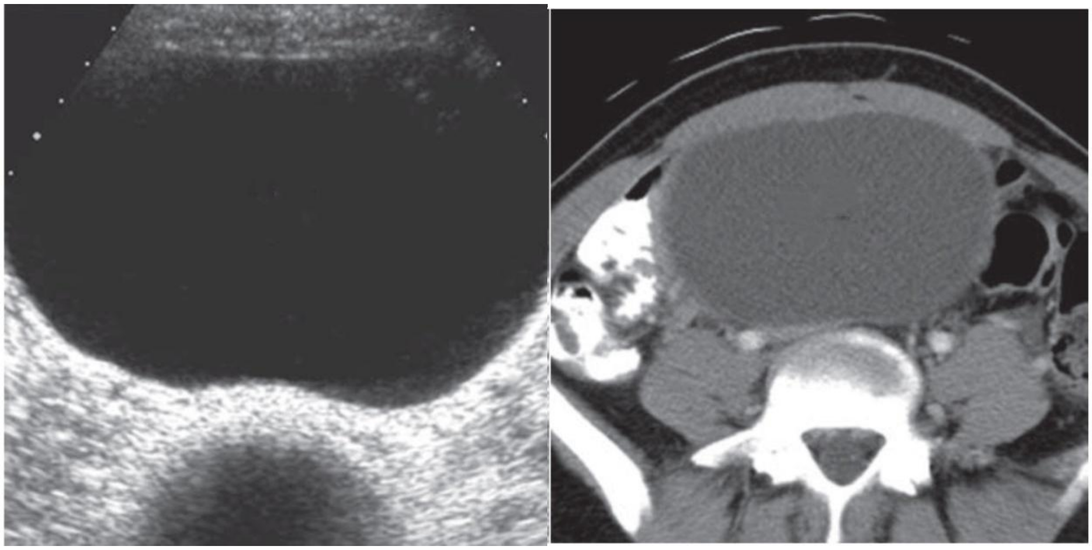


Fig 5: Mesenteric cyst **Right,** Transverse ultrasound image of midabdomen shows large anechoic cystic mass with imperceptible wall.**Left,** Contrast-enhanced axial CT image shows well-circumscribed cystic mass without enhancement in mid abdomen.

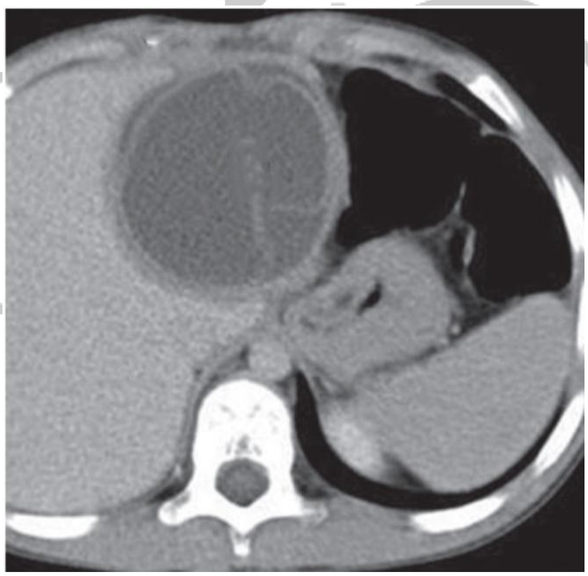


Fig 6: Hydatid infection Contrast-enhanced axial CT image showswell-defined cystic mass with several internalendocyst membranes.

Fig 7: Hepatoblastoma: Axial CECT shows heterogeneously enhancing mass lesion in the left lobe.

Fig 8: Axial CT shows large ovarian cyst displacing and compressing the urinary bladder is typically hypodense, sharply demarcated with a smooth thin wall.

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

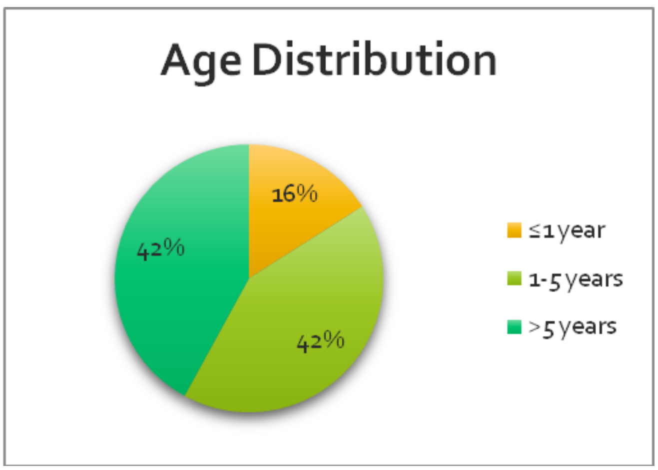


Table 2: Sex distribution

CATEGORY	NUMBER OF CASES	PERCENTAGE (%)
MALE	29	58
FEMALE	21	42
TOTAL	50	100

Maximum: Males 58%

Chart 2: Sex Distribution

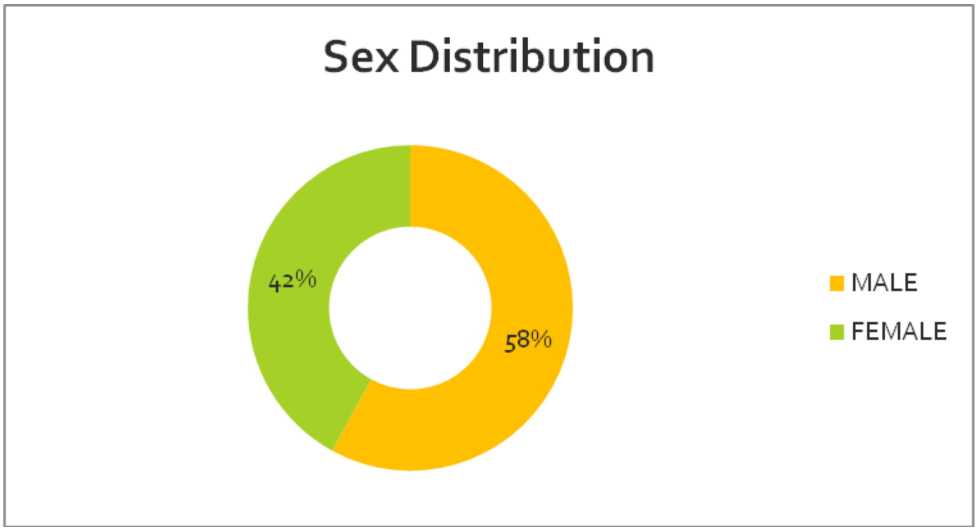


Table 3: Various clinical signs/symptoms of presentation

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: Various clinical signs/symptoms of presentation

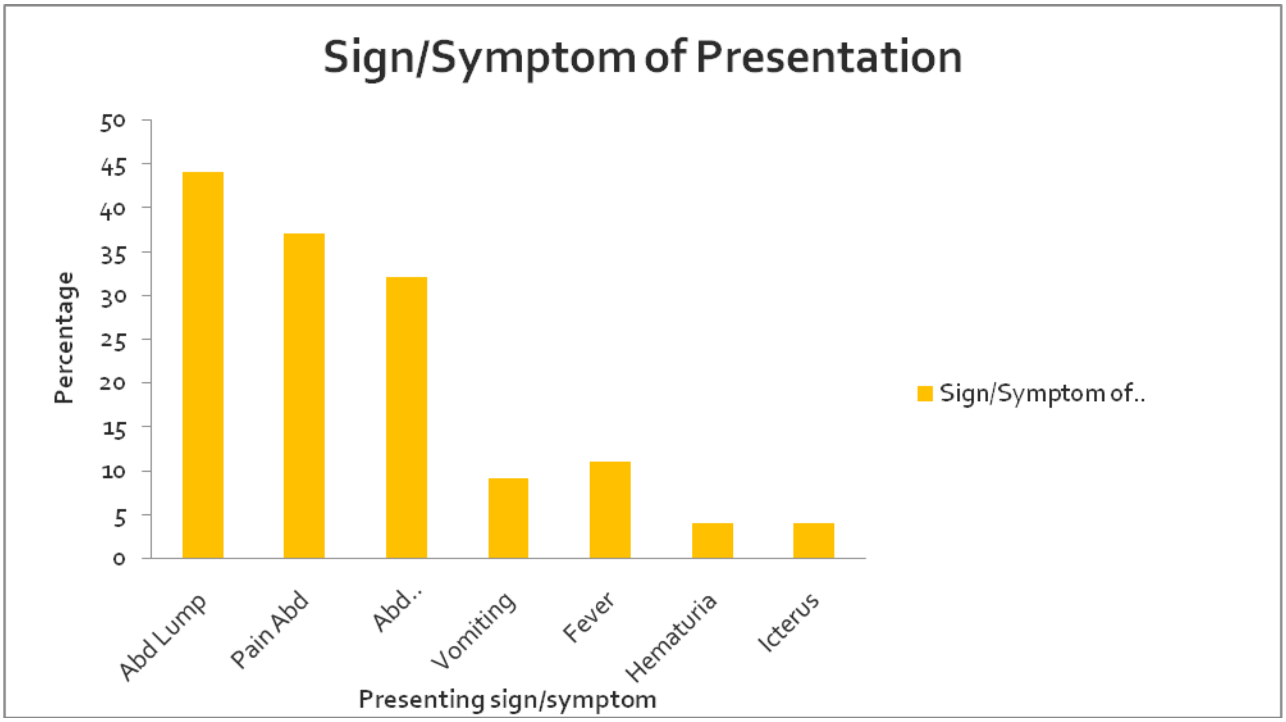


Table 4: Initial investigation for which patient was referred

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

Maximum: USG- 88%

Chart 4: Initial investigation for which patient was referred

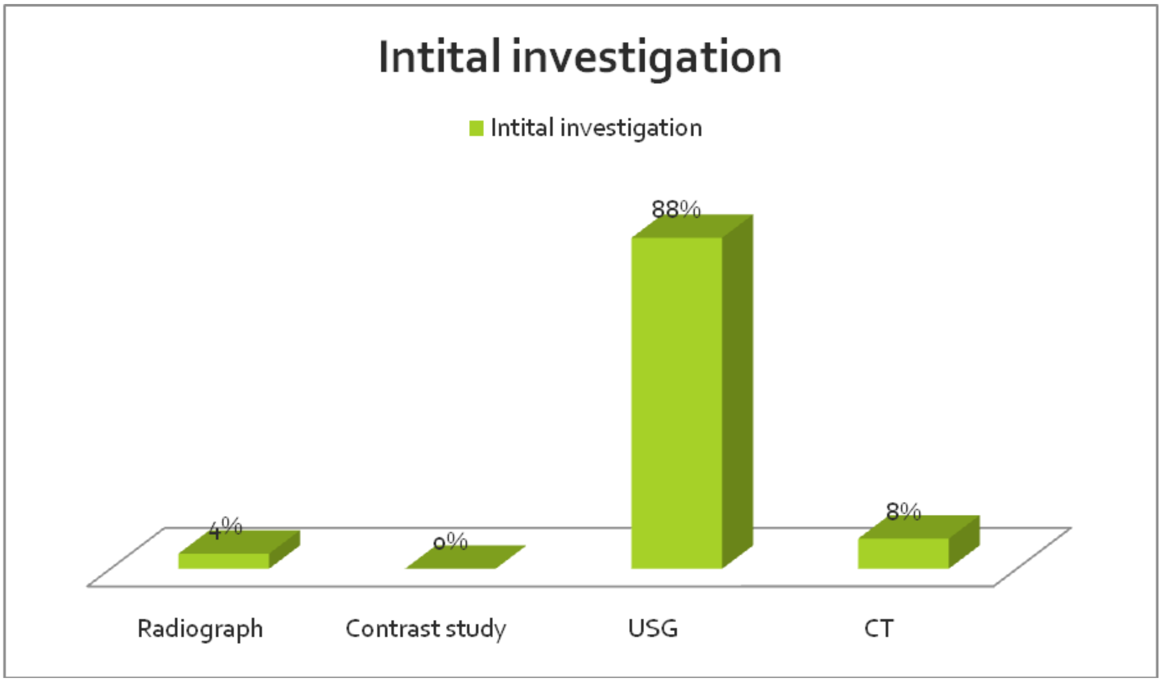


Table 5: Distribution of masses according to nature

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

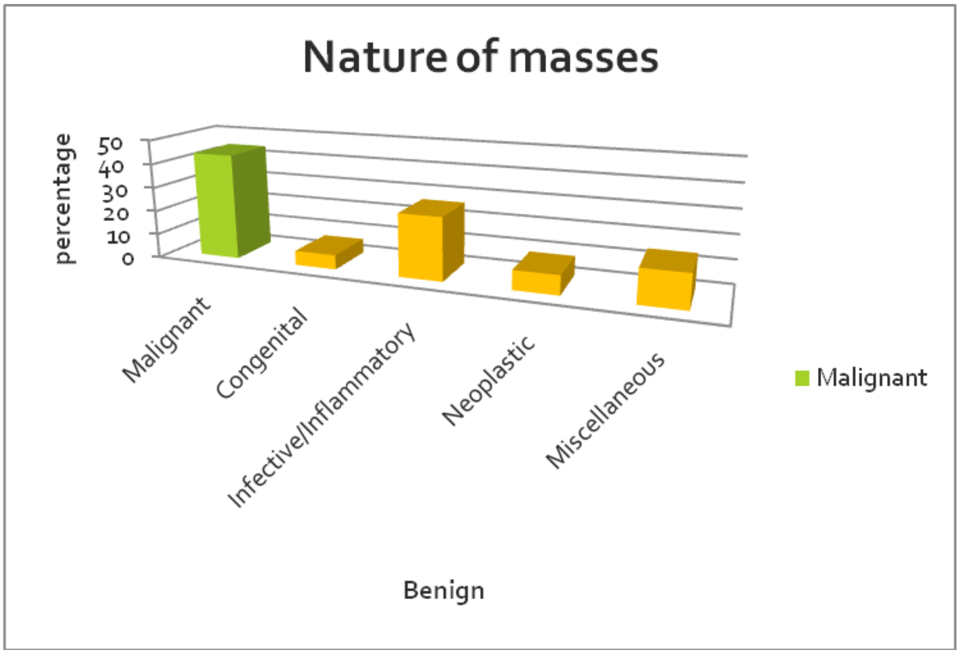
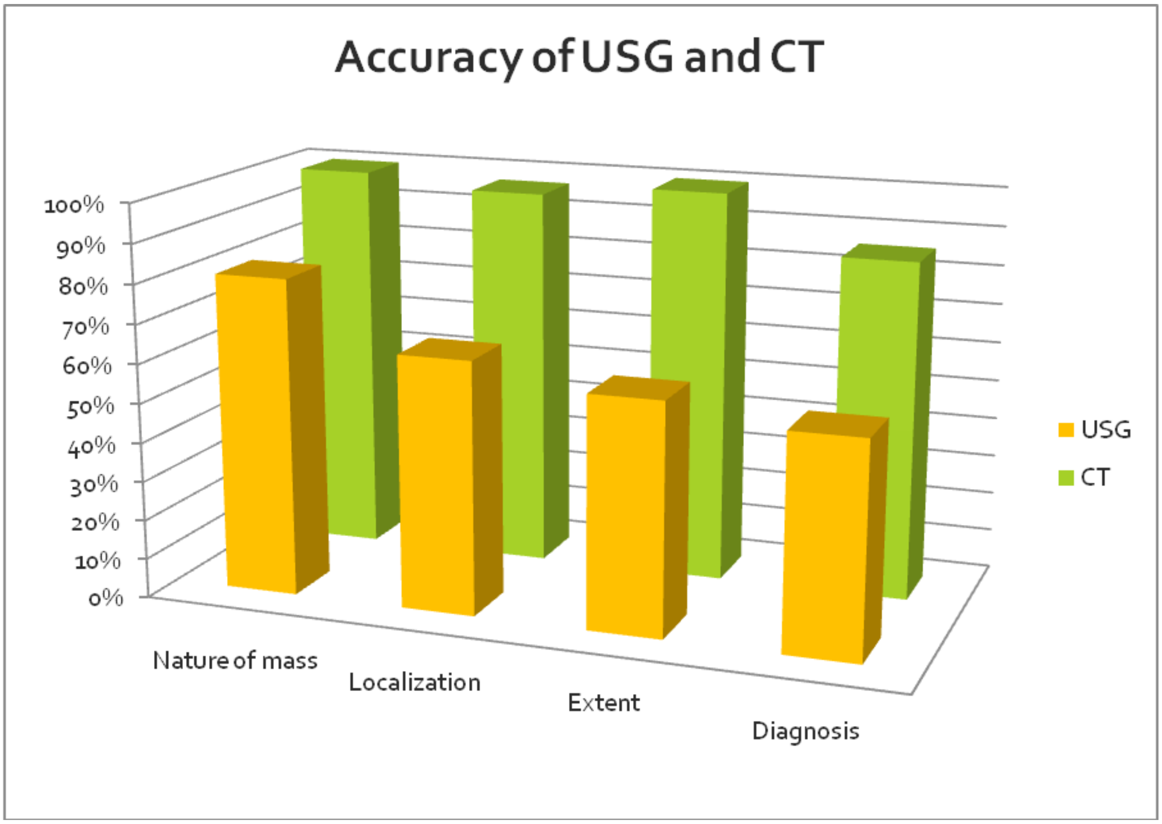


Table 6: Accuracy of CT and USG vis-à-vis surgical/cytological findings

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

Chart 6: Accuracy of CT and USG vis-à-vis surgical/cytological findings



CONCLUSION:

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

Though the percentage of most common masses in our study confirmed with those given in literature, we also encountered many interesting lesions that are uncommon as well as sometimes overlooked in various classifications. While the major proportion was constituted by renal (28%) and non renal retroperitoneal masses (24%), mesenteric/ gastrointestinal(12%) and hepatobiliary (16%) masses constituted the next most common masses. The age distribution of the masses was almost equal in the three categories (16%, 44% and 44% respectively for age groups <=1yr, 1-5yrs and >5yrs of age). Male to female ratio was 3:2 approximately.

In last many years, CT has become established as the imaging modality of choice for evaluation of pediatric abdominal masses. Recently the introduction of multisclice multidetector helical CT has resulted in improved special 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. This has made possible increased anatomic coverage lesional dual phase imaging, Ct angiography for vascular status and retrospective multiplanar reconstruction of area of interest with images of high quality to predict the exact extent of the lesion. In our study, while the accuracy of USG for 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.

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 our 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/encasement, an important finding in context of various malignancies and their staging. 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 pediatric abdominal masses. The advantage of single breath hold acquisition in cooperative children, improved vascular contrast enhancement, increased detection of parenchymal lesions, and multiplanar and three dimentional reconstruction may make it one of the modalities of choice in evaluation of pediatric abdominal masses.

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