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Correlation of radiological investigations with clinical findings in cases of abdominal mass in the paediatric age group

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ABSTRACT

Background: The aim of the following study is to find out the accuracy of clinical examination and radiological investigations in determining the organ of origin and diagnosis in cases of abdominal mass. **Patients and Methods:** This prospective study included patients presenting with a palpable abdominal mass. Complete detailed history and clinical examination were done prior to any investigation to find out the possible clinical diagnosis and determine the organ of origin. Radiological investigations were done by blinded senior radiologist to form a radiological diagnosis and determine the organ of origin. Final diagnosis was used to see the accuracy of both the pre-operative modalities. **Results:** There were 50 cases which formed the study group. Male to female ratio was 2:1. Prepubescent age was the most common age group at presentation. Right hypochondrium was the most commonly affected quadrant (18%). Most of these masses were hepatobiliary in origin. The overall accuracy of ultrasound with respect to the final diagnosis was 45/50 (90%). Ultrasonography findings correlated with a clinical diagnosis in 91% of those who were operated and in 88% in those confirmed by biopsy or other modalities. Radiological investigations in total had accuracy of 94%, which was similar to the clinical examination. Both radiological diagnosis and clinical diagnosis were correct in 47/50 (94%) cases. **Conclusions:** Most of the cases of abdominal mass can be well evaluated clinically in terms of the diagnosis and organ of origin. Both radiological investigation and a good clinical examination have equal sensitivity. Radiological investigations are thus only adjuvant to a good clinical examination.

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INTRODUCTION

A distended abdomen with a palpable mass is a common presentation in a Paediatric Outpatient Department. The first question which then strikes in mind is what is the cause of this mass? What is its organ of origin? From how long this mass is persisting? And most importantly what definitive or therapeutic procedure can be offered to this child? Most of the presenting masses are usually intra-abdominal in nature and need almost always operative management. The nature and extent of operation depends upon the cause, extent and presenting stage of the mass. Some of them like intussusception, malignant mass or mass arising due to infective pathology need urgent intervention while others may be planned after a battery of investigations.

In majority of paediatric age group abdominal masses pose a diagnostic challenge. Masses are clinically evaluated and at times it is difficult to find out the exact anatomical and pathological cause. The diagnosis remains obscure even after submitting these patients for radiological investigations. As the mass in children arises from a variety of abdominal organs, they do not necessarily present the clinical characteristics of organ from which they have originated. At times there are disparity between clinical diagnosis and various radiological investigations done for them. This creates problem to the physician to adopt a right line of management. Radiological investigations in general help the clinician in confirming or excluding the clinical diagnosis and it also helps in decision making and planning. Unfortunately with time these investigations are replacing clinical examination in decision making and reaching to a diagnosis. This study was designed to compare the sensitivity of these two modalities in reaching to the diagnosis and

predicting the organ of origin. The purpose of our study was also to find out the common causes of abdominal masses in children.

This study evaluated the incidence of each abdominal mass in the paediatric age group, their causes, and clinical presentation; to find out the accuracy of clinical examination and radiological investigations in diagnosing the organ of origin and diagnosis in these cases.

PATIENTS AND METHODS

This was a prospective study which included all the patients presenting with a palpable abdominal mass in the paediatric surgery outdoor or indoor patient department of the institute from January 2006 to December 2010. Those refusing consent for participation were excluded. Complete detailed history of the patient was taken starting from the antenatal and intranatal history, to the origin and progression of the mass, its association with various aggravating and relieving factors. All the cases were examined thoroughly to find out the possible clinical diagnosis and determine the organ of origin. All the examinations were done by a senior paediatric surgeon prior to any investigations and the findings were recorded. After clinical diagnosis child was then subjected to investigations like ultrasound abdomen, Contrast-enhanced computed tomography (CECT) abdomen and magnetic resonance imaging (MRI). All the radiological investigations were done by a senior radiologist blinded about the clinical diagnosis to form a radiological diagnosis and comment about the organ of origin. The investigation used as the first investigation by the radiologist was used for the calculation of the sensitivity. All the ultrasonography (USG) were done using Siemens USG machine with standard probes, CECT scan of slice thickness 5 mm were taken and MRI was done using 1.5 T MRI facility. Final diagnosis was confirmed by surgical resection or biopsy in cases managed conservatively. Final diagnosis obtained was used to see the sensitivity and specificity of both the pre-operative modalities of diagnosis (viz. clinical diagnosis and radiological diagnosis).

RESULTS

There were 50 cases with abdominal mass out of a total of 496 cases seen during the study duration. These cases formed the study group. There were 34 males and 16 females with male to female ratio of 2:1.

The demographic profile of the mass was as shown in Table 1. Prepubescent age formed the most common age group at presentation. Right hypochondrium was the most commonly affected quadrant (18%). Most of these masses were hepatobiliary in origin followed by congenital hypertrophic pyloric stenosis. The details of findings of clinical examination were as shown in Table 2. The status of both the pre-operative modalities, i.e., clinical examination and radiological investigations were as shown in Table 3. Both radiological diagnosis and clinical diagnosis were correct in 47/50 (94%) cases with respect to the final diagnosis as shown in Figure 1.

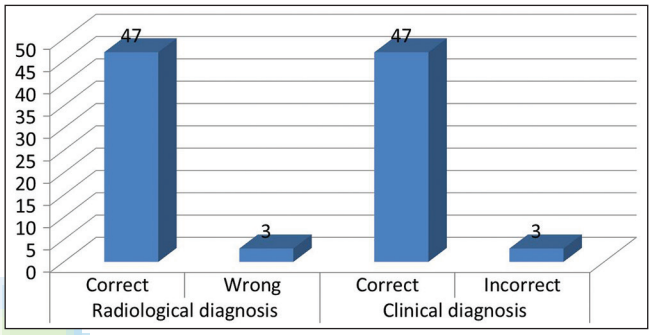

Figure 1: Correlation of pre-operative diagnosis with respect to the final diagnosis

Table 1: Details of mass as per presentation

Parameters	Sub-parameters	*n*	Percentage
Age group	Newborn (<4 week)	5	10
	Infant (1 month–1 year)	7	14
	Toddler (1-3 year)	3	06
	Preschool (3-6 year)	12	24
	School child (6-10 year)	5	10
	Prepubescent (10-14 year)	18	36
Quadrant of location	Epigastrium	0	0
	Right hypochondrium	10	18
	Left hypochondrium	9	17
	Right lumber	4	7
	Umblical	6	11
	Left lumber	9	17
	Right iliac fossa	8	15
	Hypogastrium	8	15
	Left iliac fossa	0	0
Type of mass	Parietal	5	10
	Intraperitoneal	31	62
	Retroperitoneal	14	28
Organ of origin clinical	Hepatic	5	10
	GI	17	34
	Splenic	7	14
	Renal	12	24
	Parietal	6	12
	Others	3	6
Type of mass	Malignant	08	16
	Nonmalignant	43	86

GI: Gastrointestinal

DISCUSSION

Clinical examination of a case of abdominal mass is a very strong pointer toward the organ of origin and the probable pathology. The location of the mass in the abdomen gives a clue about the possible organ through which it may arise for example a hepatic mass is usually located in the right hypochondria. Likewise the shape, mobility and consistency on palpation are also important guide to make a clinical diagnosis. Large mass however don't obey this dictum and may extend beyond their boundaries, it then becomes necessary to support our clinical examination with radiological investigations.

Table 2: Clinical examination findings as per the mass

Parameters	Sub-parameters	*N*	Percentage
Size of the mass	<1 cm	0	0
	1-5 cm	26	52
	5-10 cm	15	30
	10-15 cm	6	12
	>15 cm	3	6
Shape of the mass	Globular	19	38
	Pea-nut	9	18
	Pear	7	14
	Ill defined	14	28
	Reniform	1	2
Consistency	Soft	1	2
	Cystic	22	44
	Firm	22	44
	Hard	1	2
	Variegated	4	8
Mobility	Freely mobile	10	20
	Restricted mobility	25	50
	Fixed	15	30
Pain	Present	26	52
	Absent	24	48
Change in bowel bladder habits	Present	23	46
	Absent	27	54
Vomiting	Present	16	32
	Absent	34	68

Though clinical examination forms a very strong tool in diagnosing abdominal masses radiological investigation form a strong support in confirming the clinical diagnosis, the plain film radiography forms the primary imaging modality. Dilated bowel loops, which may simulate a mass, can be easily detected on plain film. The underlying cause may also be evident either on the plain film itself or a directed contrast examination; presence of calcification and its nature also help. Abdominal USG forms the next important imaging modality, especially if a gastrointestinal origin is not suspected. USG helps differentiate retroperitoneal form intraperitoneal masses and solid from cystic masses. Further diagnostic work is based on the information, obtained at plain film and USG. USG is the initial imaging modality of choice; it is easy to use portable, free of radiation hazards, easy to interpret and equally reliable investigation. USG also permits assessment for vascular invasion. Unfortunately with time USG is replacing the clinical acumen and most of the patients are directly subjected to USG without being thoroughly examined.

Computerized tomography (CT) is an excellent cross-sectional imaging technique in abdominal masses due to the explicit anatomical details. It helps assess the exact size and extent of the mass, thereby allowing accurate staging, which is a prerequisite to successful management in childhood malignancies. Involvement of major blood vessels by dynamic CT following intravenous contrast administration is an added advantage. MRI, especially with the advent of short scan time and open type magnets, is a very promising modality although long-term results are still awaited in imaging of paediatric abdominal masses.

Table 3: Status of radiological investigations and clinical examination in predicting the organ of origin

Parameters	Sub-parameters	Sub-parameters	Correct	Wrong	Percentage
Radiological modality	Ultrasound/CT/MRI	GI mass	12	5	71
		Renal system	12	0	100
		Hepatobiliary	5	0	100
		Spleen	7	0	100
		Parietal wall swelling	6	0	100
		Others	3	0	100
		Total	45	5	90
Clinical diagnosis	Organ of origin	GI mass	12	5	71
		Renal system	12	0	100
		Hepatobiliary	5	0	100
		Spleen	7	0	100
		Parietal wall swelling	6	0	100
		Others	3	0	100
		Total	45	5	90

CT: Computed tomography; MRI: Magnetic resonance imaging; GI: Gastrointestinal

There are a number of causes of abdominal mass in children, they could be from any of the possible organ and can attain various dimensions and extensions. An abdominal mass could be of very short duration in presentation requiring urgent intervention, while others could be managed with complete investigations and work-up.

Abdominal mass can be seen in any age group due to various causes prevailing. The age group commonly affected depends upon the region and also on the awareness of the population. Prepubescent age group (10-14 years) was the most common age group (36%) in our study. This was probably due to the occurrence of benign/chronic lesions in this age group. Most of them had splenomegaly or appendicular mass. Splenomegaly predominantly with sickle cell disease followed by portal hypertension was the most common cause of mass in the prepubescent age group [Figure 2] which was quiet justifiable as splenomegaly is a gradual onset process and commonly manifests at the age of 10-14 years, sickle cell disease being endemic in Chhattisgarh region also justify the association with it. Most of the appendicitis cases presented with mass due to poor assess to the health care facilities in our area. Among the nine quadrant of abdomen, right hypochondria was the most commonly affected quadrant (18%) most of these masses were hepatobiliary in origin. Renal mass followed the gastrointestinal masses and were present in 24% of cases. It has been reported in various published series that renal masses are the most common paediatric masses reported, which was contrary to our observation [Table 4]. The reason may be that as most of the patients coming to our centre are from remote places with low educational status most of the asymptomatic cases might get filtered. Gastrointestinal mass being symptomatic thus became the most common one.

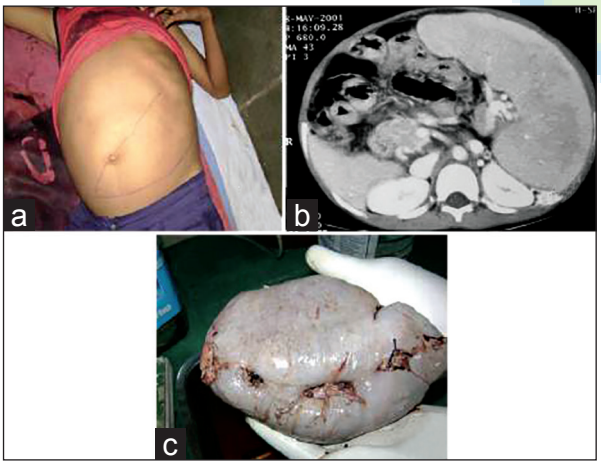

Figure 2: (a) Clinical splenic mass, (b) Contrast-enhanced computed tomography suggestive of splenomegaly, (c) Operative confirmation

The most common radiological investigation used was the USG. It was supplemented by CT/MRI in 17 cases. In these cases the findings were similar to USG in 15 cases. Annuar *et al*.[3] studied the role of USG in diagnosing abdominal mass; accordingly they did ultrasound examinations to evaluate clinically palpable abdominal masses in 125 children. The examinations were normal in 21 patients. In 15 patients, the clinically palpable masses were actually anterior abdominal wall abscesses or hematomas. Final diagnosis was available in 87 of 89 patients with intra-abdominal masses detected on ultrasound. The majority (71%) were retroperitoneal masses where two-thirds were of renal origin. Ultrasound diagnosis was correct in 68 patients (78%). All cases of hydronephrosis were correctly diagnosed based on characteristic ultrasound appearances. Correct diagnoses of all cases of adrenal hematoma, psoas abscess, liver hematoma, liver abscess and one case of liver metastases were achieved with correlation of relevant clinical information. Similarly Richardson *et al*.[4] did B mode ultrasound in 246 patients with suspected abdominal masses over a 7-year period in order to find the accuracy of USG in diagnosing paediatric abdominal masses. In 105 (40%), the accuracy of ultrasonic diagnosis was evaluated surgically. USG was proven correct in 60 (57%) patients who had undergone an operation. Among 141 patients who had not undergone operation and whose diagnoses were established by other means, USG agreed with the clinical diagnosis in

Table 4: Observed incidence of masses of various organ systems as reported in published literature

Organ system	Rastogi *et al*.[1]	Comert *et al*.[2]	Annuar *et al*.[3]	Our study
Hepatic %	7.7	5	Data NA	12
GI %	22.3	40	Data NA	34
Splenic %	ND	Data NA	Data NA	14
Renal %	53.5	55	47	24
Parietal %	ND	Data NA	Data NA	10
Others %	13.8	Data NA	Data NA	6

GI: Gastrointestinal

69 (31%). Ultrasound accuracy, as confirmed by operation, was highest for splenic masses (100%) and for aortic aneurysm (88%). Liver masses were correctly identified in 56 percent of patients and gallbladder lesions in 38%. Only 48% accuracy was obtained in diagnosing pancreatic disease and 64% of all pseudo-cysts were localised. USG correlated positively with operative findings in 56% of renal masses. Holm *et al.*[5] performed an examination in 107 consecutive patients referred to the ultrasound lab for investigation of a palpable abdominal masses and this was performed without knowledge of clinical history, lab findings, or the results of other examination. In 101 of the patients the correct diagnosis was subsequently verified, and 29 different ultrasonic diagnoses was reached. In 98 (97%) of the patients the ultrasound diagnosis was correct. Two uterine leiomyomas were erroneously diagnosed as ovarian in origin and a massive adrenal carcinoma was misdiagnosed as a hepatic tumour. It suggested that ultrasound scan was the method of choice in evaluating patients with a palpable abdominal mass. The overall accuracy of ultrasound with respect to the final diagnosis in our study was 45/50 (90%). USG was very helpful in making the diagnosis, the USG findings correlated with a clinical diagnosis in 91% of those who were operated and in 88% in those who were confirmed by biopsy or other modalities. Ultrasound was also very accurate in diagnosing the exact organ of origin. Its efficacy was however less (71%) only in gastrointestinal masses. This was 100% when seen in other organs. This was consistent to other studies as shown in Table 5. Radiological investigations in total had a sensitivity of 94% which was similar to the clinical examination. Plain X-ray was of no value in diagnosing the cases, in the majority of conditions 38 out of 50, it was nonsuggestive.

We were able to pick up the anatomical organ of origin on clinical examination in 96% of the cases and were incorrect only in two unusual cases of omental cyst and mesenteric cyst. The pathological diagnosis matched with the final diagnosis in 94% of the patient and three cases that were not picked by clinical examination were acute mesenteric lymphadenitis, mesenteric cyst and large omental cyst. However clinical diagnosis correlated with operative findings in 91% cases.

66% of the total patient underwent surgery either as definitive procedure or as palliative procedure. 34% who were not operated mainly included appendicular mass which were kept in follow-up, splenomegaly with portal hypertension and late stage inoperable malignancies. Of the patients who were offered palliative procedure most of them were cases of posterior urethral valve waiting for fulguration after vescicostomy (due to non-availability of small resectoscope).

All cases of intussusception were correctly picked up by the radiological investigations basically ultrasound which was same when compared with the findings of Dinkel

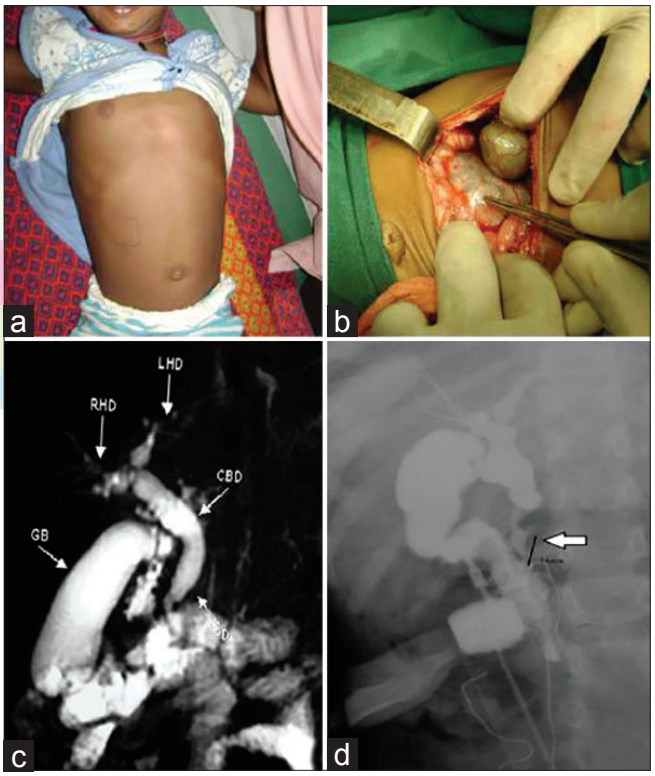

Figure 3: (a) Clinical choledochal cyst, (b) Operative confirmation, (c) Pre-operative magnetic resonance cholangiopancreatography suggesting choledochal cyst, (d) Peroperative cholangiogram confirming the diagnosis

Table 5: Accuracy of radiological investigations in diagnosing the organ of origin as compared with other studies

Organ system	Annuar *et al.*[3]	Richardson *et al.*[4]	Our study
GI masses %	Data NA	Data NA	71
Excretory system %	100	56	100
Hepatobiliary %	100	56	100
Spleen %	Data NA	100	100
Parietal wall %	Data NA	Data NA	100
Others %	Data NA	Data NA	100

GI: Gastrointestinal

et al.[6] and Swischuk *et al*.[7] who also stated that USG was the best investigation in diagnosing intussusception. All cases of choledochal cyst were correctly picked up by USG which were also confirmed by magnetic resonance cholangiopancreatography [Figure 3] and was correlating to the findings of Rattan *et al*.[8] where ultrasound was diagnostic in 92.55 cases. All these cases were operated and two of three had a nice post-operative recovery while the third patient died of hepatic failure. Of the four cases of congenital hypertrophic pyloric stenosis all were correctly picked up by radiological investigations (predominantly ultrasound) and the operative thickness correlated with the investigational findings. These were similar to Marcos Kovalivker *et al*.[9] who studied 103 cases and found that ultrasound could very efficiently pick up the findings.

There were total three mortalities out of 50 cases, first case was that of advanced carcinoma stomach, this was in the non-operable terminal stage and was offered palliative treatment of feeding jejunostomy. Second case was a case of choledochal cyst that came with severe cholangitis. This child was stabilized and then operated. She had a type 4 choledochal cyst with cirrhotic changes in the liver. She landed in hepatic failure and died. Third case was the child with obstructive uropathy (posterior urethral valve with distended palpable bladder) and died of ARF. Rastogi *et al*.[1] observed mortality of 26.2% in their series and 80% of their mortality was due to malignancy. We had a mortality rate of 6% and 33.33% cases were due to malignancy. Very few cases among those operated for abdominal masses experienced post-operative morbidity (Six out of 30 operated cases). Wound infection was the most common cause of morbidity four of six experienced this while one had burst abdomen.

CONCLUSIONS

Most of the cases of abdominal mass can be well evaluated clinically in terms of the diagnosis and organ of origin. Both radiological investigation and a good clinical examination have equal sensitivity. Radiological investigations are thus only adjuvant to a good clinical examination.

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