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Diagnostic value of ultrasonography in evaluation and management of acute abdominal conditions in the paediatric age group

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ABSTRACT

Background: The aims of this study have been elaborated below: (1) to enumerate the common causes of acute abdominal emergencies by ultrasonography in paediatric patients; (2) to establish the diagnostic efficacy of ultrasonography in evaluation of acute abdominal conditions in children and to illustrate the associated ultrasonographic findings; (3) and, to discuss the role of ultrasonography in guiding the mode of intervention in these cases. **Patients and Methods:** This prospective study of ultrasonographic examination in 146 paediatric patients presenting with acute onset abdominal pain at the emergency/ paediatric outpatient department section of Jawaharlal Nehru Medical College & Hospital, Aligarh, between June 2006 and December 2007, using 3.75 MHz and 8 MHz transducers of the ADARA (Siemens) machine. **Results**: Common causes of acute abdominal emergencies in pediatric patients as noted on ultrasonography included nonspecific pain (28%), abdominal abscess (21%), acute appendicitis (7%) and intussusception (7%). Ultrasonography was diagnostic in 45.2% cases and supportive in 12.3% of the cases. As for as the final outcome, ultrasonography prevented surgery in almost 20% cases and laparotomy was avoided in 7% of the patients as ultrasound guided interventions in the form of abscess aspiration were carried out. **Conclusion:** Ultrasonography evaluation of children with acute abdominal pain, helps in making significant changes in the management plan of the patients, and also reveals various clinically unsuspected diseases.

Key words: Computed tommography, pediatric, acute abdomen

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INTRODUCTION

Acute abdominal pain in children is one of the most common presentations at the emergency room. Inability to give reliable history, atypical clinical presentations, numerous extra-abdominal causes and the painful abdomen in children often causes difficulty in arriving at the correct diagnosis and causing diagnostic dilemma. Early diagnosis is the first step towards proper management of a patient presenting with acute abdomen. Pain is a subjective complaint and symptom; however, especially in pediatric surgery, a child in distress and with pain should always be investigated. Ultrasonography is therefore rapidly becoming an important imaging modality for the evaluation of acute abdominal pain, particularly in pediatric patients, where satisfactory examination is often not achievable for the attending clinicians. Even though it may not always help in achieving the final diagnosis, it certainly helps in ruling out the other unlikely etiologies.

In the present study, we have discussed the diagnostic efficacy of ultrasonography in the evaluation of acute abdominal conditions in pediatric age group, and we have also tried to enumerate the commonly causes of acute abdominal emergencies on ultrasonography in pediatric patients, with special reference to the age specific incidence of the most common causes encountered.

MATERIAL AND METHODS

146 patients of pediatric age group (<12 yrs), presenting with acute abdominal conditional at emergency / pediatric outpatient department were evaluated by ultrasonography from June 2006 to December 2007 in our insitiute. Ultrasonographic evaluation of these children was done using 3.75 MHz and 8 MHz transducers. Children were selected on the basis of strict

inclusion criteria. Only those children with acute onset abdominal pain and having no history of similar pain in the recent past were included in the study.

RESULTS

There were 82 male (57%) and 64 female (43%) pediatric patients. Most of the patients (74 in number – 50.7%) belonged to the age group of 9 to 12 years. All patients with acute abdominal pain underwent a routine workup consisting of history taking, clinical examination by the attending emergency physician and surgeon, and hematological investigations (hemoglobin count, coagulation and bleeding profile) during the first hour after admission. On the basis of these findings, a provisional clinical differential diagnosis was made by the attending emergency residents. The conventional plain radiograph of abdomen/chest was done in most of patients presenting with acute abdominal condition, and this was followed by ultrasound examination using the ADARA (Siemens) machine and having a 3.75 MHz and 8 MHz probe in the emergency section. A provisional ultrasonographic diagnosis was made, and confirmation of the findings was done on the basis of operative and pathological findings. In the cases managed conservatively, ultrasonographic diagnosis was correlated with clinical findings and the treatment response.

Besides pain, most common presentation in our study was vomiting (33%), followed by fever (21.9%) and constipation (14.7%). Abdominal pain in the umbilical area was seen in 19% of the patients. The organ system most commonly involved in our study was the gastrointestinal tract (38.4%), followed by the liver which accounted for 13.7% of cases. The single most common cause of pain in our study was non-specific abdominal pain, which accounted for 44 cases (30%), and was followed by abdominal abscess [Figure 1] (21%), acute appendicitis [Figure 2] (7%) and intussusception [Figure 3] (7%), respectively. Correlation of clinical and ultrasonographic findings was made done with the operative and pathological diagnosis to establish a final diagnosis, as shown in Table 1.

It was noted that initial clinical diagnosis was correct in only 38.3% of the cases. Ultrasonography was diagnostic in 45% of cases, while it provided only supportive diagnosis in 12% of cases. Thus, the overall efficacy of ultrasonography in acute abdominal pain in children was around Fifty-seven percent (57%). Therefore, the diagnostic work up of children with acute abdomen by ultrasonography changed the management plan in a significant number of patients. On the basis of provisional clinical diagnosis, laparotomy was contemplated in 45% of cases, while post ultrasonography, laparotomy was done only in around 25% of cases [Tables 2 and 3]. Thus, ultrasonography prevented laparotomy in almost 20% cases. Major surgery was avoided in 4% cases where ultrasonography guided interventions in the form of aspiration was done.

Thus, we can conclude that ultrasonography is highly informative in the evaluation of children with acute abdominal pain and brings a drastic change in management plan of the patients. Further, many clinically unsuspected diseases can be revealed using ultrasonography.

DISCUSSION

Plain radiograph of the abdomen/ chest probably remains the most frequently performed radiological investigation in the infant or child with acute abdominal

Table 1: Clinical and ultrasonographic correlation with final diagnosis for the pediatric patients in the study

Final diagnosis	No. of cases	Clinical diagnosis		Ultrasonographic diagnosis	
		Correct	Incorrect	Diagnostic	Supportive
Abscess (Abdominal)	21	43.7	57.3	93.7	6.3
Acute appendicitis	7	40	60	40	20
Intussusception	7	60	40	40	20
Renal calculi	7	60	40	100	0
Abdominal tuberculosis	4	67	33	33	67
Vesical calculus	3	50	50	100	0
Peritonitis	3	50	50	0	50
Cholecystitis	1	0	50	100	
Meckel's diverticulum	1	0	100	0	0
Others causes including non-specific pain	45	30	70	18	12
Total	100% (146)	38.3% (56)	61.7% (90)	66 (45.2%)	18 (12.3%)
Percentage		38.3	61.7	45.2	12.3

Data in Percentage

Table 2: Pre ultrasonographic management plan for the pediatric patients in the study

Management plan	Pre ultrasonography plan	
	Number	Percentage
Surgery (Laparotomy)	66	45.2
Medical	80	54.8

Table 3: Post ultrasonographic management plan for the pediatric patients in the study

Management plan	Post ultrasonography plan	
	Number	Percentage
Surgery (Laprotomy)	36	24.7
Therapeutic interventions	6	4.1
Medical	104	71.2

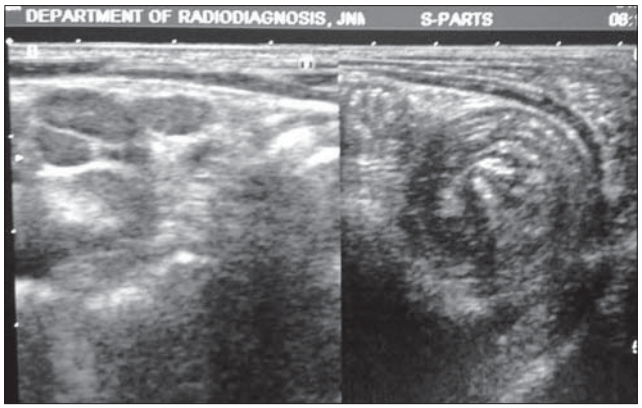


Figure 1: Ultrasonographic image showed multiple enlarged mesenteric lymph nodes and loop within loop appearance of bowel (s/o intussusception)



Figure 2: Ultrasonographic image showed well defined liver abscess in segment 5, 8 right lobes of the liver

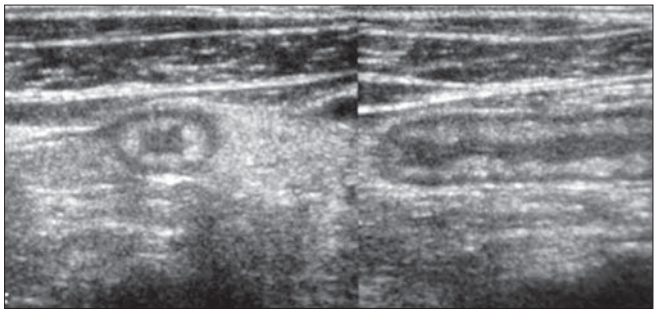


Figure 3: Ultrasonographic image showed blind ended, non-compressible, aperistaltic bowel loop with echogenic messentry in right illiac fossa s/o acute appendicitis

symptoms.[1] Laparoscopy and Computed Tomography (CT), despite their efficacies in the diagnosis of various acute abdominal conditions, are reserved as second-line investigation methods due to the risk of surgical invasiveness in laparoscopy, and radiation exposure in CT. Wittenberg and his co-workers in their study showed that CT made a significant contribution in diagnosis of acute abdominal conditions in around 41% of patients and changed the management plan to the therapeutic intervention in 17%, and previously planned treatments in 10% of cases.[2] Finberg *et al.* also found that 53% of CT examinations produced a substantial or unique help in diagnostic understanding and changed the treatment plan in 15% of the patients.[3] However, CT has few major drawbacks. The equipment is bulky and non-mobile; the procedure is time consuming, requires sedation and the results are sometimes difficult to interpret in children due to the paucity of abdominal fat. These factors limit its use in emergency settings. Emergency ultrasonography has shown almost similar results in the diagnostic work-up of children presenting with acute abdomen.

The ultrasonographic examination gives important information about various organs of the abdomen which includes the biliary tract, gall bladder, liver, spleen, pelvis and kidneys. Over the last 10 years it has shown itself to be a very important modality for acute bowel pathology. Further, it helps in the diagnosis of ascites, condition of bowel, peristalsis and abdominal collections. It is as smart as laparoscopy in diagnosing various acute abdominal pathologies; and unlike laparoscopy, there are no contraindications such as previous laparotomies. The procedure also doesn't require the need for general anesthesia. As a resident's knowledge of ultrasonographic interpretation and scanning is becoming more sophisticated, it is feasible to use ultrasonography in a setting where a radiologist is available on a 24 hour basis, especially in a university hospital setting. Thus ultrasonography is best suited for children, not only because of its non-invasive nature and cost-effectiveness, but also because it doesn't expose the children to the danger of radiation.

In our study, ultrasonography was found to be diagnostic in 45% of patients and supportive in 12%

cases. Mendelson *et al.* and Walsh *et al.* in their separate studies showed that ultrasonography is 50% diagnostic in knowing the cause of acute abdomen in children.[4,5] Studies in adult population found diagnostic accuracy of ultrasonography is around 25–34.7%.[6,7] This higher diagnostic efficacy in pediatric patients is attributed to their thinner abdominal wall and use of higher frequency probes (>5MHz).

Surgery was planned in 45.2% patients in our study on the basis of clinical evaluation; however, after performing the ultrasound the requirement for surgical procedure decreased significantly to 25% of patients. Thus it changed the management plan in around 20% of cases. These patients did not require any surgical intervention and responded well to the conservative treatment. Major surgery was avoided in 4% patients where ultrasonography guided interventions in the form of aspiration was done in our study. Walsh *et al.*[5] and Davis *et al.*[8] in their studies also found the change in the plan of management in 11–22% of cases post ultrasonography investigation. Ultrasonography, therefore, helps in faster diagnosis and faster decision making for the plan of treatment. Based on operator dependency, ultrasonography was misleading in 5% of the cases and showed appropriate results in 38% cases in our study. Also, it changed the management plan in a significant number of patients, thereby lowering not only the financial outlay for managing the acute abdominal pathology, but also the mortality and morbidity rates in these patients with acute abdomen, who would have otherwise undergone unnecessary laparotomies. Acute appendicitis is a clinical diagnosis, but for supportive evidence, Garcia Pena *et al.*[9] have advocated the use of ultrasonography as the first-line imaging technique, followed by limited CT in equivocal cases to reduce the morbidity and acute care costs. Some studies have found that ultrasonography can aid in reducing unnecessary admissions to the hospital for observation and also decrease the number of unnecessary appendectomy procedures, without increasing the risk of perforation.[10,11]

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