Role of ultrasonography in the evaluation of children with acute abdomen in the emergency set-up

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ABSTRACT

Background: Acute abdomen in children has been aptly described as Pandora’s box. Unlike computerized tomography (CT scan), ultrasonography (USG) has no radiation hazard and the present study analyses the diagnostic yield of the USG in acute abdomen in children.

Materials and Methods: Between September 2001 to October 2003, 75 patients with acute abdomen underwent clinical examination, routine biochemical tests, erect X-ray abdomen, USG and CT scan. Laparotomy and histological examination established final diagnosis.

Results: The accuracy of correct diagnosis was 60%, 66.6%, 64%, 98.7% with clinical examination alone, USG alone, clinical examination combined with conventional radiography, and clinical evaluation combined with conventional radiography and USG respectively. USG helped to prevent unnecessary laparotomy in 16.3% of patients.

Conclusions: USG is good investigative modality in the management of acute abdomen in children.

KEY WORDS: Acute abdomen, sonography, laparotomy, sensitivity

INTRODUCTION

Acute abdomen can be defined as “A syndrome induced by wide variety of pathological conditions that require emergent medical or more often surgical management”. There are a plethora of cases ranging from benign conditions like viral gastroenteritis to intussusception that can lead to acute abdomen in children. This vivid etiology, the occult nature of disease and difficulties encountered in examining these children prompted surgeons to look for some reliable diagnostic adjuncts for accurately diagnosing the intra-abdominal pathology in order to prevent negative celiotomies; which is not uncommon in children.

Plain radiograph of the abdomen has been used conventionally in the diagnostic workup of the children with acute abdomen however, its diagnostic yield is limited because of its high non-specificity and low sensitivity.

Ultrasonography since its use by Puylaert et al. in 1986 (6) for diagnosing acute abdomen pre-operatively, has been used in various acute abdominal conditions. It has been found to confirm the primary diagnosis in 21-34% of patients and second / third differential diagnosis in further 12% of patients, when used alone as a diagnostic modality. Ultrasonography is very useful in children because it is non-invasive, cost-effective, repetitive and doesn’t expose the child to radiation. It is as good as laparoscopy and can be done even in patients with scarred abdomen. It can be done as a bedside investigation.[2-5]

The purpose of this study was to evaluate the role of sonography in the diagnostic work-up of children with acute abdomen in the emergency set-up and also its role in making decision regarding surgery.

MATERIALS AND METHODS

During a period from September 2001 to October 2003, 75 patients (<15 yrs) presented with acute abdomen in the surgical emergency section of Jawaharlal Nehru Medical College were included in this prospective study. There were 49 males (65.33%) and 26 females (44.67%), their mean age was 6.5 years (age range 6 days-15 years) and 7.9 years (age range 9 months-15 years) respectively.

Clinical Diagnosis: All patients underwent routine workup consisting of history, clinical examination by the attending surgeon and hematological investigations dur-
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ing the first hour after admission; on the basis of these a clinical diagnosis was made by the senior most surgeon of emergency team with more than three years of experience in abdominal surgery. The conventional plain radiograph abdomen/chest were taken routinely.

**Diagnosis after Ultrasound:** Immediately after the radiography abdomen, the attending ultrasonologist did an ultrasound using Logic 500 proseries GE machine or ADARA (Siemens) machine using a 50-90 MHz curved/linear array probe in the emergency.

Final Diagnosis: If the diagnosis was still uncertain after the basic investigations and ultrasound, supplementary investigations including barium examination, intravenous pyelograms, CT scanning etc were done to reach the final diagnosis.

The final diagnosis was based on the investigations made, the clinical course, the intraoperative finding and histopathological examination in relevant cases.

**RESULTS**

Acute abdominal pain was the most common symptom (88.6%) followed by fever (56%) and vomiting (50.67%). Tenderness of abdomen (90.67%) was the commonest sign followed by abdominal distention (72%) and rigidity / guarding (56%) of abdomen. The final diagnosis of the 75 patients are listed in Table 1. Of the 75 patients, 45 patients were correctly diagnosed by the clinical examination alone (60%). Similarly when ultrasound was used as the only diagnostic modality then 50 patients (66.6%) were correctly diagnosed. When clinical examination was combined with radiography, diagnosis was established in 48 patients (64%). However, when clinical evaluation, radiography abdomen and ultrasound abdomen all were combined ; then diagnosis was established in 74 patients (98.67%). In one patient, no conclusive diagnosis could be established even after additional diagnostic work-up.

Use of ultrasound in the diagnostic workup of children with acute abdomen led to a change in the management plan in significant number of patients. Pre-ultrasonography, surgery was planned in 62 patients (82.67%) but after ultrasonography surgical intervention incidence decreased to 52 patients (69.33%), thus management plan was changed in 10 patients (16.33%).

**DISCUSSION**

Conventionally plain radiograph of the abdomen/ chest are used as a first diagnostic modality in children with acute abdomen presenting in the emergency. In our study we found plain radiograph to be diagnostic in 32% of cases only. Similarly in another study (5) plain radiograph was found to be diagnostic in 35% of cases. Thus, in more than 50% of cases it is non-specific. Because of the diagnostic limitations of plain film of the abdomen, any cross-sectioning technique, such as sonography or Computed Tomography (CT), is likely to provide more and sometimes entirely different information about acute abdominal pathology.

Computed Tomography, since its advent has established its effectiveness as well as its efficacy in the diagnosis of certain acute abdominal conditions. Wittenberg and his coworkers[7] in their study found that CT made a substantial contribution to diagnostic understanding in 41% of the patients, change in therapeutic plans in 17% and improved precision of previously planned therapy in 10%. Finberg et al.[8] also showed that 53% of CT examinations produced a substantial or unique contribution to diagnostic understanding and 15% contributed to a change in treatment. However, CT has certain drawbacks, the equipment is bulky, non-mobile, the procedure is time consuming, it requires sedation and is sometimes difficult to interpret in children. These factors limit its use in emergency settings. Emergency sonography has shown

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**Table 1: Results of four step diagnosis**

<table>
<thead>
<tr>
<th>Diagnosis</th>
<th>Clinical evaluation</th>
<th>USG</th>
<th>Clinical evaluation and radiography</th>
<th>Clinical evaluation and radiography and USG</th>
<th>Final diagnosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intestinal Obst.</td>
<td>24</td>
<td>12</td>
<td>24</td>
<td>23</td>
<td>23 (30.67%)</td>
</tr>
<tr>
<td>Abscess (abdominal)</td>
<td>4</td>
<td>18</td>
<td>4</td>
<td>19</td>
<td>19 (25.33%)</td>
</tr>
<tr>
<td>Peritonitis</td>
<td>8</td>
<td>3</td>
<td>11</td>
<td>13</td>
<td>13 (17.33%)</td>
</tr>
<tr>
<td>Appendicitis</td>
<td>6</td>
<td>12</td>
<td>6</td>
<td>12</td>
<td>12 (16%)</td>
</tr>
<tr>
<td>Mesenteric Lymphadenitis</td>
<td>3</td>
<td></td>
<td>3</td>
<td>3</td>
<td>3 (4%)</td>
</tr>
<tr>
<td>Renal Colic</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>2 (2.67%)</td>
</tr>
<tr>
<td>Hypertrophic Pyloric Stenosis</td>
<td>1</td>
<td></td>
<td>1</td>
<td>1</td>
<td>1 (1.33%)</td>
</tr>
<tr>
<td>Pancreatitis</td>
<td>1</td>
<td></td>
<td>1</td>
<td>1</td>
<td>1 (1.33%)</td>
</tr>
<tr>
<td>Unknown / Non-specific pain</td>
<td>30 (40%)</td>
<td>23(36%)</td>
<td>27 (36%)</td>
<td>1 (1.33%)</td>
<td>1 (1.33%)</td>
</tr>
<tr>
<td>Total</td>
<td>75</td>
<td>75</td>
<td>75</td>
<td>75</td>
<td>75 (100%)</td>
</tr>
<tr>
<td>Correct diagnosis</td>
<td>45 (60%)</td>
<td>50(66.6%)</td>
<td>48 (64%)</td>
<td>74 (98.8%)</td>
<td>75 (100%)</td>
</tr>
</tbody>
</table>

(Data is expressed as number (%) of patients)
similar results in the diagnostic work-up of children with acute abdomen.

The sonographic examination provides useful information in the areas of the abdomen viz; the biliary tract, gall bladder, liver, spleen, pelvis and kidneys. Over the past 10 years it has shown itself to be a discerning modality for acute bowel pathology; it points towards ascites, condition of bowel, peristalsis and abdominal collections. It is as good as laparoscopy in diagnosing acute abdominal pathologies, and unlike laparoscopy, there are no contraindications such as previous laparotomies and the procedure doesn’t involve the need for general anaesthesia. Since residents’ knowledge of sonographic interpretation and scanning is becoming more sophisticated therefore it is feasible to use sonography in a setting where a radiologist is available on a 24 hrs basis, especially in a university hospital setting. It is ideally suited for children not only because of its non-invasive nature and cost-effectiveness but also because it doesn’t expose the children to radiation.

In our study ultrasonography was found to be diagnostic in 48% of patients and supportive in further 18.67%. Mendelson et al, and Walsh et al, in their separate studies found ultrasonography to be 50% diagnostic in knowing the etiology of acute abdomen in children.[9,10] Studies in adult population showed diagnostic accuracy of ultrasound to be between 25-34.7%.[1-3] This higher diagnostic yield in pediatric population is attributed to their thinner abdominal wall and use of higher frequency probes (>5 MHz). In our study ultrasonographic examination was misleading in two patients. In both patients it suggested the diagnosis of intestinal obstruction but on further evaluation (Barium meal and CT scanning) they were diagnosed as cases of Hypertrophic pyloric stenosis and Pancreatitis.

Surgery was planned in 82.67% patients prior to performing ultrasound but after performing it the need for surgical intervention decreased to 69.33% of patients. Thus ultrasonography changed the management plan in 16.13% of patients. These patients did not require any surgical intervention and responded well to the conservative treatment. Walsh et al[10] and Davis et al[11] in their studies also found the change in the plan of management in 11-22% of cases.

Nothing can replace the clinical acumen of the physician, ultrasonography should however be used as an adjunct to the clinical evaluation and plain abdominal radiographs rather than replacing them as it adds to useful diagnostic information in 34.67% of patients. It will lead to faster diagnosis and earlier institution of necessary operative or radiological intervention procedures. Also it significantly changes the management plan in about 16% 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 otherwise would have undergone unnecessary laparotomies.

REFERENCES