Original article

CT SCANS OF ABDOMINAL TRAUMA IN CHILDREN

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Abstract

CT scans of a child’s abdomen after blunt abdominal trauma have become a widely accepted technique for evaluating intra-abdominal organ injuries, because clinical findings of children may not reveal anything in such circumstances. This report reviews the CT findings over a 6 year period of 26 children under 15 years old with blunt abdominal trauma at Maharaj Nakorn Chiang Mai Hospital. The spleen was the most common organ injury seen in 8 patients (30.7%). Five patients had injury to the liver, 4 to the kidney, 3 the pancreas, and 2 to the bowel. Of the 26 patients with CT films, 4 needed surgery for liver or, splenic injuries, or overt peritonitis. Twenty two patients were given symptomatic and supportive treatment only. CT scans are very helpful in evaluating abdominal organ injuries in hemodynamically stable patients and they usually act as a guide for treatment. Chiang Mai Med Bull 2005;44(1):39-45.

Keywords: blunt abdominal trauma, CT scan, children

Introduction

As physical examination of acutely ill children may not be reliable, various imaging modalities are used to provide information about abdominal organ injuries and suggest further treatment. During the last few years there have been many articles about the usefulness of CT for patients with blunt abdominal trauma. We performed this study to review the CT scan findings of children with blunt abdominal trauma in our hospital.

Materials and methods

We reviewed medical records from January 1997 to August 2003 of 37 patients aged under 15 years who had received a CT of the abdomen due to blunt abdominal trauma. These records were reviewed for age, sex, mechanism of injury, imaging studies, treatment, and outcome.

CT was performed on 37 patients using a General Electric Sytec 3000I CT scanner with slices 10-mm thick. Precontrast scans of the upper abdomen

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and postcontrast scans of the whole abdomen were carried out. Patients, who were not evaluated by CT, or whose films did not exist, were excluded. Films of 26 cases were available for review. The liver, spleen, and renal injuries were graded according to the injury scale defined by the American Association for the Surgery of Trauma.\(^{(1)}\)

**Results**

1. **Age and sex distribution**

   There were 19 boys and 7 girls with an age range of 1-14 years and a mean age of 8 years.

2. **Causes of injury**

   The causes of injury were road traffic accidents, being crushed by heavy objects such as a falling statue, and falls from high places. The road traffic accidents included motorcycles, car crashes, and pedestrians struck by cars. The patients were categorized by causes in Table 1.

3. **Injured organ seen on CT scans**

   Films from 26 of 37 patients (70.2%) were available for evaluation. Of the 26 patients the findings in 18 cases (69%) were positive. The scans of 8 patients were normal. The organs injured are listed in Table 2. Five of the 18 patients had multiple abdominal organ injuries (27%) (Table 3). The spleen was the most common organ injured.

   3.1 Spleen

   The spleen was injured in 8 patients and the only organ injured in 6. There were grade II injuries in 5 patients and grade IV in 3. Two of the three patients with grade IV injuries needed surgery, due to impending clinical shock. The CT findings for both of these patients were lacerations that extended to the vascular pedicle and massive hemo-peritoneum (Figure 1). The surgical findings were the same as the CT findings. The others patient with grade IV injury was given supportive treatment.

   3.2 Liver

   The liver was injured in 5 patients. Two of them had grade IV injuries, one had grade III, and two grade II. Only one patient with grade IV liver injuries required surgery because of hemodynamic instability. The rest of the patients with a liver injury improved with symptomatic and supportive treatment.

### Table 1. Causes of injuries

<table>
<thead>
<tr>
<th>Cause of injuries</th>
<th>No. of patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pedestrian hit by vehicle</td>
<td>8</td>
</tr>
<tr>
<td>Fall</td>
<td>7</td>
</tr>
<tr>
<td>Motor cycle accident</td>
<td>5</td>
</tr>
<tr>
<td>Car crash</td>
<td>4</td>
</tr>
<tr>
<td>Crushing</td>
<td>2</td>
</tr>
</tbody>
</table>

### Table 2. Organ injured

<table>
<thead>
<tr>
<th>Organ</th>
<th>No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spleen</td>
<td>8</td>
</tr>
<tr>
<td>Liver</td>
<td>5</td>
</tr>
<tr>
<td>Pancreas</td>
<td>3</td>
</tr>
<tr>
<td>Left kidney</td>
<td>2</td>
</tr>
<tr>
<td>Right Kidney</td>
<td>2</td>
</tr>
<tr>
<td>Small bowel/mesenteric root</td>
<td>2</td>
</tr>
<tr>
<td>Urinary bladder (extraperitoneal rupture)</td>
<td>1</td>
</tr>
</tbody>
</table>

### Table 3. Multiple organs injuries in 5 patients

<table>
<thead>
<tr>
<th>Injured organs</th>
<th>No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Liver and pancreas</td>
<td>2</td>
</tr>
<tr>
<td>Liver, spleen, left kidney mesenteric root</td>
<td>1</td>
</tr>
<tr>
<td>Spleen and bowel loops</td>
<td>1</td>
</tr>
<tr>
<td>Liver and right kidney</td>
<td>1</td>
</tr>
</tbody>
</table>
3.3 Gastrointestinal tract and mesenteric root injuries

No free air was found in our patients with gastrointestinal tract and mesenteric root injuries. There were suggestions of gastrointestinal tract injuries in 2 cases. One had focal thickening of the jejunum and the other had small bowel loop thickening with infiltration of mesenteric roots. Both of them improved after supportive treatment.

3.4 Urinary tract

There were four cases of renal injuries, grade I and III. Regardless of whether the patients had other abdominal organ injuries or not, all patients with renal injuries were given supportive and symptomatic treatment.

There was one case of extraperitoneal ruptured urinary bladder, for which surgery was performed because of overt abdominal guarding. The ruptured
bladder was repaired; and no additional organ injuries were found.

3.5 Pancreas

There were three patients with minimal peripancreatic fluid collection. However, none of them had serum amylase levels that correlated with pancreatic injuries, and all three patients were given only symptomatic and supportive treatment.

4. Relationship between free intraperitoneal fluid and organ injuries

Thirteen patients had free intraperitoneal fluid (FIF). Eleven of these (77%) had associated intraperitoneal organ injuries. Two cases had unexplained minimal FIF at the right paracolic gutter and perisplenic region.

There were 3 patients with solid organ injuries but no free intraperitoneal fluid. The organ injuries were grade II liver lacerations at segment 8 (Figure 2), right renal lacerations, and right renal contusions.

5. Morbidity and Mortality

In 22 cases that improved by supportive treatment, 13 had an injured abdomen without any other associated injury. The average hospital stay for this group was 4 days (range from 1 to 9 days). All patients who had associated injuries (usually neurological or orthopedic) improved from abdominal suffering and were allowed oral feeding within a few days.

The durations of follow up after discharge from hospital varied from 4 to 6 weeks. Three patients, who did not require surgery, were lost to follow up. The rest of the patients, who needed surgery or improved through supportive treatment, recovered without any residual symptoms of abdominal organ injury.

Discussion

Recent reports revealed the usefulness

![Figure 2](https://example.com/figure2.png)

**Figure 2.** CT scan of liver laceration without free intraperitoneal fluid. Note small liver laceration at segment VIII (arrowhead), but no intraperitoneal fluid.
of imaging modalities in the evaluation of blunt abdominal trauma patients and avoidance of unnecessary surgery.\(^{42}\) The majority of patients improved by symptomatic and supportive treatment only.

Diagnostic peritoneal lavage (DPL) is performed to confirm intra-abdominal injuries, but the nature and extent of the injuries cannot be ascertained.\(^{3-5}\) In a study on DPL, there were false negative results, with retroperitoneal injuries, one small bowel injury and a pancreatic injury overlooked, and the DPL resulted in a catheter related bowel injury.\(^{4}\) DPL may provide evidence of bowel perforation, which is difficult to diagnose by other methods, if bowel contents are present in the lavage. However, this occurs in only 30% of laparotomy-proven bowel perforations.\(^{3}\)

Intravenous pyelography (IVP) may be preferable for patients who are hemodynamically stable and not suspected of having associated abdominal injuries, as it can provide information about the kidneys at a lower cost than CT scans. However, in one report there was a sensitivity of only 50% for IVP when compared to CT scans.\(^{6}\) In our study, 2 out of 4 patients with renal injuries had other abdominal organ injuries that could not have been detected by IVP alone.

Sonography is thought to be superior to DPL.\(^{7}\) However, the limitations of sonography are bowel ileus and observer dependence. Focused assessment with sonography for trauma (FAST) to detect FIF, leads to a high degree of false positives and negatives.\(^{8-9}\) In our study, there were 3 cases of minimal FIF without any apparent associated organ injuries, but there was a patient with liver injuries without any free intraperitoneal fluid. Patients with kidney injuries alone usually do not have FIF.

CT scans are able to grade, quantify and localize injuries. Retroperitoneal injury is well evaluated. Superior to ultrasonography, a CT scan has no limitation of bowel ileus or observer dependence. Although CT grading is not a criterion for surgery, it does provide clues for nonsurgical treatment.\(^{10}\)

Our study presented 18 cases of positive findings, in which information from CT scans has been used as a clue for treatment. Among 8 cases of negative study, the CT scan helped to exclude obvious injury. However, a negative study does not mean exactly normal in terms of pathology. All these cases did not have an operation, as a gold standard together with a significant amount of film loss. Therefore, we could not conclude the true negative study in this report.

Gastrointestinal tract injuries are less common in blunt abdominal trauma, and difficult to diagnose. Bowel perforation is one of the indications for surgical exploration. Signs that are very suggestive of gastrointestinal perforation on CT scans include free intraperitoneal air, extraluminal presence of contrast media, or discontinuity of the bowel wall, but they are uncommon. The secondary signs of bowel perforation and mesenteric injury such as bowel wall thickening, unexplained peritoneal fluid, bowel wall enhancement, and mesenteric stranding are less specific.\(^{5}\) Our two patients with
bowel wall thickening and mesenteric stranding improved with supportive and symptomatic treatment. In some reports, the most important tool for early diagnosis has been repeated abdominal examinations by an experienced surgeon.\(^{(2,5,11)}\)

**Conclusions**

CT scans are very helpful in evaluating abdominal organ injuries and are usually guides for treatment. Therefore, a CT scan of the abdomen is recommended for the evaluation of hemodynamically stable patients with equivocal physical examination or associated neurological injury. According to the need of patient transportation and time consumption, for those who are hemodynamically unstable, the CT scan is not the investigation of choice.

**References**

ภาพเอกซเรย์คอมพิวเตอร์ในผู้ป่วยเด็กที่ได้รับบาดเจ็บที่ช่องท้อง

นักขา ปทมภาพน, น. พรนิช วิภุทธค์, น. ม., วิทิต ณ เชียงใหม, น. ม.

ภาควิชารังสีวิทยา คณะแพทยศาสตร์ มหาวิทยาลัยเชียงใหม่

บทคัดย่อ เอกซเรย์คอมพิวเตอร์ได้รับการยอมรับอย่างแพร่หลายในการประเมินผู้ป่วยที่ได้รับการบาดเจ็บที่ช่องท้องจากการถูกกระแทก โดยเฉพาะผู้ป่วยเด็กซึ่งการตรวจร่างกายทำได้ยาก รายงานฉบับนี้รวบรวมผลการตรวจเอกซเรย์คอมพิวเตอร์ของเด็กที่ได้รับการบาดเจ็บช่องท้องอายุน้อยกว่า 15 ปี จำนวน 26 รายที่มาโรงพยาบาลมหาวิทยาลัยเชียงใหม่ ในช่วงเวลา 6 ปี พยาบาลวัยที่ได้รับการบาดเจ็บจนถึงผู้ที่สูงอายุ จำนวน 8 ราย คิดเป็นร้อยละ 30.7 รองลงมาคือ ลำตับจำนวน 5 ราย ที่ 4 ราย และลิมบ์จำนวน 3 ราย จากผู้ป่วย 26 รายนี้มีเพียง 4 ราย ที่ต้องได้รับการผ่าตัด ส่วนผู้ป่วย 22 รายสามารถรักษาแบบประคับประคองได้ ดังนั้นการตรวจเอกซเรย์คอมพิวเตอร์ช่องท้องมีประโยชน์ในการรักษาผู้ป่วยที่ได้รับบาดเจ็บช่องท้อง

คำสำคัญ: บาดเจ็บช่องท้อง เอกซเรย์คอมพิวเตอร์