A Multicenter Study of the Risk of Intra-Abdominal Injury in Children After Normal Abdominal Computed Tomography Scan Results in the Emergency Department

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Study objective: We determine whether intra-abdominal injury is rarely diagnosed after a normal abdominal computed tomography (CT) scan result in a large, generalizable sample of children evaluated in the emergency department (ED) after blunt torso trauma.

Methods: This was a planned analysis of data collected during a prospective study of children evaluated in one of 20 EDs in the Pediatric Emergency Care Applied Research Network. The study sample consisted of patients with normal results for abdominal CT scans performed in the ED. The principal outcome measure was the negative predictive value of CT for any intra-abdominal injury and those undergoing acute intervention.

Results: Of 12,044 enrolled children, 5,380 (45%) underwent CT scanning in the ED; for 3,819 of these scan results were normal. Abdominal CT had a sensitivity of 97.8% (717/733; 95% confidence interval [CI] 96.5% to 98.7%) and specificity of 81.8% (3,803/4,647; 95% CI 80.7% to 82.9%) for any intra-abdominal injury. Sixteen (0.4%; 95% CI 0.2% to 0.7%) of the 3,819 patients with normal CT scan results later received a diagnosis of an intra-abdominal injury, and 6 of these underwent acute intervention for an intra-abdominal injury (0.2% of total sample; 95% CI 0.06% to 0.3%). The negative predictive value of CT for any intra-abdominal injury was 99.6% (3,813/3,819; 95% CI 99.3% to 99.8%); and for injury undergoing acute intervention, 99.8% (3,813/3,819; 95% CI 99.7% to 99.9%).

Conclusion: In a multicenter study of children evaluated in EDs after blunt torso trauma, intra-abdominal injuries were rarely diagnosed after a normal abdominal CT scan result, suggesting that safe discharge is possible for the children when there are no other reasons for admission. [Ann Emerg Med. 2013;62:319-326.]

Please see page 320 for the Editor’s Capsule Summary of this article.
Risk of Intra-Abdominal Injury in Children After Normal Computed Tomography Scan

Editor’s Capsule Summary

What is already known on this topic
Despite negative abdominal computed tomography (CT) scans, children with blunt torso trauma are often admitted for observation.

What question this study addressed
How common is missed intra-abdominal injury after a negative CT scan result?

What this study adds to our knowledge
In this multicenter study of 12,044 children with blunt torso trauma, missed intra-abdominal injuries were rare (0.4%) in the 3,819 patients with negative CT scan results, and resulting intervention was even rarer (0.2%).

How this is relevant to clinical practice
CT scanning rarely misses clinically important intra-abdominal injury in children with blunt torso trauma.

Importance
In the current literature, there is a need for a prospective, multicenter study of children evaluated in EDs after blunt trauma to confirm that intra-abdominal injury is rarely diagnosed after normal CT scan results. Data from such a study could also be used to improve our understanding of those few patients at higher risk of occult intra-abdominal injuries and to inform a discussion of the utility of hospital admission solely for observation for evidence of occult injury.

Goals of This Investigation
The objectives of the current study were (1) to confirm in a large, generalizable sample of children evaluated for blunt torso trauma that intra-abdominal injuries are rarely diagnosed after a normal CT scan result in the ED; and (2) to describe the clinical characteristics of those children receiving a diagnosis of intra-abdominal injuries after normal CT scan results. We hypothesized that a normal abdominal CT scan result would have a negative predictive value greater than 99% for intra-abdominal injury in children after blunt torso trauma.

MATERIALS AND METHODS
Study Design and Setting
This was a planned subanalysis of data collected during a prospective observational study conducted in the EDs of 20 centers of the Pediatric Emergency Care Applied Research Network (PECARN). The institutional review boards of each institution approved the protocol before study commencement. A complete description of the parent study protocol has been published previously.7 Below, we describe only the methodology specific to the current study.

Selection of Participants
Patients younger than 18 years were eligible for the parent study if they sustained blunt torso trauma within 24 hours of ED presentation. For the current study’s sample, we included any patient enrolled in the parent study who had a normal abdominal CT scan result during the initial ED evaluation. The treating clinician for each patient made the decision to perform a CT scan; this decision was not a part of the study protocol.

For study purposes, we used the official CT interpretation of the faculty radiologist obtained during clinical care; none of these radiologists were blinded to clinical information. We defined a normal CT scan result as the absence of both specific intra-abdominal injury and all findings potentially suggestive of intra-abdominal injury. We considered the following as suggestive of intra-abdominal injury: intraperitoneal fluid or air, bowel wall edema or thickening, contrast extravasation, or mesenteric edema or streaking.8 For study purposes and definitive interpretation, a single faculty radiologist at each site reviewed any initially inconclusive CT results. If the site radiologist was unable to make a definitive interpretation, for our study the final CT interpretation was made by the senior study radiologist at the primary site. Radiology staff at each study site performed CT scans according to their usual protocols, including the use of oral contrast. Ninety-eight percent of CT scans in our study sample were performed with intravenous contrast.

Methods of Measurement
At initial care in the ED and before any abdominal imaging, the treating clinician recorded historical and physical examination data on a standard data collection form. Recorded data pertinent to the current study included patient age, mechanism of injury, complaints of abdominal pain, the presence of vomiting, the presence of abdominal tenderness, and the initial Glasgow Coma Scale score.

To determine whether any study patient with a normal abdominal CT scan result subsequently received a diagnosis of an intra-abdominal injury, we reviewed the medical records of patients hospitalized from the ED and performed telephone follow-up surveys for those discharged home. For discharged patients not reached by telephone survey, we mailed the same survey to their home. To identify patients with missed intra-abdominal injuries among those lost to follow-up by either method, we reviewed both hospital medical records and continuous quality improvement records and conducted a separate review of county morgue records for the study period.

Outcome Measures
The 2 study outcomes were the diagnosis of any intra-abdominal injury after a normal CT scan result and the diagnosis of any intra-abdominal injury undergoing acute...
intervention after a normal CT scan result. We defined acute intervention as (1) patient death caused by intra-abdominal injury; (2) laparoscopy or laparotomy with repair of an intra-abdominal injury; (3) angiographic embolization of an actively bleeding intra-abdominal structure; (4) blood transfusion for anemia as a result of hemorrhage associated with intra-abdominal injury; or (5) intravenous fluids for 2 or more nights in patients with gastrointestinal or pancreatic injuries.

Primary Data Analysis

We tabulated all data and generated standard descriptive statistics, including frequencies and 95% confidence intervals (CIs) for both outcomes. As the principal measures for both outcomes, we calculated the negative predictive value and the negative likelihood ratio. We also included the sensitivity and specificity of CT for any intra-abdominal injury and for injuries undergoing intervention, both of which were reported previously. We performed all analyses with SAS (version 9.2; SAS Institute, Inc., Cary, NC).

RESULTS

In the parent study, 12,044 (81%) of 14,882 eligible patients who were enrolled (Figure); 5,380 (45%) of those enrolled underwent abdominal CT during initial ED evaluation. A total of 1,561 patients had abnormalities on the abdominal portion of their CT scan. In the parent study, abdominal CT had a sensitivity of 97.8% (717/733; 95% CI 96.5% to 98.7%) and specificity of 81.8% (3,803/4,647; 95% CI 80.7% to 82.9%) for any intra-abdominal injury. For injuries undergoing intervention, CT had a sensitivity of 96.9% (185/191; 95% CI 93.3% to 98.8%) and specificity of 73.5% (3,813/5,189; 95% CI 72.2% to 74.7%).

The current study sample consists of the 3,819 patients enrolled in the parent study whose initial CT scan results were normal (71% of those with a CT performed, 32% of parent sample). We completed a telephone or mailed survey for 1,175 of the 1,513 patients (78%) discharged from the ED. For the remaining 338 discharged patients lost to follow-up (8.9% of the study sample), we reviewed hospital medical records, continuous quality improvement records, and county morgue records.

Characteristics of Study Subjects

Characteristics of study patients are displayed in Table 1. Sixty percent of the patients in our sample were hospitalized and 40% were discharged home. Notable differences between these 2 subgroups include a greater percentage of patients with distracting, nonabdominal injuries among those hospitalized and a greater percentage of patients with abdominal signs or symptoms among those discharged from the ED.

Main Results

Of 3,819 patients with normal CT scan results, 16 (0.4%; 95% CI 0.2% to 0.7%) subsequently received a diagnosis of intra-abdominal injuries. Six (0.2% of the total sample; 95% CI 0.06% to 0.3%) of the 16 children with intra-abdominal injuries diagnosed after a normal CT scan result underwent an acute intervention for that injury. One of the 16 patients underwent diagnostic laparotomy, revealing a mesenteric injury, but no repair was performed; this patient was not included among the 6 with intra-abdominal injury undergoing acute intervention. For all 16 patients, CT scans were performed with intravenous contrast; 1 was also performed with oral contrast. None of these 16 scans were considered of inadequate quality by the site radiologist.

The negative predictive value of a normal abdominal CT scan result for any intra-abdominal injury was 99.6% (3,803/3,819; 95% CI 99.3% to 99.8%); and for an intra-abdominal injury undergoing acute intervention, 99.8% (3,813/3,819; 95% CI 99.7% to 99.9%). The negative likelihood ratio of CT for any intra-abdominal injury was 0.03 (95% CI 0.02 to 0.04); and for an intra-abdominal injury undergoing acute intervention, 0.04 (95% CI 0.02 to 0.09).

Additional data on the 16 patients with intra-abdominal injuries diagnosed after normal abdominal CT scan results are presented in Table 2. Fifteen of these patients were among the 2,306 hospitalized from the ED (0.7%; 95% CI 0.4% to 1.1%); 1 was from the 1,513 initially discharged home (0.1%; 95% CI 0% to 0.4%). All but 4 of the 16 children had intestinal, mesenteric, or pancreatic injuries. One of these 16 patients died within 30 days of injury because of complications of a traumatic brain injury. This patient did not undergo intervention for an intra-abdominal injury.

Five of the 6 patients with intra-abdominal injury undergoing acute intervention were hospitalized from the ED.
Two of these 5 had intestinal injuries, and both underwent laparotomy with repair. Two of the other 3 patients had pancreatic injuries; both were treated with intravenous fluids for 2 or more days. Neither of the patients with pancreatic injuries underwent surgery. The fifth patient had low-grade liver and kidney lacerations and received a blood transfusion during exploratory laparotomy; no surgical repair of an intra-abdominal injury was performed.

The single patient discharged home from the ED after a normal abdominal CT scan result, who subsequently underwent intervention for an intra-abdominal injury, presented 2 days after ED discharge, complaining of moderate abdominal pain. An intestinal injury was diagnosed on a second abdominal CT scan, and the patient had a loop ileostomy performed for an ileal perforation (diagnosed during exploratory laparotomy).

Of the 2,306 patients hospitalized after normal abdominal CT scan results, 627 (27%) had all of the following clinical characteristics: no abdominal “seat belt” sign; no pelvic, tibial, or femoral fractures; no thoracic injury; an initial Glasgow Coma Scale score in the ED of 15; were discharged home the day after hospitalization; and had no surgery performed during that “1-day” hospitalization. Among the 15 hospitalized patients in our study who received a diagnosis of intra-abdominal injury after a normal CT scan result, only 1 was in this subgroup. This child had an adrenal hematoma identified on a second CT scan and was observed without undergoing intervention.

**LIMITATIONS**

This study has certain limitations. First, the decision to perform an abdominal CT scan was made at the discretion of the treating clinician. Patients enrolled in the parent study who did not have an abdominal CT scan performed were likely at lower risk for intra-abdominal injury than patients in our study sample; their inclusion in our sample would likely have increased the negative predictive value of CT. In addition, the percentage of normal CT scan results (71%) in our study was similar to that of a multicenter adult study (65%), in which all patients underwent CT scanning.\(^1\)

Second, the negative predictive value of CT for intra-abdominal injury was dependent on the extant epidemiologic conditions during the study period, including the prevalence of intra-abdominal injury within the population. Changes in physician CT ordering practices, such as a decrease in CT use with implementation of clinical prediction rules, may result in subtle changes in the negative predictive value of CT. To address the limitations of negative predictive value, we also report the negative likelihood ratio and sensitivity and specificity of CT for any intra-abdominal injury and injuries undergoing acute intervention.

Third, abdominal CT scans were interpreted by faculty radiologists who were not blinded to clinical information, though this reflects general clinical practice in centers similar to ours. In addition, at other centers faculty radiologists may be neither immediately available to interpret CT scans nor trained in the interpretation of pediatric CT scans, either of which might further limit the generalizability of our findings.

Fourth, we classified a CT scan as abnormal if any potentially suggestive finding was present, including nonspecific findings. Although this strict definition decreased the specificity of CT for any intra-abdominal injury, we identified a subgroup of children who underwent CT who were at the lowest risk for subsequently receiving a diagnosis of an intra-abdominal injury.

Fifth, although a percentage of our study patients were likely hospitalized solely to observe for evidence of occult intra-

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**Table 1.** Characteristics of 3,819 patients with normal abdominal CT scan results in the ED by disposition from the ED* and total (number and percentage given, unless indicated).

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Hospitalized</th>
<th>Discharged</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>2,306 (60)</td>
<td>1,513 (40)</td>
<td>3,819</td>
</tr>
<tr>
<td>Age (median, IQR), y</td>
<td>10.5 (4.4–15.1)</td>
<td>12.8 (7.9–16.1)</td>
<td>11.5 (5.8–15.5)</td>
</tr>
<tr>
<td><strong>Mechanism of injury</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Motor vehicle collision</td>
<td>817 (35)</td>
<td>516 (34)</td>
<td>1,333 (35)</td>
</tr>
<tr>
<td>Fall</td>
<td>370 (16)</td>
<td>248 (16)</td>
<td>618 (16)</td>
</tr>
<tr>
<td>Pedestrian/bicyclist struck by vehicle</td>
<td>539 (23)</td>
<td>189 (12)</td>
<td>728 (19)</td>
</tr>
<tr>
<td>Bicycle collision/fall from bicycle</td>
<td>100 (4)</td>
<td>132 (9)</td>
<td>232 (6)</td>
</tr>
<tr>
<td>Motorcycle/ATV/motorized scooter collision</td>
<td>204 (9)</td>
<td>76 (5)</td>
<td>280 (7)</td>
</tr>
<tr>
<td>Object struck abdomen</td>
<td>169 (7)</td>
<td>322 (21)</td>
<td>491 (13)</td>
</tr>
<tr>
<td>Other</td>
<td>53 (2)</td>
<td>20 (1)</td>
<td>73 (2)</td>
</tr>
<tr>
<td>Unknown</td>
<td>54 (2)</td>
<td>10 (1)</td>
<td>64 (2)</td>
</tr>
<tr>
<td>History of vomiting</td>
<td>267 (12)</td>
<td>122 (8)</td>
<td>389 (10)</td>
</tr>
<tr>
<td>GCS score ≥14</td>
<td>1,842 (80)</td>
<td>1,497 (99)</td>
<td>3,339 (87)</td>
</tr>
<tr>
<td>Initial abdominal tenderness</td>
<td>766 (34)</td>
<td>985 (66)</td>
<td>1,751 (46)</td>
</tr>
<tr>
<td>Complaints of abdominal pain</td>
<td>702 (31)</td>
<td>955 (63)</td>
<td>1,657 (44)</td>
</tr>
<tr>
<td>Distracting painful injury</td>
<td>891 (39)</td>
<td>173 (11)</td>
<td>1,064 (28)</td>
</tr>
<tr>
<td>Nonabdominal surgery</td>
<td>622 (27)</td>
<td>49 (3)</td>
<td>671 (18)</td>
</tr>
<tr>
<td>Deaths</td>
<td>39 (2)</td>
<td>0</td>
<td>39 (1)</td>
</tr>
</tbody>
</table>

IQR, Interquartile range; ATV, all-terrain vehicle; GCS, Glasgow Coma Scale.
*Percentages calculated from patients with data available for the specific characteristic.
abdominal injury, many were admitted for other or additional reasons. We did not gather data on the specific reasons for hospitalization, including social concerns. Our criteria to define this “low-risk” group, however, included common markers of or specific indications for hospitalization. In addition, one criterion was a duration of admission (1 day or less) sufficiently short to exclude those patients with most other serious injuries. Future studies evaluating the necessity of hospitalization should directly ask treating physicians for the reasons for hospitalization.

**DISCUSSION**

In this prospective, multicenter, 3-year study of more than 3,800 children with normal results from abdominal CT scans performed in the ED after blunt torso trauma, we found only

**Table 2. Characteristics of 16 patients with intra-abdominal injuries diagnosed after normal CT scan results in the ED.**

<table>
<thead>
<tr>
<th>Age, Years</th>
<th>Mechanism</th>
<th>Examination</th>
<th>GCS*</th>
<th>Injury (Diagnosed)†</th>
<th>Intervention(s)‡</th>
</tr>
</thead>
<tbody>
<tr>
<td>5§</td>
<td>Struck by moving vehicle</td>
<td>Abdominal erythema, abrasion, and ecchymosis Moderate abdominal tenderness below umbilicus</td>
<td>15</td>
<td>Ileum, hemoperitoneum (laparotomy)</td>
<td>Ileostomy, blood transfusion, and IVFs and bowel rest for 2 or more days</td>
</tr>
<tr>
<td>2</td>
<td>Fall &gt;10 ft</td>
<td>Abdominal erythema, abrasion</td>
<td>14</td>
<td>Pancreas (pancreatic enzymes)</td>
<td>None</td>
</tr>
<tr>
<td>2</td>
<td>Object struck abdomen</td>
<td>Abdominal ecchymosis, distention, and absent bowel sounds Moderate and diffuse abdominal tenderness</td>
<td>15</td>
<td>Ileum, jejunum, and mesentery (laparotomy)</td>
<td>Bowel resection and serosal repair, blood transfusion, and IVFs and bowel rest for 2 or more days</td>
</tr>
<tr>
<td>3§</td>
<td>Fall, 3–10 ft</td>
<td>No abnormal findings</td>
<td>5</td>
<td>Mesentery, pancreas (autopsy)</td>
<td>None</td>
</tr>
<tr>
<td>3</td>
<td>Object struck abdomen</td>
<td>Moderate, diffuse abdominal tenderness</td>
<td>15</td>
<td>Pancreas (pancreatic enzymes)</td>
<td>None</td>
</tr>
<tr>
<td>4</td>
<td>MVC, high speed</td>
<td>No abnormal findings</td>
<td>6</td>
<td>Pancreas (pancreatic enzymes)</td>
<td>IVFs and bowel rest for 2 or more days</td>
</tr>
<tr>
<td>4</td>
<td>MVC, high speed</td>
<td>Abdominal abrasion, ecchymosis, and distention</td>
<td>7</td>
<td>Liver, hemoperitoneum (repeated CT)</td>
<td>None</td>
</tr>
<tr>
<td>7</td>
<td>Struck by a moving vehicle</td>
<td>Abdominal abrasion, ecchymosis, and distention</td>
<td>7</td>
<td>Liver, kidney (repeated CT scan)</td>
<td>Blood transfusion</td>
</tr>
<tr>
<td>8</td>
<td>Object struck abdomen</td>
<td>Mild abdominal tenderness above umbilicus</td>
<td>15</td>
<td>Pancreas (pancreatic enzymes)</td>
<td>None</td>
</tr>
<tr>
<td>9</td>
<td>MVC, high speed</td>
<td>Moderate abdominal tenderness above umbilicus</td>
<td>15</td>
<td>Adrenal gland (repeated CT)</td>
<td>None</td>
</tr>
<tr>
<td>10</td>
<td>MVC</td>
<td>No abnormal findings</td>
<td>15</td>
<td>Pancreas (pancreatic enzymes)</td>
<td>None</td>
</tr>
<tr>
<td>10</td>
<td>Bicycle collision or fall from bicycle</td>
<td>Abdominal abrasion and ecchymosis Moderate abdominal tenderness above umbilicus</td>
<td>15</td>
<td>Pancreas (pancreatic enzymes)</td>
<td>None</td>
</tr>
<tr>
<td>10</td>
<td>MVC</td>
<td>Abdominal erythema, abrasion, and ecchymosis Seat belt sign Moderate, diffuse abdominal tenderness</td>
<td>15</td>
<td>Mesentery, hemoperitoneum (laparoscopy)</td>
<td>None§</td>
</tr>
<tr>
<td>11</td>
<td>Struck by a moving vehicle</td>
<td>No abnormal findings</td>
<td>7</td>
<td>Pancreas (pancreatic enzymes)</td>
<td>IVFs and bowel rest for 2 or more days</td>
</tr>
<tr>
<td>13</td>
<td>MVC, high speed</td>
<td>Abdominal abrasion, ecchymoses Seat belt sign Severe, diffuse abdominal tenderness</td>
<td>14</td>
<td>Ileum, descending colon, hemoperitoneum (laparotomy)</td>
<td>Serosal repair, IVFs and bowel rest for 2 or more days</td>
</tr>
<tr>
<td>15</td>
<td>MVC, high speed</td>
<td>Mild, diffuse abdominal tenderness</td>
<td>13</td>
<td>Urinary bladder (cystogram, repeated pelvic CT)</td>
<td>None</td>
</tr>
</tbody>
</table>

*IVF, Intravenous fluids; MVC, motor vehicle collision.
*Initial GCS score in the ED.
†All patients received a diagnosis at laparoscopy/laparotomy, by further imaging, or by elevated laboratory values.
‡Intervention specific to intra-abdominal injury.
§One subject received a diagnosis of an intra-abdominal injury after being discharged from the ED after a normal CT scan result.
¶Patient died within 30 days of hospitalization because of traumatic brain injury.
§Patient received a diagnosis of mesenteric injury during laparoscopy; no repair performed.
Risk of Intra-Abdominal Injury in Children After Normal Computed Tomography Scan

Kerrey et al

Recent studies of children evaluated with abdominal CT after blunt torso trauma, likely provides the best evidence. Among the 3 studies included in the review, 5 of 2,596 children (0.19%; 95% CI 0.08% to 0.44%) had intra-abdominal injuries diagnosed after normal abdominal CT scan results in the ED. Two of these 5 children underwent laparotomy; only 1 underwent a therapeutic intervention (repair of bowel rupture). The pooled negative predictive value of CT for any intra-abdominal injury was 99.8% (95% CI 99.6% to 99.9%). Only 1 of the 3 studies followed children after ED discharge; no missed intra-abdominal injuries were identified in this subgroup. The agreement between our findings and those of the systematic review is not surprising, given the quality of the 3 studies included in the review and their similar patient samples and settings. These studies were limited, however, in their use of older-generation CT scanners (2 of the 3 studies) and limited follow-up of patients with normal abdominal CT scan results. In contrast, we included a much larger and more diverse patient sample (20 centers versus 3), uniformly used current-generation CT scanners, had more extensive follow-up, and described in greater detail those children with intra-abdominal injuries diagnosed after a normal CT scan result.

During the past 40 years, there has been a dramatic reduction in exploratory laparotomies after blunt trauma in children because clinicians discovered that children with solid organ injuries generally do well with nonoperative management. During this period, CT use in the ED increased substantially, and CT technology matured considerably. These changes, along with greater experience of radiologists with CT interpretation for trauma patients, have likely contributed to the higher negative predictive values of abdominal CT reported in most recent studies, including ours. Despite these recent reports, ED and trauma clinicians continue to be concerned about occult intra-abdominal injuries after normal CT scan results. Underlying this concern is the perception that no diagnostic modality, including CT, has a sufficiently high negative predictive value to exclude all types of intra-abdominal injuries, especially pancreatic and intestinal injuries. Compared with solid organ injuries, the diagnosis of pancreatic and intestinal injuries is made more challenging by their relative rarity, few pathognomonic radiographic signs, their propensity for delayed presentation, and the lack of adequate screening laboratory tests. In our study, 75% of patients (12 of 16) with intra-abdominal injuries diagnosed after a normal CT scan result had injuries to the intestines/mesentery, pancreas, or both. Although many reports suggest CT has low sensitivity for intestinal and pancreatic injuries, most of these were single-center, retrospective reviews of trauma registry data and many included only patients with injuries confirmed at laparotomy. Advancements in CT scanner technology have been associated with improved sensitivity of CT for evidence of gastrointestinal injuries, whereas the sensitivity of even current-generation CT scans has been reported to be as low as 60% for pancreatic injuries. Our study findings suggest that children rarely receive a diagnosis of any type of intra-abdominal injury, including intestinal and pancreatic injuries, after a normal abdominal CT scan result in the ED.

In the current study, one quarter of patients hospitalized after normal abdominal CT scan results might have been considered candidates to discharge home from the ED because they had no abdominal seat belt sign; no pelvic bone, tibia, or femur fracture; no thoracic injuries; a normal initial mental status in the ED; a 1-day hospitalization; and no surgery performed while hospitalized. According to these findings and the recent literature, discharge home appears safe for children with normal abdominal CT scan results in the ED after blunt torso trauma if there are no other injuries or social concerns that necessitate hospitalization and there is minimal concern for occult pancreatic or gastrointestinal injury. If there is strong clinical suspicion for occult intra-abdominal injury, pancreatic or gastrointestinal injury in particular, then hospitalization for observation and serial abdominal examinations would be appropriate. In particular, patients with persistent moderate to severe abdominal pain or tenderness, or a seat belt sign, would be excluded from the low-risk group. All patients who are discharged home should be given strict instructions about which signs and symptoms are appropriate indications to return for further evaluation.

In conclusion, a large multicenter study of children evaluated after blunt torso trauma in EDs, intra-abdominal injury was rarely diagnosed after a normal CT scan result, suggesting that safe discharge is possible for these children when no other reasons for admission exist. Injuries not identified by abdominal CT scan but that ultimately underwent acute intervention were even rarer and mostly to the intestines or pancreas. Patients’ discharge instructions should be specific to the symptoms and signs produced by injuries to these organ systems, especially given the potential for delayed presentation.
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Author contributions: JFH obtained grant funding for the project. BTK drafted the article and created the figure and tables. NK and JFH conceived the study. BTK, NK, and JFH designed the study. All authors acquired data, provided supervision for the study, and critically revised the article. MLM and the data management and observation required after a normal abdominal computed tomography scan in children with blunt abdominal trauma? Acad Emerg Med. 2000;18:512-518.


APPENDIX

Participating centers and site investigators are listed below in alphabetical order: Bellevue Hospital Center (M. Tunik); Children’s Hospital Boston (L. Lee); Children’s Hospital of Michigan (P. Mahajan); Children’s Hospital of New York–Presbyterian (M. Kwok); Children’s Hospital of Philadelphia (F. Nadel); Children’s National Medical Center (S. Atabaki); Cincinnati Children’s Hospital Medical Center (B. Kerrey); DeVos Children’s Hospital (J. Kooistra); Howard County Medical Center (D. Monroe); Hurley Medical Center (D. Borgiali); Jacobi Medical Center (S. Blumberg) Medical College of Wisconsin/Children’s Hospital of Wisconsin (K. Yen); Nationwide Children’s Hospital (B. Bonsu) University of California–Davis Medical Center (N. Kuppermann, J. Holmes); University of Maryland (J. Menaker); University of Michigan (A. Rogers); University of Rochester (M. Garcia); University of Utah/Primary Children’s Medical Center (K. Adelgais); Washington University/St. Louis Children’s Hospital (K. Quayle); Women and Children’s Hospital of Buffalo (K. Lillis).

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ABEM Policy on Board Eligibility

Beginning January 1, 2015, a policy on board eligibility will take effect. At that time, if you are not already in the certification process, you will be considered “board eligible” on the date you graduate from your EM residency program. If you meet all of the requirements of The Policy on Board Eligibility, you will remain board eligible until you become certified or for five years, whichever comes first.

Physicians who graduated from an EM residency program prior to January 1, 2015, and physicians who applied for certification through the practice pathway and have an open application as of January 1, 2015, will be board eligible for five years after that date.

For more information, email verification@abem.org, or call 517.332.4800 ext. 381.