



Indirect signs of blunt duodenal injury on computed tomography: Is non-operative management safe?



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ABSTRACT

Introduction: Clear signs of duodenal injury (DI) such as pneumoperitoneum and/or oral contrast extravasation mandate laparotomy. Management when computed tomography (CT) reveals indirect evidence of DI namely duodenal hematoma or periduodenal fluid is unclear. We evaluated the utility of indirect signs to identify DI and the success of expected management, hypothesizing patients with indirect evidence of DI on CT can be safely managed non-operatively.

Methods: We retrospectively reviewed patients with a computed tomography (CT) scan with periduodenal hematoma or periduodenal fluid treated between January 2003 and January 2013 at a level 1 Trauma Center. Demographics, injury characteristics, laboratory values, injury severity scores (ISS), and outcome measures were recorded. Patients having immediate laparotomy were compared to those initially managed nonoperatively.

Results: We identified 74 patients with indirect signs of DI, with 35 patients (47%) undergoing immediate operative exploration and 39 (53%) initially managed non-operatively. Lactate (4.5 mg/dL, standard deviation (SD) 2.1 vs 3.1 mg/dL, SD 1.4, $p < 0.001$), ISS (median (IQR) 34 (27–44) vs. 24 (17–34), $p = 0.002$) and abdominal AIS (3 (3–4) vs 2 (2–3), $p < 0.001$) were higher in those with immediate operation. The incidence of DI requiring operative repair was 11% (8 of 74). Six of 35 (17%) explored urgently had a DI requiring repair while 29 of 35 (83%) had no DI or minor injury not requiring surgical therapy. Of those managed non-operatively, 7 of 39 (18%) failed observation but only two (5%) required duodenal repair. There was no significant difference in intensive care unit (ICU) (10.2 days, standard error [SE] 2.1 vs 9.7 days, SE 4.8, $p = 0.93$) or hospital (22.5 days, SE 3.8 vs 23.6 days, SE 8.5, $p = 0.91$) length of stay between those operated on immediately and those that failed non-operative management when adjusted for age, sex, and ISS. There was no mortality in the non-operative group related to an intra-abdominal injury.

Conclusion: Observation of patients with indirect sign of DI fails in about 20% of patients, but failure rate due to DI is low at 5%. Conservative management in appropriately selected patients is reasonable with close observation.

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Introduction

Blunt duodenal injury (DI) is relatively uncommon but is associated with diagnostic and therapeutic challenges. Due to the

retroperitoneal location of the 2nd through 4th segments of the duodenum, physical examination is often unreliable, so blunt DI can be difficult to diagnose based on clinical assessment alone [1,2]. Computed tomography (CT) scans are frequently performed in the hemodynamically stable blunt abdominal trauma patient without peritonitis to further evaluate for intra-abdominal and retroperitoneal injuries. With its high sensitivity and specificity in blunt abdominal trauma, CT has become the diagnostic modality of choice in this trauma population [3–5]. In cases of DI, CT is helpful when specific direct signs of duodenal injury, such as pneumoperitoneum and/or oral contrast extravasation, are demonstrated as these findings mandate laparotomy. However,

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appropriate management when CT demonstrates indirect evidence of potential DI, including periduodenal hematoma or periduodenal fluid, is unclear. There are currently no defined treatment strategies for indirect evidence of DI. Some surgeons will operate on all patients with these CT findings, especially intubated patients and in those with unreliable exams, because of concern that delaying surgery will result in increased morbidity and mortality [6,7].

The purpose of this study is to retrospectively evaluate blunt trauma patients with these indirect CT findings, considered suggestive of DI, to determine the incidence of significant duodenal injury in the setting of these non-specific findings. We hypothesize that signs of indirect evidence of DI on CT are poor predictors of surgically important duodenal injury, and that patients with these CT findings can be managed non-operatively.

Methods

We performed a 10-year retrospective review that was approved by our Institutional Review Board. Clinical records of blunt trauma patients admitted to a level 1 Trauma Center between January 2003 and January 2013 were reviewed. Patients that had a CT scan with a description of periduodenal hematoma or periduodenal fluid on an admission CT obtained prior to abdominal exploration, if performed, were included. Patients were excluded if they were younger than 18 years, sustained penetrating trauma, or had CT findings of pneumoperitoneum or oral contrast extravasation. Severity of injury scores (Injury Severity Score [ISS] and Abbreviated Injury Scale [AIS]) were abstracted, and the mechanism of injury was documented. Admission laboratory values, time to the operating room, hospital and Intensive Care Unit length of stay (HLOS and ICU LOS, respectively), and mortality were also reported.

Patients who underwent immediate exploratory laparotomy (“immediate”) were compared with those patients initially managed non-operatively (“conservative”). For the purposes of this study immediate intervention was defined as early operative intervention (<12 h after admission) or documented operative planning. Conservative management was considered non-operative close observation with possible interval abdominal CT scans. Mean values were calculated for continuous variables and were compared using student t-tests. Mann-Whitney tests were used to compare median values, while Chi square or Fisher’s exact tests were used for categorical variables. All statistics were performed in STATA Version 13 (StataCorp, College Station, TX). A *P*-value of <0.05 was considered statistically significant, and all tests were two-tailed.

Results

We identified 84 patients who were suspected to have duodenal injury based on admission CT findings. Ten had specific direct findings diagnostic for DI, including oral contrast extravasation or periduodenal free air, and were excluded from further analysis. Of the remaining 74 patients with indirect findings of potential DI, 35 (48%) underwent immediate operative exploration and 39 (52%) were initially managed conservatively. Overall, the mean age (standard deviation (SD)) for the study population was 36.9 years, SD 17.9 and the majority (72%) of patients were male. The predominant mechanism of injury was motor vehicle collision (54%) followed by pedestrian struck (17%). Median ISS and abdominal AIS (with interquartile ranges) for the group were 29 (20–39.5) and 3 (2–4), respectively.

The incidence of DI requiring operative repair in these patients with non-specific CT findings considered suggestive of DI was 11% (8 of 74). Six of 35 (17%) explored urgently had a DI requiring surgical repair, with each of these patients presenting at admission

with diffuse abdominal tenderness on palpation and external signs of abdominal trauma. Most of these injuries were full thickness perforations found on the second (*n* = 3) and third portion (*n* = 2) of the duodenum. Only one patient required a major reconstruction due to damage of the pancreatic duct and most lacerations were managed with primary repair. The remaining 29 of 35 (83%) had no DI or a minor contusion not requiring surgical therapy, although most of these patients had other abdominal injuries such as hepatic lacerations (*n* = 15), distal small bowel and large bowel perforations (*n* = 4), vascular injuries (*n* = 6) or splenic lacerations (*n* = 2) that likely served as the motivator for early operative intervention. Pancreatic injuries were also commonly seen in this study with 10 patients having pancreatic contusions and 9 patients having pancreatic lacerations. Of those managed non-operatively, 7 of 39 (18%) ultimately failed observation and underwent laparotomy due to worsening findings on interval CT scan or worsening physical exam findings. Only two (5%) of those were found to have duodenal injury requiring surgical repair (One with a small anterior perforation of the third section of the anterior duodenum while the other had an expanding duodenal hematoma in the first section with gastric outflow obstruction). Both of these patients showed progressive escalation of abdominal tenderness on serial abdominal exams and worsening findings on abdominal CT scan (including enlargement of the periduodenal fluid collection or contrast extravasation). The positive predictive value of periduodenal hematoma or periduodenal fluid on admission CT for correctly identifying a DI that required surgical intervention was only 21%. The sensitivity and specificity for immediate exploration in correctly identifying a DI was 75% and 56%, respectively, while the positive and negative predictive values for immediate exploration were 17% and 95%, respectively. Likewise, the sensitivity and specificity for immediate exploration in identifying any repairable intra-abdominal injury was 83% and 94%, respectively, while the positive and negative predictive values for immediate exploration were 94% and 82%, respectively.

A comparison of demographics, injury mechanism, and severity scores between the groups who underwent immediate operative exploration and those who were initially managed conservatively is shown in Table 1. ISS (median (IQR) 34 (27–44) vs. 24 (17–34), *p* = 0.002) and abdominal AIS (median (IQR) 3 (3–4) vs 2 (2–3), *p* < 0.001) were higher in those who underwent immediate operation compared with the planned nonoperative group. Lactate level (4.5 mg/dL, SD 2.1 vs 3.1 mg/dL, SD 1.4, *p* < 0.001) was statistically higher in the immediate operative group as was the base deficit (5.3, SD 5.3 vs 2.5, SD 3.6, *p* = 0.02) compared with the observation group. Patients in the immediate operative group were more likely to present with acidosis on admission (7.29, SD 0.1 vs 7.35, SD 0.1, *p* = 0.04). A full comparison of admission laboratory values and vital signs between the two groups is listed in Table 2.

The initial presentation of patients with or without operative duodenal injuries did not yield many useful discriminative factors. Platelet levels were found to be higher in patients with duodenal injuries requiring operative repair ($305.7 \times 10^9/L$, SD 104.6 vs. $235.0 \times 10^9/L$, SD 80.8, *p* = 0.02), though this is still within the normal clinical range. No other laboratory value or vital sign showed to be significantly different between those patients without duodenal injuries and those with duodenal injuries requiring operative intervention including lactate, base deficit, and admission pH (Table 3).

Time to the operating room was 5.1 h, SD 2.9, for the immediate group versus 32.9 h, SD 20.4 (*p* = 0.01), for all those that failed conservative management. The time to operative intervention was 23.6 h and 58.1 h for the two patients ultimately found with an operatively repaired DI that failed initial non-operative management. After adjusting for age, sex, and ISS, the immediate group had a significantly longer HLOS (22.3 days, SE 2.9 vs 13.3 days, SE

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