Isolated blunt pancreatic trauma: A benign injury?

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BACKGROUND: Blunt pancreatic trauma is rare, and the reported mortality is high. The true outcomes in isolated pancreas trauma are not known, and the optimal management according to injury severity is controversial. The present study evaluated the incidence, outcomes, and optimal management of isolated blunt pancreatic injuries.

METHODS: National Trauma Data Bank study, including patients with blunt pancreatic trauma. Patients with major associated injuries or other severe intra-abdominal injuries were excluded. Patients' demographics, vital signs on admission, Abbreviated Injury Scale for each body area, Injury Severity Score (ISS), and therapeutic modality were extracted. Mortality and hospital length of stay were stratified according to the severity of pancreatic injury and therapeutic modality.

RESULTS: There were 388,137 patients with blunt abdominal trauma. Overall, 12,112 patients (3.1%) sustained pancreatic injury. Isolated pancreatic injury occurred in 2,528 (0.7%) of all abdominal injuries or 20.9% of pancreatic injuries. Most injuries were low-grade Organ Injury Scale ((OIS) score of 2, 82.7%) with only a small percentage of higher-grade injuries (OIS score of 3, 7.9%; OIS score of 4, 3.9%; and OIS score of 5, 5.5%). Overall, most patients (74.1%) were managed nonoperatively. Nonoperative management was selected in 80.5% of pancreas OIS score of 2, 48.5% of OIS score of 3, and 40.9% of OIS scores of 4 to 5. The overall mortality rate was 2.4%, while in severe pancreatic trauma it was 3.0%. In minor pancreatic trauma, nonoperative management was associated with lower mortality and shorter hospital length of stay than operative management. However, in the group of patients with severe pancreatic trauma (OIS scores, 4–5) nonoperative management was associated with higher mortality and longer hospital stay than definitive operative management of the pancreas.

CONCLUSIONS: The mortality in isolated pancreatic trauma is low, even in severe injuries. Nonoperative management of minor pancreatic injuries is associated with lower mortality and shorter hospital stay than operative management. However, in severe trauma, nonoperative management is associated with higher mortality and longer hospital stay than operative management. (*J Trauma Acute Care Surg.* 2016;81: 855–859. Copyright © 2016 Wolters Kluwer Health, Inc. All rights reserved.)

LEVEL OF EVIDENCE: Prognostic study, level III; therapeutic study, level IV.

KEY WORDS: Isolated blunt pancreatic trauma; optimal management; outcomes.

Pancreatic injury is a relatively rare injury with an incidence of approximately 2% to 12% after abdominal trauma.[1–4] The reported associated mortality, however, is as high as 20%.[1–5] Blunt trauma to the pancreas is often associated with other intra-abdominal and/or extra-abdominal injuries,[6–10] making it difficult to ascertain the true incidence of morbidity and mortality attributable to the pancreatic injury alone. The purpose of this study was to assess the incidence, severity, outcomes, and optimal management strategies of isolated blunt pancreatic injuries, using the National Trauma Data Bank.

PATIENTS AND METHODS

After institutional review board approval, the National Trauma Data Bank database was reviewed from 2007 to 2012. All patients with blunt abdominal injury (Abbreviated Injury Scale [AIS], abdomen ≥ 1) were extracted, and patients with pancreatic injury were selected using the *International Classification of Diseases, Ninth Revision* codes 863.81 to 863.84. Patients who sustained major associated injuries (head, chest, and extremity injuries, AIS > 3) and other severe intra-abdominal injuries (Organ Injury Scale [OIS] ≥ 3) were excluded to yield the study population. Patients' demographics, mechanism of injury, level of admitting trauma center, vital signs on admission, AIS for each body area, and Injury Severity Score (ISS) were abstracted. The primary outcome was mortality. The secondary outcome was hospital length of stay (LOS). Study groups were based on the organ-specific injury severity (pancreatic OIS) and management of the pancreatic injury (operative versus nonoperative). The American Association for the Surgery of Trauma OIS for the pancreas is shown in Table 1.

Continuous variables were converted to dichotomous variables using clinically relevant cut points (age ≥ 55 years, systolic blood pressure ≤ 90 mm Hg, heart rate ≥ 110 beats per minute, and ISS ≥ 16). Categorical variables were compared using the χ^2 test or the Fisher exact rest and continuous variables were compared using the Student *t*-test or the Mann-Whitney rank sum test. The primary outcome was further analyzed using backward stepwise likelihood ratio logistic regression models. Clinically important predictor variables were correlated with mortality. A p value less than or equal to 0.05 was considered statistically significant. All statistical analyses were performed using IBM SPSS Statistics for Mac, version 20.0, (SPSS Inc, Armonk, NY).

RESULTS

During the study period 3,456,098 blunt trauma patients were entered into the National Trauma Data Bank database. Of these, 388,137 had abdominal injuries. Overall, 12,112 patients (3.1%) sustained pancreatic injury, with isolated pancreatic injury occurring in only 2,528 patients (0.7% of all abdominal injuries and 20.9% of pancreatic injuries).

The epidemiologic and clinical characteristics of the study patients are shown in Table 2. Overall, 833 patients (34.4%) had severe trauma, as defined by ISS > 15. Median ISS and Glasgow Coma Scale (GCS) scores were 9 and 15, respectively, with very few patients presenting with hypotension (systolic blood pressure ≤90 mm Hg: n = 166 [6.8%]) or GCS ≤ 8 (n = 200 [8.4%]). The

TABLE 1. American Association for the Surgery of Trauma OIS for the Pancreas

I	Hematoma. Minor contusion without duct injury. Laceration. Superficial laceration without duct injury
II	Hematoma. Major contusion without duct injury or tissue loss. Laceration. Major laceration without duct injury or tissue loss
III	Laceration. Distal transection or parenchymal injury with duct injury
IV	Laceration. Proximal transection or parenchymal injury with duct injury
V	Laceration. Massive destruction of pancreatic head

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TABLE 2. Demographics

Demographics, Clinical Presentation, and Mechanism of Injury	Blunt Isolated Pancreatic Injuries (n = 2528)
Age, median [IQR], y	24 [31]
Male, n (%)	1,592 (63.0)
SBP ≤ 90 mm Hg, n (%)	166 (6.8)
ISS score, median [IQR]	9 [12]
ISS score ≥ 15, n (%)	833 (34.4)
GCS ≤ 8, n (%)	200 (8.4)
MVC	1,038 (41.1)
AVP	359 (14.2)
Bicycle	331 (13.1)
Fall	309 (12.2)
Other	306 (12.1)
MCC	132 (5.2)
Assault	53 (2.1)

AVP, auto versus pedestrian; GCS, Glasgow Coma Scale; HR, heart rate; IQR, interquartile range; ISS, Injury Severity Score; MCC, motor cycle crash; MVC, motor vehicle crash; SBP, systolic blood pressure.

most common mechanism of injury leading to isolated blunt pancreatic injury was motor vehicle collision (41.1%; Table 2).

In patients with isolated blunt pancreatic trauma, most injuries were low-grade (OIS score of 2: n = 2,091 [82.7%]) with only a small percentage of higher-grade injuries (OIS score, 3: n = 200 [7.9%]; OIS score, 4: n = 98 [3.9%]; OIS score, 5: n = 139 [5.5%]).

Most (82.2%) of the patients were treated at Level 1 (1,418 cases) or 2 (590 cases) trauma centers, with only 107 patients treated at level 3 or 4 centers. In 344 patients (13.6%), the data on level of trauma center were missing. Level I centers were significantly more likely to treat severe pancreatic injuries (OIS scores, 4–5) than level 2 centers (9.8% vs 6.4%; $p = 0.001$).

Overall, 1,874 patients (74.3%) were managed nonoperatively. A total of 654 patients (25.9%) underwent an operation, including 59 pancreatic repairs (2.3%), 152 partial pancreatectomies (6.0%), and 12 total pancreatectomies (0.4%). Exploratory laparotomy without pancreatic specific operation was performed in 431 patients (17.0%). A total of 60 patients (2.4%) had an endoscopic retrograde cholangiopancreatography (ERCP), and 60 patients (2.4%) had a percutaneous drainage procedure.

The type of procedures performed according to pancreatic injury severity is shown in Table 3. In minor injuries (OIS score, 2), although 19.5% underwent a laparotomy, only 4.2% had a pancreatic procedure performed. Percutaneous drainage in this group of patients was required in only 1.3%. In moderate or severe injuries (OIS scores, 3–5), a laparotomy was performed in 55.6% of patients, but only 30.6% had a pancreas-specific operation (repair or resection). In the group of 237 patients with very severe pancreatic injuries (OIS scores, 4–5), most patients (59.1%) were managed operatively, with the most common procedure being a partial pancreatectomy (27.8%). Only 3.8% of the 237 patients with severe pancreatic trauma (OIS scores, 4–5) or 0.4% of all cases with pancreatic trauma underwent total pancreatectomy.

TABLE 3. Management by Pancreas Injury Severity (OIS)

	OIS 2 (n = 2,091)	OIS 3 (n = 200)	OIS 4–5 (n = 237)	*p*
Total operations, n (%)	407 (19.5)	103 (51.5)	140 (59.1)	<0.001
Only laparotomy, n (%)	318 (15.2)	58 (29.0)	55 (23.2)	<0.001
Pancreatic repair, n (%)	38 (1.8)	8 (4.0)	13 (5.5)	<0.001
Partial pancreatectomy, n (%)	50 (2.4)	36 (18.0)	66 (27.8)	<0.001
Total pancreatectomy, n (%)	1 (0.0)	2 (1.0)	9 (3.8)	<0.001
Nonoperative management	1,684 (80.5)	97 (48.5)	97 (40.9)	<0.001

Operative management versus nonoperative management in severe pancreas injuries (OIS scores, 4–5) was similar between Level 1 and Level 2 trauma centers (operative, 60.7% vs 65.8%; nonoperative, 39.3% vs 34.2%, respectively; $p = 0.708$).

The overall mortality rate was 2.4% (60 deaths), and in the group of patients with severe pancreas trauma (OIS scores, 3–5), the mortality rate was 3.0%. The median hospital stay ranged from 9 days (interquartile range [IQR], 9) in minor trauma (OIS score, 2) to 11 [IQR, 12] in severe trauma (OIS score, 5). Analysis of the 47 patients with pancreas OIS score of 2 who died showed that 13 patients (27.7%) were older than 70 years, 34 (72.3%) had a chest AIS score of 3, 13 (27.7%) had a head AIS score of 3, and 5 (10.6%) had an extremity AIS score of 3.

Table 4 shows mortality and hospital LOS according to pancreatic injury severity and type of management. In minor pancreatic trauma (OIS score, 2), nonoperative management had significantly lower mortality and shorter hospital LOS than patients treated with operation. In patients with moderate injuries (OIS score, 3) the mortality and median hospital LOS were 1.2% and 8 days for nonoperatively managed patients and 5.2% and 14 days for those managed with an operation. In severe injuries (OIS scores, 4–5), the mortality rate was 6.9%, and the median hospital stay was 10 days in nonoperatively managed patients, and 5.6% and 11 days for those managed with laparotomy alone. In the group of patients with a pancreatic procedure, there was no mortality, and the median hospital stay was 10 days.

A logistic regression analysis was performed to detect the variables independently correlated with mortality in our population. Age, male sex, OIS, operative treatment, and ISS were included in the model. As shown in Table 5, age, operative

TABLE 4. Outcomes According to Pancreas Injury Severity and Management

	Mortality, n (%)	LOS, median (IQR), d
Pancreas OIS 2,n = 2,091	$p < 0.001$	$p < 0.001$
Treated nonoperatively, n = 1,684	25 (1.6)	5.0 (7.0)
Treated with laparotomy alone, n = 318	18 (5.8)	11.0 (14.0)
Pancreas procedure (repair or resection), n = 89	4 (4.6)	12.0 (13.0)
Pancreas OIS 3,n = 200	$p = 0.202$	$p < 0.001$
Treated nonoperatively, n = 97	1 (1.2)	8.0 (12.0)
Treated with laparotomy alone, n = 58	3 (5.2)	16.5 (14.0)
Pancreas procedure (repair or resection), n = 45	0 (0.0)	11.0 (8.0)
Pancreas OIS 4–5,n = 237	$p = 0.032$	$p = 0.001$
Treated nonoperatively, n = 97	6 (6.9)	10.0 (14.0)
Treated with laparotomy alone, n = 55	3 (5.6)	16.0 (19.0)
Pancreas procedure (repair or resection), n = 85	0 (0.0)	10.0 (7.0)

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TABLE 5. Multivariate Analysis

			95% CI	
	p-value	OR	Lower	Upper
Male	0.331	0.738	0.400	1.362
Age	<0.001	1.054	1.035	1.065
OIS Pancreas 2	0.414			
OIS Pancreas 3	0.184	1.864	0.743	4.675
OIS Pancreas 4–5	0.491	1.610	0.415	6.252
Operative treatment	0.013	2.145	1.178	3.906
ISS	<0.001	1.124	1.088	1.161

CI, confidence interval; OR, odds ratio.

treatment, and ISS were independently associated with mortality with an odds ratio of 1.054, 2.145, and 1.124, respectively.

DISCUSSION

Pancreatic injuries following blunt trauma are rare because of the well-protected position of the pancreas in the retroperitoneum. Most series report an incidence of less than 2% of all blunt trauma cases.[5,7,11] A more precise calculation of the incidence is to use blunt abdominal trauma as the denominator, not all blunt trauma cases, which may not involve the abdomen. The current study showed that pancreatic injury following blunt abdominal trauma, occurs in 3.1% of the cases. Isolated pancreatic injury is even rarer, occurring in only 0.7% of all abdominal injuries. Approximately 20 % of these injuries were isolated, with no other significant intra-abdominal injuries. Other small studies reported isolated pancreatic trauma in approximately 30% of pancreatic injuries.[12] Another interesting epidemiological finding of the present study is that most blunt pancreatic injuries are minor. Overall, 83% of injuries had a low American Association for the Surgery of Trauma OIS score (2). Fewer than 10% of the patients had severe trauma, as defined by an OIS score of 4 or 5.

The optimal management of blunt pancreatic injuries is controversial and based on small retrospective studies and personal experience. There are no randomized studies addressing this issue.[13] Based on the available class III evidence, the Eastern Association for the Surgery of Trauma recommended drainage for Grade 1 and Grade 2 injuries and resection with drainage for Grade 3 or higher.[14]

A few studies, especially in pediatric patients, suggest that low-grade injuries (OIS score of 1 or 2) can safely be managed nonoperatively. Nonoperative management should be considered only in hemodynamically stable patients without evidence of peritonitis. Patients selected for nonoperative management should be closely monitored clinically, repeated computed tomography or ultrasound, and serial pancreatic enzymes.[11,15,16] Additionally, Keller et al.,[17] in a National Pediatric Trauma Registry study, reported successful nonoperative management in approximately 80% of low-grade injuries. Subsequent limited experience in adult blunt trauma patients confirmed the safety of a nonoperative approach.[18]

The management of more complex injuries is a matter of significant controversy. Most studies suggest that all patients with significant pancreatic trauma (OIS scores of 3–5) should undergo an operation.[18,19] The operative approach can consist of laparotomy with drainage of the peripancreatic area, various degrees of pancreatic resection and pancreatic repair, depending on the severity and site of pancreatic injury.

However, some recent small series and case reports suggested that nonoperative management of carefully selected patients with severe blunt pancreatic trauma may be an acceptable and safe option. Hamidian et al. reported in a literature review of 39 patients with major pancreatic duct transection treated surgically and 12 patients who were conservatively managed with combined expectant and image-guided percutaneous procedures if needed. The authors concluded that both operative and nonoperative management of major blunt pancreatic injuries are acceptable and have similar complication rates and that the management of these patients should be determined by the clinical condition.[20] Additionally, Mercantini et al.[21] reported a case with Grade 4 blunt pancreatic trauma involving complete pancreatic transection to the right of the superior mesenteric vessels successfully managed nonoperatively. A similar case was reported by Bharati et al.[22] Endoscopic retrograde cholangiopancreatography with placement of a stent in the injured pancreatic duct has been used as an adjunct of the nonoperative approach, although the experience is still very limited to a few cases.[23–25]

The current study showed some interesting practices in the management of blunt pancreatic trauma. Nonoperative management was selected in a significant number of patients, even in those with major pancreatic trauma. Overall, 48.5% of patients with pancreatic trauma OIS score of 3 and 40.9 % of cases with OIS scores of 4 to 5 were selected for nonoperative management. In those undergoing an operation, laparotomy with drainage was the most common procedure (65.9% of operations), followed by partial pancreatectomy (23.2% of operations), and pancreatic repair (9.0%). Total pancreatectomy accounted for only 1.8% of all procedures or 0.4% of cases with pancreatic trauma.

In minor pancreatic trauma (OIS score of 2), nonoperative management seems to be superior to the operative management. The mortality rate was significantly lower than that in patients treated with laparotomy alone or pancreatic resection/repair (1.6% vs 5.8% vs 4.6%, respectively). Additionally, the hospital LOS was significantly shorter in the nonoperative group (5 [7] days vs 11 [14] days vs 12 [13] days, respectively). However, in the group of patients with severe trauma (OIS scores of 4–5) operative management was associated with significantly better survival and shorter hospital stay than those treated nonoperatively or with laparotomy alone. There was no difference in the incidence of operative versus nonoperative management between Level 1 and Level 2 trauma centers.

The overall mortality rate of 2.5% in this series is significantly lower than those of previous studies, which have found rates of up to 20% in blunt pancreatic injuries.[1–5] This difference is attributed to the fact that in previous studies, mortality included patients with blunt pancreatic injury and other associated intra-abdominal injuries, namely, associated abdominal vascular injuries, which accounted for most deaths attributed to pancreatic injury.[2,26,27] This is the first large study to examine mortality in isolated blunt pancreatic injury. Another possible explanation for the lower mortality in this series is the extensive use of nonoperative management, which is associated with

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improved outcomes in lower-grade injuries. When adjusted for possible confounders in a regression model that included also age, pancreas OIS and ISS scores, operative management was found to be independently associated with mortality, with an odds ratio of 2.145. These results could be explained with the high rate of minor injuries in our population, better managed nonoperatively.

In conclusion, pancreatic injury in blunt abdominal trauma is rare. Isolated pancreatic injury occurs in less than 1% of all abdominal trauma and in approximately 20% of all pancreatic injuries. A significant number of American surgeons practice nonoperative management, even in patients with severe pancreatic injuries. Nonoperative management of pancreatic injuries with an OIS score of 2 (hematoma, major contusion, or major laceration without tissue loss or duct injury) is associated with lower mortality rate and shorter hospital stay than operative management. However, in patients with severe trauma (OIS scores of 4–5), nonoperative management is associated with higher mortality than definitive operative management of the pancreas. The mortality in isolated pancreatic trauma is very low, even in severe injuries.

AUTHORSHIP

All authors contributed to the design of this study. S.S. conducted the literature search and the data collection. D.D., E.K., E.B., K.I. and S.S. analyzed and interpreted the data. D.D., E.B. and S.S. wrote and edited the manuscript for submission.

DISCLOSURE

The authors declare no conflicts of interest.

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