Outcomes after pancreatic trauma: experience at a single institution

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Objective: Pancreatic injury following trauma is unusual, and there are few data regarding outcomes, particularly with respect to endocrine and exocrine function. The purpose of this study was to review our institutional experience in regard to this relatively infrequent injury and to determine the incidence of trauma-induced endocrine and exocrine pancreatic dysfunction as indicated by patient self-report. **Methods:** After receiving institutional research ethics approval, we identified all patients with pancreatic injuries in our trauma registry database over a 5-year period. The diagnostic, operative information, hospital course and complication rates were abstracted from medical records. Patients who could be contacted completed a telephone-administered questionnaire to assess pancreatic function. **Results:** We identified 25 patients who had suffered a pancreatic injury. Of these, 16 patients suffered blunt injury, and 9 suffered penetrating injury. Of the 25 patients, 13 underwent pancreatic surgery, and 6 required distal pancreatectomy. Early pancreas-specific complications occurred in 7 of 22 surviving patients (31.8%). Of the 25 patients identified, 6 could not be contacted for follow-up information. Of 19 patients contacted, 4 reported endocrine dysfunction. One of these was insulin-dependant before injury. No patient in this series reported exocrine dysfunction. The overall mortality rate in our series was 12%. **Conclusion:** Pancreatic injuries comprised about 1% of injuries captured by our trauma registry. Outcomes were similar in patients who suffered blunt or penetrating trauma. Of these patients, 52% underwent pancreatic surgery; 16% of patients in this small series reported endocrine deficiency posttrauma.

Objectif : Une lésion du pancréas suite à un traumatisme est inusitée et il existe peu de données sur l'issue, particulièrement en pour ce qui est des fonctions endocrine et exocrine. Cette étude visait à passer en revue notre expérience institutionnelle de cette lésion relativement peu fréquente et à déterminer l'incidence de la dysfonction pancréatique endocrine et exocrine provoquée par traumatisme, telle qu'indiquée par l'autodéclaration du patient. **Méthodes :** Après avoir reçu l'approbation du comité d'éthique de la recherche de l'établissement, nous avons repéré dans notre base de données sur les traumatismes tous les patients qui avaient subi une lésion du pancréas au cours d'une période de cinq ans. Nous avons résumé à partir des dossiers médicaux le diagnostic, l'information sur l'intervention, l'évolution à l'hôpital et les taux de complications. Les patients avec lesquels nous avons pu communiquer ont répondu à un questionnaire administré par téléphone pour que nous puissions évaluer leur fonction pancréatique. **Résultats :** Nous avons repéré 25 patients qui avaient subi une lésion au pancréas. Seize d'entre eux avaient subi une lésion fermée et 9, une lésion pénétrante. Treize des 25 patients ont subi une intervention chirurgicale au pancréas et 6 ont eu besoin d'une pancréatectomie distale. Des complications spécifiques au pancréas se sont produites très tôt chez 7 des 22 patients survivants (31,8 %). On n'a pu communiquer avec 6 des 25 patients identifiés pour obtenir de l'information de suivi. Quatre des 19 patients avec lesquels on a communiqué ont signalé une dysfonction endocrine. Un de ces patients dépendait de l'insuline avant la lésion. Aucun patient de cette série n'a signalé de dysfonction exocrine. Le taux de mortalité global dans notre série s'est établi à 12 %. **Conclusion :** Les lésions du pancréas constituaient environ 1 % des lésions saisies dans notre registre des traumatismes. Les résultats étaient semblables selon que les patients avaient subi un traumatisme fermé ou pénétrant. De ces patients, 52 % ont subi une intervention chirurgicale au pancréas et 16 % des patients de cette série limitée ont signalé un déficit endocrinien post-traumatique.

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Pancreatic injury secondary to trauma is uncommon but carries significant morbidity and mortality. Injury to the pancreas occurs in 0.2% of patients with blunt trauma. The incidence is higher in penetrating injuries, ranging from 1% to 12% in published series.[1,2] The overall morbidity rates following pancreatic injury range from 30% to 40%[3] and are primarily related to associated injuries, including those involving the liver, porta hepatis or duodenum. The mortality rate ranges from 9% to 34% in various series.[3,4] The early mortality is secondary to uncontrolled hemorrhage, and late mortality is generally related to sepsis and associated organ failure. The mortality directly attributed to pancreatic injury ranges from 2% to 17%.[3]

After pancreatic resection, recovery of normal pancreatic physiology depends on the underlying pathology and extent of resection.[5,6] In general, if the pancreas is otherwise normal, a resection of > 90% is required to produce endocrine deficiency.[3] Patients undergoing pancreatic surgery for nontraumatic indications often have significant pancreatic dysfunction related to the underlying pathology. Functional outcome after Whipple's resection was evaluated and resulted in an incidence of postoperative diabetes ranging from 20% to 50%.[7] In chronic pancreatitis, resection improves pain, but exocrine and endocrine function are generally compromised. Long-term results of distal pancreatectomy for chronic pancreatitis in 90 patients showed little effect on exocrine function, but endocrine dysfunction was reported in 23% of patients.[5] Another study evaluated functional outcome after necrosectomy for necrotizing pancreatitis in 44 patients: 11 patients developed endocrine insufficiency, 6 patients developed exocrine insufficiency alone, and 5 developed both endocrine and exocrine insufficiency.[8]

In the trauma population, preoperative evaluation of the pancreatic function is not possible. There are limited data regarding pancreatic function after pancreatic injury or resection secondary to trauma. To our knowledge, no reports have examined postinjury exocrine and endocrine function. Our objective was to review cases of pancreatic injury at a single institution over 5 years and, through a patient-directed questionnaire, document the functional outcome after blunt and penetrating pancreatic trauma.

Methods

We reviewed the trauma registry at our level 1 centre to identify all patients with pancreatic injuries from 1999 to 2004. Demographic and mechanistic data were collected from the data registry (Table 1, Table 2). The medical record was reviewed for each patient to determine length of hospital and intensive care unit stay and number of ventilator days. Computed tomography (CT) reports dictated by the attending radiologist were reviewed, and information regarding pancreatic and other injuries was collected. Operative records were reviewed to capture operative findings, including associated visceral or vascular injuries and surgical procedures. The radiologic and operative findings were used to ascribe the American Association for the Surgery of Trauma (AAST) pancreatic injury grade score for each patient (Box 1).[3]

From our registry, we identified a total of 25 patients with pancreatic injury. Pancreatic injury was diagnosed intraoperatively in all patients who underwent laparotomy.

Table 1

Patient mortality and self-reported pancreatic dysfunction

Patient no.	Mechanism	AAST grade	Surgery	Alive/Dead	Pancreatic dysfunction
1	MVC	I	No	Alive	No
2	MVC	II	No	Alive	No
3	MVC	II	Yes	Alive	No
4	MVC	II	Yes	Alive	No
5	MVC	II	No	Alive	No
6	MVC	II	No	Dead	Not evaluated
7	MVC	I	No	Alive	No
8	MVC	II	Yes	Alive	No
9	MVC	II	No	Alive	No
10	MVC	II	No	Alive	Not evaluated
11	MVC	III	Yes	Alive	Yes*
12	MVC	II	No	Alive	Not evaluated
13	MVC	III	Yes	Alive	Yes
14	ATV	III	Yes	Alive	No
15	MVC	I	No	Alive	No
16	Stomping	III	Yes	Alive	No
17	GSW	IV	Yes	Dead	Not evaluated
18	GSW	IV	Yes	Alive	No
19	GSW	II	Yes	Alive	No
20	SW	II	No	Alive	Not evaluated
21	GSW	II	No	Dead	Not evaluated
22	SW	II	Yes	Alive	No
23	GSW	II	No	Alive	Yes
24	SW	II	Yes	Alive	No
25	GSW	V	Yes	Alive	Yes

AAST = American Association for the Surgery of Trauma; ATV = all terrain vehicle; GSW = gunshot wound; MVC = motor vehicle crash; SW = stab wound.
*This patient had preexisting type I diabetes mellitus.

In patients treated nonoperatively, the diagnosis was primarily based on clinical examination and CT findings. These patients underwent serial serum amylase determinations. We determined postinjury pancreatic functional outcomes by administrating a questionnaire (Table 4) during a telephone interview with each of the identified patients that we were able to reach. Our results are based on each patient's subjective self-reporting. The questionnaire evaluated symptoms and signs of pancreatic dysfunction, whether managed operatively or nonoperatively. It included questions on the need for insulin or other hypoglycemic drugs or pancreatic enzyme supplements before and after pancreatic injury. Institutional research ethics board approval was sought and obtained.

Results

Patient demographics

Our trauma registry yielded 25 patients with pancreatic injury (Table 2). We could not contact 6 patients to complete the telephone questionnaire, 3 patients died relative to their injury, and we could not locate 3 patients after discharge. Subjects were divided into 2 groups according to whether they suffered blunt or penetrating trauma (Table 3): 16 patients (64%) suffered blunt trauma, and 9 patients (36%) suffered penetrating injuries, including 3 patients with stab wounds and 6 with gunshot wounds (GSW). The mean age, number of ventilator days and intensive care unit length of stay were comparable between the 2 groups. There were more male patients in the penetrating injury group. The mean Injury Severity Score was

Box 1. Pancreatic Organ Injury Scale: American Association for the Surgery of Trauma

Grade*	Injury description†
I	Minor contusion or superficial laceration without duct injury
II	Major contusion or laceration without duct injury or tissue loss
III	Distal transaction or parenchymal injury with duct injury
IV	Proximal (right of superior mesenteric artery) transaction or parenchymal injury
V	Massive disruption of pancreatic head

*Advance 1 grade for multiple injuries in the same organ.
†Based on most accurate assessment at autopsy, laparotomy or radiologic study.

Table 2

Demographic and operative findings

Patient no.	Age, y	Sex	ISS	Pancreas-specific surgery	Other organs injured	LOS; no. days		
						Vent.	ICU	Hosp.
1	48	Female	21	None	Duodenum, colon, ribs	15	8	43
2	57	Female	12	None	None	2	5	12
3	43	Female	13	Repair of parenchyma	Spleen	8	10	28
4	19	Female	18	Repair of parenchyma	Liver, spleen	26	29	51
5	24	Male	23	None	Liver, mesocolon	4	7	18
6	52	Male	27	None	Brain	2	3	5
7	29	Female	5	None	None	0	0	4
8	41	Male	26	Repair of parenchyma	Liver, mesocolon, femur	3	6	27
9	19	Male	12	None	Spleen, liver, kidney	7	13	22
10	34	Male	9	None	None	0	1	2
11	33	Male	23	Distal pancreatectomy	Aorta, spleen, diaphragm	17	21	55
12	68	Male	28	None	Liver, spleen, mesentry, pelvis	27	29	51
13	38	Male	6	Distal pancreatectomy	Duodenum	2	4	9
14	36	Male	6	Distal pancreatectomy	Duodenum	0	3	7
15	35	Male	9	None	Mesentry	3	5	13
16	19	Female	25	Distal pancreatectomy	None	2	4	10
17	48	Female	29	Distal pancreatectomy	Spleen, liver, stomach, diaphragm, great vessels	1	1	1
18	40	Male	24	Distal pancreatectomy	Liver, duodenum, mesentry	7	5	52
19	39	Male	16	Repair of parenchyma	CBD, liver, spleen	1	3	37
20	31	Female	16	None	Duodenum	25	28	103
21	30	Male	29	None	Liver, spleen, gall bladder	1	1	1
22	22	Male	23	Repair of parenchyma	IVC, liver, stomach, diaphragm	4	5	10
23	36	Male	21	None	Liver, aorta	9	11	20
24	22	Male	20	Repair of parenchyma	Spleen, diaphragm	1	3	7
25	24	Male	26	Débridement and packing	Duodenum	3	7	28

CBD = common bile duct; Hosp = hospital; ICU = intensive care unit; ISS = Injury Severity Score; IVC = inferior vena cava; LOS = length of stay; Vent = ventilator.

higher and hospital length of stay was longer in the group with penetrating trauma.

Nonoperative group

Of the 25 patients identified, 11 were managed nonoperatively. These patients had no immediate indication for trauma laparotomy and underwent enteral and intravenous contrast-enhanced helical CT. In each case, radiologic findings were consistent with grade I or II injury, as reported by the attending radiologist. No additional injuries mandating laparotomy were indicated by CT. All patients who were managed nonoperatively underwent a follow-up CT within 4–7 days of admission. The follow-up scan failed to reveal pancreas-specific complications, except in 1 patient who developed trauma-induced pancreatitis. Three patients in this group underwent endoscopic retrograde cholangiopancreatography (ERCP) for a persistently elevated serum amylase level; all patients had normal ductal anatomy.

Table 3

Comparison of outcomes between patients with blunt and penetrating trauma

Characteristic	Blunt	Penetrating
No. patients, (%)	16 (64)	9 (36)
Male/female, %	62.5/37.5	78/22
Mean age (and range), y	37 (19–68)	30 (22–48)
Mean ISS score (and range)	16.4 (5–28)	12.6 (16–26)
LOS; mean (and range), d		
Ventilator	7.4 (2–26)	5.6 (1–25)
ICU	9.8 (1–29)	7.3 (1–28)
Hospital	22.6 (2–55)	28.8 (1–103)
Procedure, no.		
Distal pancreatectomy	4	2
Repair of parenchyma	3	3
Débridement and drainage	0	1
Complications, no. (and %)	5 (33.3)	2 (28.6)
Pancreatitis	1	0
Pseudocyst	2	0
Pancreatic fistulae	2	2
Endocrine dysfunction	1/13	2/6
Patients not contacted, no.	2	1
Mortality, no. (and %)	1 (6.25)	2 (22.2)
Overall mortality	3 (12)	

ICU = intensive care unit; ISS = Injury Severity Score; LOS = length of stay.

Table 4

Results of questionnaire administered by telephone to 19 patients contacted

Question	No. of positive responses
Did you have diabetes before the accident?	1
Do you have diabetes now?	3
Do you take oral medications for diabetes?	0
Do you take insulin for diabetes?	3
Do you take medications such as pancreatic enzymes?	0
Do you suffer from diarrhea?	2*
Do you suffer from steatorrhea?†	0
Have you ever been told that you have chronic pancreatitis or had a CT that demonstrates chronic pancreatitis ?	0
Did you notice postinjury weight loss or gain?	0
Have you intentionally attempted to lose weight?	0

CT = computed tomography scan.
*Self-limiting.
†Explanation provided to patients.

Operative group

The remaining 14 patients underwent immediate trauma laparotomy (Table 2). In this group, 1 patient was found to have a grade II injury in the pancreatic head that was part of a constellation of other major abdominal injuries. The pancreatic injury was managed by closed suction drainage only. Thus 13 patients underwent pancreatic surgery, of whom 6 underwent a distal pancreatectomy, 6 had repairs of parenchymal laceration in the body or tail, and 1 underwent débridement and packing of a severe pancreatic head injury in the setting of damage-control surgery secondary to a GSW. No patient in our series had a spleen-preserving distal pancreatectomy. All patients who underwent distal pancreatectomy had closed suction drains placed intraoperatively.

Among the 16 patients with blunt trauma, 7 required surgery as follows: 4 underwent distal pancreatectomies for grade III injuries, and the remaining 3 had repairs of grade II parenchymal injuries. Among the 9 patients with penetrating trauma, 6 required surgery, with 2 having distal pancreatectomies for grade IV injuries and the remaining 4 having repairs of parenchymal injuries. Of the latter, 3 patients had grade II injuries, and 1 patient had a grade V injury involving the pancreatic head, which required débridement and packing with repeated laparotomy within 36 hours to place closed suction drains.

Pancreas-specific complications

Of 22 surviving patients, 7 (31.8%)

suffered nonendocrine pancreatic-specific complications (Table 3), 6 suffered postoperative complications, and 4 developed pancreatic fistulae.

Among the 4 fistulae, 1 developed after distal pancreatectomy for grade IV injury in the setting of penetrating injury, 1 developed after débridement and drainage for grade V injury related to a GSW, and the remaining 2 developed after débridement and repair of grade II injury in the setting of blunt trauma. Among the 6 patients with postoperative complications, 2 developed pseudocysts. Both patients had undergone distal pancreatectomy for grade III injury secondary to blunt injury. One patient managed nonoperatively developed acute pancreatitis following a grade I injury from a blunt mechanism.

The overall mortality rate in our series was 12% (3/25 patients), with 1 patient in the blunt injury group and the other 2 patients in the penetrating injury group. Of these, 1 patient died intraoperatively from massive hemorrhage; 1 patient died within 24 hours of surgery, again because of hemorrhage-related complications; and 1 patient died on the fifth day postinjury with a presumed diagnosis of massive pulmonary embolism.

Pancreatic dysfunction as assessed by telephone questionnaire

The diagnosis of pancreatic dysfunction in our study was based on the patient's self-assessment in response to a questionnaire administered by telephone (Table 4). The time interval between discharge and questionnaire was 1 month to 4 years. We could not assess 6 patients because 3 had died and 3 could not be located. Among the 19 patients we contacted, 3 (15.8%) reported some manifestation of pancreatic endocrine dysfunction. Of these 3 patients, 2 had undergone surgery for pancreatic injuries. The first underwent a distal pancreatectomy for a grade III injury secondary to blunt trauma and was diagnosed with type II diabetes mellitus by his family doctor several months post-trauma. The second suffered a grade V injury in the setting of penetrating trauma managed by débridement and damage-control techniques. This patient reported new-onset insulin requirement postinjury. The third patient suffered a grade II injury from penetrating trauma that was treated nonoperatively; he responded positively to the queries regarding insulin requirement postinjury. An additional patient reported being insulin-dependent before his injuries and continued to use insulin after a distal pancreatectomy for grade III injury secondary to blunt trauma (Table 1). When queried, no patient in this series self-reported manifestations of exocrine dysfunction or use of pancreatic enzyme supplements.

Discussion

The diagnosis and management of pancreatic trauma is a challenge. The absence of early physical signs and symptoms is commonly attributed to the retroperitoneal location of the pancreas. Some authors state that pancreatic enzymes may remain inactive and that there may be decreased secretion of pancreatic fluid following injury.[3] Blunt pancreatic injury occurs when high-energy force is applied to the upper abdomen, crushing the retroperitoneal structures against the vertebral bodies and causing a spectrum of injury from minor contusion to complete transaction.[3,4] In adults, about 60% of pancreatic injuries are caused from motor vehicle crashes as a result of impact with the steering wheel, whereas in children, the most common mechanism is a direct blow to the epigastrium from bicycle handlebars.[3] In a stab wound, the weapon damages the pancreatic tissue along the tract of the injury, and in a GWS, the passage of the missile and the associated pressure wave causes a wider area of injury.[4]

The diagnosis of pancreatic injury should be made intraoperatively in all the patients undergoing surgery. The surgeon should open the lesser sac in all patients who undergo a trauma laparotomy and visualize and palpate the pancreas. In blunt trauma, the diagnosis requires a high index of suspicion, particularly in the absence of indications for laparotomy.[3] In this patient population, serum amylase is neither sufficiently sensitive nor sufficiently specific to be used alone for the diagnosis of pancreatic injury.[9] Among patients with blunt pancreatic trauma, 65%–75% will manifest an elevated serum amylase. This number rises to 84% once 3 hours have elapsed between injury and the time of measurement.[3,10] In our study, the diagnosis of pancreatic injury was not based solely on serum amylase; rather, all patients underwent immediate CT examination of the abdomen followed by repeated clinical examinations. In about 40% of patients with pancreatic injury, the initial CT can be normal, although a sensitivity of 87% and specificity of 98% with the newer generation of helical CT has been reported.[3,10] In our study, all CT images had been interpreted by an attending radiologist and compared with subsequent images to increase diagnostic accuracy. Subtle radiologic findings suggestive of pancreatic injury include the following: peripancreatic fat stranding, peripancreatic fluid collections, the presence of fluid between splenic vein and pancreas and thickening of the left anterior pararenal fascia. More conclusive findings of injury are contusion, laceration or transaction of the pancreas.[11] ERCP is a minimally invasive diagnostic and therapeutic tool used in evaluating the integrity of the pancreatic duct. It is indicated in hemodynamically stable patients with a diagnosis of pancreatic injury who have persistent abdominal pain, serum hyperamylasemia or persistent pancreatic fistulae.[3] It is valuable in defining the nature and the extent of the ductal injury, potential stent placement and planning of appropriate surgical management.[6] ERCP has been reported in relation to the

definitive management of ductal injury by endoscopically placed stents, particularly in cases of blunt trauma.[12] Intraoperative ERCP has been reported in stable patients when duct integrity cannot be determined by direct examination[3,13]; however, this adds significantly to the intraoperative procedure and is generally not warranted. We used ERCP in 3 patients in this series whose presentation included persistent serum hyperamylasemia in the setting of blunt abdominal trauma; none proved to have a ductal injury. Magnetic resonance cholangiopancreatography (MRCP) is a rapidly evolving, noninvasive alternative tool for imaging of the pancreatic duct. It is reported to have an accuracy of up to 97% in the head and 83% in the tail of the pancreas.[11,13] We did not use this modality in this series of patients. Further study of its application in trauma cases is warranted.

Surgical management of pancreatic trauma depends on the degree and location of parenchymal injury as well as on the presumed or evident integrity of the pancreatic duct.[10,13] In addition, the surgical approach must take into account the stability of the patient and the degree of associated organ injury. The surgeon must endeavour to avoid extensive and complicated pancreatic surgery in these fragile patients.[10] Injury to the pancreatic duct occurs in 15% of pancreatic trauma cases and is usually seen in the setting of a penetrating mechanism.[3,4] The presence of central retroperitoneal hematoma, edema about the pancreatic gland or clear drainage, blood or bile in the lesser sac mandates a thorough pancreatic inspection. Evaluation of the pancreas requires complete exposure. Exposure of the anterior surface and the superior and inferior borders of the body and tail is obtained by opening the lesser sac through the gastrocolic ligament. Adequate visualization of the pancreatic head and uncinate process requires mobilization of the duodenum via the Kocher manoeuvre. In addition, mobilization of the hepatic flexure facilitates visualization and bimanual examination of the head and neck. Injury to the tail of the pancreas requires mobilization of the spleen and left colon to allow medial reflection and bimanual palpation of the pancreas as well as inspection of its posterior surface. The division of the ligament of Trietz and reflection of the fourth portion of the duodenum gives the surgeon access to the inferior aspect of the pancreas.[3,4,10]

Some authors have recommended intraoperative pancreatography to assess duct integrity, with a reported decrease of 15%–55% in morbidity.[2,14,15] However, many of these reports predate the use of ERCP or MRCP. The surgeon is probably better advised to use ERCP or MRCP to investigate ductal anatomy when the patient is more stable, if these techniques are readily available.[16,17] Some authors report that a pancreatic duct injury can be diagnosed with careful inspection and achieve accuracy similar to that of intraoperative pancreatography.[14] In our experience, trauma patients may be too unstable for sufficient inspection, and the degree of staining from blood or enteric contents compromises the surgeon's view.

Grade I injuries consisting of minor contusions, hematomas and capsular lacerations account for 60% of all pancreatic injuries. Grade II injuries consisting of parenchymal lacerations without ductal injury or tissue loss account for an additional 20% of pancreatic injuries.[3,10] Grade I and II injuries are managed by hemostasis, débridement of devitalized tissue and adequate external drainage.[3,4,10,13] Closed suction drainage used instead of penrose or sump drains results in a lower incidence of infectious complications.[3,10] The surgeon should avoid the temptation to repair capsular laceration because this may result in pseudocyst formation.[3]

A distal pancreatic transection, as seen with blunt injury when the pancreas is crushed against the vertebral column, usually occurs to the left of the superior mesenteric vessels. This injury is best managed with distal pancreatectomy and easily accomplished with a stapling device. The duct is ligated separately whenever possible. Generally, the spleen is not salvaged in trauma cases, but this can be considered in hemodynamically stable patients. Again closed suction drainage should be used. A similar approach is used for major distal parenchymal injuries, particularly if there is concern for duct disruption. Pancreatic head injuries are frequently associated with other life-threatening injuries and generally require a damage-control approach with packing and wide external drainage. When the patient's stability allows, postoperative MRCP or ERCP should be considered if there are concerns about ductal integrity or in the presence of a persistent, high-output pancreatic fistula.[2–4,10,13] If a proximal duct injury is diagnosed, stenting rather than near-total pancreatectomy is a viable option.[3,4] If the main duct is spared injury, adequate external drainage is sufficient and the injury will heal with time.

Combined pancreatico-duodenal injuries are rare and account for less than 10% of injuries to the pancreas. In this constellation of injuries, the surgeon should carefully explore the retroperitoneum via a Cattell-Brasch manoeuvre because these injuries are often associated with vena caval injuries or superior mesenteric artery or vein injuries. Patients with these injuries require damage-control techniques and staged reconstruction.[13] The integrity of the distal common bile duct and ampulla, as well as the severity of the duodenal injury, will dictate the operative approach. If the distal common bile duct and ampulla are intact, primary repair and drainage will suffice.[3,4,10,13] Duodenal repairs in this setting have a high rate of leakage and are a significant cause of morbidity. The repair should be protected with a

pyloric exclusion or a 3-tube system (gastrostomy, retrograde jejunostomy for decompression and antegrade jejunostomy for feeding).[3] A Whipple's procedure may be required in 2%–10% of cases because of major injuries involving the pancreatic head, duodenum, common bile duct and ampulla. This should be done in a staged fashion, after damage-control techniques have been used to stabilize the patient.[3,10]

In the current study, the majority of patients (15/25) had grade II injuries. Of 25 identified patients, 18 (72%) had grade I and II injuries; all these patients were treated nonoperatively. Only 1 patient with grade II injury related to penetrating trauma reported type 1 diabetes. Of 4 patients (16%) who had grade III injuries in the setting of blunt trauma and were treated with distal pancreatectomy, 1 developed type II diabetes. Of 2 patients (8%) who had grade IV injury treated with distal pancreatectomy, neither reported endocrine dysfunction. One patient had a grade V injury treated with débridement and drainage, and this patient reported manifestation of type I diabetes several months after discharge.

Pancreatic trauma and, further, pancreatic surgery for pancreatic trauma are relatively infrequent. Pancreatic injury was captured in only 1% of patients in our trauma registry, and about one-half of these patients underwent pancreas-specific surgery. This is in keeping with other reports in the literature.[1,2,11] As a result, our series is relatively small and retrospective. Further, we were able to contact only 76% of patients. Our report is also limited by the instrument used to assess endocrine or exocrine dysfunction, which is based on the patients' self-report from a questionnaire administered by telephone. This tool has not been validated. Although a definitive conclusion cannot be drawn from this series, there are several observations to report. Endocrine dysfunction was self-reported in 3 of the 19 patients we were able to contact (15.8%). No patient in this study reported exocrine dysfunction or need for pancreatic enzyme supplements. Our small series suggests that in trauma cases partial resection is unlikely to result in endocrine or exocrine dysfunction. This is especially evident in low-grade injuries treated nonoperatively. We observed that the remaining pancreatic tissue can regain its normal physiology regardless of trauma-induced parenchymal damage. A larger study with a better-validated tool would add greatly to knowledge in this area.

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