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Research Article

Pancreatic and Duodenal Injuries: Experience at A Single Trauma Centre

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Abstract:

Background:

Pancreatic and duodenal injuries are uncommon due to relative protection by their posterior anatomical position and have an incidence of less than 1% of all hospital admissions for trauma. Auckland City Hospital is a tertiary referral hospital in New Zealand with Trauma and Hepatopancreatobiliary units and admits approximately 384 patients with major trauma per year, predominantly from blunt mechanisms. This study is used to assess the incidence, diagnosis and clinical management of pancreatic and duodenal injuries in trauma patients at a single trauma centre.

Method:

A retrospective study was undertaken using data from a prospectively collected trauma registry. Inpatient notes including all patients admitted from 2007 to 2020 were reviewed. Pancreatic and duodenal injuries were graded using the American Association for the Surgery of Trauma (AAST) organ injury scale (OIS) grading system. Investigations including radiology and biochemistry and clinical management were noted.

Results:

A total of 45 trauma patients admitted to Auckland City Hospital had sustained pancreatic or duodenal injuries. Six patients had combined pancreaticoduodenal injuries, 16 had duodenal and 23 had pancreatic injuries. Grade I organ injuries were the most common in pancreatic (19/29) and duodenal injuries (9/22). Majority of patients underwent laparotomy (33/45) for associated haemodynamic instability. All organ specific indications for surgery occurred in Grade II and higher injuries. 10/45 patients were managed non-operatively, of which the majority had Grade I or II organ injuries (9/45). 3/45 patients died.

Conclusion:

The incidence of pancreaticoduodenal injuries is rare (45 patients in 13 years) and in keeping with trauma literature. In our series, haemodynamically stable patients with Grade I - II pancreatic and Grade I - II (non-laceration type) duodenal injuries did not require operative management. Endoscopic pancreatic stenting may facilitate selective non-operative management in some patients with pancreatic injury or complications.

keywords: pancreatic injury; duodenal injury; trauma

Introduction

Pancreatic and duodenal injuries are uncommon due to a relative protection offered by their posterior anatomical position and have an incidence of less than 1% of all hospital admissions for trauma [1]. Management of pancreatic and duodenal trauma is dependent on the severity of injury, which can be graded according to the American Association for the Surgery of Trauma (AAST) organ injury scale (OIS) grading system [1]. Operative management is indicated for pancreatic trauma that involves the pancreatic duct and may require pancreatic resection (Grade III – V) [2]. Duodenal haematomas can be managed non-operatively, however duodenal lacerations require surgical repair, and the

method of which depends on the size and location of the defect. Primary closure using interrupted sutures is the most common approach (55-85%) [3,4]. Duodenal diversion has been used as an adjunct to primary repair. For example, pyloric exclusion which involves primary repair of the duodenum, closure of the pylorus and formation of a gastrojejunostomy [4].

Auckland City Hospital (ACH) is a tertiary referral hospital in New Zealand with Trauma and Hepatopancreatobiliary units and admits approximately 384 patients with major trauma per year (approximately 1537 patients for all traumas per year) [5]. The aim of this study was to examine all cases of pancreatic and duodenal injuries admitted to Auckland City Hospital, and to describe the diagnosis and clinical management and any long-term sequelae following these injuries.

Materials and methods:

A retrospective observational study was performed, assessing the clinical record, laboratory data, radiology imaging and reports. Patients with pancreatic and duodenal injuries were identified from the ACH trauma registry which prospectively records all patients admitted to ACH following trauma. All patients with pancreatic or duodenal injuries from 2007 to 2020 were included. The severity of injury was assessed according to the AAST OIS for pancreatic and duodenal injuries [1]. We noted the mechanism of injury, existence of concomitant injuries, diagnosis, management and complications. Patients were followed-up to assess for pancreatic and duodenal injury related complications using the electronic clinical record, which includes all presentations and correspondence for patients in the ACH and surrounding hospital catchments. Inclusion criteria included all patients with duodenal or pancreatic injuries from 2007 to 2020 admitted to ACH following trauma – confirmed by discharge diagnosis, imaging or intraoperative findings. Exclusion criteria excluded those that were thought to be duodenal or pancreatic injuries but subsequently found to have neither injuries, those with lack of notes or information in the records and those transferred from other hospitals for subsequent rehab. Data collection and simple analysis was performed in accordance with local ethical protocols.

Results:

55 patients were initially identified as having either pancreatic and/or duodenal injuries from the trauma database. In our exclusion criteria - seven patients were found to have no injuries, two patients had poorly documented notes and difficult to obtain the required information and one patient was transferred from another hospital for rehabilitation. A total of 45 patients had pancreatic or duodenal injuries during the 13-year study period (around 3.5/year). A total 23 patients had pancreatic injuries only, 16 patients had duodenal injuries only and six had combined pancreatic/duodenal injuries. Most patients were male 31/45 (68.8%) and the median age was 36 years (15 to 74). Most injuries were grade I or II (pancreatic and duodenal) [Table 1]. 23/29 (79%) patients with pancreatic injuries had serum amylase or lipase performed, of which the majority (n = 15) had elevated levels (65%).

AAST Grade	Injury Type – (Number of patients)	
	Pancreas n = 29	Duodenal n = 22
I	18	8
II	6	8
III	3	6
IV	1	-
V	1	-

Table 1

Seven patients were transferred to ACH from other hospitals. Motor vehicle crash was the most common mechanism of injury (29/45) for pancreatic and duodenal injuries (Figure1). Five patients (11%) had penetrating injuries and 40 patients (89%) had blunt injuries [Figure 1]. All patients had cross-sectional computed tomography (CT). Five patients (11.1%) had magnetic resonance imaging (MRI) to ascertain if there was a pancreatic ductal injury. Four patients had an endoscopic retrograde cholangiopancreatography (ERCP). Most patients underwent laparotomy for haemodynamic instability (33/45), followed by organ specific indications including duodenal perforation or pancreatic ductal injury. For pancreatic injuries (n = 29), the majority had grade I and II injuries (n = 26) (Table 1). In total eight patients were managed non-operatively and 21 patients had an operation. Three patients underwent distal pancreatectomy for injury involving the pancreatic duct. Two patients with pancreatic duct injuries were managed with endoscopic pancreatic duct decompression using trans-ampullary pancreatic stents. No patients received octreotide.

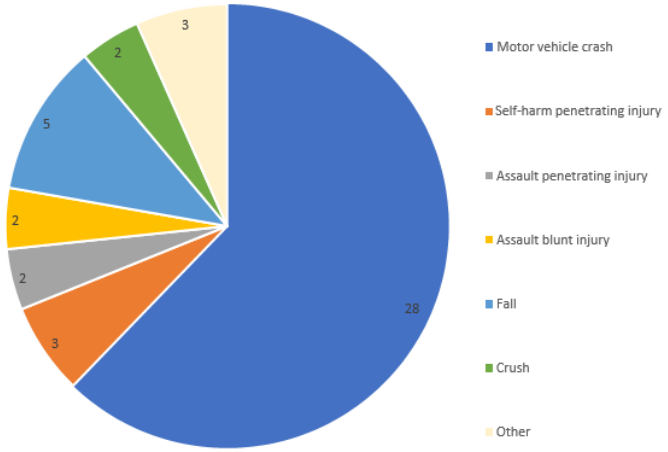

Figure 1: Mechanism of injury.

For duodenal injuries (n = 22), the majority (n = 16) had a grade I or II injury. Five patients were managed non-operatively, and 17 patients underwent an operation. Ten patients underwent primary closure of duodenal lacerations, of which four had pyloric exclusion with gastrojejunostomy procedures. One patient had a side-to-side duodenojejunostomy following a D2/3 injury (Table 2).

Management		No. of patients
Non-operative management	Non-operative management – ERCP	2
	No intervention required	10
Operative	Distal pancreatectomy	3
	Bile duct repair (+ subsequent AXIOS stent)	1
	Primary repair of duodenal injury Pyloric Exclusion	10 4
	Melecot catheter inserted into D3 perforation with a purse-string suture to create a controlled fistula + feeding NJ and draining NG placed	1
	Gastrostomy and repair of pancreatic laceration + stomach	1
	Multiple laparotomy + Side-wall duodenojejunostomy	1
	Exploratory laparotomy +/- repair of other organ injury	18

Table 2

12 patients (52%) had complications of pancreatic (Table 3) and seven (44%) had complications of duodenal injuries (Table 4). Three patients (10%) in our cohort with pancreatic injuries developed pancreatic collections which were drained. Three out of the six patients (50%) with combined injuries had complications (Table 4). In total three patients died, two patients with duodenal injuries and one patient with pancreatic injuries. Two patients died from sepsis and multiple organ failure (one pancreas and one duodenal), and one with duodenal injuries died from concomitant severe traumatic brain injury. (Table 3 + Table 5].

Complications (Pancreatic injuries)		Management	Number of patients (%) n = 12 (23 patients in total)
Post-operative complications	Post-operative collections by pancreatic bed	Percutaneous drainage	1 (4.3%)
	Ileus	Non-operative management – self resolved	1 (4.3%)
Pancreatic complications	Peri pancreatic collections Ductal injury	Pancreatic drain ERCP + stent	1 (4.3%)
	Ductal fistula + stenosis	ERCP + Stent (x3)	1 (4.3%)
	Necrotising pancreatitis Pancreatico-colo-cutaneous fistula Bile leak Peripancreatic collections	Necrosectomy for pancreatitis Non-operative management of fistula ERCP for bile leak + biliary stent AXIOS stent	1 (4.3%)
Further surgery	Bowel obstruction	Laparotomy + devolving the small bowel volvulus	1 (4.3%)
	Bleeding	Laparotomy for control of bleeding	2 (8.7%)
	Wound dehiscence	Suture closure of the dehisced wound	1 (4.3%)
Death	Sepsis, multi-organ failure, adrenal insufficiency, DVT/PE	-	1 (4.3%)
Other	Stress ulcer	Inpatient gastroscopy + proton pump inhibitor	1 (4.3%)
	DVT	Anticoagulation	1 (4.3%)

Table 3

Complications (Mixed injuries)		Management	Number of patients (%) n = 3 (6 patients in total)
Missed injury	Missed tibia fracture	Open reduction and internal fixation	1 (16.7%)
Further surgery	Bleeding	Laparotomy for control of bleeding	1 (16.7%)
	Missed retroperitoneal D3 injury at first laparotomy	Re-look laparotomy + primary repair of duodenal perforation with omental patch, pyloric exclusion and gastro-jejunal feeding tube and abdominal drains	1 (16.7%)

Table 4

Complications (Duodenal injuries)		Management	Number of patients (%) n = 7 (16 patients in total)
Other	Iatrogenic injury from insertion of nasogastric tube – pneumothorax	Chest drain	1 (6.3%)
Post-operative complications	Post-operative collections	Percutaneous drainage	2 (12.6%)
		Non-operative management – resolved with antibiotics	1 (6.3%)
	Ileus	Non-operative management – self-resolved	1 (6.3%)
Death	Sepsis, multi-organ failure	-	1 (6.3%)
	Traumatic brain injury	-	1 (6.3%)

Table 5

Discussion:

Pancreatic and duodenal injury is rare, occurring in less than 1% of all trauma admissions [1]. It has however been reported to have a high morbidity (36-60%) and mortality (18-23%) [6]. The pancreas is in retroperitoneum, shielded by the anterior abdominal wall and this is thought to be one of the reasons for low incidence of pancreatic injuries [4]. This may have implications of delayed diagnosis and is usually complicated by other intra-abdominal injuries [6-8]. Grading of pancreatic trauma is determined by the location of the injury and the presence of ductal damage [6]. Duodenal trauma is graded by injury thickness, extent of circumference of the lacerated lumen, and involvement of the common bile duct or ampulla [6].

Management of these injuries depend on the degree of injury. Clinical assessment and prompt diagnosis is important to minimise morbidity. A normal serum amylase has previously been reported to occur in up to 40% of patients with pancreatic trauma [1]. In our cohort, it was normal in 35% of patients, however this was limited by six patients that did not have a serum amylase or lipase measurement on admission. Having a baseline level for later comparison may still be of some value [1].

Cross-sectional imaging is necessary and surgical intervention may be required [1]. Contrast enhanced CT has a high specificity (90-95%) but low sensitivity for pancreatic ductal involvement (52-54%) [1]. Magnetic resonance imaging pancreatography (MRCP) can help with the diagnosis of ductal injuries [9]. Endoscopic retrograde pancreatography (ERP) can also identify pancreatic duct injuries, however, is more invasive and has an associated risk of morbidity.

MRCP should be considered for detection of pancreatic duct injuries when a pancreatic injury is suspected on cross sectional CT imaging (sensitivity of 90-100%) [10]. ERCP has the additional benefit of allowing endoscopic treatment of a ductal injury, but this must be balanced by the associated risk of ERCP related morbidity [11]. Moreover, distal pancreatectomy is still considered the gold-standard treatment for pancreatic transection with ductal injury. ERCP and pancreatic stent placement can also be of benefit for management of complications of pancreatic injuries such as pseudocysts [11-13]. Five patients in our cohort had an MRCP to exclude ductal injuries, of which two patients were managed non-operatively after.

It should be noted that even in patients with Grade I pancreatic injuries, other organs injuries were common in our cohort. As the pancreas sits in a retroperitoneal position, other intra-abdominal injuries complicated management and recovery [6-8]. For our cohort, 12/45 were managed non-operatively. This pancreatic duct fistula (distal tail) and duct stenosis (main body) was successfully managed with an endoscopic pancreatic stent placement. Grade IV and V injuries generally require operative management, with pancreaticoduodenectomy (Whipple's procedure) being indicated if there is a massive disruption of pancreatic head [12,13].

Treatment for grade I and II duodenal haematoma can be managed non-operatively, but duodenal lacerations will require surgical repair [9,10]. Duodenal obstruction may occur with large mural haematoma formation [4]. The majority of grade II lacerations can be repaired by primary repair [4] [Figure 1], which in our cohort, all were. One patient was managed with primary repair and malecot drain insertion for decompression of D3.

If the duodenum is unable to be repaired, then apancreaticoduodenectomy (Whipples' procedure) may be indicated [4]. Weale et al noted in their retrospective study that 91 patients out of 94 had a primary repair [3]. Only three patients in their cohort had pyloric exclusion. However, the majority of patients in their series were injured from a penetrating mechanism and nearly all had AAST grade II injuries [3]. In comparison, in our series of predominantly blunt trauma, ten patients had primary closure and four of which had a pyloric exclusion, all with grade III injuries. In addition, one patient from our cohort had a side-to-side duodenojejunostomy.

Complication rates for pancreatic trauma are variable and are reported to range from 26-86%, depending on severity [12,13]. The most common complication cited is a pancreatic fistula (10-35%) [1,10] which can be managed with drains [11-13], although persistent fistulas may benefit from endoscopic pancreatic duct stenting [12]. Other complications include post-traumatic pancreatitis, intra-abdominal abscess, and pseudocyst formation [1,11-13]. Three patients (10%) in our cohort with pancreatic injuries developed pancreatic collections which were drained. Only two patients in our cohort developed pancreatic fistula (7%).

Søreide et al [10] noted the risk of mortality with grade I pancreatic injuries with no other injuries was < 5% and if in shock with associated other injuries is still < 10% [10]. Grade IV and V injuries with associated shock and other injuries have an associated morbidity risk of > 50% and mortality risk 20-50% [10]. Our overall mortality rate was 3 patients out of 45 (7%), and only two of these patients died as a result of complications attributable to pancreaticoduodenal injury (4%). Krig et al [2] have noted in that in their retrospective study of 473 patients – mortality rate was 15% and that deaths, whilst uncommon, occur late and due to multiorgan failure and sepsis which is in keeping with our data [2].

This study is limited by its retrospective data and that pancreatic and duodenal injuries are rare, even in trauma centres, and thus the actual number of cases were low (45 cases in 13 years). Three patients were transferred from regions outside of our ability to follow them up, thus it is possible that late complications in these three patients were missed.

Conclusion

Pancreatic and duodenal trauma is rare, in keeping with other current trauma literature [1]. Serum amylase/lipase may initially be normal in patients with pancreatic injuries. Based on our findings, haemodynamically stable patients with Grade I-II pancreatic and Grade I and non-laceration type Grade II duodenal injuries who have no other indication for surgical exploration can be successfully managed non-operatively. Endoscopic pancreatic stenting may facilitate selective non-operative management in some patients with pancreatic injury or complications.

Abbreviations

ACH – Auckland City Hospital

AAST – American Association for the Surgery of Trauma

OIS - Organ injury scale

CT – Computed tomography

ERCP – Endoscopic retrograde cholangiopancreatography

MRCP – Magnetic retrograde cholangiopancreatography

Declarations

Ethics approval

No ethics approval was necessary as discussed with Auckland Hospital Research office as this study is based off an audit and it did not require any ethics approval.

Availability of data and materials

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Competing Interests

The authors declare that they have no competing interests. This manuscript is not under consideration for publication elsewhere.

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Author Contributions

MP collected the data, analysed, reviewed the results and drafted the manuscript. NF designed the study, assisted with reviewing the data results and revised the draft. Both authors approved of the manuscript before submissions.

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