Pancreaticoduodenal injuries: Re-evaluating current management approaches

G. E. CHINNERY, M.B. CH.B, F.C.S. (S.A.)

T. E. MADIBA, M.B. CH.B., M.MED., PH.D., F.C.S. (S.A.), F.A.S.C.R.S.

Department of Surgery, King Edward VIII Hospital, University of KwaZulu-Natal, Durban

Summary

Background. Pancreaticoduodenal injuries are uncommon owing to the protected position of the pancreas and duodenum in the retroperitoneum. Management depends on the extent of injury. This study was undertaken to document outcome of pancreaticoduodenal injuries and to re-evaluate our approach.

Patients and methods. A prospective study of all patients treated for pancreaticoduodenal trauma in one surgical ward at King Edward VIII hospital over a 7-year period (1998 - 2004). Demographic data, clinical presentation, findings at laparotomy and outcome were documented. Prophylactic antibiotics were given at induction of anaesthesia.

Results. A total of 488 patients underwent laparotomy over this period, 43 (9%) of whom (all males) had pancreatic and duodenal injuries. Injury mechanisms were gunshot (30), stabbing (10) and blunt trauma (3). Their mean age was 30.1+9.6 years. Delay before laparotomy was 12.8+29.1 hours. Seven were admitted in shock. Mean Injury Severity Score (ISS) was 14+8.6. Management of 20 duodenal injuries was primary repair (14), repair and pyloric exclusion (3) and conservative (3). Management of 15 pancreatic injuries was drainage alone (13), conservative management of pseudocyst (1) and distal pancreatectomy (1). Management of 8 combined pancreaticoduodenal injuries was primary duodenal repair and pancreatic drainage (5) and repair with pyloric exclusion of duodenal injury and pancreatic drainage (3). Twenty-one patients (49%) developed complications, and 28 required ICU admission with a median ICU stay of 4 days. Ten patients died (23%). Mean hospital stay was 18.3+24.4 days.

Conclusions. The overall mortality was comparable with that in the world literature. We still recommend adequate exploration of the pancreas and duodenum and conservative operative management where possible.

Pancreaticoduodenal injuries are uncommon owing to the relatively protected retroperitoneal position of both pancreas and duodenum.[1] These injuries are usually associated with multiple intra-abdominal injuries,[1,2] especially with vascular injuries (27.6%), which are responsible for early mortality.[3-5]

Pancreatic and duodenal injuries may initially only present with subtle clinical signs because of their retroperitoneal positioning; consequently, a high index of suspicion is required when making the diagnosis, and these injuries may therefore often be responsible for late mortality owing to sepsis and its complications.[4]

Of late, complex reconstructive procedures have been abandoned where possible in favour of simple primary surgical repair and drainage.[6-9] This study was undertaken to document the outcome of pancreaticoduodenal injuries encountered in one surgical ward at King Edward VIII Hospital over a 7-year period.

Patients and methods

Ours is a prospective study of all patients treated for abdominal trauma in a single surgical ward at King Edward VIII Hospital, Durban, over a 7-year period, from 1998 - 2004. All patients with pancreatic, duodenal or combined pancreaticoduodenal injuries were included in the study. Demographics and mode of injury were noted. The condition of the patients on arrival at the casualty department was ascertained clinically, with shock being defined as a systolic blood pressure ≤90 mmHg. Delay before surgery included both pre-hospital and in-hospital delay. All patients were resuscitated according to Advanced Trauma Life Support protocols. Patients in whom resuscitation was not successful underwent laparotomy as part of resuscitation. Patients with physiological instability who did not respond to resuscitation, and those who developed haemodynamic instability at surgery, underwent damage control laparotomy. Prophylactic antibiotics were given at induction of anaesthesia. Intra-operative findings, management and outcome were documented. The degree of organ injury was graded according to the American Association for the Surgery of Trauma (AAST) Organ Injury Scaling (OIS),[10] and severity of injury was graded using the Injury Severity Score.[11]

It is our policy to explore all central haematomas. Assessment of the duodenum involves its mobilisation using the Kocher's manoeuvre to inspect all aspects of the duodenum. Assessment of pancreatic injury involves opening the lesser sac and viewing the whole anterior surface of the pancreas. All data were entered onto a pro forma and then transferred to a computer database.

Results

A total of 488 patients underwent laparotomy for trauma in a single surgical ward. Forty-three (9%) of these patients (all of whom were male) had pancreatic and duodenal injuries. In 30 patients, the injuries were from firearms, in 10 from abdominal stab wounds, and in 3 from blunt trauma. Their mean age was 30.1 ± 9.6 years. The delay before laparotomy averaged 12.8 ± 29.1 hours from the time of injury. Seven patients were admitted in shock; their ISS was 14 ± 8.6. Only 5 patients underwent imaging. One patient with a firearm injury had an abdominal ultrasound scan with equivocal results; 2 patients with delayed presentation had an ultrasound scan indicating traumatic pancreatic pseudocysts, which were confirmed on computed tomography (CT) scan; and 2 other patients underwent pre-operative intravenous pyelograms for haematuria, both of which showed no abnormality. No patients underwent diagnostic peritoneal lavage.

Twenty-nine (67%) patients presented with varying degrees of peritonism and underwent immediate laparotomy. Of the other patients, 12 later developed peritoneal signs and required laparotomy. Of the 2 patients with pancreatic pseudocyst, 1 had a distal pancreatectomy and the other was managed non-operatively.

At laparotomy, 34 patients had haemoperitoneum with the volume ranging between 100 ml and 3 000 ml (average 1 053 ml). There were 28 duodenal injuries and 23 pancreatic injuries, therefore constituting 6% and 5% of abdominal trauma, respectively. Injury was confined to the duodenum in only 20 patients, and to the pancreas in only 15 patients; 8 patients had a combined pancreaticoduodenal injury.

Forty patients had associated intra-abdominal injuries (Table I). Of the 20 duodenal injuries, 14 underwent primary repair, 3 underwent repair and pyloric exclusion, and 3 who presented with only intramural haematoma were managed conservatively. The management of 15 patients with pancreatic injuries was by drainage alone (in 12 cases), duct ligation and drainage (1), distal pancreatectomy of a pseudocyst (1), and conservative management of a pseudocyst (1). The 8 combined pancreaticoduodenal injuries were managed by primary duodenal repair and pancreatic drainage in 5 patients, and pyloric exclusion and pancreatic drainage in 3 patients. Three patients (2 with combined pancreaticoduodenal injury and 1 with duodenal injury) underwent damage control laparotomy for bleeding liver injury.

Thirty-one patients required blood transfusions, with a median of 4 units (range 1 - 16). Twenty-eight patients required ICU admission, with a median ICU stay of 4 days (range 1 - 20). Twenty-one (49%) developed complications (Table II). Seven fistulas (pancreatic – 5, enterocutaneous – 2) developed, complicating 4 firearm injuries , 2 stab wounds and 1 blunt trauma. Four of the 5 pancreatic fistulas were managed conservatively and had closed by day 50; the 5th patient (whose fistula followed distal pancreatectomy for pancreatic pseudocyst) died a month after laparotomy from pulmonary tuberculosis and immunosuppression. The 2 enterocutaneous fistulas were managed conservatively, with the longest taking 62 days to close.

Seven patients required re-look laparotomy, for removal of packs (3), peritonitis (2), continued bleeding from the inferior vena cava and lumbar veins (1), and abdominal abscess development (1). The 2 patients with peritonitis were found to have purulent peritonitis (1) and a subphrenic collection of bile-stained fluid (1).

Ten patients died, giving a mortality rate of 23% (25%, 20% and 38% for duodenal, pancreatic and combined injuries, respectively). The causes of mortality were multiple organ dysfunction syndrome (MODS) (6), hypovolaemic shock (1), sepsis (1), septic shock (1), and active pulmonary tuberculosis with associated immunosuppression (1). Mortality increased with the number of organs injured (Table III) as well as the grading of the injuries (Table IV). The mean length of hospital stay was 18.3 ± 24.4 days. The median hospital stay for survivors was 10 (4 - 125) days, and that for non-survivors was 5 (1 - 77), with the difference not being statistically significant (p=0.134, chi-squared test).

TABLE I. ASSOCIATED INTRA-ABDOMINAL INJURIES IN 43 PATIENTS WITH PANCREATICODUODENAL INJURIES

Organ	N	%
Colon	20	47
Liver	17	40
Stomach	16	37
Small bowel	13	30
Kidney	10	23
Diaphragm	6	14
Gallbladder	3	7
Ureter	2	5

TABLE II. COMPLICATIONS ENCOUNTERED IN 43 PATIENTS WITH PANCREATICODUODENAL INJURIES

Complication	N	%
Chest infection	9	21
MODS	8	19
Fistula	7	16
Pancreatic fistula	5	12
Enterocutaneous fistula	2	5
Wound sepsis	6	14
Intestinal obstruction	2	5
Abdominal abscess	1	2
Peritonitis	1	2
Haemorrhage	1	2
Empyema	1	2
Hypovolaemic shock	1	2
Sepsis	1	2
Septic shock	1	2
Pulmonary tuberculosis	1	2
No. of patients with complications	21	49

Some patients developed more than one complication.
MODS = multiple organ dysfunction syndrome.

TABLE III. NUMBER OF ASSOCIATED INTRA-ABDOMINAL INJURIES IN 43 PATIENTS WITH PANCREATICODUODENAL INJURY

No. of associated injuries	N	Mortality (%)
0	3	1
1	11	0
2	12	2
>3	17	8

Discussion

The anatomical position of the pancreas and the duodenum fortunately results in their incidence of injury being low, with a reported pancreatic injury prevalence of 0.4 per 100 000 hospital admissions.[12] This retroperitoneal positioning in turn results in a difficult and often delayed early diagnosis with dire consequences regarding morbidity and mortality. Pancreaticoduodenal injuries are more likely to occur with penetrating trauma; as such, the incidence varies according to geographical location, those regions with more firearm and stab injuries having a higher incidence.[13] The overall occurrence of pancreatic injury is estimated to be 1 - 2% that of abdominal trauma.[1] Duodenal injuries account for 1 - 4% of abdominal injuries.[14] The figures in this series were similar to those reported in the literature. Associated intra-abdominal injuries are very common in patients with pancreatic and duodenal injuries, occurring especially with penetrating trauma.[1,2,5] Associated injuries were present in 95% of cases in this series.

Patients with clear clinical indications for laparotomy should have little need for any pre-operative imaging. While hyperamylasaemia should alert to the possibility of a pancreatic injury, the initial serum amylase level correlates poorly with the presence and degree of pancreatic injury and may in fact be normal in the initial period following the injury.[4,15] Therefore, a rising or persistently high amylase level is of more value in indicating the presence of a pancreatic injury.[16] In patients with equivocal signs where a high degree of suspicion exists regarding the possibility of a pancreaticoduodenal injury, early imaging may guide the diagnosis, as delay will affect both morbidity and mortality negatively.

Upper gastro-intestinal contrast studies and CT with enteral contrast may indicate a duodenal leak; on occasions, there may be no extravasation of contrast, and a perforation may be suggested by the presence of extraluminal air alone.[17,18] A thickened left anterior renal fascia, inflammatory changes in peri-pancreatic fat and mesentery, pancreatic ductal dilatation, fluid in the lesser sac, between retroperitoneal structures (such as the splenic vein, mesenteric artery and the pancreas) and anterior and posterior para-renal spaces, and haemorrhage into peri-pancreatic fat, mesocolon and mesentery, are some of the more subtle signs that may arouse suspicion of the presence of a pancreatic injury.[19-23] CT, however, is not always accurate for pancreatic injuries in the early post-injury hours;[24,25] if suspicion remains, the most accurate means of excluding duodenal injury is an exploratory laparotomy.[26]

Endoscopic retrograde cholangiopancreatography (ERCP) in the acute injury setting has gained popularity because of its accurate duct assessment and potential for therapeutic intervention.[27-29] It should, however, only be considered for haemodynamically stable patients.[29,30] Stenting via ERCP over the main pancreatic duct injury or transection or simply over the sphincter of Oddi in order to decrease transpapillary pressure are therapeutic options.[31-33] Magnetic resonance cholangiopancreatography (MRCP) holds diagnostic promise in that it is non-invasive.[34,35]

Missed duodenal and pancreatic injury leads to increased morbidity and mortality. Inspection of both anterior and posterior aspect of the duodenum and the whole surface of the pancreas is therefore crucial at laparotomy. There has been a move away from the more complex reconstructive procedures for both pancreatic and duodenal injuries. Conservative management of duodenal haematomas and simple primary repair of perforations with drainage has become the treatment approach of choice.[26,36-39] Three duodenal haematomas in this series were managed conservatively, while 14 perforations were repaired primarily and drained. The more complex reconstructive operations or exclusion procedures should be reserved for selected patients with severe duodenal or combined pancreaticoduodenal injuries.[37] Risk factors that determine the outcome of duodenal injury include pre-operative and intra-operative shock (blood pressure <90 mmHg); an abdominal trauma index >25; associated injuries to the pancreas, superior mesenteric vessels, colon and spleen; and final operating room core body temperature <35ºC.[40,41] Some authors advocate complex repair for all grade III duodenal injuries and above.[42] However, it appears that even severe duodenal injuries may now be safely managed by simple primary repair without pyloric exclusion.[43,44] Only 3 of our patients required pyloric exclusion.

In patients with physiological instability, we advocate a primary duodenal repair if possible, pancreatic drainage, and

TABLE IV. SPECTRUM OF DUODENAL AND PANCREATIC INJURY GRADING AND MORTALITY

Grade	Duodenal injuries		Pancreatic injuries	
	N	Mortality (%)	N	Mortality (%)
1	9	11	4	0
II	10	20	3	0
III	0	0	5	20
IV	1	100	3	67
V	8	38	8	38

that the principles of damage control surgery are followed for other associated intra-abdominal injuries. The pancreatic duct can then be evaluated once the patient is haemodynamically stable, and a more definitive reconstructive procedure planned for a later stage.[45]

Isolated pancreatic injuries may be managed by drainage alone, distal resection with[46] or without[47] splenic resection, pancreatico-enterostomy,[45,48] endoscopically placed stents, or pancreaticoduodenectomy, depending on the degree of injury.[49] It is our practice to treat pancreatic injuries conservatively where possible and not to attempt to identify any specific ductal injury that is not immediately obvious at initial laparotomy, as suggested by local[6,50] and other studies.[51] Only if there is an obvious main duct injury at exploratory laparotomy is a reconstructive procedure attempted. Thirteen of the 15 pancreatic injuries with no duodenal involvement were managed conservatively by drainage alone. One patient with a pseudocyst was managed non-operatively; the other underwent distal pancreatectomy but died from an unrelated cause. While endoscopic pancreatic stenting for main duct leaks is now commonplace, it remains rare in trauma, although it is gaining popularity as its safety and efficacy are being proven, provided that the services and expertise are available.[52,53]

In patients with combined pancreaticoduodenal injury, management depends on the severity of the injuries of the individual organs. All the pancreatic injuries were managed by drainage alone, and over half of duodenal injuries had simple repair; pyloric exclusion was performed in only 3. Simple primary repair and drainage should be encouraged for duodenal injuries where possible, with complex reconstructive procedures reserved for individual cases.[43]

Despite the small numbers, this series has shown that conservative management is successful in the majority of patients in the form of primary repair for duodenal injuries and simple drainage for pancreatic injuries, and this approach has been shown by others to have better outcomes than with more complex procedures.[7,39] Some suggest that it is actually the pancreatic component of the combined pancreaticoduodenal injury that is responsible for the majority of infective complications.[54] We advocate a closed system suction drainage as it is associated with less infective complications in comparison with sump drainage.[6]

The pancreatic fistula rate of 21% falls within previously quoted figures of 11 - 38%.[3,53,55,56] The choice of drainage or resection for the pancreatic injury does not appear to affect mortality (if those with associated vascular injuries are excluded), but it has been noted that patients drained operatively have a higher postoperative pseudocyst rate in comparison to those resected.[3] This observation may explain our fistula rate.

It is notable that the mortality rate was lowest for pancreatic-only injuries and highest for combined injuries. Complex pancreaticoduodenal injuries requiring pancreaticoduodenectomy are uncommon and carry a very high mortality rate (31 - 36%); this procedure is advised only for haemodynamically stable patients where the pancreatic head and duodenum are severely injured and devitalised.[57-59] Initial damage control surgery with delayed reconstruction is an alternative option.[7,19,60] Associated injuries occurred in 95% of patients, and it is not surprising that the mortality rate increased with the number of associated organ injuries. The patient's physi-ological state appears to be the most important factor in predicting mortality.[61]

Firearm injuries, which were a common injury mechanism in this series, tend to be more devastating than knife wounds because of the much greater point pressure and momentum of a bullet, and its shock wave phenomenon. We believe that the more devastating nature of firearm injuries is responsible for the high morbidity rate, including fistulas, as well as high mortality rate. The high mortality rate in this series appears not to be related to the management approach but rather to the mechanism of injury and the associated injuries, suggesting that the current management approaches employed at our institution are adequate.

In conclusion, pancreaticoduodenal injuries remain uncommon, even in areas with a high prevalence of penetrating trauma. Simple primary repair and drainage and simple drainage are adequate in the majority of duodenal and pancreatic injuries, respectively. The overall morbidity and mortality rates in this series are comparable with other published series. The combined pancreaticoduodenal injury subgroup tends to be associated with the highest morbidity and mortality. We believe that current management approaches in our setting remain valid in the management of these complex injuries.

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