

Conservative and surgical management of pancreatic trauma in adult patients

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Background: The management of pancreatic trauma is complex. The aim of this study was to report our experience in the management of pancreatic trauma.

Methods: All patients hospitalized between 2005 and 2013 for pancreatic trauma were included. Traumatic injuries of the pancreas were classified according to the American Association for Surgery of Trauma (AAST) in five grades. Mortality and morbidity were analyzed.

Results: A total of 30 patients were analyzed (mean age: 38±17 years). Nineteen (63%) patients had a blunt trauma and 12 (40%) had pancreatic injury ≥ grade 3. Fifteen patients underwent exploratory laparotomy and the other 15 patients had nonoperative management (NOM). Four (13%) patients had a partial pancreatectomy [distal pancreatectomy (n=3) and pancreaticoduodenectomy (n=1)]. Overall, in hospital mortality was 20% (n=6). Postoperative mortality was 27% (n=4/15). Mortality of NOM group was 13% (n=2/15) in both cases death was due to severe head injury. Among the patients who underwent NOM, three patients had injury ≥ grade 3, one patient had a stent placement in the pancreatic duct and two patients underwent endoscopic drainage of a pancreatic pseudocyst.

Conclusions: Operative management of pancreatic trauma leads to a higher mortality. This must not be necessarily related to the pancreas injury alone but also to the associated injuries including liver, spleen and vascular trauma which may cause impaired outcome more than pancreas injury.

Keywords: Pancreatic trauma; conservative treatment; pancreatic resection; radiological drainage; endoscopic treatment

Submitted Apr 01, 2016. Accepted for publication Jun 16, 2016.

doi: 10.21037/hbsn.2016.07.01

View this article at: <http://dx.doi.org/10.21037/hbsn.2016.07.01>

Introduction

The pancreas is an organ located deep in the abdominal cavity, whose anatomical relationship with the digestive and vascular structures (1-4) explains the complexity and severity of pancreatic trauma which represents less than 5%

of abdominal trauma (5,6). Pancreatic trauma is potentially lethal when combined with duodenal perforation or closely related arterial bleeding (2,7). These injuries remain difficult to diagnose and undeniably pose a problem in therapeutic strategy. An abdominal computer tomography (CT) allows diagnosis and severity assessments of pancreatic

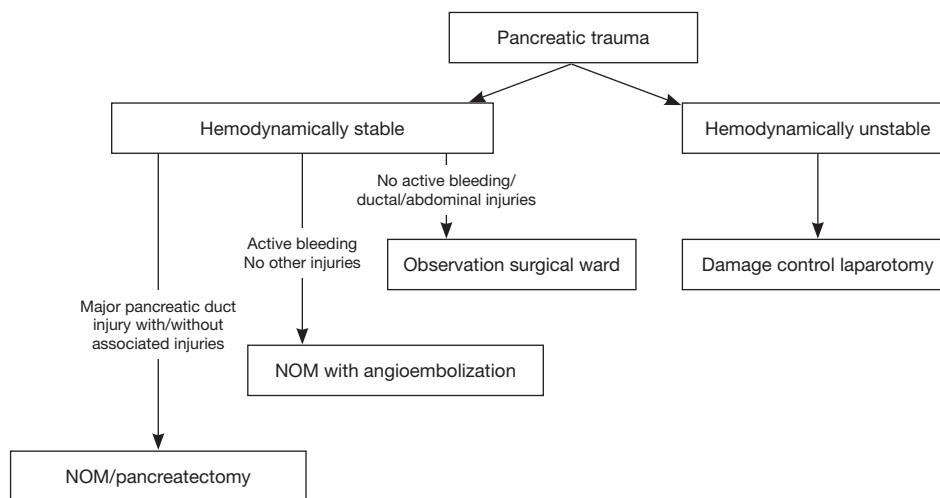


Figure 1 Conservative and operative management of pancreatic trauma. NOM, nonoperative management.

trauma, presence of pancreatic duct injury or associated bleeding (8-11). A delay in diagnosis or underestimation of its severity may be responsible for serious complications such as intra-abdominal bleeding, pancreatic fistula or intra-abdominal collections (12-14). The aim of this retrospective study was to report our single-center experience in the management and treatment of pancreatic trauma.

Methods

Patients

All patients hospitalized for pancreatic trauma in the Digestive Surgery Service, Hepatobiliary, Pancreatic and Liver Transplantation at the Henri Mondor University Hospital (Créteil, France) were identified from the Programme de Médicalisation des Systèmes d'Information database (PMSI) between 2005 and 2013. Data from the PMSI were the dates, the main diagnosis, associated diagnosis, age and sex of the patients. All standardized summaries on PMSI whose code belonging to the categories of the International Classification of Diseases, 10th Revision (ICD-10), in connection with abdominal and pancreatic trauma or associated diagnosis were selected.

Classification of traumatic injury of the pancreas according to the American Association for Surgery of Trauma (AAST) (15)

- (I) Grade 1: minor contusion without ductal injury;
- (II) Grade 2: major contusion/laceration without ductal

- injury or tissue loss;
- (III) Grade 3: distal transection or parenchymal injury with ductal injury;
- (IV) Grade 4: proximal transection or parenchymal injury involving ampulla;
- (V) Grade 5: mass destruction of the pancreatic head.

Management of traumatic injury of the pancreas

The first step is to comprehend that we are dealing with a trauma patient and usually not just an isolated pancreatic injury. The management directly correlated to other variable besides the injured pancreas itself, including the patient's hemodynamic status, presence and severity of associated injuries such as cranial, chest, pelvic and extremities, and hypothermia. Different patients with more or less same grade of pancreatic injury can have different management as shown in *Figure 1*.

Statistical analysis

Quantitative variables were expressed as mean \pm standard deviation. The qualitative variables are expressed as a percentage. As it is not homogenous groups we mainly used simple descriptive statistics.

Results

Baseline characteristics

Thirty patients with pancreatic trauma (11.5% of all

Table 1 Population characteristics (n=30)

| Characteristics | No. of patients [%] |
|---|---------------------|
| Sex male/female | 22 [74]/8 [26] |
| Age: mean \pm SD [range] (years) | 38 \pm 17 [15–83] |
| Causes, n [%] | |
| Penetrating trauma | 11 [37] |
| Fall/blunt | 5 [17] |
| Public accident | 14 [46] |
| AAST classification, n [%] | |
| Grade 1 | 8 [27] |
| Grade 2 | 10 [33] |
| Grade 3 | 5 [17] |
| Grade 4 | 0 |
| Grade 5 | 7 [23] |
| Associated extra-pancreatic injuries, n [%] | |
| Isolated pancreatic trauma | 2 [7] |
| Duodenum injury | 2 [7] |
| Digestive tract injury other than duodenum | 8 [27] |
| Liver and spleen injury | 4 [13] |
| Vascular injury | 6 [19] |
| Extra-abdominal injury | 13 [43] |

SD, standard deviation; AAST, American Association for Surgery of Trauma.

abdominal injuries) were hospitalized in our department between 2005 and 2013. The majority of them were male (74%) and the average age was 38 \pm 17 years (15–83 years). The general characteristics of the study population are described in *Table 1*.

Mechanisms and localization of pancreatic trauma

More than half (63%, n=19) of pancreatic trauma were blunt, and they occurred due to motor vehicle accident in 46% of the cases (n=14) or after fall/crushing in 17% of the cases (n=5). In 37% of patients (n=11), penetrating trauma (stab/gunshot wound) was the cause of the pancreatic injury. As for the location of the trauma within the pancreas it was located at the head in 11, body in 7 and tail of the pancreas in 9 patients. The injury was located at the junction body-tail in two cases and one case at the junction

between the head and body.

Hemodynamic state on arrival and injuries

Fifteen patients (50%) were hemodynamically unstable upon arrival and needed an emergency laparotomy. Of these patients, 2 had severe hemorrhage accompanied by hypovolemic shock. The other 13 patients were operated due to penetrating trauma with hemodynamically instability. Thirteen (43%) of the total number of patients had extra-abdominal injuries such as brain, chest and pelvic. Eight patients (27%) had associated hollow organ injury.

Characteristics of patients who underwent exploratory laparotomy (n=15)

The diagnosis of pancreatic injury was made during the exploratory laparotomy in 10 patients. Diagnosis of pancreatic injury was done by the preoperative CT scan in 5 patients. Pancreatic resection was performed in 4 patients: 3 patients had distal pancreatectomy with splenectomy and 1 patient had pancreaticoduodenectomy for pancreatic injury grade 5. The other 11 patients had a wide peri-pancreatic surgical drainage (*Tables 2,3*).

Postoperative mortality and morbidity following laparotomy

Among the patients operated, 4 died, 3 of them within 24 hours of admission, and the fourth patient after 115 days of hospitalization. Eight (8/15, 53%) patients had a postoperative complication (*Table 3*). From the 4 patients who had pancreatectomy, 3 patients (75%) had pancreatic fistula. Five patients had intra-abdominal collection that required radiological drainage. One patient had peritonitis due to perforated duodenal ulcer and needed reoperation. One patient suffered from pneumonia and polyneuropathy.

Characteristic of patients who underwent nonoperative management (NOM)

Fifteen (50%) patients underwent NOM (*Table 4*). Twelve patients initially needed intensive care unit (ICU) supervision with a mean stay of 13 \pm 12 days. The other three patients were hospitalized in our surgical ward with a mean stay of 9 \pm 4.5 days. Monitoring CT scan on the 7th day of hospitalization did not find any abdominal fluid collection in 10 patients. Two patients died within 24 hours of

Table 2 Pancreatic trauma management

| AAST classification | No. of patients [%] | Exploratory laparotomy | | | Conservative treatment | | |
|---------------------|---------------------|------------------------|--------------------------|----------------------|------------------------|----------------------------|------------------------------|
| | | Total (n=15) | Surgical drainage (n=11) | Pancreatectomy (n=4) | Total (n=15) | Endoscopic treatment (n=3) | Radiological drainage (n=12) |
| Grade 1 | 8 [27] | 1 [7] | 1 [7] | 0 | 7 [47] | 0 | 7 [47] |
| Grade 2 | 10 [33] | 5 [33] | 4 [27] | 1 [7] | 5 [33] | 1 [7] | 4 [27] |
| Grade 3 | 5 [17] | 4 [27] | 2 [13] | 2 [13] | 1 [7] | 1 [7] | 0 |
| Grade 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Grade 5 | 7 [23] | 5 [3] | 4 [33] | 1 [7] | 2 [13] | 1 [7] | 1 [7] |

AAST, American Association for Surgery of Trauma.

admission due to associated severe head injury. In one patient sphincterotomy and stenting of the pancreatic duct was performed.

Long-term survival of patients

The average hospital stay was 28.9±23.4 days (range, 1–115 days). Overall mortality was 20% (n=6). Among the 24 surviving patients, 2 patients developed pancreatic pseudocyst and were drained by endoscopy, and 2 patients had atrophy of the pancreatic gland correlated to the old contusion site.

Discussion

This retrospective study shows that the prevalence of pancreatic trauma among all abdominal trauma patients hospitalized in our department was 11.5% with an overall mortality of 20%. Pancreatic injuries were mostly blunt trauma (63%) and the etiology was dominated by motor vehicle accident in 46% of the cases, followed by stab wounds in 37% and falls or crushing in 17% of the cases. The incidence of pancreatic trauma is greater than reported in the literature which stands between 3–5% (16), an explanation to that is by the relatively small size of our series and the fact that not all abdominal trauma were hospitalized in our department. The average age of patients is 38 years old, which does not differ from other published series where the age is less than 40 years in 80% of the cases, in addition 74% of patients in our series are males, as well correspond to the literature data (1,17,18). Isolated pancreatic trauma is rarely the case, as this study shows that in 90% of the patients other associated injuries were treated. This is not

the case for pancreatic injuries occurring in children which are often isolated (sports injuries or bike fall). The main causes of pancreatic trauma in this series were motor vehicle accident and stab wounds, unlike data from the United States where the main cause of pancreatic trauma is penetrating (firearms and knives) (1,3,19-21). The reason is probably due to much stricter legislation regarding firearms in Europe where most pancreatic trauma are blunt ones and the most frequent mechanisms are linked to acceleration-deceleration or abdominal contusion to the driver from steering wheel (2,22). In this study 21 patients had a full body CT scan, only 1 patient had a CT scan that was consider normal, a false negative rate of 5% which is lower than the data reported in the literature (40%) (8). Also in our series, the diagnosis of pancreatic injury was made by magnetic resonance imaging (MRI) (3 patients), however access to MRI in emergency setting and its yield is under evaluation (23,24).

The decision to perform pancreatectomy in the setting of trauma is still a pending question. The majority of patients who were operated in our series (n=11/15) had a peri-pancreatic drainage, except 4 patients who had pancreatectomy (distal n=3, head n=1). As for pancreatic injury grades 1 and 2, the NOM is the most effective as long as there is no involvement of the main pancreatic duct. This strategy is effective since morbidity is less than 20% and mortality is relatively low (20,25). This is in accordance with our results which show that 80% (12/15) were successfully treated with this strategy. As for grade 3 and 4 pancreatic injury, distal pancreatectomy or surgical drainage are the indication of choice for body-tail contused areas associated with distal pancreatic duct injury (1,25). Distal pancreatectomy is often preferred over drainage because it decreases mortality and the risk of operative complications

Table 3 Characteristics of patients who underwent laparotomy

| Patient (n) | Mechanism | AAST grade | Surgical management | Associated injuries | Postoperative complication | Length of hospital stay (ICU/Surgery Department) | Survival |
|-------------|------------------------|--|--|---|---|--|--------------------|
| 1 | Penetrating trauma | 2 | Distal pancreatectomy* | Stomach and diaphragm injuries | None | 5/12 | |
| 2 | Penetrating trauma | 3 | Drainage | Superior mesenteric artery injury | None | 1/0 | Deceased POD 1 |
| 3 | Penetrating trauma | 3 | Distal pancreatectomy* | Superior mesenteric vein injury | Pancreatic fistula and intra-abdominal collection | 47/30 | |
| 4 | Penetrating trauma | 3 | Distal pancreatectomy* | Splenic vein injury, left kidney injury, left renal artery dissection, splenic injury, liver injury, pulmonary injury and aortic dissection | Pancreatic fistula and intra-abdominal collection | 32/20 | |
| 5 | Motor vehicle accident | 5 | Drainage | | | 1/0 | Deceased POD 1 |
| 6 | Penetrating trauma | 5 | Pancreaticoduodenectomy | Duodenum and inferior vena cava injuries | Pancreatic fistula, neurologic complications | 95/0 | |
| 7 | Penetrating trauma | 2 | Drainage | Stomach injury | Pancreatic fistula (ERCP with wirsung endoprosthesis) | 3/13 | |
| 8 | Penetrating trauma | 5 | Drainage | Duodenum and left colon injuries and inter-renal aortic injury | None | 1/0 | Deceased POD 1 |
| 9 | Motor vehicle accident | 5 | Drainage | Right arm injury, left wrist luxation, liver injury, left renal artery thrombosis, right colon injury | Intra-abdominal collection and abscess | 27/6 | |
| 10 | Motor vehicle accident | 2 | Drainage | Small bowel injuries | None | 16/7 | |
| 11 | Motor vehicle accident | 1 | Drainage | Leg fracture | Intra-abdominal collection | 23/17 | |
| 12 | Penetrating trauma | 2 | Drainage | Gastric and liver injuries | None | 9/19 | |
| 13 | Penetrating trauma | 5 | Drainage | Gastric and inferior vena cava injuries | None | 115/0 | Deceased POD 115 |
| 14 | Penetrating trauma | 3 | Drainage | Spleen injury | Duodenum injury with peritonitis | 5/15 | |
| 15 | Penetrating trauma | 2 | Drainage | Left kidney injury | None | 27/0 | |
| Total | | Grade 1 (n=1); grade 2 (n=5); grade 3 (n=4); grade 5 (n=5) | Distal pancreatectomy*: three patients; pancreaticoduodenectomy: one patient | | | | Four patients died |

*, with splenectomy. AAST, American Association for Surgery of Trauma; ICU, intensive care unit; POD, post-operative day; ERCP, endoscopic retrograde cholangiopancreatography.

Table 4 Characteristics of patients who underwent nonoperative management

| Patient (n) | Mechanism | AAST grade | Associated injuries | Pancreato-MRI | Radiological drainage of intra-abdominal collection | Endoscopic management | Length of hospital stay (ICU/Surgical Department) | Survival |
|-------------|------------------------|---|---|---|---|---|---|--------------------------------|
| 16 | Blunt trauma | 3 | Lung contusion, spleen and liver injuries | Yes, distal injury of pancreas with wirsung injury | Yes | Yes (wirsung endoprosthesis) | 7/24 | |
| 17 | Fall | 2 | None | No | No | No | 2/5 | |
| 18 | Fall | 2 | Cranial trauma | No | No | No | 1/0 | Deceased from cranial injuries |
| 19 | Motor vehicle accident | 5 | Intra-cranial injury and spleen artery dissection | Yes, distal pancreatic injury and pseudocyst of 25 mm | Yes | Yes (endoscopic drainage of pseudocyst) | 7/25 | |
| 20 | Motor vehicle accident | 1 | Lung contusion | No | No | No | 2/3 | |
| 21 | Motor vehicle accident | 1 | Bone and face injuries | No | No | No | 24/11 | |
| 22 | Motor vehicle accident | 1 | Liver, spleen, and right kidney injuries | No | No | No | 6/3 | |
| 23 | Motor vehicle accident | 1 | Liver injury | No | No | No | 5/0 | |
| 24 | Motor vehicle accident | 1 | Duodenum hematoma | No | No | No | 0/14 | |
| 25 | Fall | 2 | Duodenum contusion and sacro-iliac luxation | No | Yes | No | 34/69 | |
| 26 | Motor vehicle accident | 1 | Left hemothorax and left pulmonar contusion, bone | No | No | No | 13/13 | |
| 27 | Motor vehicle accident | 5 | None | Yes, medial pancreatic injury and pseudocyst of 80 mm | No | Yes (endoscopic drainage of pseudocyst) | 4/28 | |
| 28 | Motor vehicle accident | 2 | Bone and face injuries | No | Yes | No | 0/9 | |
| 29 | Motor vehicle accident | 2 | Bone and face injuries | No | No | No | 0/5 | |
| 30 | Fall | 1 | Intracerebral hemorrhage and bone face injuries | No | No | No | 1/0 | Deceased from cranial injuries |
| Total | | Grade 1 (n=7); grade 2 (n=5); grade 3 (n=1); grade 5 (n=2) | | | | | | Two patients died |

AAST, American Association for Surgery of Trauma; MRI, magnetic resonance imaging; ICU, intensive care unit.

(1,20,26). In case of complete traumatic transection of the pancreatic neck (i.e., pancreaticojejunostomy of the distal stump and sutured of the cephalic stump) may be suggested. In our series, 5 patients had pancreatic injury grade 3, of whom 2 patients had distal pancreatectomy, 2 patients had surgical drainage and 1 patient was not operated and a stent was placed within the wirsung duct via endoscopic retrograde cholangiopancreatography (ERCP). The objective of ERCP is twofold: to confirm the diagnosis of pancreatic duct injury and to insert a bridge prosthesis over the contused area (27). A therapeutic alternative is to perform only sphincterotomy which aims to reduce the rate of pancreatic fistula by reducing the intra-ductal pressure (28). For pancreatic injury grade 5 there are several possibilities varies from NOM to surgical drainage and up to pancreaticoduodenectomy. The published data favor NOM with satisfactory results (19,25), even in cases of duodenal or bile duct injuries (29). Pancreaticoduodenectomy is associated with high mortality rate (45%) while more conservative approach has much lower mortality rate of 22–25% (29–31). Some authors have described the possibility to perform pancreaticoduodenectomy in two steps with a reconstruction 24 to 48 hours later (32). In our study the majority of patients (n=5/7) with grade 5 injury underwent surgical drainage, with a mortality rate of 43% (n=3/7), though two patients died within 24 hours due to associated injuries and probably not from the pancreatic injury itself.

The mortality of the NOM group was 13% (2/15) which is higher than reported in the literature. When NOM is decided, it includes: resuscitation, analgesia, parenteral nutrition and monitoring in surgical ward, similar in many ways to the treatment in case of acute pancreatitis. The issue of antibiotics or octreotide treatment in the nonoperative group is still controversial (33).

The limitations of this study include its retrospective nature and the limited sample size. It is difficult to draw any robust conclusions from comparison of the two groups since it is not homogeneous groups.

In conclusion, operative management of pancreatic trauma leads to a higher mortality, but this must not be necessarily related to the pancreas injury alone but also to the associated injuries including liver, spleen and vascular trauma which may cause impaired outcome more than pancreas injury.

Acknowledgements

None.

Footnote

Conflicts of Interest: The authors have no conflicts of interest to declare.

Ethical Statement: The study was approved by the local committee.

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Cite this article as: Menahem B, Lim C, Lahat E, Salloum C, Osseis M, Lacaze L, Compagnon P, Pascal G, Azoulay D. Conservative and surgical management of pancreatic trauma in adult patients. *HepatoBiliary Surg Nutr* 2016;5(6):470-477. doi: 10.21037/hbsn.2016.07.01