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TITLE: Trauma pancreatoduodenectomy: How and why?

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ABSTRACT

Introduction
Blunt duodenopancreatic trauma is a rare clinical entity, occurring in less than 2% of all cases of closed abdominal trauma. However, duodenopancreatic injury has high morbidity and mortality rates, especially when severe. While most injuries need only simple surgical techniques, such as debridement or drainage, grade V injuries often require more complex solutions. These may include major pancreatic resection, such as the technically demanding Whipple procedure, which may need to be performed by surgical teams without adequate preparation, in an unstable patient, often at late hours.

Case Report
We present the case of a 51-year-old man who sustained blunt abdominal trauma with complex duodenopancreatic injury when he was hit by a motor vehicle. The patient was initially managed with damage control laparotomy; pancreaticoduodenectomy was performed in a second operation, with acceptable results.

Conclusion
Treatment of complex duodenal and pancreatic injury may require pancreaticoduodenectomy. The use of damage control techniques allows restoration of the patient’s physiological parameters prior to the extensive surgical procedure.

Keywords: Abdominal injuries, Pancreatic trauma, Pancreatoduodenectomy, Damage Control, Surgery
INTRODUCTION
Blunt duodenopancreatic trauma is a rare clinical entity, occurring in less than 2% of all cases of closed abdominal trauma [1]. However, duodenopancreatic injury has high morbidity (19 to 74.5%) and mortality rates (9 to 34%), especially in cases of severe trauma [1, 2].

The American Association for the Surgery of Trauma classifies pancreatic and duodenal trauma separately into 5 grades (Tables 1 and 2) [3]. Simultaneous involvement of the pancreas and duodenum, often with associated injury to the common bile duct, is classified as Grade V, the most severe form of this injury. The proximity of the structures involved often necessitates a common solution [2, 4, 5].

While most pancreatic and duodenal injuries need only simple surgical debridement or drainage [4, 5], grade V injuries often require more complex solutions. These include major pancreatic resection, such as the technically demanding Whipple procedure, which may need to be performed by surgical teams without adequate preparation, in an unstable patient, often at late hours. These factors undoubtedly affect the outcomes of the procedure [2, 5–7].

CASE REPORT
A 51-year-old man was admitted to the emergency department with abdominal pain and hematemesis 6 hours after sustaining blunt abdominal trauma in a motor vehicle collision. The patient initially walked to the Basic Emergency Department of his neighborhood and was later transferred to our hospital. He showed no mental status changes or respiratory symptoms. The patient was hemodynamically stable. He had pain on abdominal palpation, with evident signs of peritoneal irritation. FAST exam was positive for free intraperitoneal fluid. Aside from a history of chronic alcoholism, the patient's medical history did not contain relevant previous diseases or surgeries.

Laboratory test results included: hemoglobin, 13 g/dL; white cell count, 34,000/mL; International Normalized Ratio, 0.9; amylase, 243; pH, 7.13; lactate, 4.1 mmol/L; pO₂, 119 mmHg. A chest X-ray showed no changes. Because the patient was
hemodynamically stable, abdominal computed tomography was performed. This exam revealed the presence of a bulky periduodenal hematoma involving the head of the pancreas and air bubbles in the retroperitoneum. The arterial phase revealed active bleeding into the stomach (Figure 1), indicating that surgical management was warranted.

Laparotomy revealed moderate hemoperitoneum along with a bulky zone 1 retroperitoneal hematoma and a laceration of the anterior aspect of the duodenal bulb. An extensive Cattell–Braash maneuver revealed the retroperitoneal hematoma extending along the root of the mesentery as well as transection of the duodenum between the first and the second portions, extending through the pancreas to the isthmus and including the common bile duct (Figures 2–4).

By this time, the patient’s acidosis had worsened and he was hypothermic (pH 7.03 and temperature 35ºC). Volume replacement was started with crystalloids and later with 3 units of packed red blood cells and 2 units of fresh frozen plasma. The surgeons decided to proceed with a damage control procedure to achieve hemostasis, bile duct drainage with an endoluminal tube, pyloric exclusion through a gastrotomy and extensive retroperitoneal drainage. A laparostomy was performed, using the Barker technique. The patient was admitted to the Intensive Care Unit where supportive care was initiated. His physiological parameters improved and hemodynamic stability was attained. After 56 hours he was afebrile; re-exploration revealed an uncontaminated abdomen without edema of the bowel loops. It was decided that pancreaticoduodenectomy without preservation of the pylorus should be performed, because of extensive damage to the duodenopancreatic complex. The hospital's hepatobiliary surgical team performed this operation. Two additional units of packed red cells and 2 units of fresh frozen plasma were administered during surgery. The patient was already receiving broad-spectrum antibiotic therapy with meropenem. On the eighth postoperative day he developed a fever. Repeat computed tomography revealed a retrogastric abscess, which was subsequently drained percutaneously. The patient started an oral diet on postoperative day 9. He was discharged from the Intensive Care Unit 20 days after surgery. After 20 days in the general ward, under vigorous physical rehabilitation, the patient was discharged.
home. There have been no complications, metabolic or otherwise, in 2 years of follow-up.

**DISCUSSION**

Proximal pancreatic injury involving the pancreatic and bile ducts as well as the duodenum is difficult to handle, with no consensus on the ideal approach [2–7]. Opting for a major surgery, such as pancreaticoduodenectomy, is not easy, because very high mortality rates have been reported, up to 46.2% in some case series [2]. Fortunately, most pancreatic and duodenal injuries can be repaired with simple debridement, suturing or drainage, with acceptable morbidity and mortality [2, 4, 5]. Pancreaticoduodenectomy is performed in less than 10% of surgeries for duodenopancreatic trauma [8].

There are few indications for trauma pancreaticoduodenectomy. This technique is justified only in patients with severe combined injuries of the duodenopancreatic complex that involve the bile duct and in those with uncontrollable bleeding from vessels adjacent to these structures [2, 4–6]. Pancreaticoduodenectomy should not be attempted in unstable trauma patients. It is a major, complex operation, requiring several hours to complete, and will not be tolerated by an unstable patient with shock and coagulopathy. Pancreaticoduodenectomy should only be performed in a second stage, after an initial damage control procedure to control hemorrhage and contamination [2, 5]. This approach allows recovery of the patient's physiological parameters in an intensive care environment.

Given the technical complexity and results of pancreaticoduodenectomy, some authors suggest that the second intervention should be assisted or performed by experienced hepatobiliary surgeons [9]. This second intervention may be delayed for 48 hours, allowing the assembly of the appropriate staff for the pancreaticoduodenectomy reconstruction phase.

Pancreaticoduodenectomy after trauma is technically similar to that performed for neoplasia. Resection is often facilitated by the dissection started by the trauma itself and also by the damage control procedures required for exploration, such as the Cattell–Braash maneuver. After control of bleeding, control of contamination presents some important challenges. Pyloric exclusion techniques may be needed to prevent contamination from the stomach in patients with duodenal lesions [2, 8].
Temporary duodenal repair is also suitable, when possible. The bile duct can be cannulated or ligated [5]. Ligation of the biliary tract may cause widening, which will be helpful during reconstruction, especially if the bile duct is very thin. In such cases, the duct can be widened up to 5 mm in diameter in 48 hours. Pancreatic diversion is more difficult, especially if there is disruption of the main pancreatic duct or destruction of the papilla. The solution can be wide drainage of the retroperitoneum with Jackson–Pratt-type closed-suction drains. In the trauma patient, resection of the uncinate process is not necessary because there is no indication for lymphadenectomy [5]. This simplifies the procedure, allowing the surgeon to work away from the mesenteric vessels and section the medial portion with a vascular stapling device [10]. The gallbladder should be spared initially, as it may be used in biliodigestive reconstruction if the biliary duct is too thin [5]. Lastly, the pancreatic stump must be addressed. Trauma patients have normal, soft pancreatic tissue and a thin main pancreatic duct. With the need for blood transfusion products, the risk of pancreatic fistula increases significantly [11]. Ligation of the stump in elective situations has been shown not to reduce the rate of pancreatic fistula formation and should not be performed, although there are few reports of trauma pancreaticoduodenectomy. However, in some situations, pancreatic stump ligation may be the only possible option [5]. Pancreatoco-digestive reconstruction with jejunum or stomach is feasible and safe. Although the literature favors pancreaticogastric over pancreaticojejunal reconstruction, results depend on surgeon’s experience; both approaches are recommended and should be used at the surgeon’s discretion and according to personal experience [5]. Total pancreatectomy has also been reported, obviating the problem of pancreatic fistula, but creating significant morbidity; this procedure should be used only in very select elective cases [5].

Data regarding morbidity after trauma pancreaticoduodenectomy is scarce [2, 4, 5]. The rate of global postoperative complications is high, ranging from 8% to 86% [2, 4, 5, 9]. Pancreatic fistula is the most frequent pancreatic complication, occurring in between 2% and 37% of patients [2, 5]. In addition to the septic complications of pancreatic fistula, it may cause pseudocyst formation or cataclysmic bleeding resulting from digestion of adjacent vessels, usually the stump of the gastroduodenal
artery [2]. Up to 7% of patients with fistula require additional surgery to treat the
complication [2]. Pancreatic abscess is also important and contributes significantly to
postoperative mortality. The incidence of pancreatic abscess ranges between 10%
and 25%; it is lethal in 27% of cases. The best way to deal with this complication is
imaging-guided percutaneous drainage [2].

Like elective pancreaticoduodenectomy, the trauma procedure usually does not
produce metabolic complications. Animal models and human experience have
shown that more than 80% to 90% of the pancreas must be removed to result in
diabetes or malabsorption; pancreatic head removal is well tolerated [2].

CONCLUSION

Treatment of complex duodenal pancreatic injury may require
pancreaticoduodenectomy. The use of damage control techniques allows restoration
of the patient’s physiological parameters so that he or she can withstand the
extensive surgical insult of the procedure.

CONFLICT OF INTEREST

There is no identifiable conflict of interest to report. The authors have no financial or
proprietary interest in the subject matter or materials discussed in the manuscript.

AUTHOR’S CONTRIBUTIONS

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Group1 - Conception and design, Acquisition of data, Analysis and interpretation of
data
Group 2 - Drafting the article, Critical revision of the article
Group 3 - Final approval of the version to be published

Débora Aveiro

Group1 - Conception and design, Acquisition of data, Analysis and interpretation of
data
Group 2 - Drafting the article, Critical revision of the article
Group 3 - Final approval of the version to be published
REFERENCES


SUGGESTED READING
### Table 1: Grading of pancreatic injury (from Moore et al.)

<table>
<thead>
<tr>
<th>Grade</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Hematoma: mild contusion without duct injury</td>
</tr>
<tr>
<td></td>
<td>Laceration: superficial laceration without duct injury</td>
</tr>
<tr>
<td>II</td>
<td>Hematoma: major contusion without duct injury or tissue loss</td>
</tr>
<tr>
<td></td>
<td>Laceration: major laceration without duct injury or tissue loss</td>
</tr>
<tr>
<td>III</td>
<td>Distal transection or parenchymal injury with duct injury</td>
</tr>
<tr>
<td>IV</td>
<td>Proximal transection or parenchymal injury</td>
</tr>
<tr>
<td>V</td>
<td>Massive disruption of pancreatic head</td>
</tr>
</tbody>
</table>

Advance one grade for multiple injuries up to grade III. Proximal pancreas is to the patients’ right of the superior mesenteric vein.
Table 2: Grading of duodenal injury (from Moore et al.)

<table>
<thead>
<tr>
<th>Grade</th>
<th>Description</th>
</tr>
</thead>
</table>
| I     | Hematoma: involving single portion of the duodenum  
Laceration: partial thickness, no perforation |
| II    | Hematoma: involving more than one portion of the duodenum  
Laceration: disruption of <50% of circumference |
| III   | Laceration: disruption of 50 to 75% circumference of D2  
Laceration: disruption of 50 to 100% circumference of D1, D3, and D4 |
| IV    | Laceration: disruption of >75% circumference of D2  
Laceration: involving the ampulla or distal common bile duct |
| V     | Laceration: massive disruption of the duodenopancreatic complex  
Vascular: devascularization of the duodenum |

Abbreviations: D1, D2, D3, D4: anatomic portions of the duodenum

Advance one grade for multiple injuries up to grade III. D1-first position of duodenum; D2-second portion of duodenum; D3-third portion of duodenum; D4-fourth portion of duodenum
FIGURE LEGENDS

Figure 1: Abdominal computed tomography. (A) and (B): Scan without contrast showing free fluid and a bulky periduodenal hematoma. (C) and (D): Scan with intravenous contrast, showing (C) fresh blood in the stomach and (D) air bubbles in the retroperitoneum.

Figure 2: Postoperative sketch made by the surgeon showing the injuries sustained: anterior laceration of first portion of the duodenum and transection involving the second portion of the duodenum, head of the pancreas and bile duct.

Figure 3: Intraoperative image showing the duodenal transection.

Figure 4: Intraoperative image showing the bile duct injury and drainage.

FIGURE

![Image of abdominal computed tomography scans and intraoperative images](image-url)
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