

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:** A case of a 51-year-old male who sustained blunt abdominal trauma with complex duodenopancreatic injury when he was involved in a motor vehicle collision. 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

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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 (19–74.5%) and mortality rates (9–34%), 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.

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

Grade I	Hematoma: mild contusion without duct injury Laceration: superficial laceration without duct injury
Grade II	Hematoma: major contusion without duct injury or tissue loss Laceration: major laceration without duct injury or tissue loss
Grade III	Distal transection or parenchymal injury with duct injury
Grade IV	Proximal transection or parenchymal injury
Grade V	Massive disruption of pancreatic head

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.)

Grade I	Hematoma: involving single portion of the duodenum Laceration: partial thickness, no perforation
Grade II	Hematoma: involving more than one portion of the duodenum Laceration: disruption of <50% of circumference
Grade III	Laceration: disruption of 50–75% circumference of D2 Laceration: disruption of 50–100% circumference of D1, D3, and D4
Grade IV	Laceration: disruption of >75% circumference of D2 Laceration: involving the ampulla or distal common bile duct
Grade 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

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 male was admitted to the emergency department with abdominal pain and hematemesis six

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. As the patient was hemodynamically stable, abdominal computed tomography scan 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 35°C). Volume replacement was started with crystalloids and later with 3 units of packed red blood cells and 2

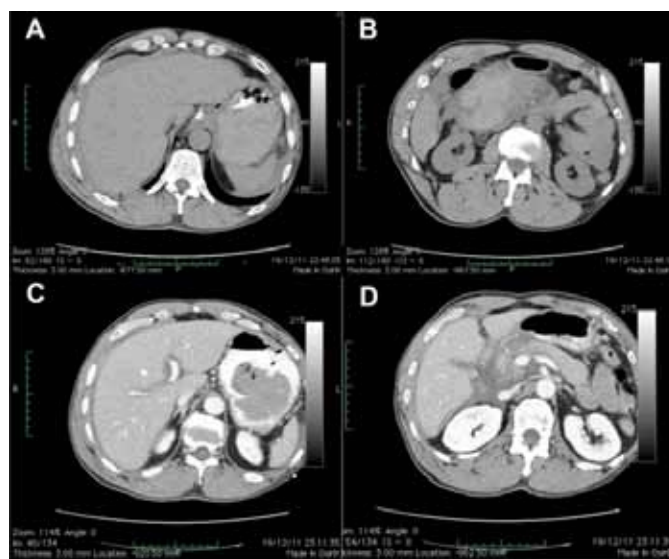


Figure 1: Abdominal computed tomography. (A) and (B): Scan without contrast showing free fluid and a bulky periduodenal hematoma, (C) and (D): Scan with intravenous contrast, showing (C) fresh blood in the stomach and (D) air bubbles in the retroperitoneum.



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.

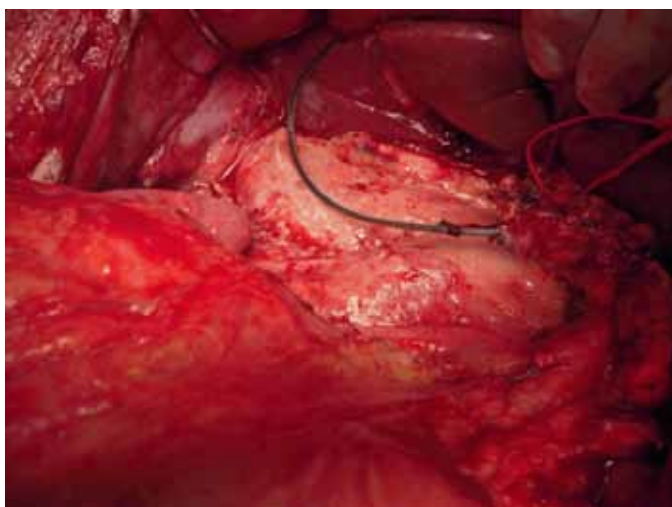


Figure 4: Intraoperative image showing the bile duct injury and drainage.

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 two 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]. Pancreatico-digestive reconstruction with jejunum or stomach is feasible and safe. Although the literature favors pancreatogastric over pancreatjejunal 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 8–86% [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 80–90% 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.

Author Contributions

Jorge Pereira – Substantial contributions to conception and design, Acquisition of data, Analysis and interpretation of data, Drafting the article, Revising it critically for important intellectual content, Final approval of the version to be published

Débora Aveiro – Substantial contributions to conception and design, Acquisition of data, Analysis and interpretation of data, Drafting the article, Revising it critically for important intellectual content, Final approval of the version to be published

Júlio Constantino – Substantial contributions to conception and design, Acquisition of data, Analysis and interpretation of data, Drafting the article, Revising it critically for important intellectual content, Final approval of the version to be published

Ana Oliveira – Substantial contributions to conception and design, Acquisition of data, Analysis and interpretation of data, Drafting the article, Revising it critically for important intellectual content, Final approval of the version to be published

Luis Filipe Pinheiro – Substantial contributions to conception and design, Acquisition of data, Analysis and interpretation of data, Drafting the article, Revising it critically for important intellectual content, Final approval of the version to be published

Guarantor

The corresponding author is the guarantor of submission.

Conflict of Interest

Authors declare no conflict of interest.

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