



Whipple Procedure in Trauma: A Case Report of Complex Gunshot Injury

Translation of "Cirurgia de Whipple no Trauma: Relato de Caso de Lesão Complexa Por Arma de Fogo"

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Abstract

Introduction: Firearm violence accounts for more than 70% of homicides in Brazil and represents a significant cause of years of potential life lost. Gunshot wounds to pancreaticoduodenal organs are rare (representing only 0.3% of abdominal traumas) and carry high morbidity and mortality rates. The literature recommends conservative treatment or primary repair for AAST grade 1–2 injuries, while more severe injuries (AAST 3–5) may require damage control strategies and, in selected cases, extensive resections such as pancreaticoduodenectomy (Whipple procedure).

Case Report: A 23-year-old male, victim of a thoracoabdominal gunshot wound, arrived at the emergency department with a Glasgow score of 5 and hemodynamic instability. He was intubated and underwent an emergency midline laparotomy.

The identified injuries were: 1. Transverse colon > 50% of the circumference (AAST grade 3); 2. Transfixing stomach injury (AAST grade 3); 3. Duodenum, D2 portion (AAST grade 3); 4. Head of the pancreas with distal bile duct rupture (AAST grade 5).

A damage control approach was chosen: primary suture of the colon, partial gastrectomy, and resection of the duodenum and pancreatic head, followed by vacuum-assisted closure (peritoneostomy). After 48 hours in the ICU, a second-look surgery was performed for definitive reconstruction: Roux-en-Y gastroenteroanastomosis, duct-to-mucosa pancreaticojejunostomy, and bilioenteric anastomosis. During the postoperative period, transverse colostomy dehiscence and a biliopancreatic mucous fistula occurred, which were managed with a definitive colostomy, local drainage, and prolonged vacuum-assisted closure. The patient was discharged after 87 days, without a stoma, ambulating, and on oral intake. Approximately 14 months after the initial trauma, the patient underwent intestinal reconstruction and incisional hernioplasty, with no further complications following the procedure.

Discussion: High-grade pancreaticoduodenal traumas (AAST 4–5) present an in-hospital mortality rate exceeding 12%, primarily due to hemorrhage and injury to adjacent organs. The protocol for unstable patients indicates immediate laparotomy. For AAST 3–4 injuries, primary repair or external drainage associated with damage control is usually sufficient; however, AAST 5 injuries (involving the pancreatic duct or Ampulla of Vater) indicate resection. Pancreaticoduodenectomy in trauma, although controversial, is indicated in < 1% of cases when primary repair of the pancreatic and duodenal ducts is impossible. Studies report mortality rates of up to 34% in this context,...

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ARCHIVAL RECORD

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Keywords: Trauma, Wounds, Laparotomy, Multiple Trauma

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1. Introduction

Interpersonal violence and public insecurity remain major challenges for both the Brazilian population and governmental authorities. In Brazil, violence is the leading cause of healthy years of life lost. Among the causes of lethal violence, firearm-related injuries stand out, accounting for more than 70% of all homicides in the country. Although the number of firearm-related deaths and hospital admissions has declined over the past decade, more than 35,000 firearm-related deaths continue to occur annually, according to data from the Instituto Sou da Paz. In 2021, among the 35,217 firearm-related deaths recorded nationwide, only 7,893

occurred within hospitals or other healthcare facilities, reflecting the extremely high lethality of this mechanism of injury (1).

Patients who survive the initial injury and reach healthcare services often require highly complex treatment, resulting in substantial costs to the Brazilian Unified Health System (SUS) and hospital services. Firearm injuries (FIs) account for approximately one-quarter of all deaths from external causes but only 1.4% of hospital admissions related to external causes. Nevertheless, these injuries generated healthcare expenditures of approximately BRL 41 million for the SUS in 2022. The average hospitalization cost for firearm-injured patients is 59% higher than that associated with other forms of assault (1).

Given its relevance within the national context, surgeons must be familiar with the diagnosis and management of the diverse injuries resulting from firearm trauma. Despite the high incidence of penetrating trauma caused by firearms, pancreatic and duodenal injuries remain uncommon. Among severe traumatic injuries, duodenal involvement occurs in approximately 0.2–0.6% of cases and represents only 3–5% of abdominal trauma cases (2). Pancreatic injuries are similarly rare, occurring in approximately 0.2% of blunt trauma cases and 1.1% of penetrating trauma cases, accounting for less than 12% of all abdominal injuries (3,4).

In a study conducted by O'Reilly et al., more than 350,000 trauma cases admitted to hospitals in England, Wales, and Northern Ireland between 1989 and 2013 were analyzed to assess the epidemiology of pancreaticoduodenal trauma. Despite important epidemiological differences compared with Brazil, only 0.32% of all trauma cases involved pancreaticoduodenal injuries, corresponding to 4.7% of all abdominal trauma cases identified in the study (5).

Due to the rarity of these injuries, the optimal surgical management remains controversial. Clinical outcomes depend largely on the severity of organ damage and the patient's hemodynamic status, factors that directly influence mortality, morbidity, and treatment strategy (2,4,6). While less severe injuries may be managed conservatively or with simple primary repair, more extensive injuries often require aggressive surgical intervention and/or a damage control approach (2,4,7).

Considering the rarity of these lesions and the challenges associated with defining the optimal treatment strategy, we report a case of a firearm injury involving multiple abdominal organs, with particular emphasis on pancreatic and duodenal trauma. As part of a damage control strategy, a pancreatoduodenectomy with gastric resection was performed, followed by delayed reconstruction in a second-stage procedure.

2. Case presentation

A previously healthy 23-year-old male was admitted to the emergency department after sustaining a firearm injury. The interval between injury and hospital admission was approximately one hour. During prehospital care, the trauma team administered 1 g of tranexamic acid and 500 mL of normal saline.

Upon arrival, the patient presented with a Glasgow Coma Scale (GCS) score of 5 (eye opening: 2, verbal response: 2, motor response: 1), and immediate endotracheal intubation was performed to secure the airway. Physical examination revealed a gunshot entry wound at the left midclavicular thoracoabdominal junction, associated with omental evisceration, without an identifiable exit wound. Palpation detected the projectile lodged in the posterior aspect of the right hemithorax, along the posterior axillary line at the level of the tenth rib. The abdominal examination was also suggestive of generalized peritonitis. Given the patient's hemodynamic instability and visceral evisceration, he was immediately transferred to the operating room.

A midline exploratory laparotomy was performed. Intraoperative findings included a transverse colon injury involving more than 50% of the circumference without complete transection (AAST grade III), a through-and-through gastric injury (AAST grade III), a penetrating injury to the second portion of the duodenum (AAST grade III), and a severe pancreatic head injury associated with disruption of the distal common bile duct (AAST grade V).

Considering the extent of the injuries and the patient's critical hemodynamic condition, a damage control strategy was adopted. A primary repair of the transverse colon was performed, followed by partial gastrectomy using a linear stapler. The third portion of the duodenum was mobilized and transected using a linear stapler. The pancreatic head was resected with a linear stapler, while the remaining pancreatic structures were left in situ because of the patient's profound hemodynamic instability. At the conclusion of the procedure, the patient required high doses of vasopressor support. Temporary abdominal closure with negative-pressure therapy was performed, and a fine nasogastric tube was positioned through the common bile duct for external biliary drainage into an ostomy collection bag. Massive transfusion was required intraoperatively, including four units of cryoprecipitate, two units of fresh frozen plasma, and two units of packed red blood cells.

After 48 hours of intensive care unit (ICU) resuscitation and stabilization, vasopressor requirements had significantly decreased, allowing definitive reconstruction. Re-exploration was performed with restoration of gastrointestinal and biliary continuity. Reconstruction included a gastrojejunostomy, a pancreaticojejunostomy with placement of a urethral catheter as an internal pancreatic duct stent, duct-to-mucosa anastomosis, and pancreatic invagination (telescoping) technique. Biliary continuity was restored through a Roux-en-Y hepaticojejunostomy.

During the following month, the patient developed dehiscence of the transverse colonic repair and obstruction of the biliopancreatic limb. Consequently, a transverse colostomy and a mucous fistula of the biliopancreatic limb were created. Following the procedure, the patient remained with an open abdomen managed by negative-pressure therapy, with dressing changes every 48 hours.

After multiple surgical interventions, two attempts at definitive abdominal closure were unsuccessful: one due to leakage from an enteroatmospheric fistula and the other because of the inability to mobilize the retracted skin in a hostile frozen abdomen. Following multidisciplinary discussion with the wound and ostomy care team, a specialized home-based dressing protocol was established, which was feasible due to the family's ability to provide adequate care with support from a private healthcare service.

The patient was discharged after 87 days of hospitalization. At discharge, he tolerated a full oral diet, had a well-functioning stoma, and was independently ambulatory. Tracheostomy decannulation was successfully performed under bronchoscopic guidance before discharge. Outpatient follow-up was scheduled for continued monitoring and management of potential late complications.

During follow-up, the patient demonstrated an excellent recovery, rapidly adapting to his new routine and experiencing no additional complications. Approximately six months after discharge, preoperative preparation for restoration of intestinal continuity and repair of the large incisional hernia was initiated. Definitive reconstruction was performed 14 months after the initial operation. The stoma and mucous fistula were resected and stapled, followed by a hand-sewn side-to-side colocolonic anastomosis. Complete abdominal wall closure was achieved, and a large polypropylene mesh was implanted. The patient was discharged during the same week. At the outpatient visit seven days later, he was asymptomatic and recovering well. Subsequently, he was lost to follow-up.

3. Discussion

Pancreaticoduodenal trauma is uncommon but associated with substantial morbidity and mortality, with reported in-hospital mortality rates approaching 12% (2). Early mortality is primarily related to uncontrolled hemorrhage and associated vascular or visceral injuries, whereas late mortality is more frequently attributable to infectious complications and multiple organ failure (6).

The initial management of these patients is dictated by their physiological status. Trauma assessment should follow Advanced Trauma Life Support (ATLS) principles, with subsequent management guided by hemodynamic stability and the presence of peritoneal signs. In hemodynamically stable patients without indications for immediate laparotomy, contrast-enhanced computed tomography is the diagnostic modality of choice, demonstrating a sensitivity of 86% and specificity of 88% for duodenal injuries (2).

Most pancreatic and duodenal injuries are low-grade lesions. High-grade injuries, such as those described in the present case, are considerably less frequent and usually require aggressive surgical management (5,6). Low-grade pancreatic injuries (AAST grades I–II) may be managed nonoperatively in selected patients, whereas grades III and IV frequently require resection when technically feasible. Due to their rarity and high associated mortality, grade V pancreatic injuries remain poorly represented in the literature, and their optimal management remains controversial (4).

Similarly, contemporary management of duodenal trauma favors a “less-is-more” philosophy, emphasizing the simplest effective repair whenever possible. While low-grade injuries can often be managed conservatively or with primary repair, more extensive injuries may necessitate complex reconstruction. In cases of severe tissue destruction, technical difficulty, or profound physiological derangement, damage-control surgery followed by delayed definitive repair after 24–48 hours of intensive care resuscitation is generally recommended (2).

In the present case, extensive destruction of the pancreatic head associated with distal bile duct disruption and severe duodenal injury precluded organ-preserving strategies. Ongoing hemorrhage and extensive tissue devitalization prompted the decision to perform a pancreaticoduodenectomy. Accepted indications for trauma-related pancreaticoduodenectomy include massive pancreatic head injury involving the main pancreatic duct, irreparable distal bile duct disruption, ampullary avulsion, and devastating combined pancreaticoduodenal injuries (2,6).

Although pancreaticoduodenectomy is a well-established procedure in hepatopancreatobiliary oncology, its role in trauma remains controversial because of the considerable physiological burden imposed on critically injured patients. Morbidity and mortality are strongly influenced by the patient's physiological reserve, associated injuries, and timing of intervention (3). In a review by Krige et al., encompassing 220 trauma-related pancreaticoduodenectomies, the overall mortality rate reached 34%, highlighting the severity of these injuries and the complexity of their management (6).

Current evidence supports a staged approach in unstable patients. Damage-control surgery allows rapid control of hemorrhage and contamination while avoiding prolonged operative times during periods of physiological exhaustion. Definitive reconstruction can then be performed after adequate resuscitation in the intensive care unit. In the present case, restoration of gastrointestinal, biliary, and pancreatic continuity was successfully achieved during a planned second-look operation. While some au-

thors advocate temporary management of the pancreatic remnant with delayed reconstruction by specialized hepatopancreatobiliary teams, the availability of a liver transplantation and hepatobiliary surgery team at our institution allowed complete reconstruction during the second-stage procedure (2).

Postoperative management is equally critical and requires a multidisciplinary approach. Open abdomen management is frequently employed following damage-control surgery to prevent abdominal compartment syndrome and facilitate planned re-exploration. Current recommendations advocate reoperation within 24–48 hours whenever possible, with definitive closure pursued as soon as physiological and technical conditions permit. Temporary abdominal closure using negative-pressure therapy has become the preferred strategy because of its effectiveness in controlling contamination and facilitating abdominal domain preservation (8).

Despite these advantages, prolonged open abdomen management is associated with significant complications, including severe nutritional deficits, enteroatmospheric fistula formation, frozen abdomen, and loss of abdominal wall domain. Several of these complications were observed in the present case, ultimately requiring prolonged hospitalization and delayed abdominal wall reconstruction (8).

Anastomotic dehiscence and fistula formation remain among the most feared complications following pancreaticoduodenectomy in the trauma setting. Given that approximately 5 liters of gastric, biliary, pancreatic, and salivary secretions pass through the duodenum daily, leakage from the reconstruction can result in severe local and systemic consequences. In most cases, management is based on adequate external drainage, source control, nutritional support, and negative-pressure wound therapy. In selected retroperitoneal leaks, additional drainage procedures, including flank approaches and controlled external diversion techniques, may be necessary to achieve adequate source control (2).

Despite a prolonged and highly complex postoperative course, the patient ultimately achieved full oral intake, independent ambulation, successful restoration of intestinal continuity, and definitive abdominal wall reconstruction. This favorable outcome highlights the importance of multidisciplinary management, staged surgical strategies, and access to specialized hepatopancreatobiliary expertise in the treatment of catastrophic pancreaticoduodenal trauma.

4. Conclusion

The management of complex pancreaticoduodenal trauma requires rapid decision-making, familiarity with damage-control principles, and coordinated multidisciplinary critical care. In such scenarios, surgical decisions influence not only patient survival but also long-term morbidity and functional recovery.

The present case illustrates the successful management of a catastrophic penetrating pancreaticoduodenal injury through a staged damage-control approach followed by delayed definitive reconstruction. Despite a prolonged postoperative course and multiple complications, favorable functional recovery was achieved in a specialized trauma center with access to hepatopancreatobiliary expertise, advanced critical care resources, and comprehensive multidisciplinary support.

Although pancreaticoduodenectomy is traditionally associated with oncologic surgery, it remains a valuable therapeutic option in carefully selected patients with devastating pancreatic head, distal

bile duct, and duodenal injuries. When combined with physiological resuscitation and delayed reconstruction, this strategy may provide a lifesaving alternative in otherwise unsurvivable injuries.

Given the rarity of high-grade pancreaticoduodenal trauma and the limited evidence available, further multicenter studies are required to better define treatment algorithms and establish consensus regarding the optimal management of these challenging injuries.

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