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## Three-stage management of complex pancreatic trauma with gastroduodenopancreatectomy: A case report<sup>☆</sup>

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### ABSTRACT

**INTRODUCTION:** Severe injuries of the pancreatic head and duodenum in haemodynamically unstable patients are complex management. The purpose of this study is to report a case of complex pancreatic trauma induced by gunshot and managed with surgical approaches at three different times.

**PRESENTATION OF CASE:** Exploratory laparotomy was indicated after initial emergency room care, with findings of cloudy blood-tinged fluid and blood clots on the mesentery near the hepatic angle, on the region of the 2nd portion of the duodenum and at the pancreatic head. Gastroduodenopancreatectomy was performed with right hemicolectomy and the peritoneal cavity was temporarily closed by a vacuum peritoneostomy. Surgical reopening occurred on the fifth postoperative day, and the patient was subjected to single-loop reconstruction of the intestinal transit with telescoping pancreaticojejunal anastomosis, biliodigestive anastomosis with termino-lateral hepaticojejunal anastomosis with a Kehr drain and gastroenteroanastomosis in 2 planes. The terminal ileostomy was maintained. After 2 days, the patient was subjected to abdominal wall closure without complications, which required relaxing Gibson incisions and wound closure with polypropylene mesh placement in a pre-aponeurotic position closed with multiple stitches.

**RESULTS:** The patient was discharged on the 40th post-trauma day without drains, with a functioning ileostomy and with a scheduled reconstruction of intestinal transit.

**CONCLUSION:** In the presence of multiple associated injuries, hemodynamic instability and the need for an extensive surgical procedure such as duodenopancreatectomy, damage control surgery performed in stages as reported here enables the clinical stabilization of the patient for definitive treatment, achieving better survival results.

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### 1. Introduction

Pancreatic and duodenal injuries occur in approximately 2–3% of all traumatic abdominal injuries [1]. Pancreatic trauma is classified according to the magnitude of the injury, ranging from a simple hematoma to rupture of the pancreatic duct and complete destruction of the organ. Isolated pancreatic injury is rare due to the proximity to other vital structures and the intensity of the trauma usually associated with the injury [1,2].

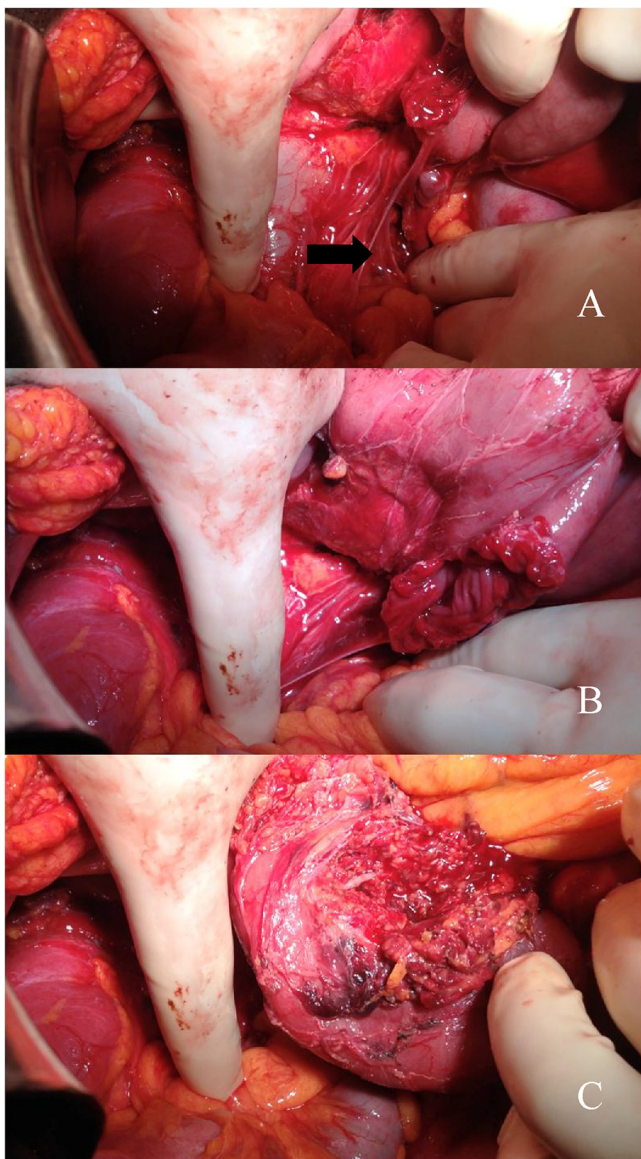
Although most pancreatic and duodenal injuries are low-grade and are treated nonoperatively or with relatively simple surgical techniques, the mortality rate associated with cases of complex injury is high, and such cases often require pancreatic and/or duodenal resection and reconstruction in patients clinically decompensated by the trauma at a single time point or following damage control surgery [3].

In cases involving complex trauma of the pancreatic head involving the duodenum in seriously ill patients, the operative procedure involves different issues related to damage control surgery, resection time and survival after intestinal reconstruction. The objective of this study is to report a case of complex pancreatic trauma with surgical approaches used at different times. This work has been reported in line with the SCARE criteria [4].

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**Fig. 1.** Gunshot wound trajectory. A – Posterior wound medial to the vena cava (arrow). B – Duodenal injury. C – Pancreatic head injury.

## 2. Presentation of case

A Nigerian patient, J.A., 40 years of age, suffered 4 gunshot wounds and was brought by firefighters to our institution, 1.5 h after the incident.

An initial examination showed patent airways without changes upon chest examination and 94% oxygen saturation with supplemental oxygen using a non-rebreather mask. The patient was hemodynamically stable with no evidence of active bleeding and conscious, although he was observed to be sleepy and disoriented. The abdomen showed no signs of peritonitis and FAST (Focused Assessment with Sonography for Trauma) was performed. Two likely entry wounds were apparent in the right lumbar region (thoracoabdominal transition), and an exit wound was observed on the right hypochondrium with an eviscerated omentum. An entry wound was also found on the right forearm in addition to entry and exit wounds on the right hand.

Exploratory laparotomy was indicated after initial emergency room care. Access to the abdominal cavity was achieved by supra- and infraumbilical median laparotomy, with findings of cloudy



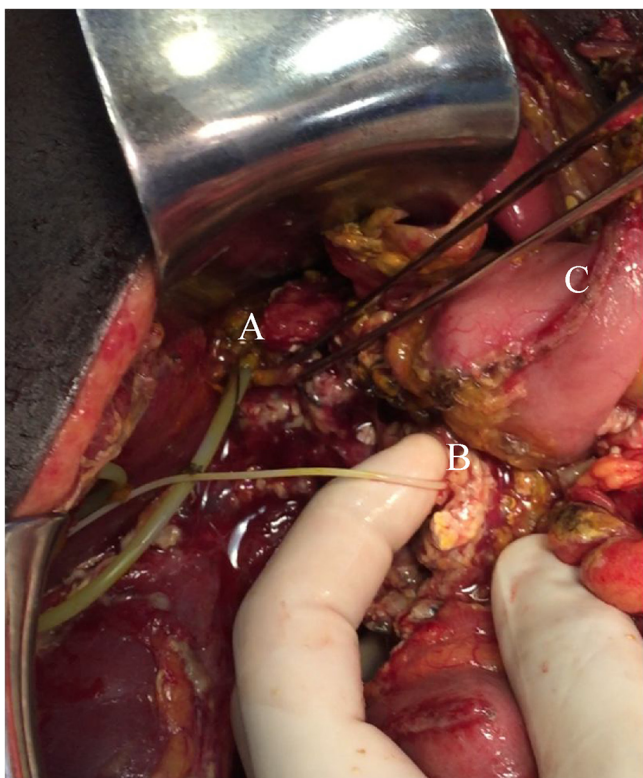
**Fig. 2.** Resected surgical specimen.

blood-tinged fluid (approximately 2000 ml) and blood clots on the mesentery near the hepatic angle, on the region of the 2nd portion of the duodenum and at the pancreatic head.

The gastrocolic ligament was sectioned to assess the retroperitoneal space, and the celiac and superior mesenteric arteries were inspected. No injuries were found in the middle colic, superior mesenteric or portal veins, followed by Cattell-Braasch and Kocher maneuvers with findings of a complex injury of the pancreatic head with bile duct and Wirsung duct injuries (grade V), and an injury of the second portion of the duodenum with the involvement of a > 75% narrowing and transfixing injury of the transverse colon with local contamination, indicating the need for a gastroduodenopancreatectomy with a right hemicolectomy (Fig. 1).

Resection was initiated by tunneling into the pancreas via the superior mesenteric and portal veins. An antrectomy was performed using a cutting stapler in 2/3 of the stomach. Dissection of the pancreatic head and uncinata process, with the ligation of the tributary vessels of the portal and superior mesenteric veins, was followed by sectioning with a linear cutting stapler. Sectioning with stapling of the proximal jejunum followed the dissection of the 3rd and 4th portions of the duodenum, cholecystectomy and dissection of the hepatic hilum. Immediately afterward, a right hemicolectomy with stapling and sectioning of the transverse colon and distal ileum was performed using a linear cutting stapler (Fig. 2).

After 100 min of surgery, hemodynamic and metabolic parameters were assessed, and worsening of perfusion parameters and hemodynamic instability were observed. Stabilization was difficult even with vasoactive drugs. Therefore, the Whipple surgery was interrupted, and anastomoses were not performed. The hepatic and the Wirsung ducts were catheterized with urethral catheters 10 and 4, respectively, and exteriorized in the right hypochon-



**Fig. 3.** 5th postoperative day. A – Hepatic duct with Kehr drain. B – Pancreas with a catheter in the Wirsung duct. C – Stapled stomach.

drium. The terminal ileum was exteriorized in the left flank using the Brooke technique. The peritoneal cavity was temporarily closed by a vacuum peritoneostomy. Throughout the anesthetic period, the patient received 10,000 ml of crystalloid solutions and two red blood cell concentrates with 800 ml diuresis.

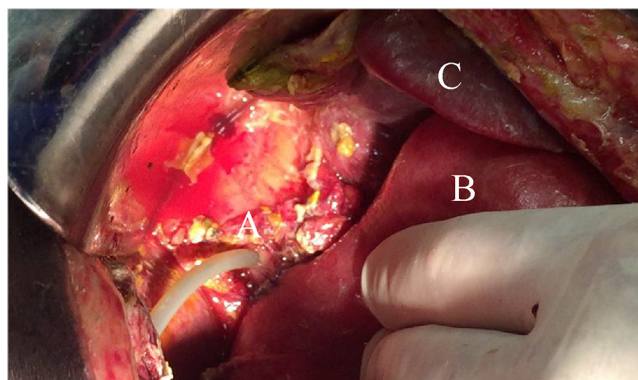
The patient was referred to intensive care and given 0.7 mcg/kg/min noradrenaline and vasopressin and antibiotic therapy with ceftriaxone and metronidazole. He responded well to the aggressive surgery, and weaning from vasoactive drugs was performed on the second postoperative day, with the patient under mechanical ventilation with good ventilatory parameters until surgical reopening.

Surgical reopening occurred on the fifth postoperative day (Fig. 3), and the patient was subjected to single-loop reconstruction of the intestinal transit with telescoping pancreaticojejunal anastomosis, biliodigestive anastomosis with termino-lateral hepaticojejunal anastomosis with a Kehr drain (Fig. 4) and gastroenteroanastomosis in 2 planes. The terminal ileostomy was maintained, and a vacuum peritoneostomy of the peritoneal cavity was performed again due to edema of the intestinal loops.

The patient progressed with hemodynamic stability and was extubated on the first postoperative day to begin a parenteral diet.

On the second postoperative day after the single-loop reconstruction, the patient was subjected to abdominal wall closure without complications, which required relaxing Gibson incisions and wound closure with polypropylene mesh placement in a pre-poneurotic position closed with multiple stitches (Fig. 5). The patient was referred to the intensive care unit, extubated and required no vasoactive drugs.

Regarding complications, the patient developed a surgical site infection from the abdominal wall reconstruction, which was detected by physical examination on the 8th day; the infection progressed to a grade-A pancreatic fistula and was managed conservatively. The patient was discharged on the 40th post-trauma



**Fig. 4.** A – Hepaticojejunal anastomosis with proximal Kehr drain. B – Jejunal loop for biliodigestive anastomosis. C – Liver edge.

day without drains, with a functioning ileostomy and with a scheduled reconstruction of intestinal transit (Fig. 6).

### 3. Discussion

Pancreatic trauma is uncommon, regardless of the type of abdominal impact, occurring in approximately 2–3% of all traumatic abdominal injuries and primarily resulting from penetrating trauma [1]. A gunshot wound to the pancreas may result in severe injuries due to its high energy, proximity to neighboring organs and critical vascular structures, although most require no major intestinal resections or bypass [5–7].

Injuries associated with other organs are common, occurring in 50%–90% of cases, and are related to higher complication and mortality rates. The most commonly injured organs are the liver (42%), stomach (40%), major abdominal vessels (35%), thoracic viscera (31%), colon and small intestine (29%) and duodenum (18%) [1]. The mean number of organs involved is 3.5, and the mortality rate ranges from 10 to 25%. Vascular lesions are the main cause of death among victims of pancreatic trauma. In the initial trauma assessment, crystalloid was initially infused (2000 ml) and the response was observed during the initial administration, being requested blood typing with reserve of hemacea concentrate and FAST was performed, which exam shows no cardiac abnormalities. Our patient had a transfixing, anteroposterior, abdominal gunshot wound in the right hypochondrium with an eviscerated omentum, and after assessment in the emergency room, he was immediately referred to surgery. FAST was performed in the initial care for pericardial evaluation, even if the patient already had a surgical indication.

During the inventory, we identified a complex pancreatic lesion involving the duodenum and right colon, without major vascular involvement but with continuous bleeding of the pancreatic head. For complex injuries of the pancreatic head associated with duodenal, bile duct and papilla injuries (which are more serious but rarer cases), the best option is gastroduodenopancreatectomy. For hemodynamically unstable patients, this surgery can be performed in two stages [8]. Hemostasis and resectioning are performed in the first stage, and reconstruction is performed in the second stage. In hemodynamically normal patients, a single-stage surgery is still recommended if possible.

Although the current literature indicates that single-stage duodenopancreatectomy remains the first choice [3], intraoperative assessment is essential in the management of these patients because their technical challenges are frequently aggravated by shock, massive blood loss and serious intraoperative complications, including acidosis, hypothermia and coagulopathy. In the first approach to the patient, duodenopancreatectomy requiring



**Fig. 5.** Abdominal wall reconstruction with onlay mesh after relaxing Gibson incisions.

a right colectomy was indicated due to the complex pancreatic trauma (grade V, according to the classification by the American Association for the Surgery of Trauma) [9]. The hemodynamic and metabolic parameters severely worsened, with hemodynamic instability and refractory shock, thus following the consensus indication of the literature of not continuing with anastomoses after removing the surgical specimen. The hepatic and the Wirsung ducts must be intubated to avoid the accumulation of biliary and pancreatic secretions in the peritoneal cavity. Options include catheterization and external drainage. Experience with pancreatic trauma is limited, and pancreatic duct ligation and catheterization have been advocated as available techniques when treating an unstable patient who is unable to tolerate other surgeries [10]. In addition to biliary duct catheterization, we also intubated the Wirsung duct to prevent further pancreatic damage [10].

The case reported also illustrates an indication for peritoneostomy, due to excessive fluid resuscitation with a positive water balance, a systemic inflammatory response due to shock and the need for a planned reoperation. In our case, vacuum-assisted closure (VAC) was used. This technique enables draining the peritoneal fluid, minimizes visceral edema and applies greater fascial



**Fig. 6.** The patient was discharged on the 40th day of his hospital stay.

tension to the abdominal wall, thereby increasing the odds of a definite abdominal closure without the formation of hernias or major defects [11].

Upon achieving clinical stabilization with adequate fluid resuscitation, the improvement of perfusion parameters and the correction of hydroelectrolytic and coagulation deficits in the intensive care unit, the second stage of the surgery can be planned, completing anastomoses 48 h later [8,12]. In the case reported here, improvement occurred during intensive care monitoring, enabling a new surgical approach on the 5th postoperative day, including the choice to perform anastomoses. Single-loop reconstruction of the intestinal transit is advocated in the literature because the results are similar to those of the double-loop technique, with a shorter operative time and fewer enteric anastomoses. Telescoping pancreaticojejunal anastomoses are preferred in the context of trauma because trauma patients usually have small-caliber unobstructed Wirsung ducts [13].

In this case, we applied the concept of damage control surgery. Although statistical comparisons between the results from multiple- and single-stage surgical procedures are difficult given the limited number of cases, most patients will develop acidosis, hypothermia and coagulopathy. Performing an initial approach that applies damage control principles overcomes the mortal triad and produces a favorable environment with a firmer pancreas and reduced intestinal edema, which may facilitate reconstruction.

The benefits from damage control surgery reported in the literature are considerable. Similarly, a multi-stage pancreaticoduodenectomy for trauma patients results in more favorable surgical conditions for reconstruction. When applying the principles of damage control surgery with late reconstruction, a decreased mortality rate is reported [14]. Early deaths in cases of complex duodenal and pancreatic trauma are primarily caused by

bleeding and hemorrhagic shock, and late deaths result from complications including sepsis, the formation of fistulas and multiorgan failure [1]. Due to the high morbidity rate, we chose to retain the ileostomy.

Another complication associated with complex pancreatic trauma with peritoneostomy and multiple surgical approaches is abdominal wall closure and late incisional hernias. Despite the use of the peritoneostomy technique with VAC, retraction of the abdominal wall muscles still occurs, which, combined with muscle-aponeurotic edema, becomes a major obstacle to the hermetic closure of the abdominal cavity without increasing intra-abdominal pressure. It is then necessary to use alternative techniques, including aponeurosis detachment from the subcutaneous tissue, a relaxing incision in the abdominal rectus sheath and aponeurosis transposition to achieve closure, and closure-reinforcement techniques, including mesh placement, to reduce the incidence of incisional hernia [15]. The case discussed here illustrates two options, a relaxing incision in the abdominal rectus sheath and mesh placement on the aponeurosis (onlay placement). The use of a prophylactic mesh is recommended based on studies showing a reduction in the incidence of incisional hernias of up to 85%, without increasing the number of adverse effects [15].

Fistula formation is the most frequently observed complication. Traumatic pancreatitis, pseudocyst and abscess formation and duct stenosis are common complications. These complications occur in 35–40% of patients, and most pancreatic fistulas, if well drained, will close spontaneously [16]. Our patient developed a superficial surgical site infection with mesh integration and a drained pancreatic fistula, which was treated clinically.

#### 4. Conclusion

Duodenal and pancreatic surgery in the context of complex trauma remains a challenge. In the presence of multiple associated injuries, hemodynamic instability and the need for an extensive surgical procedure such as duodenopancreatectomy, damage control surgery performed in stages as reported here enables the clinical stabilization of the patient for definitive treatment, achieving better survival results.

#### Conflict of interest

The authors declare no conflict of interest.

#### Funding

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#### Ethical approval

This study was submitted to the Evaluation of the Ethics Committee for Analysis of Research Projects (CAPPesq) of the Clinics Hospital of the University of São Paulo Medical School (HC/FMUSP).

#### Consent

Written informed consent was obtained from the patient for publication of this case report and accompanying images.

#### Authors contribution

SHBD Physician responsible for surgery, postoperative care, literature review and manuscript writing; GFB contributed to manuscript writing; RSL contributed to surgery and postoperative care; ARCJ contributed to postoperative care and manuscript review; PHAF contributed to postoperative care; COB contributed to the discussion and corrected the manuscript; EMU corrected the manuscript and was involved in the final approval of the version to be published.

#### Guarantor

Sergio Henrique Bastos Damous

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