

Duodenal and Pancreatic Trauma

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ABSTRACT

Duodenal and pancreatic trauma are rare injuries difficult to recognize and, when severe, difficult to treat. The present article talks about the clinical presentation and surgical options for this type of trauma.

Keywords: Abdominal trauma, Duodenal trauma, Pancreatic trauma.

ABSTRATO

Trauma duodenal e pancreático são lesões raras, difíceis de reconhecer e, quando graves, difíceis de tratar. O presente artigo discute a apresentação clínica e as opções cirúrgicas para esse tipo de trauma.

Palabras clave: Trauma abdominal, Trauma duodenal, Trauma pancreático.

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INTRODUCTION

The difficulty in diagnosing injuries to the duodenum and pancreas is attributed to the fact that they are retroperitoneal structures, therefore, well protected by the surrounding viscera. As a result, injuries to these organs are rare and also easily missed. Most trauma surgeons have limited experience in treating them. The epidemiologic study from Trauma Audit and Research in the UK found a combined incidence of 4.7% for pancreatic and duodenal injuries among patients with abdominal trauma.¹ The retroperitoneal location of these organs results in a delay of symptomatology and frequently diagnosis. Injuries requiring surgical repair are more common as a consequence of a penetrating mechanism. In most cases, trauma to the duodenum and pancreas is associated with other injuries potentially changing the surgical approach. Moreover, in patients with pancreatic or duodenal injury, a complete evaluation must be performed in order to rule out an associated visceral injury.

Injuries caused by blunt or penetrating trauma with high mechanisms can continue to evolve over time such as contusion of the mesentery or blunt trauma to the bowel. This is particularly important when evaluating injuries to the pancreas and the duodenum, since injuries that might have appeared insignificant can result in ischemia and perforation if not treated appropriately.²

There are significant implications of a joint pancreatic and duodenal injury. Injury to the pancreatic duct results in uncontrolled leak of pancreatic enzymes that become a threat to any repair. Secretion of pancreatic enzymes increases morbidity and mortality secondary to suture line dehiscence and secondary intra-abdominal sepsis.³

The outcomes of these injuries have improved over the years secondary to increased awareness, earlier diagnosis and treatment, appropriate resuscitation to euvolemia avoiding secondary physiological insult to the patient, and advances in adjuncts for nutritional support.⁴

The following chapter will focus on clinical presentation and operative techniques that can help the surgeon treat these complicated patients.

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ANATOMICAL CONSIDERATIONS

Vascular Supply

The vascular supply to the duodenum and pancreas is provided by the superior and inferior pancreaticoduodenal arteries, which are branches from celiac and superior mesenteric arteries, respectively. Both pancreaticoduodenal arteries provide anterior and posterior branches. In turn these branches have several small vessels entering the duodenal wall and the head of the pancreas. Therefore, dissecting and isolating the duodenum from the pancreas is a difficult maneuver due to bleeding. Duodenal devascularization is always a concern.

The right gastric artery and the splenic artery give rise to additional arterial branches to the duodenum and the body and tail of the pancreas. The venous drainage follows the arteries and provides tributaries to the splenic vein and superior mesenteric vein. Both drain into the portal vein.

Pancreas

Since the pancreas is a retroperitoneal organ it requires exploration to diagnose and treat an injury. A normal adult pancreas can reach up to 20 cm in length, 2 cm in thickness, and spans from the right side of the spine to nearly adjacent to the spleen.

Behind the pancreas there are important vascular structures, i.e., the aorta is right behind it as well as the inferior vena cava. Portal structures are also nearby, and the splenic vessels course behind the body.

This anatomy has implications when mobilizing this structure.

Duodenum

The duodenum extends from the pylorus to the jejunum at the ligament of Treitz. The four portions of the duodenum are as follows:

- First portion: passes close to the biliary structures and it is intraperitoneal.
- Second portion: this refers to the descending portion and it becomes retroperitoneal adjacent to the head of the pancreas.
- Third portion: this is the transverse retroperitoneal portion that is in close proximity to the inferior vena cava and aorta posteriorly and mesenteric vessels anteriorly.
- Fourth portion: this is a more mobile part where the duodenum ascends again into the peritoneal cavity.

CLINICAL CONSIDERATIONS

If the patient presents with the penetrating trauma, most of the time the diagnosis is made intraoperatively with obvious damage to the structures. However, in some cases the injury will present with other less obvious but important signs such as edema, leakage of bile, hematomas, and bruising in the area.

In patients with blunt trauma, recognizing the early symptoms is important for an accurate diagnosis.^{4,5} Since some part of the duodenum is retroperitoneal as well as the pancreas, symptoms can be insidious and less obvious compared to the damage caused to intraperitoneal structures.

Subtle clinical signs and symptoms of duodenal and/or pancreatic injury in blunt trauma are as follows:

- Abdominal pain radiating to the back.
- Inability to tolerate a diet.
- Seat belt sign.
- Cullen sign = bruising in the subcutaneous fatty tissue around the umbilicus.
- Grey Turner's sign = bruising of the flank between the last rib and the top of the hip. This sign is also present with slow retroperitoneal bleeding.

Duodenal injury can be associated with deceleration in patients that experience high-speed motor vehicle crashes and are wearing seatbelts.⁶ The trauma surgeon should have high suspicion in patients who have epigastric pain, nausea, and vomiting or a seat belt signs on physical examination.

In stable patients, computerized tomography is safe and accurate for the diagnosis of intra-abdominal trauma, including duodenal trauma. Bowel injury can be diagnosed with several indicators. Free fluid without solid organ injury, hematoma in the area, and free air are ominous signs that need to be taken seriously and indicate surgical exploration.

Ultimately the clinical presentation depends on the severity of the trauma.

Early mortality is usually due to bleeding and injury to associated organs, and late mortality is largely attributed to septic complications.⁷⁻⁹

AVOIDING MORTALITY FROM THESE INJURIES

In the majority of cases, the mortality associated with these injuries in the first 24 hours is due to bleeding. As we discussed, the duodenum and the pancreas are in very close proximity to vessels that can cause this problem. The inferior vena cava and the aorta are two major structures that can cause significant bleeding.

Pivotal points to consider in these cases are early bleeding control, resuscitation to euvolemia with blood and blood products, and an initial damage control operation.^{1,5}

When the patient recovers from the initial insult, the most common cause of late mortality is sepsis. One of the causes of sepsis can be intra-abdominal infections as a result of an enteric leak of the surgical repair.¹⁻⁵ Subsequently we will discuss strategies to avoid this complication.

MECHANISM OF INJURY

Penetrating

If the injury is perpetrated by a stab wound, the damage to the tissue will be less and therefore operative treatment is generally less complicated. Gunshot wounds to the area are accompanied by blast injury to the tissues as well as can severe blood loss from adjacent vascular structures.

Blunt

The blunt mechanism can be associated with severe tissue loss. Crushing injuries can occur with a direct force applied to the abdominal wall, transferred to the duodenum, and compressed posteriorly against the spinal column. Shearing injuries occur when the mobile and nonfixed portions of the organ accelerate and decelerate forward and backward, respectively. This is usually seen with high-speed motor vehicle crashes. Burst force injury occurs when intraluminal trauma is applied to a gas- and fluid-filled duodenum against a closed pylorus and acutely flexed duodenojejunal angle.

INJURY CLASSIFICATION

Traditionally the classification used to grade these injuries is the one proposed by the American Association for the Surgery of Trauma (AAST). This refers to the degree of tissue damage in both the pancreas and duodenum.

Grades IV and V duodenal injuries are associated with vascular compromise, complicating the operative repair.

Pancreatic injuries of stage three and above involve the duct. For distal injuries involving the duct, distal pancreatectomy is indicated. In instances where there is an injury to the head of the pancreas, the treatment is wide drainage. Resection is preferred when the trauma is so extensive that the resection is already performed by the injury.^{10,11}

TREATMENT

The treatment of these injuries largely depends on the patient's condition on arrival and associated injuries.

Patients who are hemodynamically unstable, with peritoneal signs and abdominal trauma require surgical exploration.

Duodenal hematomas can be watched only when not associated with any other injury and the hematoma is intraluminal without ischemia or complete rupture. Small and superficial wounds to the pancreas can be managed with drainage only. However, deeper pancreatic injuries with potential duct injuries cannot be watched without any intervention since the spillage of pancreatic enzymes can be disastrous to the patient. When faced with patients who could have pancreatic injuries with ductal involvement, magnetic resonance cholangiopancreatography or endoscopic retrograde cholangiopancreatography could be performed to confirm the diagnosis on stable patients.

SURGICAL TECHNIQUES

In the past decade, there has been a lot of controversy in the literature about what is the best surgical treatment for complex pancreaticoduodenal injuries. In most series simple primary repair has fared better than other procedures. For completeness we will describe a myriad of options for the surgeon.

Primary Repair

The blood supply of the duodenum is vast and allows for adequate healing of the suture line if there are no other confounding factors such as hypotension or hypovolemia. The repair can be done by debriding the healthy tissues and approximating the mucosa and then reinforcing with Lambert stiches. Closing the enterotomy horizontally can help with avoiding narrowing.

Several risk factors for duodenal suture besides the AAST grade are the following:

- Injuries on the pancreatic border. As previously noted, the pancreatic head is in proximity and not easy to dissect from the duodenum. The pancreaticoduodenal artery is hidden in the pancreatic head. Several small branches can be found during dissection. Leakage of pancreatic enzymes, bleeding, and hematoma increase the risk for dehiscence of the suture line. This is particularly true in gunshot wound injuries. It is wiser to open the duodenum and suture under direct vision. A larger wound with a good suture is much better than a small one with a doubtful suture line.
- Severe contamination, such as liquid fecal material from the ascending colon which is very close.
- Delayed recognition of the injury and therefore delaying definitive surgery. Since the duodenum is retroperitoneal, delayed diagnosis is common. The suture line after 6 hours is much more likely to dehisce.
- Hemodynamic instability. Injuries of the IVC are common due to the proximity of the structures. As a result, bad perfusion can occur shortly after the trauma. Even if this is corrected and the patient stabilizes, once the perfusion is compromised and there is an ischemic insult, there may be no reversal of the physiological insult.

ADJUNCTS TO DUODENAL REPAIR

Pyloric Exclusion

This procedure involves closing the pylorus and diverting the gastrointestinal (GI) content away from the primary repair. This can be achieved in several ways:

- To suture the pylorus, first open the stomach and grasp it with a Babcock clamp. The pylorus is closed with absorbable stiches. This can be done with a running technique.
- Some operators use the stapling technique, to do this it is of pivotal importance to use a noncutting stapler.
- The pyloric exclusion can be done with or without a gastrojejunostomy. Anastomosing the stomach to the jejunum is associated with defined complications such as the occurrence of marginal ulcers and suture dehiscence which can be worse than a duodenal fistula. The jejunum does not have the protective barrier that the stomach has against acid. Since the gastrojejunostomy is done without an antrectomy, gastric acid continues to be secreted. Furthermore, as the pylorus is excluded, gastric acid does not reach the duodenum, impeding the biofeedback for decreasing gastrin production, perpetuating the cycle of acid. Smokers and patients with *Helicobacter pylori* are

at risk of ulcerogenic complications. Other options are diverting the gastric juices with a venting gastrostomy and placing a distal jejunostomy for feeding until the exclusion is open. This would happen in about 4–6 weeks, allowing for enough time to heal the duodenal repair. However, keep in mind that on a hypotensive, malnourished patients, with poor perfusion, any healing is impaired; therefore, leak from the gastrostomy and the jejunostomy sites is also possible. When this occurs, an option is total parenteral nutrition (TPN) and naso gastric (NG) tube drainage, avoiding the GI sutures.

Antegrade Duodenal Tube

Another technique that has been described is the placement of an antegrade drainage duodenostomy tube as well as a feeding jejunostomy to protect the primary repair with or without an external drain. This technique, with initially promising results, has been shown to result in a high fistula rate.

Whipple Procedure

This procedure is reserved for extensive damage to the pancreas and duodenum. It should not be performed in patients who are hypotensive, and if the rare opportunity to perform this procedure arises, it is advised to be done in two stages, allowing correction of physiologic abnormalities.

The steps to the procedure are as follows:

Open the gastrocolic omentum and expose the pancreas as well as the stomach. At this point, a very generous Kocher maneuver should be performed.

- A standard cholecystectomy is performed.
- The gastroduodenal artery should be palpated and isolated to ensure it is not mistaken for the hepatic arteries.
- Establish a plane behind the neck of the pancreas and the portal vessels.
- Identify the inferior mesenteric vein and artery inferiorly. The standard procedure includes an antrectomy that is not necessary if only treating trauma to the duodenum and pancreas.
- The pancreas can be transected using the harmonic scalpel or a stapler.
- The head of the pancreas, common bile duct, and the entire duodenum and jejunum can be transected en bloc.
- The pancreaticojejunostomy can be difficult since the duct in most trauma patient will be very small. The anastomosis can be completed with 4-0 or 3-0 PDS. The hepaticojejunostomy can be performed using running 3-0 PDS.

ISOLATED PANCREATIC INJURY

The surgical treatment of isolated pancreatic injury depends on the extent of injury, the involvement of the duct, and the location. If the injury is just a contusion with minor duct involvement, wide drainage is adequate. If there is more destruction and the injury is in the tail or body, a resection can be a safe way to reduce the likelihood of ductal leak. Ductal injuries proximal to the mesenteric vessels are problematic.^{3,12–14,17}

Distal Pancreatectomy with Splenectomy

For this procedure, the spleen and the pancreas are mobilized medially, and once the dissection is done proximal to the injury, the pancreas can be transected with a stapler or harmonic stapler. If the duct is visualized, it should be ligated with 3-0 absorbable suture.

The same operation can be done through a medial approach. The lesser sac is opened and the pancreas is exposed. The mesenteric vessels and porta hepatis are identified and dissected free of the avascular plane behind the pancreas. The splenic artery and vein are isolated and ligated. The only blood supply to the spleen at this point is from the short gastric vessels. The decision to perform splenectomy or to preserve the spleen is based on the hemodynamic stability of the patient and splenic perfusion.^{15,16}

Spleen-sparing Distal Pancreatectomy

In order to completely maintain the blood supply to the spleen, the operator must progressively dissect and free the splenic vein and splenic artery from the tail of the pancreas from right to left. Small venous branches supplying the pancreas will need to be clipped and divided. This can be tedious. This procedure should be reserved for patients who are hemodynamically stable.^{15,16}

SUMMARY

- Surgical treatment of complex pancreaticoduodenal injuries is still controversial.
- The physiological state of the patient and degree of tissue loss will be determinants of the appropriate surgical treatment.
- Resuscitation to euvolemia and adequate nutritional support are pivotal for the recovery.
- Avoiding sepsis has a positive impact on mortality.

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