



Short Communication

Duodenal injury: A challenging diagnostic enigma for clinicians

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Received: 29 May, 2023
Accepted: 22 June, 2023
Published: 23 June, 2023

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Keywords: Duodenum; Perforation; Hematoma; Retroperitoneum; CT scan

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Abstract

The objective of the article is to familiarize clinicians with duodenal injury and to recognize timely intervention to prevent morbidity and mortality associated with such injury. Although uncommon, duodenal injury challenges a clinician's ability to diagnose and treat it in a timely fashion to prevent any associated mortality. The retroperitoneal anatomy makes duodenal injury difficult to diagnose. However, a high degree of suspicion based on the mechanism of injury and appropriate, timely diagnostic study leads to the correct identification of injury to the duodenum. The specific treatment depends on the type of injury that is detected. In conclusion, early recognition, and timely intervention of duodenal injury leads to a successful outcome.

Introduction

The incidence of duodenal injury constitutes 3% - 5% of all abdominal injuries [1]. Duodenal injuries can result from penetrating or blunt abdominal trauma. Penetrating trauma is due to gunshot or stabbing injury whereas blunt trauma results from motor vehicle accidents or falls from a height. Penetrating trauma is more [2] common (53.6% - 90%) than blunt abdominal trauma. Mortality results from injury to other anatomically located nearby organs such as the liver, pancreas, small intestine, large intestine, and vasculatures such as the aorta and inferior vena cava. The 2nd portion of the duodenum is more commonly involved in an injury; while injury to different portions of the duodenum (14%) makes it a challenge to manage duodenal injury.

Embryology and anatomy of the duodenum

An understanding of embryology and applied anatomy

makes it easier to understand the nuances involved in managing duodenal injury.

Embryology

During the fourth week of gestation, the duodenum begins to develop from two sources, namely, the caudal part of the foregut and the cranial part of the midgut, and the junction between the two lies just distal to the origin of the bile duct. The developing duodenum forms a C-shaped loop that initially projects ventrally. However, once the stomach rotates, the duodenum rotates to the right and becomes pressed against the posterior abdominal wall, thus becoming retroperitoneal [3].

Applied anatomy

The duodenum constitutes the beginning of the small bowel and measures approximately 21 cm. [4]. The duodenum consists of four parts, the first part is the superior part,



followed by the descending part, which is the 2nd part, trailed by the transverse portion, which is the 3rd part, and the 4th and final part is the ascending portion. The 1st part extends from the pylorus to the opening of the common bile duct, the 2nd part extends from the common bile duct to the ampulla of Vater, the 3rd part extends from the ampulla of Vater to the superior mesenteric vessels, and the 4th part extends from the superior mesenteric vessels to the jejunum, which is to the left of 2nd lumbar vertebra. The duodenum, which is retroperitoneal, is fixed in its entirety except at the pylorus and at its 4th portion [5]. The 1st portion, part of the 3rd portion, and 4th portion lie on the vertebral column.

Blood vessels that supply the duodenum include the gastroduodenal artery and its branches, the retro duodenal artery, the supraduodenal artery, the superior pancreaticoduodenal artery and the superior mesenteric artery and its first branch, the inferior pancreaticoduodenal artery.

Venous drainage follows the arterial supply and drains into the portal venous system.

Lymphatic drainage of the duodenum terminates in pancreaticoduodenal lymph nodes situated along pancreaticoduodenal vessels and superior mesenteric lymph nodes.

The duodenum is well innervated by parasympathetic via the vagus nerve after passing through the celiac plexus.

Physiology

The duodenum mixes partially digested chyle from the stomach, the proteolytic and lipolytic secretions of the biliary tract and pancreas. The duodenum contains food, and powerful and activated digestive enzymes, including lipase, trypsin, amylase, elastase, and peptidases [6]. Over a 24-hour period about 10 liters of fluid from the stomach, pancreas, and bile duct passes through the duodenum. The spillage of the duodenal contents into the abdominal cavity produces severe inflammation and tissue damage.

Mechanism of injury

The retroperitoneal location of the duodenum protects it from injury; however, it also makes it difficult to diagnose the injury. A blunt injury such as severe pressure on the anterior abdominal wall from a steering wheel of a car or the handlebar of a cycle may crush the duodenum between the spine and anterior abdominal forces. It may also be associated with flexion/distraction fracture of L1-L2 vertebrae, termed the Chance fracture. Deceleration results in tears between the 3rd and the 4th parts and rarely between the 1st and the 2nd parts of the duodenum [7].

Clinical diagnosis

A high index of suspicion is essential in diagnosing duodenal injury. The signs and symptoms are delayed because of the retroperitoneal location of the duodenum. The clinical presentation also depends on the type of injury such as perforation versus hematoma.

Duodenal perforation is characterized by upper abdominal pain, vomiting with tenderness over the upper abdomen that progresses to fever, and tachycardia. Peritonitis/peritoneal inflammation develops from spillage of the duodenal content into the peritoneal cavity. Spillage into the lesser sac of the peritoneum leads to the containment of peritonitis, whereas escape of duodenal contents into the greater sac of the peritoneum via the foramen of Winslow leads to the generalized spread of peritonitis [8]. A serial serum amylase level determination that shows elevation may be helpful in the diagnosis of duodenal injury.

Intramural duodenal hematoma results from blunt abdominal trauma. It is more common in children due to pliable and flexible abdominal wall musculature. Child abuse must be ruled out as a cause of duodenal hematoma. Hematoma develops either in the serosal or the muscular layer of the duodenum. Obstructive symptoms develop over 48 hours and are secondary to the breakdown of hemoglobin in hematoma and the formation of heme that increases the intraluminal viscosity of the duodenum; thereby inducing a fluid shift into the duodenum [8].

Radiological diagnosis

The findings of plain radiography in perforation may include the presence of retroperitoneal air next to the right psoas, surrounding the right kidney, or anterior to the upper lumbar spine. The presence of free intraperitoneal air, the obscuring of right psoas muscle shadow, and/or the fracture of the transverse process of lumbar vertebrae may alert the possibility of duodenal perforation [9]. Gastrograffin visualization via a nasogastric tube with fluoroscopy is helpful. If the study is negative, a barium contrast study has been suggested as a diagnostic entity in both duodenal perforation and duodenal hematoma. In duodenal hematoma, a contrast study shows a coiled spring appearance. A CT scan may be useful in diagnosing duodenal perforation and hematoma. CT can pick up small amounts of air in the retroperitoneal area, extravasated contrast agents in duodenal perforation, and periduodenal wall thickening. CT can also show hematoma without contrast extravasation in duodenal hematoma [10].

Treatment

Duodenal injury severity is graded using the American Association for the Surgery of Trauma scheme [11] (Table 1).

When clinical symptoms, signs, and diagnostic testing are equivocal and if there is a high suspicion of duodenal injury based on the mechanism of trauma, then an exploratory laparotomy is an option. The mortality rate rises from 11% to 40% if surgery is delayed for more than 24 hours from the time of injury.

Perforation of the duodenum is surgically treated, and, in most cases, it involves a simple procedure. However, a small number of high-risk injuries such as those associated with pancreatic injuries, missile or blunt injury, injuries involving more than 75% duodenal wall, injury to the 1st and 2nd parts of the duodenum, and if the interval between injury and surgical

**Table 1:** Grading of duodenal injury

Grade	Injury	Description
I	Hematoma Laceration	A single portion of the duodenum Partial thickness only
II	Hematoma Laceration	Involving more than one portion Disruption of < 50% of the circumference
III	Laceration	Disruption of 50% - 75% circumference of D2 Disruption of 50% - 100% of D1, D3, D4
IV	Laceration	Disruption of greater than 75% of D2 involving ampulla or distal common bile duct
V	Laceration	Massive disruption of duodenopancreatic complex Devascularization of duodenum

D1, D2, D3, D4: first, second, third, and fourth portions of the duodenum. For multiple injuries, the grade is advanced by 1.

intervention is more than 24 hours; then different adjunctive surgical procedures are carried out [12].

Isolated duodenal hematoma is treated medically for the most part. If, after three weeks, there is no improvement on total parenteral nutrition and nasogastric tube decompression, surgery is undertaken [13].

Conclusion

Duodenal injury, although uncommon, is difficult to diagnose because of its location. Clinicians must have a high degree of suspicion to make an early diagnosis and to prevent unacceptable high mortality rates. Perforation of the duodenum requires a surgical approach, while duodenal hematoma is treated medically. CT scan with contrast appears to be the best diagnostic modality in confirming injury to the duodenum.

Acknowledgment

The author would like to thank Malini Ravindranath Ph.D. for her editorial guidance.

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