INTRODUCTION

The anatomical site of the duodenum as a retroperitoneal organ and its relations to many vital structures is considered the main obstacle for the management of duodenal perforation with the increase of its complicated death rate ***(Hermansson et al., 2003)***.

Duodenal perforation is one of the serious surgical emergencies. The Literature is controversial on the exact management of various cases of duodenal perforation which leads to high mortality rate,that reaches to 60 -70% ***(Velmahos et al., 2007).***

Perforation from a duodenal ulcer, prior to the 1980s, was the most common cause of small bowel perforation. Today, perforation that occurs during endoscopy is the most common cause, specifically during ERCP with endoscopic sphincterotomy. Other causes of perforation include infections (tuberculosis and cytomegalovirus), Crohn’s disease, ischemia, injury from radiation therapy, cancer (lymphoma, adenocarcinoma, etc.), foreign body ingestion, blunt or sharp trauma ***(Lambert et al., 2007).***

In the last decade, management has shifted towards a more selective approach, even some authors' advocate mandatory surgical exploration but they did not elaborate distinct surgical guidelines ***(Primrose et al., 2008).***

Helicobacter pylori was first identified as the major cause of peptic ulcers, it was found in 90% of people with duodenal ulcers. Long-term use of NSAIDs (Non steroidal anti-inflammatory drugs) is the second most common cause of ulcers, and the rate of NSAID-caused ulcers is increasing. More than 30 million people take prescription NSAIDs regularly, ***(Bertleff et al., 2009).***

Duodenal ulcer perforation is a common surgical emergency in our part of the world. A review of literature failed to reveal any accepted definition of either small or giant perforations of duodenal ulcers. Commonly, duodenal ulcer perforations are less than 1 cm in greatest diameter, and as such, are amenable to closure by omentopexy. Perforations that are larger that have been the cause of much confusion in their definition and management ***(Gupta et al., 2005)***.

Treatment of patients with duodenal perforation following endoscopic retrograde cholangiopancreatography is a dilemma for the treating physicians. A mortality rate of almost 50% has been reported for those who fail conservative therapy. This has led some authors to recommend early operation in all duodenal perforations' based on the high mortality rate of failure of conservative management ***(Stapfer et al., 2008).***

In cases of penetrating trauma, the duodenum due to its protected retro-peritoneal position it is infrequently injured ***(Velmahos et al., 2007).***

Blunt abdominal trauma to the duodenum is more common in children than they are in adults and include vehicle-related trauma, bicycle handlebar injuries, and seatbelt syndrome ***(Langell et al., 2008).***

There are several options to deal with traumatic duodenal injury, which range from simple repair like primary closure (duodenorrhaphy) to more complex procedures like resection and anastomosis, duodenal diverticulation, pyloric exclusion or pancreaticoduodenectomy. However, no single method of repair completely eliminates the possibility of a duodenal fistula. Most of the duodenal injuries are adequately managed with primary closure (duodenorrhaphy) in one or two layers or by resection and anastomosis ***(Hemanga et al., 2011).***

A patient with perforation but without evidence of pneumoperitoneum can safely assume that perforation has sealed off on its own, with a nonoperative approach for such patients. However, operative treatment in patients with perforated ulcer and evidence of pneumoperitoneum is indicated ***(Moller et al., 2011).***

Additionally since Bilroth described the technique of gastric resection with gastrojejunal reconstruction in the 1800s, duodenal leak has been a potentially devastating complication for the general surgeon. A variety of surgical techniques have been developed to avoid duodenal stump blowout. In addition, the use of duodenostomy tubes for decompression has, alternatively, been espoused or decried in the surgical literature ***(Betty et al., 2010).***

Large perforations are considered particularly hazardous because of the extensive duodenal tissue loss and surrounding tissue inflammation, which are said to preclude simple closure using omental patch, often resulting into post-operative leak or gastric outlet obstruction. The tendency to leak may further be aggravated by the high intraluminal pressures, extrusion of the duodenal mucosa through the closure, and, autodigestion by the pancreatic enzymes and bile, thereby further compromising an already sick patient ***(Gupta et al., 2005)***.

Perforations of the duodenum may be encountered in which there exists the threat of post-operative leakage following closure by the simple method. Here, other surgical options such as partial gastrectomy, jejunal serosal patch, jejunal pedicled graft, free omental plug, suturing of the omentum to the nasogastric tube, proximal gastrojejunostomy, or, even, gastric disconnection may be deemed necessary for adequate closure ***(Gupta et al., 2005).***

Surgical closure of a duodenum inflamed or scarred from chronic ulcer disease can be tenuous and, thus, predisposed to leakage. In an attempt to reduce the potential for these complications,many surgical techniques have been developed to avoid duodenal resection and closure, as Those described by Bancroft and Nissen which were developed early in the twentieth century,and they have remained largely unchanged in the modern era ***(Betty et al., 2010).***

Still early diagnosis and prompt management of shock and septicaemia is important for better prognosis of patients. The simple closure with omentopexy of peptic perforation still remains the first choice as a treatment. H-pylori eradication treatment is mandatory after simple closure of the perforation to prevent recurrence of ulcer ***(Hiren et al., 2013).***

AIM OF THE WORK

To review the causes of duodenal perforations, indications of duodenal closure, cases of difficult and complex duodenal injuries and perforations, and to highlight the different techniques of difficult duodenal closure.

Chapter One
ANATOMY OF THE DUODENUM

The adult duodenum is 20-25 cm long and is the shortest, widest and most predictably placed part of the small intestine. It is only partially covered by peritoneum although the extent of the peritoneal covering varies along its length: the proximal 2.5 cm is intraperitoneal; the remainder is retroperitoneal. The duodenum forms an elongated C that lies between the level of the first and third lumbar vertebrae in the supine position. The lower limb of the C extends further to the left of the midline than the upper limb. The head and uncinate process of the pancreas lie within the concavity of the C. The duodenum lies entirely above the level of the umbilicus and is described as having four parts ***(Standring, 2004).***

First (superior) part:

The first part of the duodenum is 5 cm long and starts as a continuation of the duodenal end of the pylorus. It is the most mobile portion of the duodenum. Close to the pylorus, peritoneum covers the anterior, superior and upper part of the posterior aspect where the duodenum forms part of the anterior wall of the epiploic foramen. Here the lesser omentum is attached to its upper border and the greater omentum to its lower border. This part is frequently referred to as the duodenal cap it has a triangular, homogeneous appearance during contrast radiology and shows the same pattern of rugae as the pylorus ***(Standring, 2004).***

It is often visible on plain radiographs of the abdomen as an isolated triangular gas shadow to the right of the first or second lumbar vertebra. The first part then passes superiorly, posteriorly and laterally for 5 cm before curving sharply inferiorly into the superior duodenal flexure, which marks the end of the first part. Through this course it rapidly becomes more retroperitoneal and is covered by peritoneum only on its anterior aspect ***(Moore, 2007).***

The section from the duodenal cap to the superior duodenal flexure lies posterior and inferior to the quadrate lobe of the liver. At the junction with the second part of the duodenum it lies posterior to the neck of the gallbladder. The first part of the duodenum lies anterior to the gastroduodenal artery, common bile duct and portal vein and anterosuperior to the head and neck of the pancreas. The gastroduodenal artery lies immediately posterior to the outer muscular layers of the posterior wall of the first part. The common hepatic and hepatoduodenal lymph nodes also lie close to the first part of the duodenum and can be visualized using endoscopic ultrasound ***(Moore, 2007).***

The second (descending) part:

The second part of the duodenum is 8-10 cm long. It starts at the superior duodenal flexure and runs inferiorly in a gentle curve, which is convex to the right side of the vertebral column, extending to the lower border of the third lumbar vertebral body. It then turns sharply medially into the inferior duodenal flexure which marks its junction with the third part. It is covered by peritoneum only on its upper anterior surface, lies posterior to the neck of the gallbladder and the right lobe of the liver at its start, and is crossed anteriorly by the transverse colon ***(Standring, 2004).***

The origin of the transverse mesocolon is attached to the anterior surface of the duodenum by loose connective tissue. Below the attachment of the transverse mesocolon, the connective tissue and vessels forming the mesentery of the upper ascending colon and hepatic flexure are loosely attached to the anterior surface of the duodenum ***(Standring, 2004).***

The second part lies anterior to the hilum of the right kidney, the right renal vessels, the edge of the inferior vena cava and the right psoas major. The head of the pancreas and the common bile duct are medial and the hepatic flexure is above and lateral. A small part of the pancreatic head is sometimes embedded in the medial duodenal wall, and pancreatic rests in the duodenal wall produce small filling defects on double contrast barium meal ***(Standring, 2004).***

The common bile duct and pancreatic duct enter the medial wall obliquely and unite to form the hepatopancreatic ampulla (fig. 1). The narrow distal end opens on the summit of the major duodenal papilla (ampulla of Vater), situated on the posteromedial wall of the second part 8-10 cm distal to the pylorus. An accessory pancreatic duct may open 2 cm above the major papilla on a minor duodenal papilla ***(Standring, 2004).***

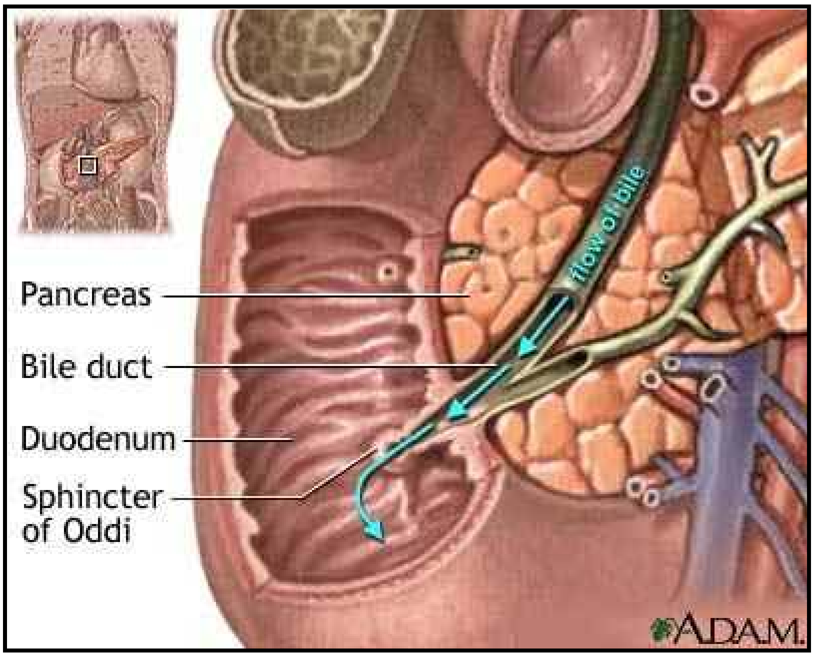

Fig (1): Insertion of CBD into the duodenum ***(Standring, 2004).***

The third (horizontal) part:

The third part of the duodenum starts at the inferior duodenal flexure and is 10 cm long. It runs from the right side of the lower border of the third lumbar vertebra, angled slightly superiorly, across to the left, anterior to the inferior vena cava, and ends in continuity with the fourth part in front of the abdominal aorta ***(Lawerenuce et al., 2002).***

Peritoneum covers the lower portion of the anterior aspect and is reflected anteriorly to form the posterior layer of the origin of the small bowel mesentery. The anterior surface of the left lateral end, close to the junction with the fourth part, is also covered with peritoneum ***(Standring, 2004).***

The third part is anterior to the right ureter, right psoas major, right gonadal vessels, inferior vena cava and abdominal aorta (at the origin of the inferior mesenteric artery), and inferior to the head of the pancreas. Anteroinferiorly, loops of jejunum lie in the right and left infracolic compartments ***(Lawerenuce et al., 2002).***

In the mid portion, the third part is potentially pinched between the superior mesenteric vessels just below their origin anteriorly, and the abdominal aorta posteriorly; this arrangement very occasionally gives rise to intermittent obstruction of the duodenum at this point ***(Lawerenuce et al., 2002).***

The fourth (ascending) part:

The fourth part of the duodenum is 2.5 cm long. It starts just to the left of the aorta and runs superiorly and laterally to the level of the upper border of the second lumbar vertebra. It then turns anteroinferiorly at the duodenojejunal flexure and is continuous with the jejunum. The aorta, left sympathetic trunk, left psoas major, left renal and left gonadal vessels are all posterior, and the left kidney and left ureter are posterolateral. The main trunk of the inferior mesenteric vein lies either posterior to the duodenojejunal flexure or beneath the adjacent peritoneal fold (The duodenojejunal flexure is a useful landmark to locate the vein radiologically or surgically) ***(Standring, 2004).***

Anteriorly are the upper part of the root of the small bowel mesentery, the left lateral transverse mesocolon and transverse colon, which separate it from the stomach. The peritoneum of the root of the small bowel mesentery continues over the anterior surface. The lower border of the body of the pancreas is superior ***(Standring, 2004).***

At its left lateral end, the fourth part becomes progressively covered in peritoneum on its superior and inferior surfaces, such that it is suspended from the retroperitoneum by a double fold of peritoneum, the ligament of Treitz, at the start of the duodenojejunal flexure ***(Standring, 2004).***

The ligament of Treitz is not a mesentery because the vascular supply to the fourth part of the duodenum continues to enter its wall from the posteromedial aspect. It may contain a small slip of muscle called the suspensory muscle of the duodenum. When present, the suspensory muscle contains skeletal muscle fibers that run from the left crus of the diaphragm to connective tissue around the coeliac axis, and smooth muscle fibers that run from the coeliac axis; its function is unknown ***(Standring, 2004).***

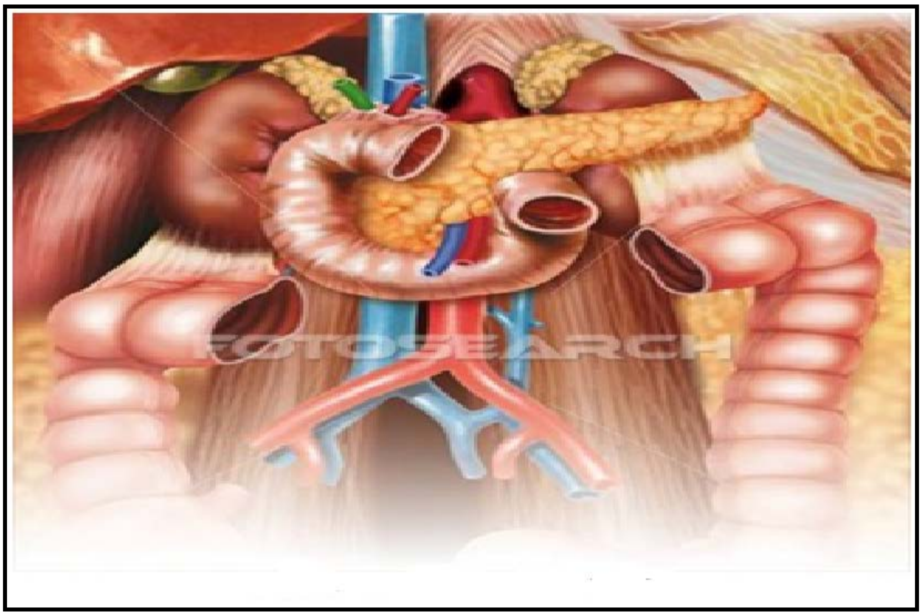

Fig (2): Relations of the duodenum ***(Standring, 2004).***

Vascular supply:

Arteries:

The main vessels supplying the duodenum are the superior and inferior pancreaticoduodenal arteries. The first and second parts also receive contributions from several sources including the right gastric artery, the supraduodenal artery, the right gastroepiploic artery, the hepatic artery and the gastroduodenal artery ***(Standring, 2004).***

Branches of the superior pancreaticoduodenal artery may contribute to the supply of the pyloric canal, with some anastomosis in the muscular layer across the pyloroduodenal junction ***(Standring, 2004).***

Gastroduodenal artery:

The gastroduodenal artery arises from the common hepatic artery behind, or sometimes above, the first part of the duodenum. It is of moderately large caliber and descends between the first part of the duodenum and the neck of the pancreas, immediately to the right of the peritoneal reflection from the posterior surface of the first part. It usually lies to the left of the common bile duct but is occasionally anterior ***(Standring, 2004).***

At the lower border of the first part of the duodenum it divides into the right gastroepiploic and superior pancreaticoduodenal arteries. Before its division the lowest part of the artery gives rise to small branches that supply the pyloric end of the stomach and the pancreas, and retroduodenal branches that supply the first part and the proximal portion of the second part of the duodenum directly ***(Standring, 2004).***

The supraduodenal artery often arises from the gastroduodenal artery behind the upper border of the first part of the duodenum and supplies the superior aspect of the first part. Although the gastroduodenal artery usually branches from the common hepatic artery it may also arise as a trifurcation with the right and left hepatic arteries ***(Standring, 2004).***

Occasionally the origin is from the superior mesenteric artery or the left hepatic artery, and rarely it may arise from the coeliac axis and right hepatic artery. The supraduodenal artery occasionally arises from the common hepatic artery or right gastric artery ***(Lawerenuce et al., 2003).***

Superior pancreaticoduodenal artery: The superior pancreaticoduodenal artery is usually double. The anterior artery is a terminal branch of the gastroduodenal artery and descends in the anterior groove between the second part of the duodenum and the head of the pancreas. It supplies branches to the first and second parts of the duodenum and to the head of the pancreas, and anastomose with the anterior division of the inferior pancreaticoduodenal artery ***(Standring, 2004).***

The posterior artery is usually a separate branch of the gastroduodenal artery and is given off at the upper border of the first part of the duodenum. It descends to the right, anterior to the portal vein and common bile duct as the latter lies behind the first part of the duodenum. It then runs behind the head of the pancreas, crosses posterior to the common bile duct (which is embedded in the head of the pancreas), enters the duodenal wall and anastomose with the posterior division of the inferior pancreaticoduodenal artery ***(Moore, 2007).***

The posterior artery supplies branches to the head of the pancreas, the first and second parts of the duodenum, and