SURGICAL TREATMENT
OF PEPTIC ULCER

AN ESSAY

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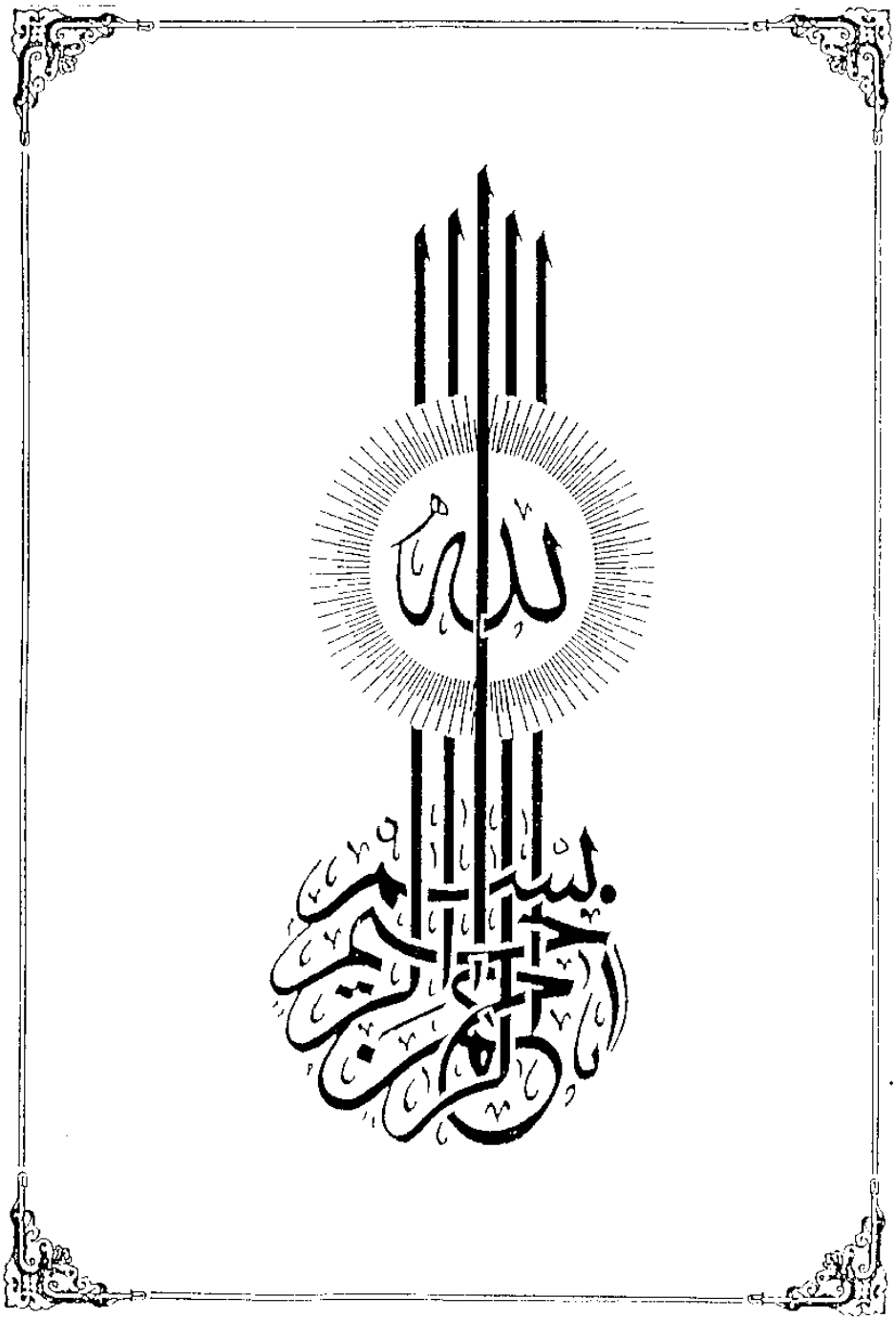
ANATOMY OF THE STOMACH AND DUODENUM



ANATOMY OF STOMACH

The stomach lies obliquely in the upper left part of the abdomen. Although its shape varies very markedly in different people, and in the same person under varying conditions of activity and posture, it is usually described as piriform in outline, with two surfaces and two blunt borders. The surfaces are anterior and posterior and the borders are the lesser and greater curvatures.

The lesser curvature begins on the right side of the cardiac orifice, the greater curvature on its left side. The cardiac orifice is relatively fixed owing to its continuity with the oesophagus; it lies behind the seventh left costal cartilage 2.5 cm. from the median plane, and at a depth of 10 cm. from the anterior surface of the body. On the posterior surface the position of the cardiac orifice corresponds to a point 2.5 cm. to the left of the ninth thoracic spine.

The pylorus shows great variation in position in different people and is alsovery mobile.

The fundus of the stomach is that part which is above the level of the cardiac orifice. It bulges upwards into the left copula of the diaphragm, and its upper limit reaches the fifth rib behind and even above the level of the apex of the heart. Because of the close relationship of stomach to heart, distension of the fundus with gas may produce cardiac discomfort by direct pressure.

The long axis of the stomach is conventionally stated to be directed downwards, forwards and to the right but especially in women the stomach is J-shaped, and the long axis is vertical.

The anterior surface is related to the left half of the diaphragm, and the posterior surface of the left lobe of the liver; the part of it which lies medial to the left costal margin and below the inferior border of the liver is in direct contanct with the anterior abdominal wall. The whole surface is part of the posterior "wall" of the supracolic peritoneal compartment, which is therefore infected by perforating ulcers on the anterior wall of the stomach.

The posterior surface of the stomach is related to the stomach bed. In its upper part, this surface is in contact with the left half of the diaphragm, the left kidney, the left suprarenal gland and the spleen; its lower part rests on the pancreas, the transverse mesocolon and the transverse colon. The last two structures are supported inferiorly by colis of small intestine, and together they form a movable shelf, which slopes downwards and forwards.

The greater curvature forms the upper, left and inferior border of the stomach and is at least four times as long as the lesser curvature. It begins immediately above the cardiac orifice at the notch called the cardiac notch, passes over the uppermost part of the fundus not infrequently almost to

the umbilicus when the body is in a horizontal position, and then ascends to the pylorus in the erect posture it descends to the umbilicus, and sometimes to a lower level. Along the distal two-thirds of the greater curvature, the twolayers of peritoneum which clothe the stomach pass downwards to form the greater omentum, and from the proximal third part they pass backwards to the spleen as the gastrosplenic ligament.

The lesser curvature forms the upper and right border of the stomach. At first it passes almost directly downwards from the cardiac orifice and then, turning to the right passes below the tuber omentle of the liver. Between its vertical and horizontal limbs there is an angular notch which is never recognisable in the living stomach.

In the erect posture, the curvature is straighter than when recumbant because of the descent of the pylorus and the fixation of the cardiac end of the stomach. Along the lesser curvature the lesser omentum leaves the stomach and passes to the liver and diaphragm.

The distal or pyloric portion of the stomach includes the pyloric antrum, the pyloric canal and the pylorus. The pyloric antrum is the dilatation which succeeds the body of the stomach and is placed proximal to the pyloric canal.

There is no line of demarcation between the body of the stomach and the pyloric antrum. A line dropped from the angular notch is sometimes stated the junction of these two parts of the stomach but in view of what has been stated about the variability of the notch even in the same stomach.

It follows that such surgical terms as antrectomy (excision of the antrum) and antral exclusion operations have no precise anatomical meaning.

The pyloric antrum is here regarded as the short segment of the stomach which immediately merges proximally with the body of the stomach.

The pyloric canal is about 2.5 cm. long, tubular in cross-section and in it the circular muscle fibres are prominent. The circular muscle coat became thicker as it is traced distally and at the terminal part of the canal it is of sufficient thickness to warrant the term pyloric valve or merely pylorus on account of the gradual manner in which the circular coat attains its maximum thickness, the pylorus should be regarded as a region rather than a sharply defined entity. The position of the pylorus is sometimes indicated on the surfce of the stomach by a groove, frequently termed the pyloric constriction, along the anterior aspect of which the prepyloric vein, vein of Mayo, ascends.

The pylorus can usually be palpated and its thick wall can be felt in contrast to the thin wall of the first part of the duodenum with which it is continuous.

With the body in the supine position and the stomach moderately distended the pylorus often lies in the transpyloric plane, 1 cm. to the right of the median line, but there are great variations in its position. In the erect posture it may lie as low as the third lumbar vertebra or even lower.

ANATOMY OF DUODENUM

The duodenum extends from the pylorus to the duodenojejunal flexure and forms a C-shaped bend which encloses the head of the pancreas; its total length is about 25 cm. It is divided into four parts.

The superior (first) part is about 5 cm. long and is the most movable part of the duodenum. When the body is in the spine position the superior part of the duodenum passes backwards to the right and slightly upwards from the pylorus to reach the neck of the gall bladder, and is in relation to the inferior surface of the liver.

When the body is in erect position this part passes vertically upwards owing to the descent of the pylorus, and the level of the first flexure of the duodenum sinks downwards sometimes to the 2nd lumbar vertebra. The first 2.5 cm. is very distensible, is prominent in X-ray, and is called the duodenal cap. It is this part which is freely movable, as it is invested by the same two layers of peritoneum as enclose the stomach; it is for this reason that it may be moved about in deep palpation of the abdominal wall. The upper border of the juxta-pyloric part of the duodenum is related to the lesser comentum and the right gastric artery, and its lower border to the greater omentum and the right gastro-epiploic artery.

The distal 2 cm. or more of this part receives only an anterior covering of peritoneum so that its range of movement depends entirely on the elasticity

or looseness of its peritoneal coat. The postermodial surface of the superior part of the duodenum is in immediate relation to the bile duct, portal vein and gastroduodenal artery, and the inferior vena is separated from it by these structures and by some areolar tissue.

The whole of the anterolateral surface of the superior part of the duodenum lies in the supracolic subdivision of the peritoneal cavity. This aspect is the commonest site of duodenal ulceration, and perforation. It will primarily infect the supracolic compartment. On the other hand, perforation of an ulcer on the posteromedial surface will, if it is placed more distally, the infection will be retroperitoneal and may pass up along the *inferior* vena cava to the right extraperitoneal subphrenic space.

Mayo has suggested that the frequency with which duodenal ulcer occurs on the anterolateral wall is due to the fact that the over acid chyme, as it is squirted through the pylorus, mainly impinges on this wall. Also it is supplied by a small branch from the hepatic or gastroduodenal arteries, and that its terminal twigs are end arteries. Thrombosis in this artery would cause necrosis of the area supplied by it.

The descending (second) part passes downwards from the neck of the gall bladder along the medial border of the right kidney to the level of the third lumbar vertebra, lying in front of the hilum of the right kidney and the beginning of ureter. It is crossed anteriorly by the transverse colon,

which at this part may or may not possess a mesentery, and in this situation the peritoneum, which gives it a partial anterior covering only, is lifted from its surface. Above the transverse colon, the descending part of the duodenum lies in the supracolic compartment; below, it lies in the right infracolic compartment and is related laterally to the ascedning colon. The head of the pancreas and the terminal part of the bile duct are related to its medialside.

Owing to its peritoneal relations, the second part of the duodenum is fixed in position.

The horizontal or third part of the duodenum runs transversely to the left in front of the ureter, the inferior vena cava; and the aorta, to end at the left side of the third lumbar vertebra. It lies behind the peritoneum in the right infracolic compartment, but at its terminaiton it is crossed by the root of the mesentery. The superior mesentaric vessels and accompanying nerves run downwards over its anterior surface and enter the root of the mesentery.

The ascending or fourth part of the duodenum runs upwards, and slightly to the left , to the duodenojejunal flexure. Its side is covered with the peritoneum of the posterior wall of the left infracolic compartment, while its right side is in contact with.The pancreas and the aorta. At the left side of the second lumbar vertabra the fourth part of the duodenum bends sharply forwards, donwnwards and to the left to form the duodenojejunal flexure.

Surface Marking of the Duodenum

The first flexure lies a little above the transpyloric plane at a distance about 5 cm. from the middle line. The descending portion passes almost vertically downwards for about 10 cm. The inferior portion passes horizontally 2 cm. to the left of the midline where it becomes continuous with the ascending part which passes upwards to the duodenojejunal flexure 2.5 cm. to the left of the median line.

BLOOD SUPPLY OF THE STOMACH

The arterial supply of the stomach is derived directly or indirectly from the coeliac artery. It arises from the aorta below the aortic opening in the diaphragm. It is only 1 cm. long and after passing forwards above the pancreas it divides into:

1. The left gastirc.
2. The splenic.
3. The hepatic arteries.

1. The Left Gstric Artery :

The left gastric artery is larger than the right artery. It passes upwards behind the lesser sac towards the oeosophageal opening in the diaphragm. It gives off ltwo or three oesophageal branches and then runs forwards aboye the lesser sac, and so it descends along the lesser curvature from left to

right and frequently divides into 2 parallel branches which anastomose with the right gastric artery. In 25% the left gastric share in the arterial supply to the liver and for that reason it was called the gastrohepatic artery by HALLER.

2. Hepatic Artery :

Hepatic artery runs to the right along the upper border of the pancreas turn forwards around the right border of the omental bursa below the epiploic foramen and reaches the superior border of the first part of the duodenum. It then turns upwrds and ascends between the two layers of the lesser omentum to the porta hepatis.

The gastroduodenal artery is usually the first branch of the hepatic and arises near the upper border of the first part of the duodenum to which it gives the supraduodenal and the retroduodenal arteries. It descends behinds the duodenum and gives off the posterior superior pancreaticoduodenal branch before it reaches the lower border of the duodenum; it then divides into its two terminal branches, namely the smaller anterior superior pancreaticoduodenal and the right gstroepiploic arteries. The latter passes to the left along the greater curvature of the stomach between the anterior two layers of the greater omentum, and usually anastomoses with the smaller left gastroepiploic.

These vessels are slightly tortuous and are usually about 1 cm. from the greater curvature. This pattern and position ensure that they are not subjected to streatching or pressure when the stomach is distended.

The right gastric artery which runs to the left along the lesser curvature and anastomoses with the left gastric. The right gastric artery may, however, arise from either the gastroduodenal or from the left hepatic artery.

3. The Splenic Artery :

The splenic artery runs to the left behind the lesser sac. (The omental bursa). It has a tortuous course and tends to run along the upper border of the pancreas although it may be in front of or behind this bordér or even within the substance of the pancreas. During this part of its course it gives off two to ten pancreatic branches which normally pass downwards into the viscus. On the anterior surface of the left kidney the splenic artery turns forwards between the two layers of the lienorenal ligament and ends in the spleen.

The short gastric arteries are distributed to the fundus; the left gastro-epiploic passes the right along the geater curvature and anastomoses with the right gastriepiploic in about 90/cent, of people. An important feature of the gastroepiploic arteries is the occasional absence of a direct anastomois between them and sometimes the only anastomosis that does exist is between their terminal capillaries.

The stomach, therefore, is supplied by branches from arterialarcade that lie along its lesser and greater curvatures and also by short gastric vessels that take origin from the terminal branches of the splenic artery.

The arteries that participate in the blood supply of the stomach all normally arise, directly left gastric or indirectly the remainder from the coeliac artery and the importance of this is selfevident. The vessels that arise from the gastrics, short gastrics and gastroepiploics supply adjoining areas on both surfaces of the stomach and run at approximately right angles to the long axis of the stomach. The branches of the gastrics usually penetrate the muscular coat about 1 cm. from the lesser curvature whereas the branches of the gastroepiploics do so about 2 cm. from the greater curvature. In the submucosa the arteries participate in the formaiton of a network of fair sized vessels which is called the main submucous plexus associated with this arterial plexus is a corresponding network of veins. The richness of the arterial anastomosis in the submucosa is so geat that almost any of the principal gastric arteries may be ligated without affecting the vascularity of any part of the stomach. It is for this reason that ligature of the obvious vessels in the vicinity of a bleeding peptic ulcer is unlikely to control the haemorrhage, and attempts to reduce the produciton of acid by extensive arterial ligation SOMERVELL's operation fails. The mucosal arteries arise from the submucosal plexus; they, in turn, communicate with each other and therefore do not constitute end arteies.

Furthermore the arteries and veins in the submucosa are connected by arteriovenous anastomotic channels so that blood may be shunted from arteries tov eins without necessarily passing through capillaries.

In the wall of the pyloric antrum the submucosal plexus is composed of smaller vessels than in the body or fundus of the stomach. Although the submucosal plexus is absent in the region of the lesser curvature the mucosal vessels themselves are connected by fine anastomosing channels as are the mucosal vessels throughout the stomach.

The veins accompany the arteries on the surfaces and along the curvatures of the stomach and they terminate either in the portal vein directly or in one of its major tributaries, viz., the supperior mosenteric or splenic.

There is a free anastomosis between the gastric veins and, like all vessels of the portal system, these are valveless. It is on account of these features that the anastomosis between the left gastric vein and the systemic veins of the oesophagus assume such clinical importance. In obstruction to the portal system the veins at the lower end of the oesophagus become enlarged and varicose, and the first sign of portal obstruction may be haematemesis from rupture of one of the oesophagal varices.

The right gastric usually enters the portal vein directly but it may terminate at a lower level in the superior mesenteric. The left gastric likewise usually ends in the portal and most often near its formation; it may, however, terminate at a higher level or it may not deviate so much to the right and end in the splenic vein. The right gastroepiploic almost invariably