

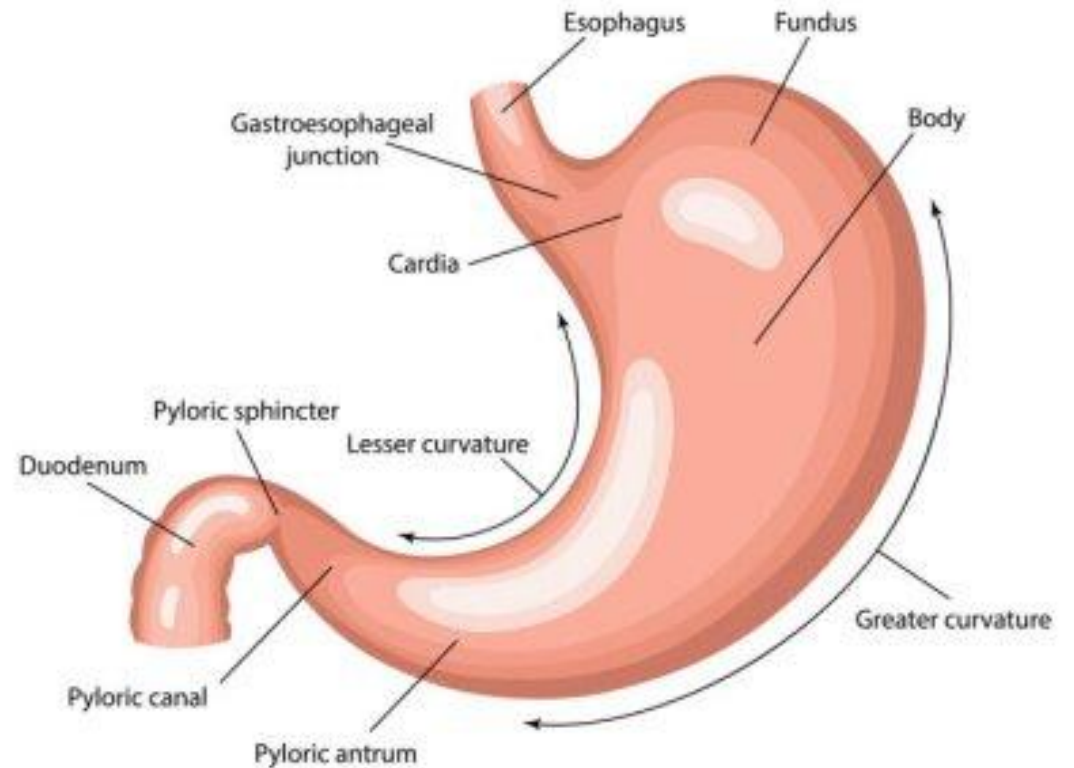
SURGICAL ANATOMY OF STOMACH



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Stomach anatomy



INTRODUCTION

- Stomach is a muscular bag forming the widest and most distensible part of the digestive tube.
- Begins as a dilatation in tubular embryonic foregut during fifth week of gestation.
- By seventh week, it descends, rotates and further dilates with a disproportionate elongation of greater curvature into its normal anatomic shape and position.

- MAIN FUNCTIONS OF THE STOMACH ARE:

- Forms a reservoir for the food.
- Mixes food with gastric secretions to form a semi fluid substance called CHYME.
- Controls the rate of delivery of chyme into the small intestine to allow proper digestion and absorption in the small intestine.
- Hcl secreted by the gastric glands breaks down the food & destroys bacteria present in the food and drink.
- Castle's intrinsic factor present in the gastric juice helps in the absorption of vitamin B12 in the small intestine.

LOCATION, SHAPE, SIZE AND CAPACITY

- Lies obliquely in upper and left part of the abdomen occupying the epigastric, umbilical and left hypochondriac regions.
- Most of it lies under the cover of the left costal margin and the ribs.
- Shape depends upon the degree of distension and that of the surrounding viscera eg colon.
- When empty, it is J shaped (vertical), when partially distended, it is pyriform in shape.
- In short and obese persons, it is more horizontal as a steer horn shape.

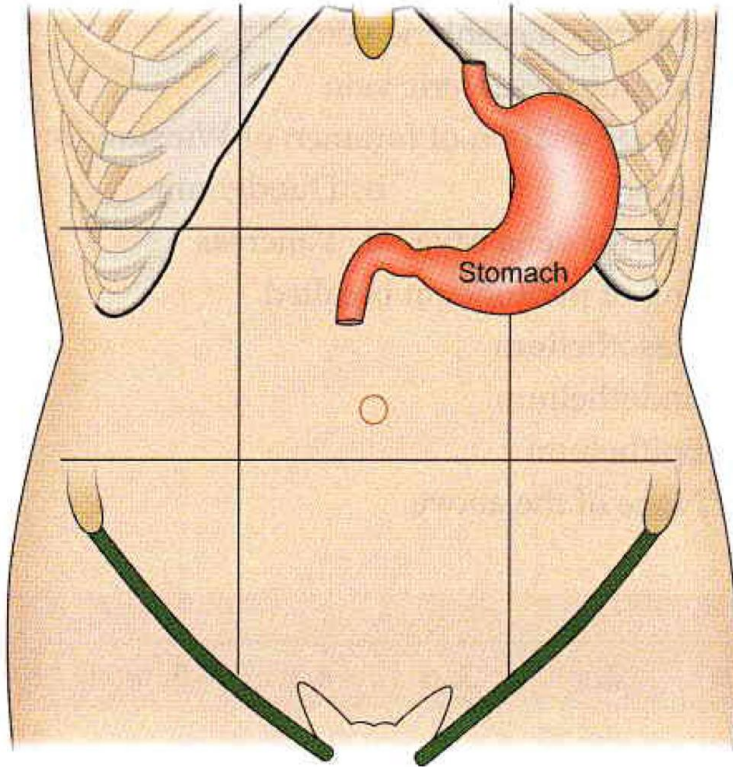


Fig. 19.1: Location of the stomach

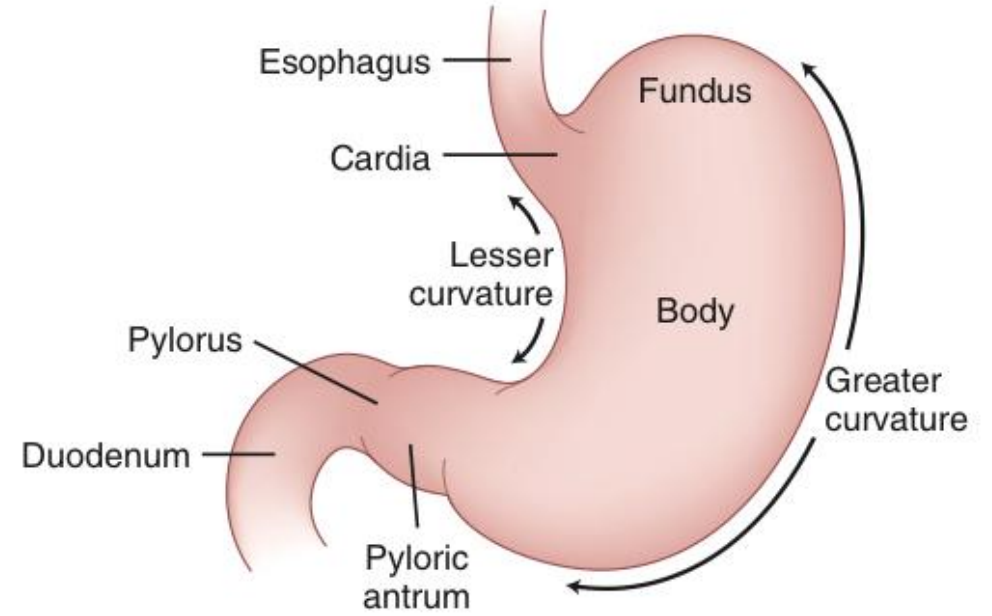
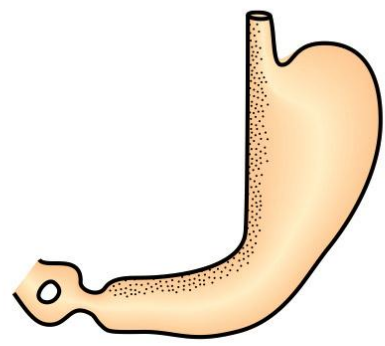
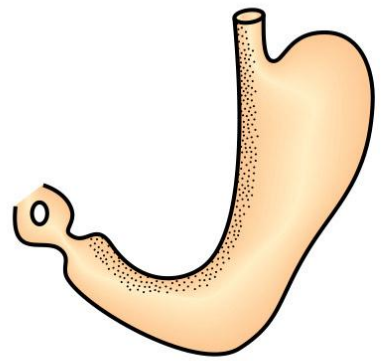


FIGURE 48-1 Divisions of the stomach. (From Yeo C, Dempsey DT, Klein AS, et al, editors: *Shackelford's surgery of the alimentary tract*, ed 6, Philadelphia, 2007, Saunders.)

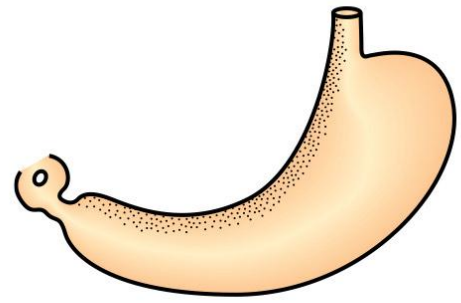
- Low and elongated in Tall and weak persons.
- The shape of the stomach is studied by radiographic examination using barium meal .Generally 4 types of shape of the stomach are seen in barium meal X ray reverse L shaped, J shaped,semilunar shaped and Steer horn shaped
- It is 25cms long,capacity of 30ml at birth,1 litre at puberty, 1 ½ to 2 litres or more in adults.



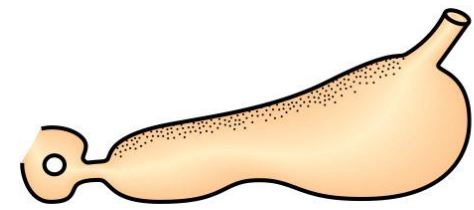
A



B



C



D



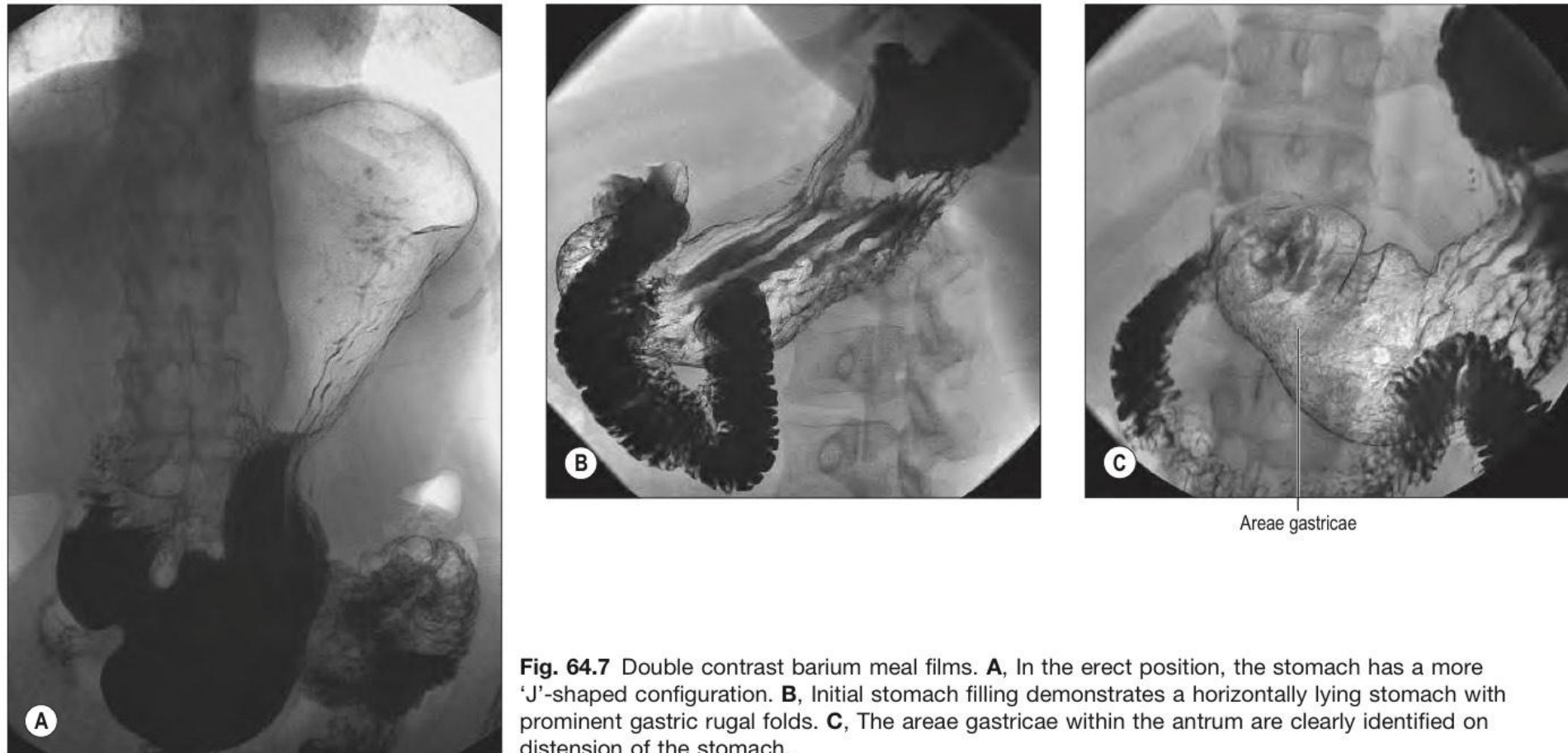
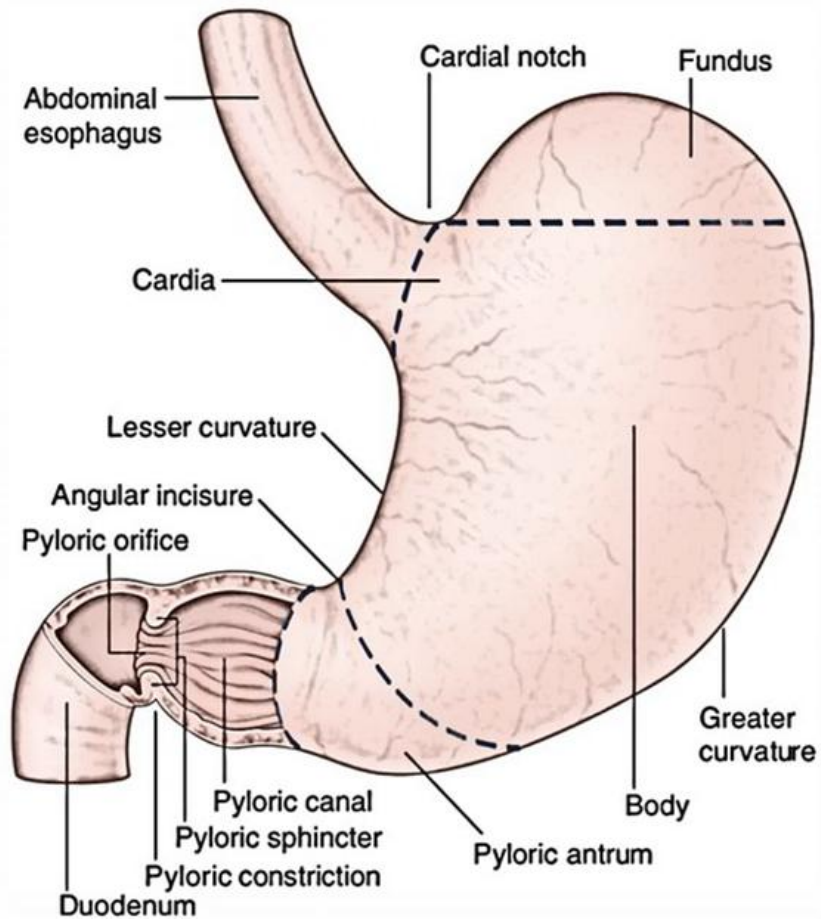


Fig. 64.7 Double contrast barium meal films. **A**, In the erect position, the stomach has a more 'J'-shaped configuration. **B**, Initial stomach filling demonstrates a horizontally lying stomach with prominent gastric rugal folds. **C**, The areae gastricae within the antrum are clearly identified on distension of the stomach.

PARTS

- CARDIAC PART-CONTAINS FUNDUS AND BODY
- FUNDUS-Upper convex dome shaped part and projects above and to the left of the esophageal opening(cardiac orifice) and lies in contact with the left dome of diaphragm.It is floppy and distensible.
- Superiorly ,the fundus usually reaches at the level of the left 5th intercostal space just below the nipple, hence gastric pain sometimes imitate the pain of angina pectoris.
- The cardiac notch lies between the fundus and esophagus.
- ANGLE OF HIS -Formed by the fundus with the left margin of the esophagus.
- BODY-Lies between fundus and pyloric antrum.It is the largest portion,also referred to as the corpus.

- **TRAUBE SPACE**- it is a topographic area overlying the fundus of the stomach which is tympanic on percussion. It is bounded superiorly by the lower border of the left lung ,inferiorly by the Left costal margin, on the left side by the lateral end of the spleen and on the right side by the lower border of the left lobe of the liver.
- **PYLORIC PART**-Divided into pyloric antrum and pyloric canal.
- **PYLORIC ANTRUM**-Separated from the pyloric canal by an inconstant sulcus,sulcus intermedius present on greater curvature.it is about 3 inches long and leads into the pyloric canal.
- **PYLORIC CANAL**-Narrow and tubular part measuring one inch in length.It lies on the head and neck of the pancreas. It terminates at pyloric orifice.



MICROSCOPIC STRUCTURE

- The wall of the stomach contains of 4 coats, from outside inwards, these are serous, muscular, sub mucous and mucous layer.
- The serous coat is formed by the peritoneum.
- Muscular coat consists of 3 layers of unstriated muscles ,outer longitudinal ,middle circular and inner oblique.
- Close to the pyloric end ,the longitudinal muscle coat separates into superficial and deep fibres. The deep fibres turn inwards at the pylorus and join with the circular muscle coat to help form the pyloric sphincter.
- The major sphincteric component of the pyloric sphincter is derived from the circular muscle coat and its minor dilator component is derived from the longitudinal muscle coat.

- The sub mucous coat consists of loose areolar tissue.
- Mucous membrane is thick soft and velvety. It presents a number of temporary folds(rugae) which disappear when the stomach is distended.
- The mucous membrane of the stomach is lined by simple columnar epithelium which forms simple tubular glands.
- Glands in the cardiac region secrete mucus.
- Glands in the fundus and body contains **neck cells** which secrete mucus.

- **Parietal or oxyntic cells** which secrete hydrochloric acid and castle's intrinsic factor.
- **Chief cells** secrete pepsinogen
- Glands in the pyloric region secrete mucus.
- **Ecl cells** secrete histamine ,key factor in driving gastric acid secretion.
- **D cells** secrete somatostatin,which have negative regulatory role.
- **G cells** ,present in the gastric antrum produces gastrin.

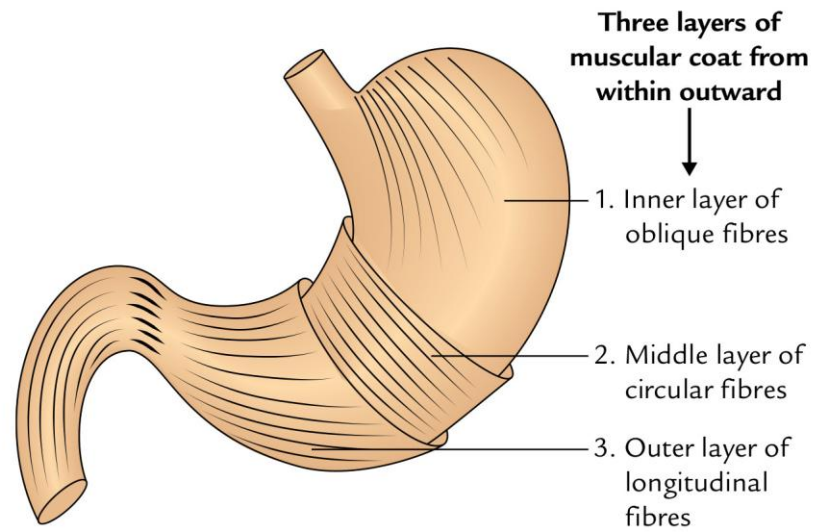


Fig. 7.8 Three layers of the muscular coat of the stomach.

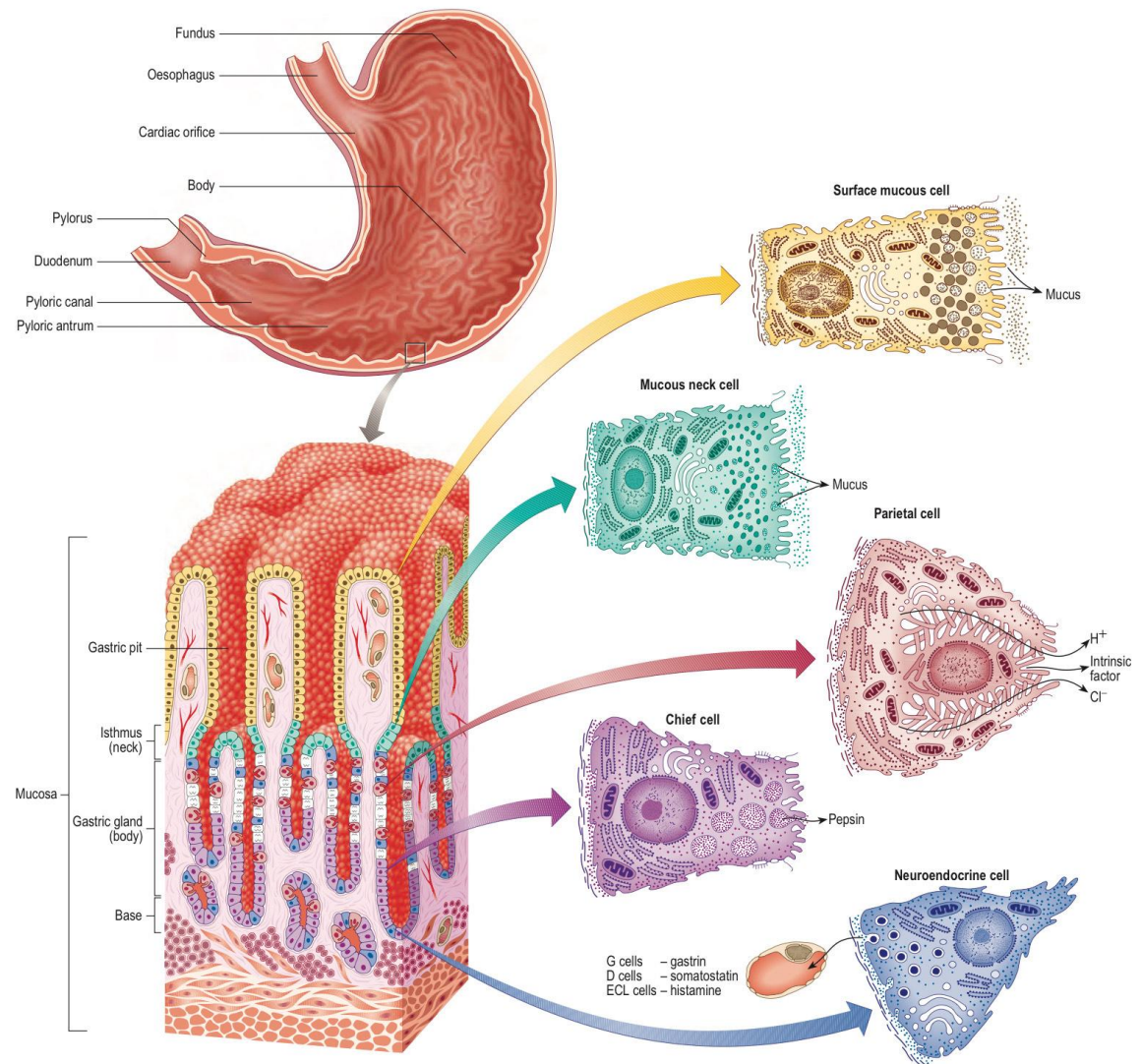


Fig. 64.16 Principal regions of the interior of the stomach and the microstructure of tissues and cells within its wall. Undifferentiated, dividing cells are shown in white. Abbreviations: ECL, enterochromaffin-like.

INTERNAL APPEARANCES

- During endoscopic examination the stomach is typically partially distended by air.
- The cardiac orifice and the lowest portion of the abdominal esophagus viewed from above are typically closed at rest by tonic contraction of the lower esophageal sphincter.
- Viewed retrogradely from within the distended stomach, the cardiac orifice lies medial to the fundus of the stomach.
- In a partially distended stomach, the mucosa of the body and to the lesser extent the fundus is thrown into the longitudinal folds called rugae.
- They are longitudinal along the lesser curvature and irregular in the remaining part, the rugae are flattened and when the stomach is distended.

- **GASTRIC CANAL OR MAGENTRASSE**: Longitudinal furrow that forms temporarily during swallowing between the longitudinal folds of the mucosa along the lesser curvature.
- The gastric canal forms due to firm attachment of the gastric mucosa to the underlying muscular layer which does not have an oblique layer at this site.
- This canal allows a rapid passage of the swallowed liquids along the lesser curvature to the lower part before it spreads to the other part of the stomach.
- Thus the lesser curvature is subject to maximum insult of the swallowed spicy food and the irritable liquids such as alcohol which makes it vulnerable for the gastric ulceration.

- The area gastricae within the antrum are small undulations of the mucosal surface that give a subtle cobblestone appearance on double contrast barium meal examination.
- The few folds present in the antrum when the stomach is relaxed disappear with distension, the antrum adjacent to the pyloric canal, the prepyloric antrum has a smooth mucosal surface

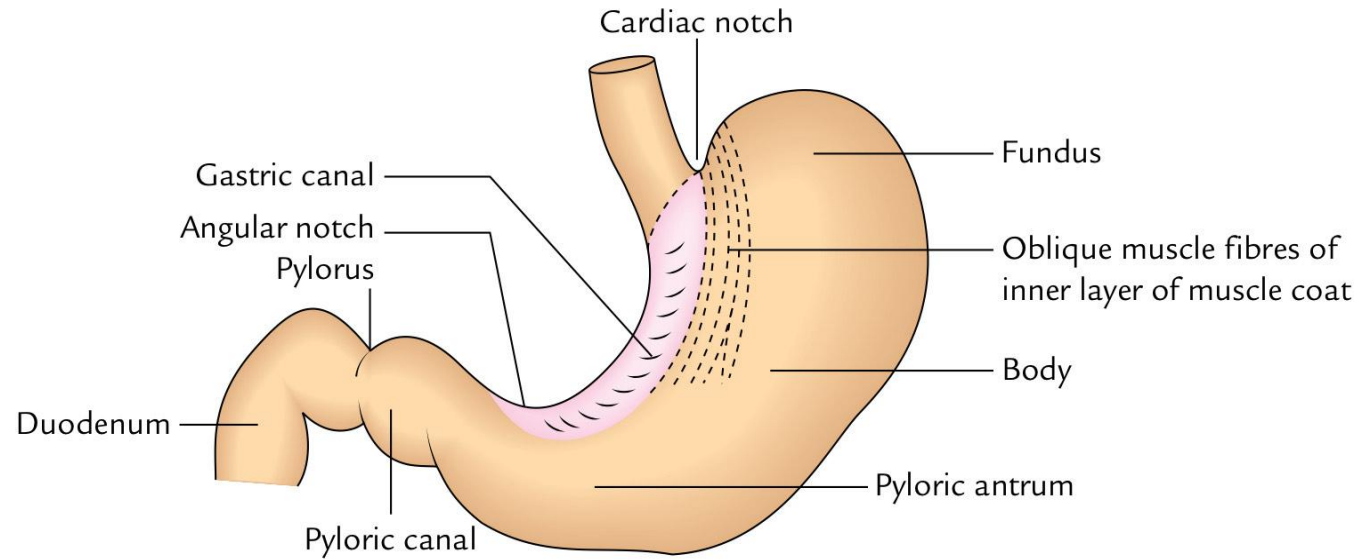
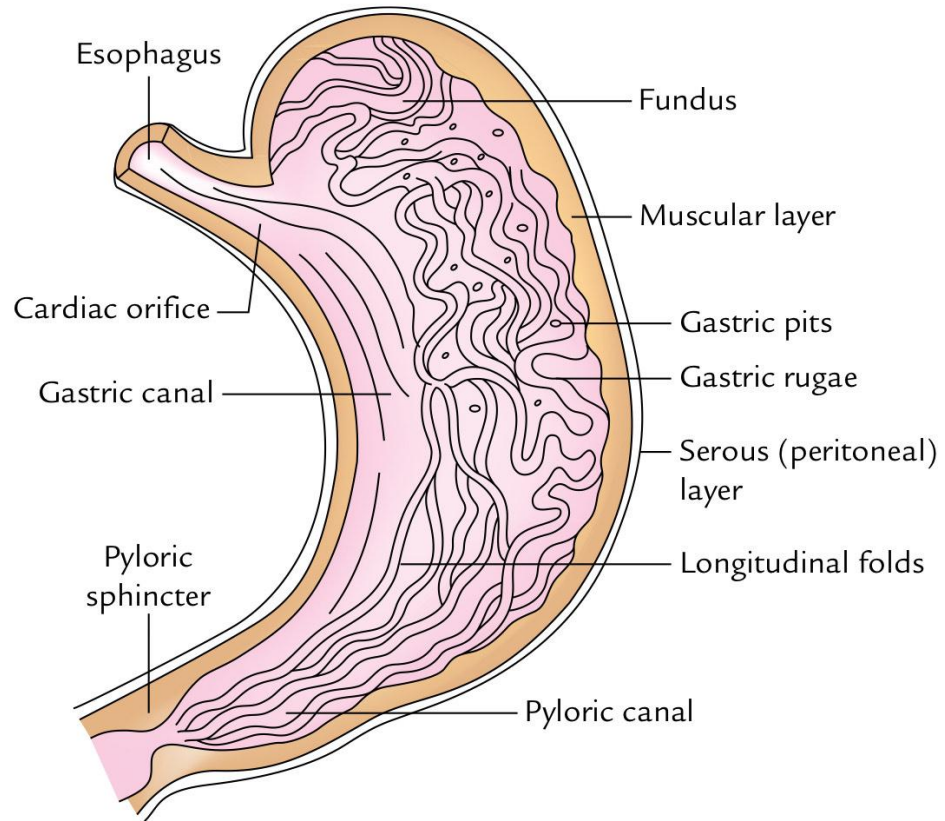


Fig. 7.10 Interior of the stomach showing folds in mucous lining.

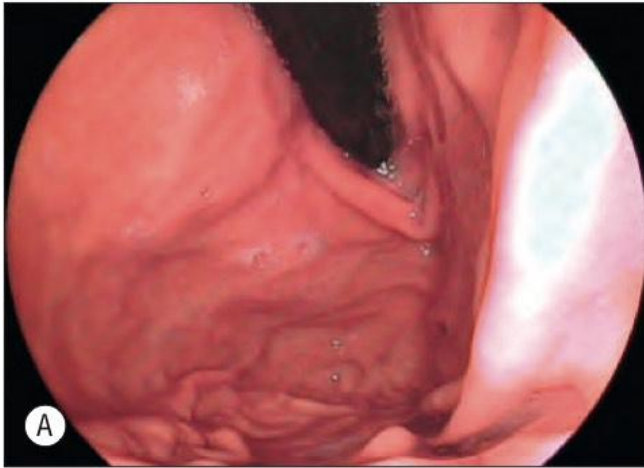


Fig. 64.8 Endoscopic appearances of the stomach. **A**, The cardiac orifice and fundus from below, showing the pronounced lateral mucosal fold at the cardiac orifice. **B**, The body and greater curvature, showing mucosal folds ('*magenstrasse*'). **C**, The antrum, showing the internal appearance of the incisura angularis. **D**, The prepyloric antrum and opening of the pyloric canal.

EXTERNAL FEATURES

- It has 2 orifices, 2 curvatures and 2 surfaces.
- **CARDIAC ORIFICE**- the esophagus opens into the stomach at the Cardiac orifice, lies behind the left 7th costal cartilage at the level of T11. It marks the level at which curvatures begin.
- **PYLORIC ORIFICE**- Opens into proximal end of the duodenum, 1.5cms to right of the median plane at the lower border of L1. has an anatomical pyloric sphincter formed by the thickening of the circular coat of the muscle assisted by a deep set of longitudinal muscle coat.
- **LESSER CURVATURE**- Forms the medial border of the stomach, descends from the medial side of esophagus in front of the decussating fibres of the right crus of the diaphragm, curves downwards and to the right and ends at the pylorus. It contains right and left gastric vessels, and provides attachment to the lesser omentum.

- Most dependant part of curvature is marked by **INCISURA ANGULARIS**.
- **GREATER CURVATURE**-It is two to three times longer than the lesser curvature, starts from the cardiac notch formed between the lateral border of the abdominal esophagus and the fundus of the stomach, and arches upwards, posterolaterally and to the left. Its highest convexity, the apex of the fundus is approximately at the level of 6th rib anteriorly. From there, it sweeps anteriorly and inferiorly, to end at the pylorus in transpyloric plane at lower border of first lumbar vertebra, and forms the left border of the stomach. It provides attachment to the greater omentum, gastrosplenic ligament, gastrophrenic ligament.
- **ANTERIOR OR ANTEROSUPERIOR SURFACE**- Entirely covered by peritoneum, faces forwards and upwards.
- **POSTERIOR OR POSTEROINFERIOR SURFACE**- Faces backwards and downwards.

RELATIONS

- RELATIONS OF THE ANTERIOR SURFACE:
- On the right side this surface is related to the gastric impression of the left lobe of the liver and near the pylorus to the quadrate lobe of the liver.
- The left half of this surface is related to the diaphragm and rib cage.
- The lower half is related to the anterior abdominal wall.

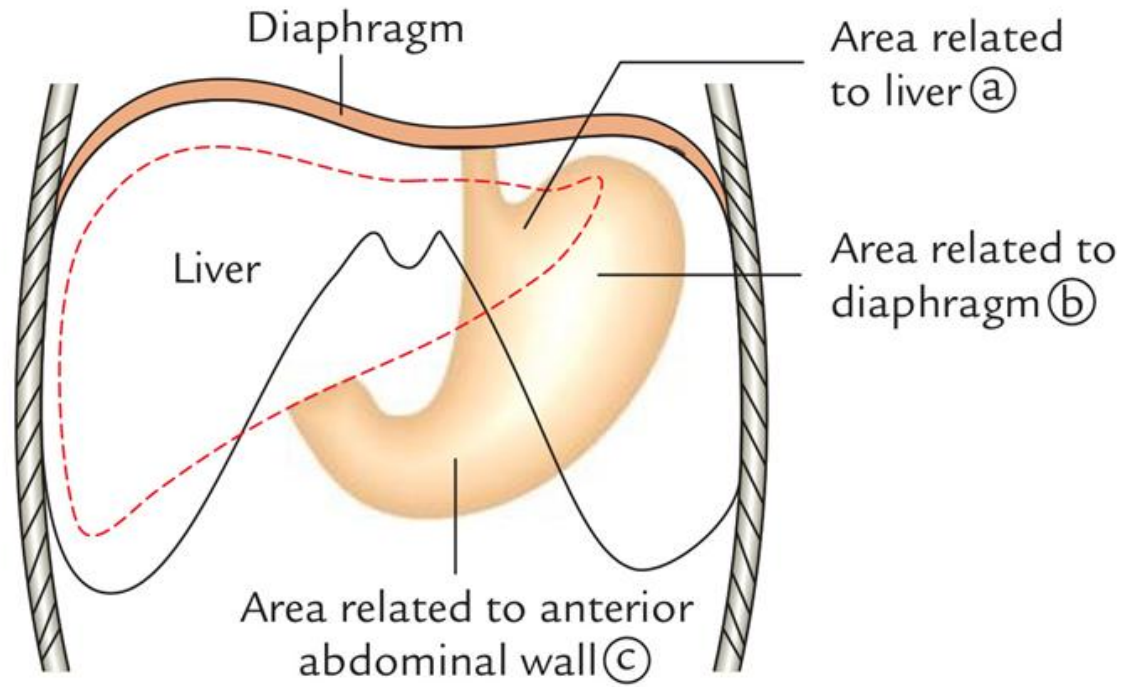


Fig. 7.6 Anterior relations of the stomach.

- RELATIONS OF THE POSTERIOR SURFACE:

- This surface is related to a number of structures on the posterior abdominal wall which collectively form the 'stomach bed'.
- These structures are:
 - Left kidney
 - Left suprarenal gland
 - Pancreas
 - Transverse mesocolon
 - Left colic flexure
 - Splenic artery
 - Spleen

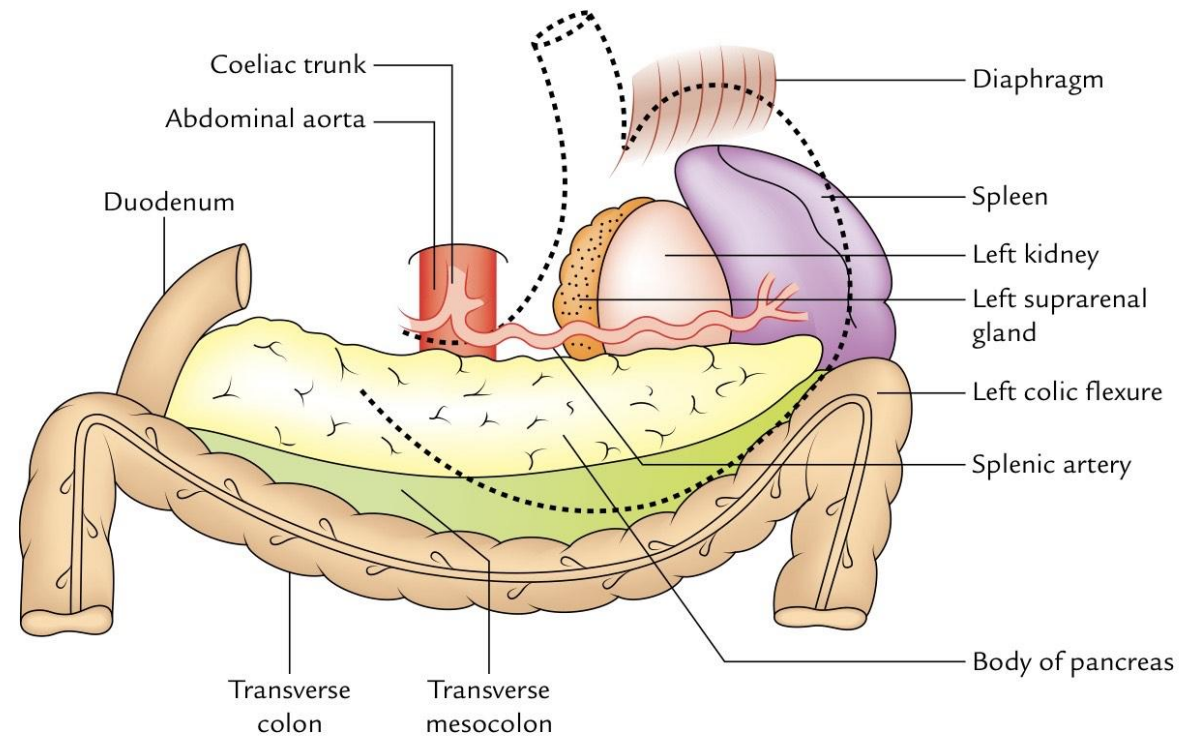


Fig. 7.7 The "stomach bed."

BLOOD SUPPLY

- **CELIAC TRUNK** –MOST OF THE BLOOD SUPPLY.
- **RIGHT GASTRIC ARTERY**-BRANCH OF HEPATIC ARTERY PROPER.
- **LEFT GASTRIC ARTERY**-ARISES DIRECTLY FROM CELIAC TRUNK.
- IN 15-20% PEOPLE,ABERRANT LEFT HEPATIC ARTERY ORIGINATES FROM IT.
- LIGATION OCCASIONALLY RESULTS IN ACUTE LEFT SIDED ISCHEMIA.
- RIGHT GASTRIC ARTERY AND LEFT GASTRIC ARTERY LIES ALONG LESSER CURVATURE

- **RIGHT GASTROEPIPLOIC ARTERY**-BRANCH OF GASTRODUODENAL ARTERY, ends by anastomosing with the left gastroepiploic artery although this anastomosis is variably developed and maybe absent.
- **LEFT GASTRO EPIPLOIC ARTERY**- Largest branch of splenic artery. It gives off gastric branches to the fundus of the stomach through the gastrosplenic ligament and to the body of the stomach through the gastrocolic omentum.
- A particularly large **epiploic branch** commonly originates close to the origin of the left gastroepiploic artery, descends in the lateral portion of the greater omentum and provides a large arterial supply to the lateral half of the omentum.

- **POSTERIOR GASTRIC ARTERY**- posterior gastric artery supplying the posterior wall of the upper part of the gastric body is commonly present ,it usually arises from this splenic artery,usually from its midsection.
- **SHORT GASTRIC ARTERY**-Branch of splenic artery-supplies fundus of the stomach on its greater curvature.
- **THE PYLORIC ARTERIES** are branches of the right gastric and right gastroepiploic artery.
- They pierce the duodenal wall around its entire circumference just distal to the pyloric sphincter and reach the submucosal layer, here they divide into 2 or 3 rami that run towards the stomach in the submucosa of the pyloric canal and terminate in the mucosa of the pyloric antrum.

- They anastomose with the sub mucosal arteries in the duodenum and gastric antrum ,close to their origin and termination respectively.
- Extensive anastamotic connection ensures that stomach will survive even if 3 out of 4 arteries are ligated.

- In patients requiring replacement of esophagus for severe congenital anomalies or after a resection for cancer, a gastric tube supplied by left gastroepiploic artery can be fashioned from the greater curvature of the stomach and anastomosed to the cervical esophagus.
- The right gastroepiploic artery has been used for coronary artery revascularization in some centers and this may pose a particular hazard if the patient is subsequently required surgery for gastric cancer.
- Abnormalities of the intramural vascularity of the stomach are a rare cause of the acute upper GI haemorrhage .The so called Dieulafoy lesion occurs most often near the lesser curvature within a few centimeters of gastroesophageal junction and consists of an abnormally large artery that penetrates the muscular coat of the stomach runs a tortuous course in the sub mucosa and protrudes through a small mucosal defect where it is vulnerable to rupture.

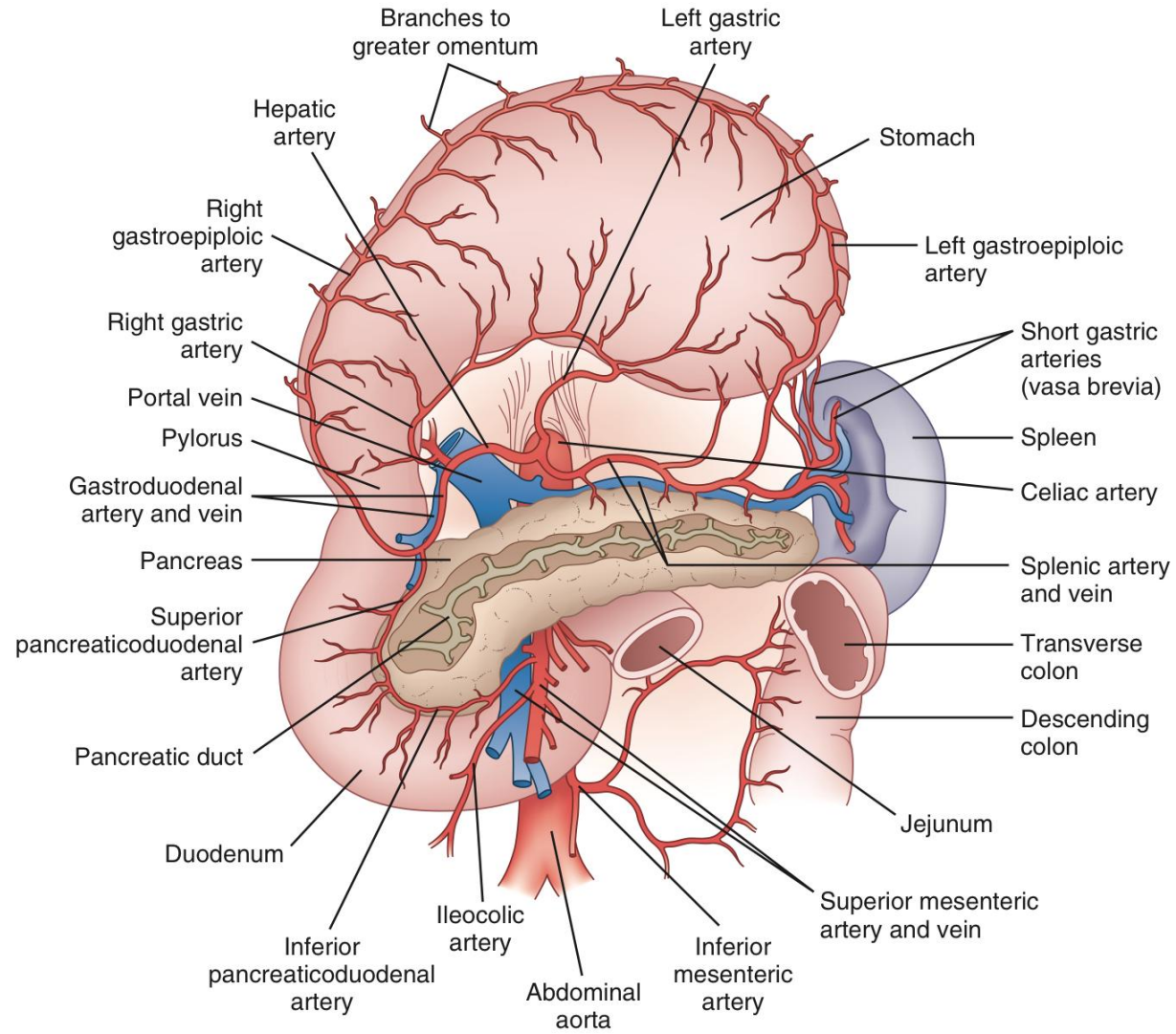
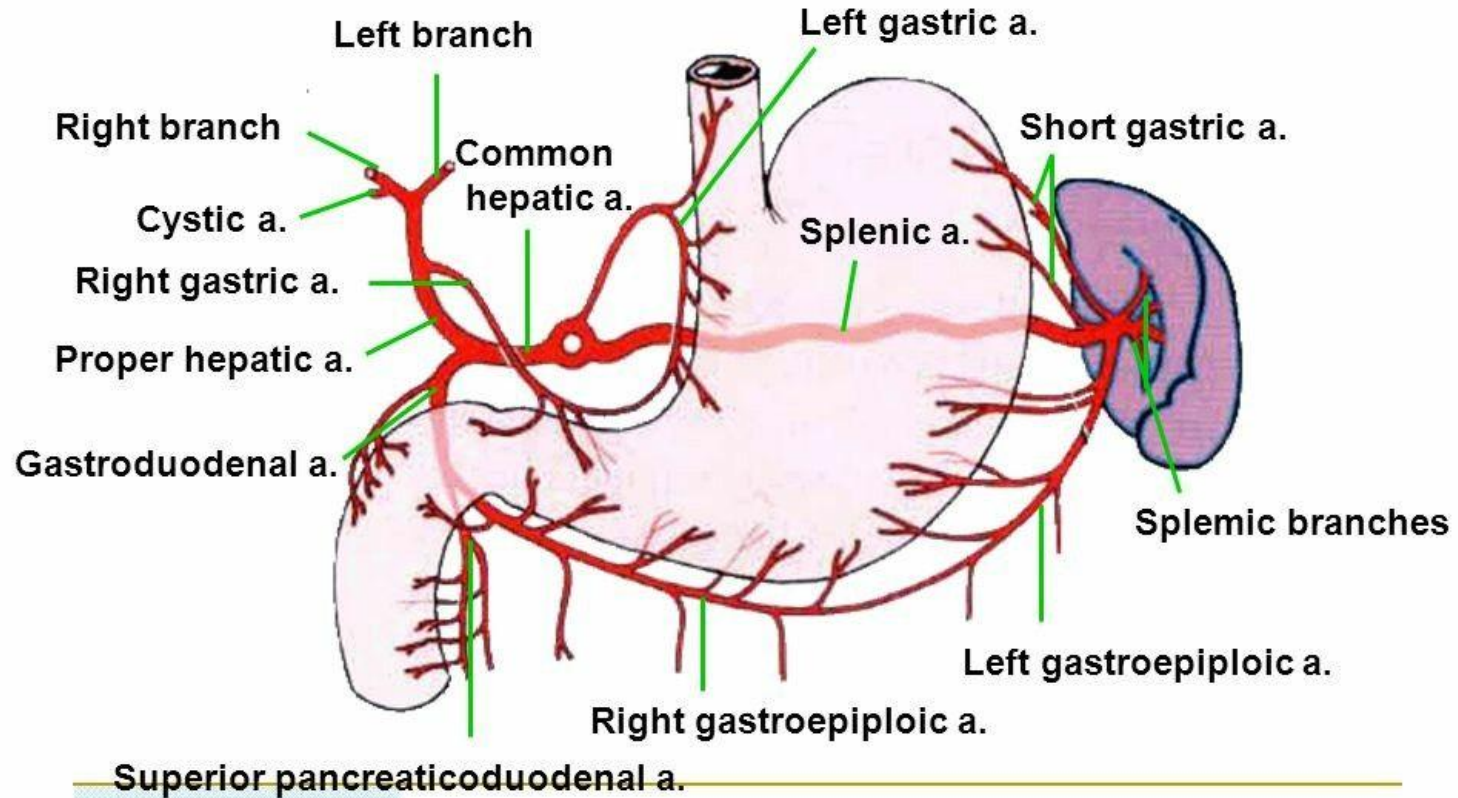


FIGURE 48-2 Blood supply to the stomach and duodenum showing anatomic relationships to the spleen and pancreas. The stomach is reflected cephalad. (From Yeo C, Dempsey DT, Klein AS, et al, editors: *Shackelford's surgery of the alimentary tract*, ed 6, Philadelphia, 2007, Saunders.)

Celiac trunk



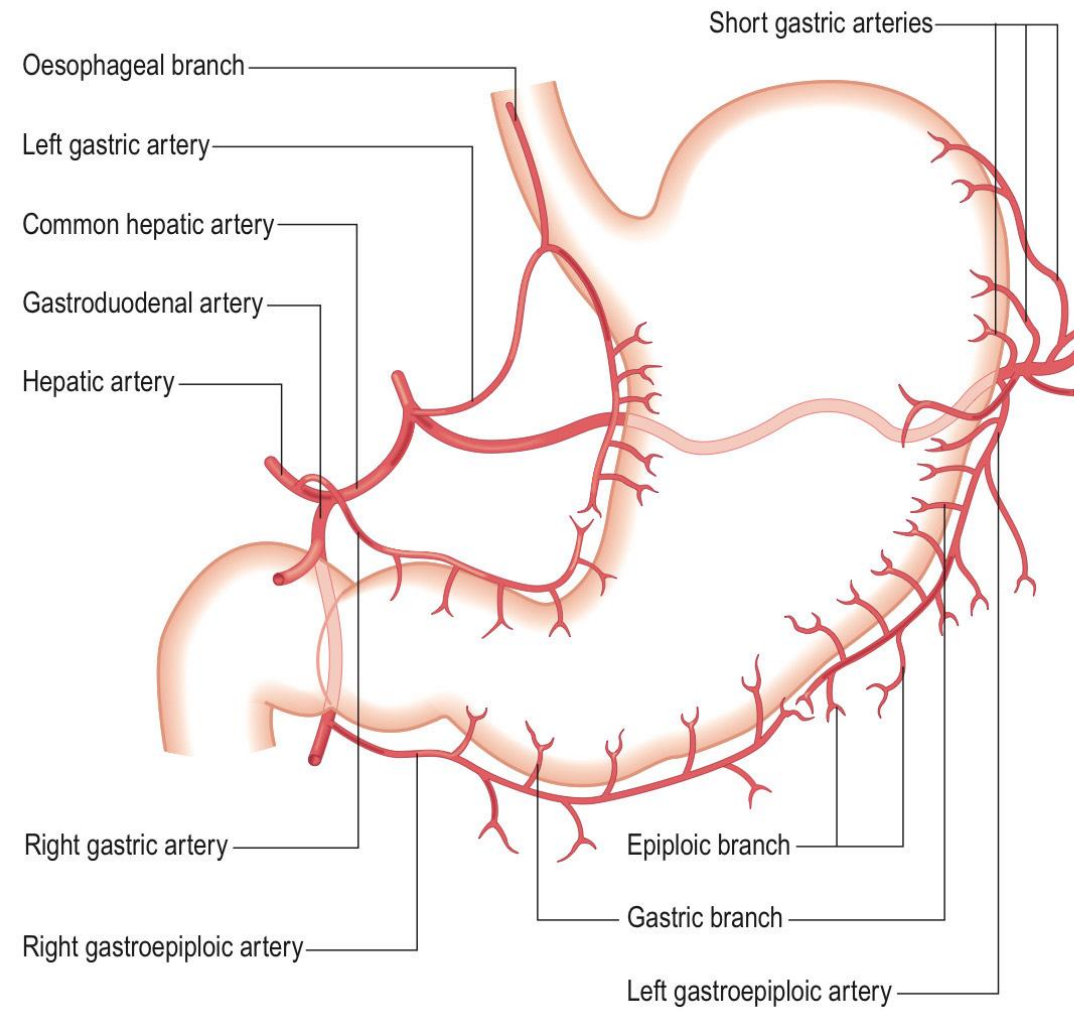


Fig. 64.9 The arterial supply of the stomach. A posterior gastric artery is not shown in this illustration.

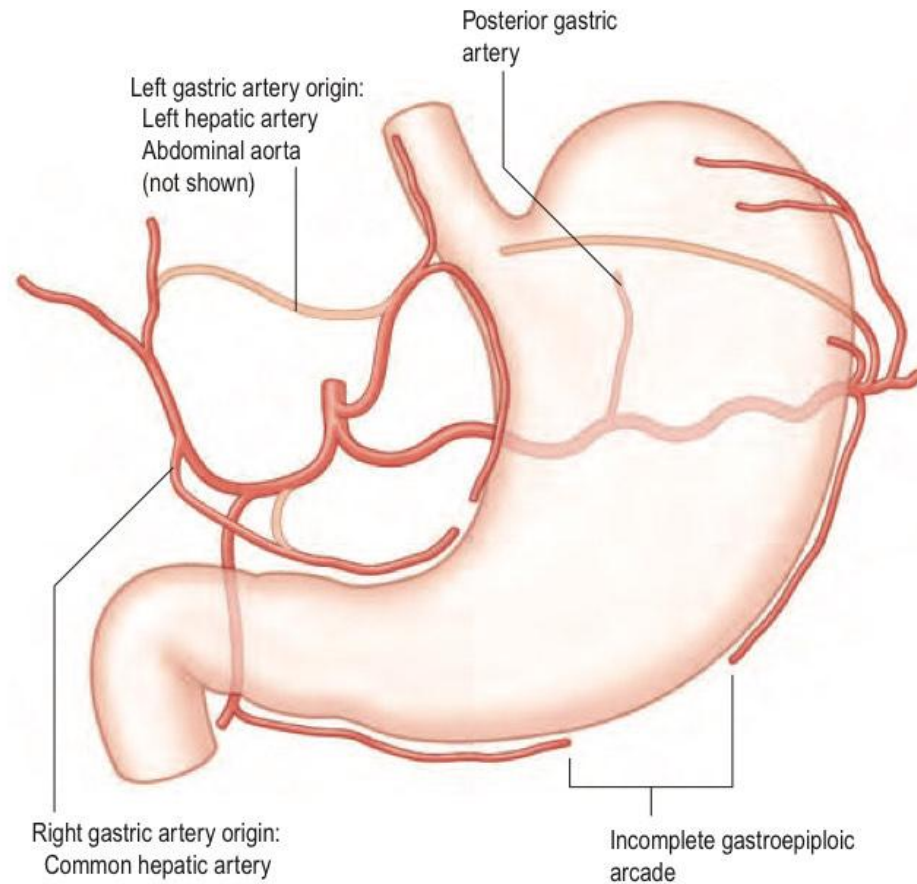


Fig. 64.11 Principal variations in the gastric arterial supply. Accessory vessels or possible replaced origins of vessels are shown by pale pink lines.

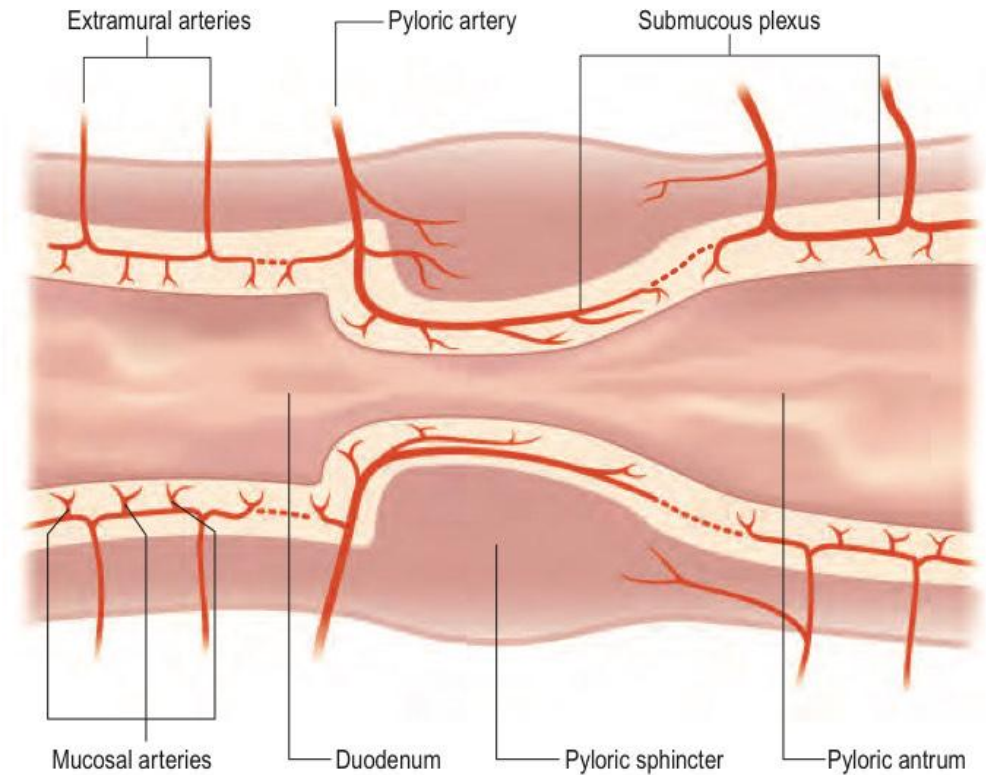
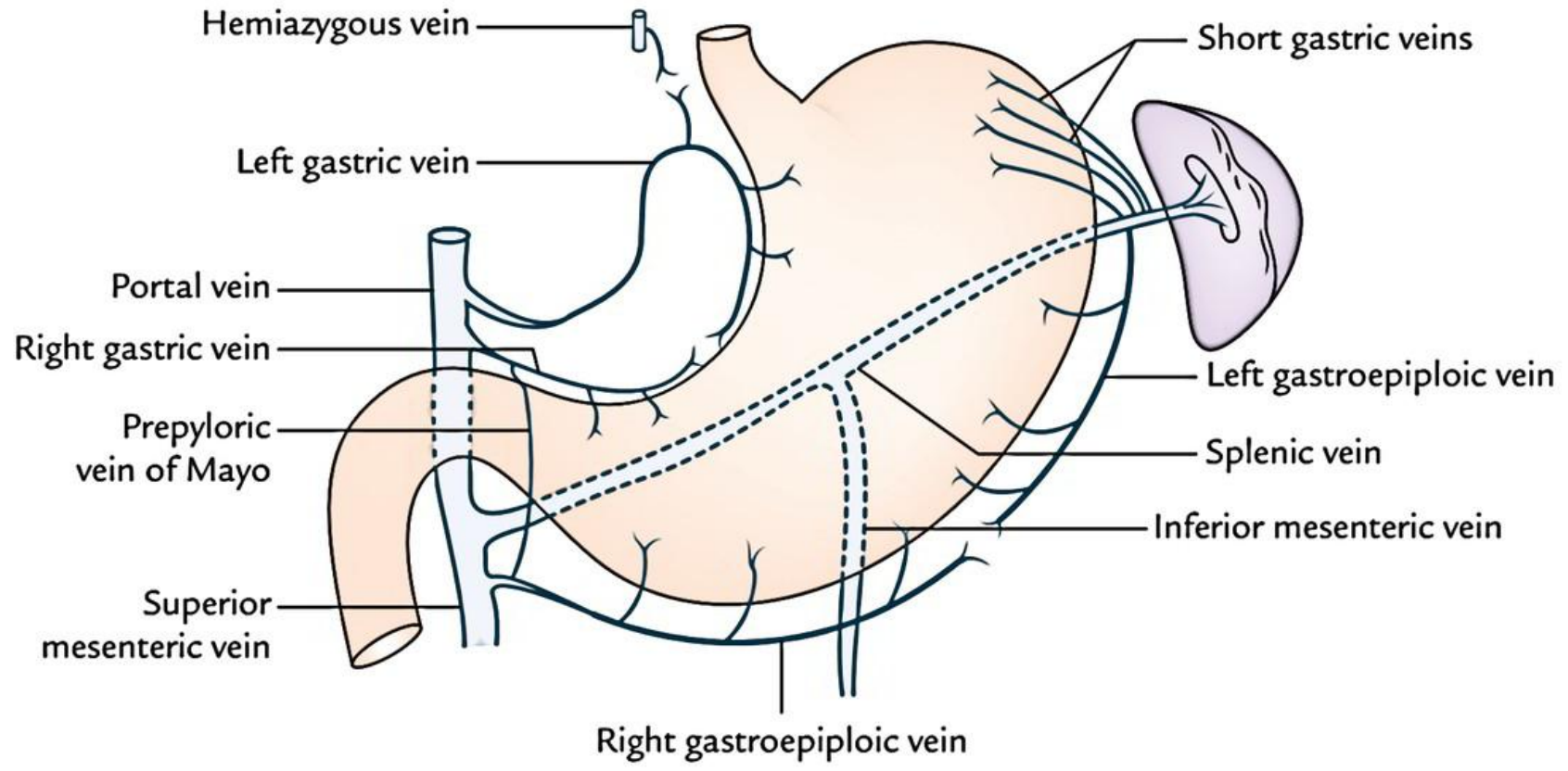


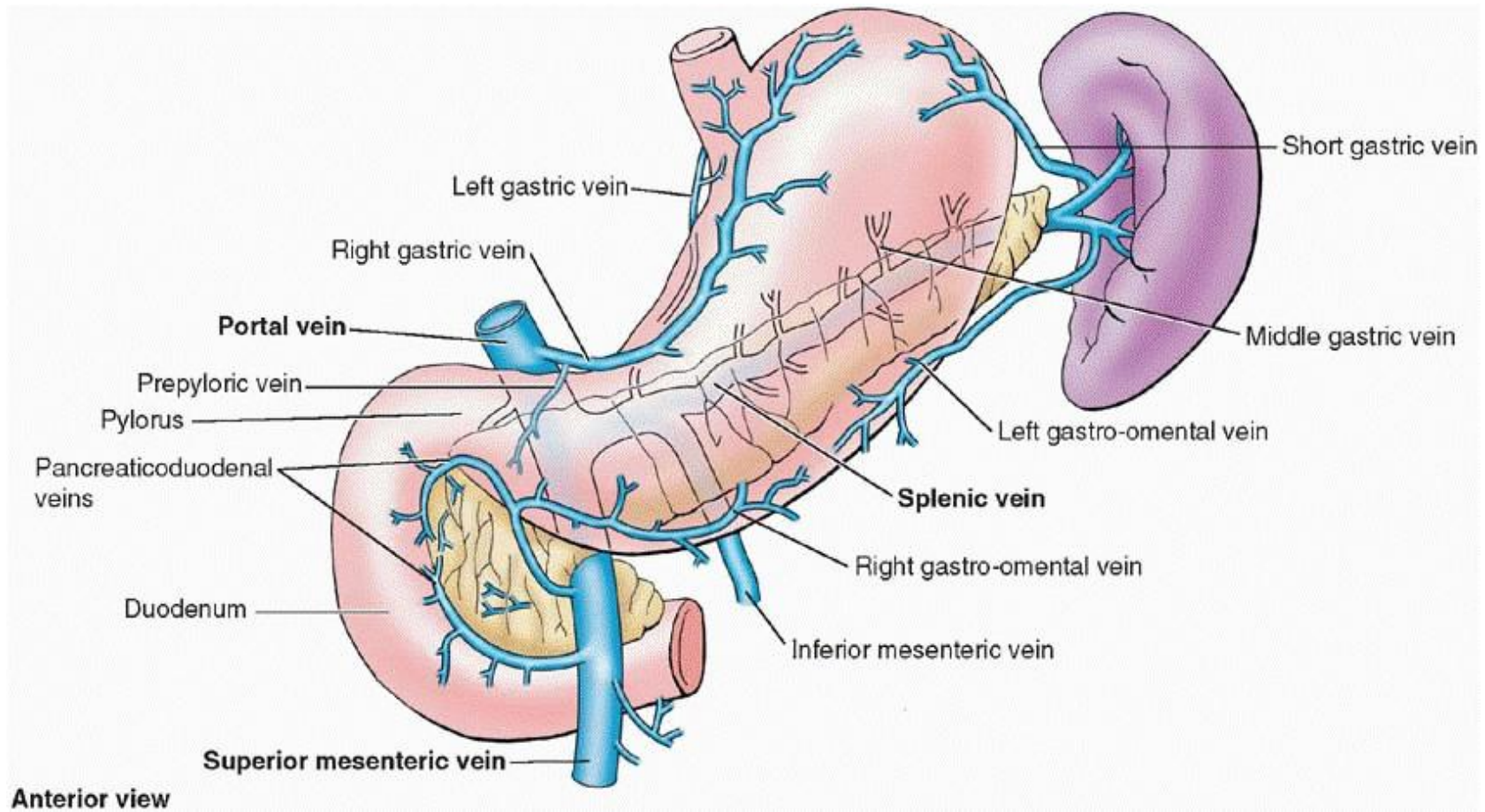
Fig. 64.12 The blood supply of the stomach and the proximal duodenum: a scheme of arterial arrangements at the gastroduodenal junction. Dotted lines indicate sites where the submucous plexus may be non-continuous. Shaded areas represent the muscular layer of the visceral wall. (Redrawn courtesy of C Piasecki, Department of Anatomy, Royal Free Hospital School of Medicine, London, and the Journal of Anatomy.)

VENOUS DRAINAGE

- **LEFT GASTRIC VEIN** - Drains the upper body and fundus of the stomach, drains into PORTAL VEIN.
- **RIGHT GASTRIC VEIN**- lies anterior to stomach ,drains into PORTAL VEIN.
- **RIGHT GASTROEPIPLOIC VEIN** - Drains greater omentum ,distal body and antrum of stomach, drains into SUPERIOR MESENTERIC VEIN.
- **LEFT GASTROEPIPLOIC VEIN** Drains both anterior and posterior surface of the body of the stomach and the adjacent greater omentum via multiple tributaries ,drains INTO SPLENIC VEIN.

- **SHORT GASTRIC VEINS** drains gastric fundus in the upper part of the greater curvature into **SPLENIC VEIN**.
- **POSTER GASTRIC VEINS** -one or more distinct posterior gastric veins may be present draining in the middle of the posterior surface of the stomach in to the **SPLENIC VEIN** they become particularly prominent in portal hypertension.
- **PREPYLORIC VEIN OF MAYO** DISTINGUISHES PYLORIC CANAL FROM THE FIRST PART OF DUODENUM.





LYMPHATIC DRAINAGE

- The knowledge of lymphatic drainage of the stomach is clinically very important as the gastric cancer spreads through lymph vessels.
- The lymphatic drainage of the stomach parallels the vasculature and drains into four zones of lymph nodes.
- 1.SUPERIOR GASTRIC GROUP-Drains lymph from the upper lesser curvature into the left gastric and paracardial nodes.
- 2.SUPRAPYLORIC GROUP -Drains the antral segment on the lesser curvature of the stomach into right suprapancreatic nodes.
- 3.PANCREATOSPLENIC GROUP-Drain lymph high on the greater curvature into the left gastroepiploic and splenic nodes.
- 4.INFERIOR GASTRIC AND SUBPYLORIC GROUP OF NODES -Drains lymph along the right gastroepiploic vascular pedicle.
- All these lymph nodes drain into the celiac group and into the thoracic duct.

- Gastric ca. Spreads through the lymphatic vessels to **left supraclavicular lymph nodes**.
- Enlarged and palpable left supraclavicular node is called **virchows node** and this sign is called troisier's sign
- Cancer cells reach the supraclavicular lymph nodes through the thoracic duct.

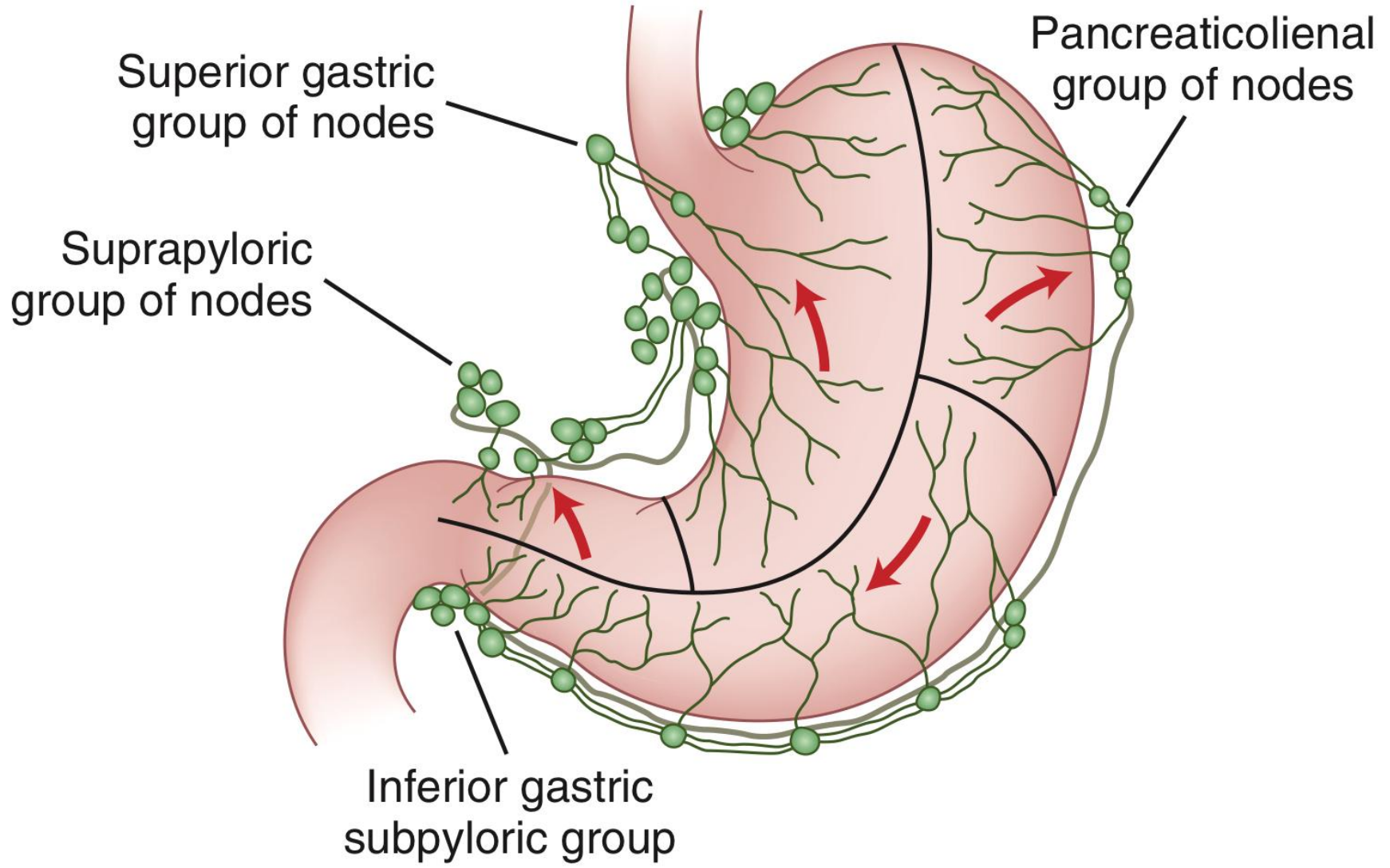


FIGURE 48-3 Lymphatic drainage of the stomach.

INNERVATION

- Extrinsic innervation of stomach is parasympathetic via vagus and sympathetic via celiac plexus.
- Sympathetic fibres are derived from T6 to T10 spinal segments via greater splanchnic nerves, celiac and hepatic plexuses.
- Sympathetic supply to stomach is vasomotor, motor to pyloric sphincter, inhibitory to remaining gastric musculature, serves as chief pathway for pain sensation from the stomach.
- Vagus originates in the vagal nucleus in the floor of the fourth ventricle and traverses the neck in carotid sheath to enter the mediastinum where it divides into several branches around the esophagus.
- These branches coalesce above the esophageal hiatus to form the left and right vagus nerves.
- At the GE junction, left vagus is anterior and right vagus is posterior.

- Anterior vagus gives a
 - a) hepatic branch to the liver,
 - b) celiac branch which follow the left gastric artery to the celiac plexus
 - c) and continues along the lesser curvature as **ANTERIOR NERVE OF LANTARJET**.
- Posterior or right vagus gives off the first branch-**CRIMINAL NERVE OF GRASSI**-supplies gastric fundus causes recurrence of the ulcers when left undivided.
- Also gives off a branch to celiac plexus and continues posteriorly along the lesser curvature.

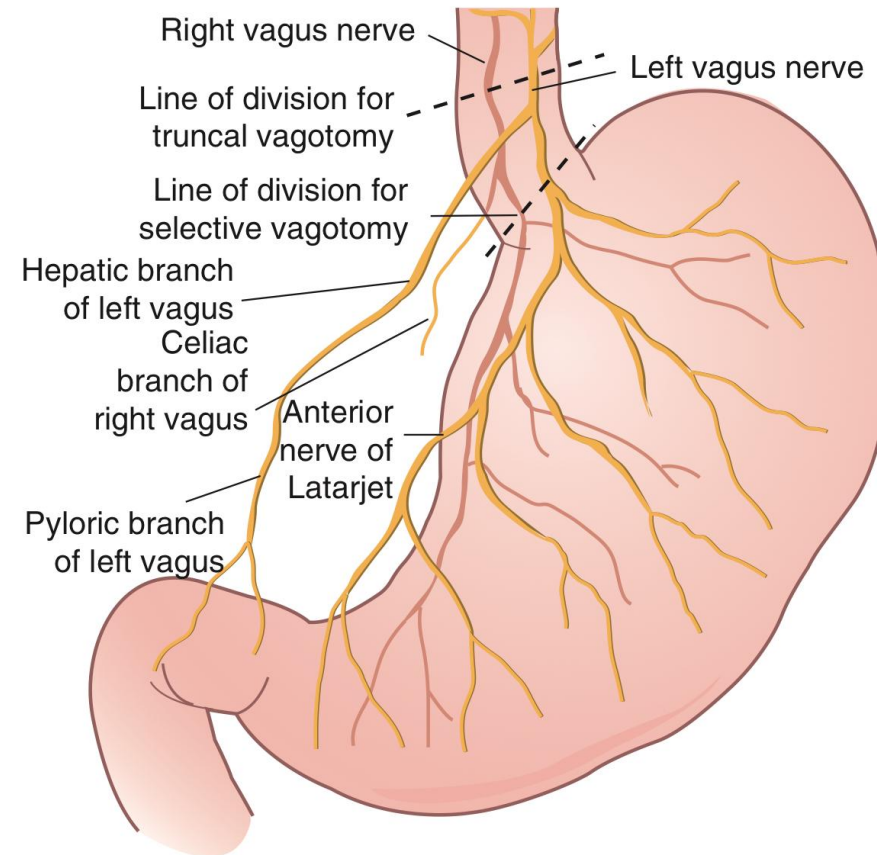


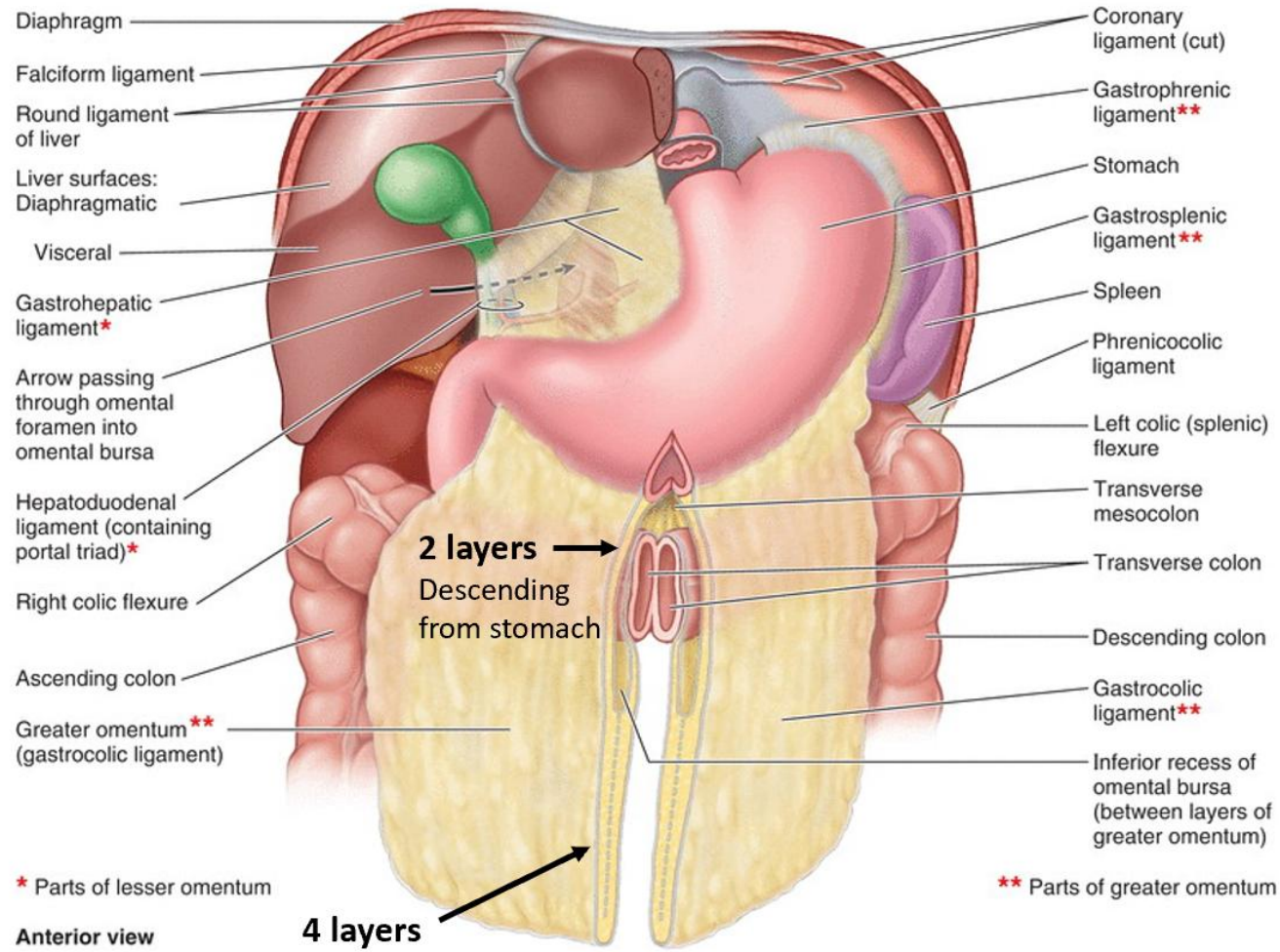
FIGURE 48-4 Vagal innervation of the stomach. The line of division for truncal vagotomy is shown; it is above the hepatic and celiac branches of the left and right vagus nerves, respectively. The line of division for selective vagotomy is shown; this is below the hepatic and celiac branches. (From Mercer D, Liu T: Open truncal vagotomy. *Oper Tech Gen Surg* 5:8–85, 2003.)

VAGOTOMY

- In peptic ulcer disease, there is increased acid output.
- As acid production is under the control of vagus, vagotomy is done, healing occurs.
- TRUNCAL VAGOTOMY-anterior and posterior vagal trunks are cut at the lower end of the esophagus above the origin of hepatic and celiac branches.
- SELECTIVE VAGOTOMY-both the vagus nerves are cut below the origin of hepatic and celiac branches.
- HIGHLY SELECTIVE VAGOTOMY -is performed by dividing the vagus nerves to the proximal stomach while preserving the innervation of the antral and pyloric parts of the stomach.

LIGAMENTS OR PERITONEAL RELATIONS

- Stomach is lined by peritoneum on both its surfaces.
- At the lesser curvature the layers of peritoneum lining the anterior and posterior surfaces meet and become continuous with the lesser omentum.
- Along the greater curvature ,2 layers meet to form greater omentum.
- HEPATOGASTRIC LIGAMENT-It is the proximal part of lesser omentum,extends from porta hepatis to the lesser curvature of the stomach.
- Contains left gastric artery and vein,hepatic divisions of anterior vagal trunk,nerve of Latarjet,lymph nodes and vessels.



* Parts of lesser omentum

** Parts of greater omentum

Anterior view

4 layers
Where double layer folds back on itself

2 layers
Descending from stomach

- **HEPATODUODENAL LIGAMENT**-Is the distal part of the lesser omentum, extending from liver to first 2.5cms of the duodenum.
- The free edge envelops the hepatic triad.
- **GASTROSPLENIC LIGAMENT**-At the hilum of the spleen, visceral peritoneum joins the right layer of the greater omentum, forms the gastrosplenic ligaments and splenorenal ligaments, these two form the splenic pedicle.
- Splenic capsule is formed by the visceral peritoneum and is as friable as spleen itself and excessive traction during the mobilisation of greater curvature might result in tearing of the capsule,
- **GASTROPHRENIC LIGAMENT**- It is continuous with the hepatogastric ligament to the left, has a avascular region through which the surgeons finger can easily pass through which a penrose drain can be placed easily around the cardia to pull down the esophagus.
- Upper part is avascular and lower part contains short gastric arteries, veins and lymph nodes.