



THE



SYSTEM

Anatomy

Sheet

Slide

Handout

Number: 4

Subject: Esophagus, Stomach and Small Intestines

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Price:

In this lecture, we're going to discuss the esophagus and stomach, and a small introduction to the small intestines (the duodenum).

The Esophagus:

*It starts: at the lower border of the cricoid cartilage of the larynx, so at the level of C6 cervical vertebra.

*It ends: at the cardia of the stomach, at the esophageal cardiac sphincter (which is a **physiological sphincter**).

The esophagus is a muscular tube, 25 cm in length (45 cm in length if we start from the incisors).

The esophagus contains a lot of constrictions that may work as lodges for foreign bodies.

These constrictions are located:

- 1. At the beginning, at the pharynx** (as the pharynx is wide and the esophagus is narrow).
- 2. Adhesion with the arch of the aorta**, so the arch of the aorta would be deviated backwards and to the left, which would put pressure on the esophagus.
- 3. The left main bronchus crosses anterior to the esophagus**, also causing constriction.
- 4. The opening in the diaphragm contains a physiological sphincter** which causes constriction.

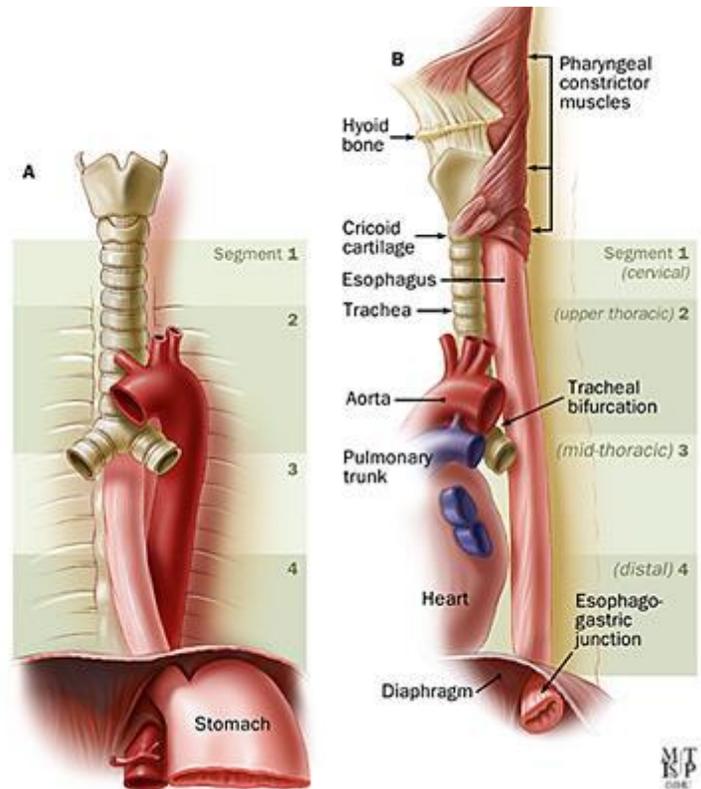
So any foreign body will be lodged in one of these four locations.

Relations of the Esophagus:

Anteriorly:

- The larynx and the trachea.
- Situated between the esophagus and the trachea is the left recurrent laryngeal nerve.
- The left main bronchus.
- The pericardium, which separates the esophagus from the left atrium.

[**Note:** The left recurrent laryngeal nerve is longer than the right one because it's a branch from the vagus nerve in the thorax (on the left side). However, with the right recurrent laryngeal nerve, the branching happens at the root of the neck, so it only ascends on the right side of the neck, meaning it doesn't pass into the thorax.]



Posteriorly:

- The bodies of the thoracic vertebrae, since the esophagus is located at the posterior mediastinum, in front of the vertebral column.
- Thoracic ducts
- The azygos veins (which provide venous drainage for the chest).
- Posterior intercostal arteries, which are branches from the descending thoracic aorta.
- At the lower part, in order for the esophagus to pass through the opening in the diaphragm (the esophageal orifice at the level of T10), it deviates in front of the descending aorta. Then the descending aorta continues to the midline at the level of T12, opening into the aortic

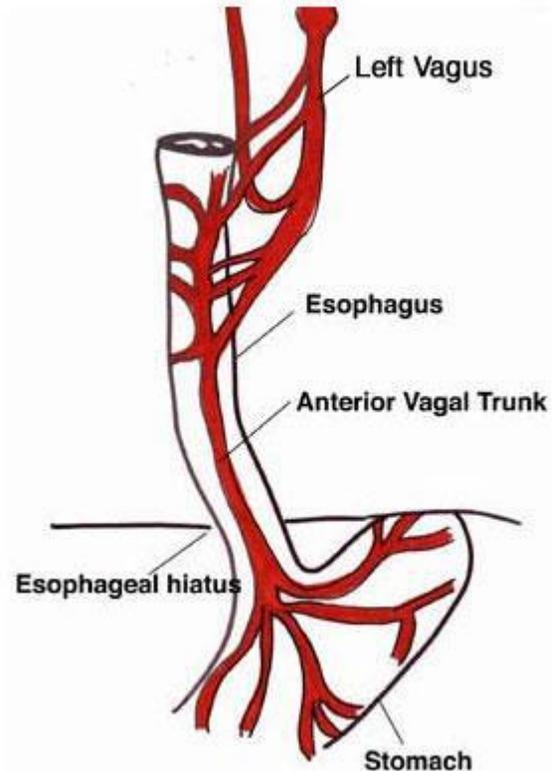
orifice. In other words, the descending aorta and the esophagus cross at the midline, with the esophagus going anterior to the descending aorta.

Right side:

- Right pleura and lung
- Azygos vein

Left side:

- Subclavian artery
- Arch of the aorta
- Thoracic ducts
- Left pleura and lung



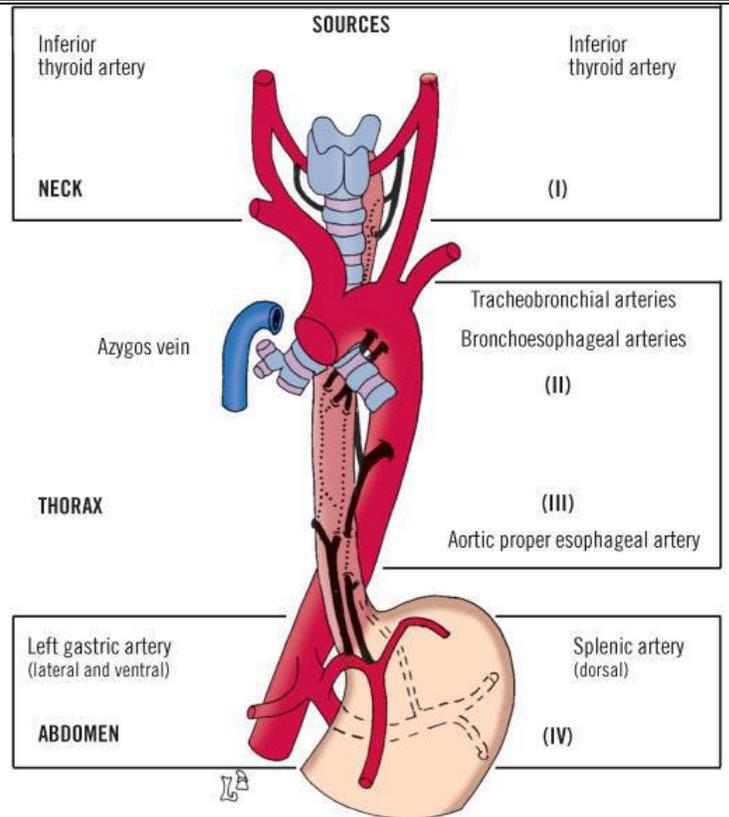
[Note: The left and right vagus nerves descend downwards and pass through the opening of the esophagus in the diaphragm, where the left becomes anterior and the right becomes posterior. They form a plexus of nerves around the esophagus called the esophageal plexus which provides parasympathetic and sympathetic fibers].

The Blood Supply of the Esophagus:

The upper third: receives blood supply from the inferior thyroid artery, and the venous drainage of the inferior thyroid vein.

The middle third: receives blood supply from the bronchoesophageal arteries and the tracheobronchial arteries which are branches from the descending thoracic aorta. The venous drainage goes to the azygos veins which drain into the arch of azygos, then to the superior vena cava and to the right atrium.

The lower third: receives blood supply from the left gastric artery, which is a branch from the celiac trunk. The venous drainage goes to the left gastric vein, then to the portal vein.

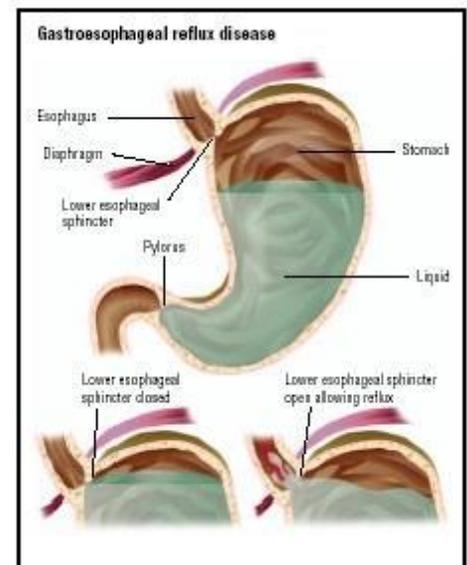


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The Gastroesophageal Sphincter:

The differences between the gastroesophageal sphincter and the pyloric sphincter are in:

- a) The **location** of the sphincter: the gastroesophageal sphincter is located at the opening in the diaphragm, 1 inch to the left from the midline at the level of T10, and is 10 cm away from the anterior abdominal wall. Meanwhile, the pyloric sphincter (which is between the stomach and duodenum) is located at the level of L1, 1 inch to the right from the midline.



b) The **structure** of the sphincter: the gastroesophageal sphincter is considered a physiological sphincter as it doesn't contain a thickening of the inner circular smooth muscles. However, the pyloric sphincter is an anatomical sphincter because it contains that thickening (in the inner circular smooth muscles).

[**Note:** The sphincters are innervated by sympathetic fibers which provide motor stimulation and closure of the sphincters.]

The Stomach:

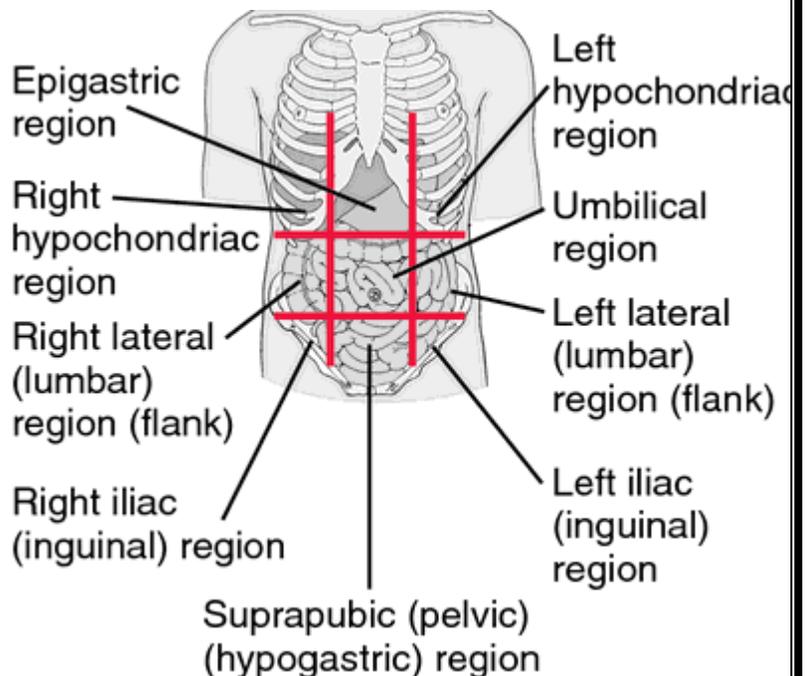
It is a dilated part in the alimentary canal. It lies between the esophagus and the duodenum.

Location of the Stomach:

The stomach is located in the epigastric region in the upper quadrant.

[**Note1:** the doctor mentioned that the ascending and descending colons of the large intestines are retroperitoneal, they are located at the posterior abdominal wall. As for the transverse colon, it's intraperitoneal.]

Note2: The small intestine is located in the umbilical region.



The Shape of the Stomach:

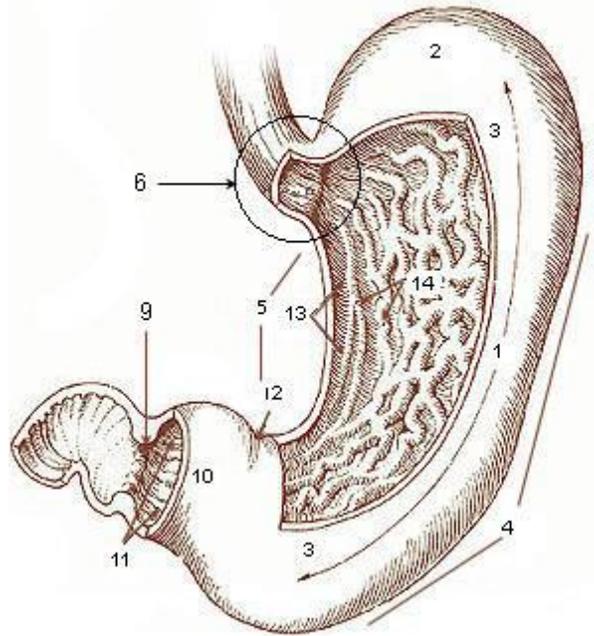
It depends on the content, but it is J shaped (in normal people), or 'steer horn' (in obese people).

It depends on:

1. The volume of its contents
2. The position of the body
3. The phase of respiration.

To put it simply, the stomach has:

1. **2 orifices:** cardiac orifice and pyloric orifice.
2. **2 curvatures:** the lesser curvature and the greater curvature.
3. **2 surfaces:** anterior surface and posterior surface (where the stomach bed is located).



On the inside, the stomach contains gastric rugae, which are foldings of the mucosa and submucosa. They are usually transverse and oblique, but at the lesser curvature they are longitudinal folds.

The Function of the Stomach:

- The main function of the stomach is digestion.

[Note: in histology, the stomach contains parietal cells, chief cells, mucus cells, and gastrin which secrete the gastrin hormone... etc.]

→ It mixes the food with gastric secretions to form a semi-fluid chyme, which is an acidic chyme, which stays in the stomach for a few hours before it is evacuated to the duodenum.

Parts of the Stomach:

1. The Fundus:

It is located above the level of cardiac orifice and usually contains air, which appear on the x-ray.

2. The Body:

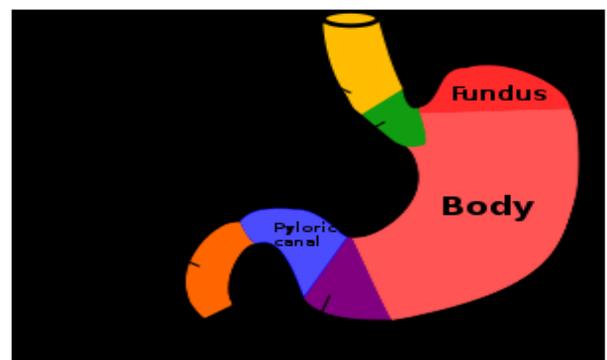
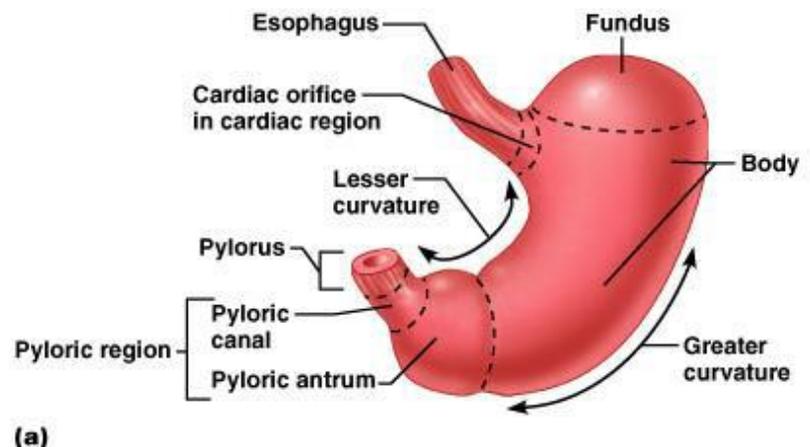
Located below the fundus and extends to the incisura angularis (which is a notch in the lower part of the lesser curvature).

3. Pyloric Region:

Divided into:

- a) The antrum
- b) Pyloric canal
- c) Pyloric sphincter (which contains a thickening of the inner circular muscles).

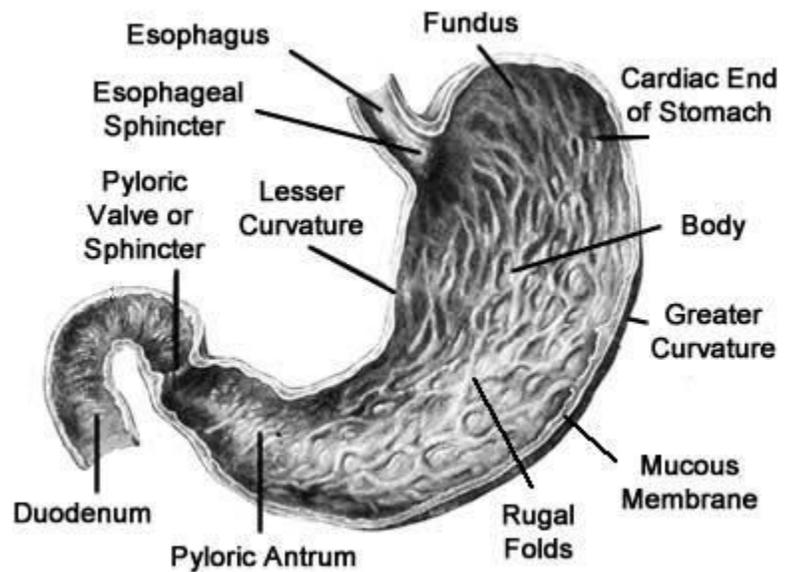
[Note: on the anterior wall of the pyloric sphincter, there is an important landmark called the **vein of mayo**. It is important for



surgeons when they access the pyloric sphincter, as it is the first structure that they see.]

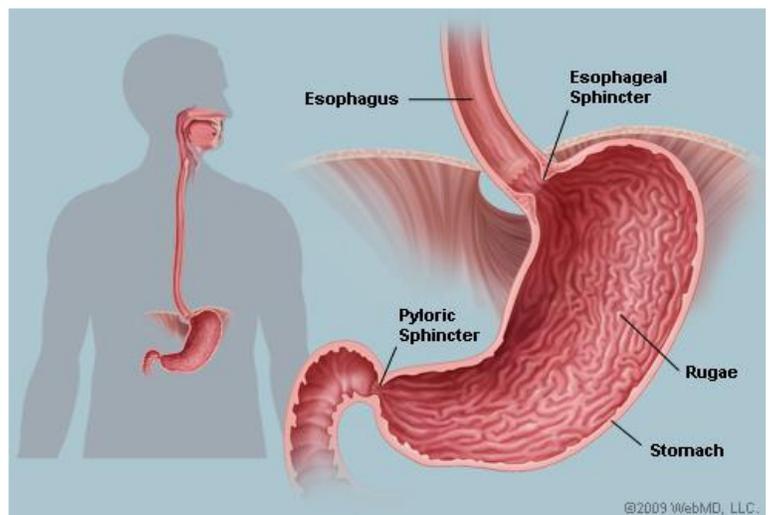
Remember: the cardiac and pyloric orifices:

- a) **The cardiac orifice** is physiological sphincter. Surface anatomy: 1 inch to the left at the level of T10, 10 cm from the anterior abdominal wall.
- b) **The pyloric orifice** is an anatomical sphincter because it contains the thickening. Surface anatomy: 1 inch to the right, at the level of L1 [transpyloric line].



Clinical note:

We said that the cardiac orifice is 45 cm away from the incisors. Nowadays, all GIT specialists have gastroscopes in their clinics, which they use for gastroscopy in relation to problems in the upper GIT. The gastroscope is a fibro-optic flexible tube which is inserted through the mouth with light at its tip. The



gastroscope has a scale that reads 5 cm, 10 cm, 20 cm... etc. When it reaches 45 cm, the physician will know that they have reached the cardiac orifice and, subsequently, the stomach. It can also be used to inject medicine. Therefore, it is a diagnostic and therapeutic tool.

The function of the pyloric sphincter is controlled by:

→ **Nerve fibers:**

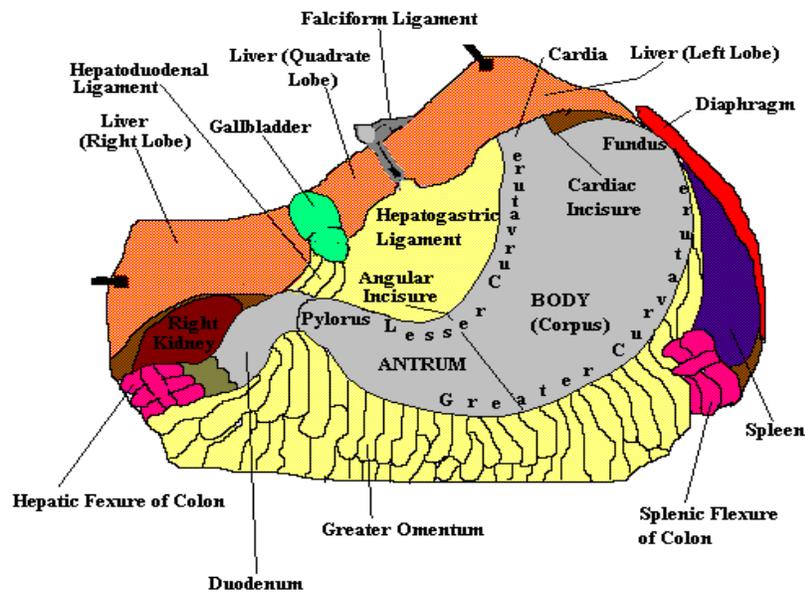
- a) **Sympathetic fibers** which are motor for the sphincter.
- b) The inhibition happens by the **vagus nerve** for drainage.

→ **Hormonal influence**, which helps in the secretion of cholecystokinin (CCK) from the duodenum.

Curvatures of the stomach:

1) The Lesser Curvature

2) The Greater Curvature: attached to it is the greater omentum, and in the upper part the gastrosplenic ligament (between the stomach and the spleen). At the fundus, there is the gastrocolic ligament (attached to the diaphragm). All of them help in the fixation of the stomach in its place, and delivers the blood supply and nerve supply to it.



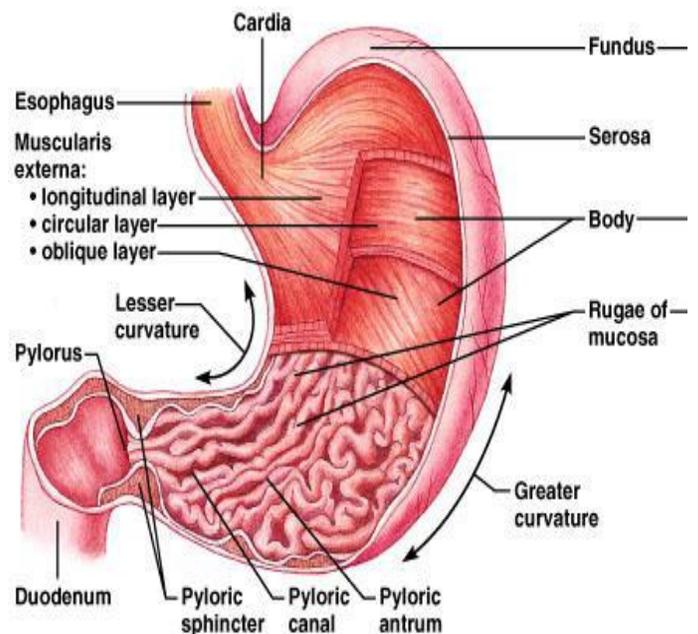
Histology of the Stomach

The stomach contains a layer of serosa since it is located in the peritoneum.

The muscular layer contains 3 layers:

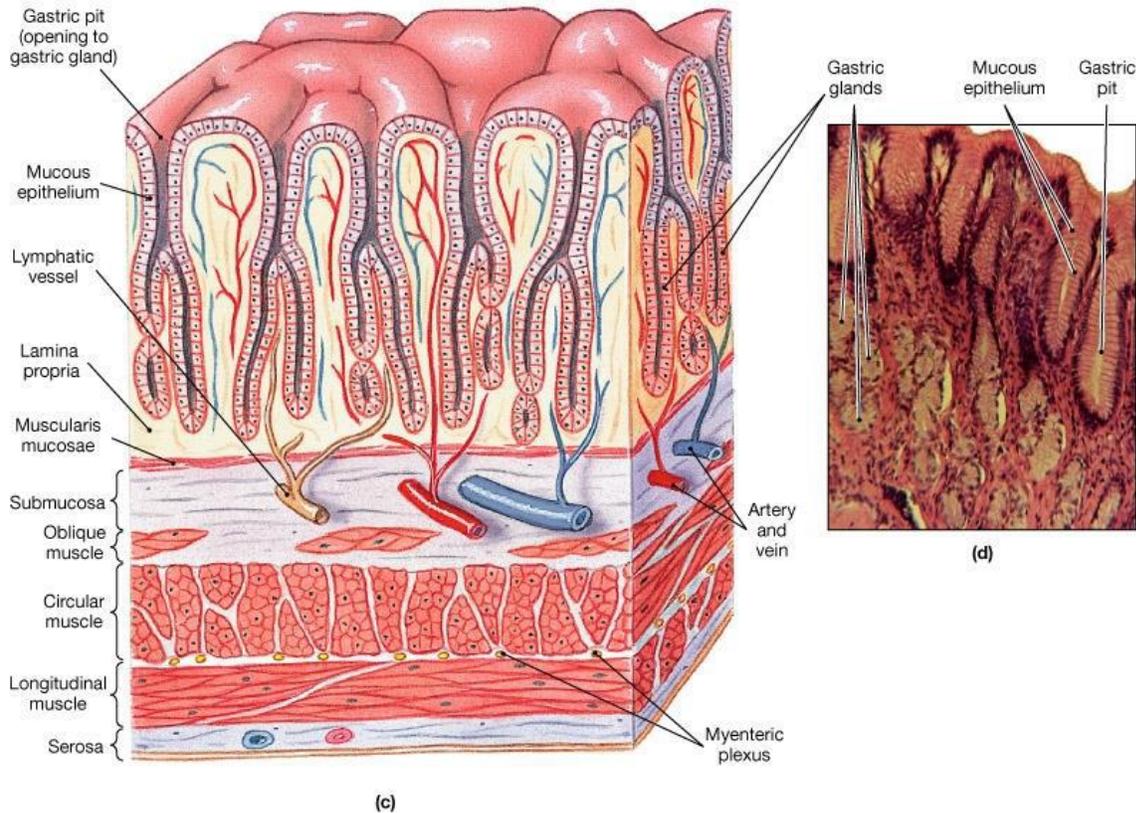
- 1) Outer longitudinal.
- 2) Inner circular (Forms the sphincter).
- 3) The most inner, which is oblique.

The stomach also has rugae.

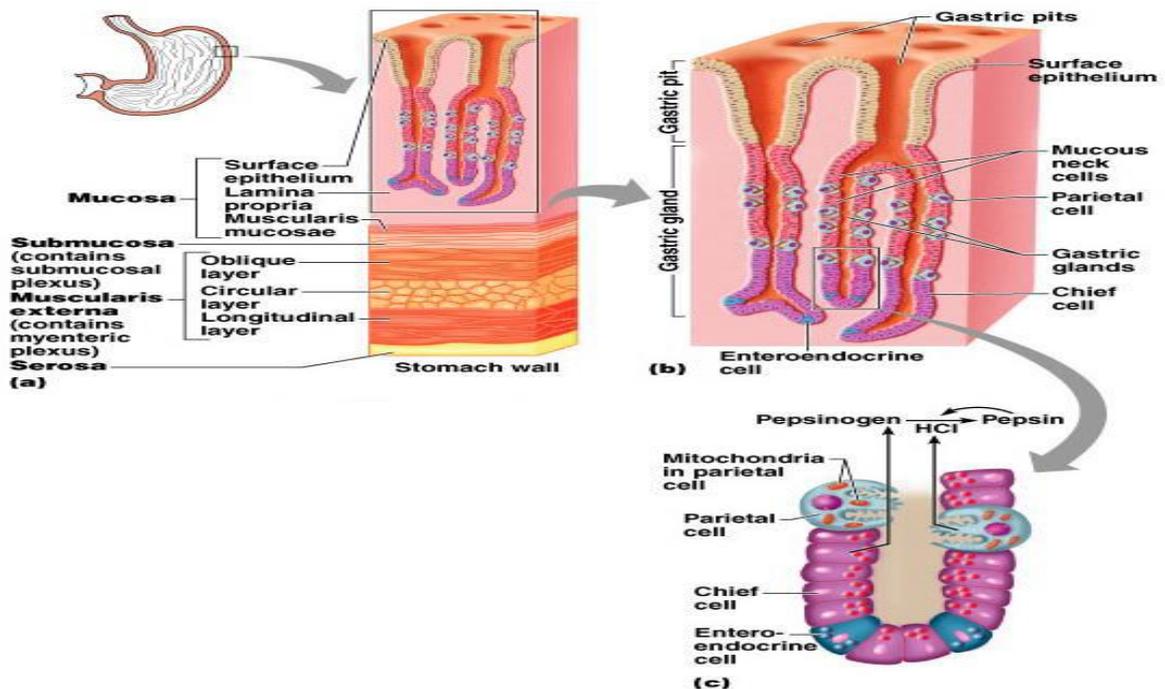


(b)

Remember: gastric pits, gastric gland, mucosa, myenteric plexus between the inner circular and outer longitudinal muscular layers.



The stomach also contains mucous cells, parietal cells in the neck, chief cells at the base, and enteroendocrine cells.



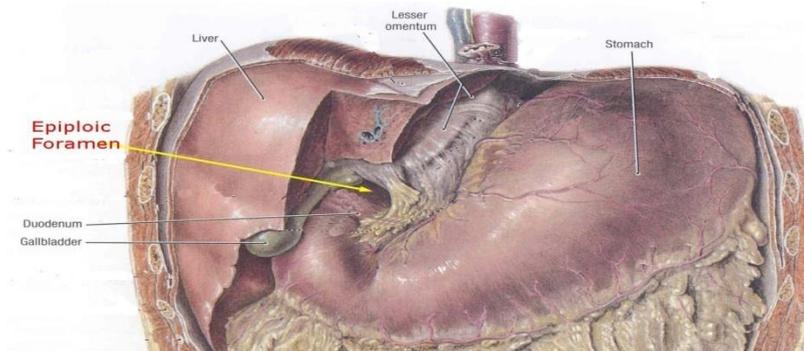
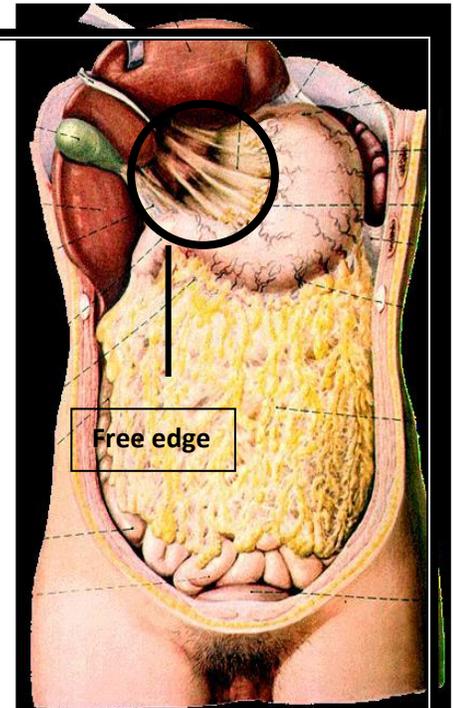
Peritoneum of the Stomach

The stomach is connected by the porta hepatis of the liver, which produces the lesser omentum.

The Lesser Omentum:

The lesser omentum is composed of 2 layers of peritoneum which extend from the lesser curvature of the stomach to the porta hepatis of the liver, and they extend upwards until they reach the diaphragm.

It has a free edge, which contains an opening that lies deep to it called the **epiploic foramen, or foramen of Winslow.**



The importance of this foramen is that it reaches the lesser sac of peritoneum, posterior to the stomach. You can insert your fingers through it.

The free edge contains:

- 1) Common bile duct
- 2) Hepatic artery
- 3) And deep to it, it contains the portal vein.

So, when you insert your fingers in the epiploic foramen, these structures would be anterior to your fingers. Posterior to your fingers would be the inferior vena cava.

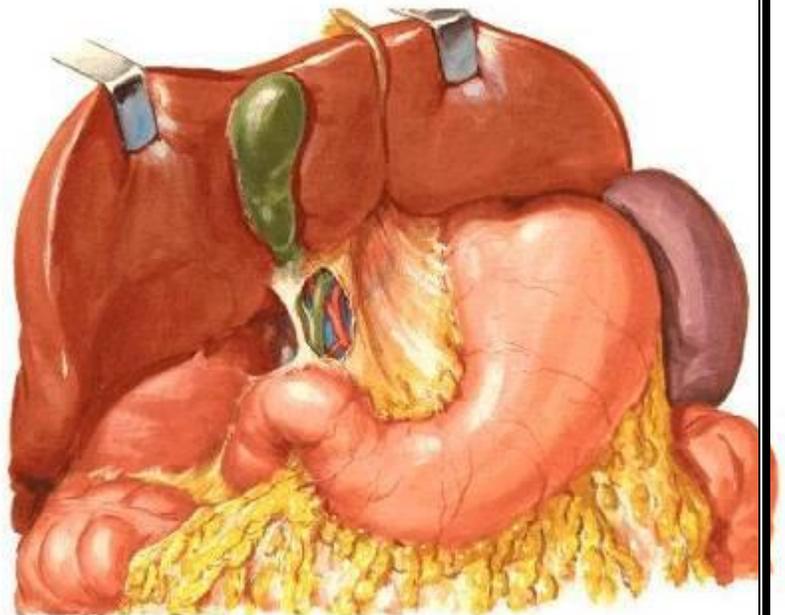
The Greater Omentum: It is composed of 2 layers of peritoneum, descending from the greater curvature of the stomach downwards in the abdominal cavity, and ascends upwards until they reach the transverse colon (intraperitoneal), surrounding it.

Gastrosplenic Ligament:

The word 'ligament' means 2 layers of peritoneum which are thickened.

So, the gastrosplenic ligament is located between the fundus of the stomach and a part of the greater curvature, and goes to the spleen. It contains blood vessels, nerves, lymph nodes and lymphatics.

Liver in Situ

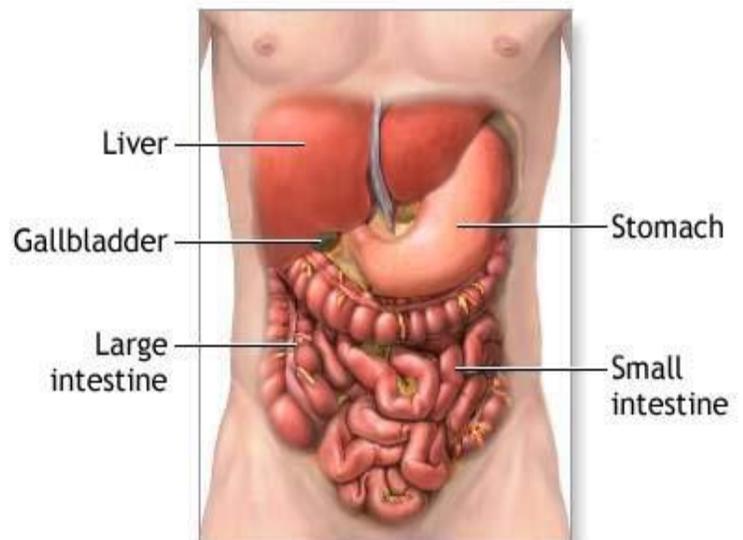


Anterior Relations of the Stomach:

- The anterior abdominal wall
- the left costal margin
- the left pleura and lung
- the diaphragm
- the left lobe of the liver

Posterior Relations of the Stomach (Stomach Bed)

- The lesser sac [space behind the stomach]
- the left crus of diaphragm
- the spleen (only a small part)



ADAM.

- the left suprarenal gland
- the upper part of the left kidney
- the splenic artery [upper border of pancreas]
- the body of pancreas
- the transverse mesocolon
- the transverse colon

The Blood Supply and Venous Drainage of the Stomach:

The GI tract (according to embryology) is divided into 3 parts:

- 1) **Foregut** -> takes blood supply from the celiac trunk
It extends from the lower third of the esophagus, the stomach, until the upper half of the duodenum.
- 2) **Midgut** -> takes blood supply from the superior mesenteric artery
It extends from the lower half of the duodenum and ends at the lateral third of the transverse colon.
- 3) **Hindgut** -> takes blood supply from the inferior mesenteric artery
It includes the lateral third of transverse colon, descending colon, rectum, and anal canal.

The Celiac Trunk

It is called a trunk because it is very short (about 5 cm in length).

It originates from the abdominal aorta at the level of T12 (between T12 and L1).

It gives off 3 main arteries:

- 1) **Left gastric**, which goes to the lesser curvature and gives blood supply to the stomach and the lower third of the esophagus.
- 2) **Splenic**, which moves behind the stomach, then on the upper border of the pancreas and gives blood supply to the stomach.
- 3) **Hepatic**, which moves towards the liver. It gives small branches such as:
 - a) Right gastric artery
 - b) Gastro-Epiploic artery

c) Gastro-duodenal artery [passes behind the first part of the duodenum]

So, in short, the blood supply of the stomach contains:

→ 2 gastric arteries

- 1) The left gastric branches from the celiac trunk.
- 2) The right gastric branches from the hepatic artery, goes towards the lesser curvature of the stomach. Supplies the lower part of the body and pylorus.

→ 2 gastro-epiploic arteries

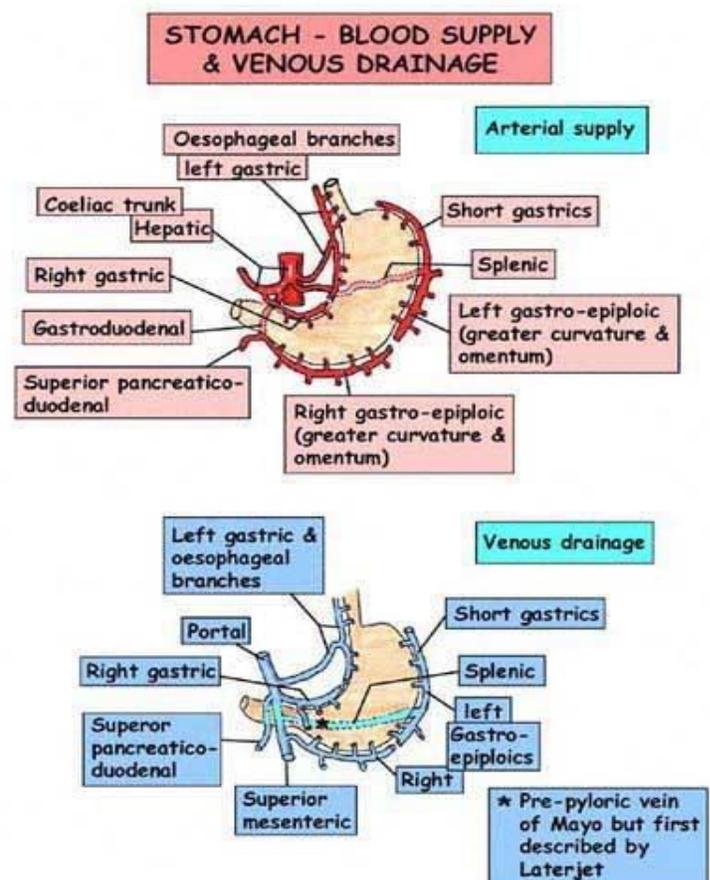
- 1) The right gastro-epiploic branches from the gastro-duodenal (from the hepatic) which continues towards the duodenum [superior pancreaticoduodenal artery]
- 2) The left gastro-epiploic branches from the splenic artery.

→ 5-6 short gastric arteries from the splenic artery, located in the gastrosplenic ligament and going towards the fundus.

The Venous Drainage of the Stomach

The portal circulation contains the portal vein which carries the venous drainage to the liver. The most important function of the portal circulation is to take the absorptive material to the liver.

→ The 2 gastric veins (left and right) drain into the portal vein.



- ➔ The right gastro-epiploic vein drains into the superior mesenteric vein, and the left gastro-epiploic vein drains into the splenic vein.
- ➔ The short gastric veins also drain into the splenic vein.
- ➔ The superior mesenteric and the splenic behind the neck of the pancreas form the portal vein.

The Celiac Trunk

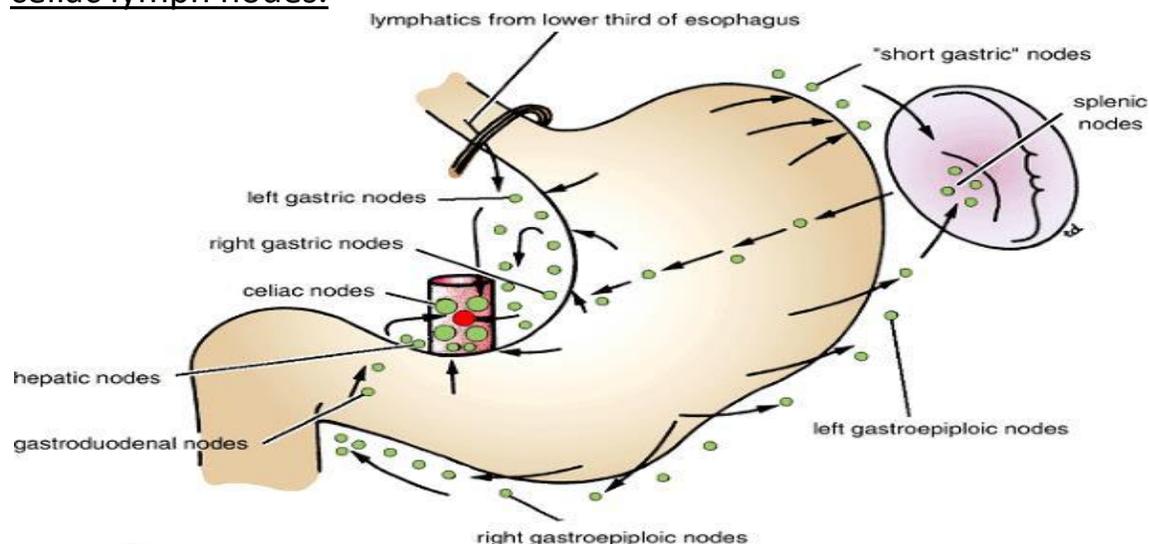
On each side, it contains the celiac ganglia (contain sympathetic and parasympathetic fibers) and lymph nodes, which are named after it. Behind it, we have the crus of the diaphragm. The main arteries are the left gastric, splenic and hepatic arteries.

The Lymphatic Drainage of the Stomach

It is very similar to the venous drainage:

- Gastric lymph nodes [with the left and right gastric veins]
- Gastro-epiploic lymph nodes at the greater curvature [with the right and left gastro-epiploic veins]
- Pancreatico-duodenal lymph nodes [around the splenic vein]

In the end, all lymphatic drainage will gather around the celiac trunk in the celiac lymph nodes.



The Nerve Supply of the Stomach:

We have **sympathetic** fibers that go towards the celiac plexus of nerves around the celiac trunk. The sympathetic fibers mainly go towards the sphincters for contraction (such as the pyloric sphincter), and they also carry pain sensation.

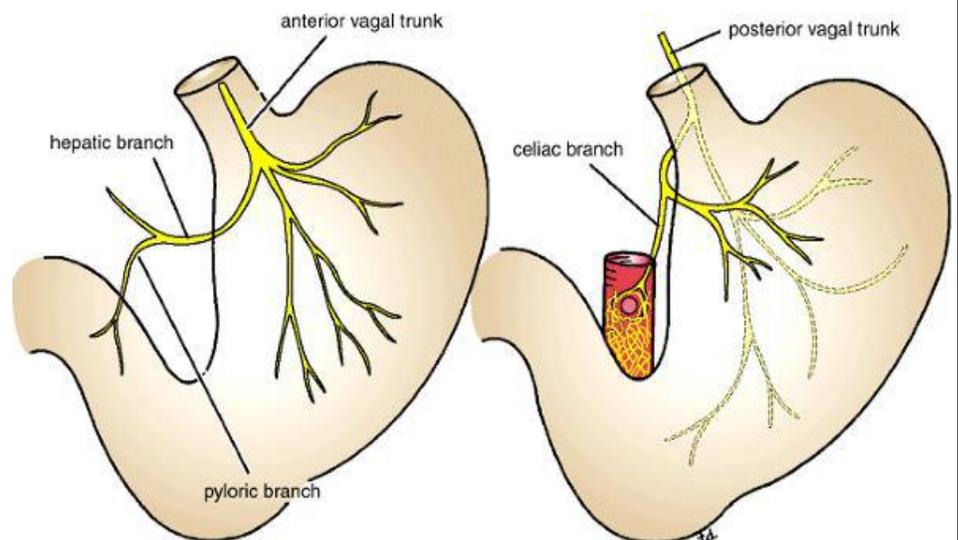
We also have **parasympathetic** fibers from the vagus nerve.

The parasympathetic fibers are mainly secretomotor for the gastric glands, and motor for smooth muscles, so they are responsible for peristaltic movement.

Around the esophagus we had left and right vagus nerves. After passing through the opening, the left vagus nerve became anterior, and the right vagus nerve became posterior. They are part of the contents of the lesser omentum.

The anterior vagal nerve innervates:

- 1) The anterior wall of the stomach.
- 2) Gives a hepatic branch that goes to the liver and gallbladder.
- 3) Gives another branch called anterior nerve of Latarjet that goes towards the pylorus.



The posterior vagal nerve innervates:

- 1) The posterior wall of the stomach.
- 2) Posterior nerve of Latarjet to the pylorus.

- 3) Celiac branch which innervates the small intestines and the medial two thirds of the transverse colon.

Clinical Points:

1) Gastric Ulcer

15 years ago, the rule said that hyperacidity meant peptic ulcer, and its treatment was surgery to the vagus nerve.

Now, it has changed completely. The real cause of peptic ulcer is a bacteria known as **Helicobacter pylori**. It is present inside the human body and is usually non-pathogenic. Under certain conditions, when there is resistance in the body, it may lead to peptic ulcer. Its treatment consists of a combination of 4 drugs for 21 days. 95% of the cases are completely cured with this method.

Peptic ulcer has two forms: gastric and duodenal. The gastric ulcer is considered malignant until proven that it is not malignant.

The duodenal ulcer is a peptic ulcer until proven otherwise (they are the opposite of each other). It is very common, especially in the first inch, since it receives acidic chyme which may result in irritation → Ulcer. So, a biopsy needs to be taken to prove malignancy.

2) Trunkal Vagotomy

We used to cut the vagus nerve below the diaphragm, so the stomach stopped receiving parasympathetic innervations, which resulted in bad drainage. Now, we perform a highly selective vagotomy where we only cut the nerve of Latarjet.

- 3) Gastroscopy** (where we enter an endoscope into the oral cavity to check the stomach, esophagus, and duodenum, (to be more specific, until the second part of the duodenum)).

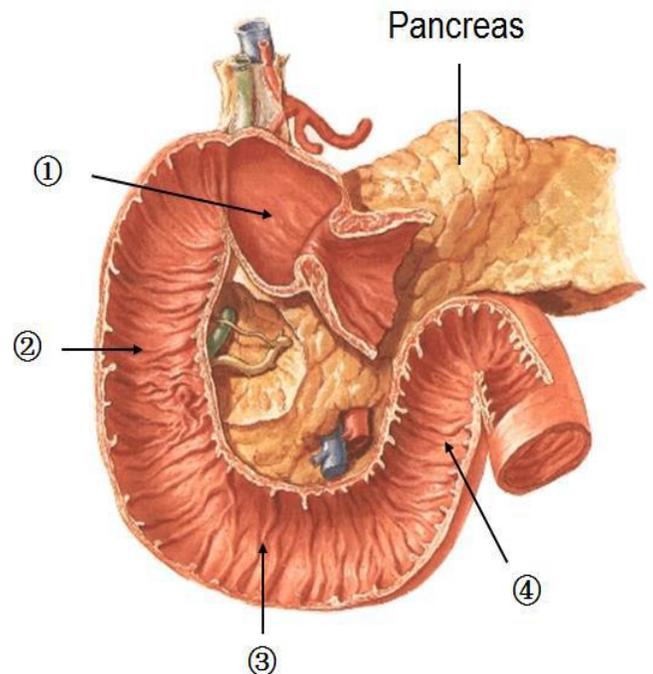
- 4) Pyloroplasty**, means drainage, where the pyloric sphincter has a thickening and continuous contraction that results in no drainage. So,

they cut it and add stitches which will lead to the dilatation of the sphincter.

The Duodenum

The small intestines are divided into 3 parts:

- 1- The duodenum [retroperitoneal except for the first and last inch]
Why? Because the first inch is below the stomach, and the stomach is intraperitoneal. The last inch is before the jejunum, and the jejunum is also intraperitoneal.
- 2- The jejunum [intraperitoneal]
- 3- The ileum [intraperitoneal]



The main function of the jejunum and the ileum is absorption.

The duodenum forms a C-shaped curve, directed medially and backwards, and the head of the pancreas is located at the concavity of the duodenum. It is about 25 cm (10 inches) in length, whereas the entire small intestines are around 6 meters in length.

The duodenum is divided into 4 parts:

- 1) The first part [2 inches]**
- 2) The second part [3 inches]**

The middle part of it opens for the common bile duct and pancreatic duct, in order to complete digestion (especially for fat). It also separates the duodenum into upper half [follows foregut] and a lower half [follows Midgut].

3) The third part [horizontal] [4 inches]

4) The fourth part [the last inch]

Sheet Over

Shout-out to Reem Elmousa, Ruba Abul-Huda, and Raya Alashram.