بسم الله الرحمن الرحيم

DIGESTIVE SYSTEM

By Dr Ahmed Amer

DIGESTIVE SYSTEM

The digestive system consists of:

A. digestive tract

B. associated organs of digestion: **teeth, tongue, salivary glands, liver, gallbladder and pancreas.**

⇨ **It provides water, electrolytes, vitamins and nutrients to the body with the help of the circulatory system.**

DIGESTIVE SYSTEM

⇨**This is done by the following steps (The functions of digestive system):**

1. **Ingestion:** taking in food through mouth.
2. **Mastication:** movements of the lower jaw during chewing to pulverize food and mix it with the saliva.
3. **3. Deglutition: swallowing of food so that it passes from mouth to stomach.**

DIGESTIVE TRACT

4. **Digestion:** chemical breakdown of food material.

5. **Absorption:** nutrient molecules absorbed into circulatory system through mucous membrane of small intestine.

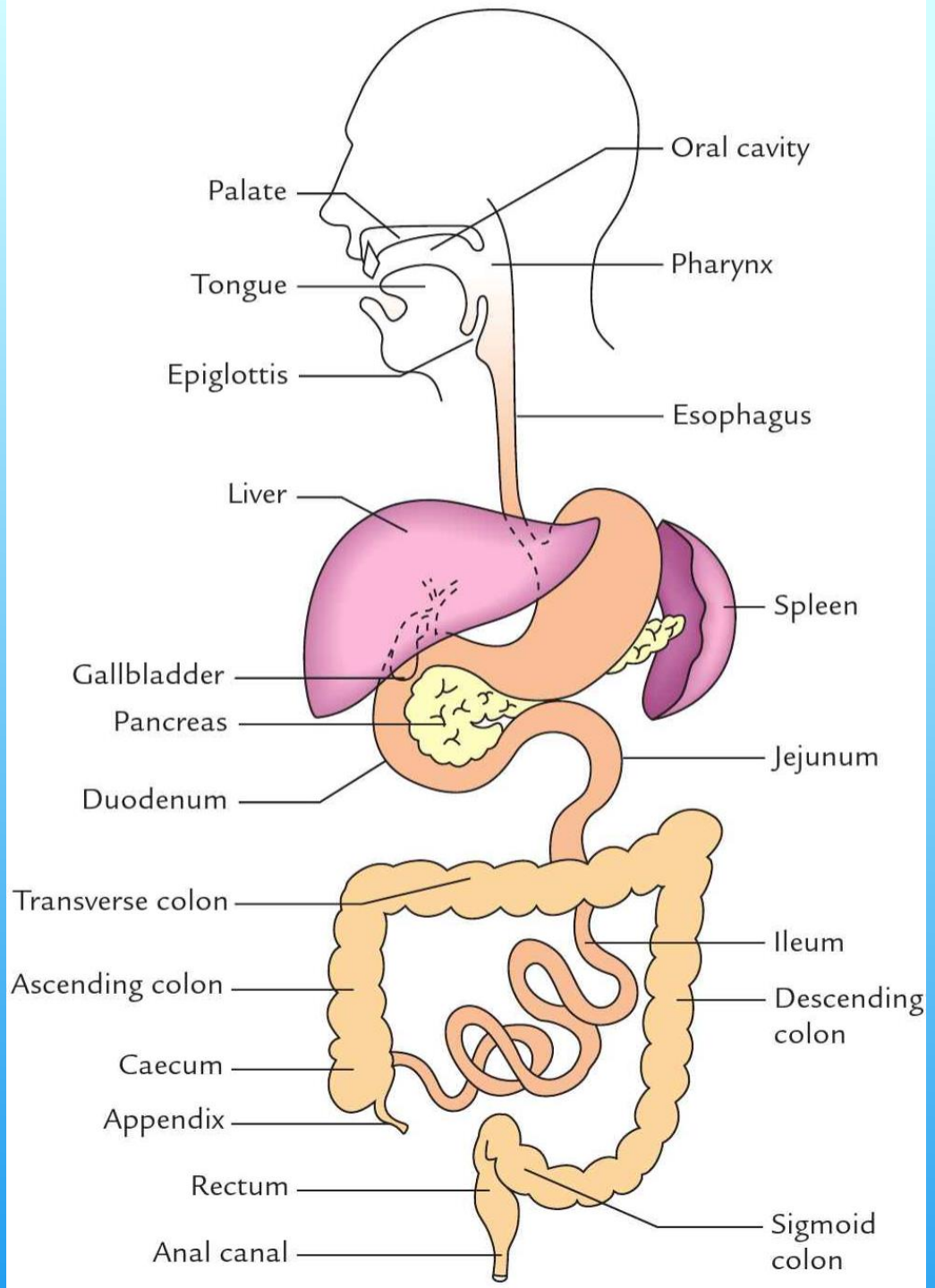
6. **Peristalsis:** rhythmic wave-like intestinal contractions that move food through digestive tract.

7. **Defecation:** elimination of solid/semisolid/liquid waste material of food (i.e. feces) through anus.

DIGESTIVE TRACT

- The digestive tract extends from the mouth to the anus.
- Roughly, it is a tubular passage and measures about 10 m (30 ft) in length.
- The digestive tract consists of the following parts from proximal to distal ends in succession:

1. Mouth (oral cavity)
2. Pharynx
3. Esophagus
4. Stomach
5. Small intestine
6. Large intestine
7. Rectum
8. Anal canal


Oral cavity
Palate
Pharynx
Tongue
Epiglottis
Esophagus
Liver
Spleen
Gallbladder
Pancreas
Jejunum
Duodenum
Transverse colon
Ileum
Ascending colon
Descending colon
Caecum
Appendix
Rectum
Sigmoid colon
Anal canal

DIGESTIVE TRACT

1. Mouth (Oral Cavity)

- The **mouth or oral cavity is the first part of the digestive tract.**
- The oral cavity communicates externally through a cleft, between the upper and lower lips, called **oral orifice** and internally through **oropharyngeal isthmus**.
- **Oral cavity** is divided **into two parts**:

(a) vestibule

(b) oral cavity proper.

DIGESTIVE TRACT

A. The Vestibule:

- **This is the space bounded externally by the lips and cheeks and internally by the gums and teeth.**
- **It communicates posteriorly behind the teeth with the mouth cavity proper.**

B. The Mouth Cavity Proper:

- Extends from **teeth to oropharyngeal isthmus** through which it communicates with the **oral part of the pharynx**.
- **Roof:** formed by **hard palate ant. & soft palate post.**
- **Floor:** formed mainly by **tongue & reflection of the mucous membrane on the gums.**

The Oral Vestibule

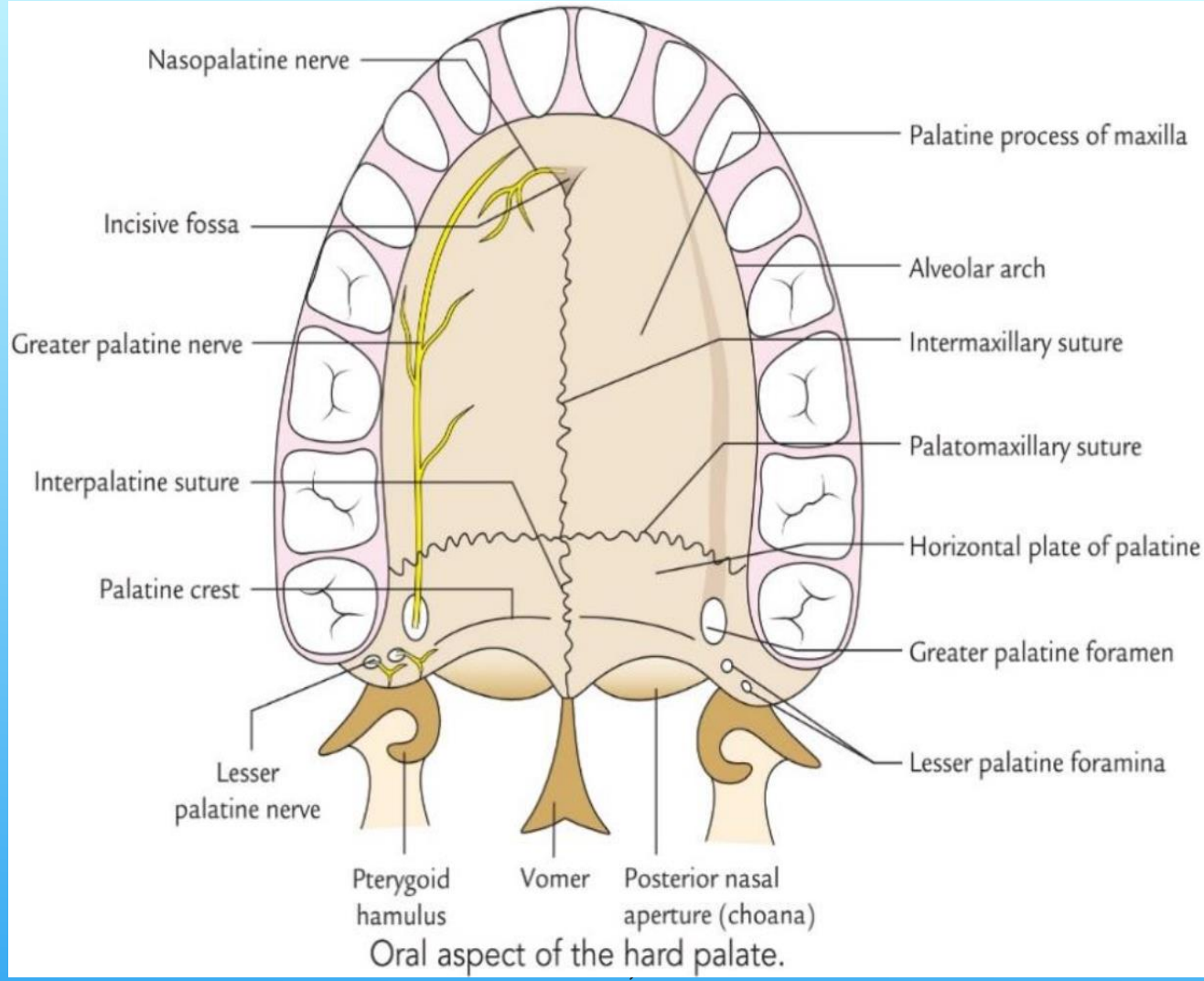
DIGESTIVE TRACT

A. Hard palate

Each half is formed by 2 parts:

a) Anterior 3/4: formed by palatine process of maxilla.

b) Posterior 1/4: formed by the horizontal plate of the palatine bone.

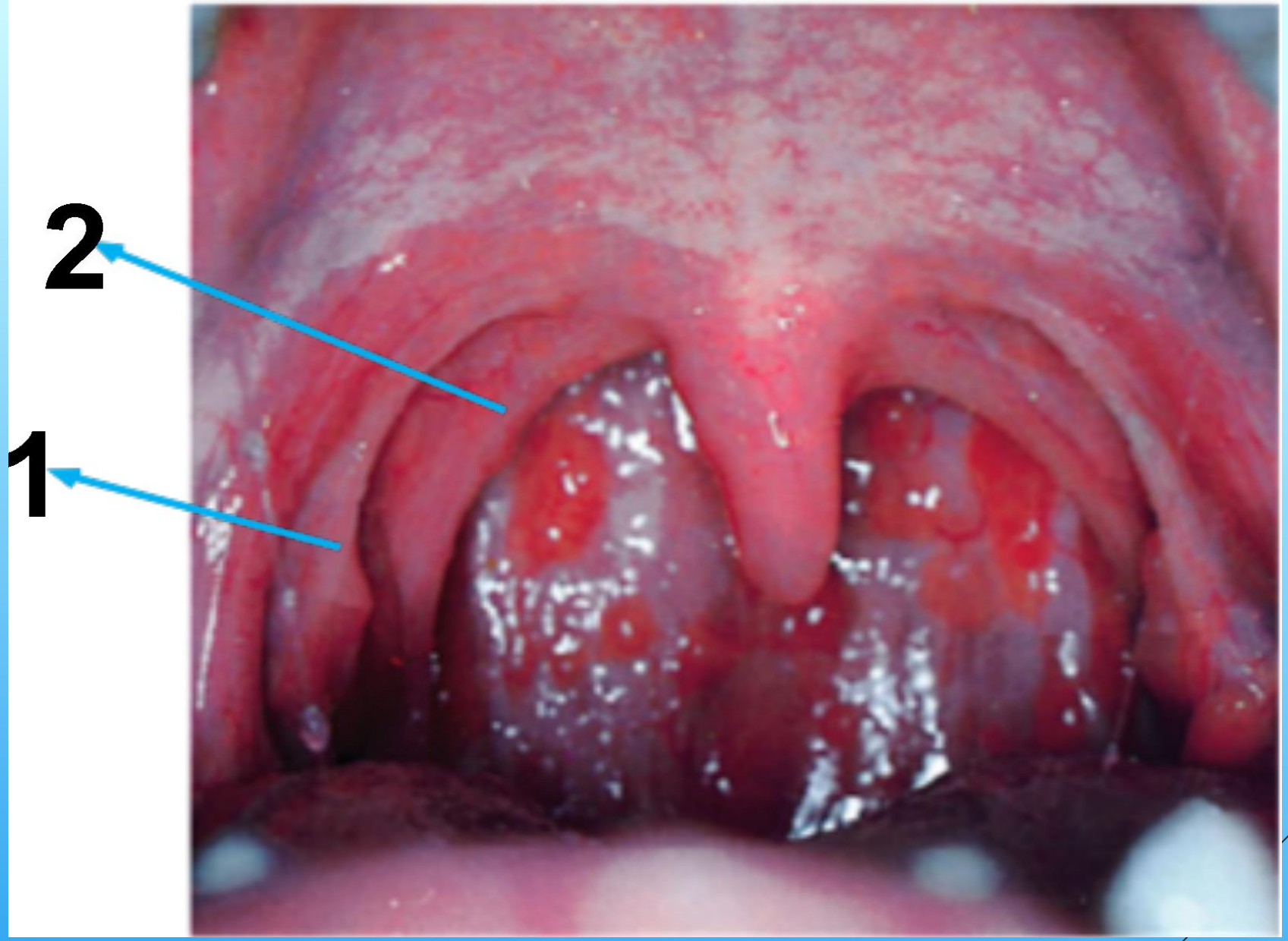


Oral aspect of the hard palate.

DIGESTIVE TRACT

B. Soft palate

- ⇨It has attached (upper) border & Free (lower) border.
- ⇨The lower border Bounds the oro-pharyngeal isthmus
- ⇨Shows: Uvula, Palatoglossal fold & Palatopharyngeal fold.



1: Palatoglossal Arch (Fold)
2: Palatopharyngeal Arch (Fold)

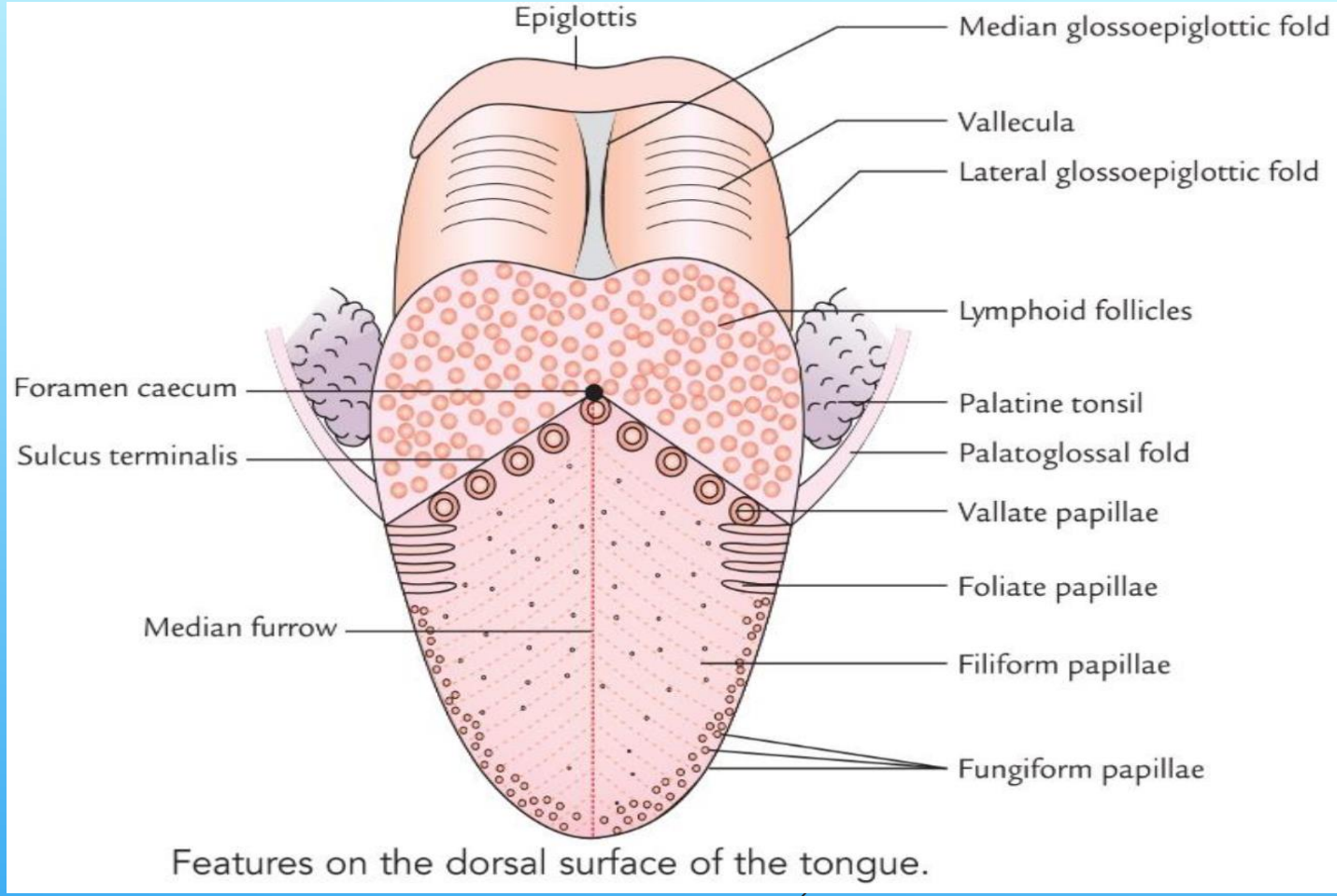
DIGESTIVE TRACT

C. The Tongue

- **Definition: a muscular organ formed of mass of muscles covered by mucous membrane**

- **Functions:** the tongue performs the following functions:

1. **Taste.**
2. **Speech.**
3. **Mastication.**
4. **Deglutition.**



Features on the dorsal surface of the tongue.

DIGESTIVE TRACT

- Parts of the tongue:

1. **Tip:** tapering anterior end & lies opposite to teeth & gums.

2. **Root:** Attached to the mandible and hyoid bone by group of muscles.

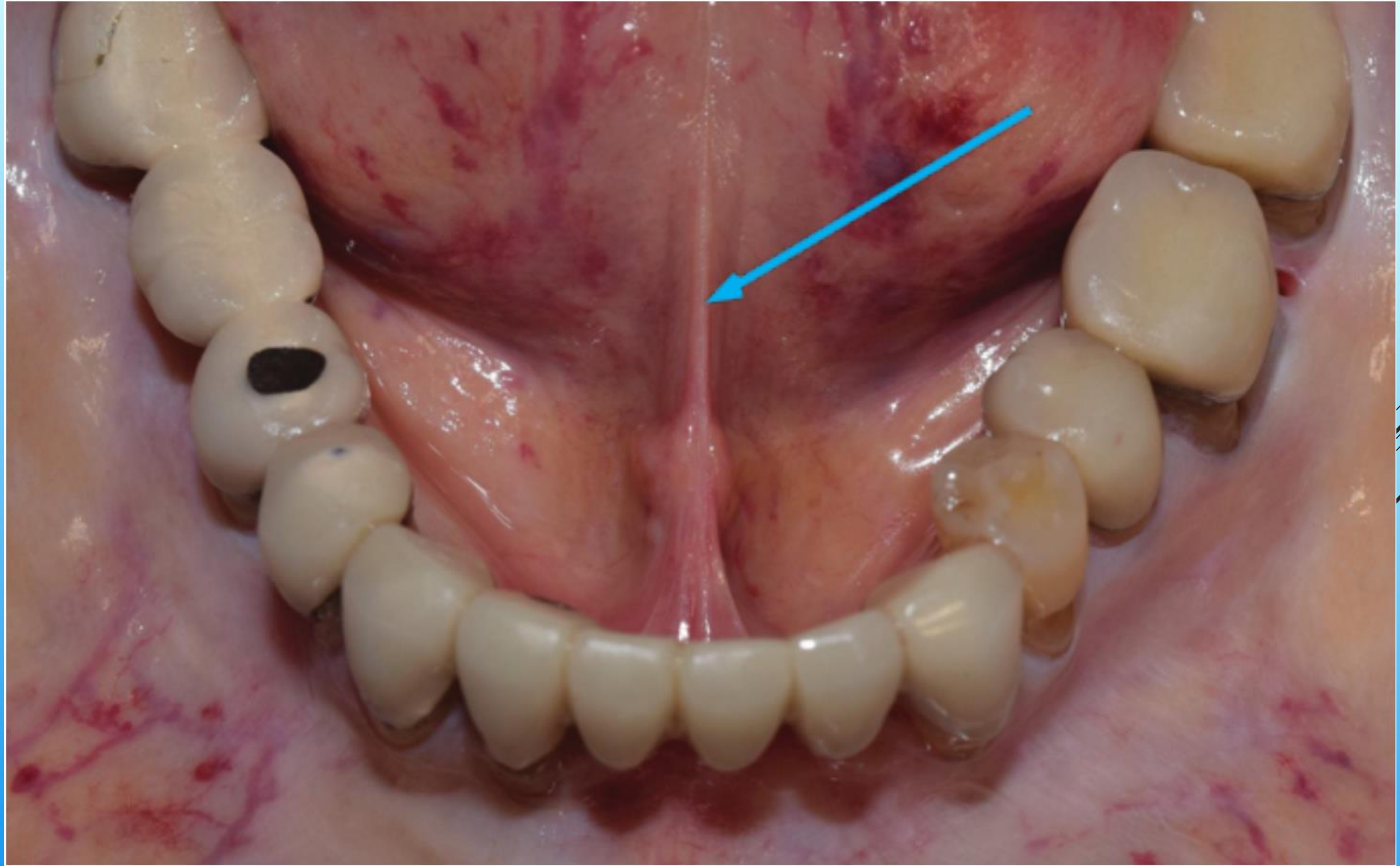
3. **Body:** which has:

A. Dorsal surface:

→ Divided by V-shaped groove (sulcus terminalis) which shows blind opening at the apex called foramen cecum into oral part (anterior 2/3) & pharyngeal part (posterior 1/3).

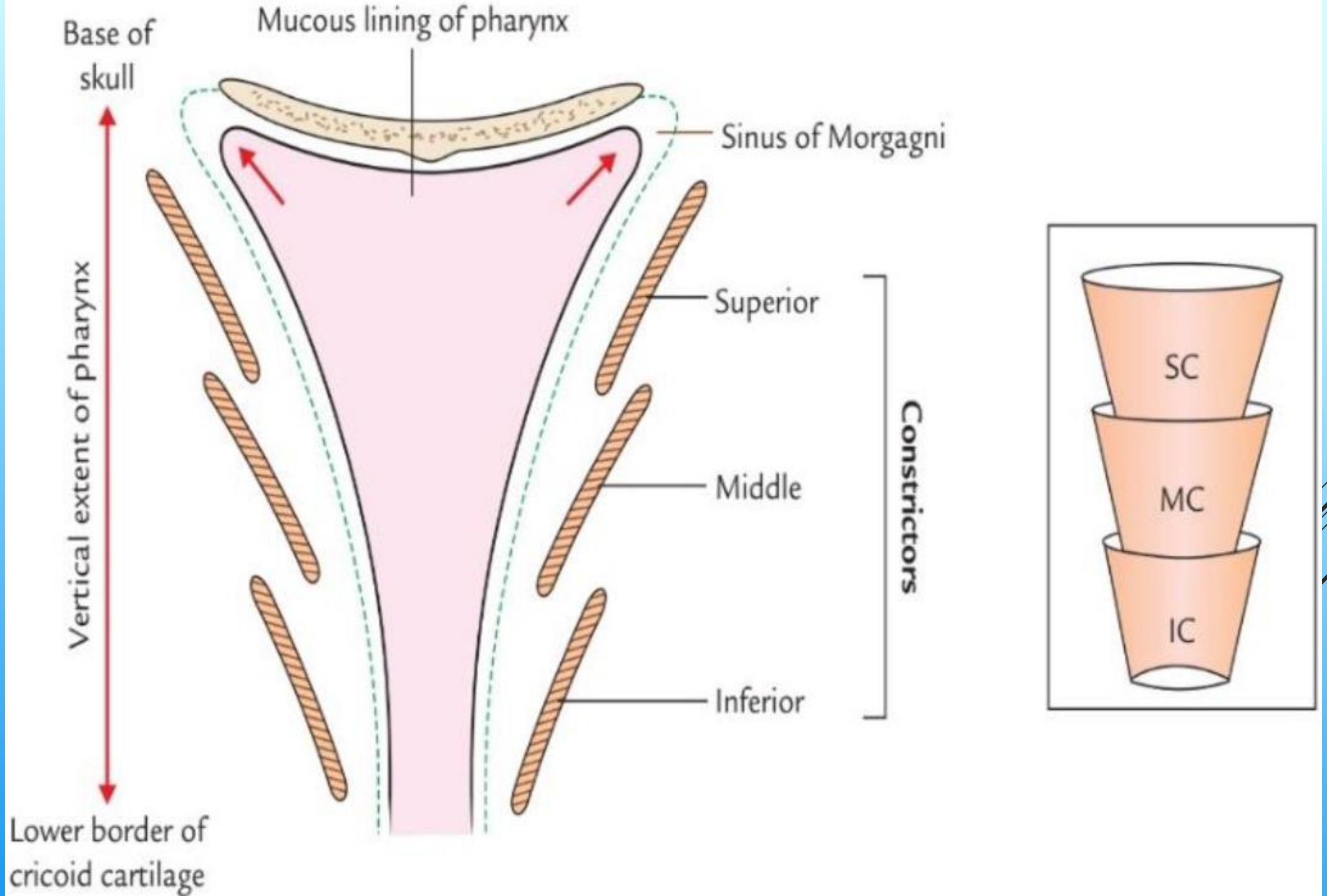
B. Ventral or Inferior surface:

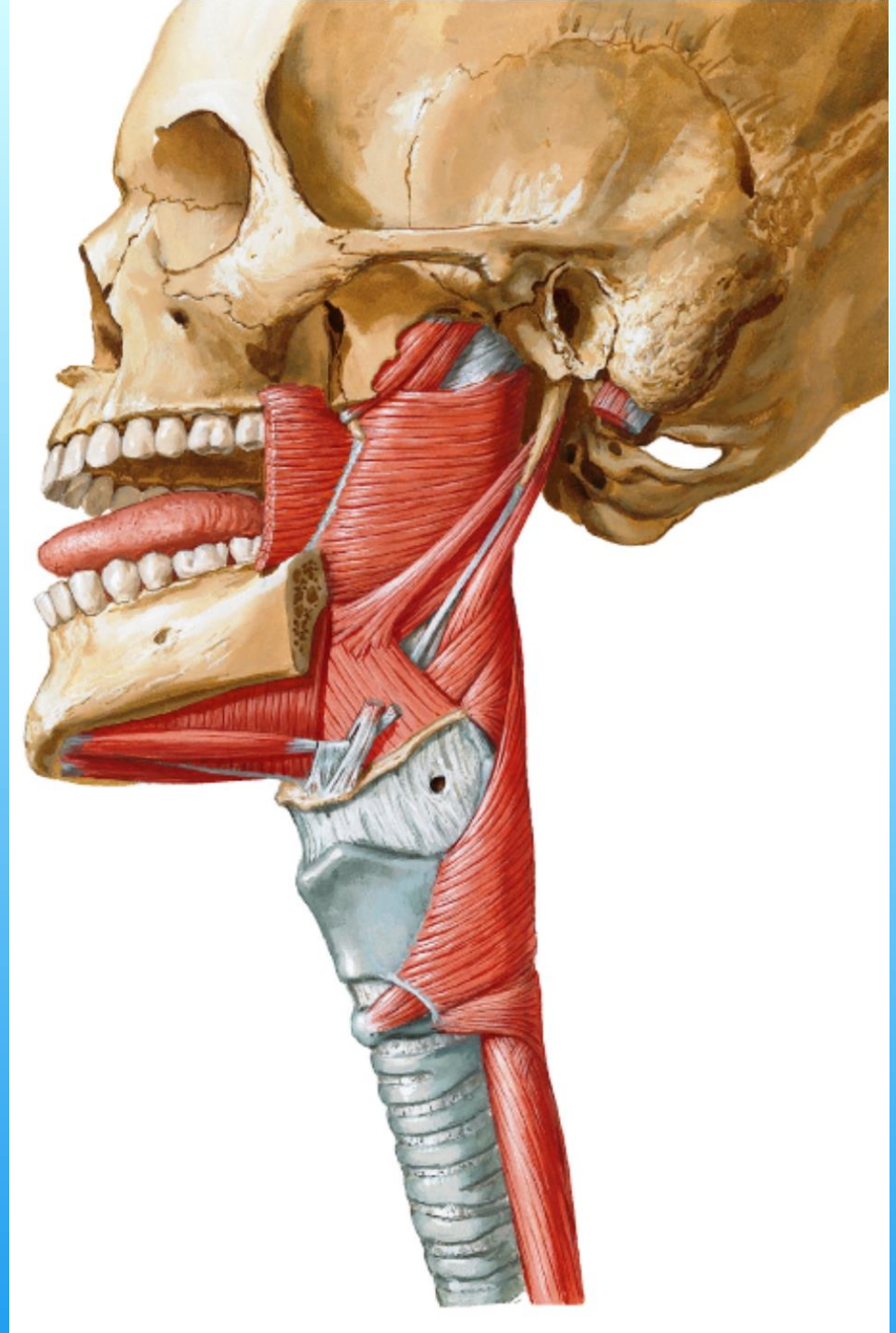
→connected to flour of mouth by frenulum linguae and covered by transparent mucosa



2. Pharynx

- **Definition:** it is a muscular tube Extending from base of skull to the lower border of C6 vertebra.
- **Size & shape:** 5 inches long & funnel shaped.
- **The wall of the pharynx has:**
  - Three circular muscles (superior, middle and inferior constrictors)
  - Three longitudinal muscles (stylopharyngeus, palatopharyngeus, and salpingopharyngeus muscles).
- **The main function of the pharynx:** It receives bolus of food from oral cavity and directs it to the esophagus.


Base of skull
Mucous lining of pharynx
Sinus of Morgagni
Vertical extent of pharynx
Superior
Middle
Inferior
Constrictors
Lower border of cricoid cartilage
SC
MC
IC



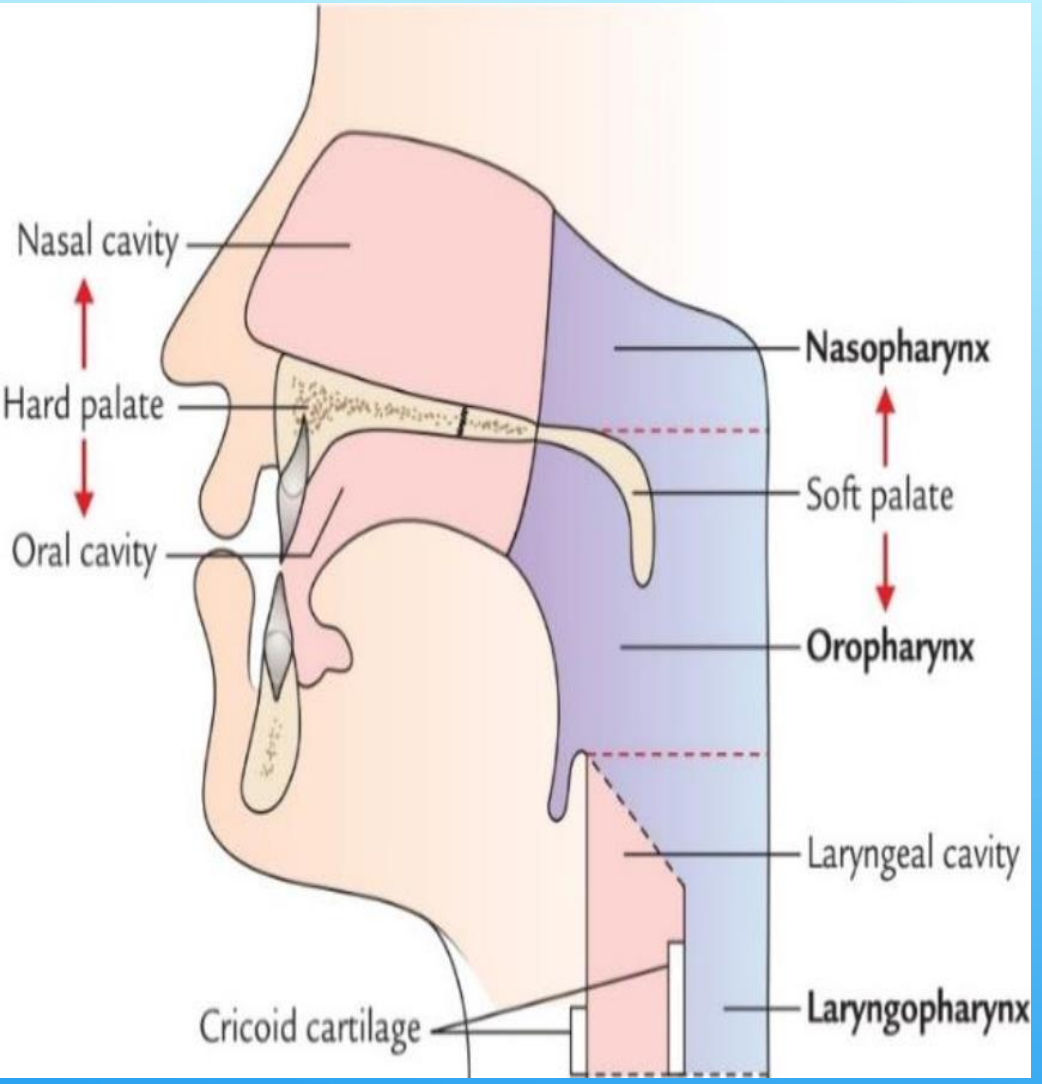
DIGESTIVE TRACT

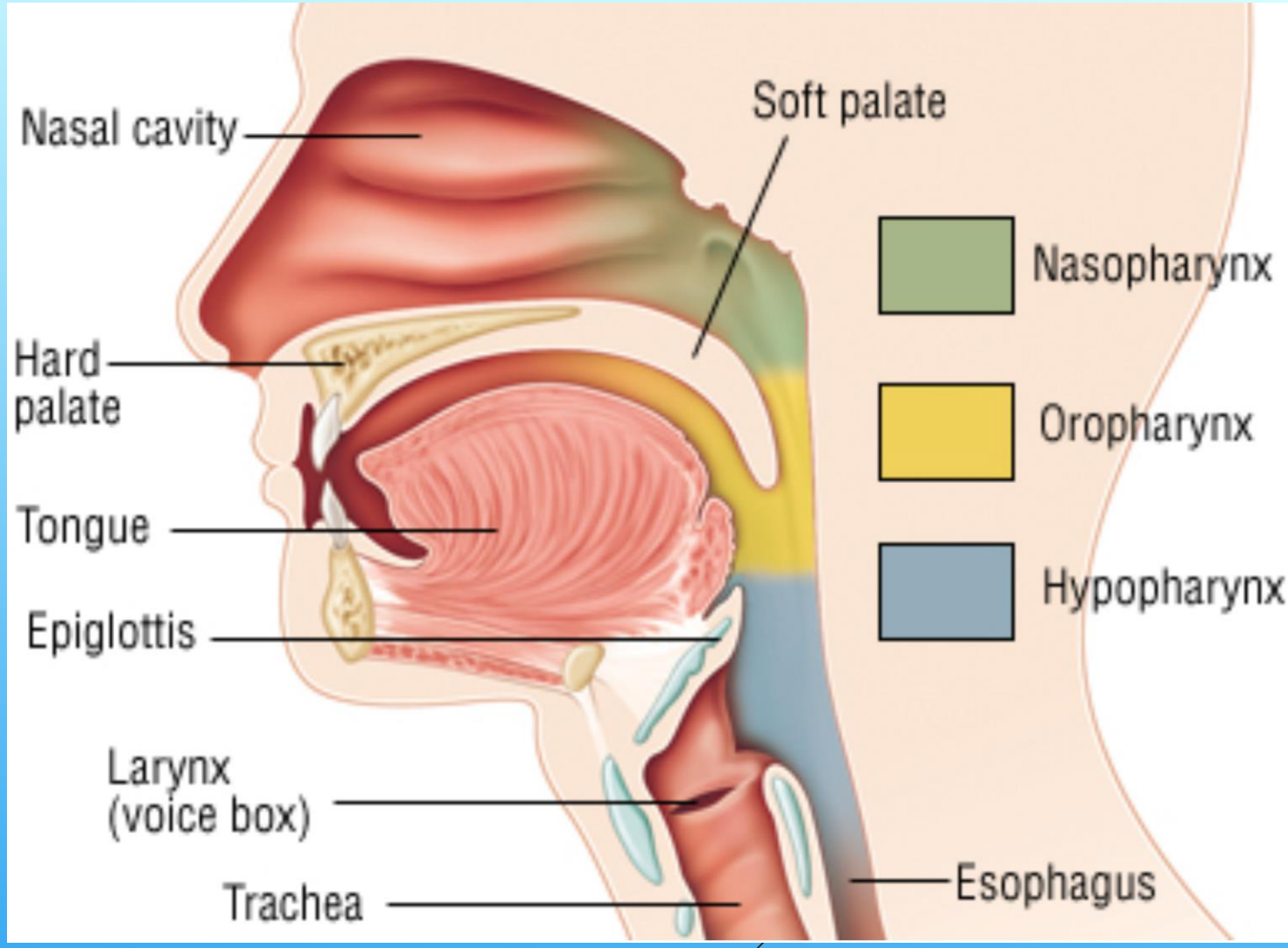
Function of the pharynx:

- The successive contraction of the constrictor muscles propels the bolus of food down into the esophagus.

- The longitudinal muscles elevate the pharynx and larynx during swallowing.

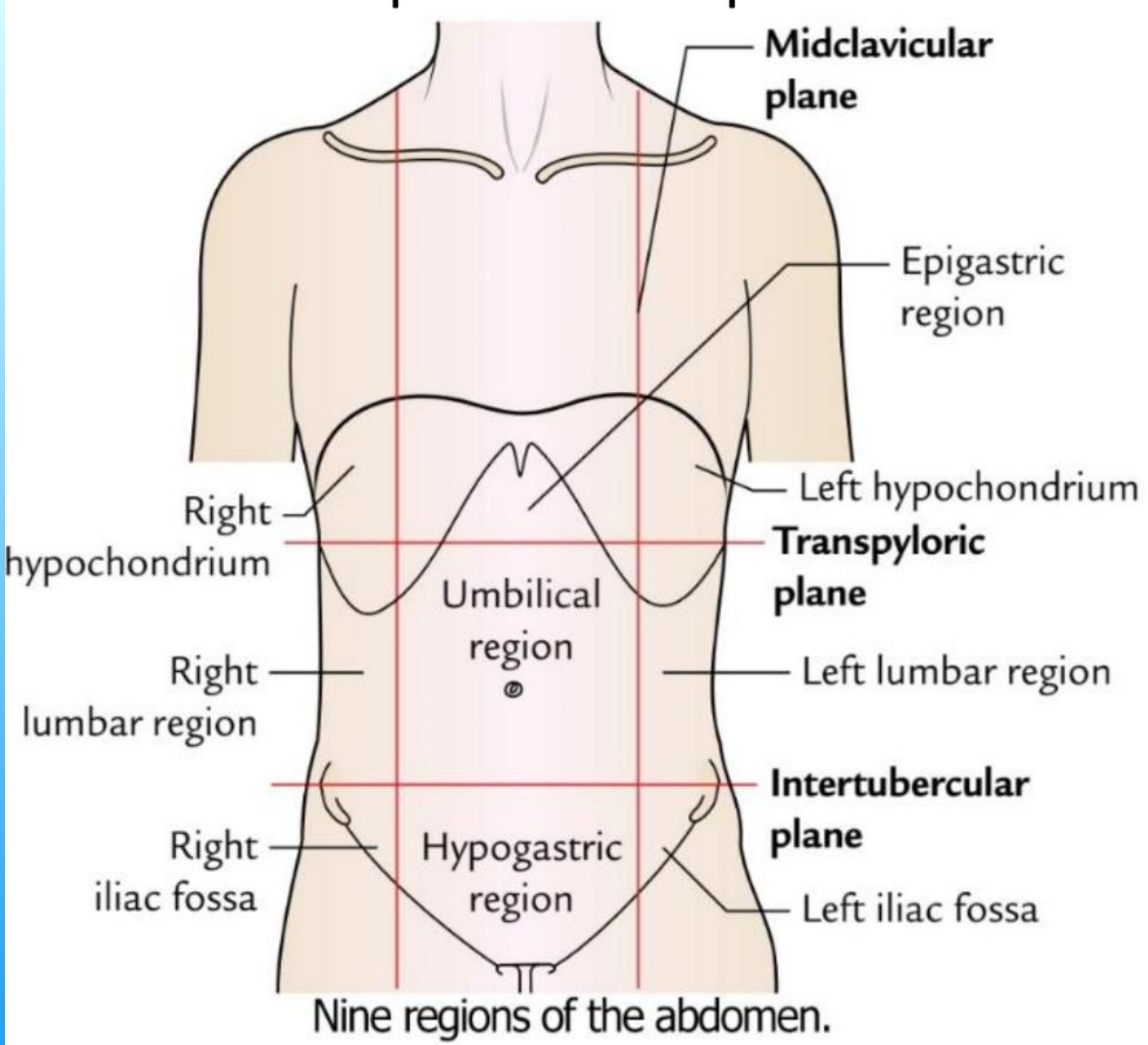
DIGESTIVE TRACT
Parts of the pharynx





DIGESTIVE TRACT

Regions of the Abdominal Cavity



Nine regions of the abdomen.

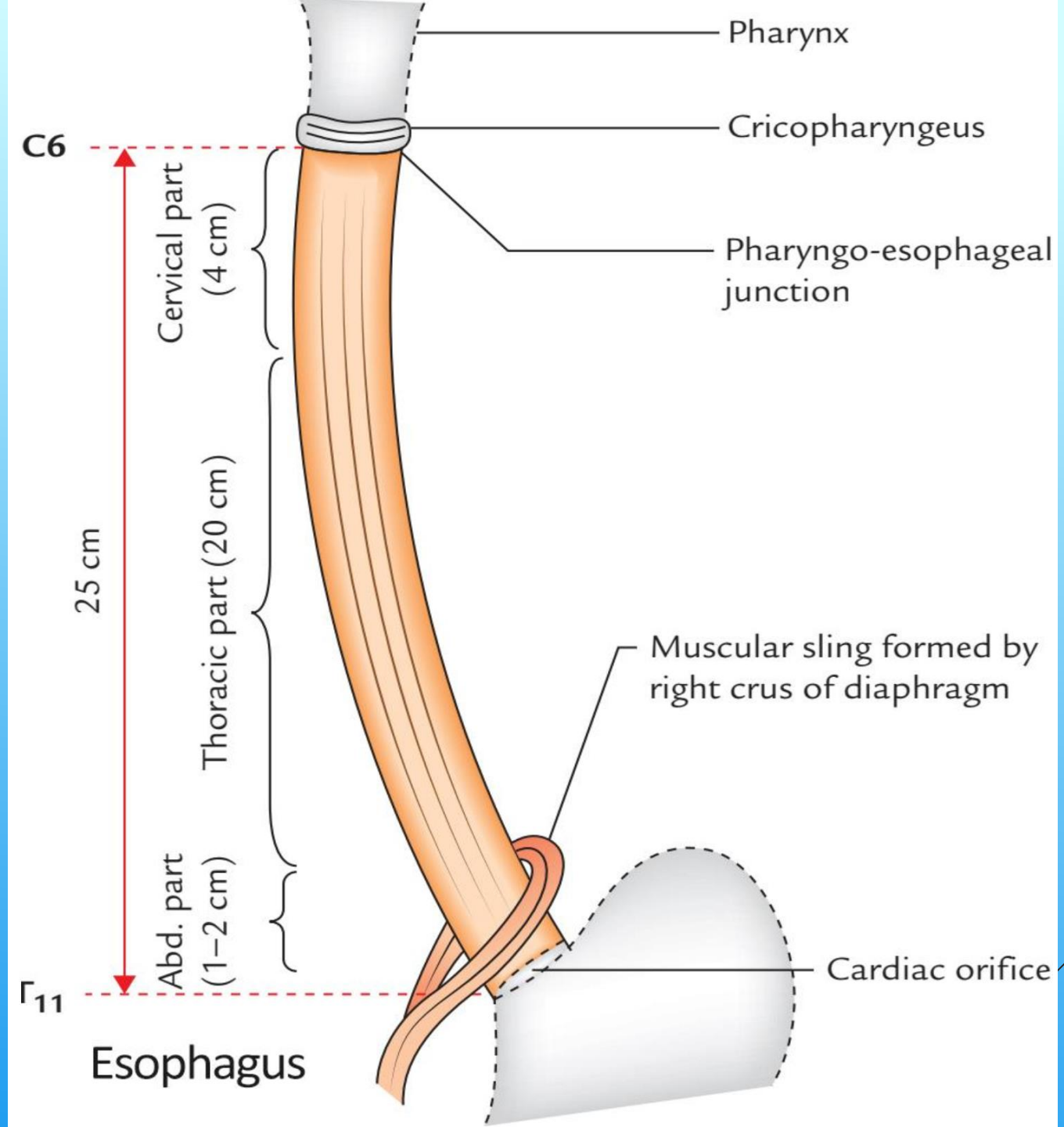
DIGESTIVE TRACT

3. Oesophagus

- It is a muscular tube (continuation of pharynx) which extends from the level of 6th cervical vertebra (lower border of cricoid cartilage) to the cardiac end of stomach.
- Parts:

1. A short cervical part.
2. A long thoracic part.
3. A short abdominal part which opens in the stomach.

- Esophagus transports bolus of food from pharynx to stomach by peristaltic movements.


Pharynx
Cricopharyngeus
C6
Cervical part (4 cm)
Pharyngo-esophageal junction
25 cm
Thoracic part (20 cm)
Muscular sling formed by right crus of diaphragm
Abd. part (1–2 cm)
Cardiac orifice
Esophagus

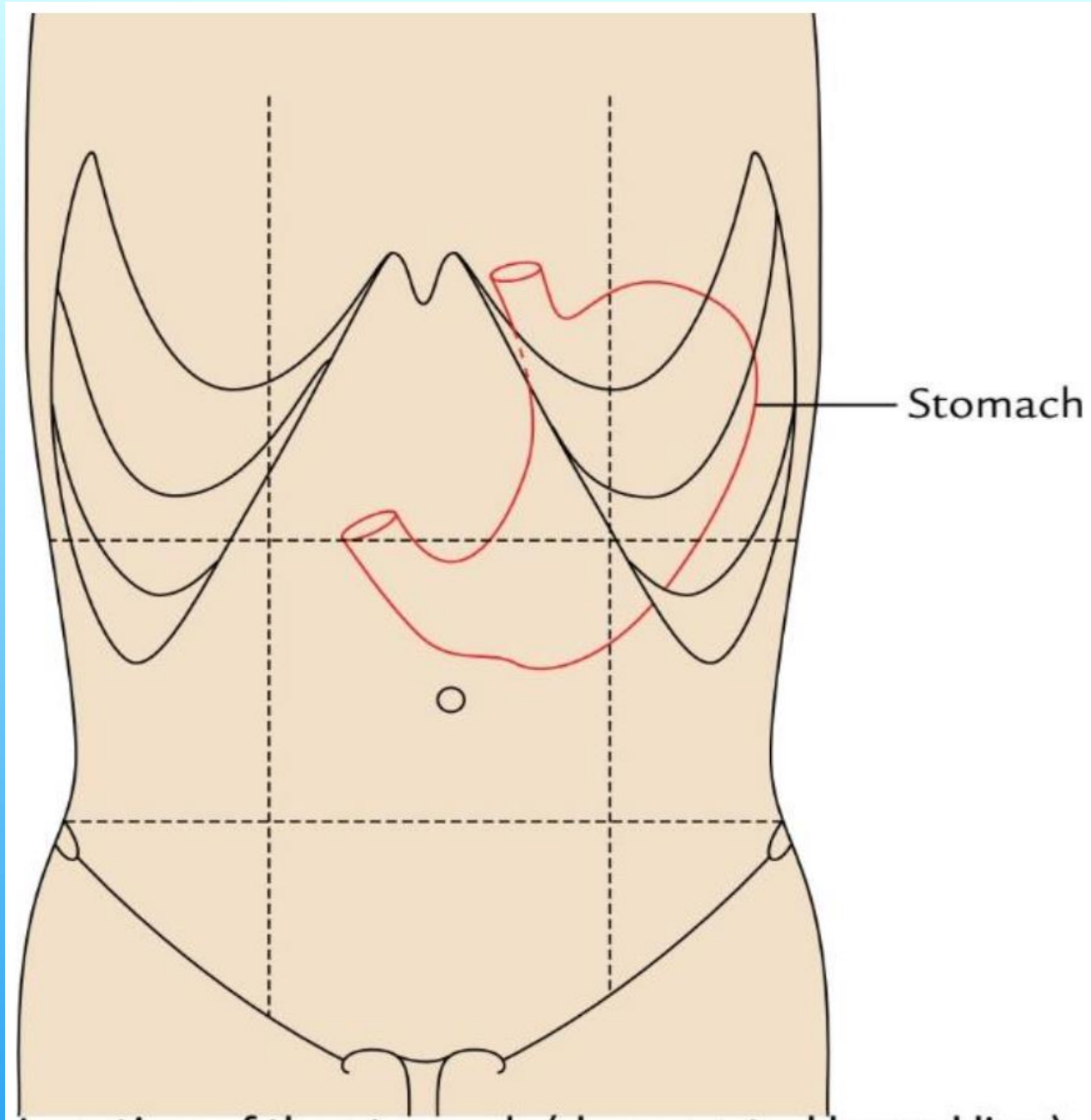
DIGESTIVE TRACT

4. Stomach

- **Definition:** the widest & most distensible part of the G.I.T.

- **Site:** LT. hypochonderium, epigastrium& umbilical regions.

- **Shape:** J- shaped (commonest shape)



Location of the stomach (demarcated by red line).

DIGESTIVE TRACT

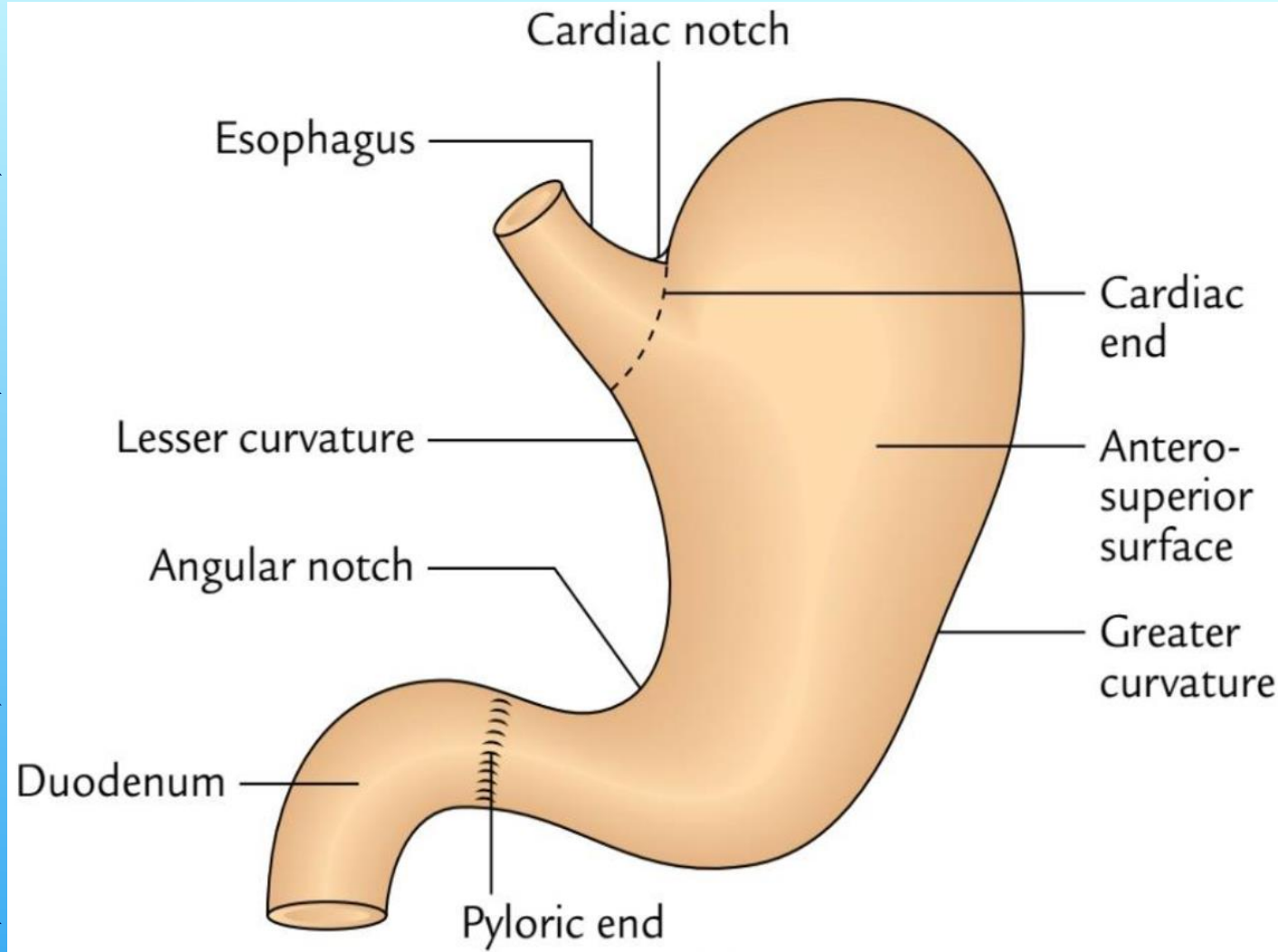
- **The stomach has:**

a) 2 orifices: cardiac & pyloric

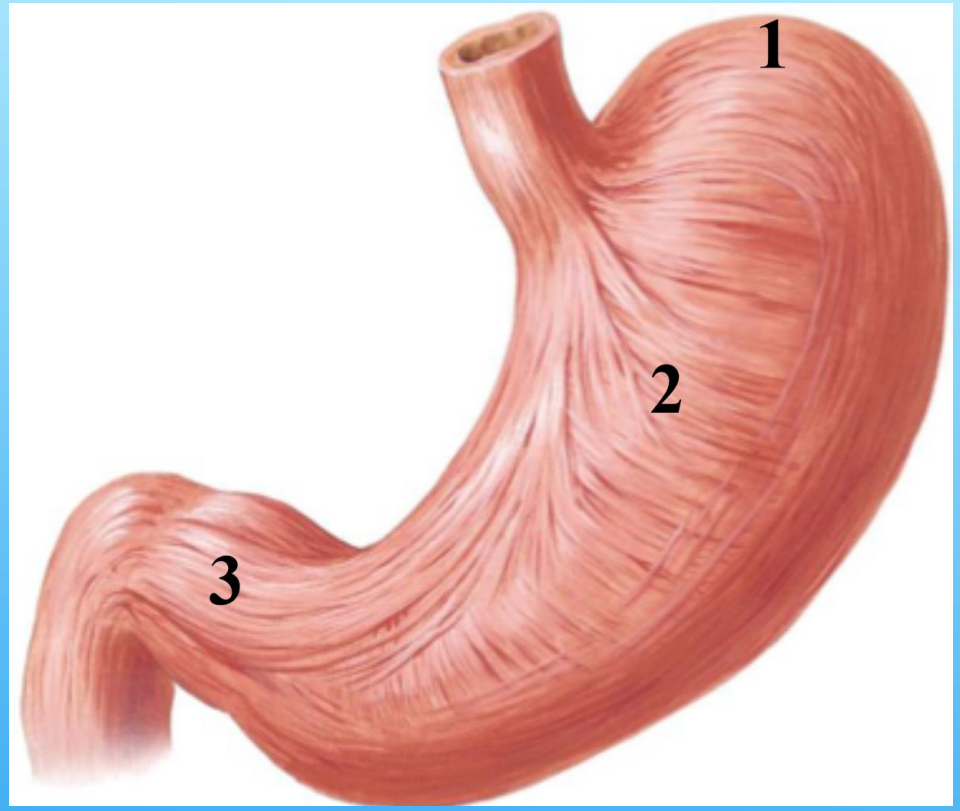
b) 2 borders: lesser & greater curvatures

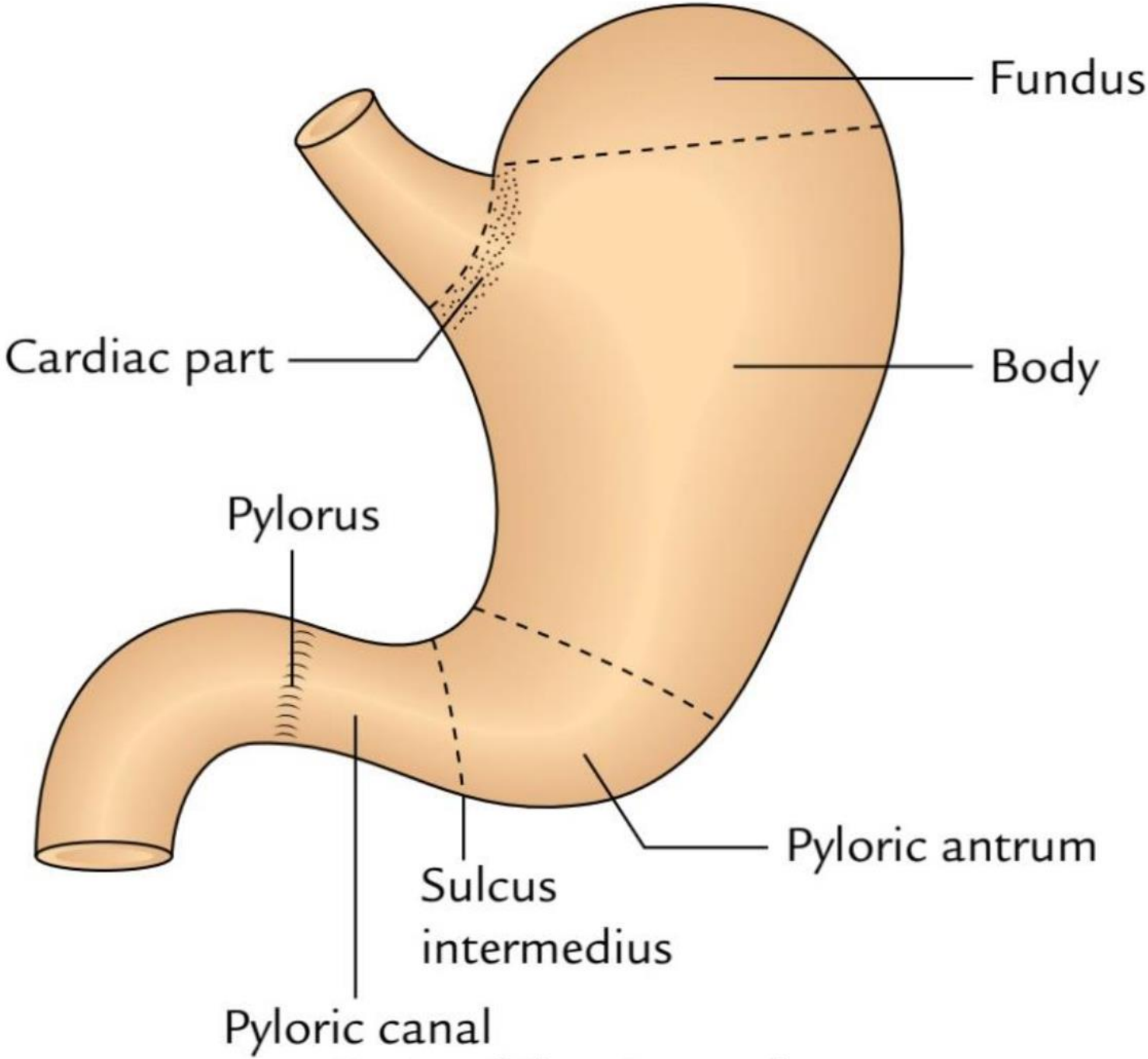
c) 2 surfaces: anterosuperior & posteroinferior

d) 3 parts: fundus, body & pyloric part



External features of the stomach.





Parts of the stomach.

GIT TRACT

The functions of the stomach are as follows:

1. To store food as it is mechanically churned with gastric secretions
2. To initiate digestion of proteins
3. To move the food into small intestine as a pasty material called chime.

5. Small Intestine

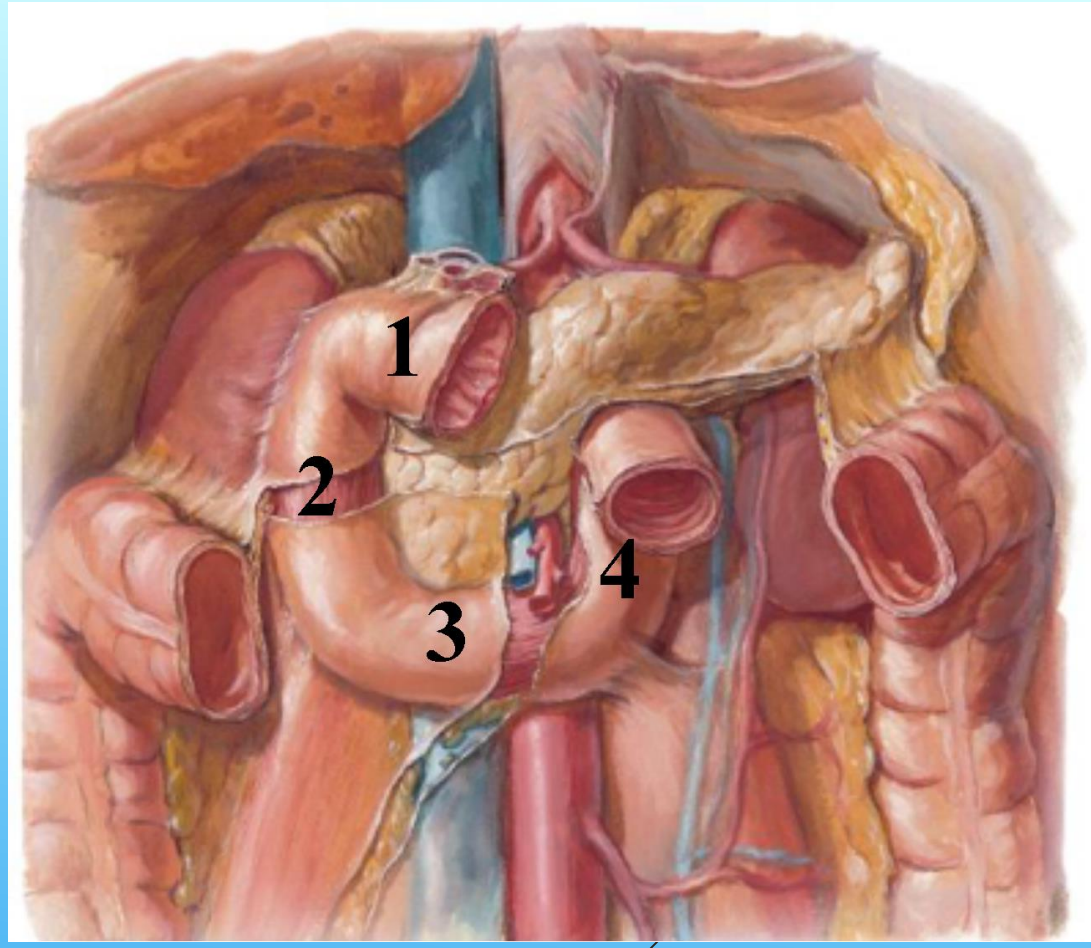
- The small intestine is a long hollow muscular tube about 6 m (20 ft) that connects stomach with the large intestine.
- It is located in the center of abdominal cavity surrounded by the large intestine.
- The small intestine is divided into three parts:

1. Duodenum
2. Jejunum
3. Ileum

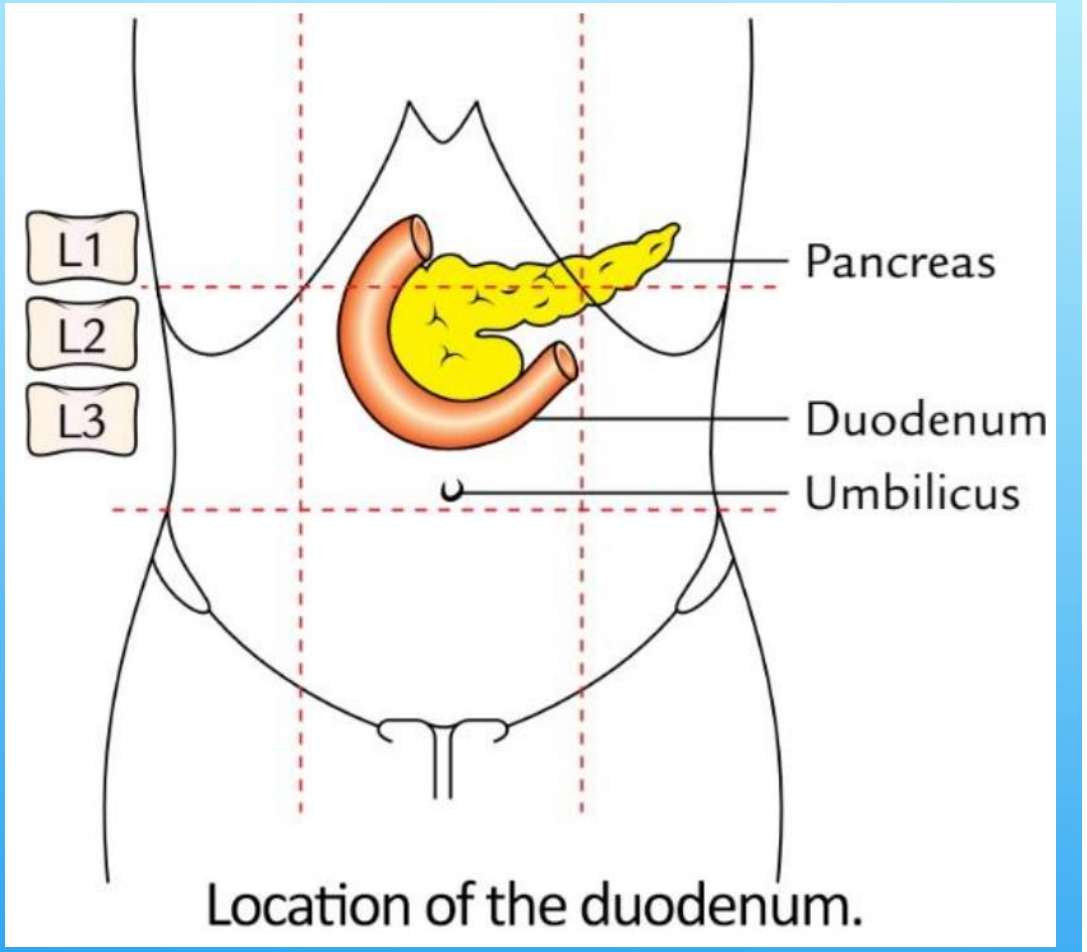
GIT TRACT

I. Duodenum:

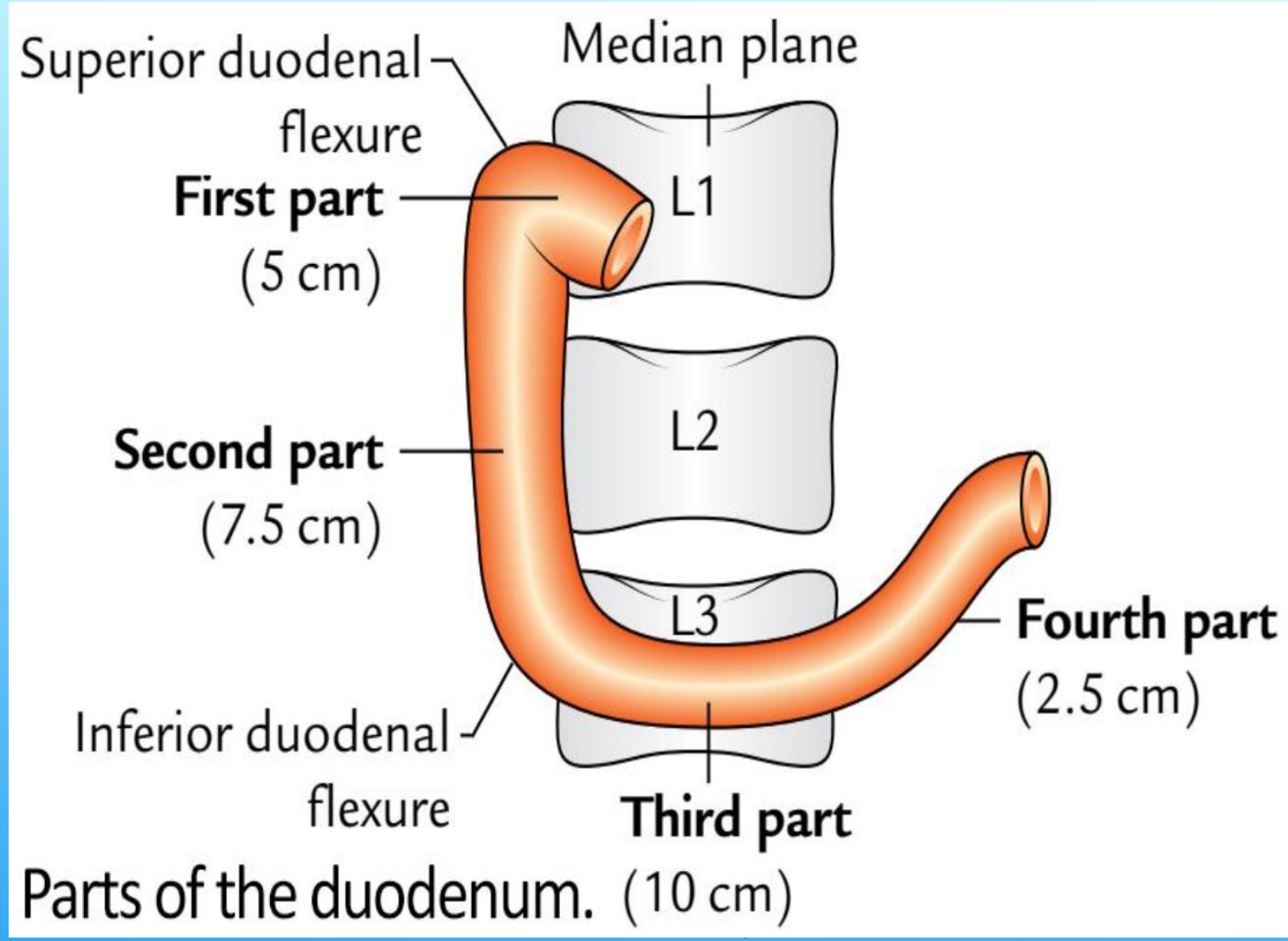
- It is C-shaped and formed of 4 parts.
- It contains the pancreas in its concavity.
- Openings in the second part of duodenum:
  1. The main pancreatic duct joins the common bile duct to open together.
  2. Accessory pancreatic duct.
- In the duodenum, digestion continues and absorption of water and digestive products begins.



GIT TRACT



Location of the duodenum.

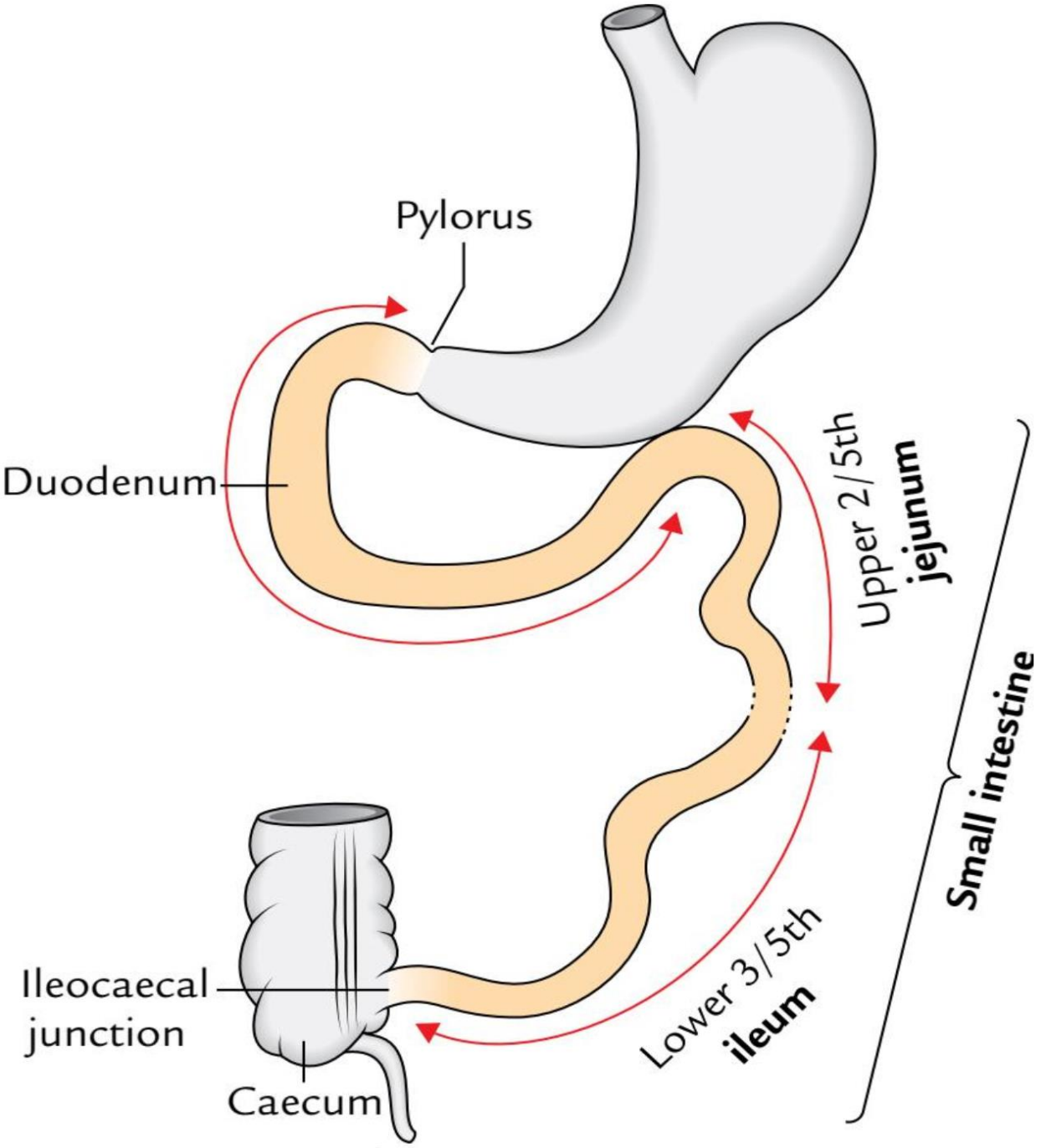


Parts of the duodenum.

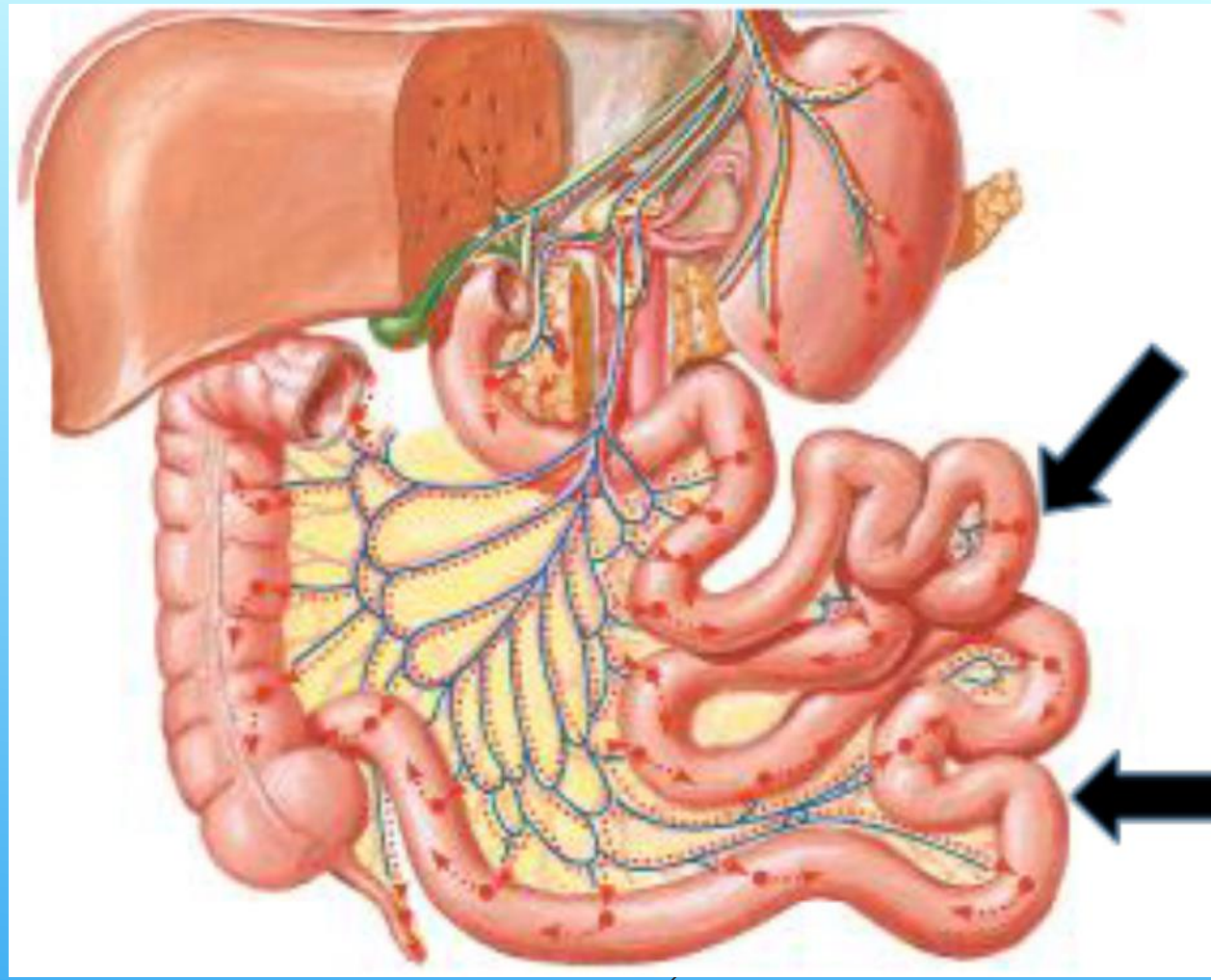
GIT TRACT

II. Free Parts of Small Intestine:

- These are the jejunum and ileum.
- The jejunum constitutes the proximal 2/5 and the ileum constitutes the distal 3/5.
- The ileum opens in the Caecum.
- They are freely mobile as they are completely covered by peritoneum and suspended by a peritoneal fold called mesentery.
- The main function of small intestine is absorption of nutrients from digested food.



Parts of the small intestine.



GIT TRACT

6. Large Intestine

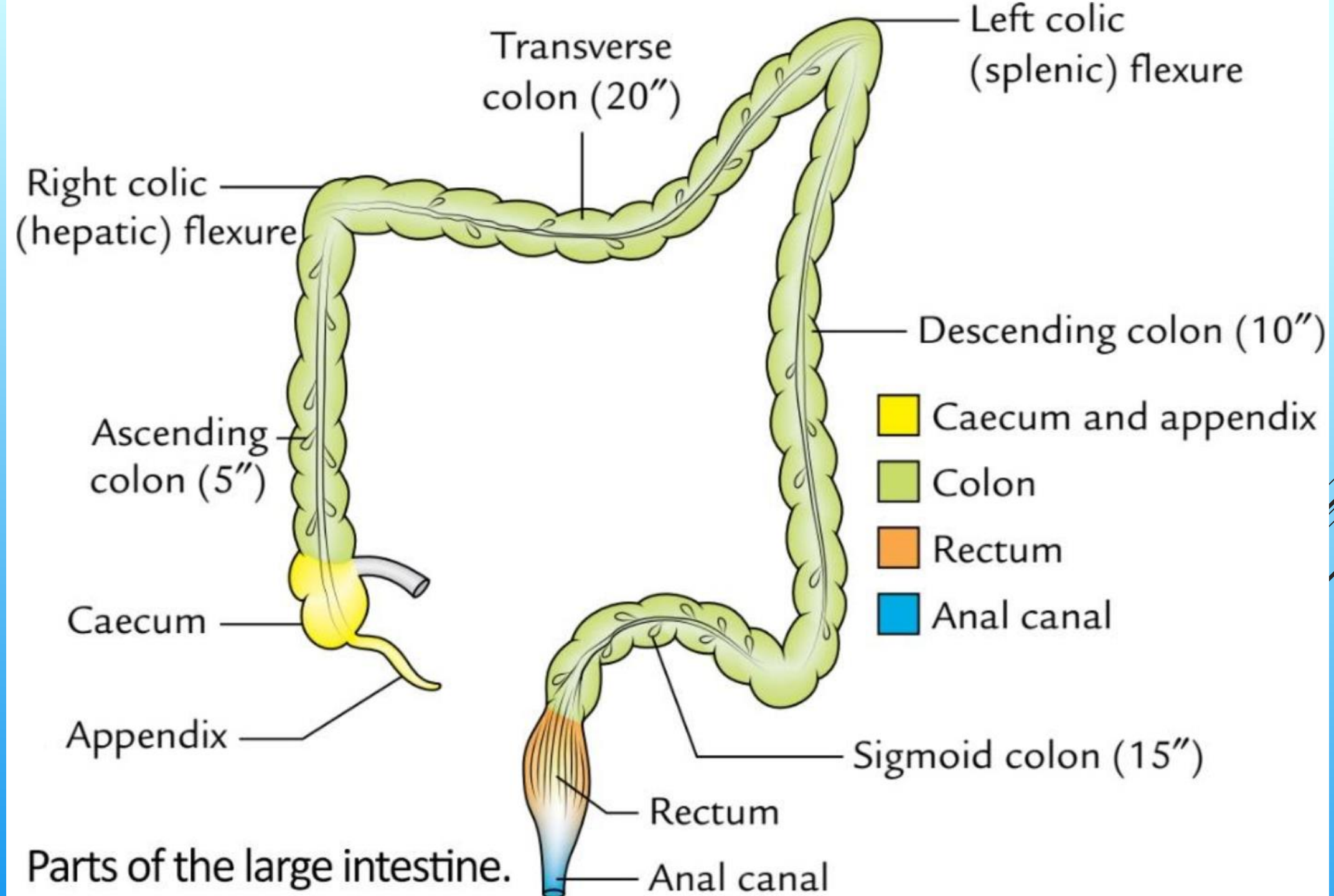
- **Length:** about 1.5 m long and
- **Extensions:** from the caecum in the right iliac fossa to the anus in the perineum.
- **Functions:**

1. Absorption of water from fluid contents in it to help form the feces.
2. Storage, lubrication, and expulsion of feces.
3. Synthesis of vitamin B complex by normal bacterial flora present its lumen.
4. Protection from invasion by microorganisms by its mucoid secretion which is rich in IgA group of antibodies.

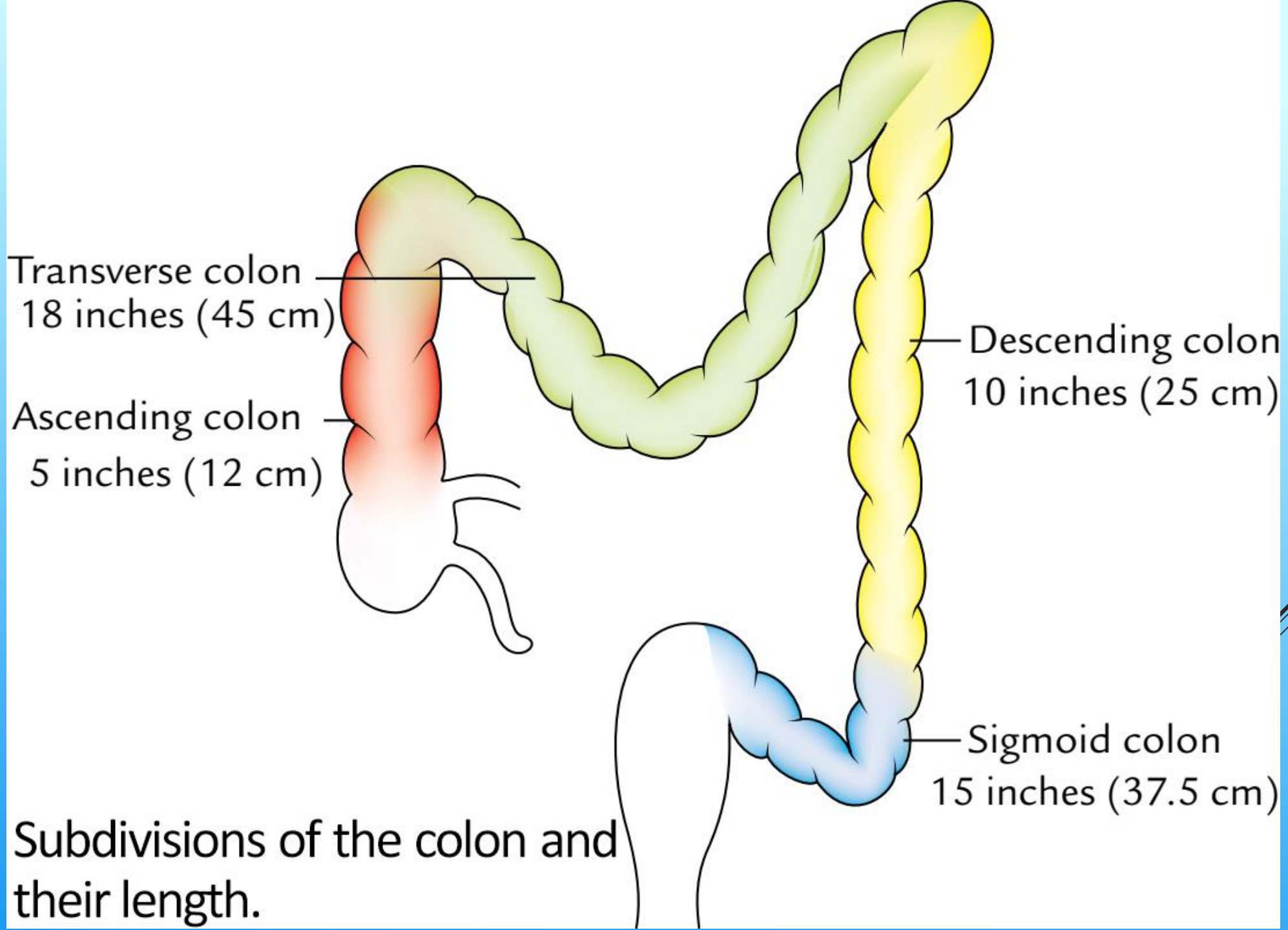
GIT TRACT

- **Parts:** divided into the following four parts:

1. Caecum and appendix.
2. Colon: is further divided into four parts:
    i. ascending colon.
    ii. transverse colon.
    iii. descending colon.
    iv. sigmoid colon
3. Rectum.
4. Anal canal.



Parts of the large intestine.

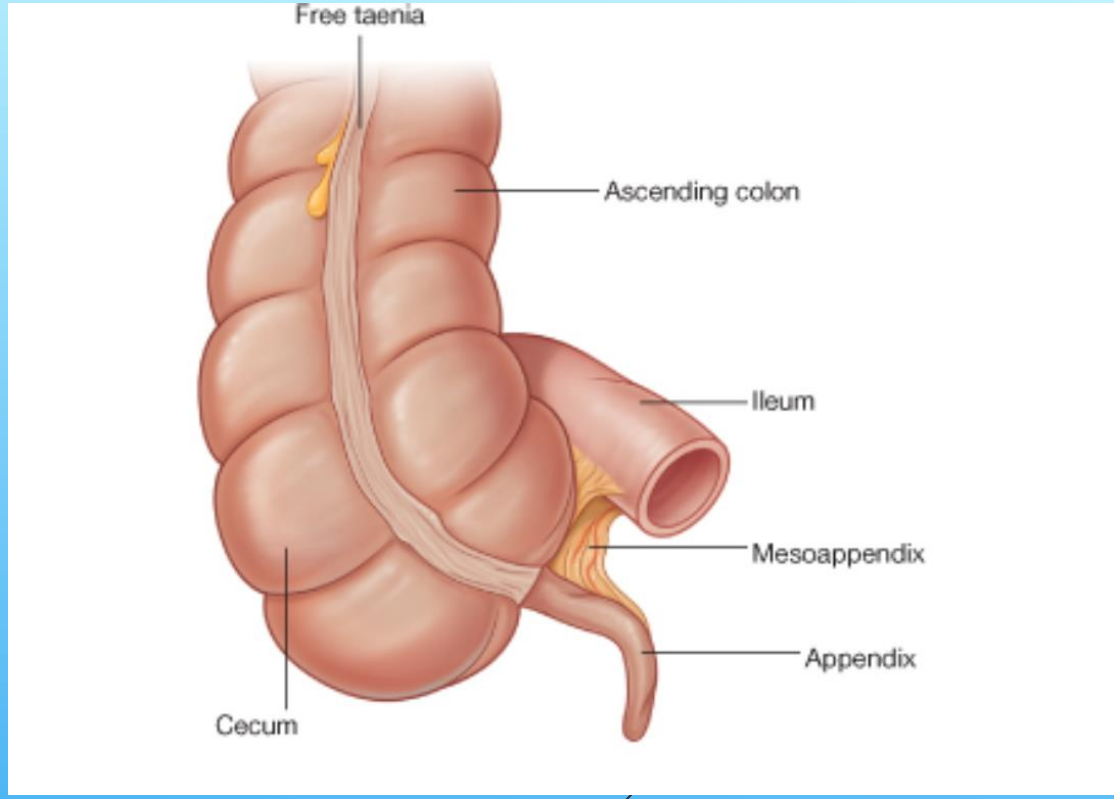


Subdivisions of the colon and their length.

GIT TRACT

1. Caecum:

- It is a sac which receives the ileum and opens in the ascending colon.
- The vermiform appendix is attached to the caecum.
- As the appendix and the umbilicus are supplied by the same nervous segment, the pain from the appendix is referred to the umbilicus.



GIT TRACT

2. Colon

i. Ascending colon:

- It extends from the caecum to the right colic (hepatic) flexure.

ii. Transverse colon:

- It extends from the hepatic flexure to the left colic (splenic) flexure.
- It is completely covered by peritoneum and suspended by a peritoneal fold called transverse mesocolon.

iii. Descending colon:

- It extends from the splenic flexure to the sigmoid colon.

GIT TRACT

vi. Sigmoid colon (Pelvic colon):

- It extends from the end of descending colon, enters the pelvis and takes an S-shape.

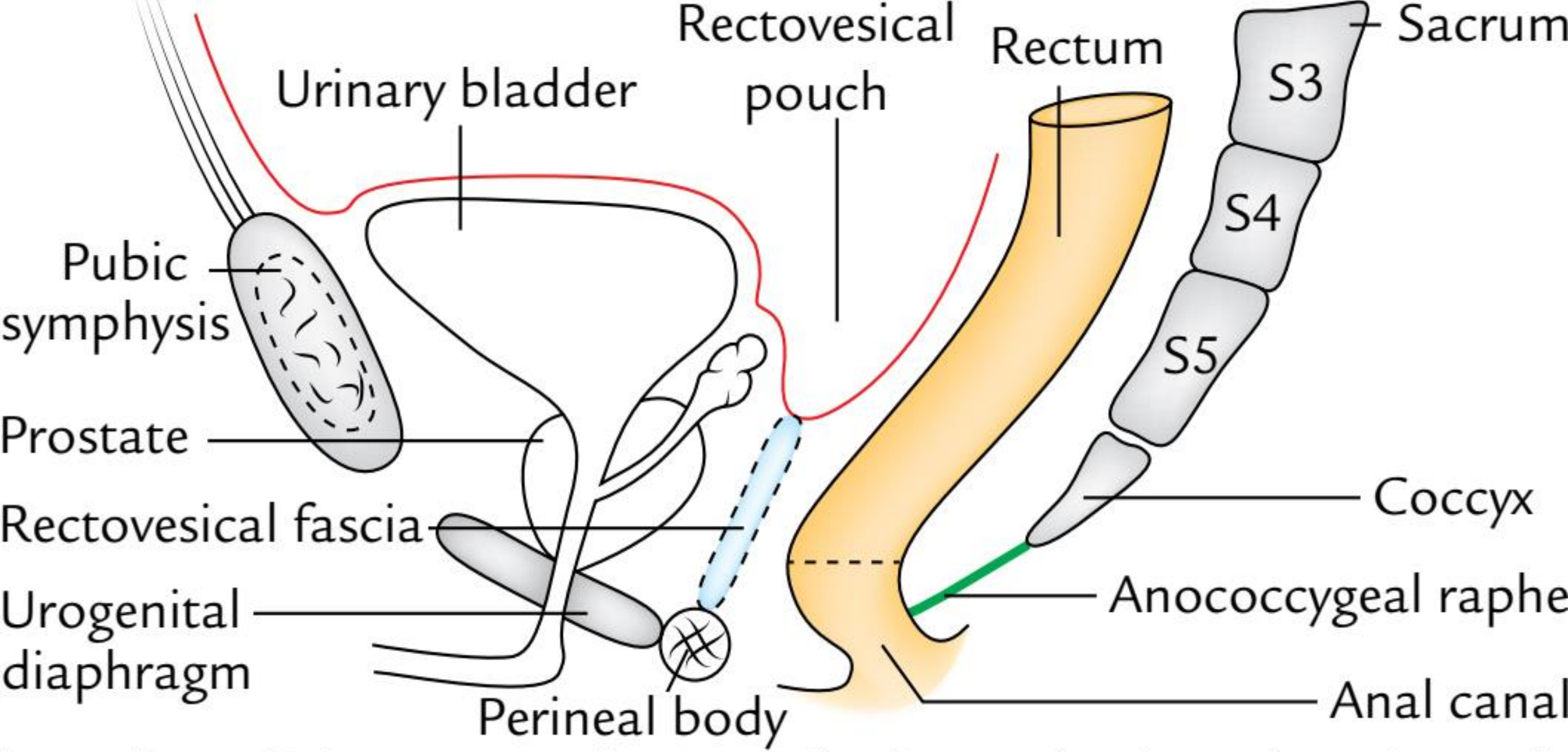
It ends in front of the 3rd sacral vertebra where the rectum begins.

3. Rectum:

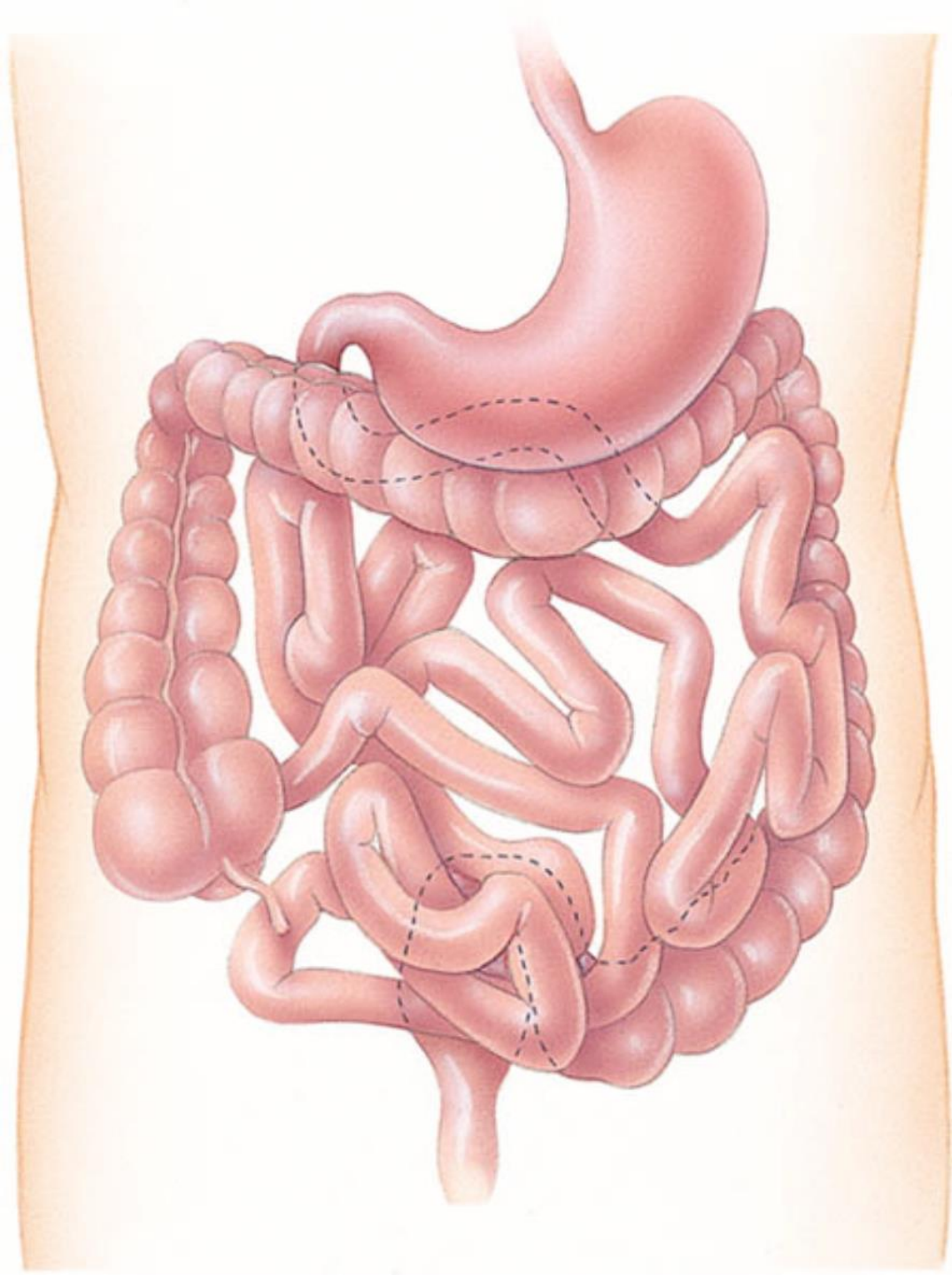
- It begins in front of the sacrum (at the level of 3rd sacral vertebra) and ends one inch in front and below the coccyx.

4. Anal canal:

- It begins one inch in front and below coccyx and ends at the anus.
- It is directed downward and posteriorly.



Location of the rectum (as seen in the sagittal section through the male pelvis).



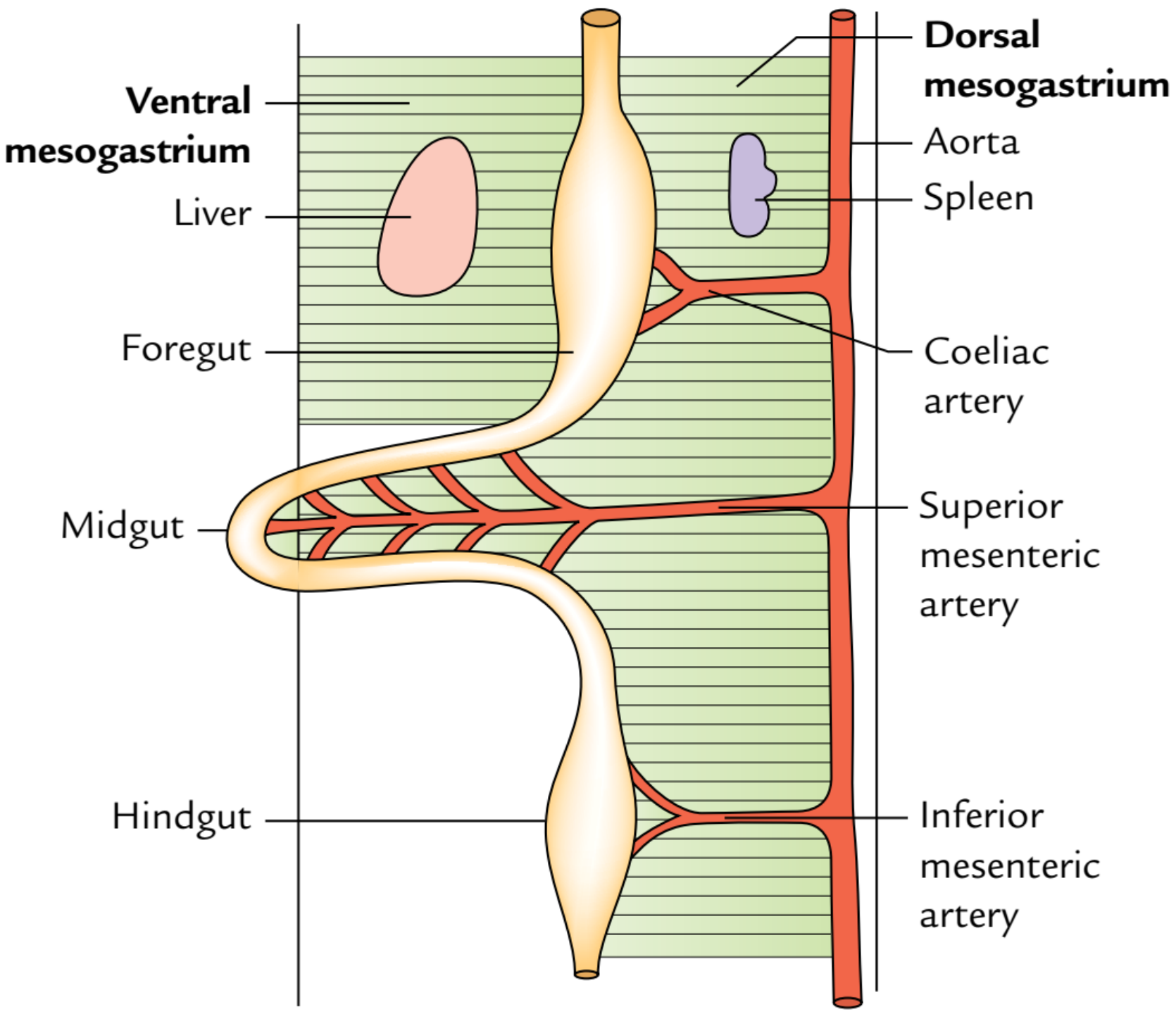
Embryological basis of GIT

- The developing gut is divided from above downward into three parts: foregut, midgut, and hindgut.
- Each part has its own artery—a ventral branch of the abdominal aorta.
  - The coeliac artery is the artery of foregut,
  - Superior mesenteric artery is the artery of midgut
  - Inferior mesenteric artery is the artery of hindgut
- The venous blood of the gut is drained by the portal vein.

GIT TRACT

The derivatives of the foregut, midgut, and hindgut are given in table.

Part	Derivatives
Foregut	Esophagus Stomach Upper half of the duodenum (up to the opening of common bile duct)
Midgut	Lower half of the duodenum (distal to the opening of common bile duct) Jejunum Ileum Appendix Caecum Ascending colon Right two-third of the transverse colon
Hindgut	Left one-third of the transverse colon Descending colon Sigmoid colon Rectum Upper part of the anal canal


Ventral mesogastrium
Liver
Foregut
Midgut
Hindgut
Dorsal mesogastrium
Aorta
Spleen
Coeliac artery
Superior mesenteric artery
Inferior mesenteric artery

From **distal esophagus** down to **proximal half of 2nd part of duodenum**.

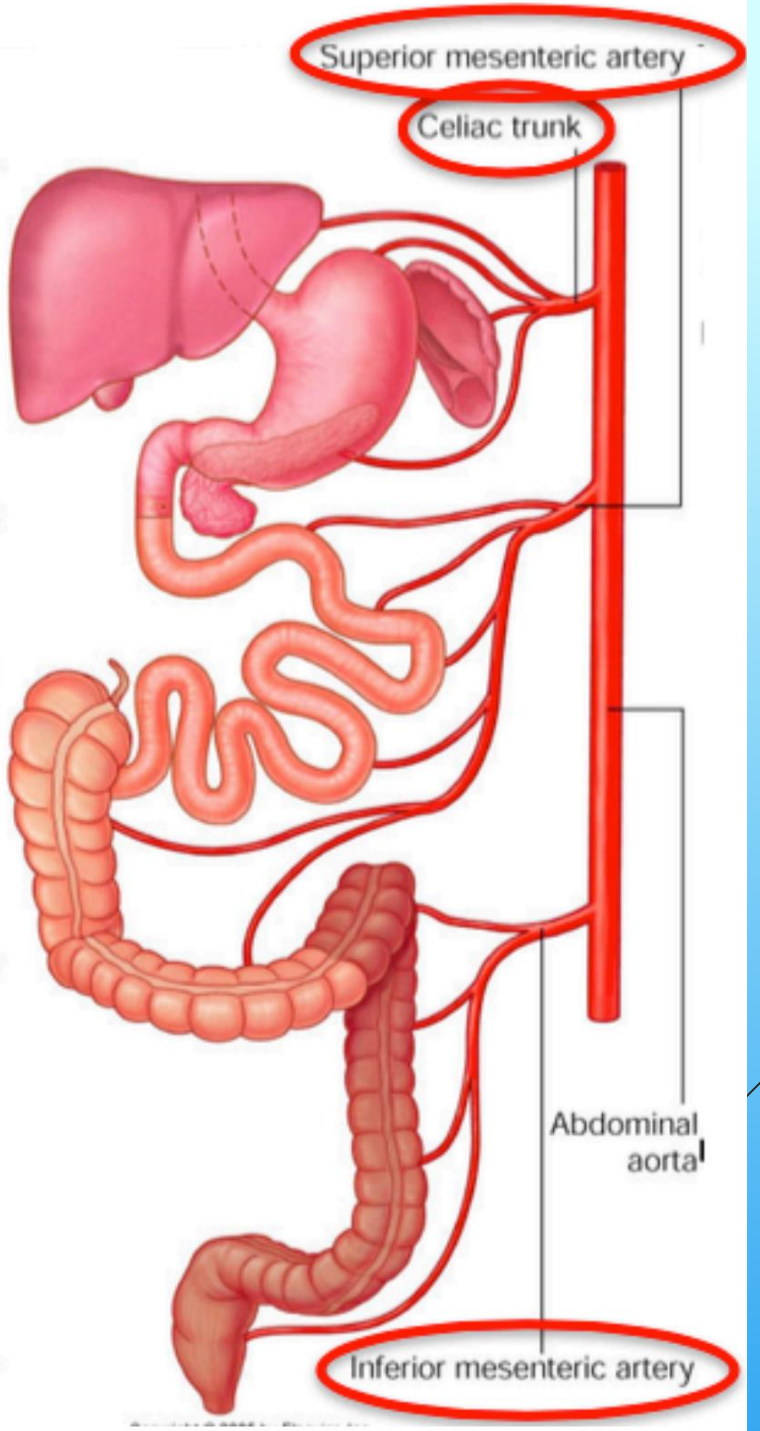
Foregut

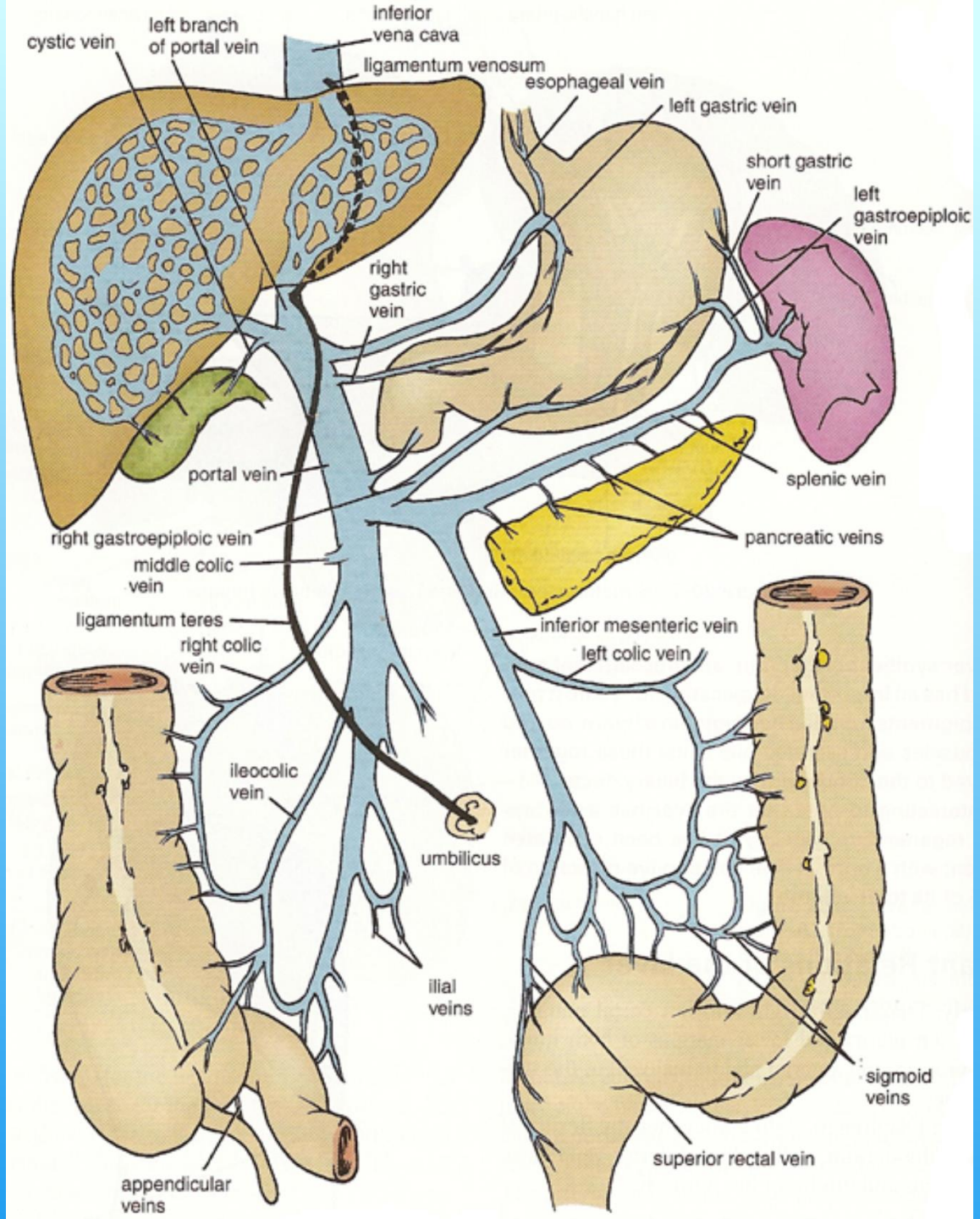
From **distal half of 2nd part of duodenum** down to **proximal 2/3 of transverse colon**.

Midgut

From **distal 1/3 of transverse colon** to **rectum**.

Hindgut




cystic vein
left branch of portal vein
inferior vena cava
ligamentum venosum
esophageal vein
left gastric vein
short gastric vein
left gastroepiploic vein
right gastric vein
portal vein
splenic vein
right gastroepiploic vein
pancreatic veins
middle colic vein
ligamentum teres
inferior mesenteric vein
right colic vein
left colic vein
ileocolic vein
umbilicus
ilial veins
sigmoid veins
superior rectal vein
appendicular veins

Major digestive glands

1. Salivary glands

- These are accessory glands of digestion that produce saliva.
- The saliva acts as a solvent in cleaning the teeth and dissolving the food chemicals so that they can be tasted.
- The salivary glands can be classified into two types:
  1. Minor salivary glands
  2. Major salivary glands
- The minor salivary glands are located in the mucous membranes of palate, cheeks and lips and they produce small quantity of saliva.

MAJOR DIGESTIVE GLANDS

Major salivary glands: they lie outside the oral cavity

1. **Parotid**
2. **Submandibular**
3. **sublingual**

The parotid gland is largest and located below and in front of the external ear.

The parotid duct opens into the **vestibule of mouth opposite the second upper molar tooth**.

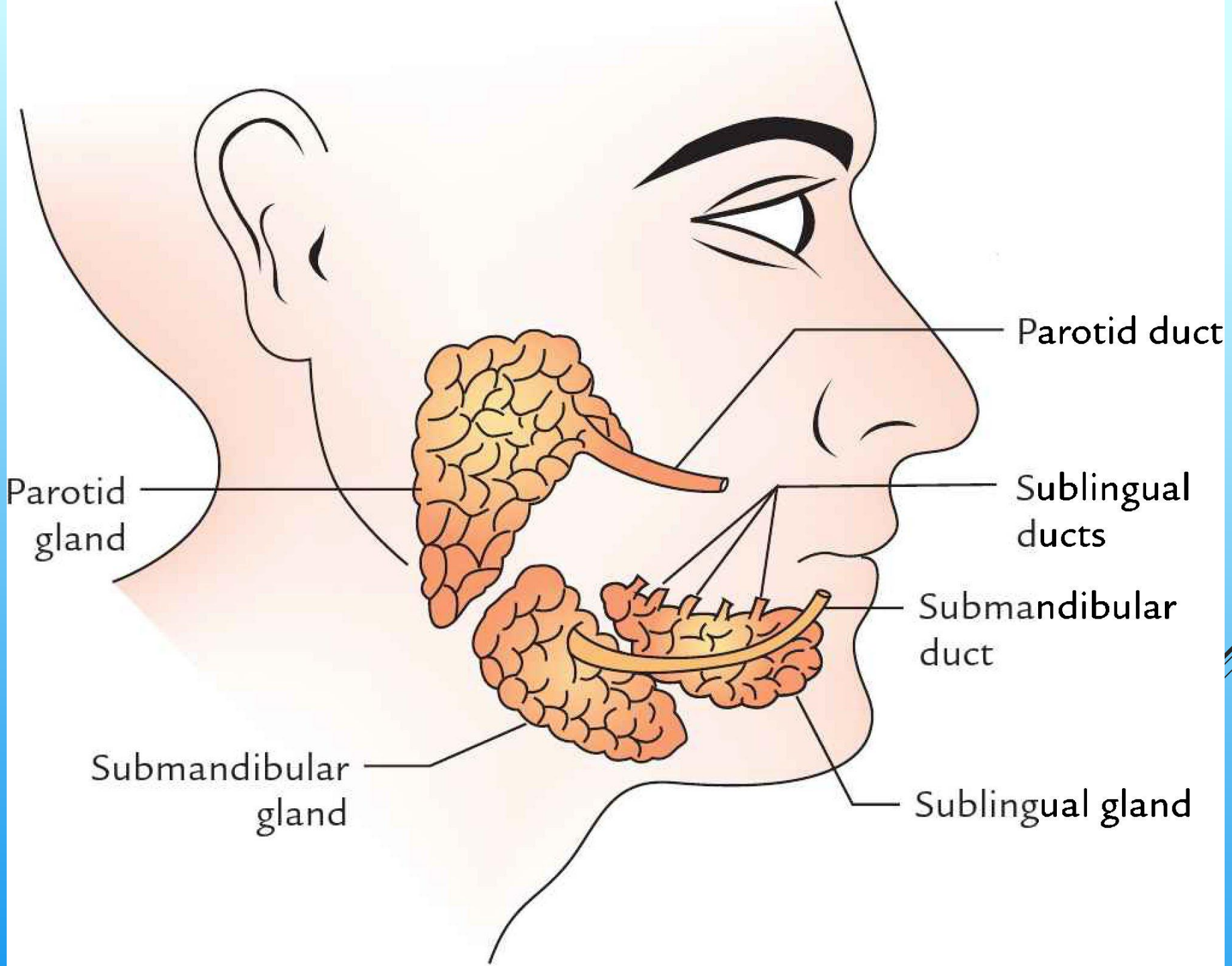
MAJOR DIGESTIVE GLANDS

The submandibular gland is located inside and below the mandible.

The submandibular duct opens in the **floor of oral cavity proper onto a papilla on the side of root of frenulum of tongue** behind the lower incisor teeth.

The sublingual gland lies underneath the mucosa of the floor of mouth on the side of the tongue.

The sublingual ducts, several in number and small, **open into the floor of mouth**.


Parotid duct
Parotid gland
Sublingual ducts
Submandibular duct
Submandibular gland
Sublingual gland

MAJOR DIGESTIVE GLANDS

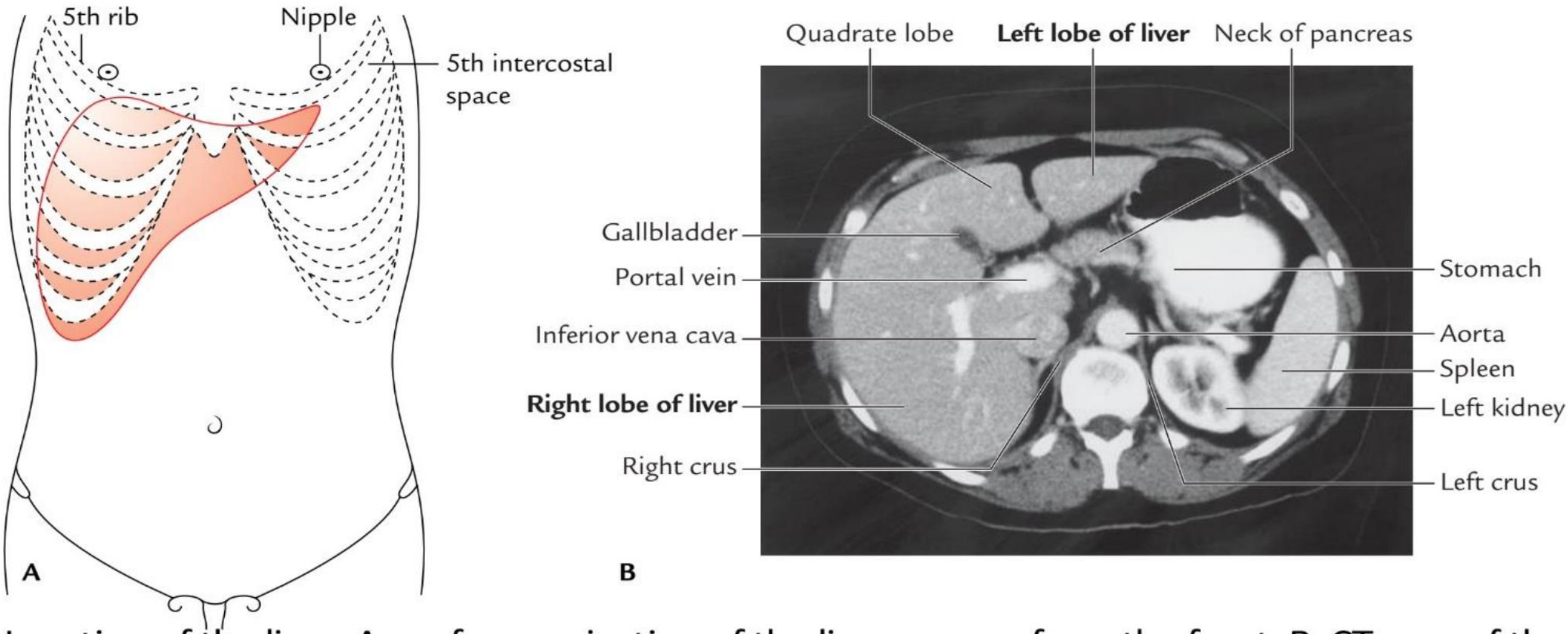
2. Liver

The liver is the largest gland of the body. It consists of both exocrine and endocrine parts.

Location:

- The right hypochondrium.
- Upper part of the epigastrium.
- Part of the left hypochondrium.

MAJOR DIGESTIVE GLANDS



Location of the liver: A, surface projection of the liver as seen from the front; B, CT scan of the abdomen showing the location of the liver.

MAJOR DIGESTIVE GLANDS

- **Functions:**

1. It secretes bile and stores glycogen.
2. It synthesizes the serum proteins and lipids.
3. It detoxifies blood from endogenous and exogenous substances (toxins, drugs,

alcohol, etc.) that enter the circulation.

4. It produces hemopoietic cells of all types during fetal life.

MAJOR DIGESTIVE GLANDS

- **Shape:** wedge shaped and resembles a four-sided pyramid lies on one side with its

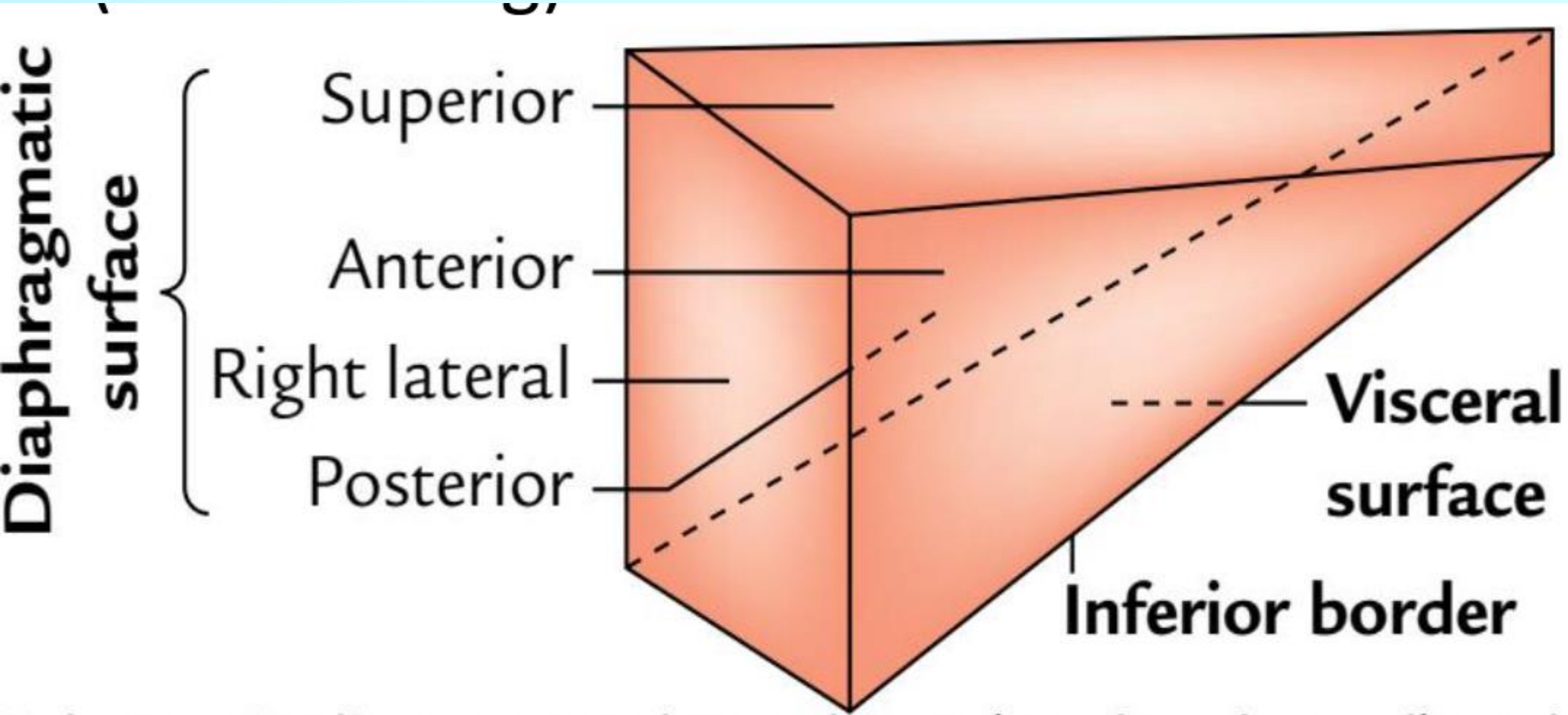
base directed towards the right and apex directed towards the left.

- **Weight:** It is 1/50 of body weight of the adult (about 1.5 kg).

- **Color:** red-brown in colour.

- **External features:** The liver presents;

1. Diaphragmatic surface
2. Visceral surface.
3. One well-defined border, inferior border.



Schematic diagram to show shape (wedge shaped) and surfaces of the liver.

MAJOR DIGESTIVE GLANDS

1. Diaphragmatic Surface

- **Shape:** convex and extensive dome-shaped.
- **Subdivision:** superior, anterior, right lateral, and posterior surfaces, but there is no distinct demarcation between these surfaces

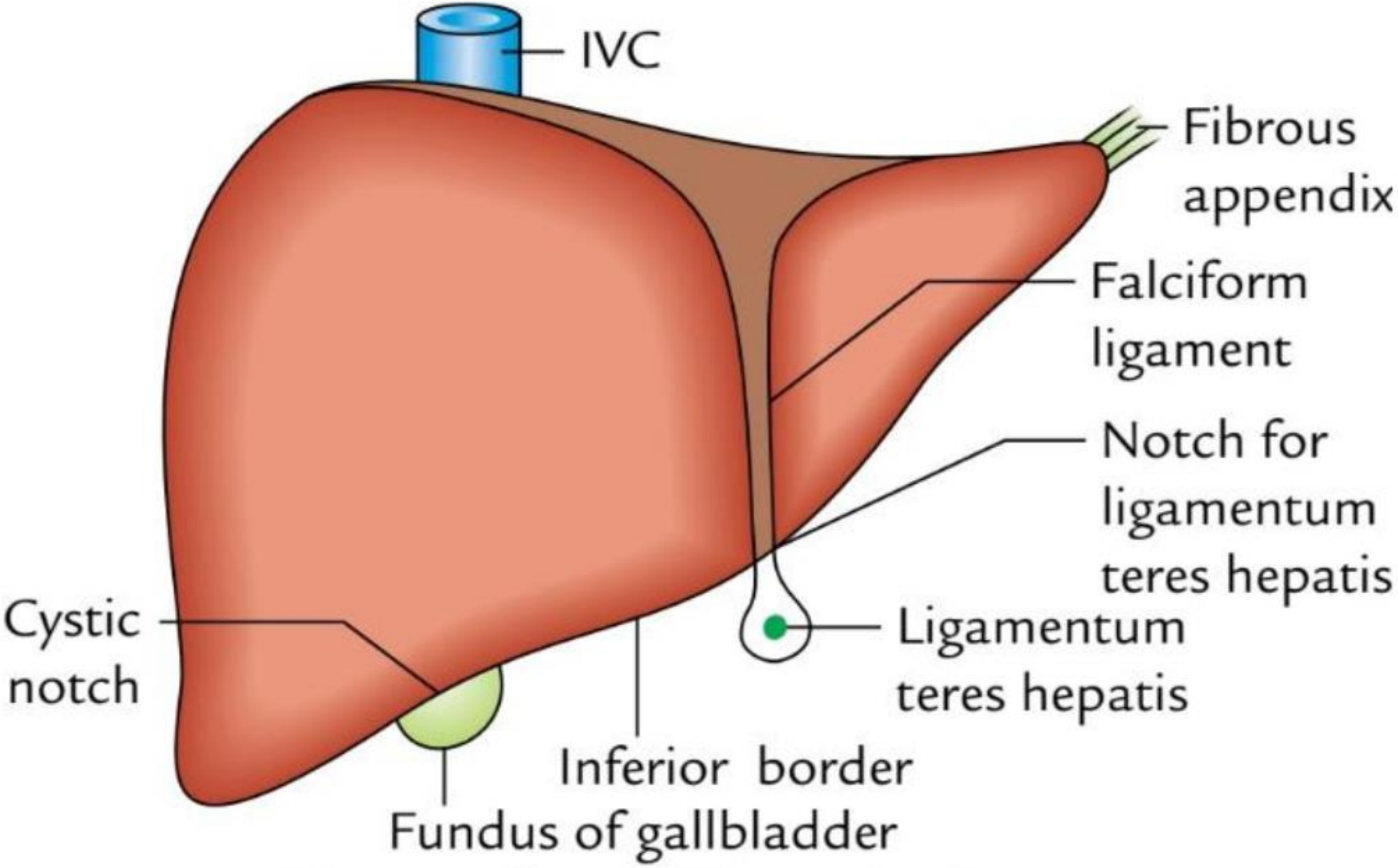
2. Visceral Surface (Inferior Surface)

- **Shape:** relatively flat or concave.
- **Features:**

a. Fossa for the gallbladder.

b. Fissure for the ligamentum teres

c. Porta hepatis



Liver—viewed from the front.

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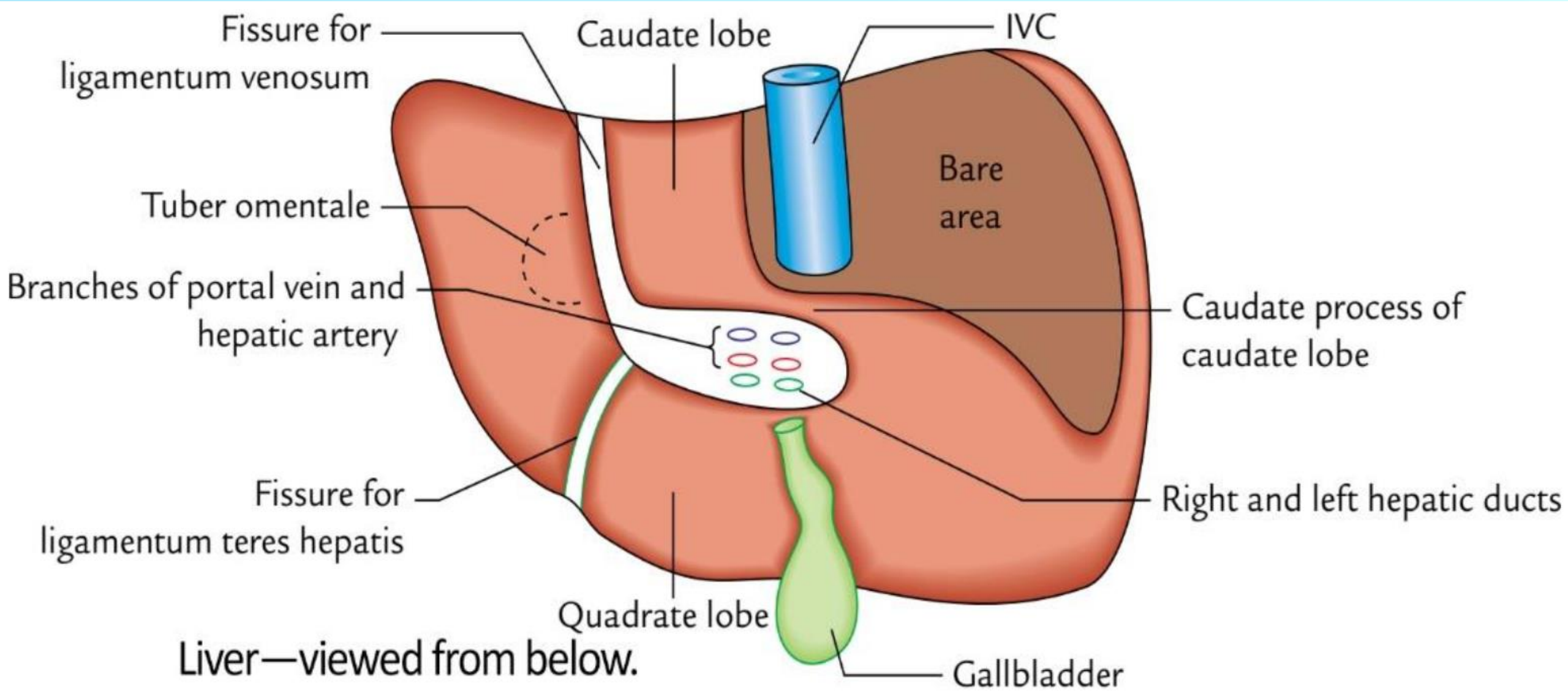

Liver—viewed from below.

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- Lobes of the liver

1. Anatomical Lobes

a. On the diaphragmatic surface: the falciform ligament divided the liver into right and left lobes. The right lobe is approximately six times larger than the left lobe.

b. On the visceral surface: the fissures and fossae present on this surface and form an H-shaped fissure divided the liver into four lobes:

1) Right lobe: on the right of the fossa for gallbladder.

2) Left lobe: on the left of the fissures for ligamentum teres and ligamentum venosum.

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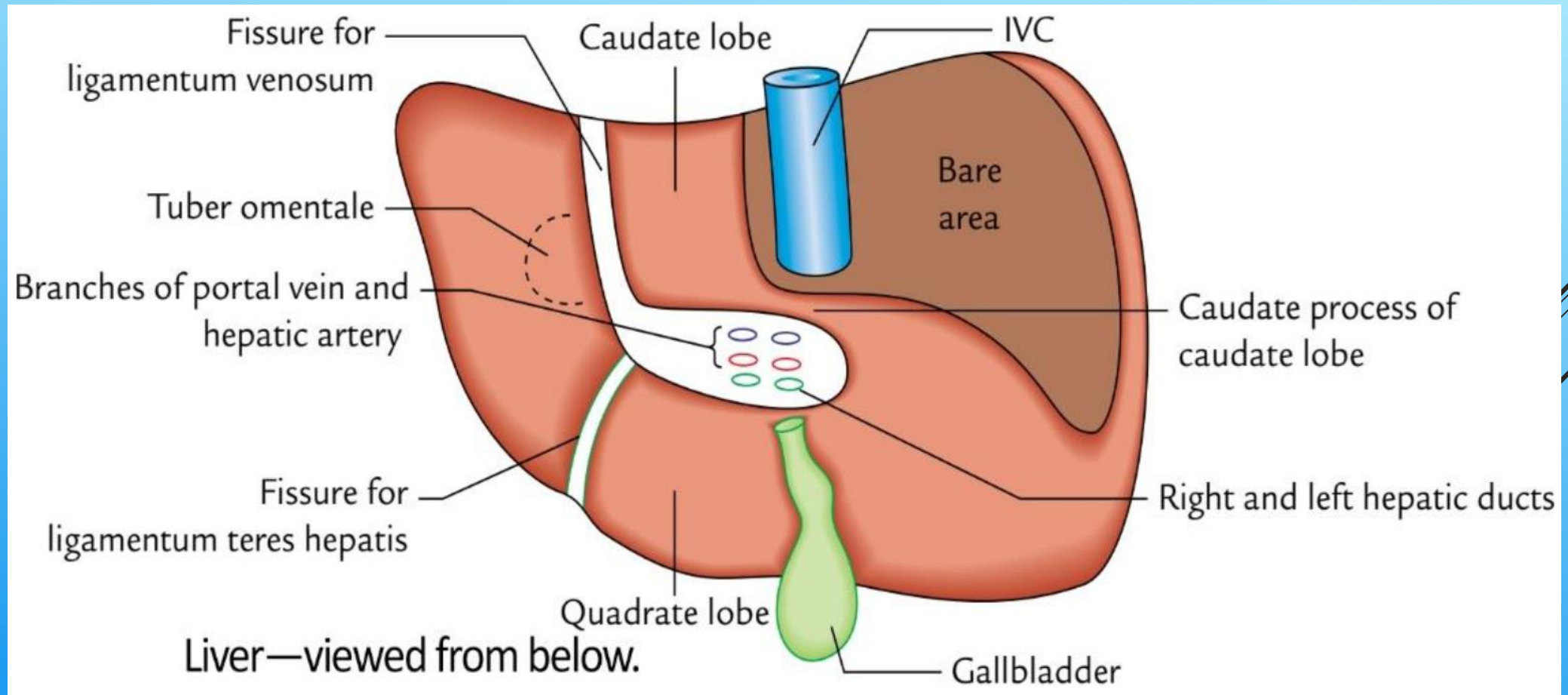
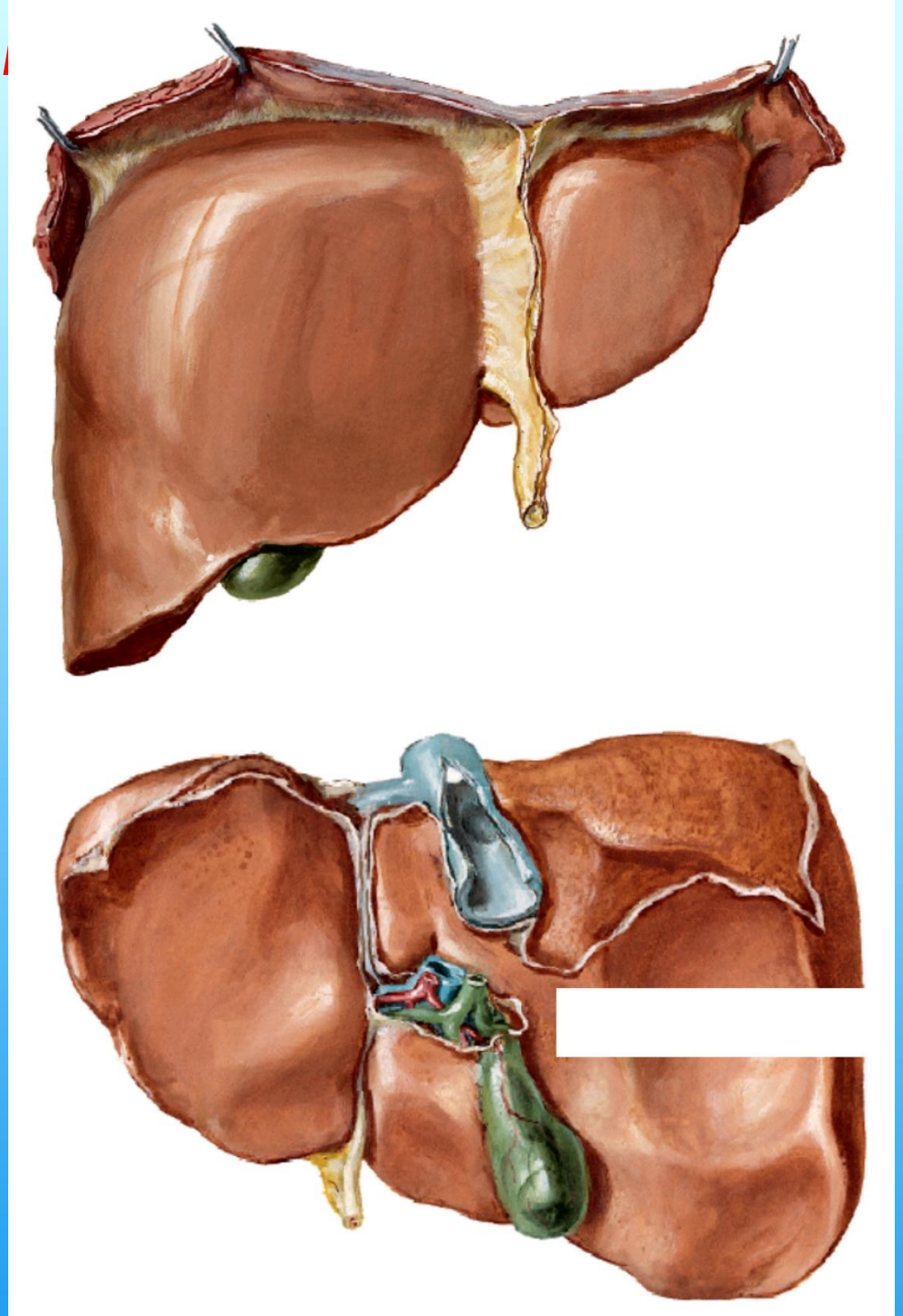
3) Quadrate lobe: between the fossa for gallbladder and the fissure for ligamentum teres below the porta hepatis.

4) Caudate lobe: between the groove for IVC and the fissure for ligamentum venosum above the porta hepatis.





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Porta hepatis:

It is the hilum of the liver.

It lies between the caudate and quadrate lobes of the liver.

Structures passing through it:

1. Portal vein and its branches.
2. Hepatic artery and its branches.
3. Hepatic ducts.

Blood supply of the liver:

1. Rt. & lt. Hepatic arteries.
2. Rt. & lt. Portal veins.
3. Right & left hepatic veins which drain into I.V.C.

Physiologically, hepatic artery 25 % of blood and 50 % of oxygen demand, while portal vein 75% of blood and 50 % of oxygen demand.

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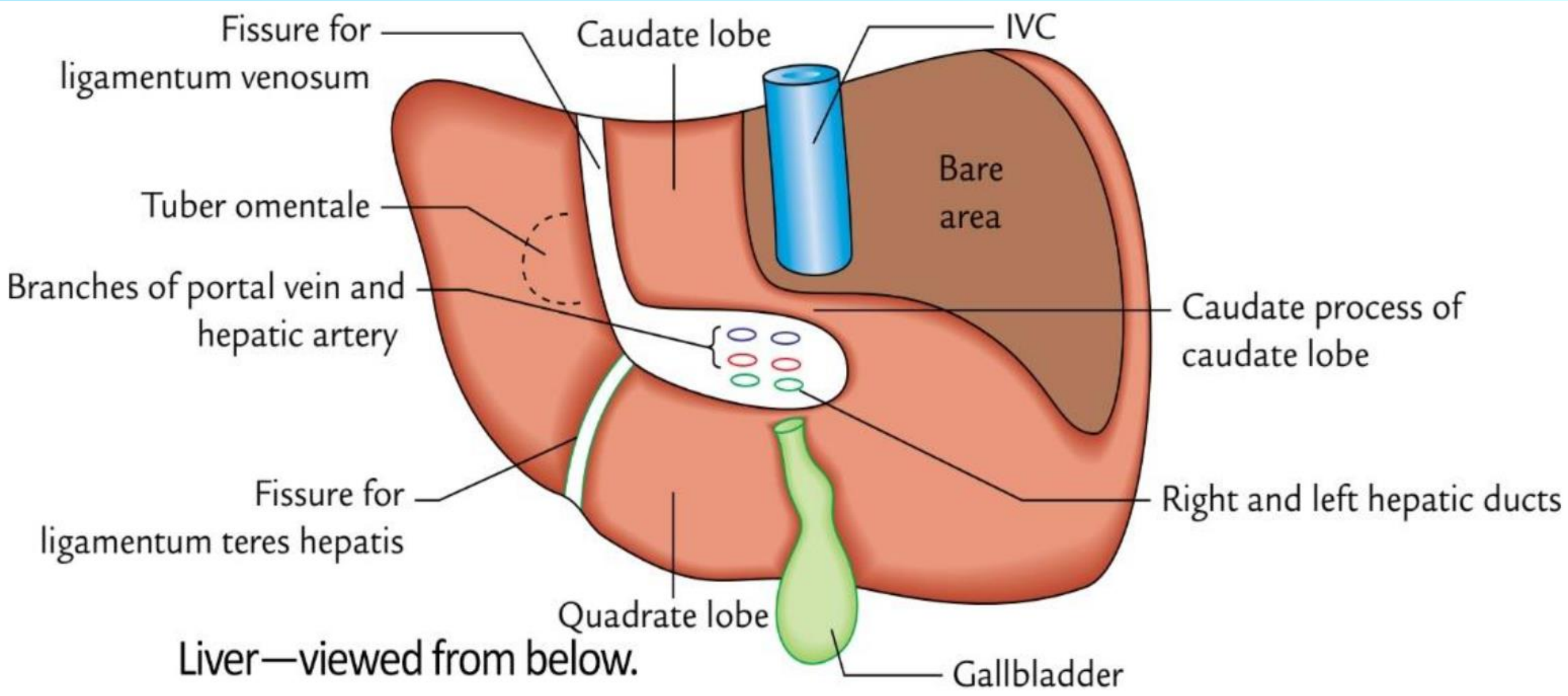

Liver—viewed from below.

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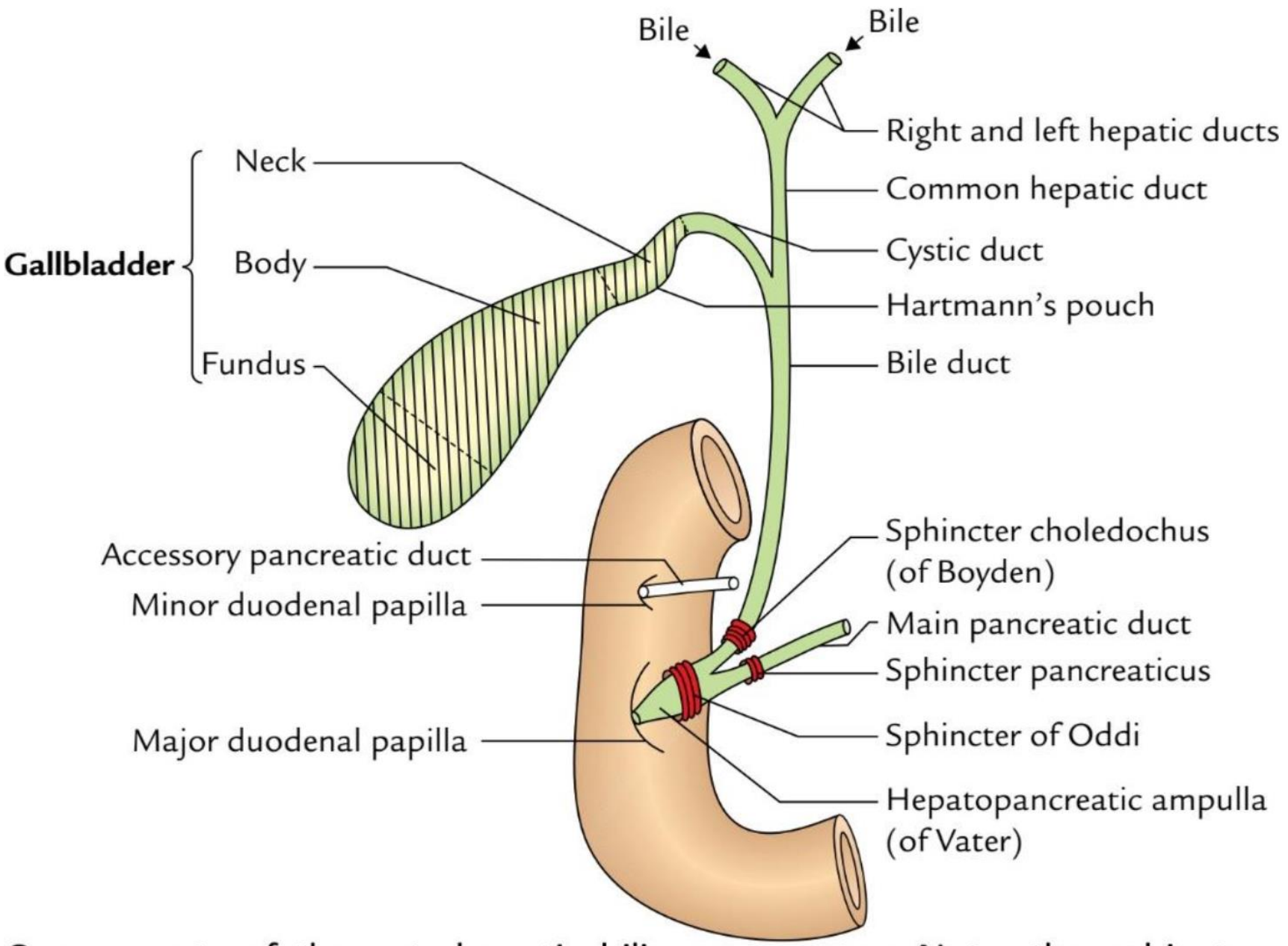
3. Biliary system

This system includes:

1. Right and Left hepatic ducts.
2. Common hepatic duct.
3. Gall bladder formed of 3 parts; fundus, body and neck. The neck gives rise to cystic duct.
4. Bile duct : formed by the union of Common hepatic duct and cystic duct



Components of the extrahepatic biliary apparatus. Note: the sphincters around hepatopancreatic ampulla and terminal parts of the bile, and main pancreatic ducts.

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4. Pancreas

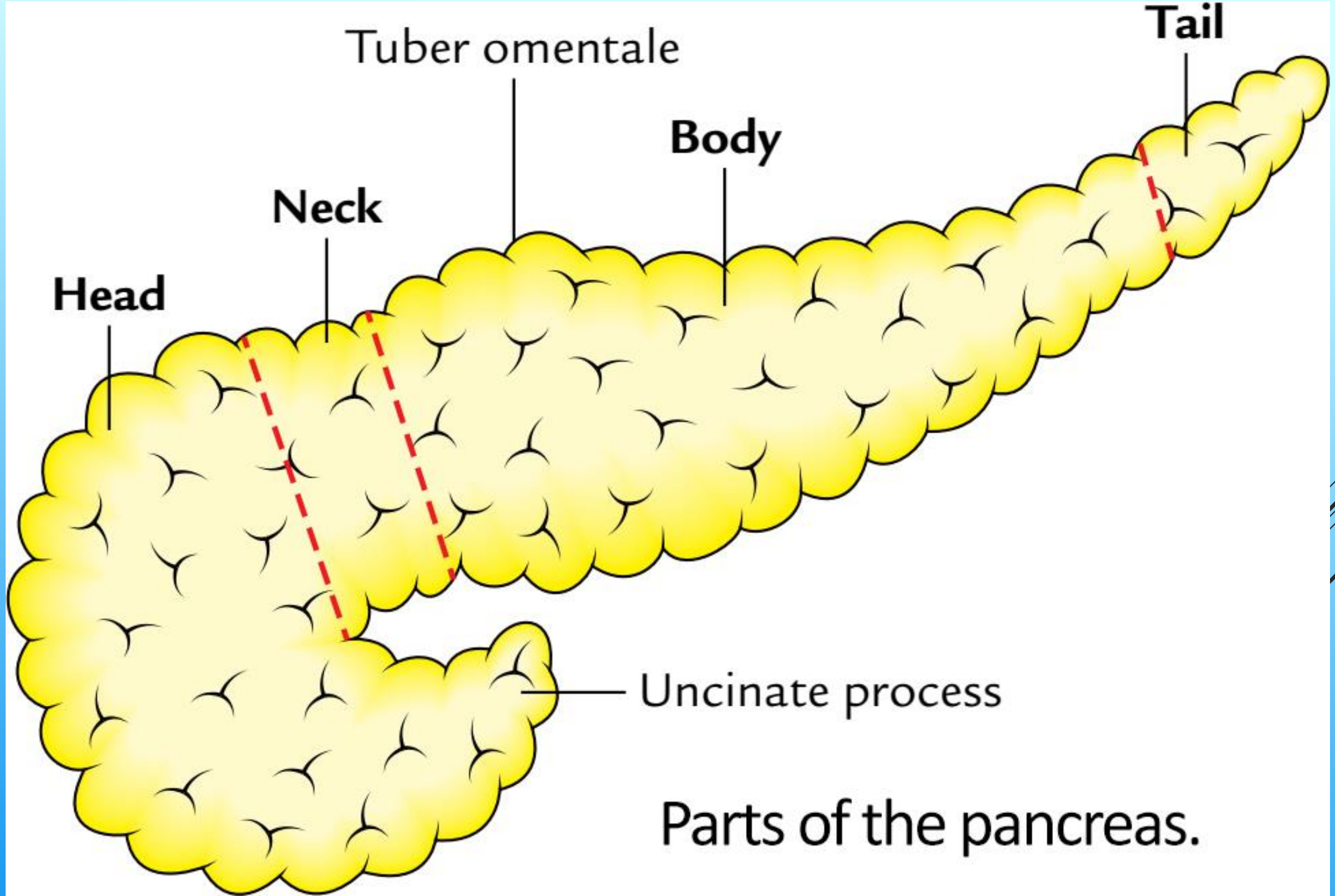
A mixed endocrine and exocrine gland.

It lies across the posterior abdominal wall from duodenum to spleen.

It is formed of 4 parts:

1. Head.
2. Neck.
3. Body.
4. Tail.

Runs through it the main pancreatic duct which joins the bile duct to form the hepatopancreatic ampulla of Vater which opens in the duodenum.



Parts of the pancreas.

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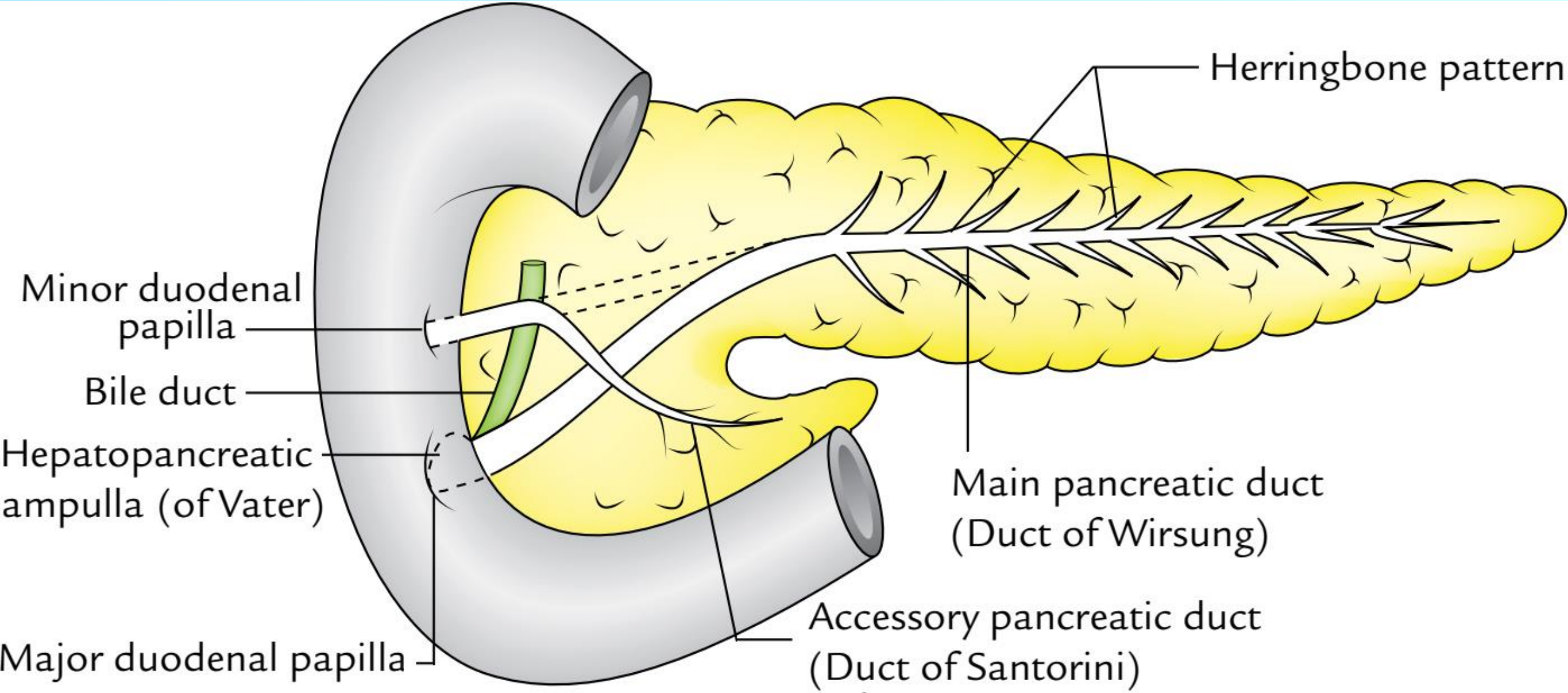
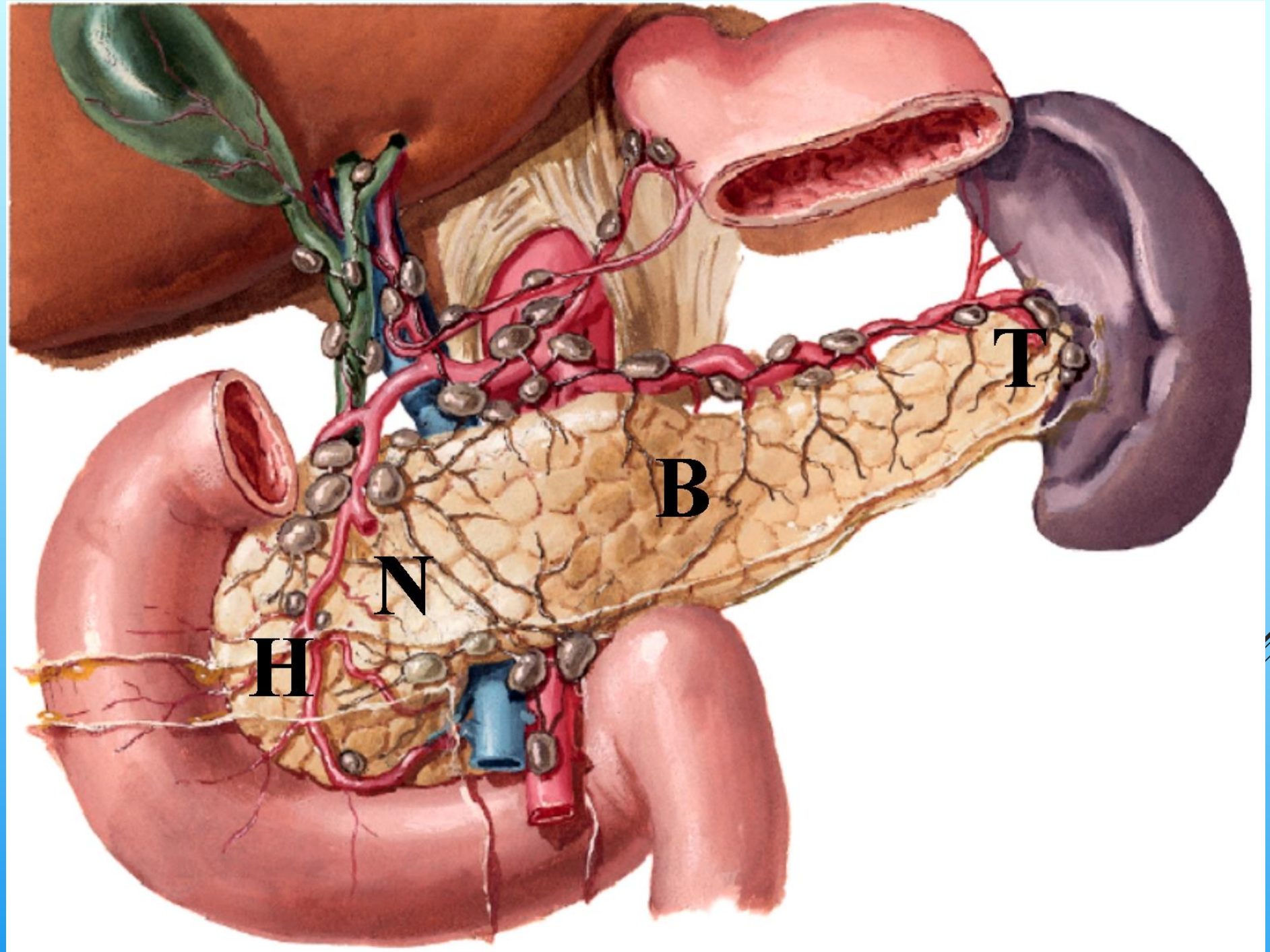


Pancreatic ducts.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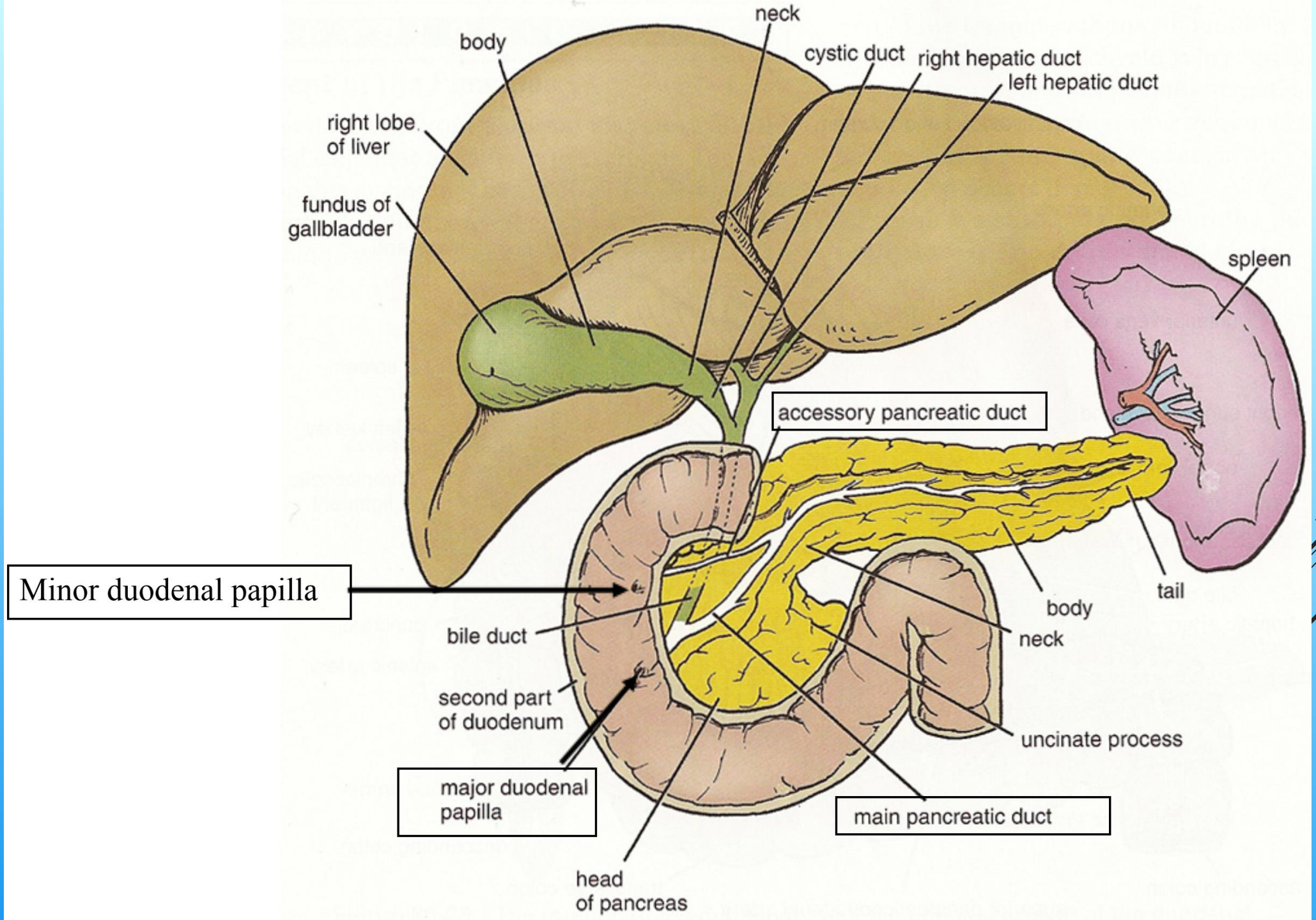
neck
body
cystic duct
right hepatic duct
left hepatic duct
right lobe of liver
fundus of gallbladder
spleen
accessory pancreatic duct
Minor duodenal papilla
bile duct
body
tail
neck
second part of duodenum
uncinate process
major duodenal papilla
main pancreatic duct
head of pancreas

شکرا

DIGESTIVE TRACT

GIT TRACT

MAJOR DIGESTIVE GLANDS