Gastrointestinal System

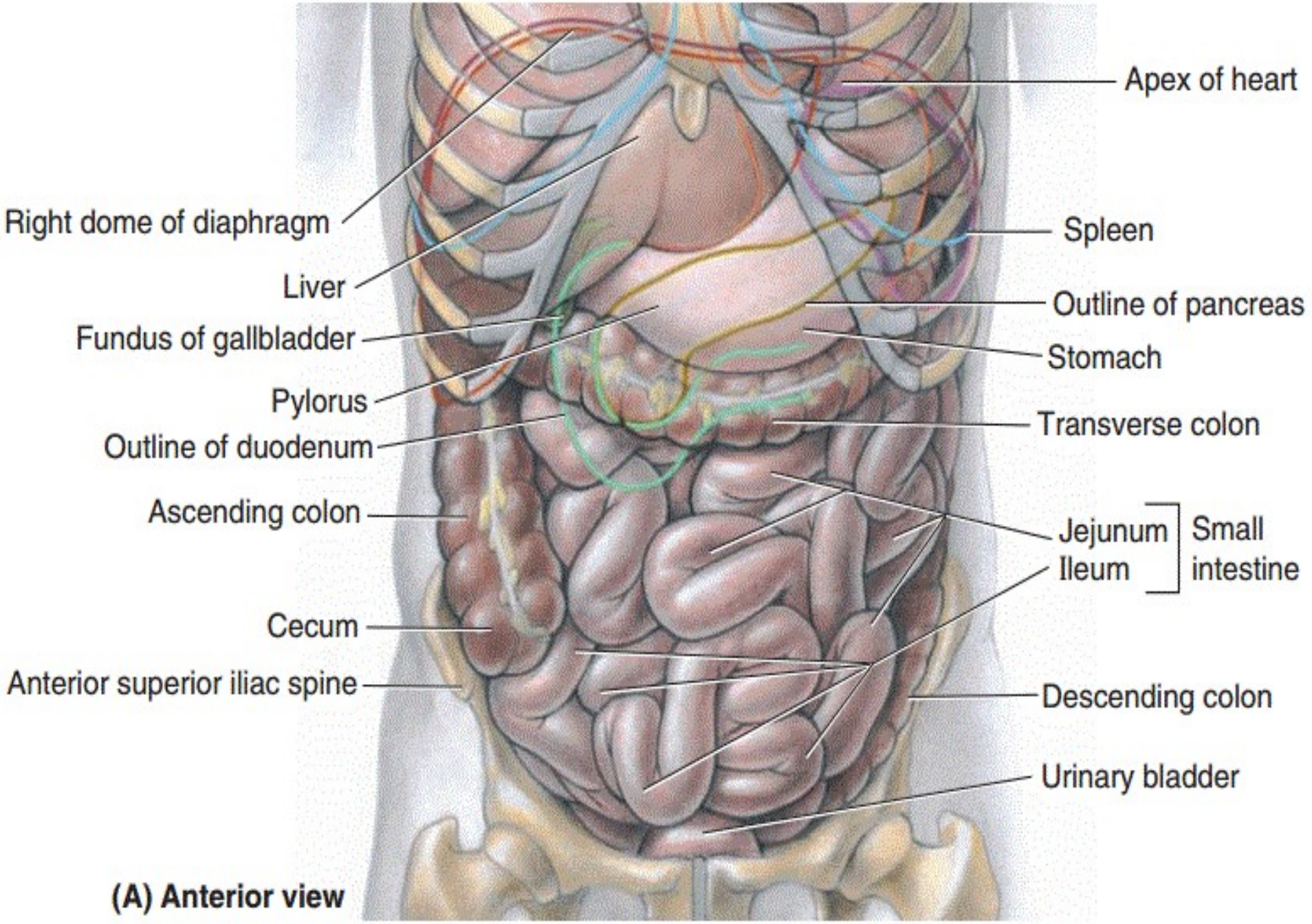
Dr. Yared T.

Introduction

- The abdomen is the part of the trunk between the **thorax** and the **pelvis**
- It is a **flexible**, **dynamic** container, housing most of the **organs** of the alimentary system and part of the urogenital system

Functions

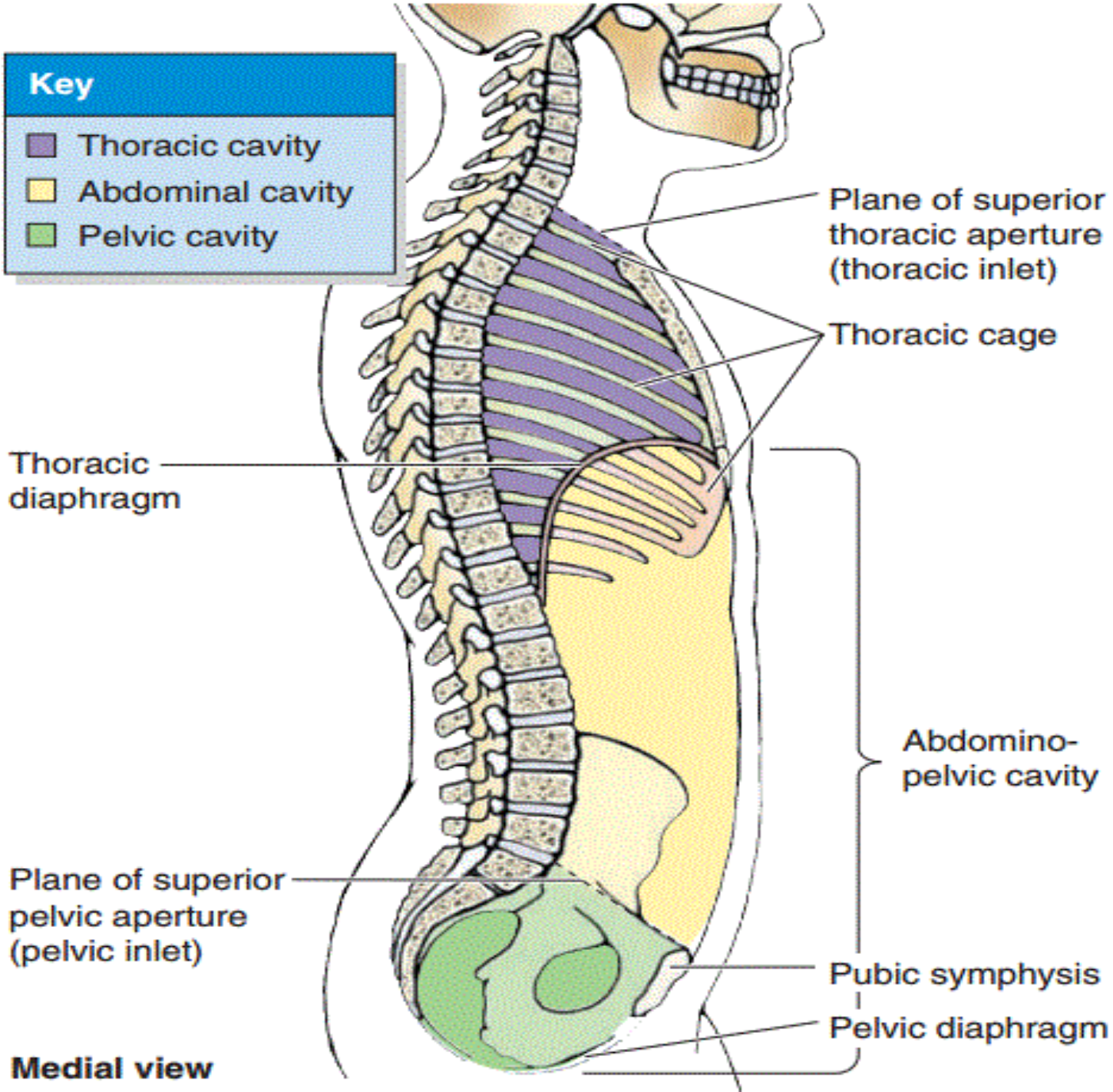
- Houses & **protects** major viscera
- Assists in **breathing**
- **Intra abdominal pressure**, help in expulsion of air from the thoracic cavity and fluid
- Accommodating **expansions** caused by ingestion, pregnancy, fat deposition, or pathology


Apex of heart
Right dome of diaphragm
Spleen
Liver
Outline of pancreas
Fundus of gallbladder
Stomach
Pylorus
Transverse colon
Outline of duodenum
Ascending colon
Jejunum
Ileum
Small intestine
Cecum
Anterior superior iliac spine
Descending colon
Urinary bladder
(A) Anterior view

Abdominal Cavity

- Forms the **superior** and major part of the **abdominopelvic** cavity
- **Continuous** cavity that extends between the **thoracic diaphragm** and **pelvic diaphragm**.
- Extends **superiorly** into **4th intercostal** space

- More superiorly placed abdominal organs (**spleen**, **liver**, part of the **kidneys**, and **stomach**) are protected by the **thoracic cage**.
- The **greater pelvis** supports and partly protects the lower abdominal viscera (part of the **ileum**, **cecum**, and **sigmoid** colon)

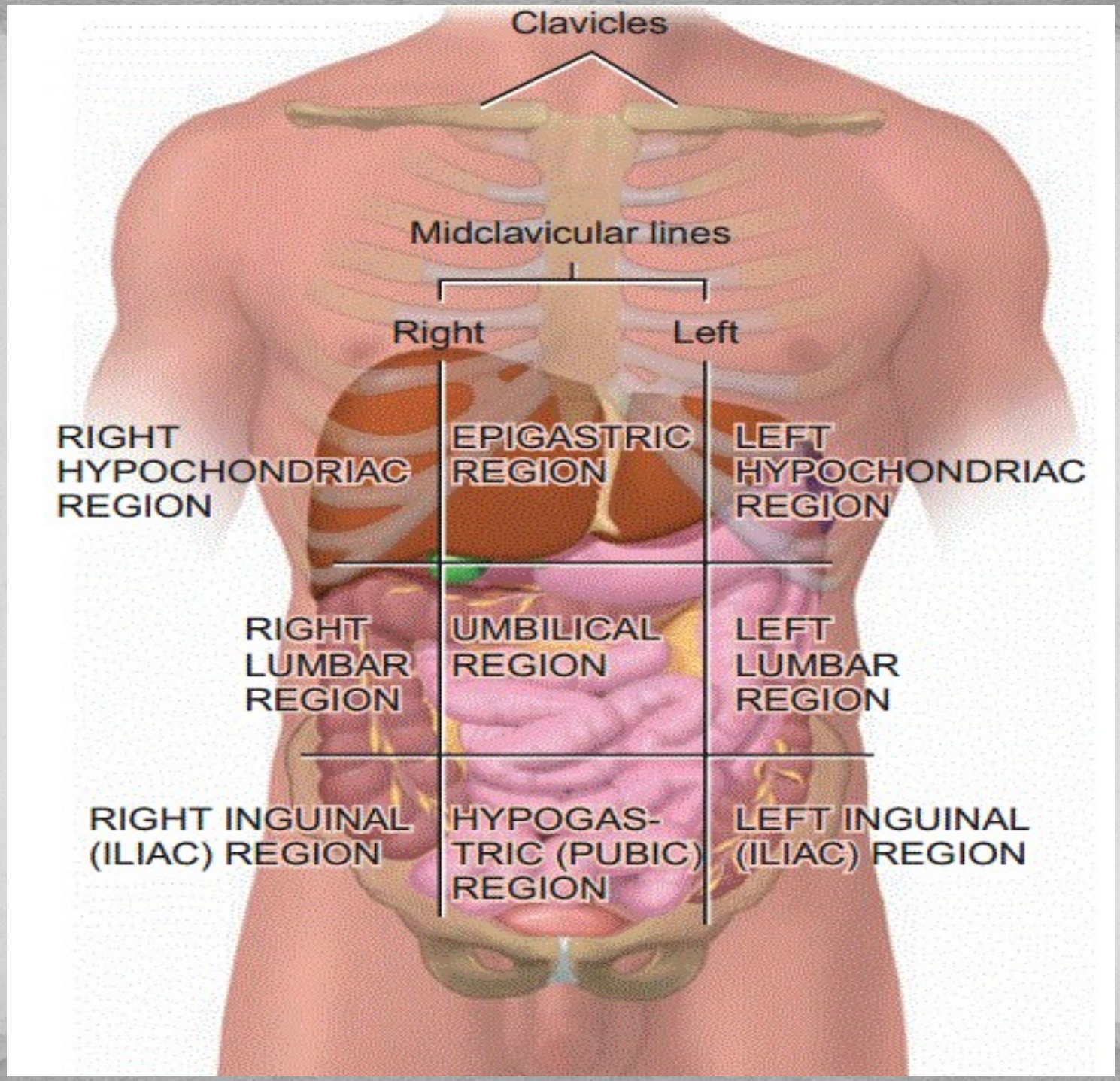

Key
Thoracic cavity
Abdominal cavity
Pelvic cavity
Plane of superior thoracic aperture (thoracic inlet)
Thoracic cage
Thoracic diaphragm
Abdomino-pelvic cavity
Plane of superior pelvic aperture (pelvic inlet)
Pubic symphysis
Pelvic diaphragm
Medial view

Abdominal regions

- This are the two methods of dividing the **abdominal cavity** into smaller areas

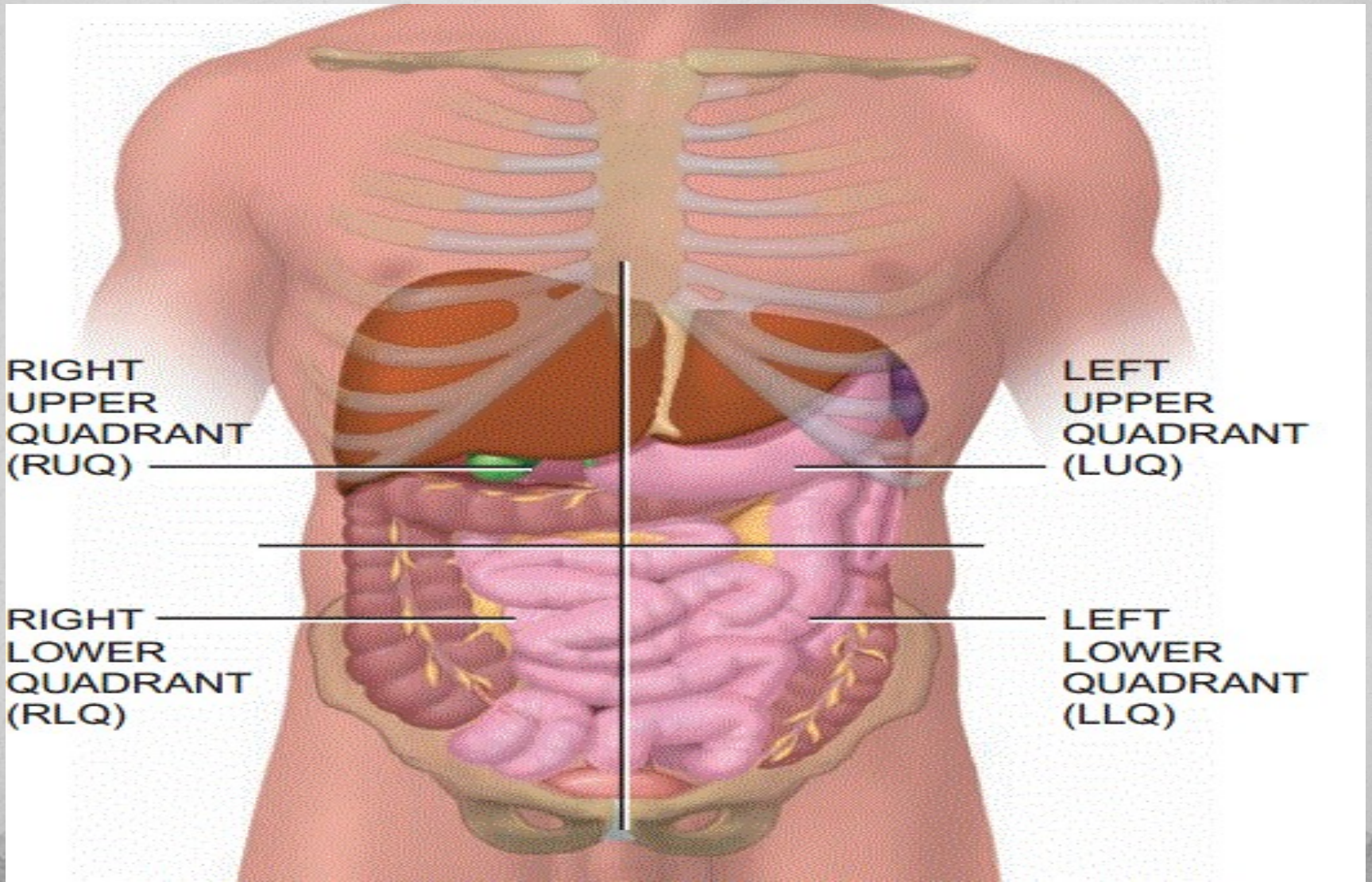
Abdominal regions

- Made by **two horizontal** and **two vertical** lines, partition this cavity into **nine** regions
- **Subcostal line,** drawn just **inferior** to the **rib cage**,
- **Transtubercular line**, drawn just **inferior** to the tops of the **hip bones**.
- Two **vertical** lines, the left and right **midclavicular** lines


Clavicles
Midclavicular lines
Right
Left
RIGHT HYPOCHONDRIAC REGION
EPIGASTRIC REGION
LEFT HYPOCHONDRIAC REGION
RIGHT LUMBAR REGION
UMBILICAL REGION
LEFT LUMBAR REGION
RIGHT INGUINAL (ILIAC) REGION
HYPOGAS-TRIC (PUBIC) REGION
LEFT INGUINAL (ILIAC) REGION

Abdominal quadrants

Vertical line and a horizontal line are passed through the **umbilicus,** make for **four quadrants**



Abdominal wall

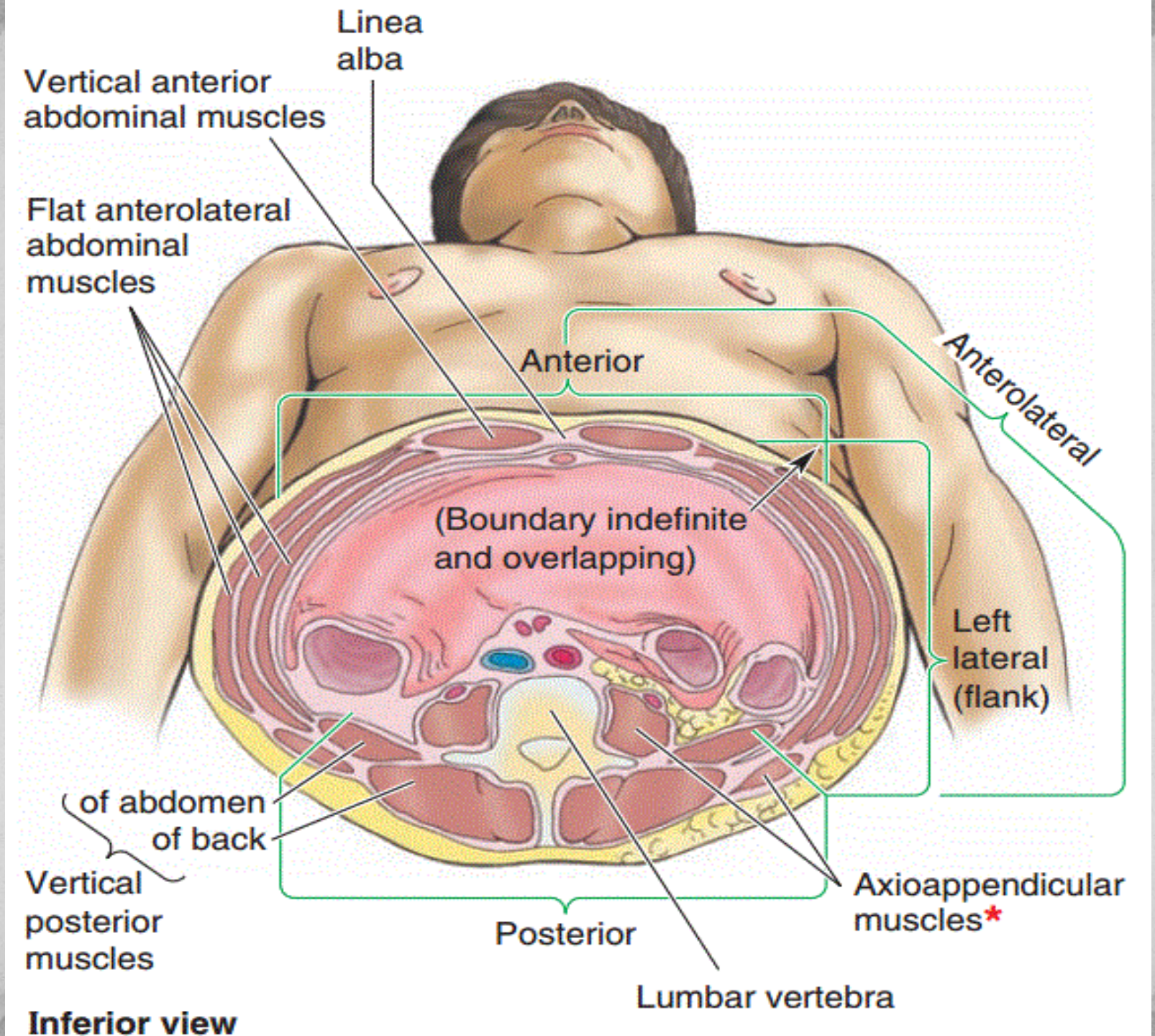
- The wall is **musculoaponeurotic**
- Posterior wall, includes **lumbar** region of the **vertebral** column
- Subdivided into the **anteriorlateral** walls and **posterior** wall for descriptive purposes

Anteriorlateral walls

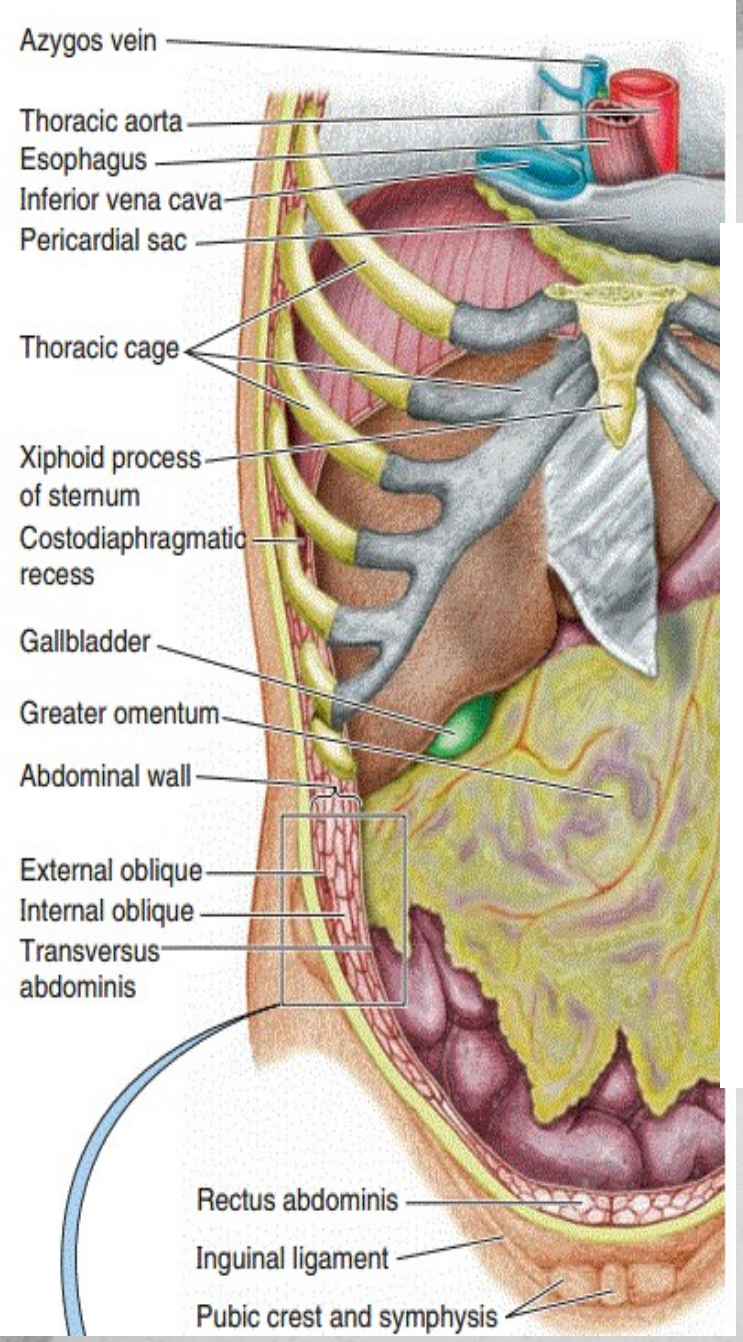
- Extends from the **thoracic cage** to the **pelvis**
- **Superiorly**: **cartilages** of 7th–10th ribs and **xiphoid** process
- **Inferiorly**: **inguinal ligament** and **superior margins** of anterolateral pelvic girdle (iliac crests, pubic crests, and pubic symphysis)

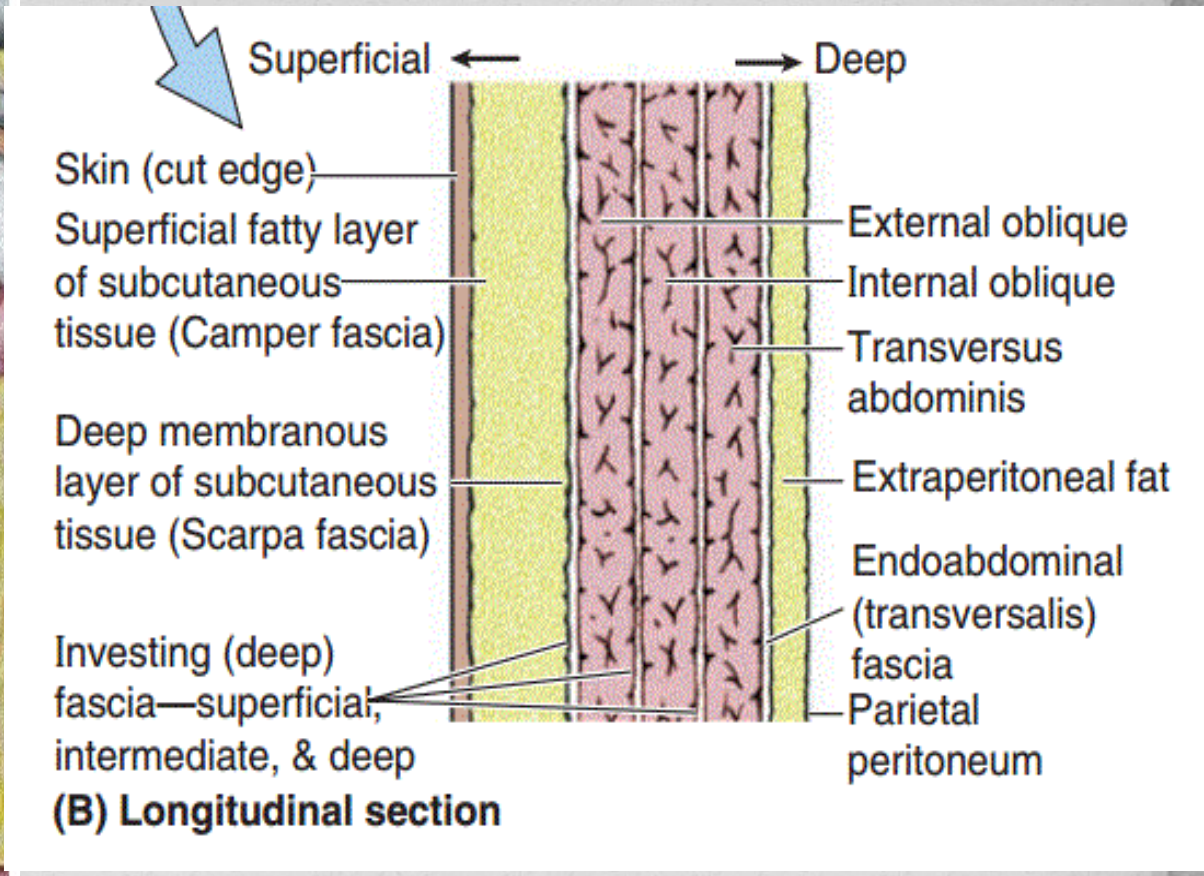
Consists of

- **Skin**
- **Subcutaneous tissue** (superficial fascia): has **two** layers, **Superficial fatty** layer **(Camper fascia**) and **Deep membranous** layer (**Scarpa fascia**)


Linea alba
Vertical anterior abdominal muscles
Flat anterolateral abdominal muscles
Anterior
Anterolateral
(Boundary indefinite and overlapping)
Left lateral (flank)
of abdomen
of back
Vertical posterior muscles
Posterior
Axioappendicular muscles*
Lumbar vertebra
Inferior view

- **Muscles:** Five muscles(paired)
- **Deep fascia,** endoabdominal fascia: Line **internal** aspect of abdominal wall
- **Extraperitoneal fat:** Separate **transversalis fascia** and **parietal peritoneum**
- **Peritoneum:** Lines the abdominopelvic cavity

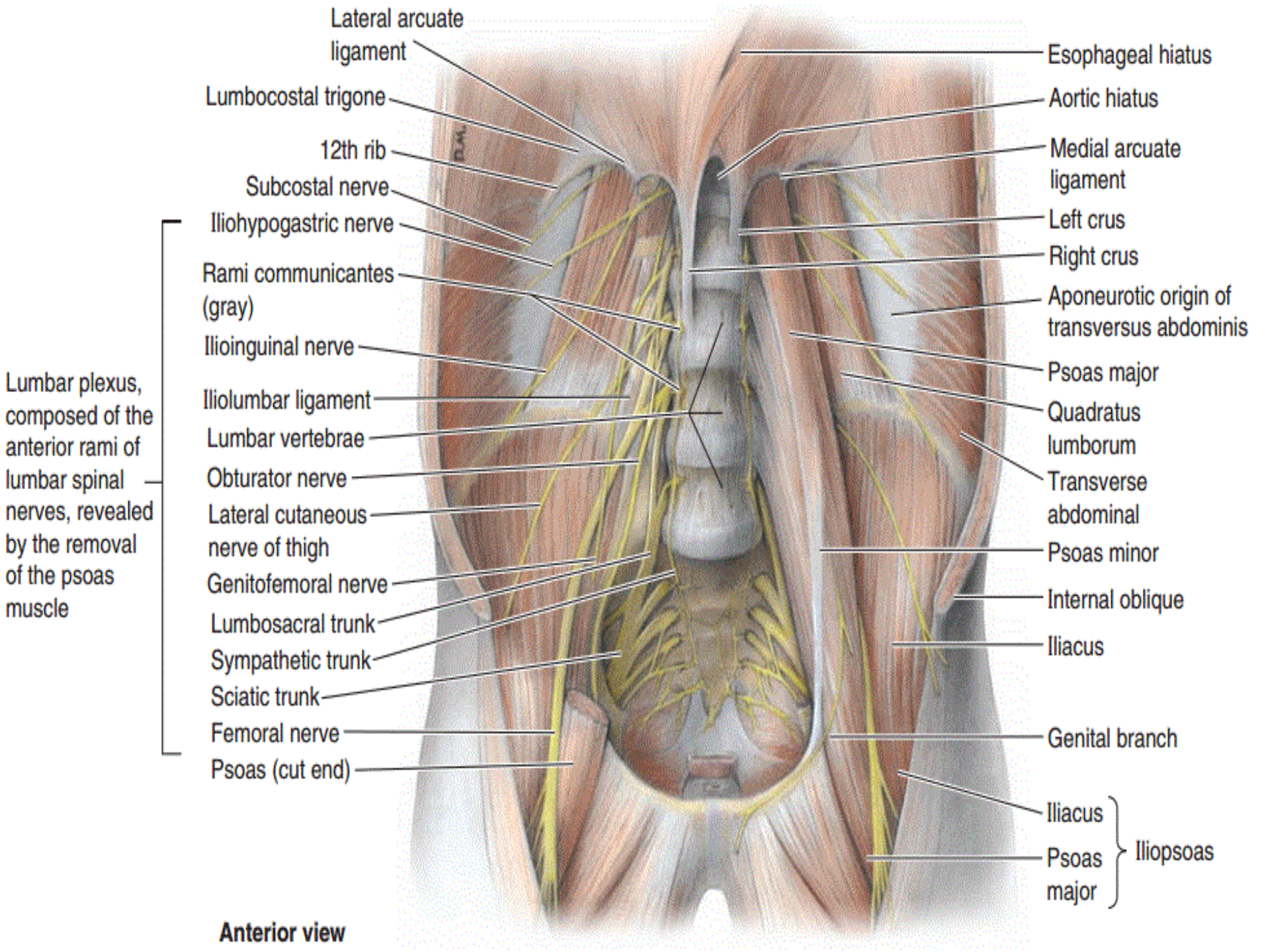




(B) Longitudinal section

Posterior abdominal wall

- **Five lumbar** vertebrae and associated IV discs
- **Muscles**, including , **psoas**, **quadratus lumborum**, **iliacus**, **transversus abdominis**, and **oblique muscles** (laterally).
- **Diaphragm**, which contributes to the **superior** part.
- **Fascia**, including the **thoracolumbar fascia**.
- **Fat**, **nerves**, **vessels** (e.g., aorta and IVC), and **lymph** nodes



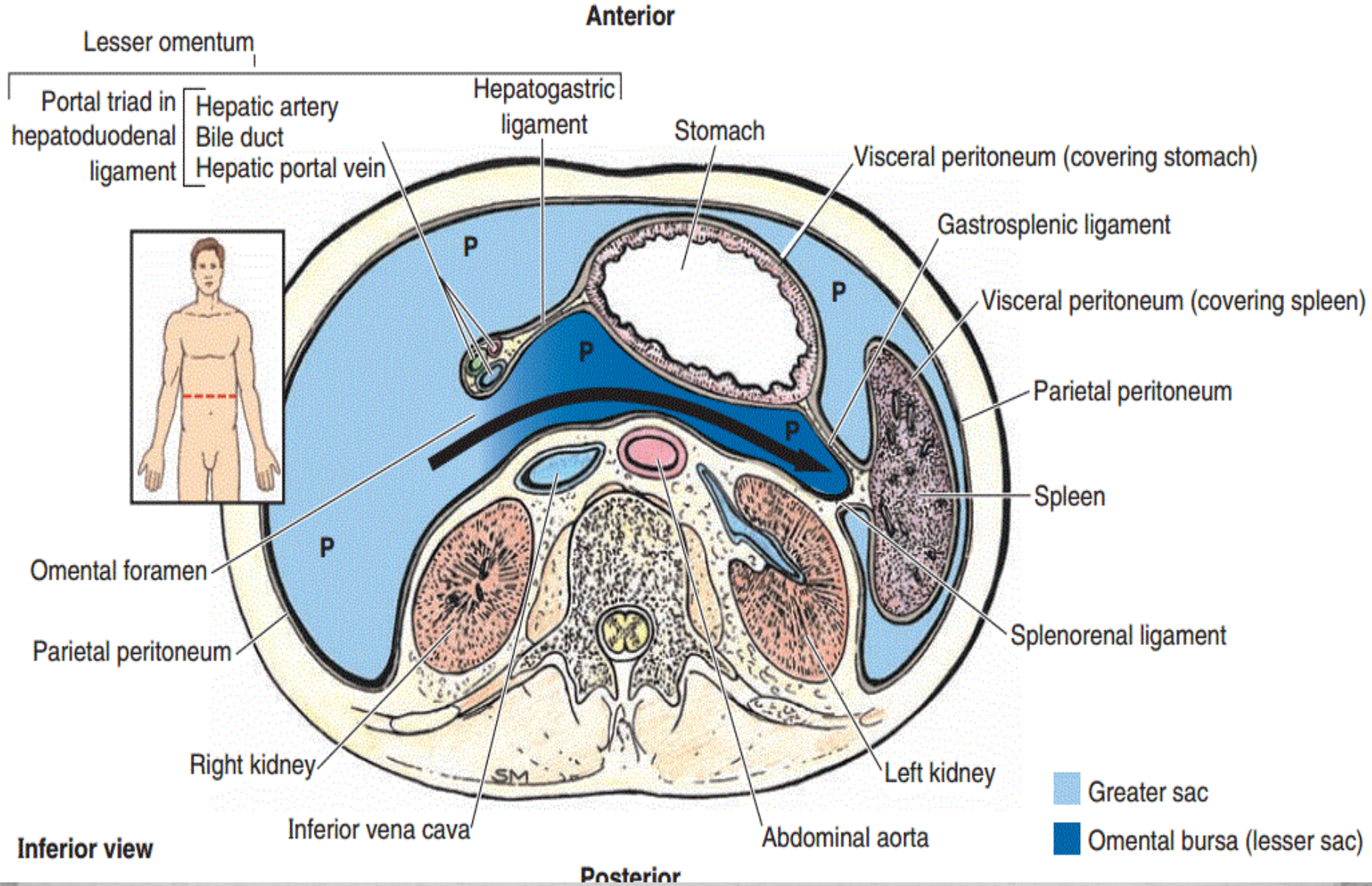
Anterior view

Peritoneum

- **Continuous**, **glistening**, and **slippery** transparent serous membrane.
- It lines the **abdominopelvic** cavity and **invests** the **viscera**
- Two continuous layers: **parietal** peritoneum and **visceral** peritoneum
- A layer of **simple squamous** epithelial cells
- **Potential space** of capillary thinness between the **parietal** and **visceral** layers of peritoneum.
- Contains a thin **film** of peritoneal fluid

Peritoneal fluid

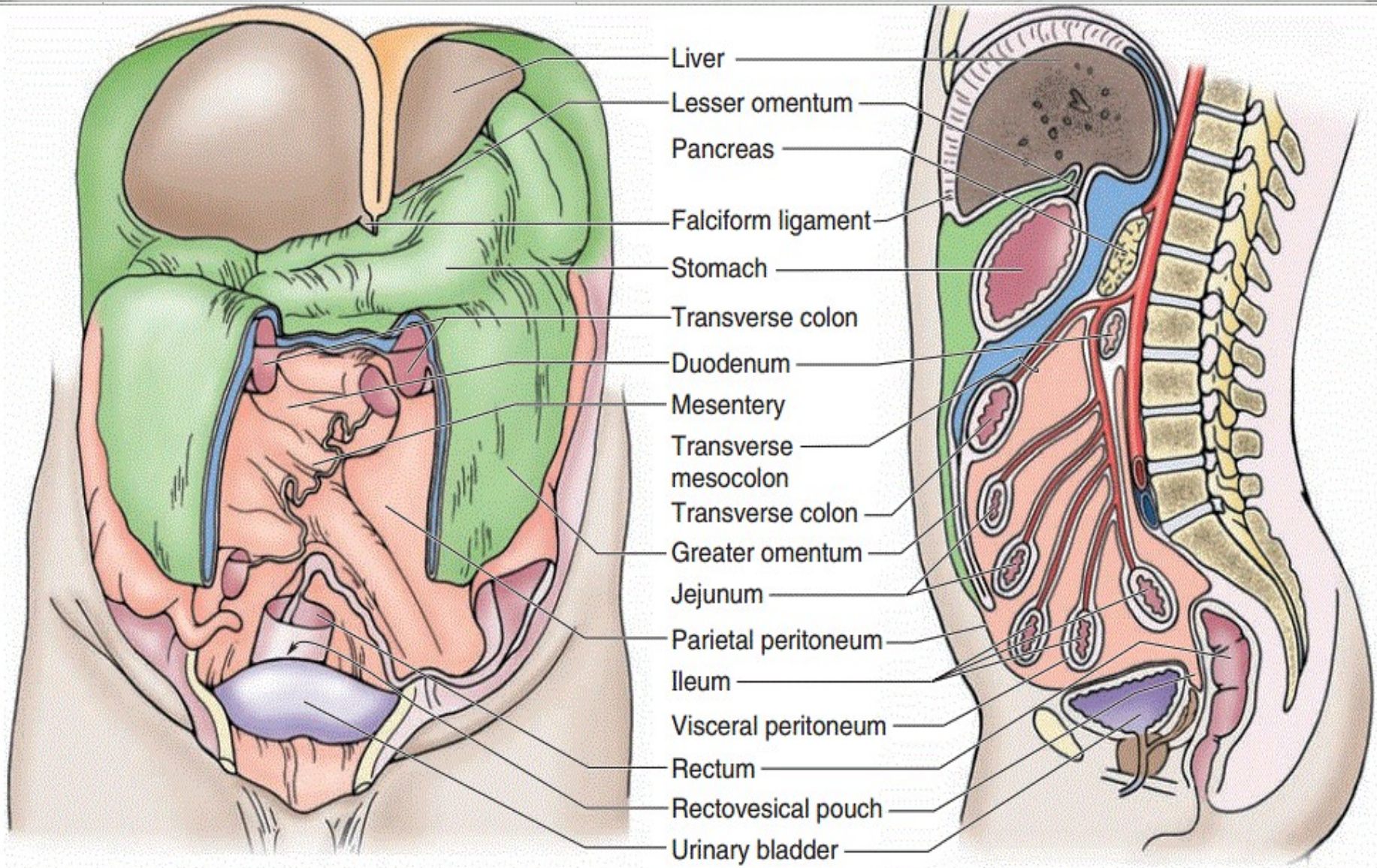
- Composed of **water**, **electrolytes**, and other substances
- **Lubricates** the peritoneal surfaces, allowing the **movements** of digestion
- Contains **leukocytes** and **antibodies** that resist infection


Anterior
Lesser omentum
Portal triad in hepatoduodenal ligament
Hepatic artery
Bile duct
Hepatic portal vein
Hepatogastric ligament
Stomach
Visceral peritoneum (covering stomach)
Gastrosplenic ligament
Visceral peritoneum (covering spleen)
Parietal peritoneum
Spleen
Splenorenal ligament
Left kidney
Abdominal aorta
Inferior vena cava
Right kidney
Parietal peritoneum
Omental foramen
P
SM
Greater sac
Omental bursa (lesser sac)
Inferior view
Posterior

Relationship of viscera to peritoneum

- **Intraperitoneal organs**:
  - Almost completely **covered** with visceral peritoneum (e.g., stomach and spleen)
- **Extraperitoneal, retroperitoneal,** and **subperitoneal organs:**
  - Almost **outside** the peritoneal cavity
  - **Partially** covered (usually on just one surface)

- **Retroperitoneal** organs, **kidneys** , have parietal peritoneum only on **anterior** surfaces
- **Subperitoneal**, urinary **bladder** only on **superior** surface.


Liver
Lesser omentum
Pancreas
Falciform ligament
Stomach
Transverse colon
Duodenum
Mesentery
Transverse mesocolon
Transverse colon
Greater omentum
Jejunum
Parietal peritoneum
Ileum
Visceral peritoneum
Rectum
Rectovesical pouch
Urinary bladder
(A) Anterior view
(B) Left lateral view

Mouth

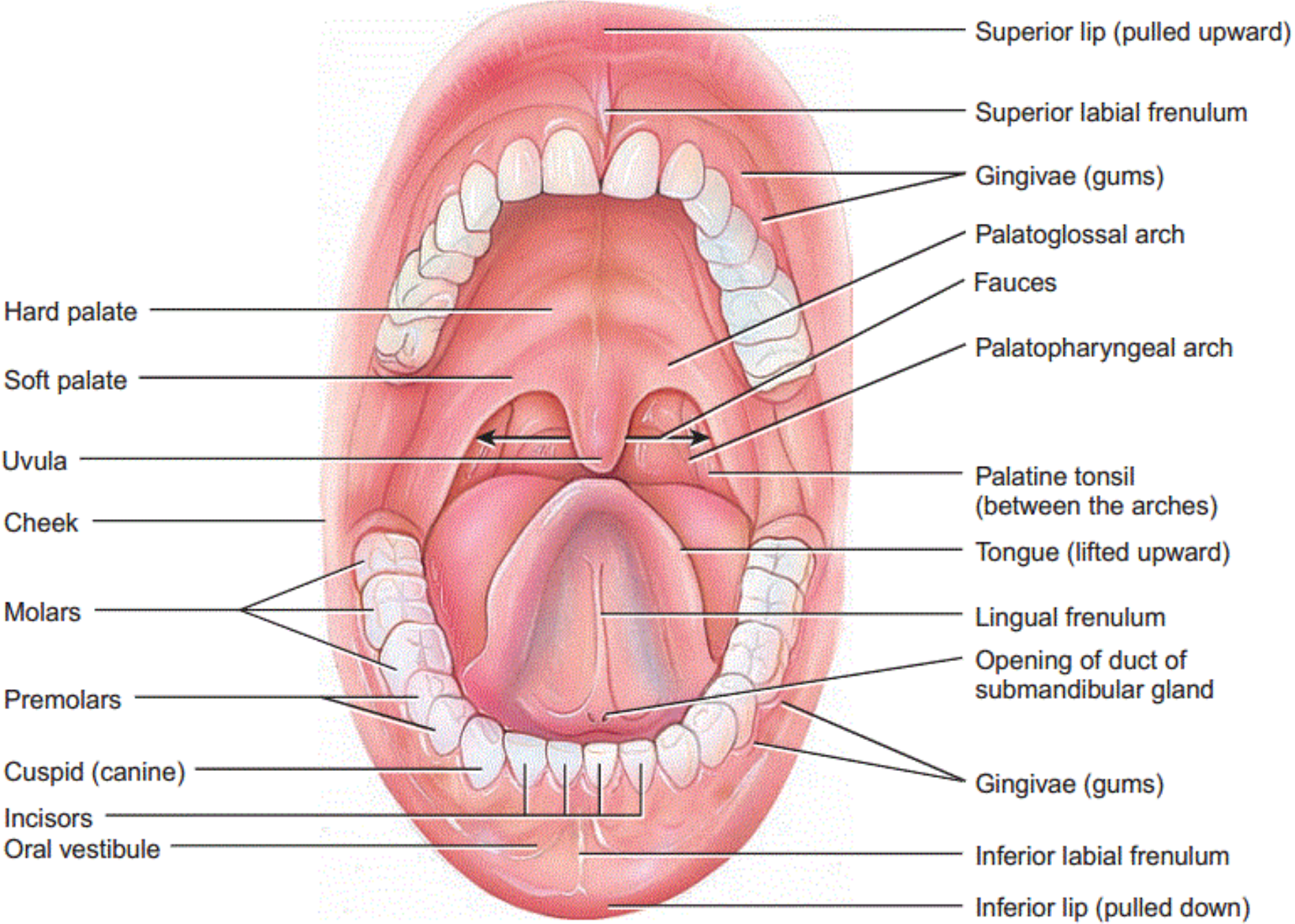
- Also **oral** or **buccal** cavity
- Formed by the **cheeks**, **hard** and **soft palates**, and **tongue**

Cheeks

- Form the **lateral walls** of the oral cavity.
- They are covered externally by **skin** and internally by a **mucous membrane**
- **Nonkeratinized stratified** squamous epithelium
- **Buccinator** muscles and **connective** tissue lie in **between**
- The **anterior** portions end at the **lips**

Lips (labia)

- **Fleshy** folds surrounding the **opening** of the mouth.
- Contain the **orbicularis oris** muscle
- **Labial frenulum**, a midline **fold** attached inner surface of each lip to corresponding gum
- **Buccinator** and **orbicularis oris** keep **food** between the upper and lower teeth and assist in **speech**.



Anterior view

Oral cavity

- **Space** bounded externally by the **cheeks** and **lips** and internally by the **gums** and **teeth**
- **Oral vestibule**, **entrance** to of the oral cavity
- **Oral cavity proper**, space that extends from the **gums** and **teeth** to the **fauces**
- **Fauces** , **opening** between the **oral cavity** and the **oropharynx** (throat)

Palate

- A wall or septum that separates the oral cavity from the nasal cavity
- Forming the roof of the mouth.
- **Hard palate**
  - **Anterior** portion of the roof of the mouth

- **Soft palate**
  - **Posterior** portion
  - **Uvula**, conical **muscular** process **hanging** from the free border of the soft palate
  - **Palatine tonsils**

Tongue

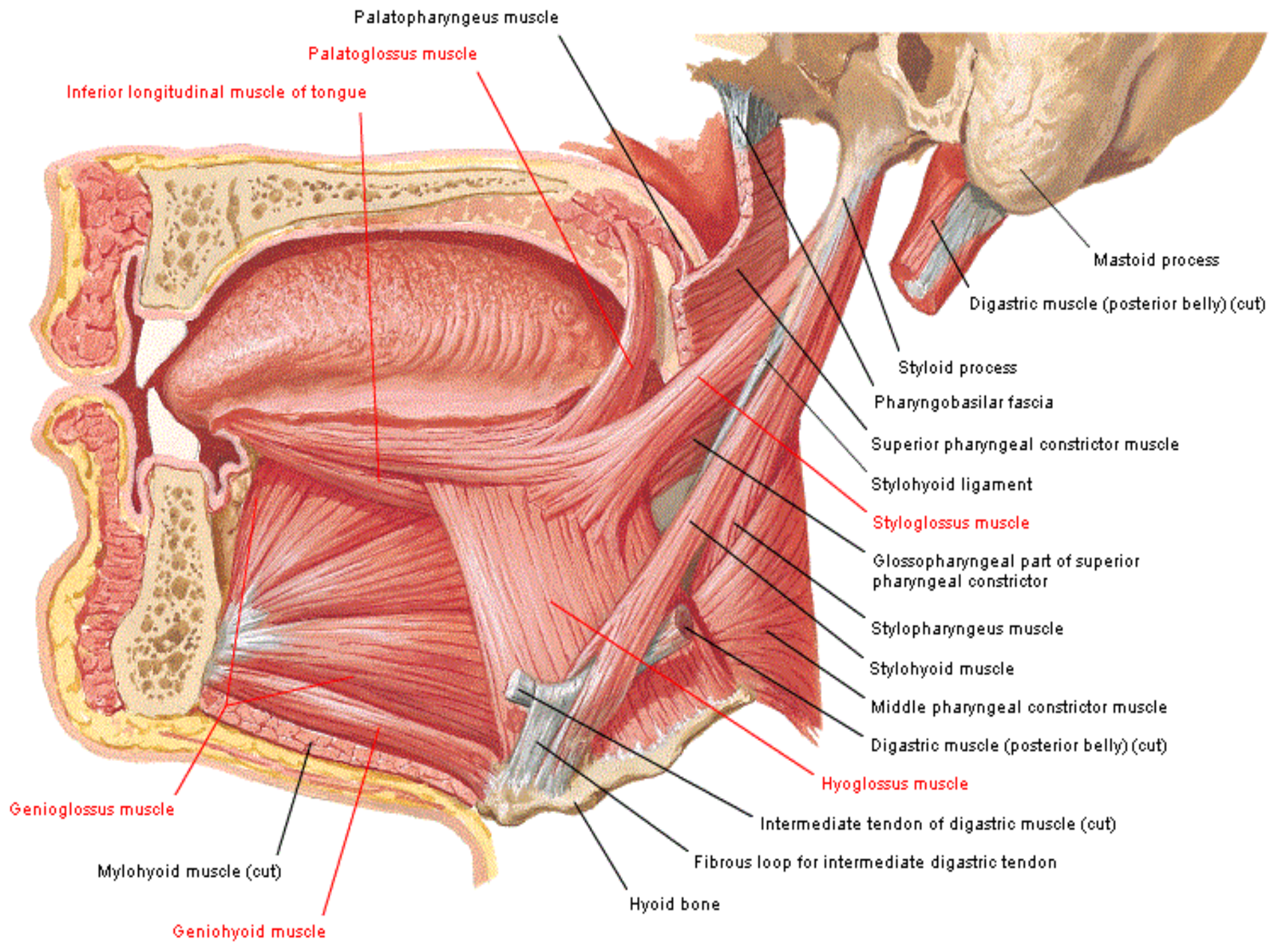
- **Accessory** digestive organ
- Composed of **skeletal muscle** covered with **mucous membrane**.
- Forms the **floor** of the oral cavity
- **Divided** symmetrical by a median septum
- Attached **inferiorly** to **hyoid** bone, **styloid process**, and **mandible**.
- Consists of **extrinsic** and **intrinsic** muscles.

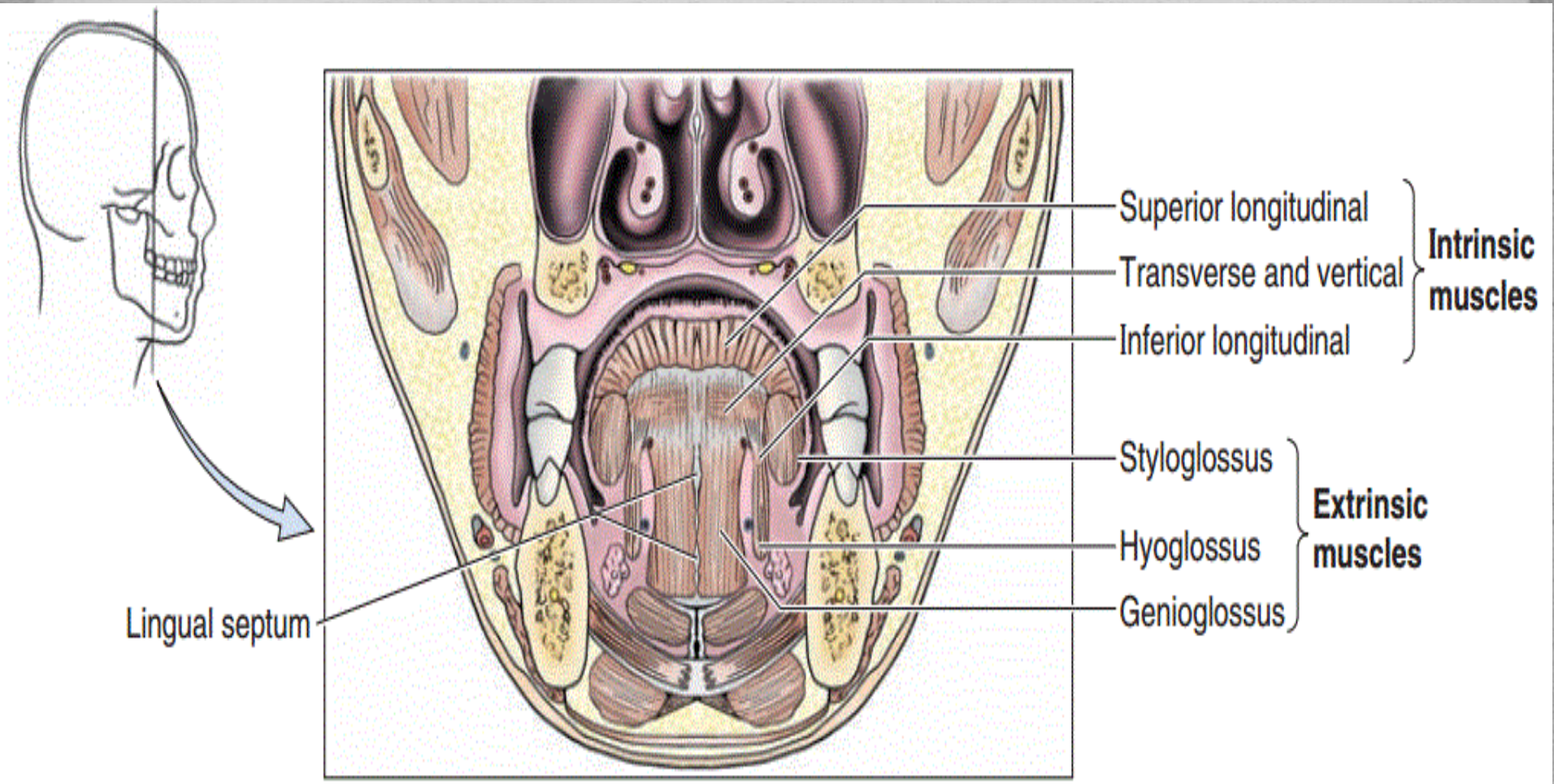
Extrinsic muscles

- **Hyoglossus**, **genioglossus**, and **styloglossus** muscles
- Move tongue from **side** to **side** and **in** and **out** for chewing

Intrinsic muscles

- Originate and insert into connective tissue within the **tongue**.
- Alter the shape and size of the tongue for **speech** and **swallowing**.
- Muscles, **longitudinalis superior**, **longitudinalis inferior**, **transversus linguae**, and **verticalis linguae**.

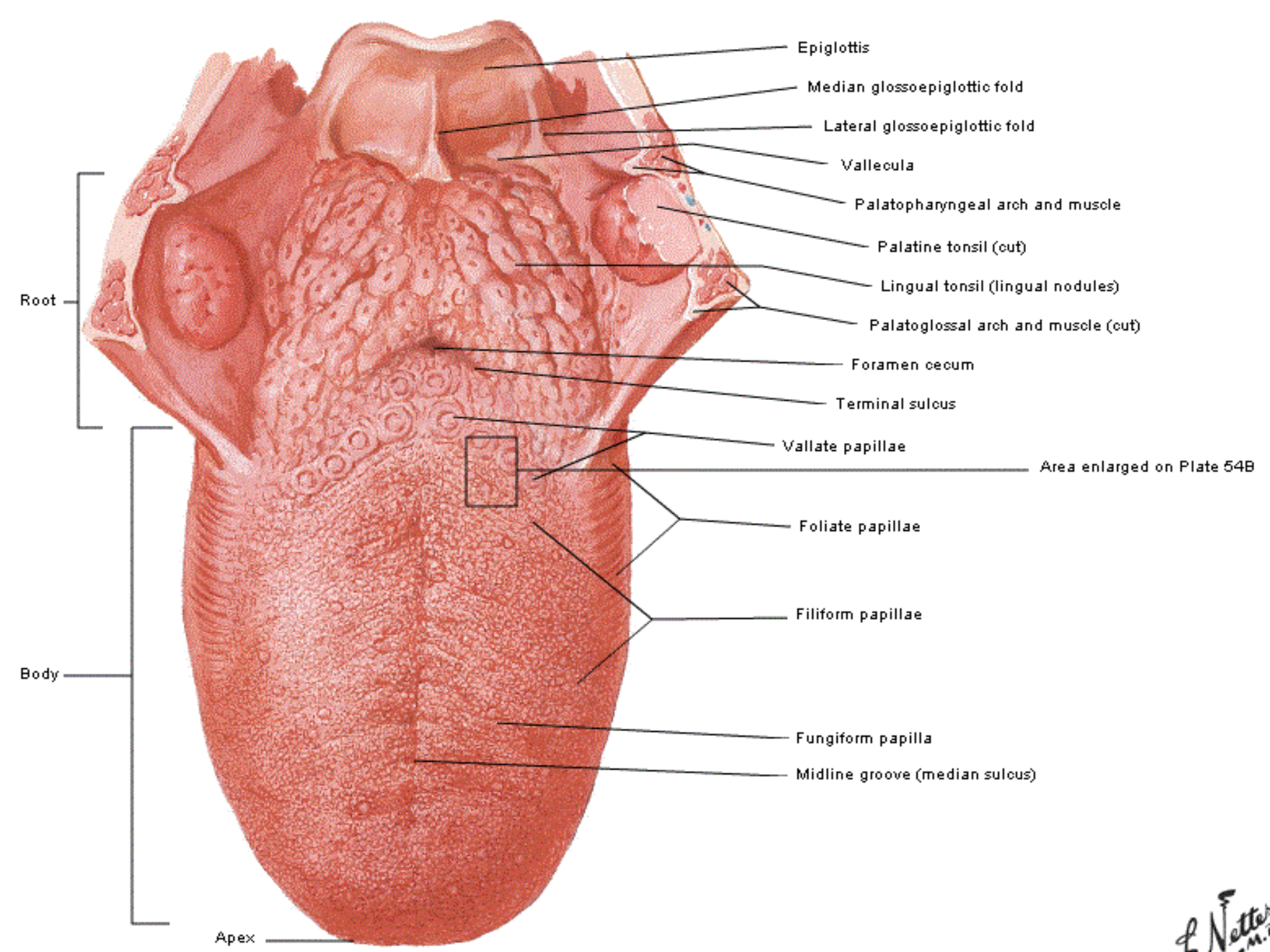

Palatopharyngeus muscle
Palatoglossus muscle
Inferior longitudinal muscle of tongue
Mastoid process
Digastric muscle (posterior belly) (cut)
Styloid process
Pharyngobasilar fascia
Superior pharyngeal constrictor muscle
Stylohyoid ligament
Styloglossus muscle
Glossopharyngeal part of superior pharyngeal constrictor
Stylopharyngeus muscle
Stylohyoid muscle
Middle pharyngeal constrictor muscle
Digastric muscle (posterior belly) (cut)
Hyoglossus muscle
Intermediate tendon of digastric muscle (cut)
Fibrous loop for intermediate digastric tendon
Hyoid bone
Genioglossus muscle
Mylohyoid muscle (cut)
Geniohyoid muscle



(C) Anterior view of coronal section of mouth

FIGURE 7.90. Muscles of tongue.

- **lingual frenulum:** A **fold** in the midline of the **undersurface** of the tongue
- **Papillae:** Nipple-shaped **projections**
- Many contain **taste buds**, the receptors for taste
- **Lingual glands:** Secrete both **mucus** and a **watery** serous fluid


Epiglottis
Median glossoepiglottic fold
Lateral glossoepiglottic fold
Vallecula
Palatopharyngeal arch and muscle
Palatine tonsil (cut)
Lingual tonsil (lingual nodules)
Palatoglossal arch and muscle (cut)
Foramen cecum
Terminal sulcus
Vallate papillae
Area enlarged on Plate 54B
Foliate papillae
Filiform papillae
Fungiform papilla
Midline groove (median sulcus)
Root
Body
Apex

Salivary gland

- Releases a secretion called **saliva**
- Keep mouth and pharynx **moist** and to **cleanse** the **mouth** and **teeth**.
- **lubricates**, **dissolves**, and begins the **chemical** breakdown

- **Three** pairs of **major** salivary glands

Parotid glands

- **Inferior** and **anterior** to the **ears**,
- **Parotid duct**, open into the vestibule opposite the **second maxillary molar** tooth

Submandibular glands

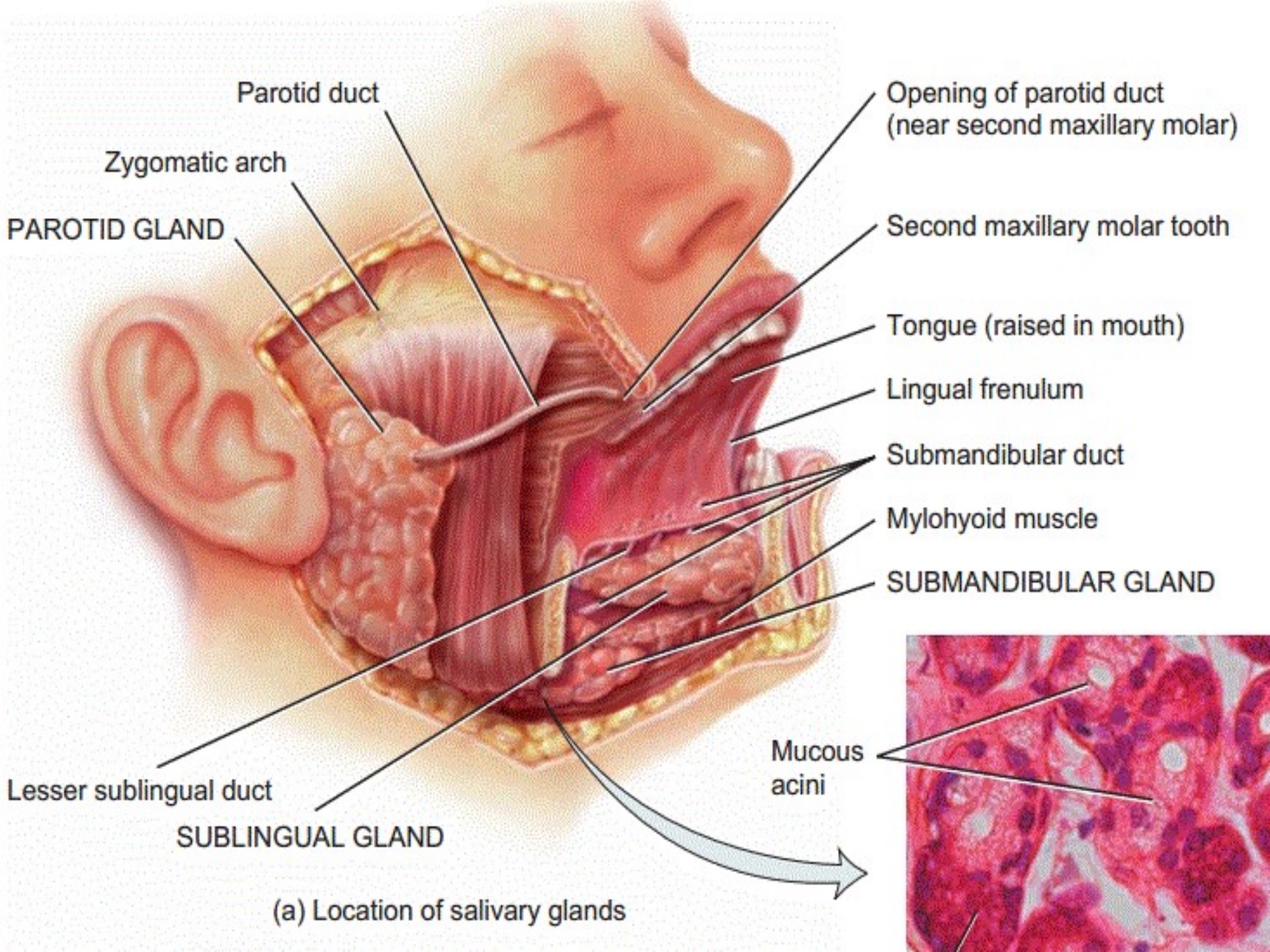
- In the **floor** of the mouth
- Submandibular **ducts**, enter oral cavity proper **lateral** to the **lingual frenulum**

Sublingual glands

- Beneath the **tongue**
- **Lesser sublingual ducts**, open into the **floor** of the **mouth**

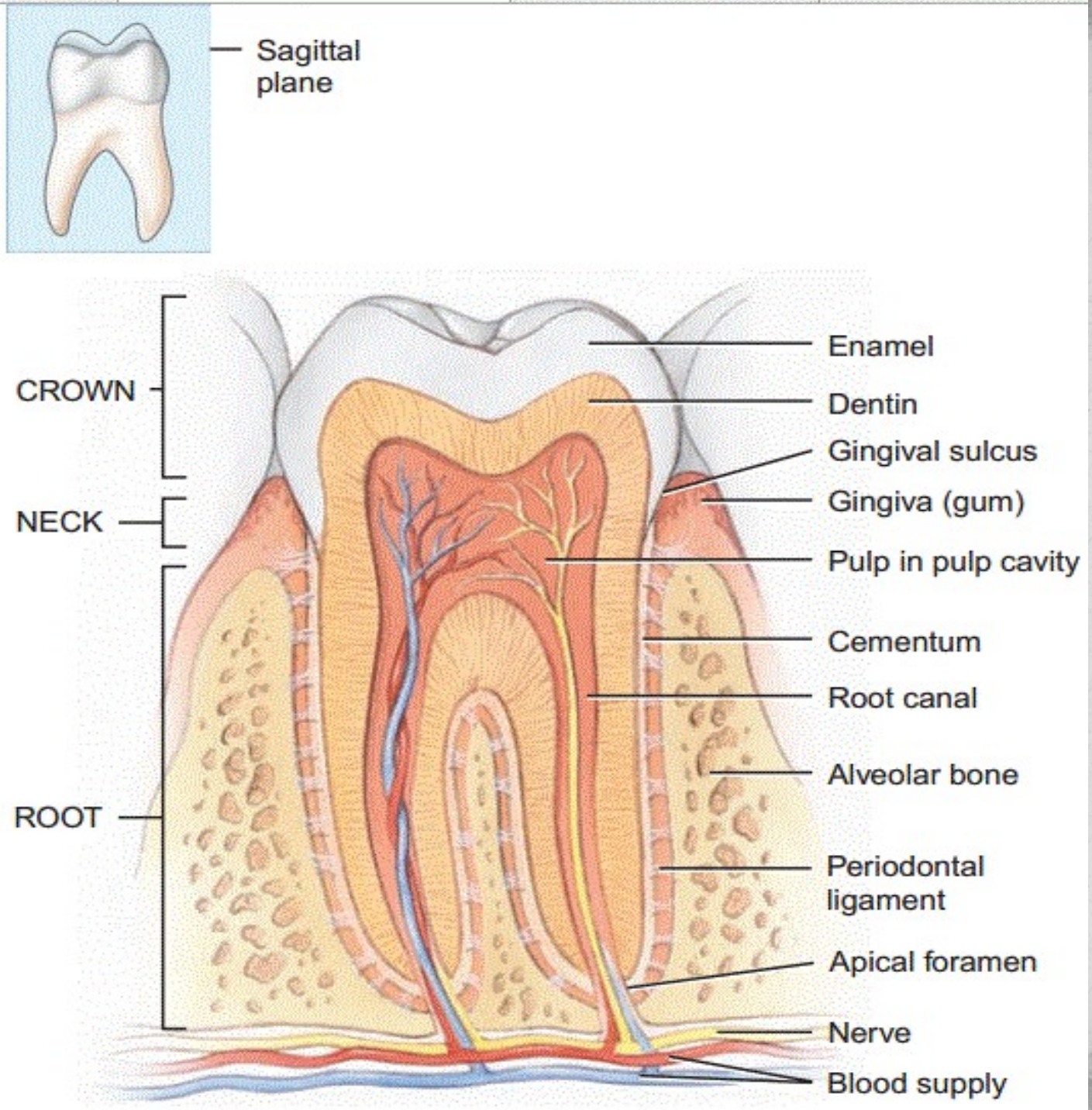
Saliva

- 99.5% **water** and 0.5% **solutes** includes,
- **Ions**: sodium, potassium, chloride, bicarbonate, and phosphate.
- **Dissolved gases** and **organic** substances,


Parotid duct
Zygomatic arch
PAROTID GLAND
Opening of parotid duct
(near second maxillary molar)
Second maxillary molar tooth
Tongue (raised in mouth)
Lingual frenulum
Submandibular duct
Mylohyoid muscle
SUBMANDIBULAR GLAND
Lesser sublingual duct
SUBLINGUAL GLAND
Mucous
acini
(a) Location of salivary glands

Teeth

- Also called **dentes**, accessory digestive organs
- Located in **sockets** of the **alveolar processes** of the mandible and maxillae.
- **Gingivae** (gums), **cover** alveolar processes are extend **slightly** into each socket.


Sagittal plane
CROWN
NECK
ROOT
Enamel
Dentin
Gingival sulcus
Gingiva (gum)
Pulp in pulp cavity
Cementum
Root canal
Alveolar bone
Periodontal ligament
Apical foramen
Nerve
Blood supply

Dental regions

- **Crown**: **visible** portion above the level of the gums.
- **Neck**: constricted **junction** of crown and root
- **Roots**: **embedded** in the socket, one to three

Cusp

- An **elevation** on an **occlusal** surface of posterior teeth and canines.

Parts of teeth

Dentin: Forms the **majority** of the tooth.

- **Calcified** connective tissue

Enamel: Cover dentin of the **crown**

- **Hardest** substance in the body.

Cementum

- **Cover** dentin of the **root,** connect it with socket

Pulp cavity

- **Enlarged** part of space **encloses** by dentin, within the **crown**
- Filled with **pulp**, connective tissue containing **blood** vessels, **nerves**, and **lymphatic** vessels.

Root canals

- **Narrow** extensions of the pulp cavity,
- **Apical foramen**, opening at the base
- **Blood** vessels, **lymphatic** vessels, and **nerves** extend through apical foramen

Type of teeth

- Humans have **two** sets of dentition

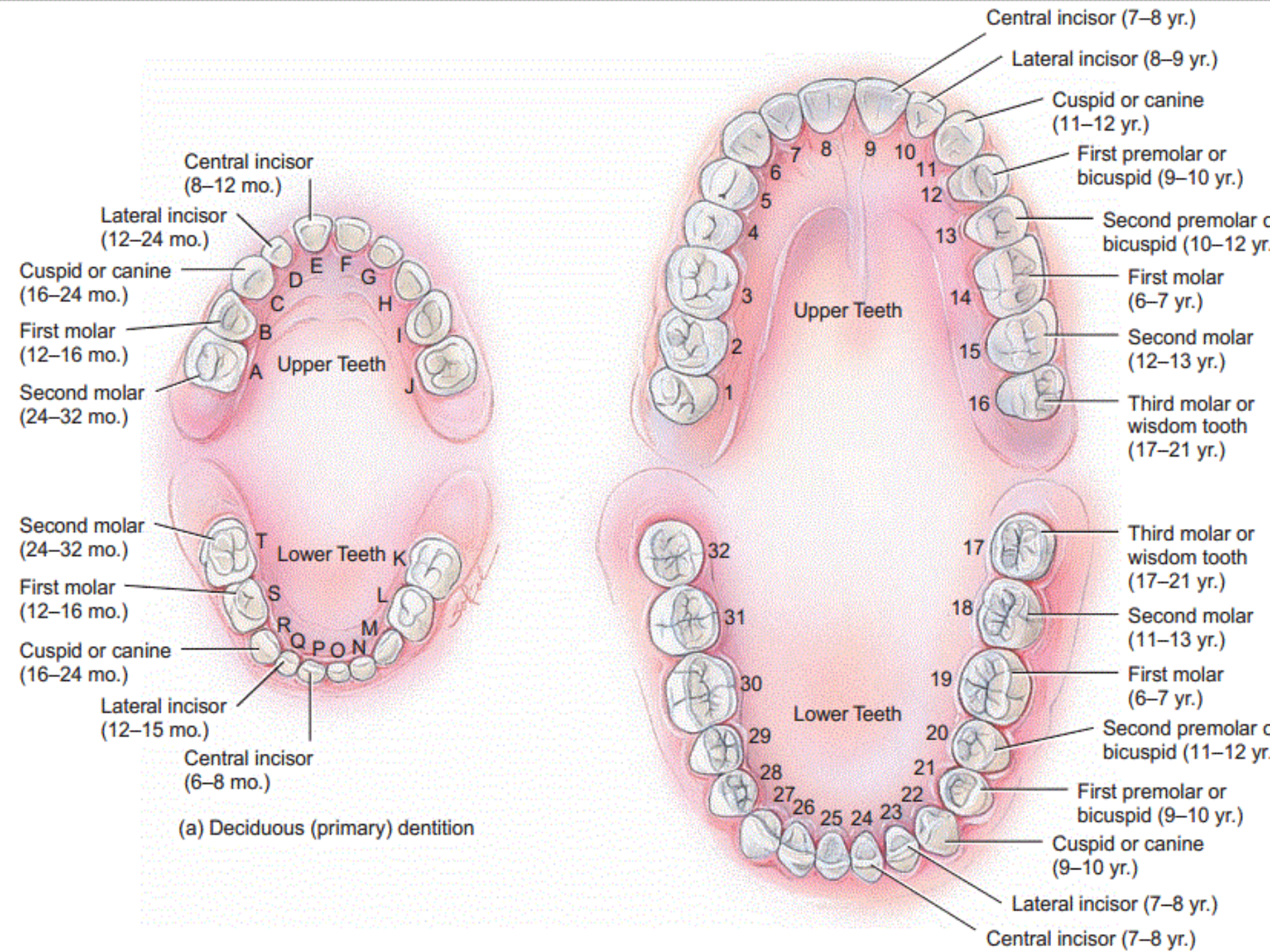
Primary teeth

- **20** deciduous teeth.
- Start to shade in average at **6-7**
- Disappear all in all at the age of **10 - 12**

Permanent teeth

- **32**
- Replace primary .
- remain for a lifetime

- **Four** types of teeth
- Incisor, canine, premolar and molars
- The **two primary molars** replaced by **premolars**.
- The **permanent molars** erupt on an **open space** behind the second premolars as the jaws grow in size


Central incisor (8–12 mo.)
Lateral incisor (12–24 mo.)
Cuspid or canine (16–24 mo.)
First molar (12–16 mo.)
Second molar (24–32 mo.)
A
B
C
D
E
F
G
H
I
J
Upper Teeth
Second molar (24–32 mo.)
First molar (12–16 mo.)
Cuspid or canine (16–24 mo.)
Lateral incisor (12–15 mo.)
Central incisor (6–8 mo.)
T
S
R
Q
P
O
N
M
L
K
Lower Teeth
(a) Deciduous (primary) dentition
Central incisor (7–8 yr.)
Lateral incisor (8–9 yr.)
Cuspid or canine (11–12 yr.)
First premolar or bicuspid (9–10 yr.)
Second premolar or bicuspid (10–12 yr.)
First molar (6–7 yr.)
Second molar (12–13 yr.)
Third molar or wisdom tooth (17–21 yr.)
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
Upper Teeth
Third molar or wisdom tooth (17–21 yr.)
Second molar (11–13 yr.)
First molar (6–7 yr.)
Second premolar or bicuspid (11–12 yr.)
First premolar or bicuspid (9–10 yr.)
Cuspid or canine (9–10 yr.)
Lateral incisor (7–8 yr.)
Central incisor (7–8 yr.)
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
Lower Teeth

Incisor

- There are **two pairs** of incisors in **each jaw**.
- There are **two types**; **central** and **lateral** incisors.
- Their function is **cutting** and **biting** food.

Canine

- There is a **pair** of **canine** in each jaw.
- Both the **maxillary** and **mandibular** canines are called the "**cornerstone**" of the mouth.
- **Tearing** of food.
- There is a **single cusp** and **root canal**

Premolar

- There are **two pairs** of premolars in each jaw.
- They are **bigger** than **incisors** and canines and are **flattened** on top with **two cusps**
- **Chewing** and **grinding**.
- They are **divided** into **first** and **second** premolars.
- There are **no deciduous premolars**.

Molar

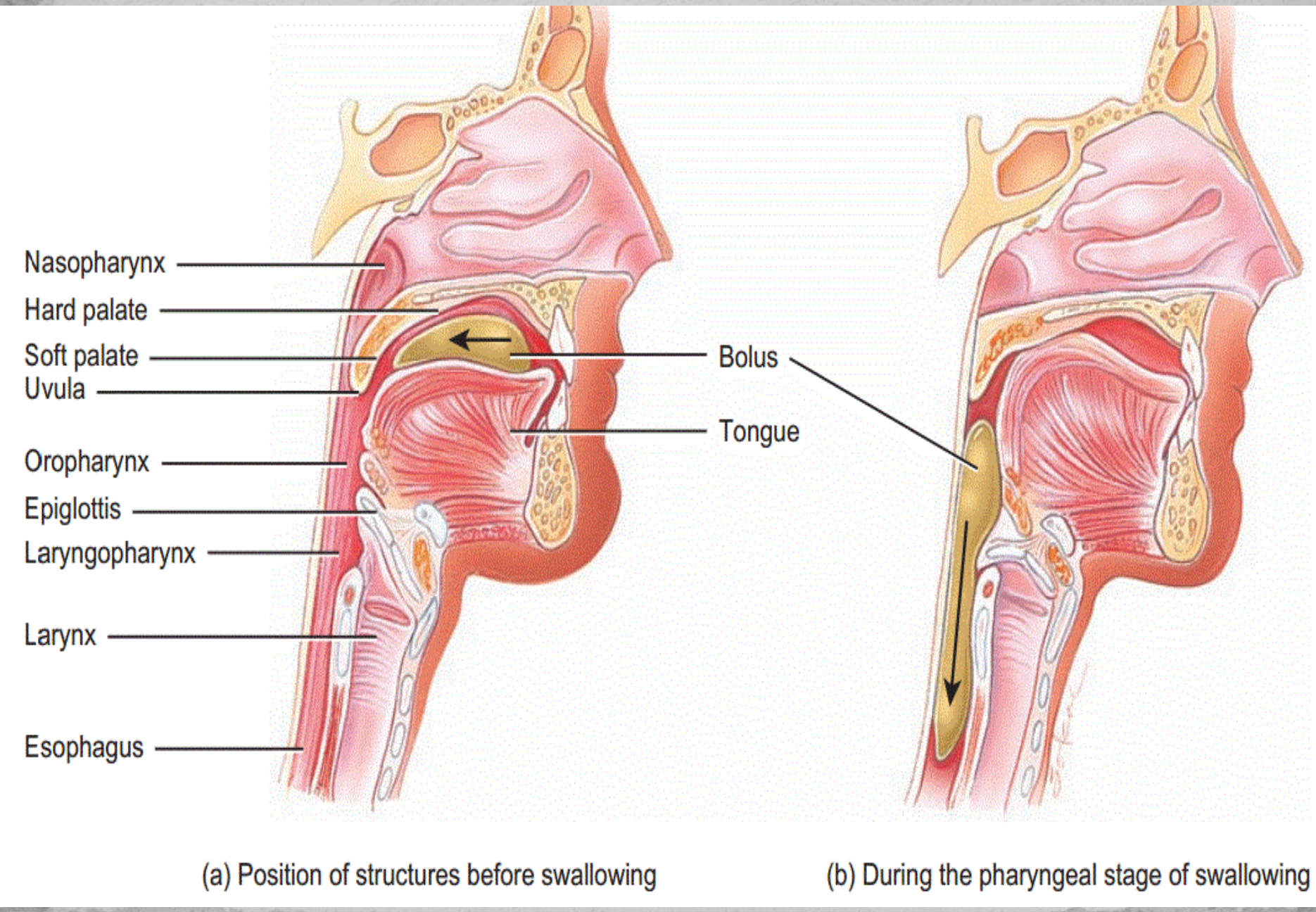
- There are **three pairs** of molars in each jaw.
- They are the most **posterior** teeth in the mouth.
- Their function is to **grind** food during chewing.
- The number of **cusps**, ranging from **3** to **5**.
- The number of the **root canal** is also **variable**.
- The **third molars** are commonly called "**wisdom teeth**", which appears only much later in the adulthood, after age of **17**

Pharynx

- **Funnel-shaped** tube that extends from the **internal nares** to the **esophagus** posteriorly and to the **larynx** anteriorly
- Composed of **skeletal muscle** and lined by mucous membrane
- Divided into **three parts**

Nasopharynx

- Has a **respiratory** function;
- Posterior **extension** of the **nasal cavities**.
- Extends from the **base** of the **skull** to the **soft palate**

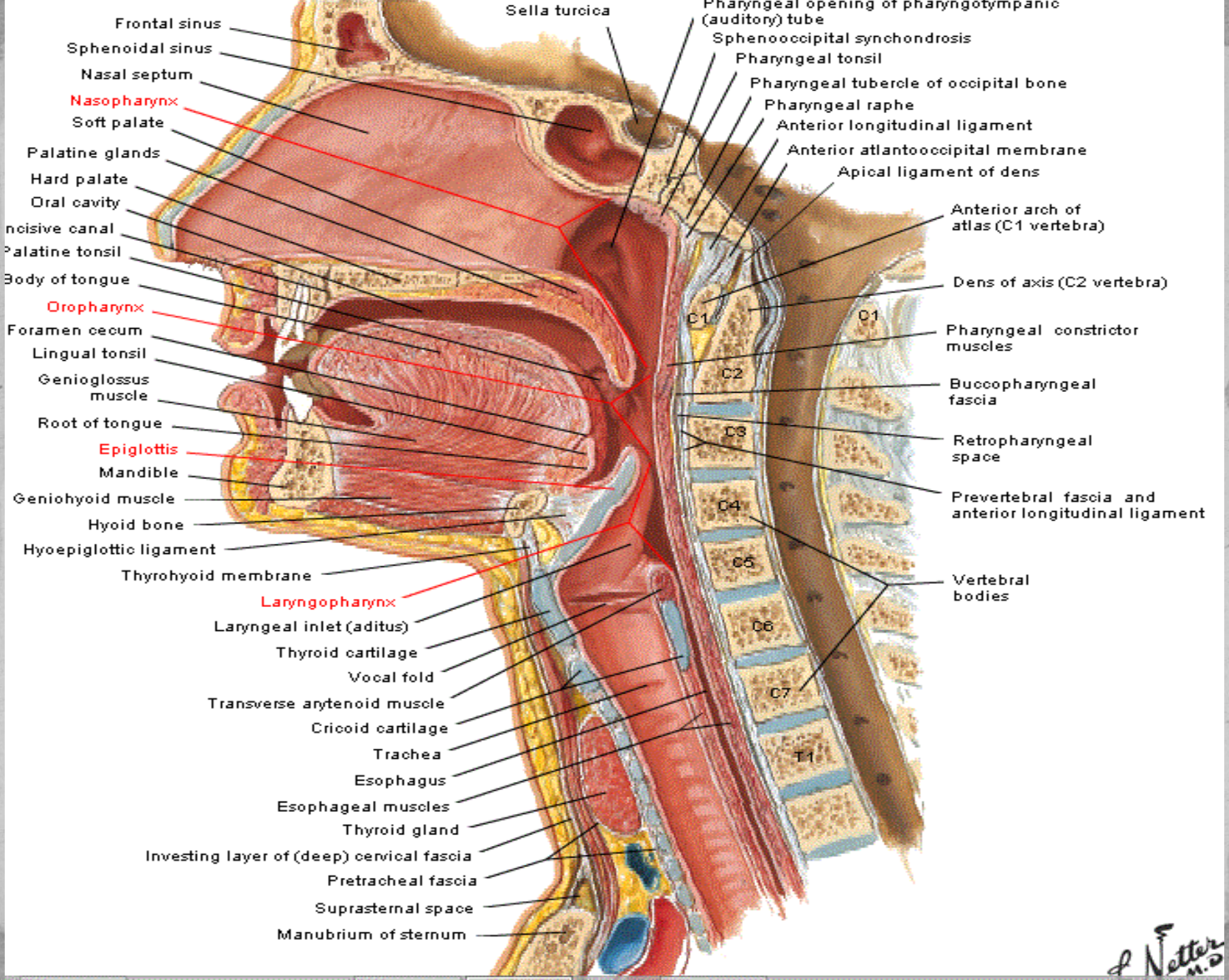

Nasopharynx
Hard palate
Soft palate
Uvula
Oropharynx
Epiglottis
Laryngopharynx
Larynx
Esophagus
Bolus
Tongue
(a) Position of structures before swallowing
(b) During the pharyngeal stage of swallowing

Oropharynx

- Has a **digestive** function.
- Extends from the **soft palate** to the superior border of the **epiglottis**.
- **Palatoglossal** & **palatopharyngeal** arches **laterally**.
- Opens into the **faucial isthmus** superiorly
- **Faucial isthmus**, region connecting the **oropharynx** with the **oral cavity**

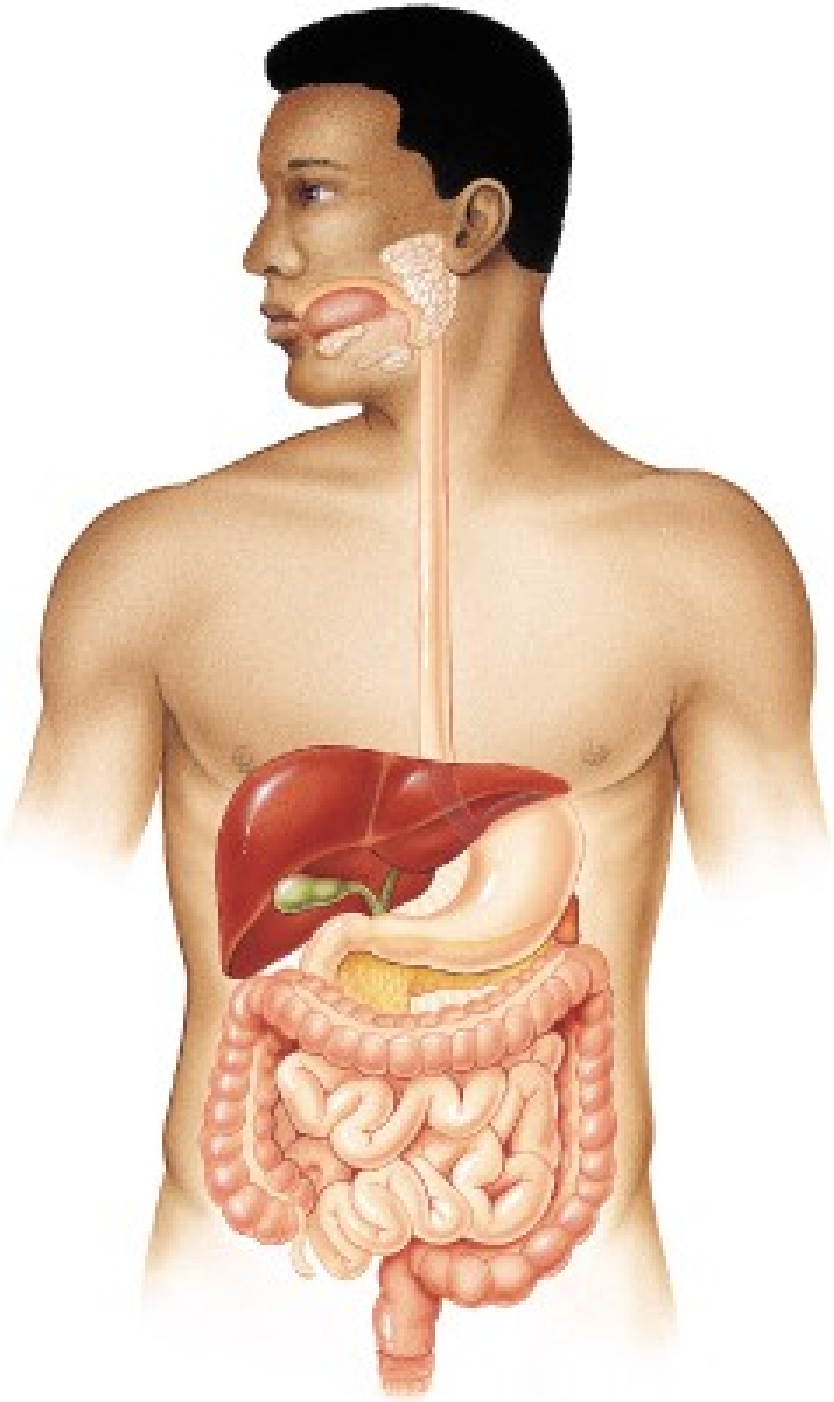
Laryngopharynx

- Has **digestive** function
- Lies **posterior** to the **larynx**; related to **C4-C6** vertebrae.
- Extends from the **superior** border of the **epiglottis** to the **esophagus**
- **Anterior** wall opens into the **laryngeal aditus/inlet** superiorly
- **Inferiorly**, is formed by the mucosa covering the posterior aspect of the **larynx**

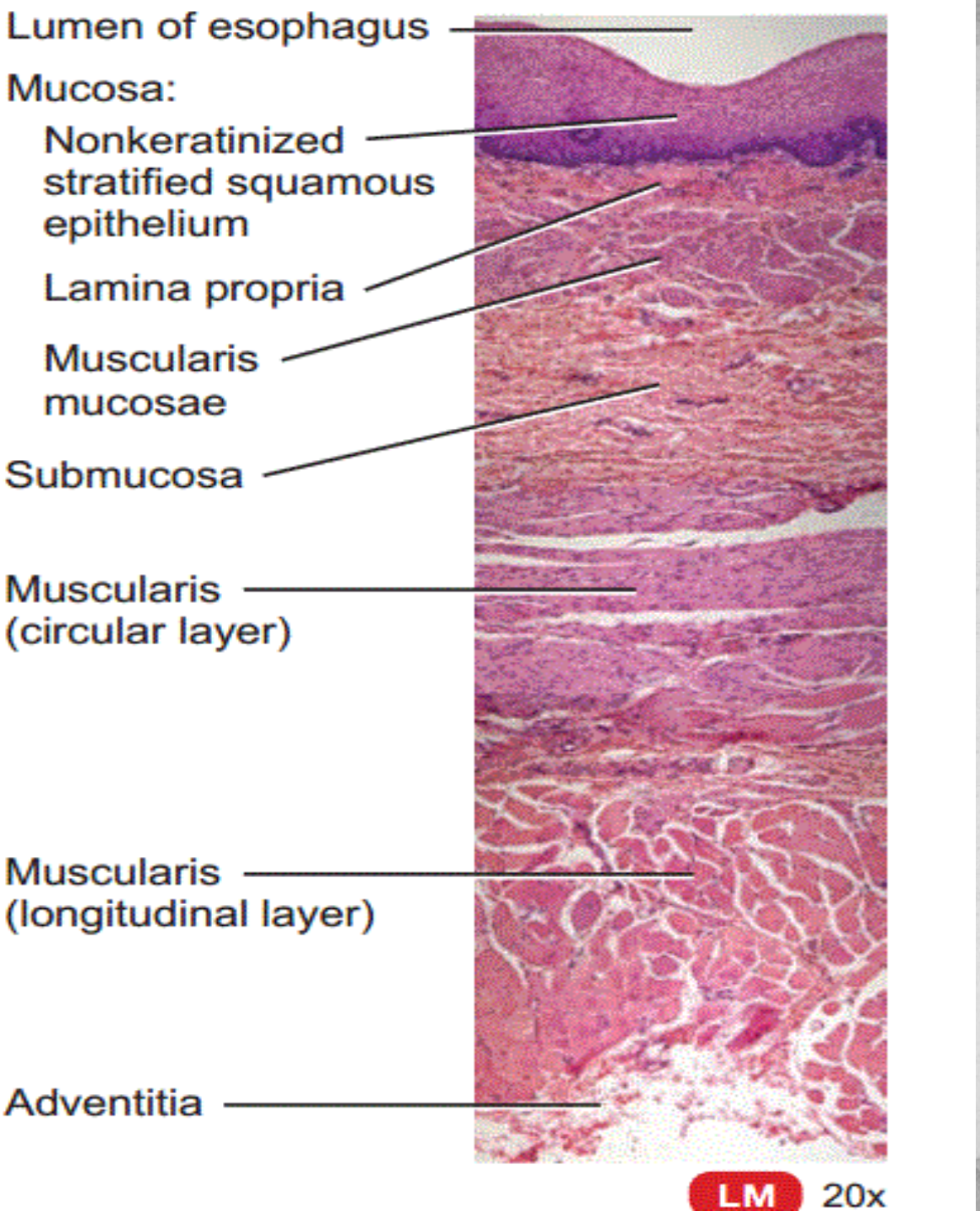

Frontal sinus
Sphenoidal sinus
Nasal septum
Nasopharynx
Soft palate
Palatine glands
Hard palate
Oral cavity
ncisive canal
Palatine tonsil
Body of tongue
Oropharynx
Foramen cecum
Lingual tonsil
Genioglossus muscle
Root of tongue
Epiglottis
Mandible
Geniohyoid muscle
Hyoid bone
Hyoepiglottic ligament
Thyrohyoid membrane
Laryngopharynx
Laryngeal inlet (aditus)
Thyroid cartilage
Vocal fold
Transverse arytenoid muscle
Cricoid cartilage
Trachea
Esophagus
Esophageal muscles
Thyroid gland
Investing layer of (deep) cervical fascia
Pretracheal fascia
Suprasternal space
Manubrium of sternum
Sella turcica
Pharyngeal opening of pharyngotympanic (auditory) tube
Sphenooccipital synchondrosis
Pharyngeal tonsil
Pharyngeal tubercle of occipital bone
Pharyngeal raphe
Anterior longitudinal ligament
Anterior atlantooccipital membrane
Apical ligament of dens
Anterior arch of atlas (C1 vertebra)
Dens of axis (C2 vertebra)
C1
C1
Pharyngeal constrictor muscles
C2
Buccopharyngeal fascia
C3
Retropharyngeal space
Prevertebral fascia and anterior longitudinal ligament
C4
C5
Vertebral bodies
C6
C7
T1
F. Netter M.D.

Esophagus

- A **collapsible** muscular tube
- About **25** cm long, that lies **posterior** to the **trachea**.
- Begins at the inferior end of the **laryngopharynx**
- Passes through the **mediastinum** anterior to the vertebral column.
- It pierces the **diaphragm** through an opening called the **esophageal hiatus**,
- Ends in the **superior** portion of the **stomach**
- Found between the **left bronchus** and the **aorta**



- Esophagus has four layers,
- **Mucosa: inner layer**
- **Submucosa: blood vessels**, and **mucous glands**
- **Muscularis:** Has **circular** and **longitudinal** layers
- Upper 1/3 = **Striated** muscle, Middle 1/3 = **Smooth** and **striated** muscles, (transitional zone) and Lower 1/3 = **Smooth** muscles
- **Adventitia:** Superficial layer of the esophagus


Lumen of esophagus
Mucosa:
Nonkeratinized stratified squamous epithelium
Lamina propria
Muscularis mucosae
Submucosa
Muscularis (circular layer)
Muscularis (longitudinal layer)
Adventitia
LM
20x

- **Two sphincters**

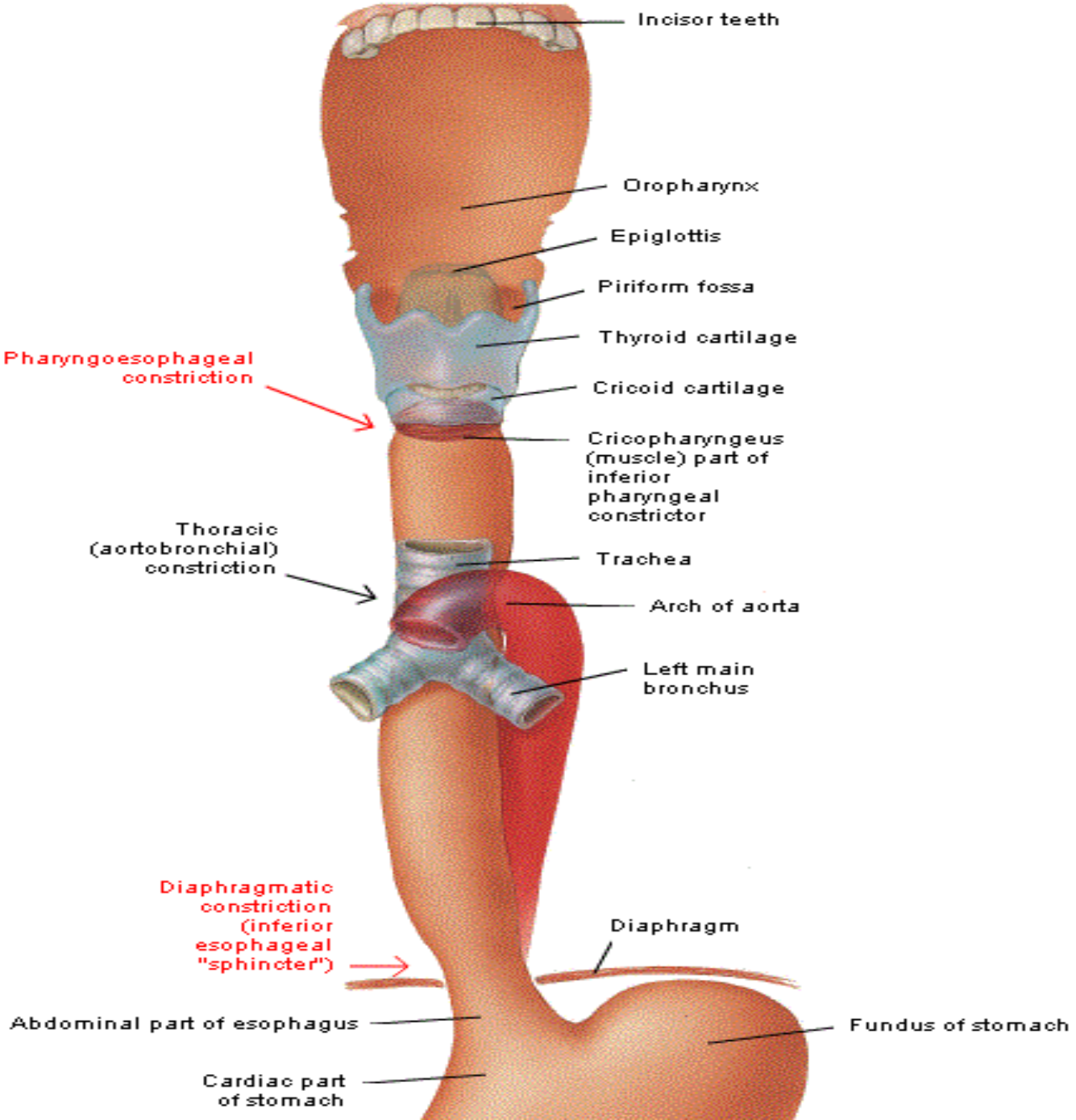
Upper esophageal sphincter (UES)

- A **true sphincter**, prevents **excess air** from entering the esophagus

Lower esophageal sphincter (LES)

- **Not** a **true** anatomical sphincter
- Zone of **relatively high pressure** that prevents gastric contents from **refluxing** into the lower esophagus

Schema - Anterior view



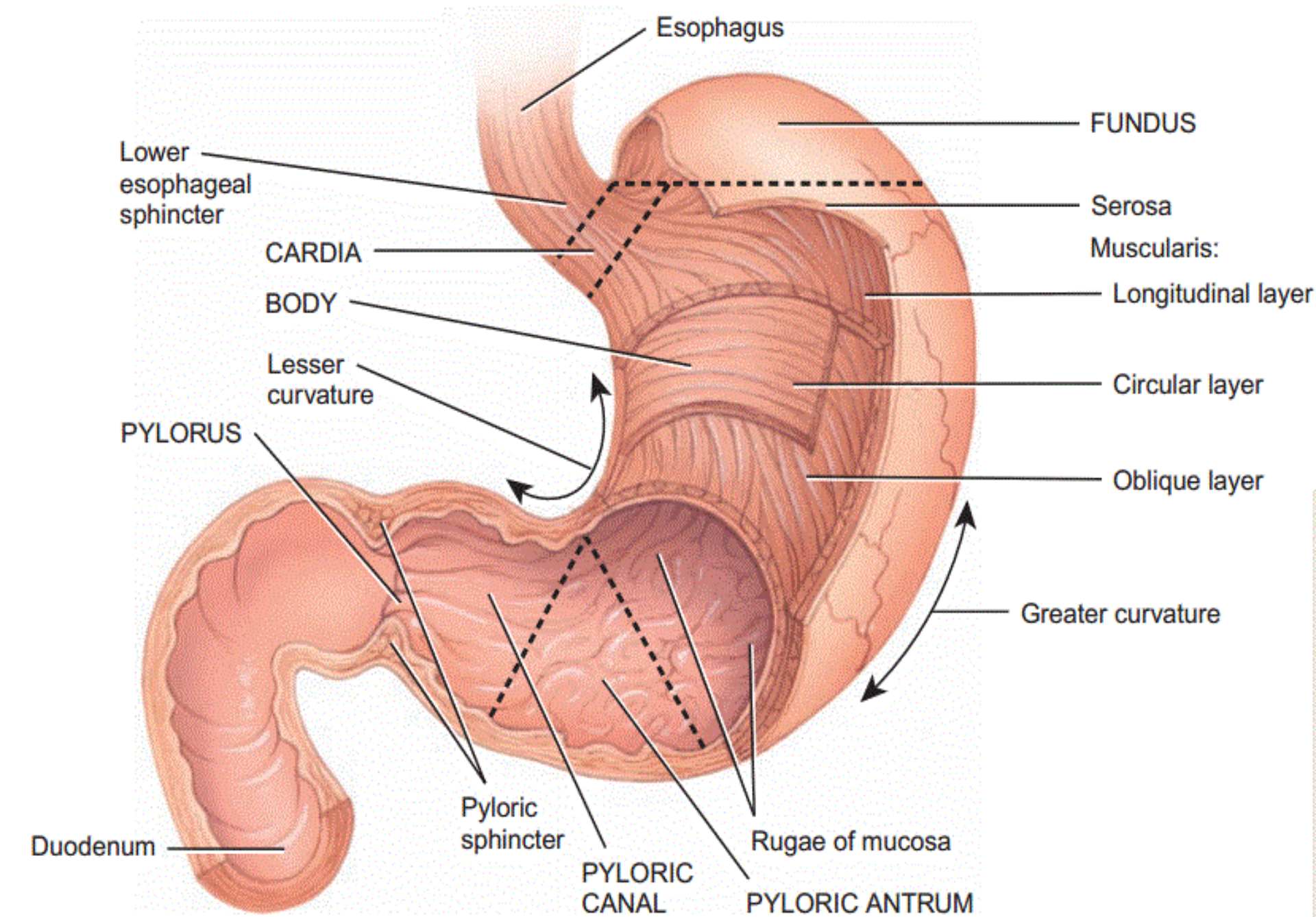
Stomach

- **Expanded** part of the digestive tract between the **esophagus** and **small intestine**
- **Chemical** and **mechanical digestion** and **passage** into the duodenum.
- Gastric **juice** gradually converts a mass of food into a **semiliquid mixture**, **chyme**
- can hold **2–3**L of food
- In the **supine** position, lies **epigastric region**
- Covered by **peritoneum**

Parts of stomach

Stomach parts

- **Cardia:** The **superior opening** or inlet of the stomach.
- **Fundus**: **Dilated** superior part
- **Body:** Between the **fundus** and **pyloric antrum**.
- **Pyloric part: Funnel-shaped** outflow region of the stomach
- **Pylorus** (G., gatekeeper) Is the **distal**, **sphincteric region** of the pyloric part.



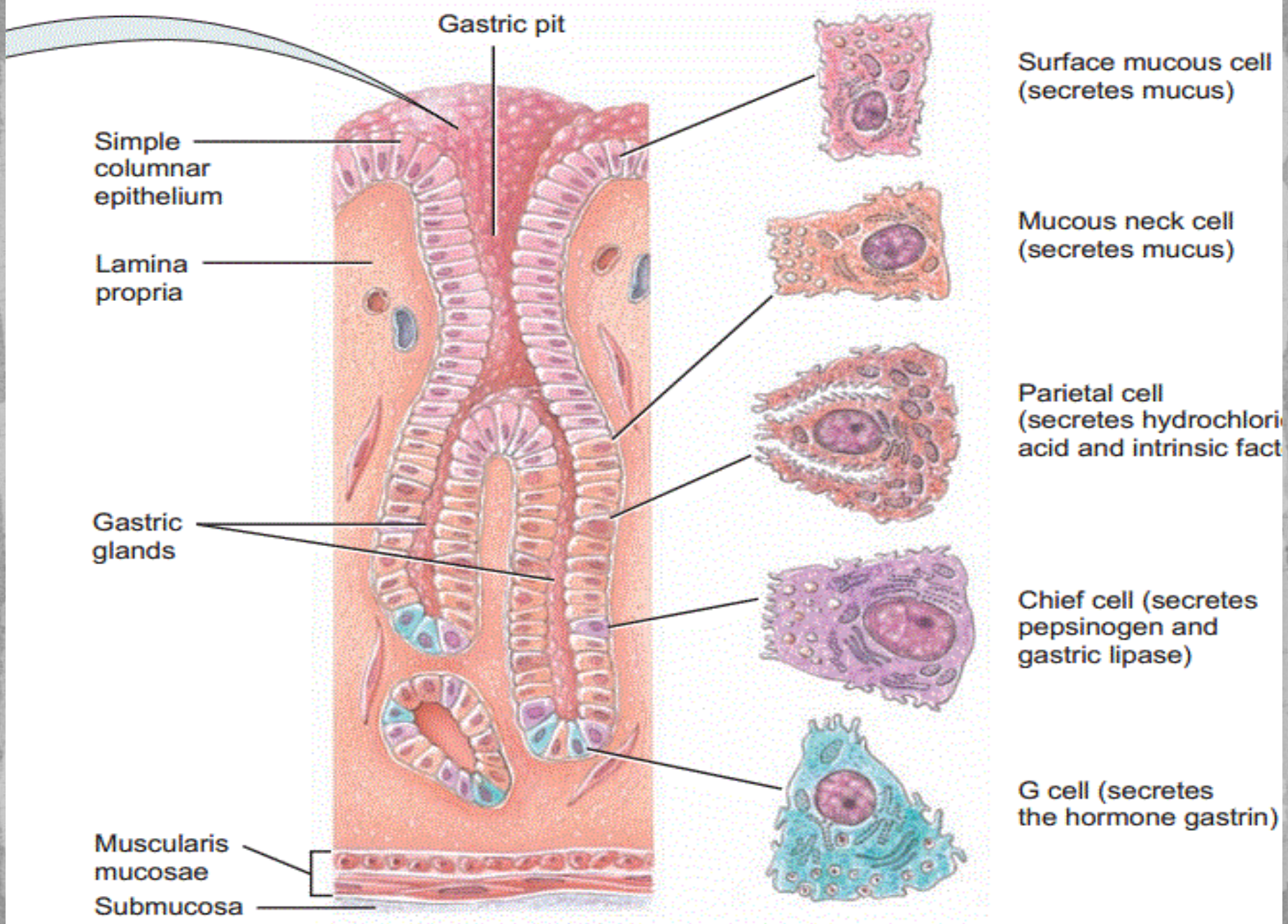
(a) Anterior view of regions of stomach

Two **curvatures**

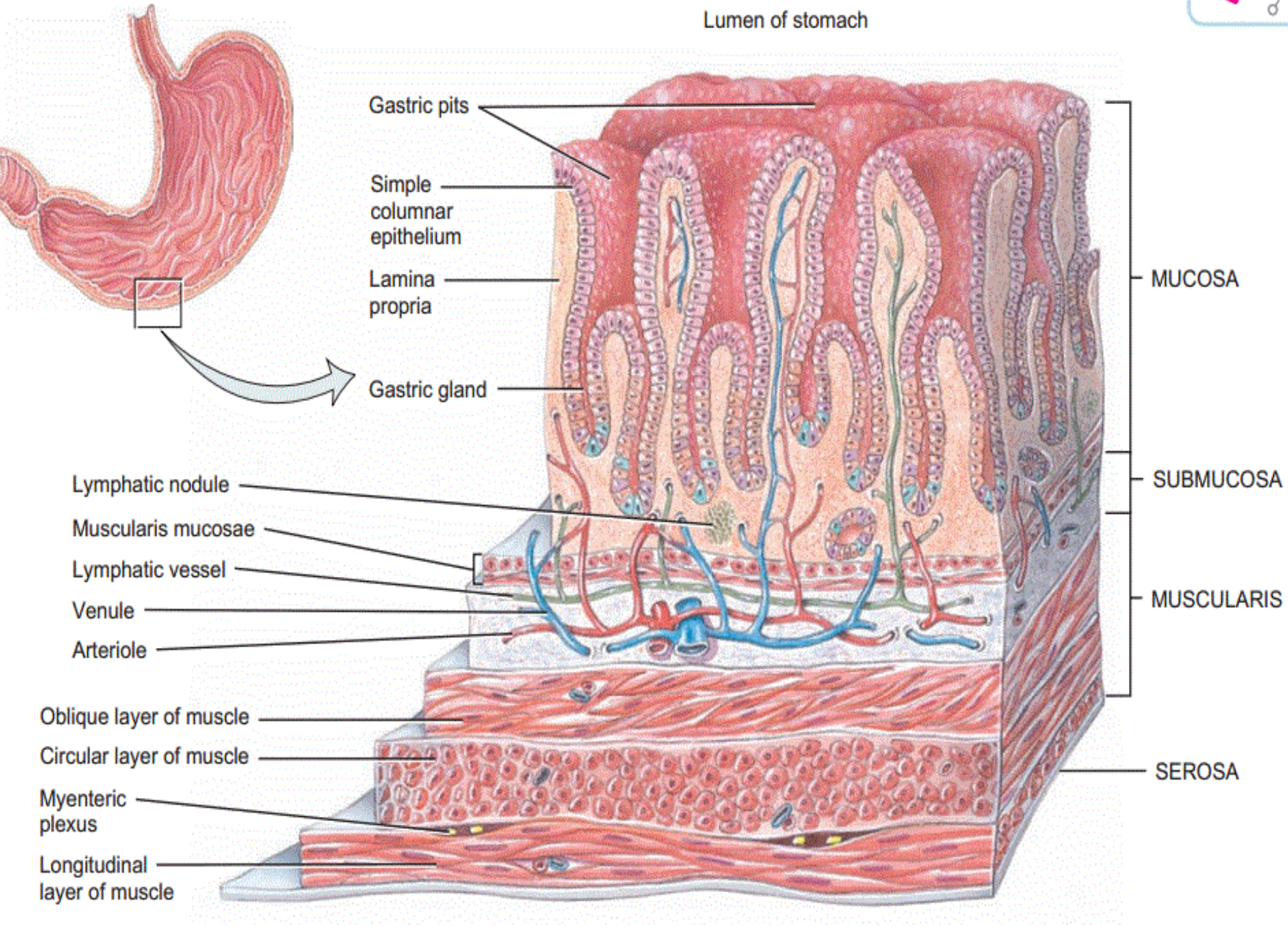
- **Lesser curvature:** Forms the **shorter concave right** border of the stomach.
- **Greater curvature:** Forms the **longer convex left** border of the stomach.

Stomach layers

- **Mucous:** Epithelium extend down into the lamina propria,
- Form three **gastric glands, Mucous neck cells, Chief cells and Parietal** cells
- **Submucosa:** Composed of **areolar connective** tissue
- **Muscularis: Three layers** of smooth muscle
- **Serosa: superficial layer**



(b) Sectional view of the stomach mucosa showing gastric glands and cell types



(a) Three-dimensional view of layers of the stomach

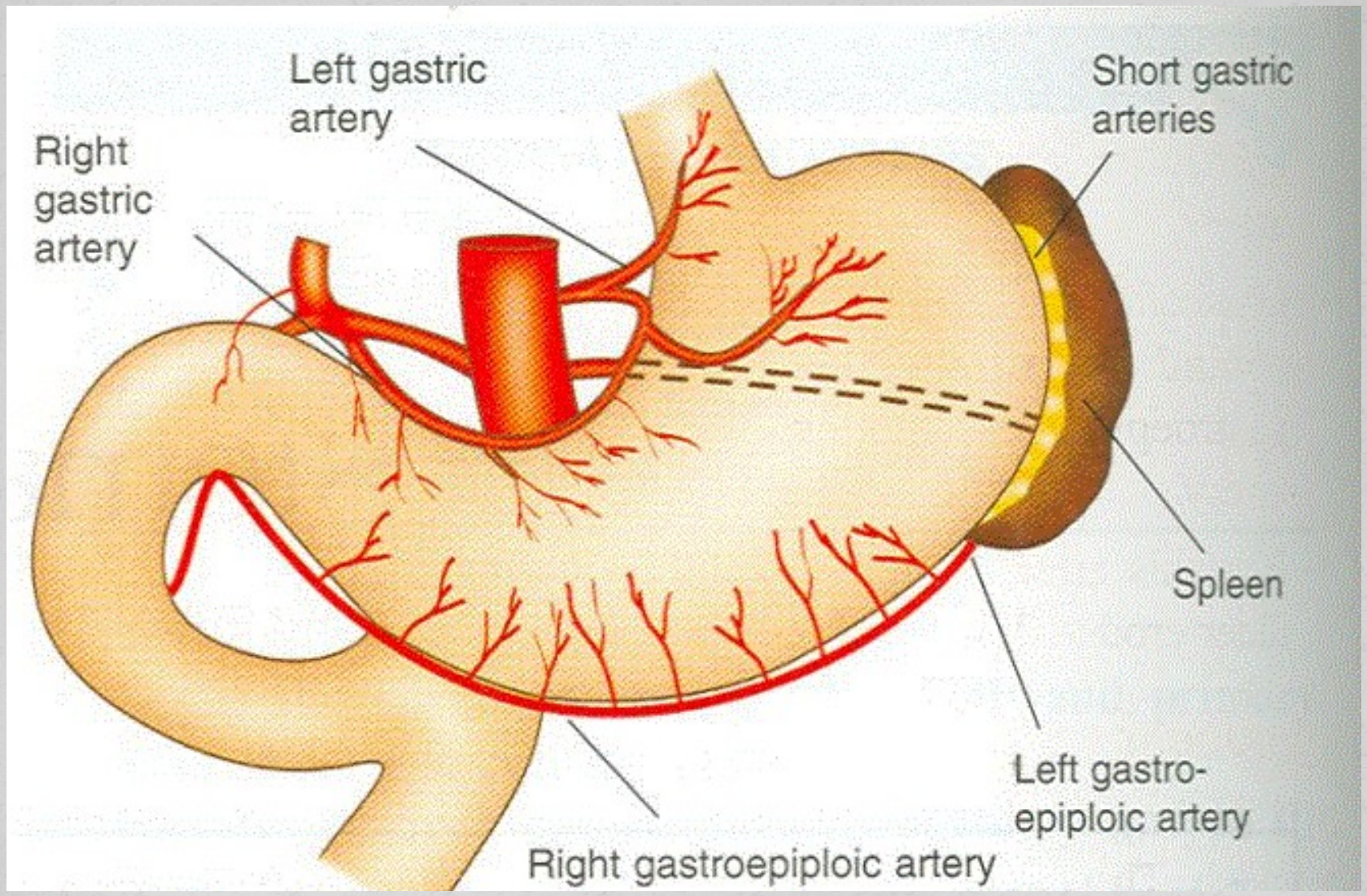
Vessels and nevres

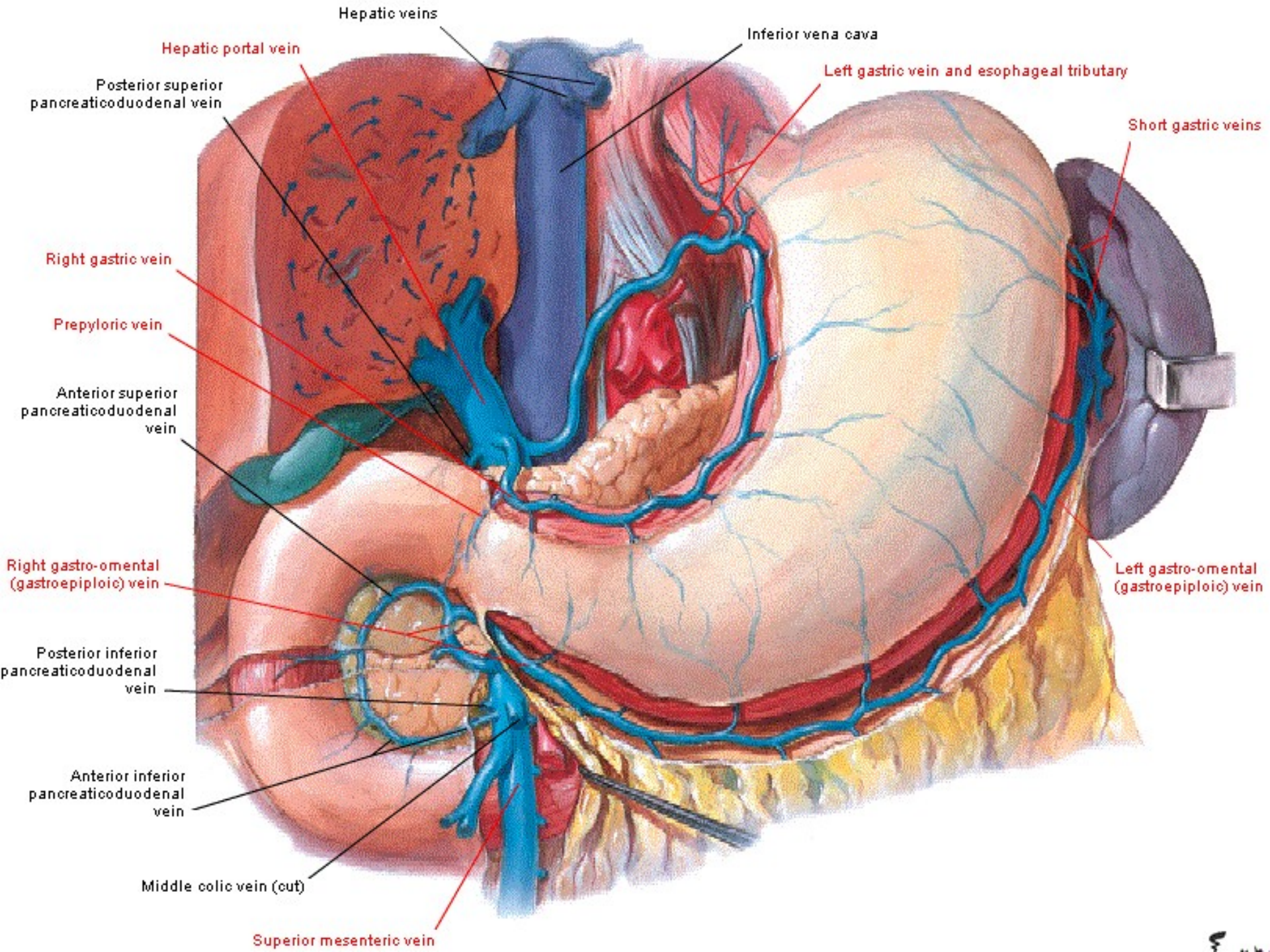
Artery

- Arises from the **celiac trunk** and its **branches**
- right and left **gastric arteries,** right and left **gastro-omental** arteries and **posterior gastric arteries**

Veins

- **Parallel** the **arteries**
- Right and left **gastric veins, Short gastric veins** and leftand right **gastro-omental** veins
- drain into the **hepatic portal vein**


Left gastric artery
Short gastric arteries
Right gastric artery
Spleen
Left gastro-epiploic artery
Right gastroepiploic artery


Hepatic veins
Inferior vena cava
Hepatic portal vein
Left gastric vein and esophageal tributary
Posterior superior pancreaticoduodenal vein
Short gastric veins
Right gastric vein
Prepyloric vein
Anterior superior pancreaticoduodenal vein
Right gastro-omental (gastroepiploic) vein
Left gastro-omental (gastroepiploic) vein
Posterior inferior pancreaticoduodenal vein
Anterior inferior pancreaticoduodenal vein
Middle colic vein (cut)
Superior mesenteric vein

Lymphatic

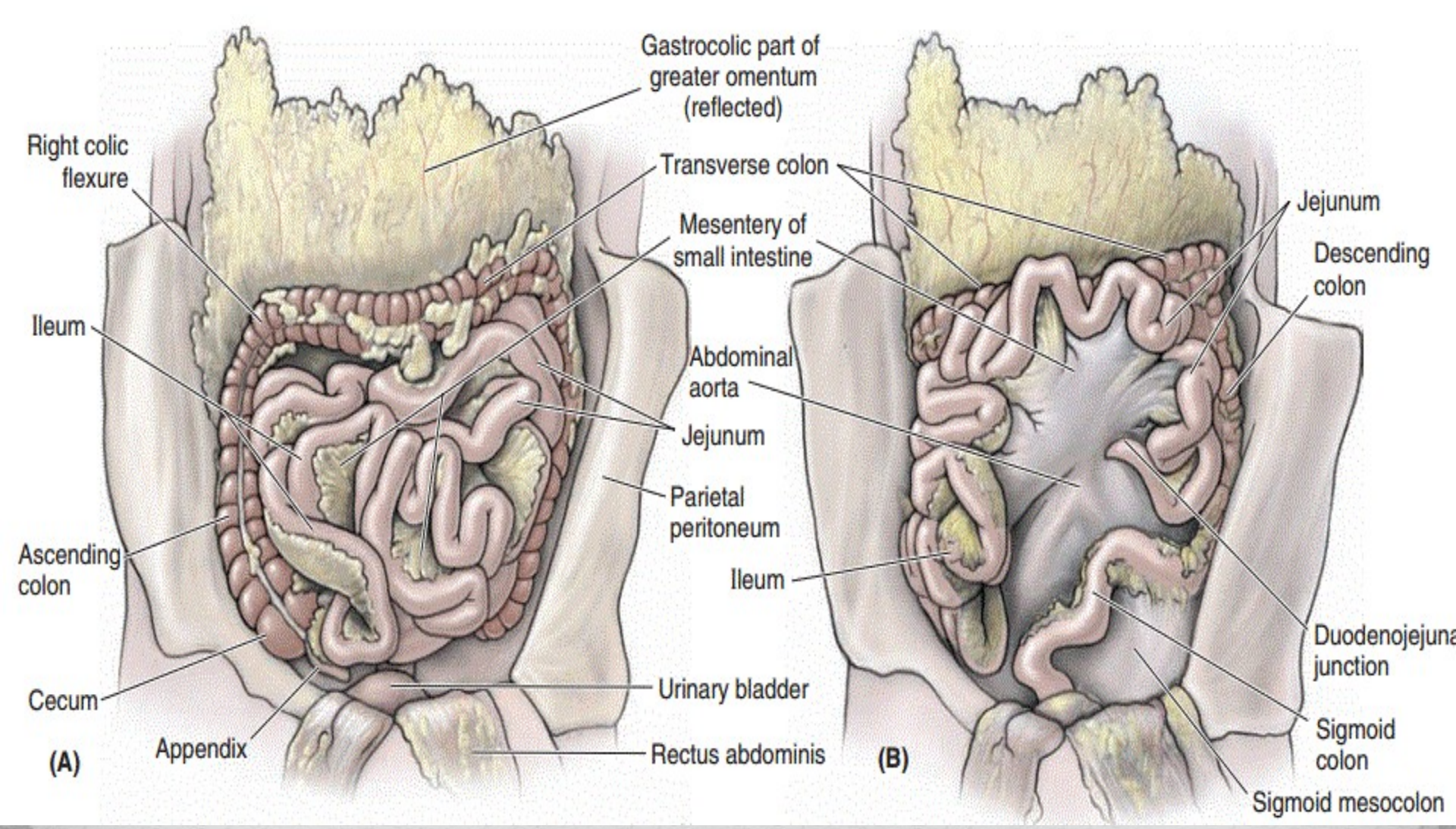
- **Accompany arteries**
- **gastric** lymph nodes, **pancreaticosplenic** lymph nodes, **pyloric lymph** nodes and **pancreaticoduodenal** lymph nodes

Nerve

- **Parasympathetic nerve, vagus nerve** (CN X)
- **Sympathetic nerve:** From the **T6** through **T9** segments of the **spinal cord**

Small intestine

- Primary site for **absorption**
- From the **pylorus** to the **ileocecal junction** where the ileum joins the cecum
- Consisting of the **duodenum**, **jejunum**, and **ileum**


Gastrocolic part of greater omentum (reflected)
Right colic flexure
Transverse colon
Mesentery of small intestine
Ileum
Abdominal aorta
Jejunum
Parietal peritoneum
Ascending colon
Ileum
Cecum
Urinary bladder
Appendix
Rectus abdominis
(A)
(B)
Jejunum
Descending colon
Duodenojejuna junction
Sigmoid colon
Sigmoid mesocolon

Duodenum

- **First** and **shortest** (25 cm) and
- **C-shaped** course around the head of the pancreas
- ends at the **duodenojejunal** flexure (junction) on the left side
- Partially retroperitoneal.
- divisible into **four** parts, **Superior(first**) part, **Descending(second**) part, **Inferior(third**) part and **Ascending(fourth**) part

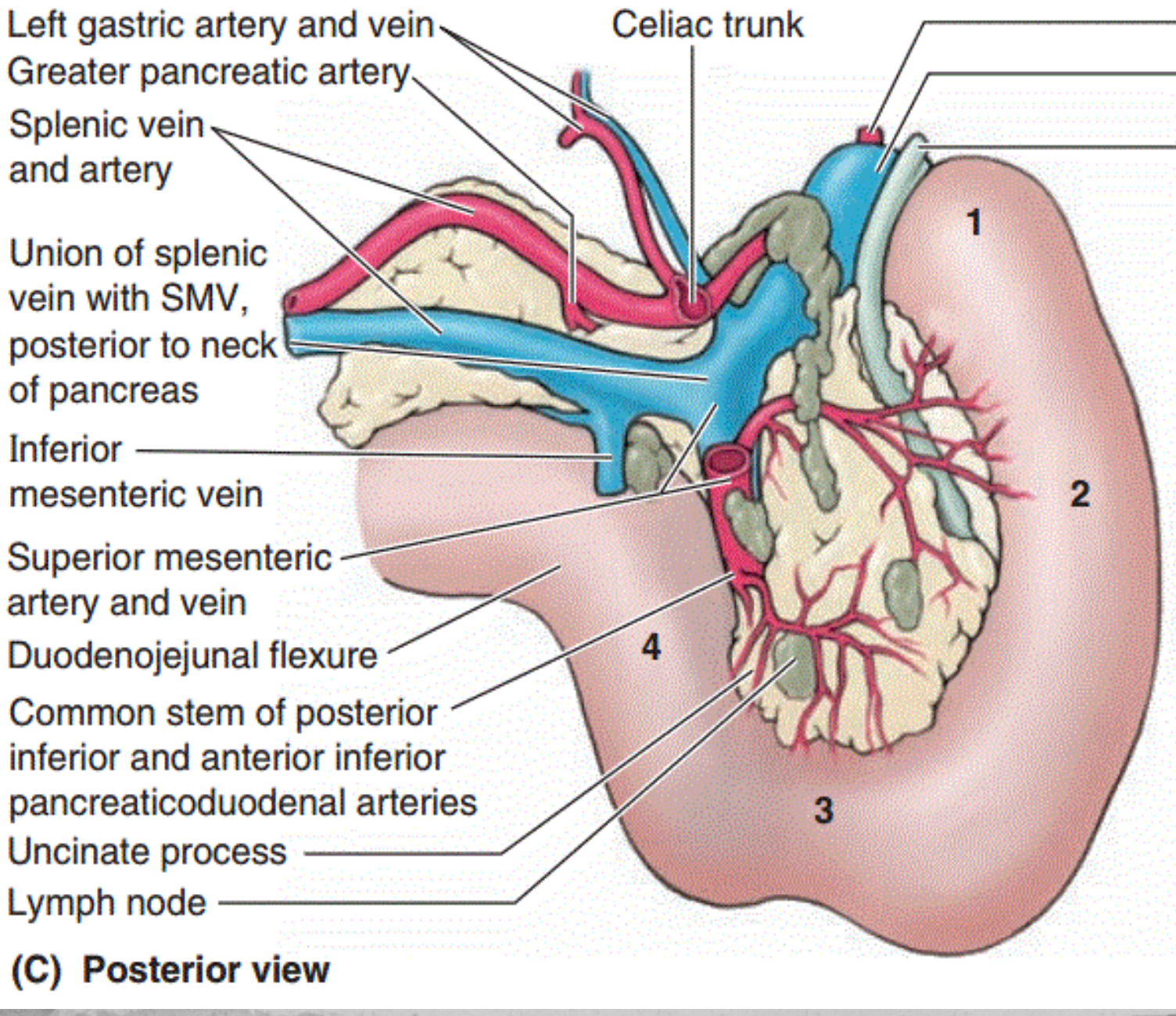
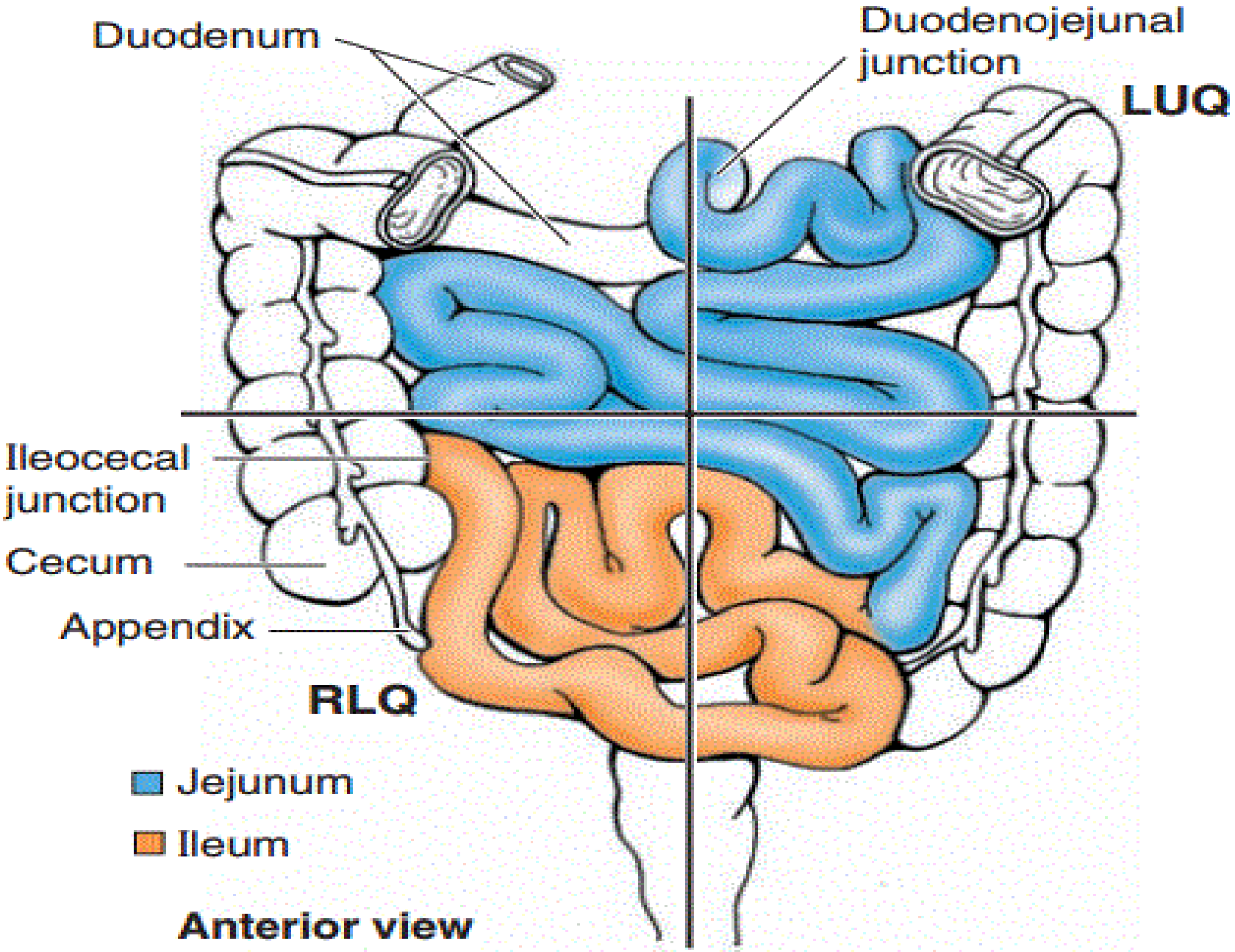


FIGURE 2.44.
pancreas, and sp
stomach, transv
duodenum, pan
molded around
duodenum and
cava occupy the
and third part o
the head of the p
vessels. The bile
rior part of the h

Jejunum and Ileum

- Together, the jejunum and ileum are **6–7 m** long
- **No** clear **line** of demarcation between
- Distinctive characteristics that are surgically important


Duodenum
Duodenojejunal junction
LUQ
Ileocecal junction
Cecum
Appendix
RLQ
Jejunum
Ileum
Anterior view

Jejunum

- **Second** part of the small intestine
- Most lies in the left upper quadrant (**LUQ**) of the **infracolic** compartment

Ileum

- **Third** part of the small intestine
- Ends at the **ileocecal junction**
- Most lies in the right lower quadrant (**RLQ**).

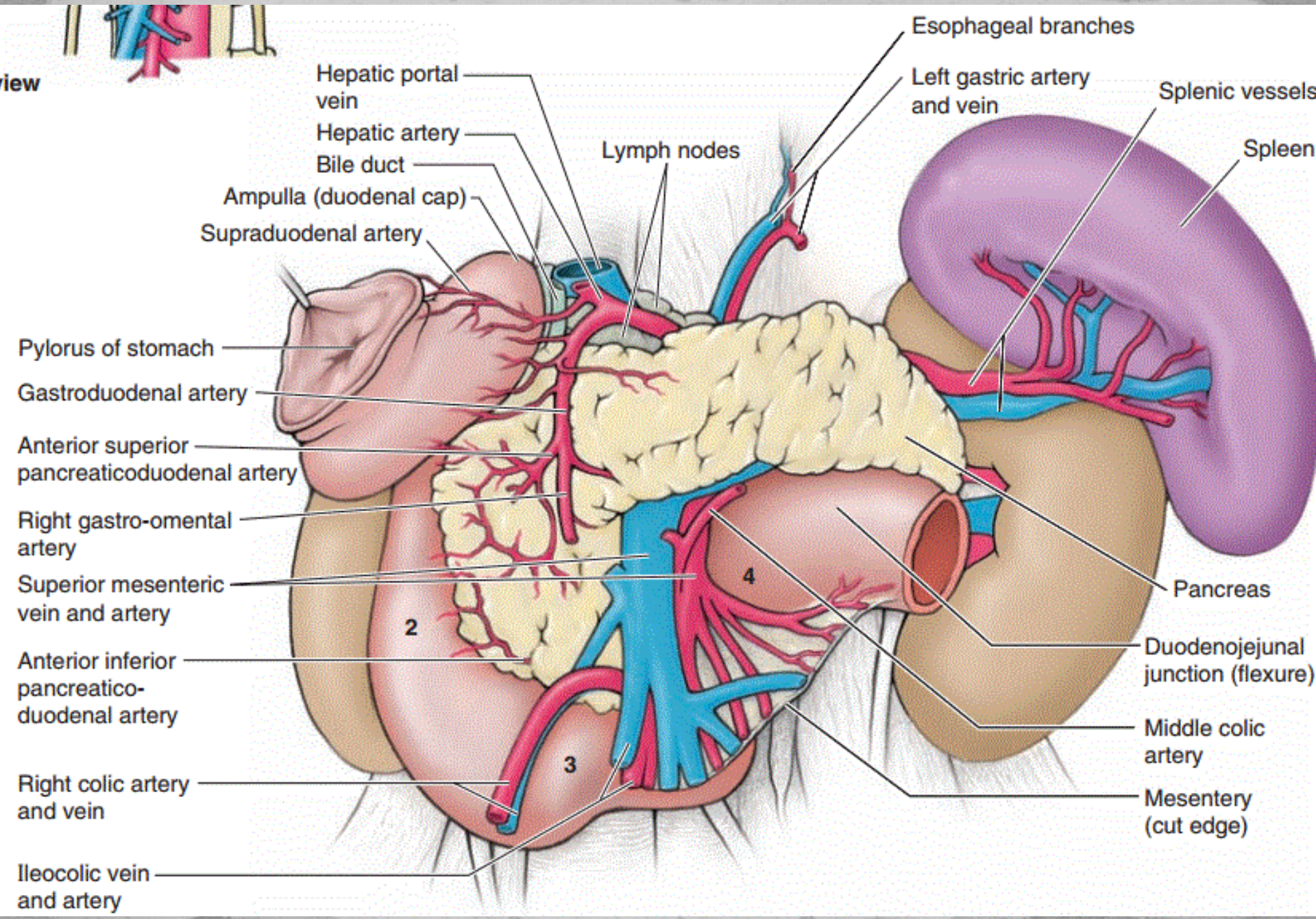
Vessels and nevres

Arteries

- Arise from the **celiac trunk** and the **superior mesenteric artery(SMV**)

Veins

- **Follow** the arteries
- Drain into the **hepatic portal vein**, directly and through **superior mesenteric** and **splenic veins**

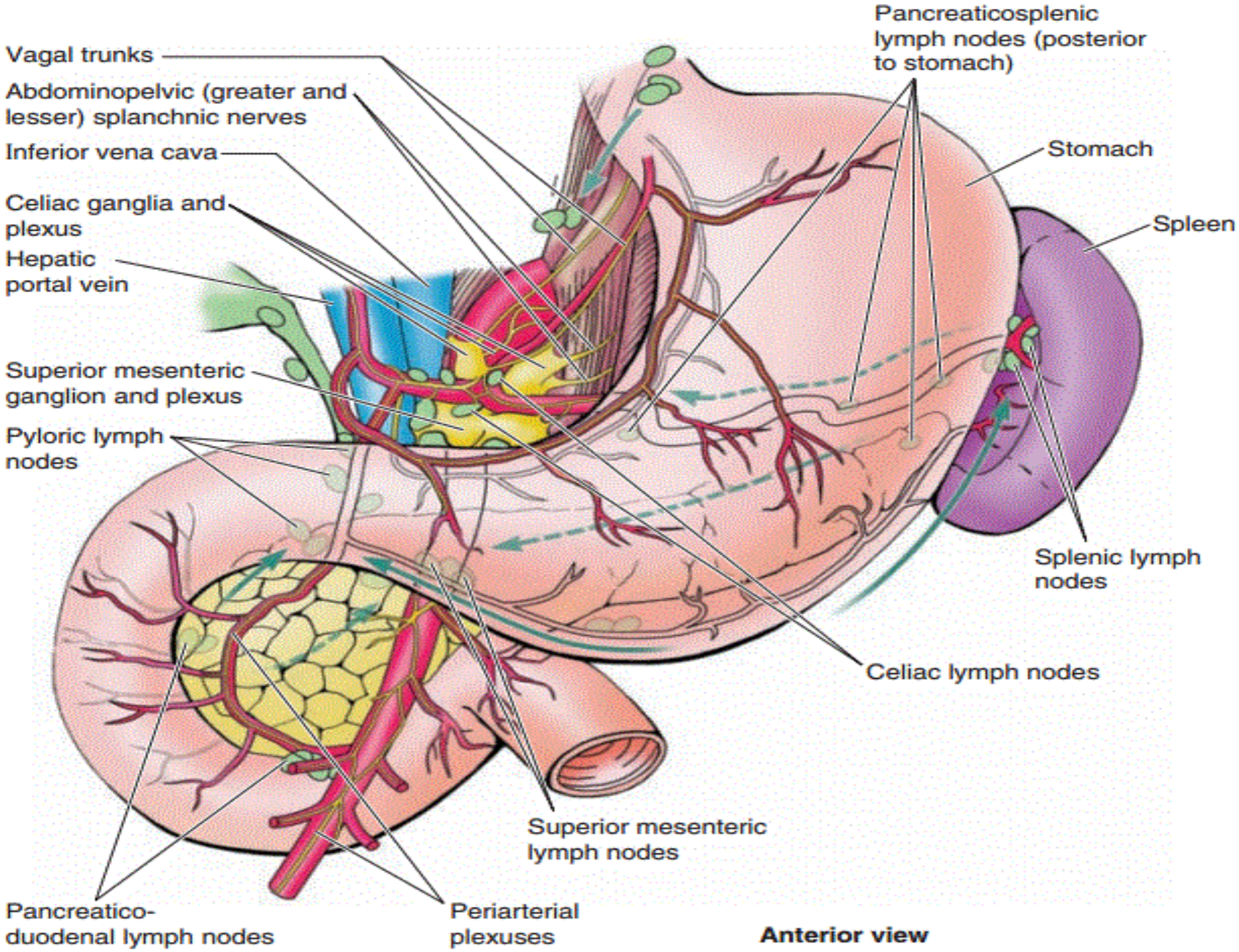

Esophageal branches
Hepatic portal vein
Left gastric artery and vein
Splenic vessels
Hepatic artery
Lymph nodes
Spleen
Bile duct
Ampulla (duodenal cap)
Supraduodenal artery
Pylorus of stomach
Gastroduodenal artery
Anterior superior pancreaticoduodenal artery
Right gastro-omental artery
Superior mesenteric vein and artery
Pancreas
2
4
Duodenojejunal junction (flexure)
Anterior inferior pancreatico-duodenal artery
Middle colic artery
3
Right colic artery and vein
Mesentery (cut edge)
Ileocolic vein and artery

Lymphatic vessels

- **Intestinal villi** (tiny projections of the mucous membrane) that absorb fat are called **lacteals**
- **pancreaticoduodenal lymph** nodes and **pyloric** lymph nodes**, superior mesenteric** lymph nodes and **celiac lymph nodes**.

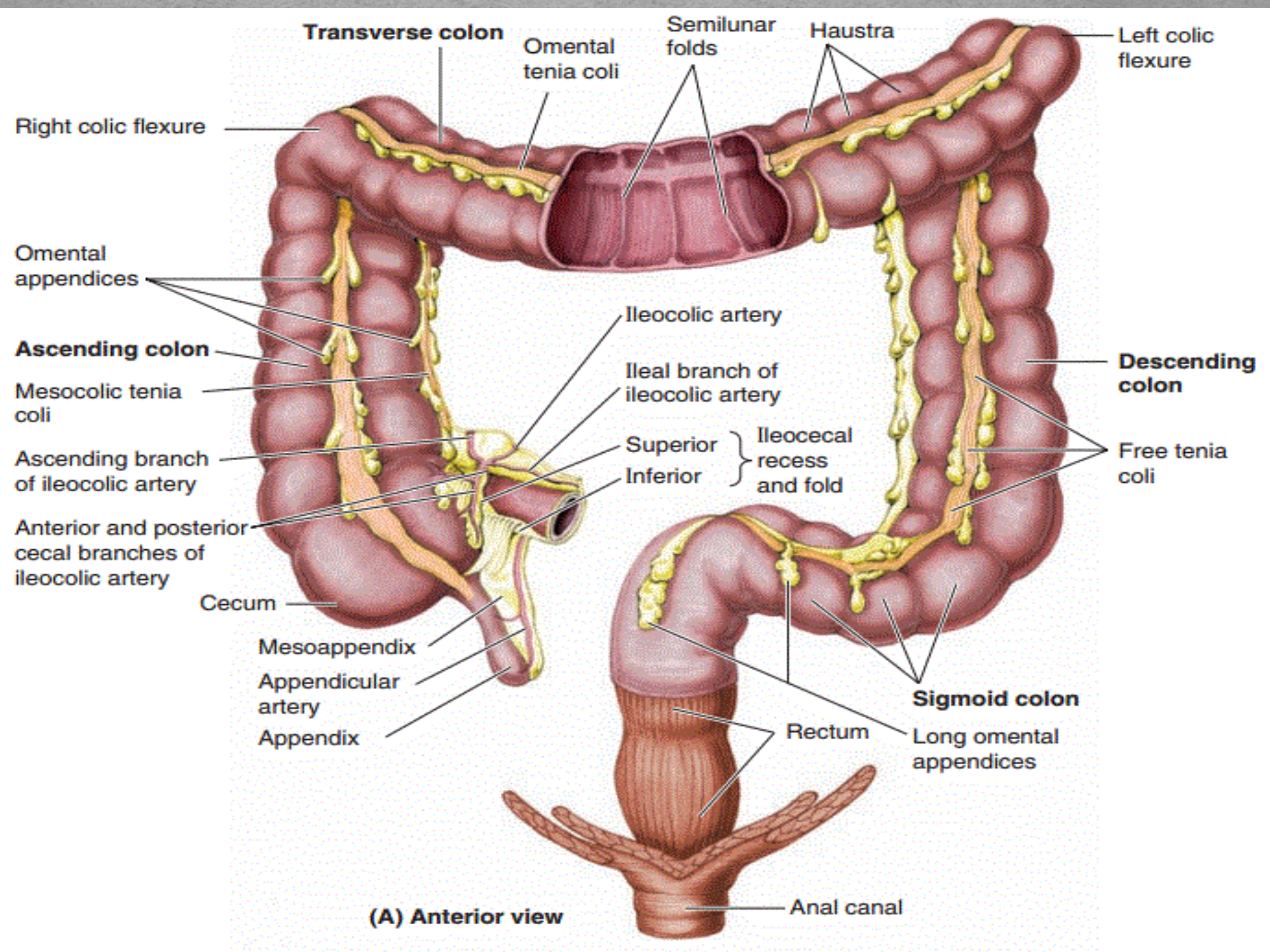
Nerves

- Derive from the **vagus** and greater and lesser(abdominopelvic) **splanchnic nerves**


Vagal trunks
Abdominopelvic (greater and lesser) splanchnic nerves
Inferior vena cava
Celiac ganglia and plexus
Hepatic portal vein
Superior mesenteric ganglion and plexus
Pyloric lymph nodes
Pancreaticosplenic lymph nodes (posterior to stomach)
Stomach
Spleen
Splenic lymph nodes
Celiac lymph nodes
Superior mesenteric lymph nodes
Pancreatico-duodenal lymph nodes
Periarterial plexuses
Anterior view

Large intestine

- **water** is **absorbed** from the indigestible residues of the liquid chyme
- Converting **chyme** into **semisolid** stool or feces that is stored temporarily until **defecation**
- Consists of the **cecum**; **appendix**; **ascending**, **transverse**, **descending**, and **sigmoid** colon; **rectum**; and **anal** canal


Transverse colon
Omental tenia coli
Semilunar folds
Haustra
Left colic flexure
Right colic flexure
Omental appendices
Ileocolic artery
Ascending colon
Ileal branch of ileocolic artery
Descending colon
Mesocolic tenia coli
Superior
Inferior
Ileocecal recess and fold
Ascending branch of ileocolic artery
Free tenia coli
Anterior and posterior cecal branches of ileocolic artery
Cecum
Mesoappendix
Appendicular artery
Appendix
Sigmoid colon
Rectum
Long omental appendices
Anal canal
(A) Anterior view

Can be distinguished from the small intestine by:

Omental appendices

- Small, fatty, **omentum-like** projections.

Teniae coli

- **Thickened bands** of smooth muscle representing most of the longitudinal coat
- form **haustra**

Haustra

- **Sacculations** of the wall of the colon between the teniae

A much **greater caliber** (internal diameter)

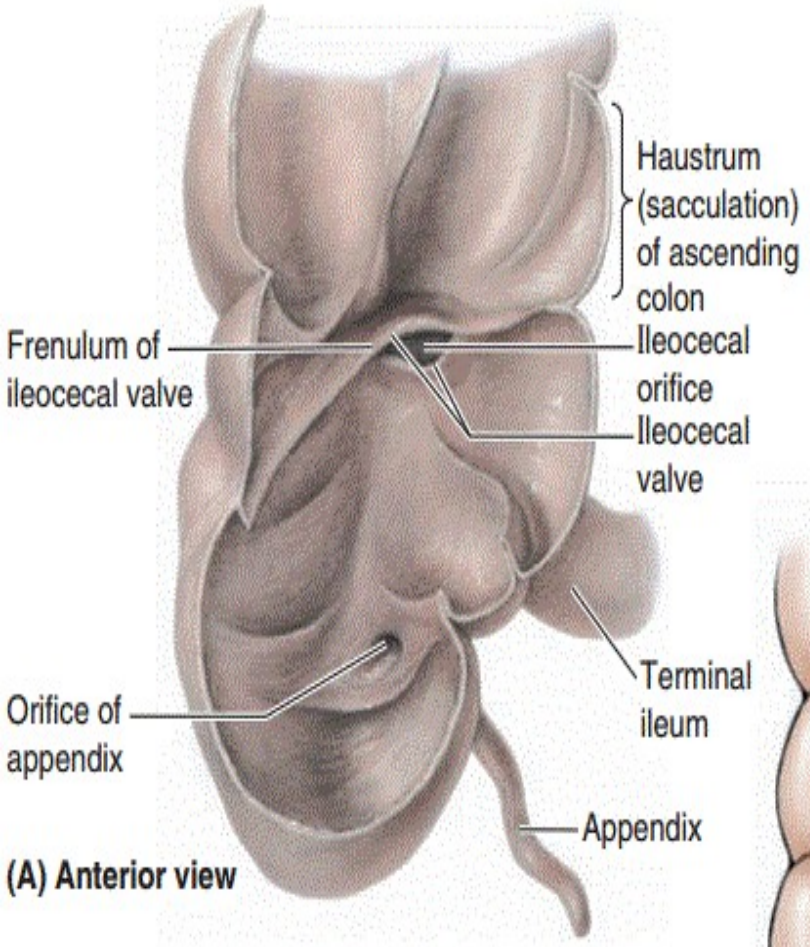
Cecum and Appendix

Cecum

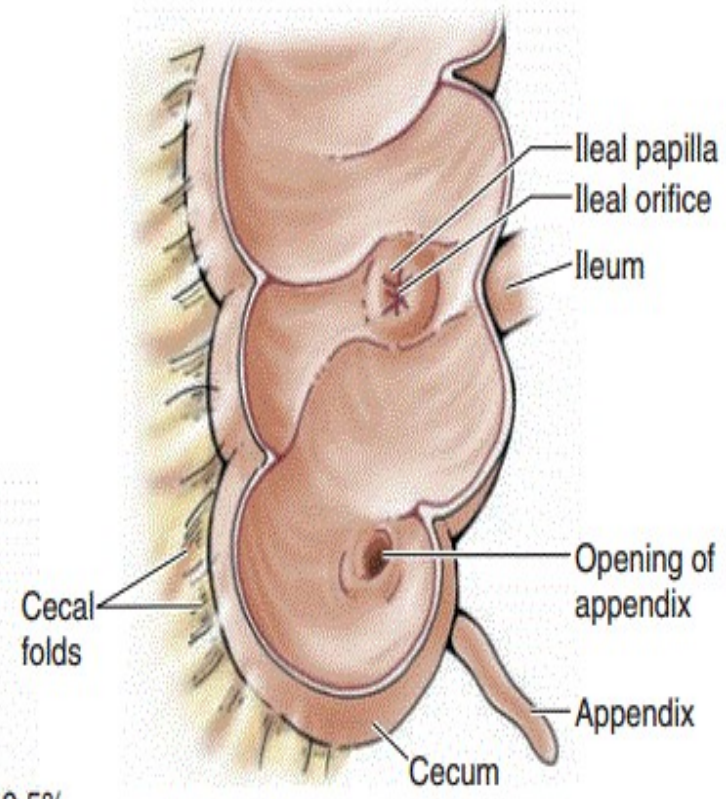
- **First** part of the large intestine
- Continuous with the **ascending colon**.
- **Blind** intestinal **pouch**
- Lies in the **iliac fossa** of the **RLQ** of the abdomen
- **Inferior** to the **junction** of the terminal ileum and cecum
- Al most entirely enveloped by **peritoneum**

Appendix

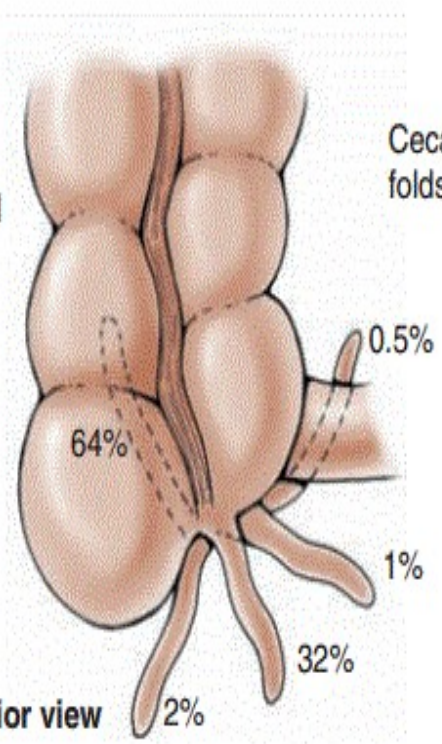
- Traditionally, **vermiform appendix** (L. vermis, worm-like)
- **Blind** intestinal diverticulum, **6–10** cm in length
- Contains masses of **lymphoid** tissue
- Position **variable**, usually **retrocecal**
- Arises from the **posteromedial** aspect of the cecum



(A) Anterior view



(B) Anterior view



(C) Anterior view

Vessels and Nerves

Artery

- **ileocolic artery, appendicular artery**

Veins

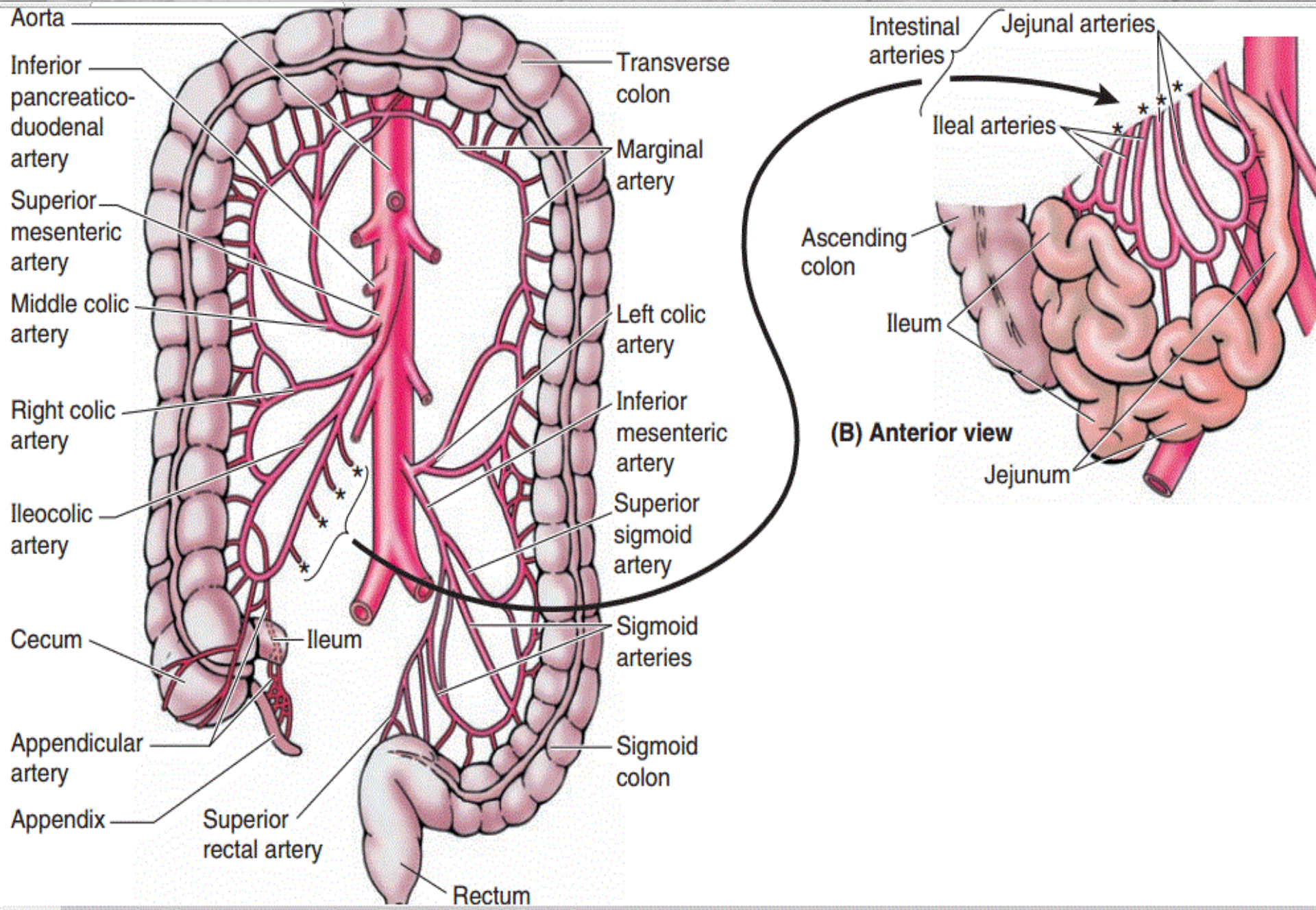
- **SMV**, **ileocolic vein**

Lymph vessels

- **mesoappendix** and **ileocolic** lymph nodes that lie along the ileocolic artery

Nerves

- **superior mesenteric plexus**


Aorta
Inferior pancreatico-duodenal artery
Superior mesenteric artery
Middle colic artery
Right colic artery
Ileocolic artery
Cecum
Ileum
Appendicular artery
Appendix
Superior rectal artery
Rectum
Transverse colon
Marginal artery
Left colic artery
Inferior mesenteric artery
Superior sigmoid artery
Sigmoid arteries
Sigmoid colon
Intestinal arteries
Jejunal arteries
Ileal arteries
Ascending colon
Ileum
(B) Anterior view
Jejunum

Colon

- Has **four parts**, ascending, transverse, descending, and sigmoid
- **Encircles** the small intestine, ascending to the right, transverse superior and/or anterior, descending to the left, and sigmoid inferior

Ascending colon

- **Second** part of the large intestine.
- Passes superiorly on the **right** side of the abdominal cavity
- turns to the left at the **right colic flexure(hepatic flexure)**
- **Narrower** than the cecum

Transverse colon

- **Third**, **longest**, and **most mobile** part of the large intestine
- Variable in position, usually **hanging** to the level of the **umbilicus** (**L3 vertebral** level)
- Crosses the abdomen from the **right colic** flexure to the **left colic flexure**

Descending colon

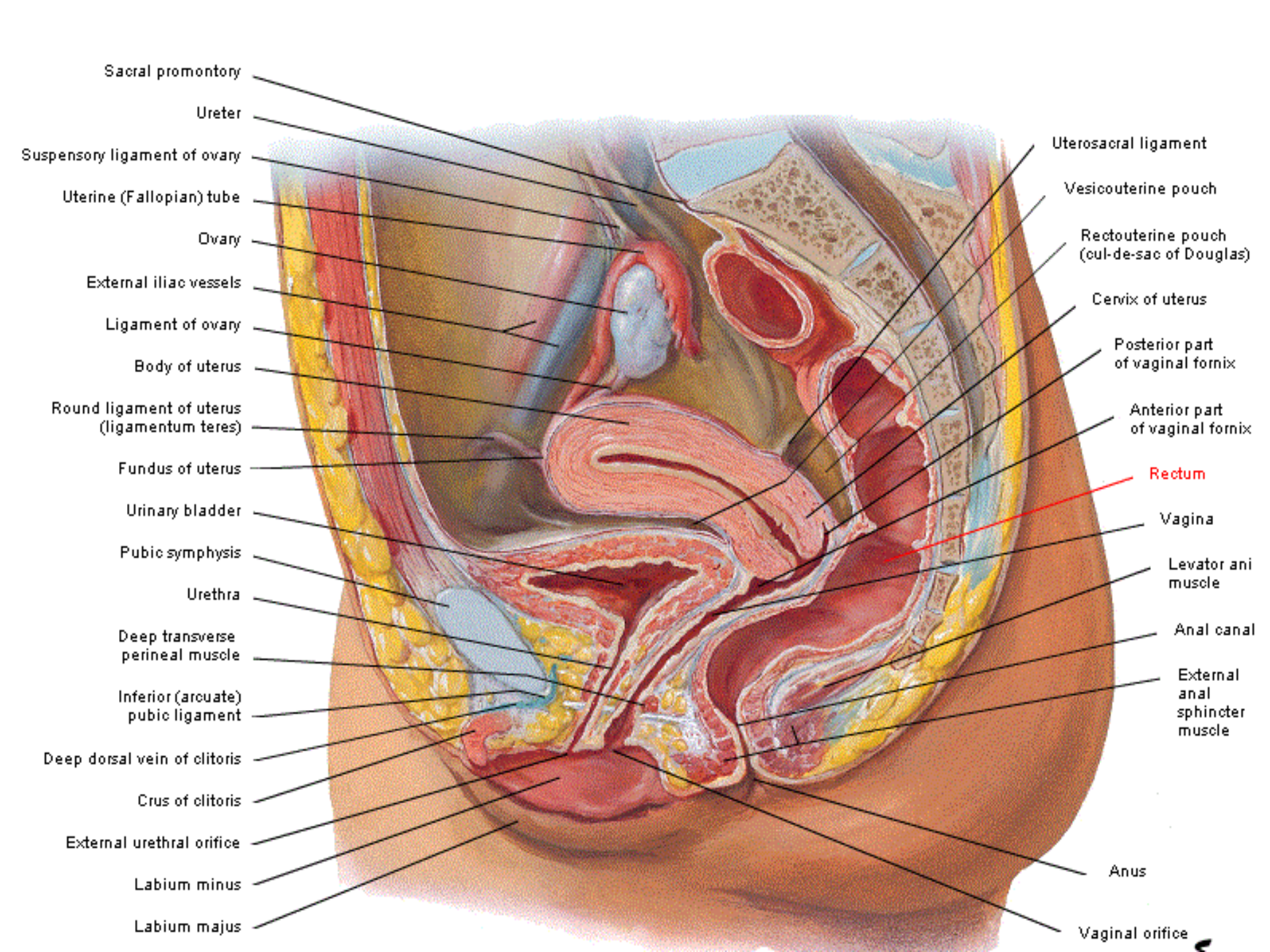
- Between the **left colic flexure** and the **left iliac fossa**
- Continuous with the **sigmoid colon**

Sigmoid colon

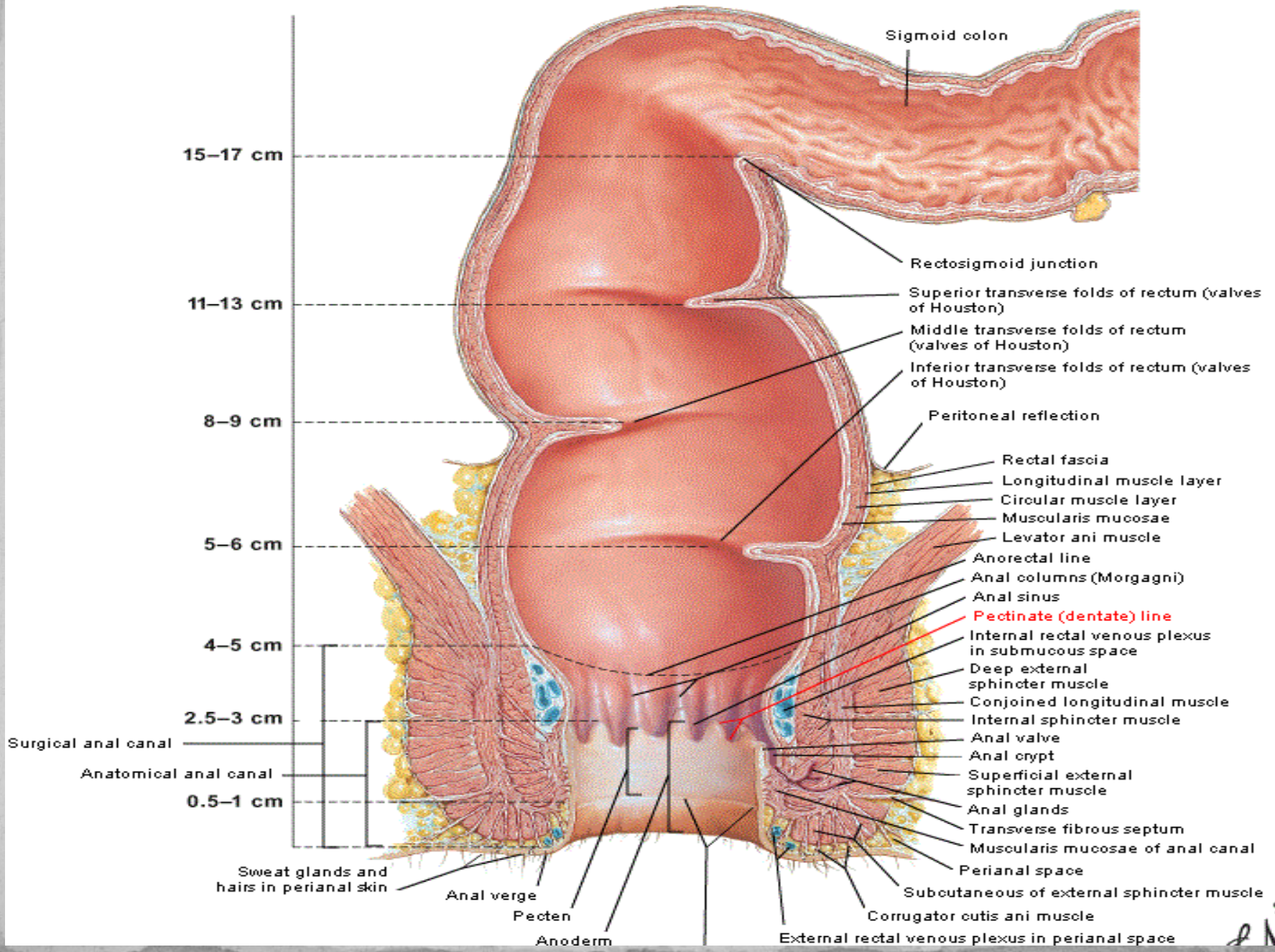
- **S-shaped** loop of variable length
- Links the descending colon and the rectum
- **Rectosigmoid junction**, **termination** of the **teniae coli,** approximately 15 cm from the anus
- **Sigmoid mesocolon: Long mesentery** has considerable **freedom** of **movement**, cause **Volvulus**

Rectum

- The rectum is about 5 in. (**13** cm) long
- continuation of the sigmoid colon.
- becoming continuous with the anal canal.
- The lower part of the rectum is dilated & is called the **rectal ampulla**.
- At the junction of the rectum with the **anal** canal there is an angle called the **anorectal angle**


Sacral promontory
Ureter
Suspensory ligament of ovary
Uterine (Fallopian) tube
Ovary
External iliac vessels
Ligament of ovary
Body of uterus
Round ligament of uterus (ligamentum teres)
Fundus of uterus
Urinary bladder
Pubic symphysis
Urethra
Deep transverse perineal muscle
Inferior (arcuate) pubic ligament
Deep dorsal vein of clitoris
Crus of clitoris
External urethral orifice
Labium minus
Labium majus
Uterosacral ligament
Vesicouterine pouch
Rectouterine pouch (cul-de-sac of Douglas)
Cervix of uterus
Posterior part of vaginal fornix
Anterior part of vaginal fornix
Rectum
Vagina
Levator ani muscle
Anal canal
External anal sphincter muscle
Anus
Vaginal orifice

Rectum and Anal Canal



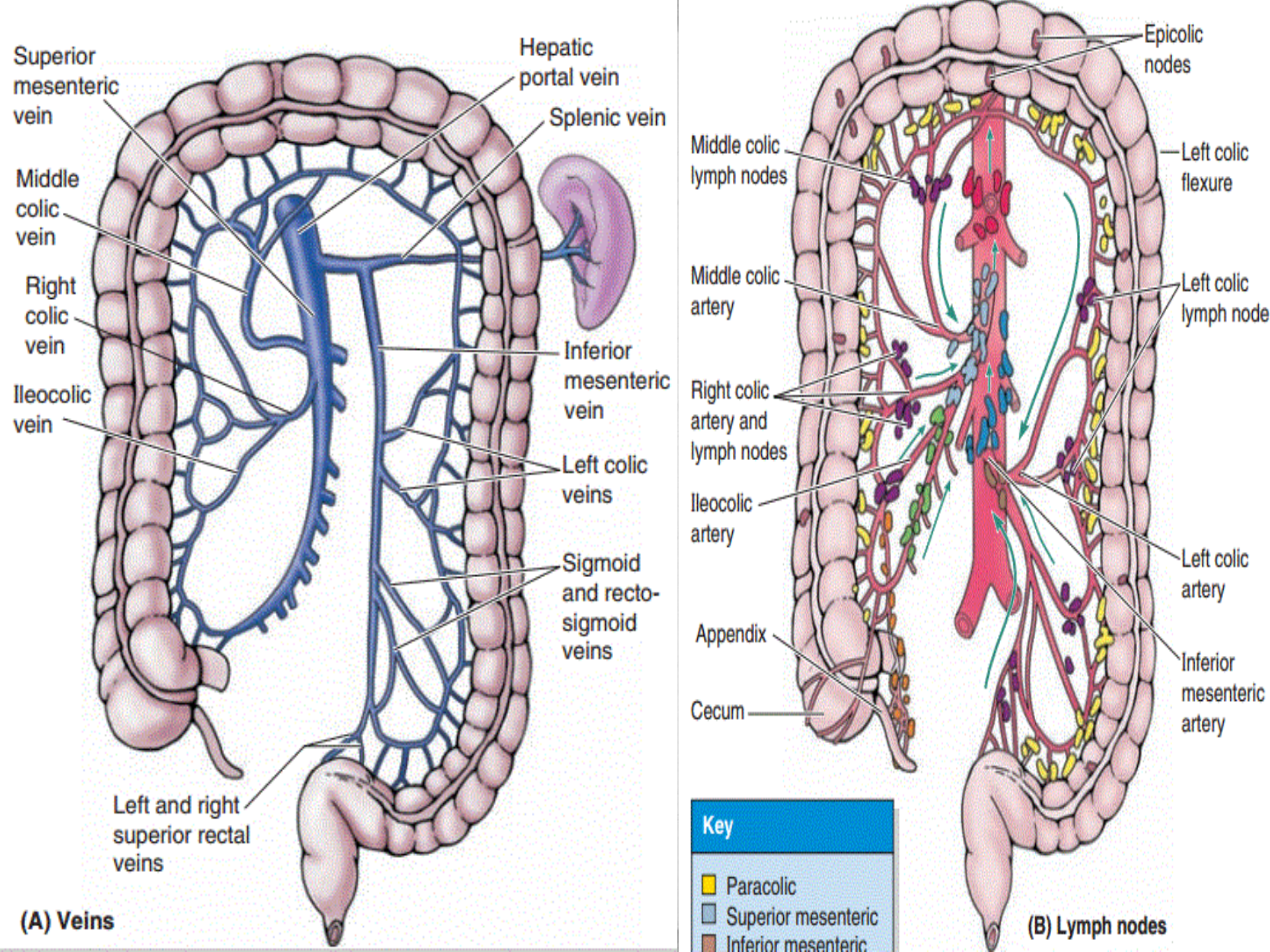
Vessels and Nerves

Artery

- Branches of the **SMA**, **ileocolic, right colic** arteries and **middle colic artery**
- **Branches of IMA, left colic, three sigmoidal branches, and superior rectal artery**

Veins

- Flows artery
- Drain in to **SMV** and IMV, then to portal vein

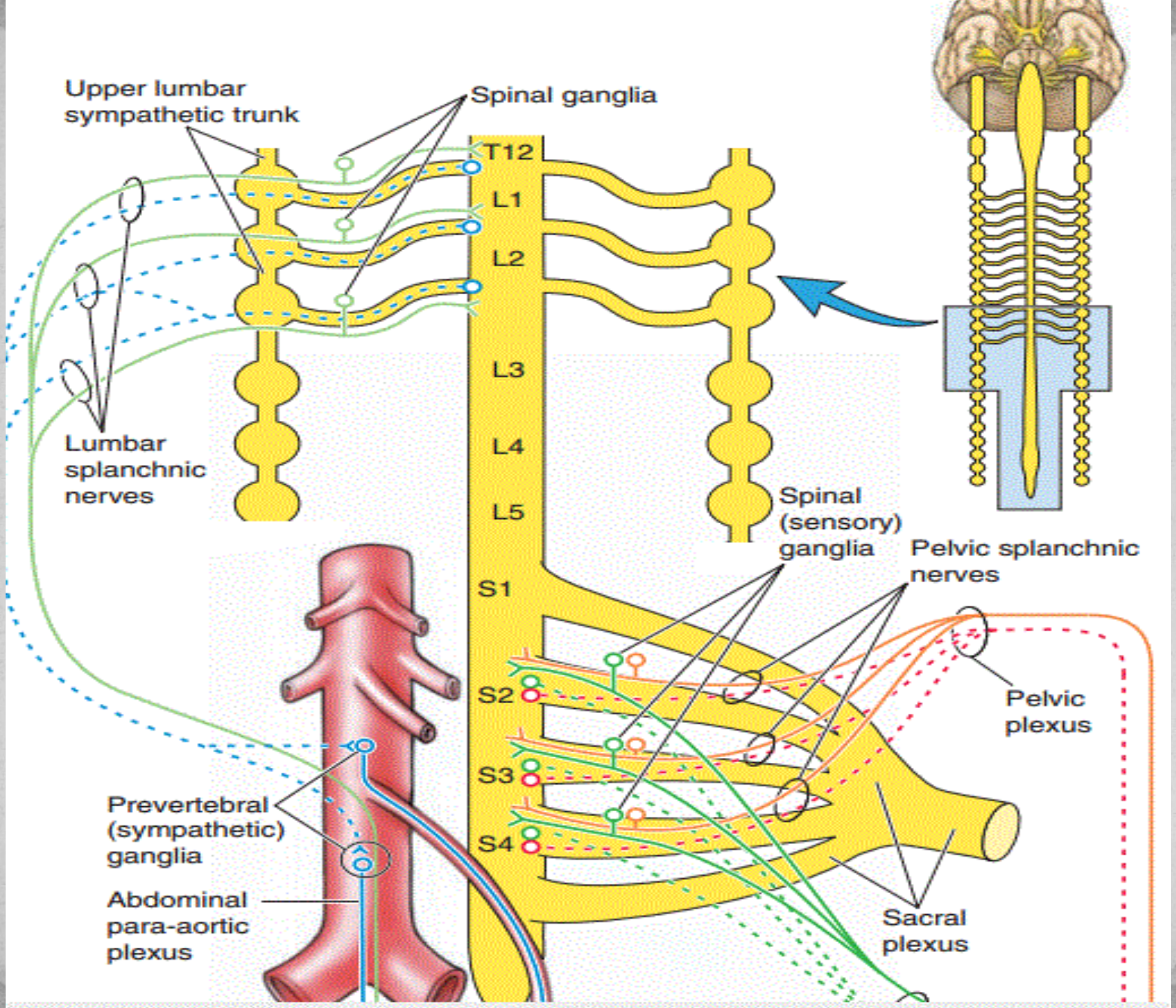

Superior mesenteric vein
Hepatic portal vein
Splenic vein
Middle colic vein
Right colic vein
Ileocolic vein
Inferior mesenteric vein
Left colic veins
Sigmoid and recto-sigmoid veins
Left and right superior rectal veins
(A) Veins
Epicolic nodes
Middle colic lymph nodes
Left colic flexure
Middle colic artery
Left colic lymph node
Right colic artery and lymph nodes
Ileocolic artery
Left colic artery
Appendix
Inferior mesenteric artery
Cecum
Key
Paracolic
Superior mesenteric
Inferior mesenteric
(B) Lymph nodes

Lymph

- First to the **epicolic** and **paracolic** lymph nodes
- Next to the **ileocolic** and **intermediate right colic** lymph nodes
- Then, to **superior** and inferioir **mesenteric lymph nodes**

Nerve

- **Sympathetic**: from T6-T12 and L1-L3
- **Parasympathetic**: vagus nerve and sacral nerve


Upper lumbar sympathetic trunk
Spinal ganglia
T12
L1
L2
L3
L4
L5
S1
S2
S3
S4
Lumbar splanchnic nerves
Spinal (sensory) ganglia
Pelvic splanchnic nerves
Pelvic plexus
Prevertebral (sympathetic) ganglia
Abdominal para-aortic plexus
Sacral plexus

Anal canal

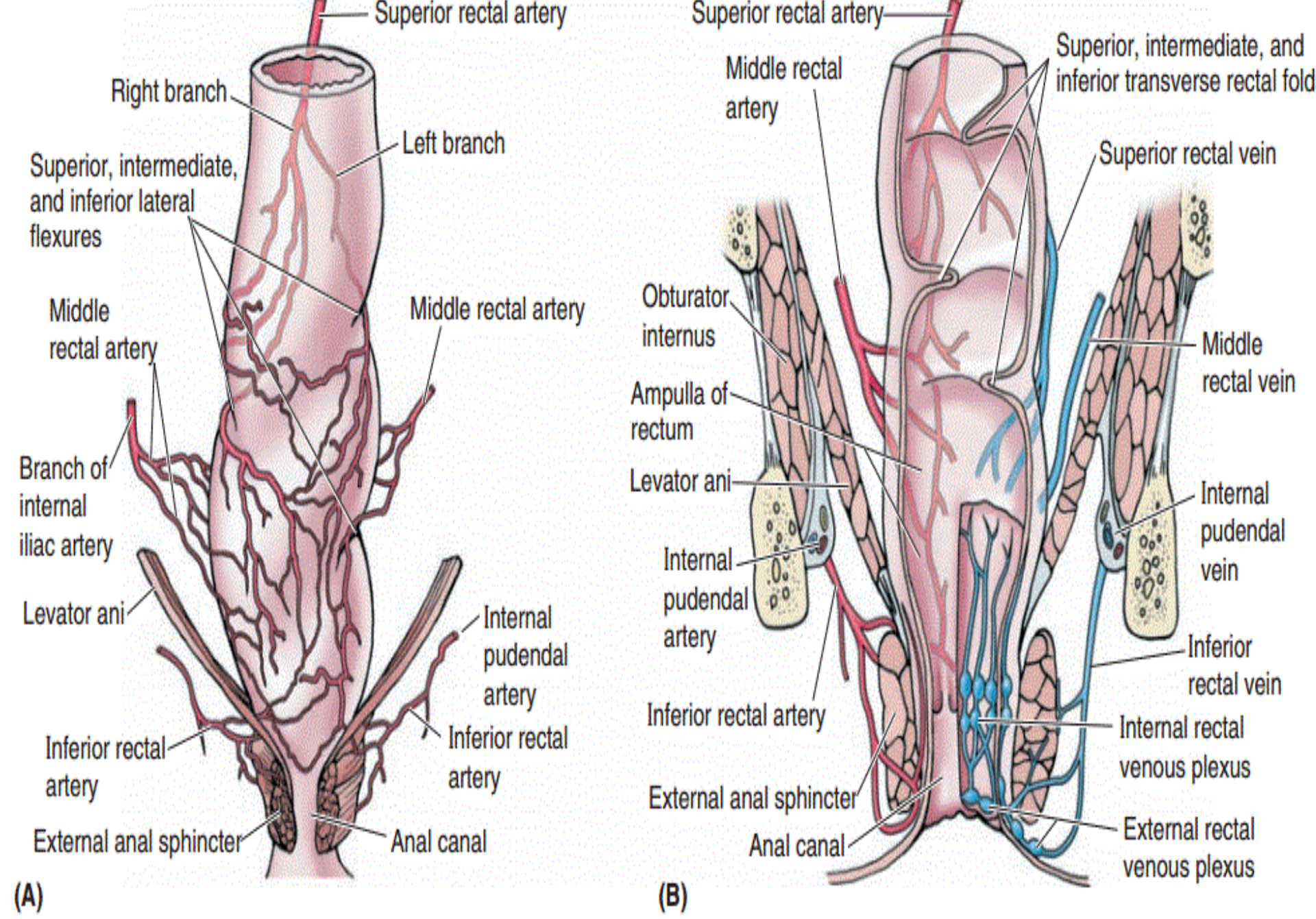
- The anal canal is about **4 cm** long and passes downward and backward from the rectal ampulla to the anus.
- Except during defecation, its lateral walls are kept in **apposition** by the levatores ani muscles and the anal sphincters.

Upper half of anal canal

- It is lined by **columnar epithelium**.
- It is thrown into vertical folds called **anal columns**,
- The nerve from the **autonomic hypogastric plexuses**.
- It is sensitive only to **stretch**.

Lower half of anal canal

- It is lined by **stratified squamous epithelium**.
- There are **no** anal **columns**.
- The nerve supply is from the **somatic inferior rectal nerve**; it is thus sensitive to **pain**, **temperature**, **touch**, and **pressure**.
- The **pectinate line** indicates the level where the upper half of the anal canal joins the lower half.



Anterior views

Anal sphincter

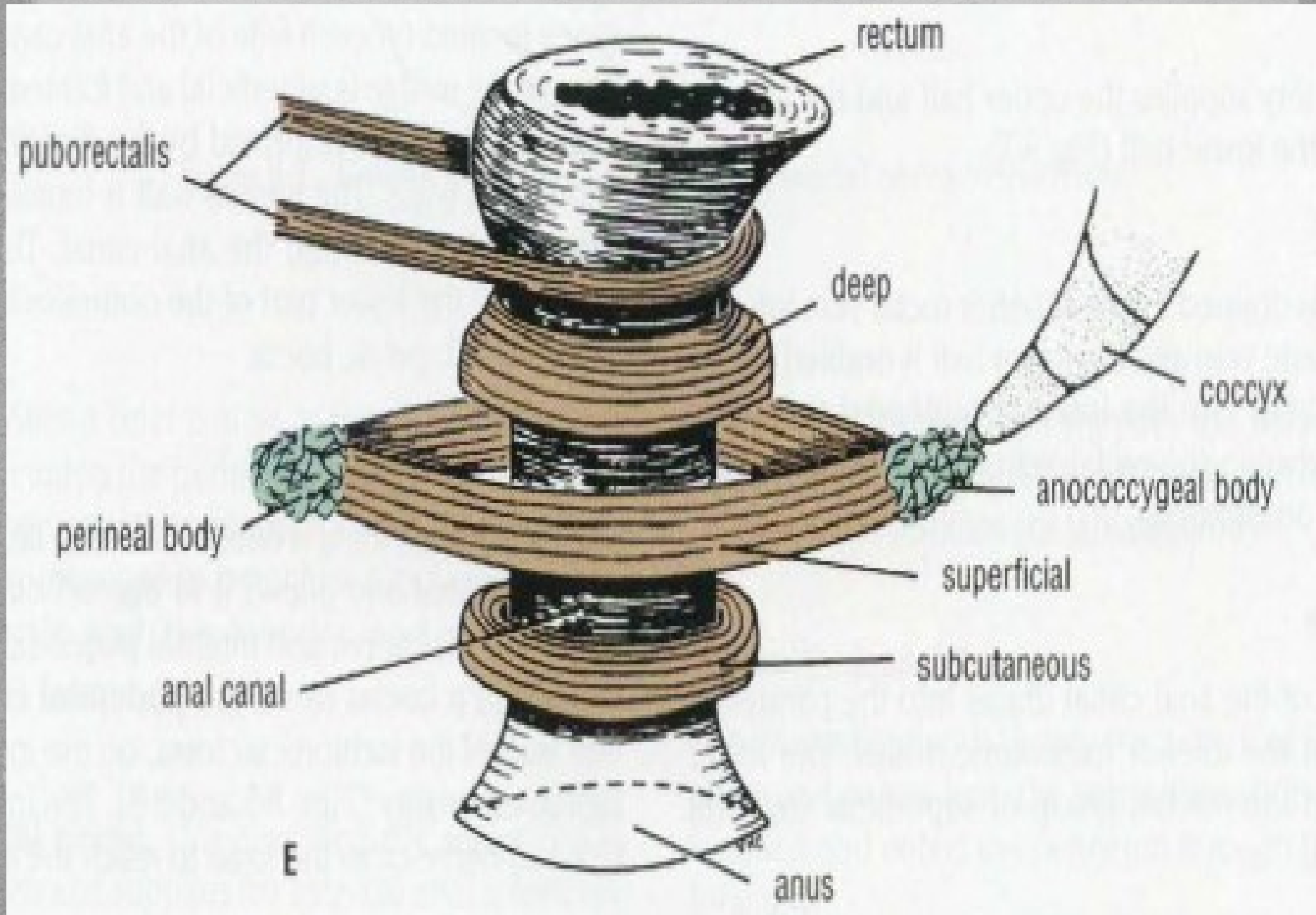
Internal sphincter

- Formed from a thickening of the **smooth muscle** of the circular coat at the upper end of the anal canal.
- Enclosed by a sheath of **striped muscle** that forms the **voluntary external sphincter** .

External sphincter

- Can be divided into **three parts**:
- A **subcutaneous part**: which encircles the **lower** end of the anal canal and has **no bony** attachments.

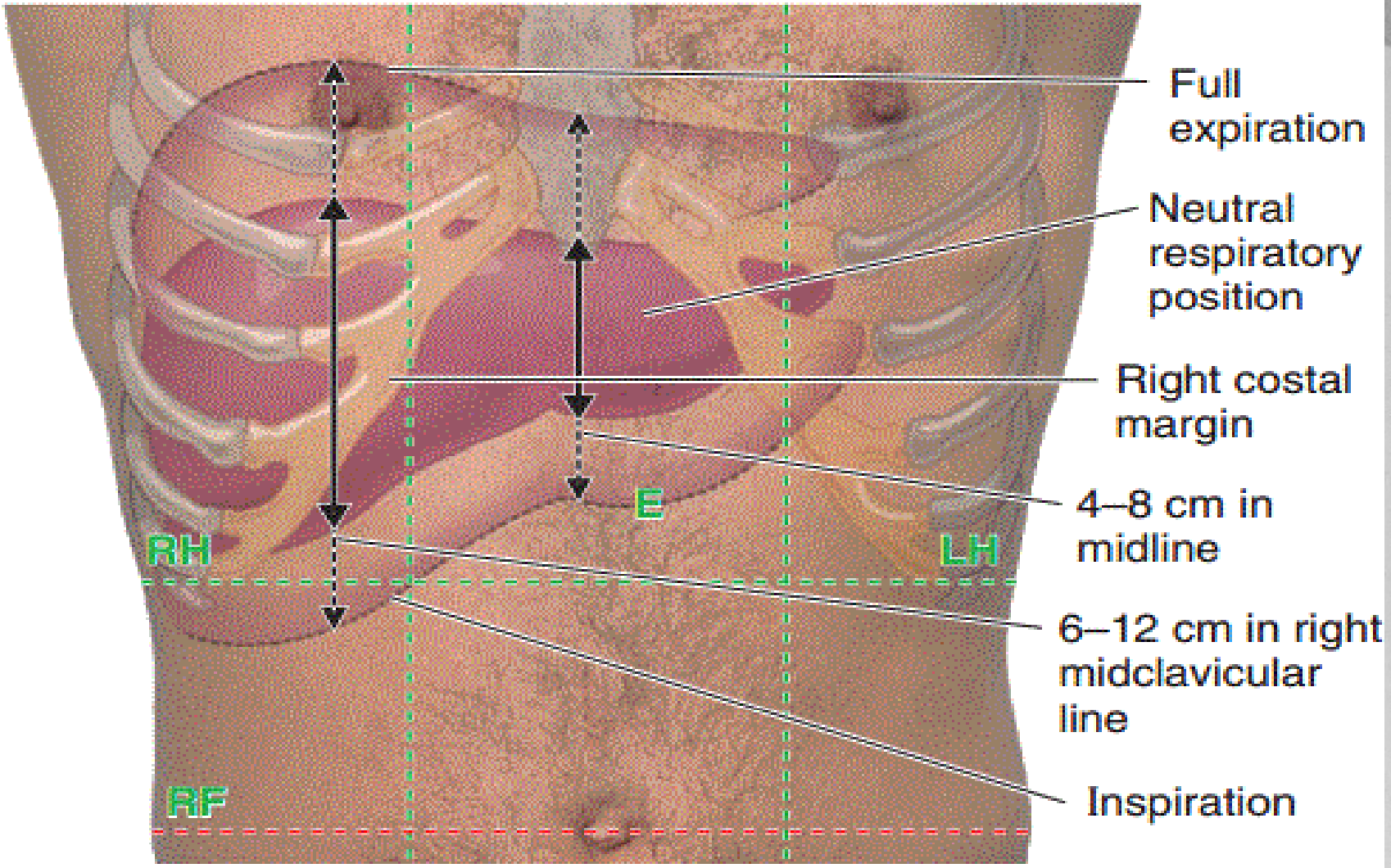
- A **superficial part**: which is attached to the **coccyx** behind and the **perineal body** in front.
- A **deep part**: which encircles the **upper end** of the anal canal and has **no bony** attachments.


rectum
puborectalis
deep
coccyx
anococcygeal body
perineal body
superficial
subcutaneous
anal canal
anus
E

Abdominal viscera

Liver

- The liver is the **largest** gland in the body and has a wide variety of **functions**
- Weight: 1/50 of body weight in **adult** & 1/20 of body weight in **infant**
- It is **exocrine** (bile) & **endocrine** organ (Albumen , prothrombin & fibrinogen)
- Occupies **right hypochondrium + epigastrium** & extends to **left hypochondrium**



Vertical dimensions and range of movement of liver

E Epigastric region	RF Right flank
LH Left hypochondrium	RH Right hypochondrium
- - - - - - - - - Midclavicular and transpyloric planes	
- - - - - - - - - Transumbilical plane	

Function

- Secretion of **bile** & **bile salt**
- Metabolism of **carbohydrate**, **fat** and **protein**
- Formation of **heparin** & **anticoagulant** substances
- **Detoxication**
- Storage of **glycogen** and **vitamins**
- **Activation** of vita .D

Liver Surfaces

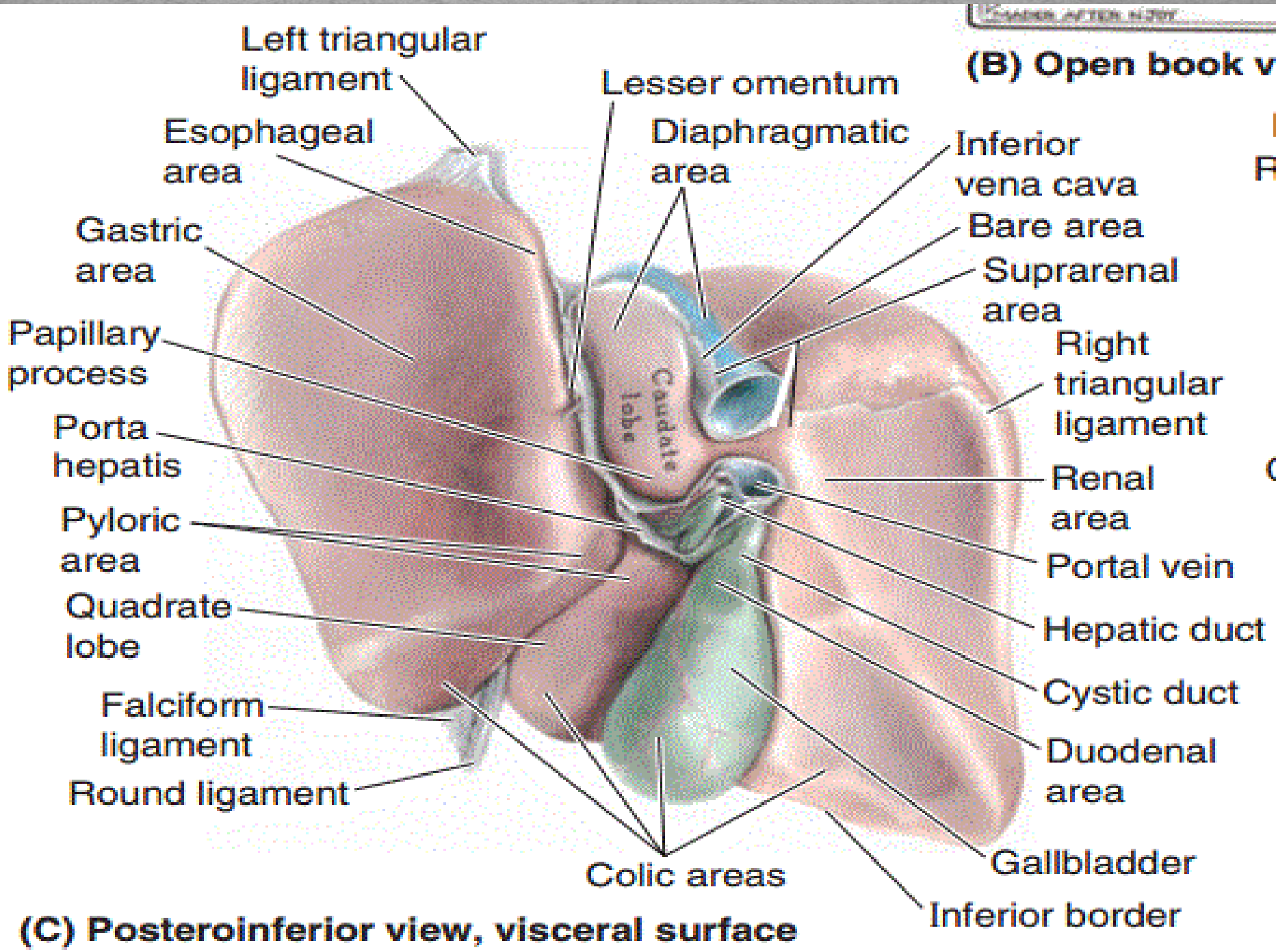
- has 2 main surfaces

1. **Posteroinferior** surface (**visceral** surface)

- Relatively **flat** or even **concave**

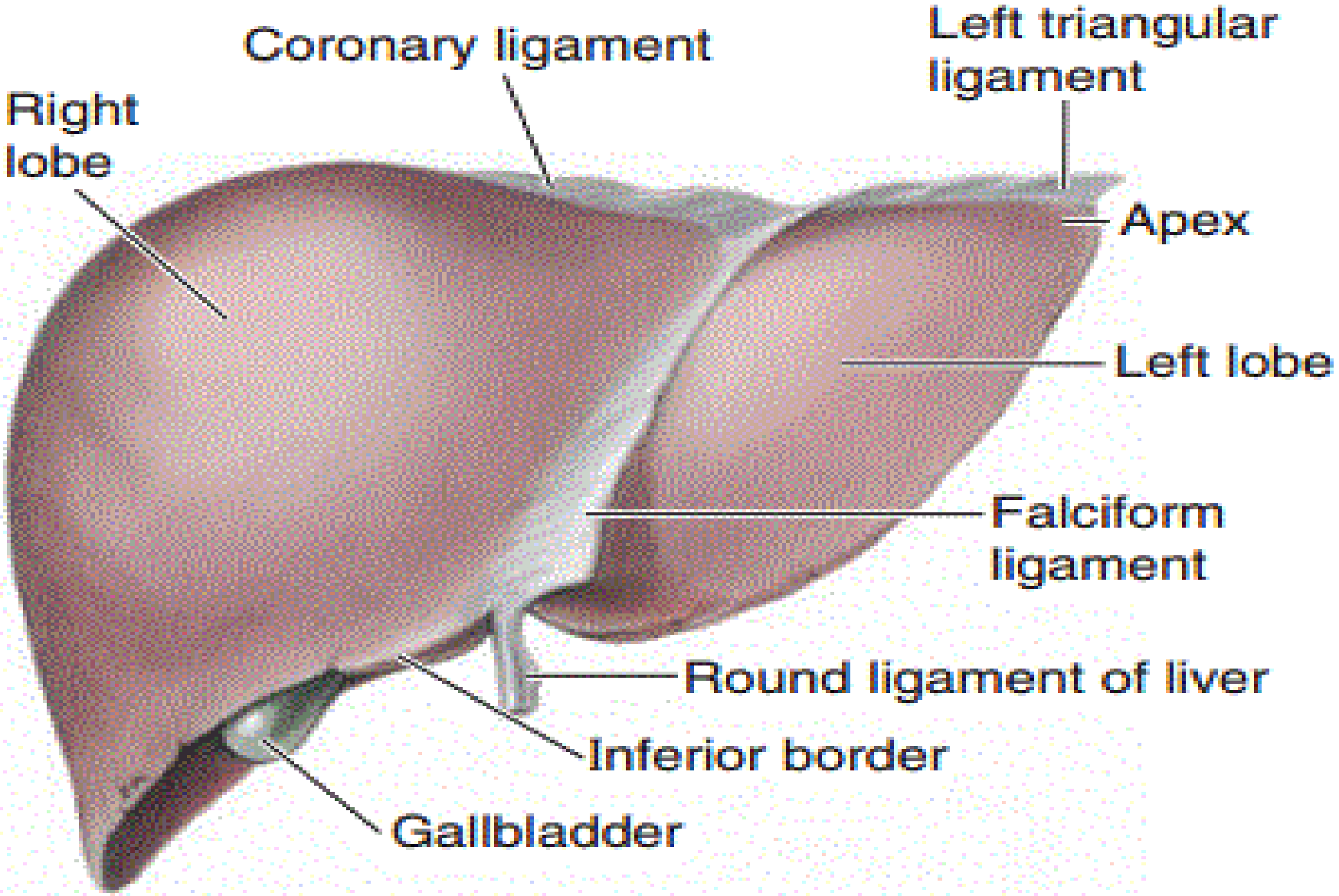
Porta hepatis

- **Hilum** of the liver
- lies between the **caudate** and **quadrate** lobes
- **Contains** Hepatic portal vein, hepatic artery, and lymphatic vessels, Hepatic nerve plexus and Hepatic ducts.


Left triangular ligament
Esophageal area
Gastric area
Papillary process
Porta hepatis
Pyloric area
Quadrate lobe
Falciform ligament
Round ligament
Lesser omentum
Diaphragmatic area
Caudate lobe
Inferior vena cava
Bare area
Suprarenal area
Right triangular ligament
Renal area
Portal vein
Hepatic duct
Cystic duct
Duodenal area
Gallbladder
Colic areas
Inferior border
(B) Open book v
(C) Posteroinferior view, visceral surface

2. Superior surface

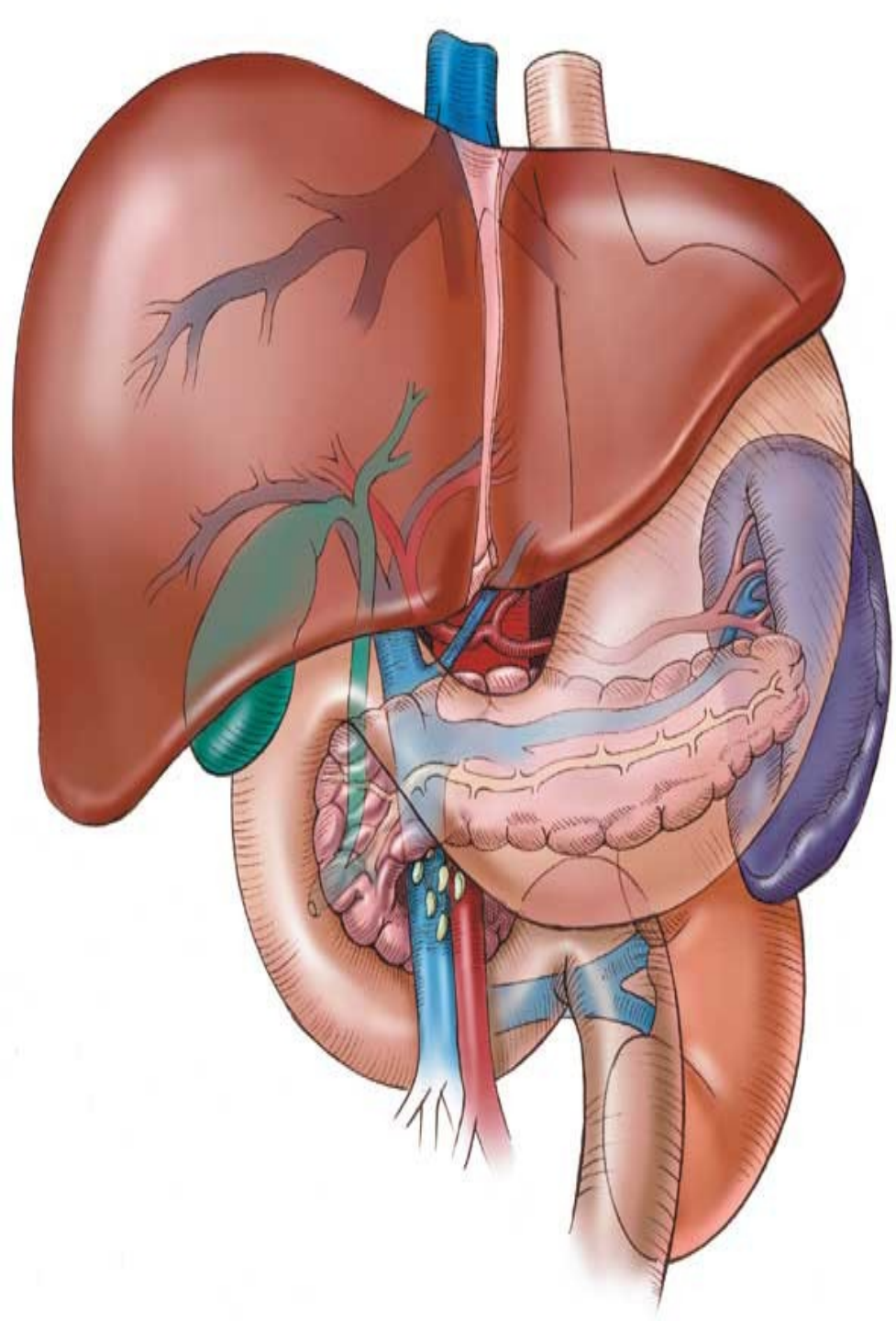
- Convex **diaphragmatic** surface
- Related to the concavity of the inferior surface of the **diaphragm**

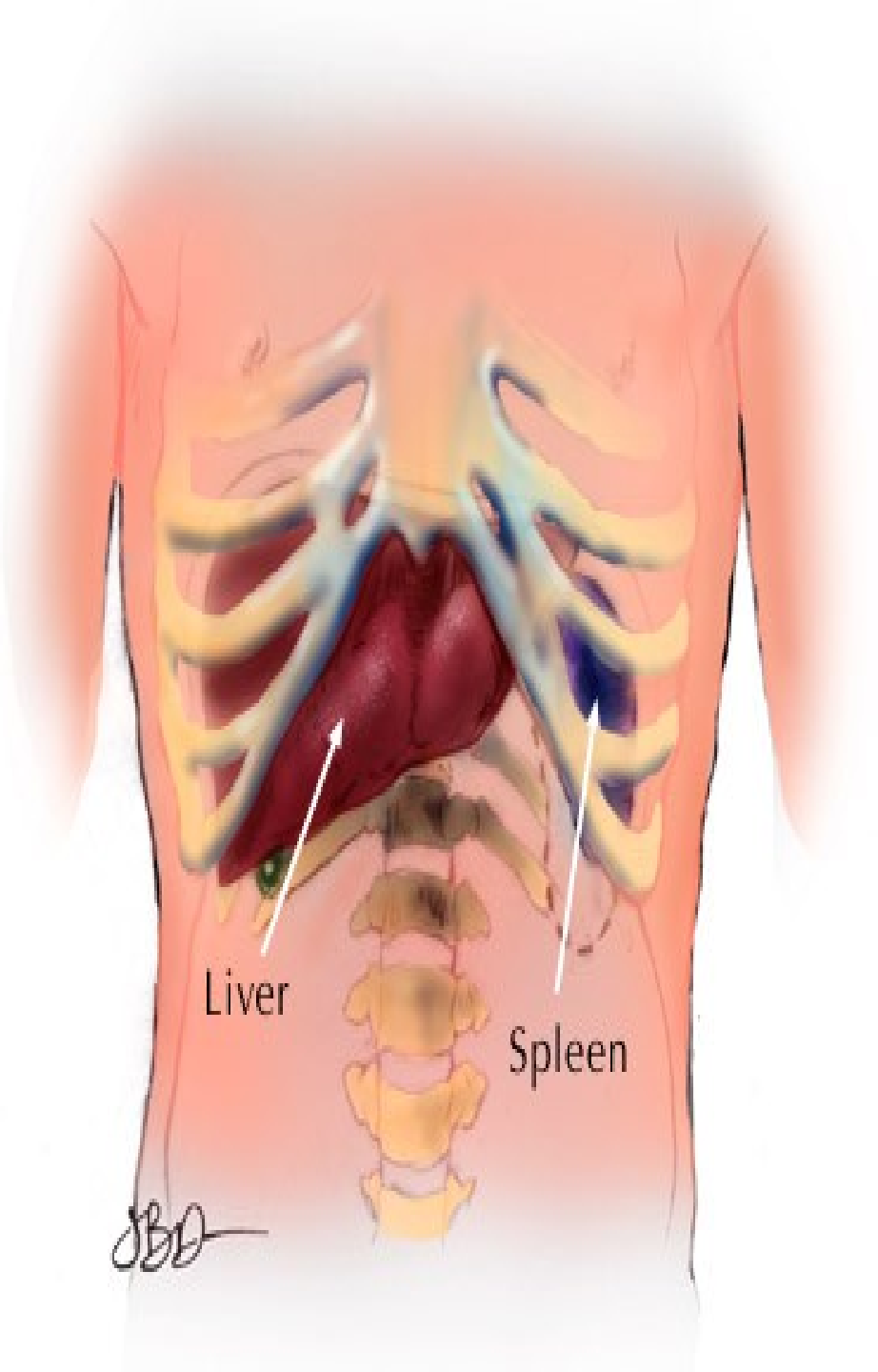


(A) Anterior view, diaphragmatic surface

Relations of the liver

- Right side of the anterior aspect of the **stomach** (gastric and pyloric areas)
- Superior part of the **duodenum(duodenal** area)
- **Lesser omentum** (extends into the fissure for the ligamentum venosum).
- **Gallbladder** (fossa for gallbladder).
- **Right colic flexure** and right **transverse** colon (colic area).
- **Right kidney** and **suprarenal gland** (renal and suprarenal areas?




Liver
Spleen

Lobes of liver

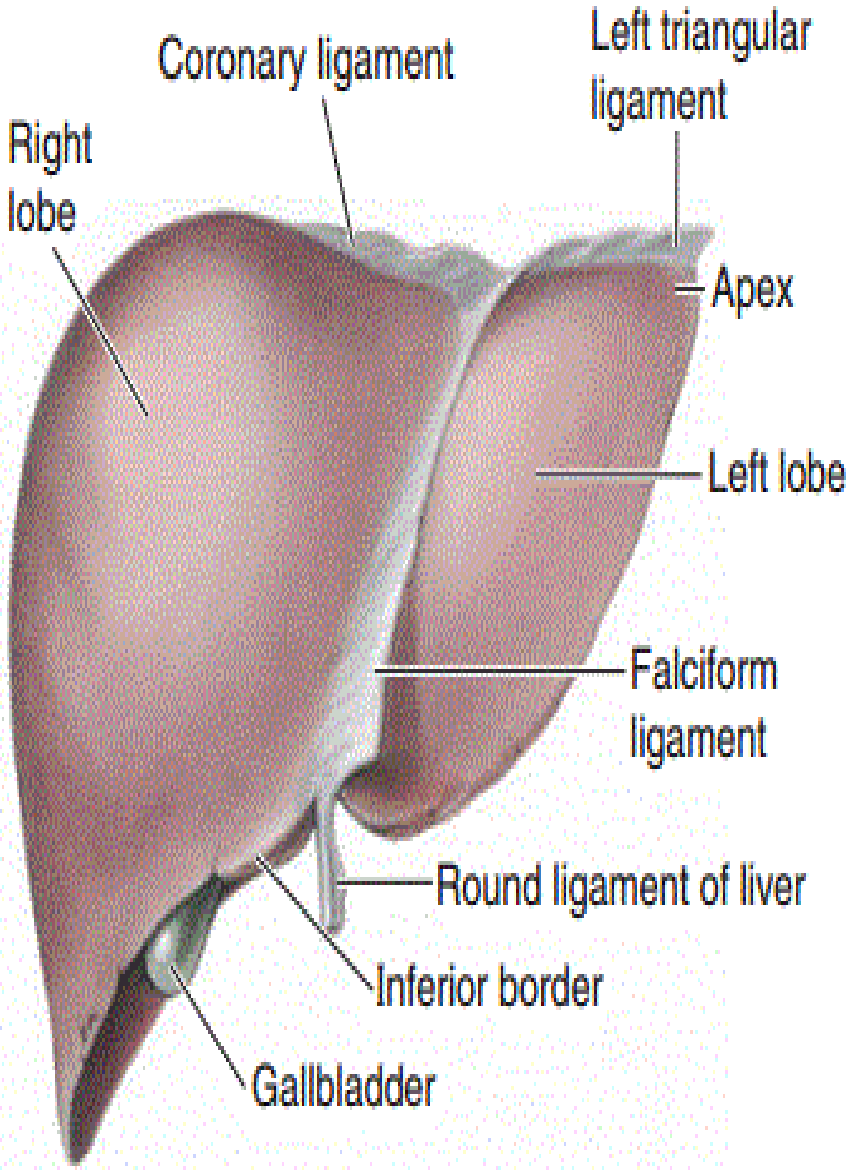
- Liver is divided into **four** lobes

Right Lobe

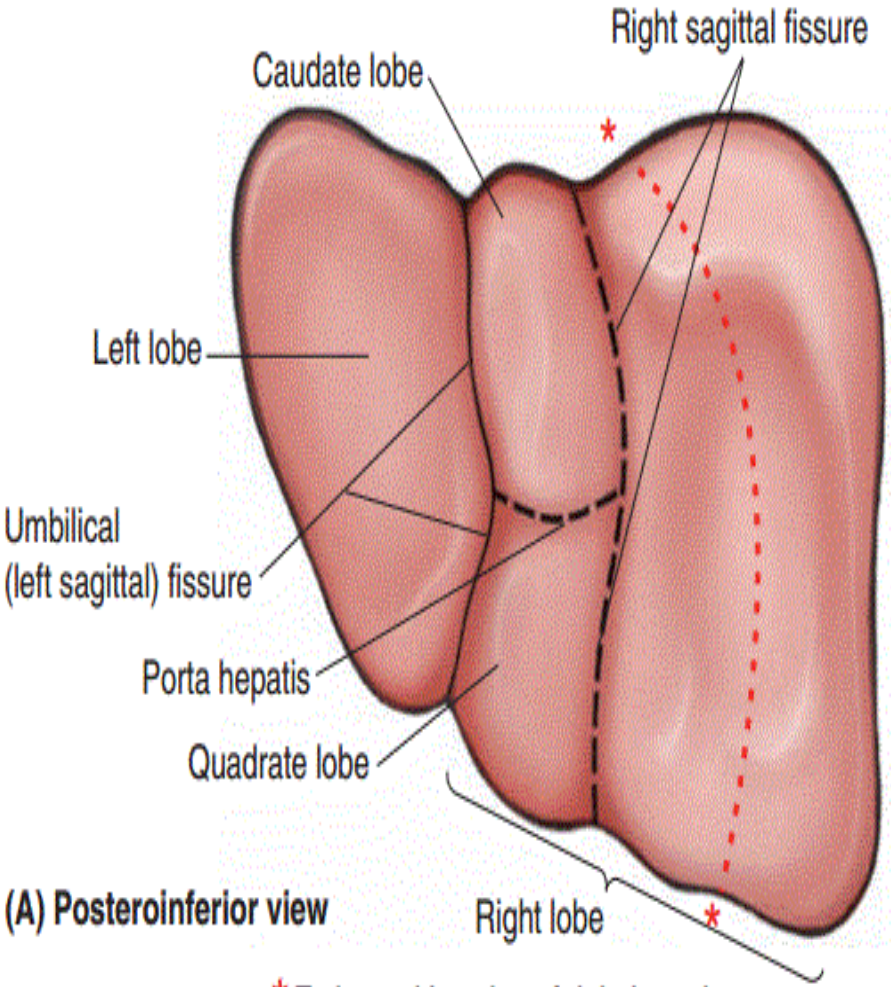
- **Largest** lobe
- Occupies the **right hypochondrium**

Left lobe

- **Varied** in size
- Lies in the **epigastric** and **left hypochondriac** regions



(A) Anterior view, diaphragmatic surface



(A) Posteroinferior view

* Estimated location of right hepatic vein = right portal fissure

Caudate lobe

- It is bounded
- **Anatomically** is it a **part** of the right lobe, but **physiologically** it is connected to the **left** lobe

Quadrate lobe

- Situated on the **under surface** of the **right** lobe.
- It is **oblong** in shape, its anteroposterior diameter being greater than its transverse

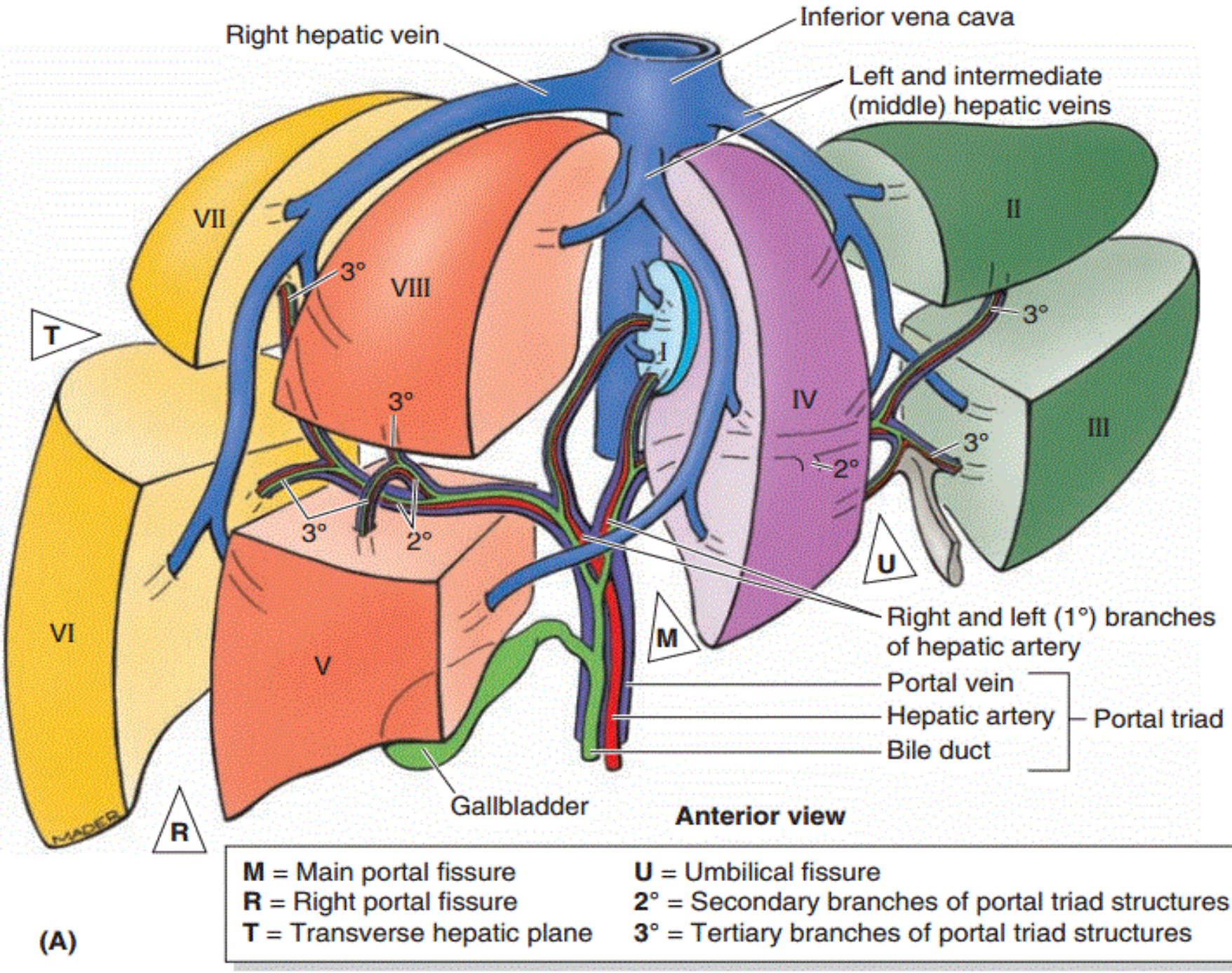
Vessels and nevres

Blood Vessels

- The liver has a **unique dual** blood supply
- **proper hepatic artery** (**20-40%)** and from the **portal vein** (**60-80**%)

Lymphatic drainage

- Produce **large** amount of lymph~ one third – one half of total body lymph
- **lymph node** in **porta hepatis**, **celiac nodes and mediastinal lymph nodes**.


Right hepatic vein
Inferior vena cava
Left and intermediate (middle) hepatic veins
VII
VIII
II
III
IV
I
V
VI
3°
2°
T
M
R
U
Right and left (1°) branches of hepatic artery
Portal vein
Hepatic artery
Bile duct
Portal triad
Gallbladder
Anterior view
MADER
M = Main portal fissure
R = Right portal fissure
T = Transverse hepatic plane
U = Umbilical fissure
2° = Secondary branches of portal triad structures
3° = Tertiary branches of portal triad structures
(A)

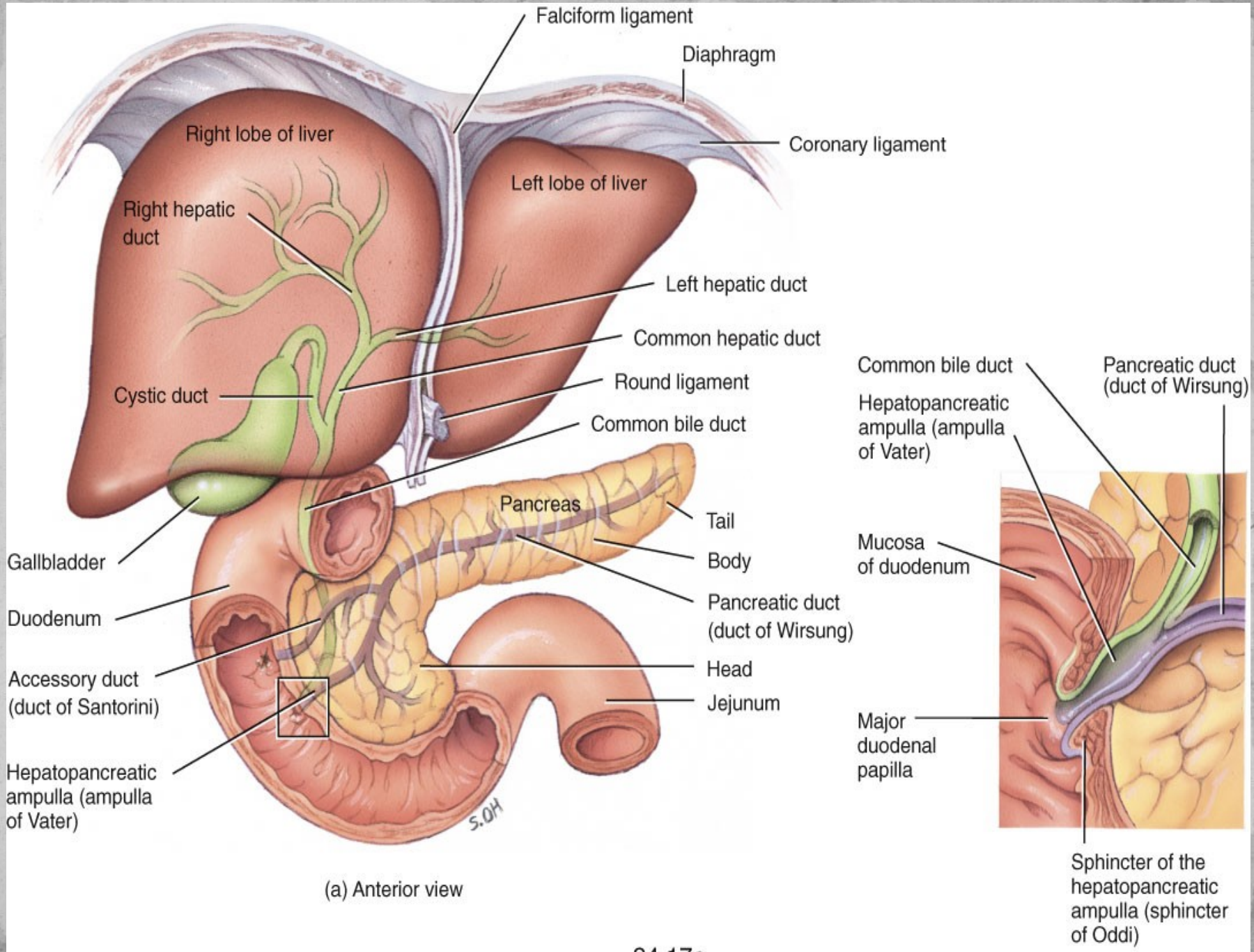
Nerve supply

- **Sympathetic** and **parasympathetic** nerves form the **celiac plexus**.

Gallbladder and biliary ducts

Gallbladder

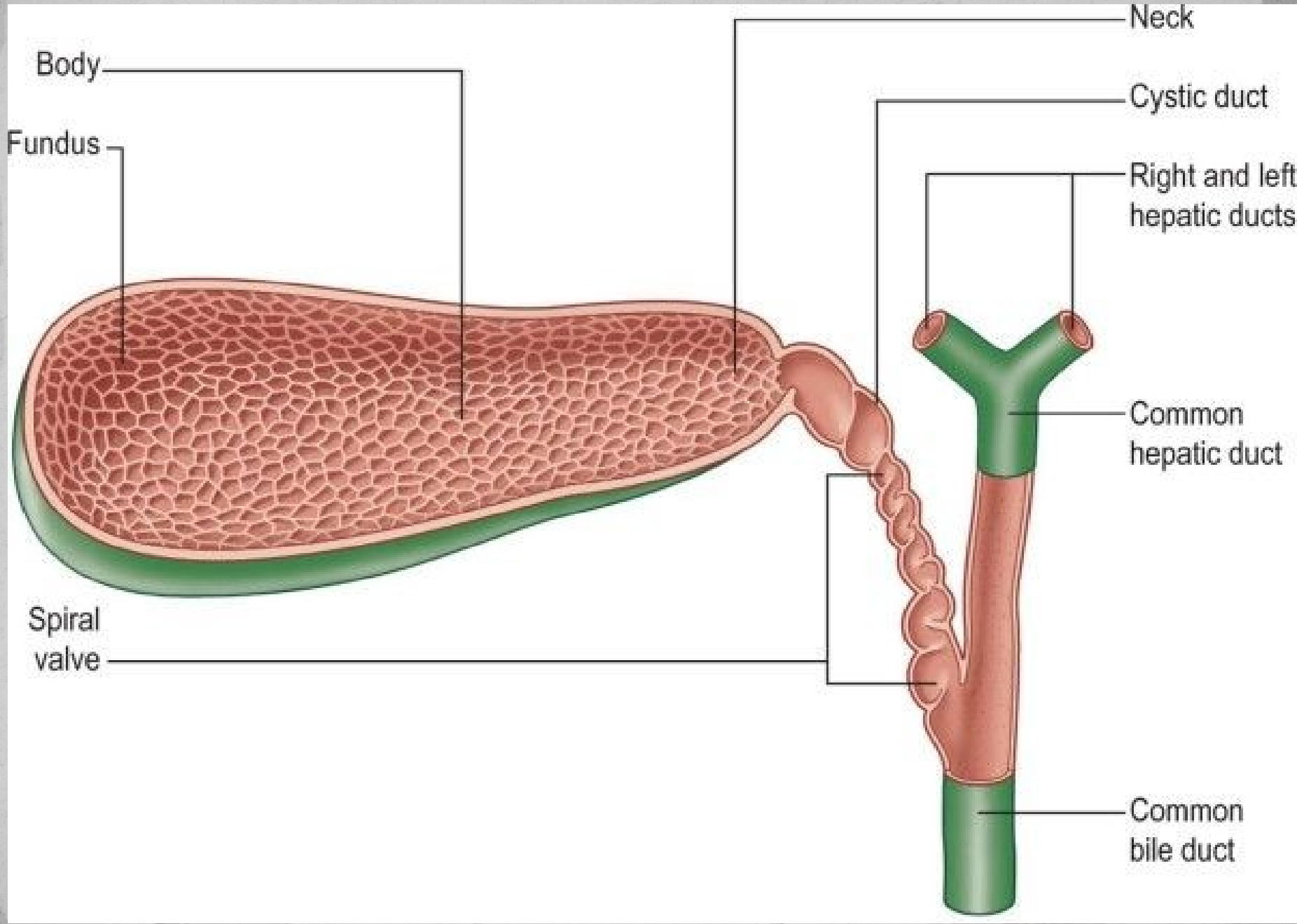
- 7–10 cm long, **Pear-shaped**, hollow structure
- Lies in the fossa for the gallbladder on the **visceral** surface of the liver
- **Green muscular organ**
- Epigastric, right hypochondrium region
- Capacity 40- 60 cc


Falciform ligament
Diaphragm
Right lobe of liver
Coronary ligament
Left lobe of liver
Right hepatic duct
Left hepatic duct
Common hepatic duct
Cystic duct
Round ligament
Common bile duct
Pancreas
Tail
Gallbladder
Body
Duodenum
Pancreatic duct (duct of Wirsung)
Accessory duct (duct of Santorini)
Head
Jejunum
Hepatopancreatic ampulla (ampulla of Vater)
S.OH
(a) Anterior view
Common bile duct
Pancreatic duct (duct of Wirsung)
Hepatopancreatic ampulla (ampulla of Vater)
Mucosa of duodenum
Major duodenal papilla
Sphincter of the hepatopancreatic ampulla (sphincter of Oddi)

24.17a

Parts of gallbladder

- Three parts
- **Fundus:** The **wide** blunt end
- projects from the inferior border of the liver
- **Body: Main** portion
- **Neck:** Narrow, tapering end
- **The cystic duct: Connects** the neck of the gallbladder to the common hepatic duct

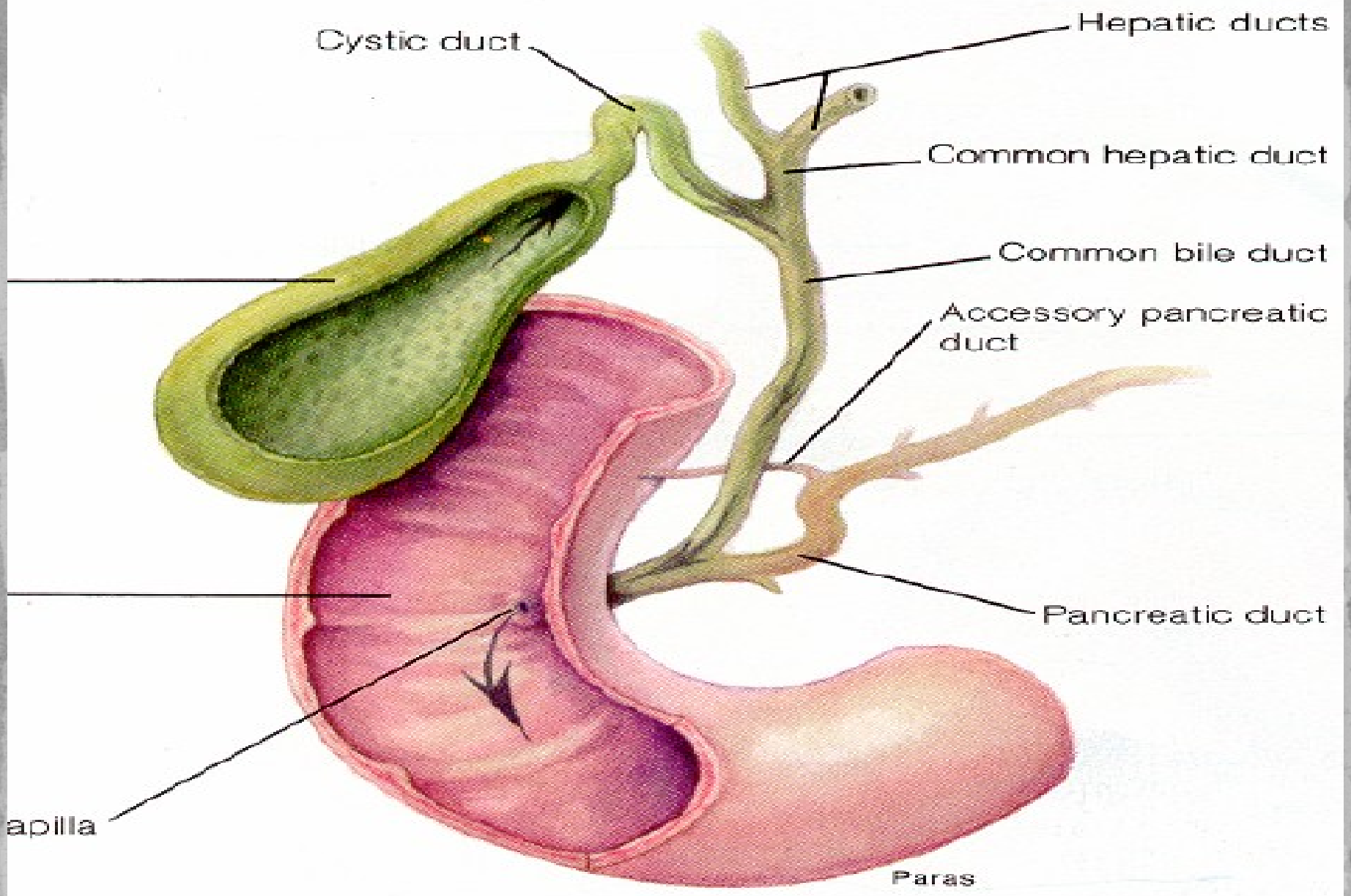

Neck
Body
Cystic duct
Fundus
Right and left
hepatic ducts
Common
hepatic duct
Spiral
valve
Common
bile duct

Extra hepatic biliary system

- Rt. **hepatic duct** and Lt hepatic duct join to make **common hepatic duct**
- **Cystic** duct and common hepatic duct form **common bile duct**

Common bile duct

- Has **supra duodenal, retro duodenal** and **retro pancreatic** part
- End in the half second part of duodenum at **ampulla of Vater**


Cystic duct
Hepatic ducts
Common hepatic duct
Common bile duct
Accessory pancreatic duct
Pancreatic duct
apilla
Paras

Bile

- Bile composed of **water**, **ions**, **bile acids**, **organic molecules** (including **cholesterol**, **phospholipids**, **bilirubin**)
- Acids and salts **emulsify** fats for **absorption** across wall of small intestines into lacteal lymph capillaries
- Contains **waste** products from **RBC breakdown** and other metabolic processing (color of feces from bilirubin in bile)

Vessels and nevres

Artery

- **Cystic artery**: branch of Rt. Hepatic artery

Vein

- **Cystic vein**: end in portal vein
- Small branches (arteries and veins run between liver and gall bladder)

Lymphatic

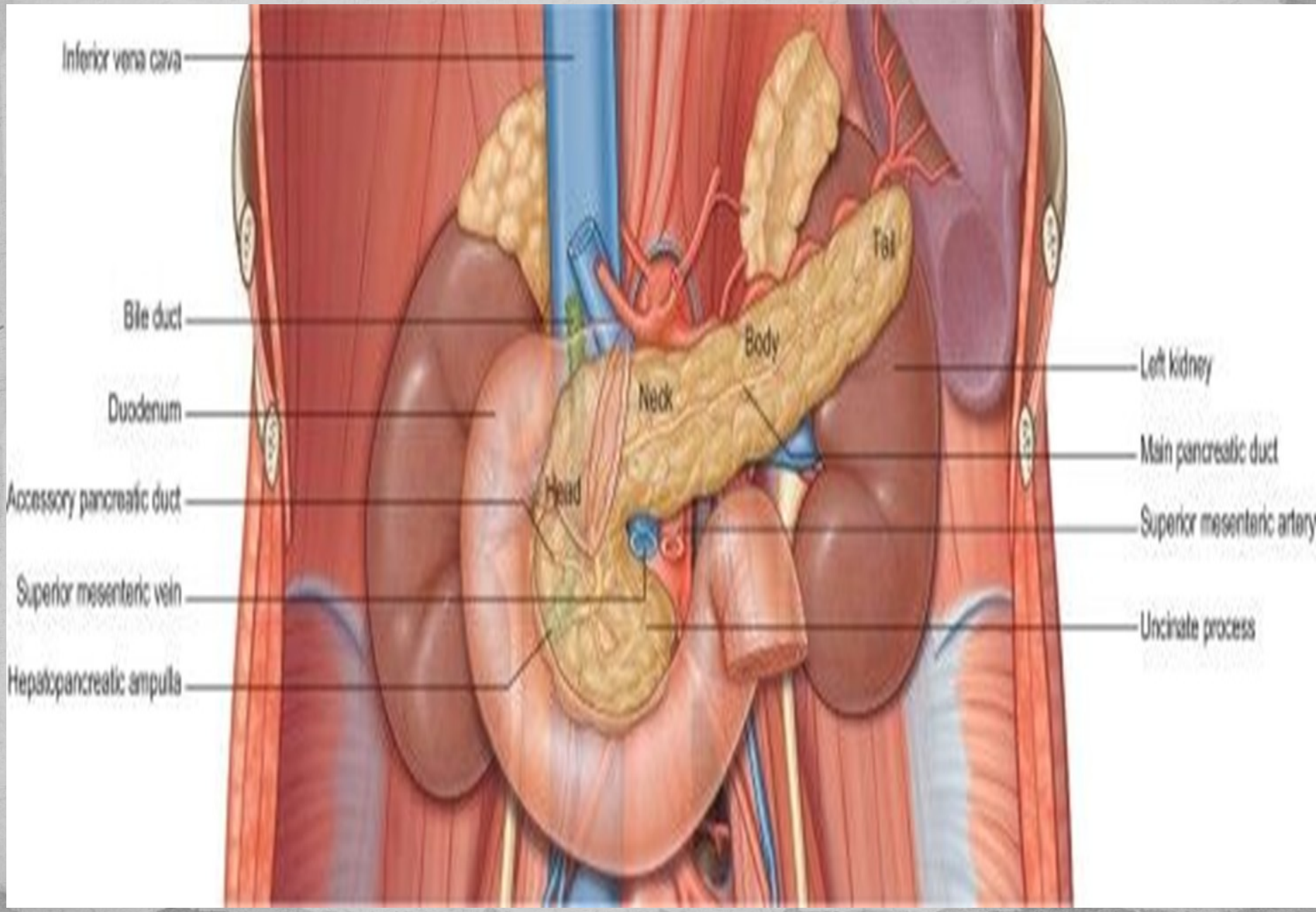
- **celiac** nodes, **Cystic node** at neck of GB, **hepatic node, pancreaticoduodenal** artery

Nerves

- Sympathetic and parasympathetic from **celiac plexus**
- Parasympathetic, **vagous nerve**

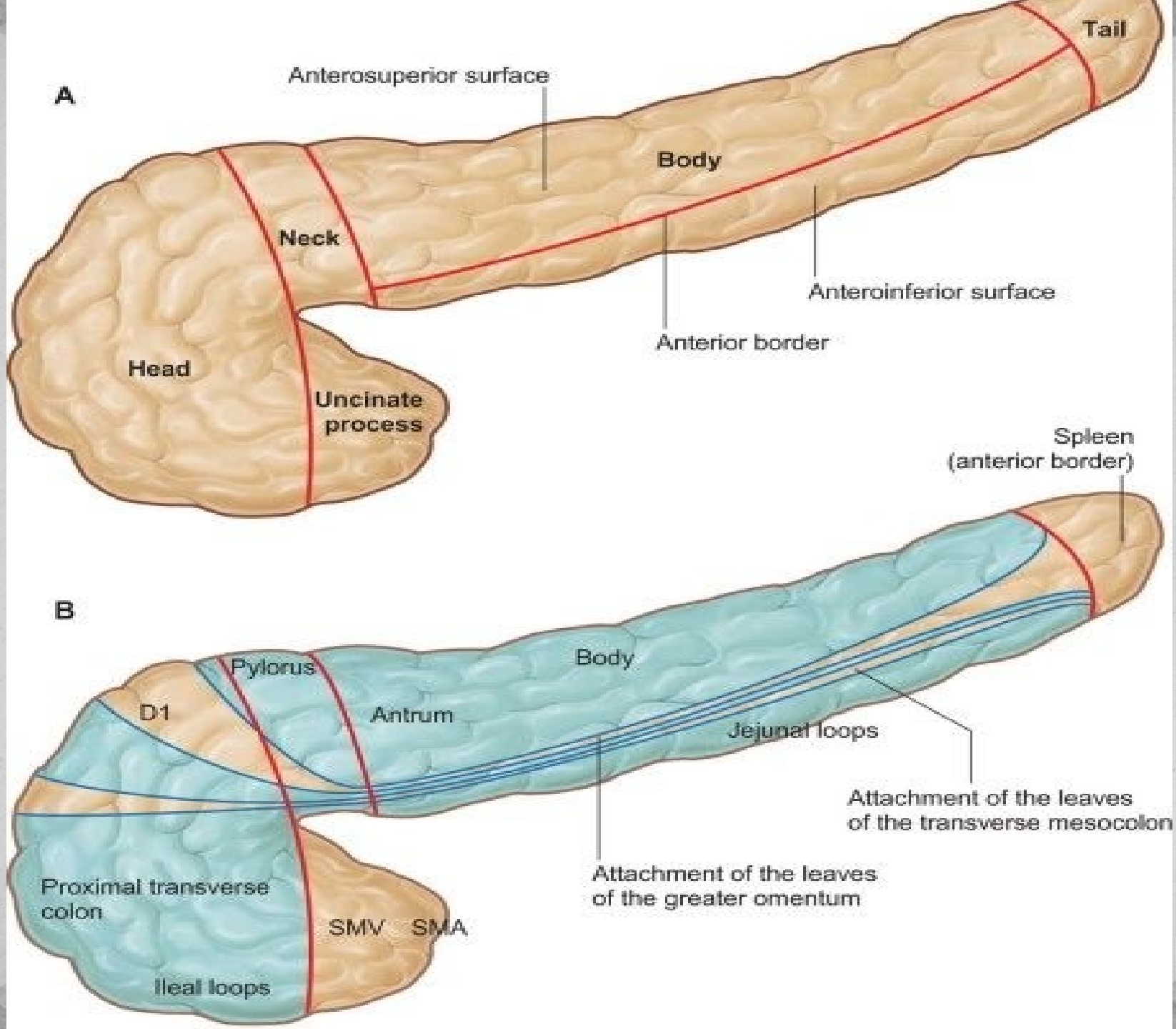
Pancreas

- The pancreas is both an **exocrine** and **endocrine** gland,
- Producing **pancreatic juice** that is secreted into the **duodenum** for digestion
- Producing **insulin** and **glucagon** that are released as hormones into the **blood**
- Located in **epigastric** & **left hypochondriac** regions


Inferior vena cava
Bile duct
Duodenum
Accessory pancreatic duct
Superior mesenteric vein
Hepatopancreatic ampulla
Tail
Body
Neck
Head
Left kidney
Main pancreatic duct
Superior mesenteric artery
Uncinate process

Parts of pancreas

- **Head:** Lies within the **C-shaped** concavity of the **duodenum**;
- **Uncinate** (hooklike) **process:** Projects from the lower part of the **head**.
- **Neck: Anterior** to the superior mesenteric vessels
- **Body:** Which links the **neck** to the **tail**.
- **Tail: Ends part**


A
Tail
Anterosuperior surface
Body
Neck
Anteroinferior surface
Anterior border
Head
Uncinate process
Spleen (anterior border)
B
Body
Pylorus
D1
Antrum
Jejunal loops
Attachment of the leaves of the transverse mesocolon
Attachment of the leaves of the greater omentum
Proximal transverse colon
SMV
SMA
Ileal loops

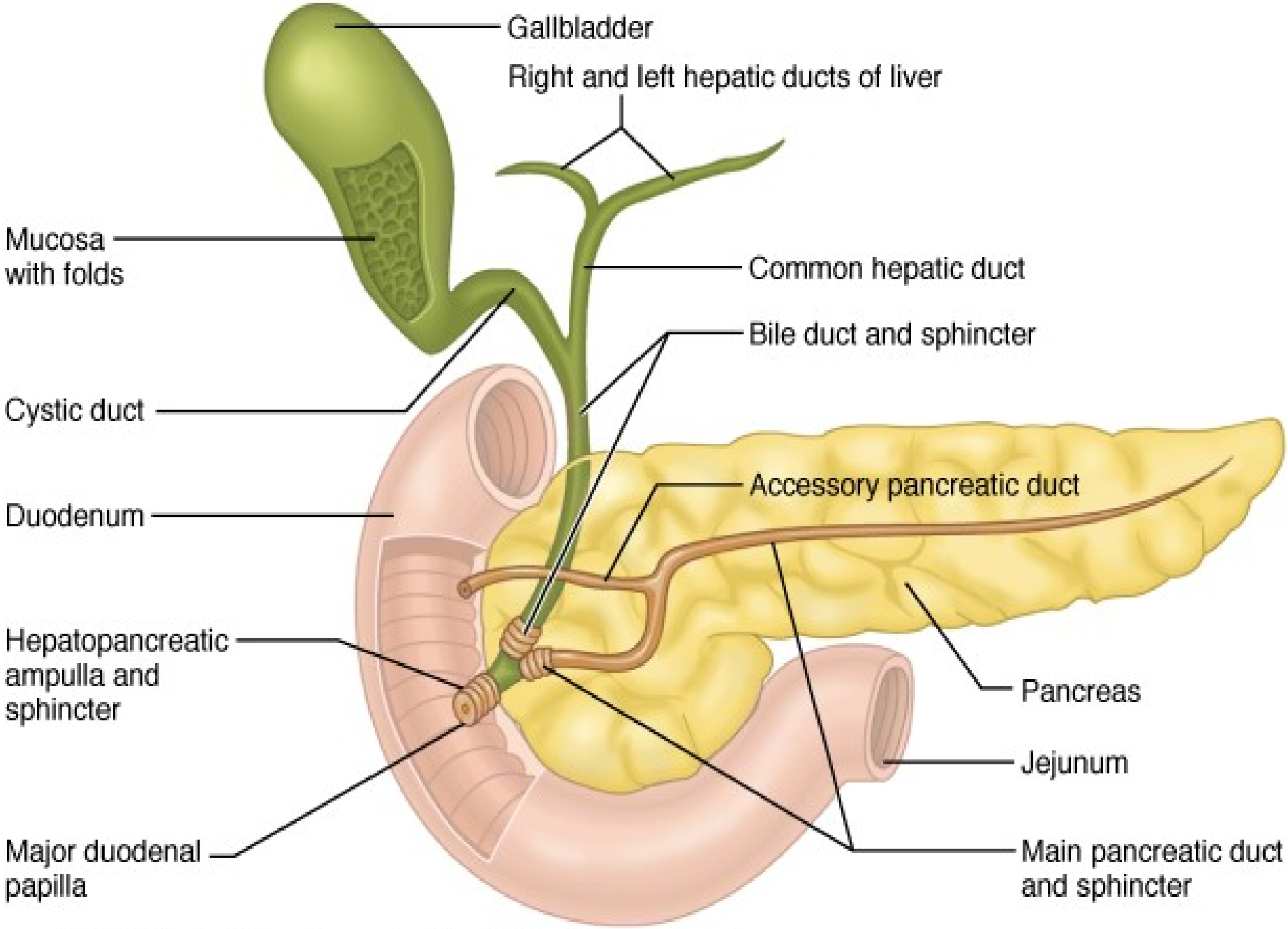
Pancreatic duct system

Main Pancreatic Duct (of Wirsung)

- Begins at the **tail**
- Course is **left** to **right**
- **joins** CBD at **Ampulla of Vater**

Duct of Santorini

- **Accessory** pancreatic duct
- Joins duodenum at **minor papilla**



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Vessels and nevres

Artery

- **pancreaticoduodenal** artery and **splenic artery**

Vein

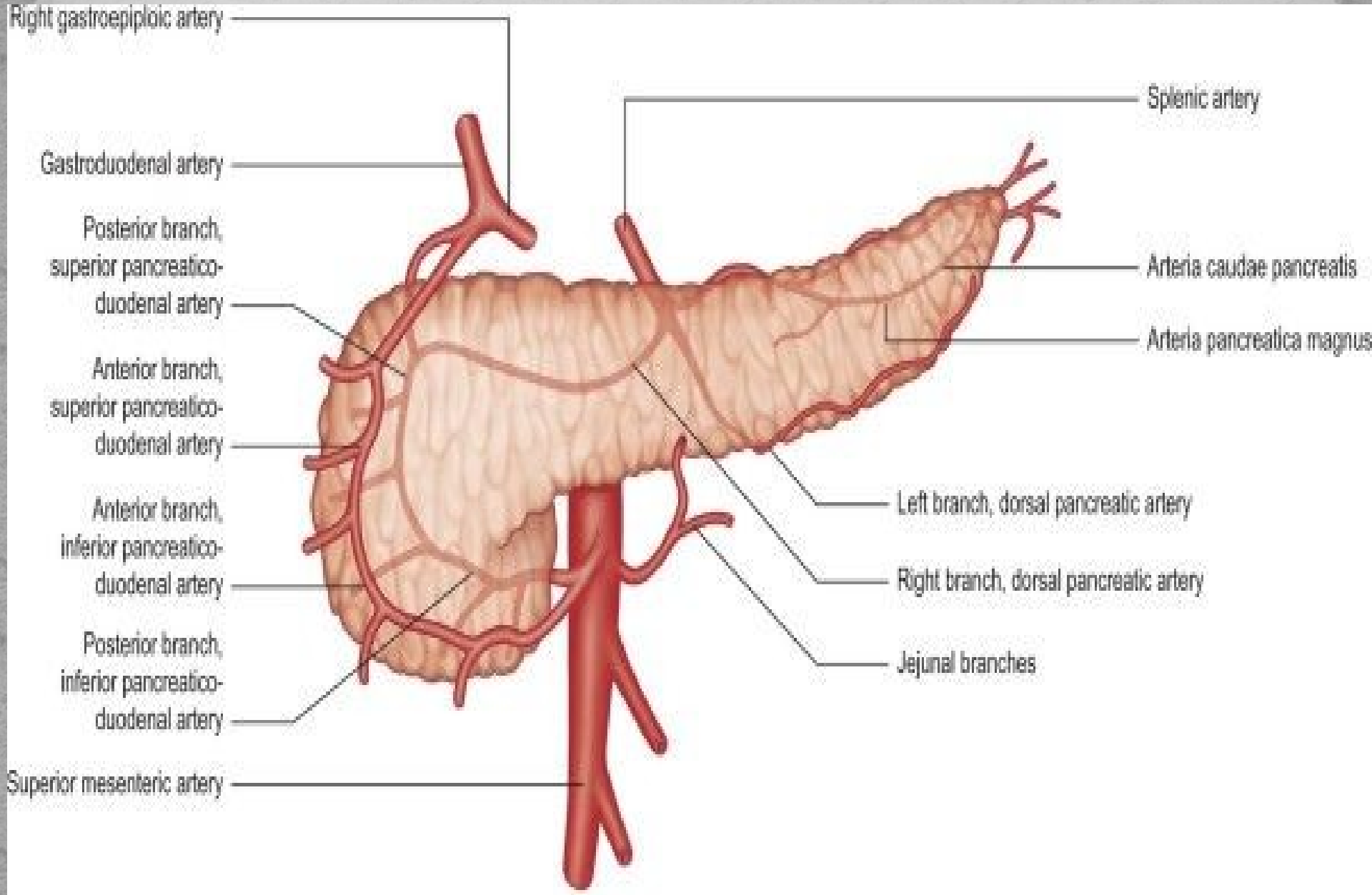
- Is by superior & inferior **pancreatic vein**, **splenic vein**.
- All these vein drains into the **portal vein**.

Lymphatic drainage

- **pancreatico-duodenal** lymph nodes and **pancreatico splenic** lymph nodes.

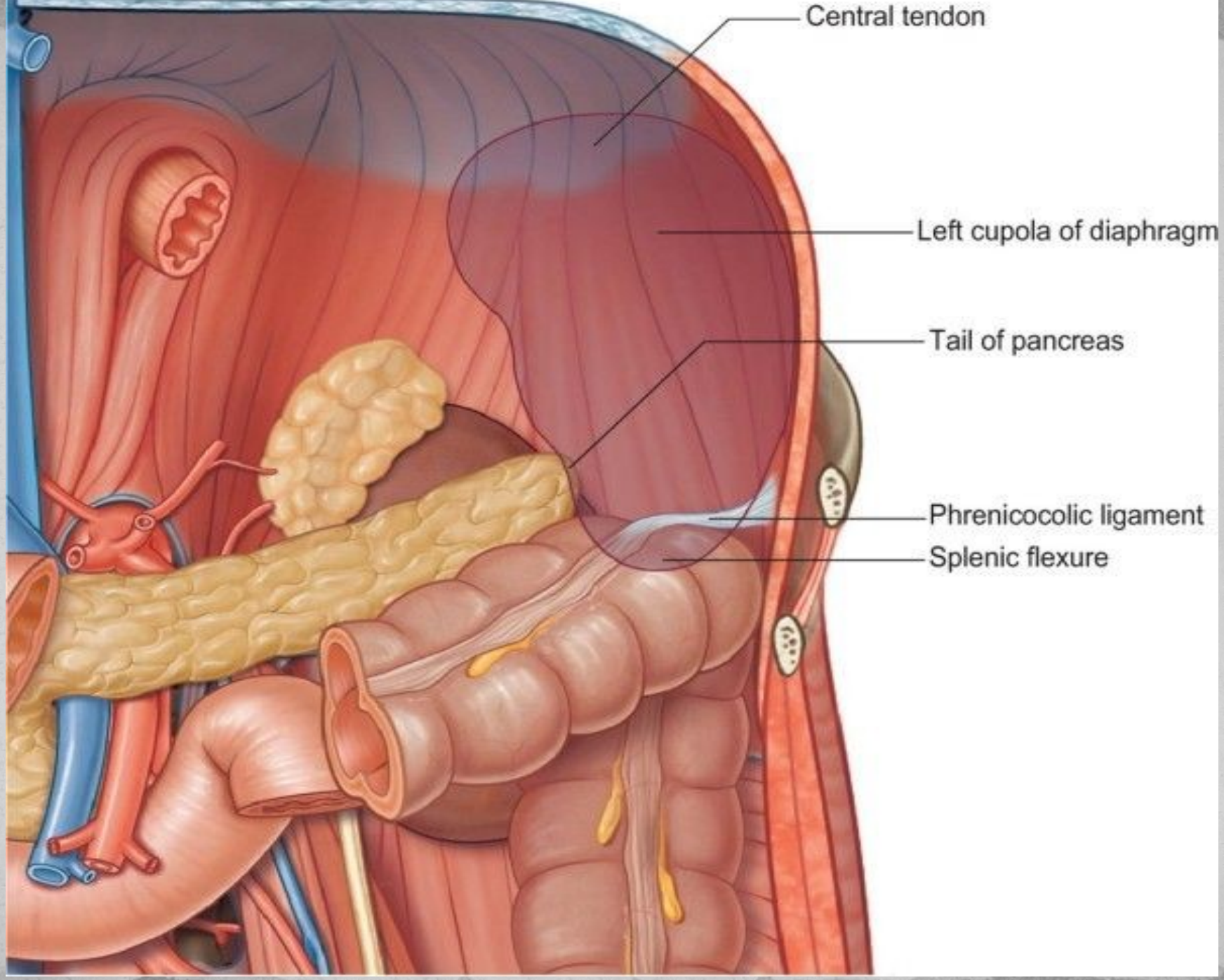
Nerve supply

- **Sympathetic** from 6th-10th **thoracic** spinal segments
- **Parasympathetic-posterior vagal** trunk


Right gastroepiploic artery
Splenic artery
Gastroduodenal artery
Posterior branch, superior pancreatico-duodenal artery
Arteria caudae pancreatis
Arteria pancreatica magnus
Anterior branch, superior pancreatico-duodenal artery
Left branch, dorsal pancreatic artery
Right branch, dorsal pancreatic artery
Anterior branch, inferior pancreatico-duodenal artery
Jejunal branches
Posterior branch, inferior pancreatico-duodenal artery
Superior mesenteric artery

Spleen

- The spleen is an **ovoid**, usually **purplish**, pulpy mass about the size and shape of one's **fist**.
- It is the **largest lymphoid** tissue in the body
- The spleen is concealed at the **left hypochondrium**:
- It is not palpable under **normal** conditions
- Has **two surfaces**, **two ends** or extremities or poles and **three borders**


Central tendon
Left cupola of diaphragm
Tail of pancreas
Phrenicocolic ligament
Splenic flexure

Surfaces

- Two surfaces

Superolateral or **diaphragmatic**

- **convex** and **smooth**

Inferomedial or **visceral** surface.

- faces inferomedially towards the **abdominal cavity**,
-

Borders

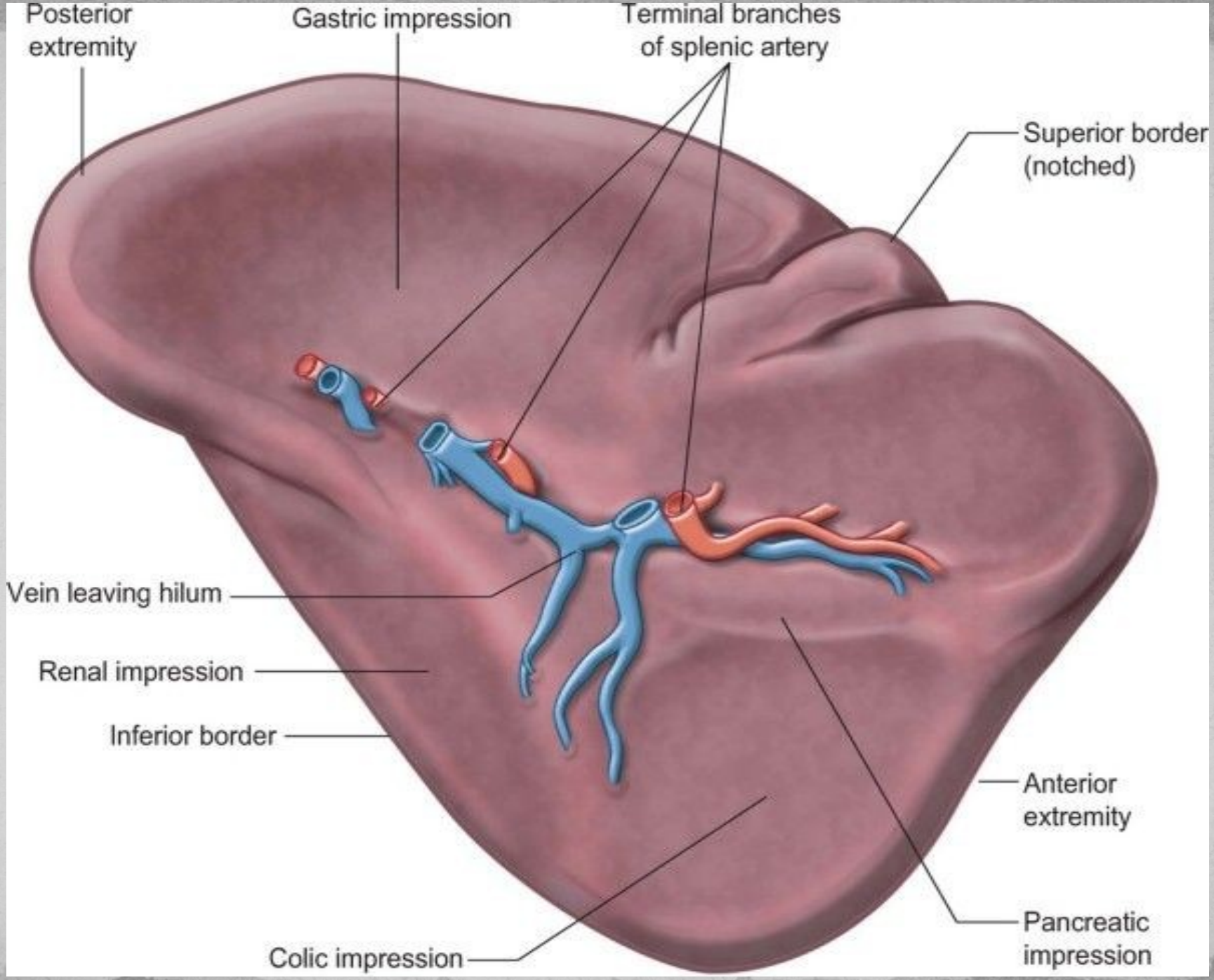
- **Two** to **three** borders:

The superior (anterior)

- This border is sometimes separated into separate **anterior** and **superior** borders
- In an **enlarged** spleen, it is **palpated**.

ii. **The inferior** (posterior)

- More **rounded** and **blunter**
- Separates the **renal** from the **diaphragmatic** surface;


Posterior extremity
Gastric impression
Terminal branches of splenic artery
Superior border (notched)
Vein leaving hilum
Renal impression
Inferior border
Anterior extremity
Pancreatic impression
Colic impression

Hilum

- The hilum of the spleen is a **long fissure** in the medial border
- Through which the branches of the splenic **artery** and **vein** as well as **nerves** and **lymphatic's** enter and leave the spleen.

Vessels and nevres

Artery

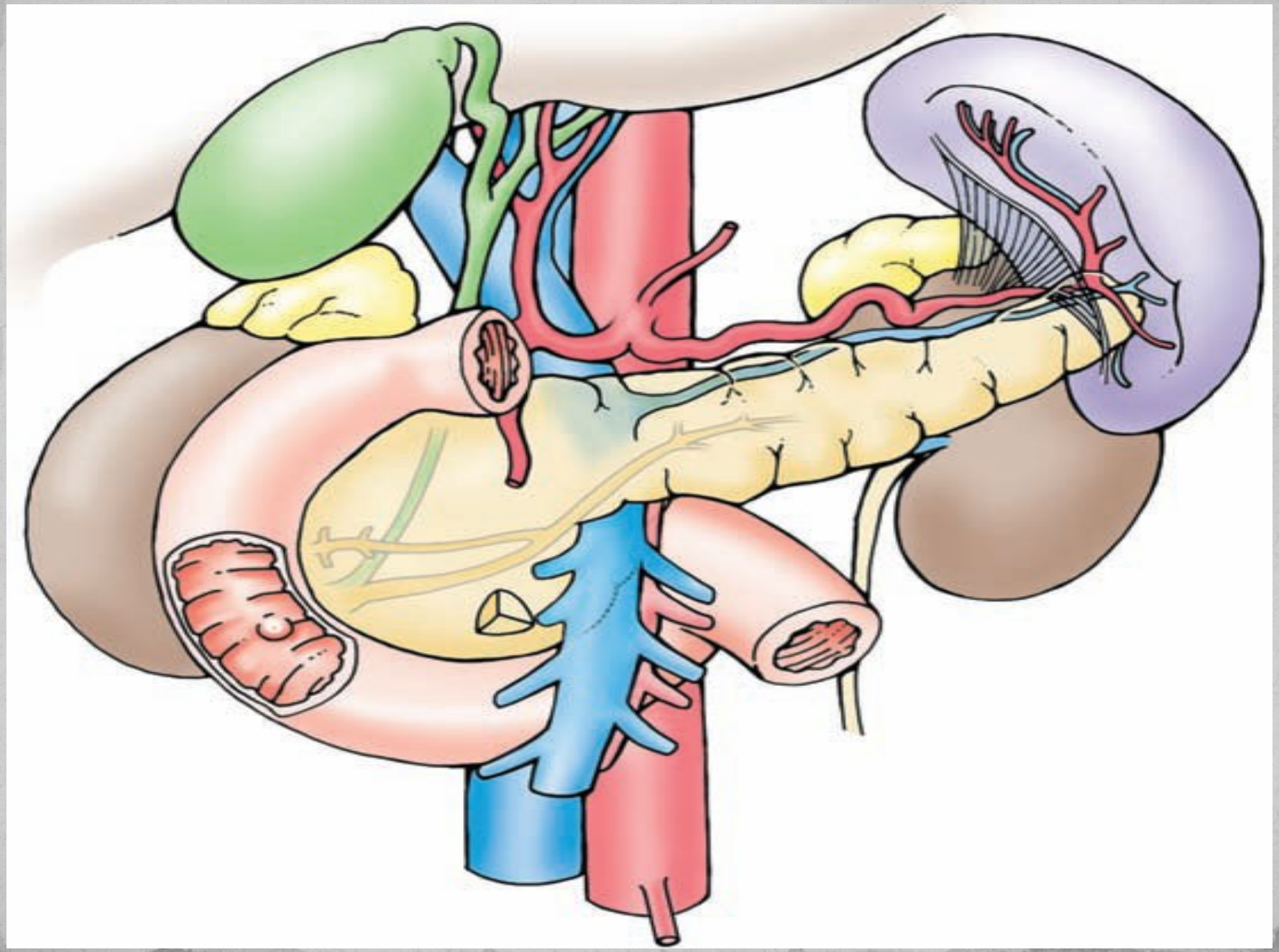
- **Splenic Artery**.

Vein

- Usually **posterior** to the artery
- Empties into the **portal vein**

Lymphatic drainage

- The splenic lymphatic vessels to the **pancreaticosplenic lymph nodes**



Thank You!