ANATOMY

GASTROINTESTINAL SYSTEM

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GASTROINTESTINALSYSTEM

- Two groups of organs compose the digestive system
  - The gastrointestinal (GI) tract
  - The accessory digestive organs.

- The gastrointestinal (GI) tract or alimentary canal is a continuous tube that extends from the mouth to the anus through the thoracic and abdominopelvic cavities.
- 9 meter long
- Organs of the gastrointestinal tract include the mouth, most of the pharynx, esophagus, stomach, small intestine, and large intestine.

- The accessory organs are not part of the GI tube, but often develop as outgrowths from and are connected to the GI tract. The accessory digestive organs assist the GI tract in the digestion of material.
- Accessory digestive organs include the teeth, tongue, salivary glands, liver, gallbladder, and pancreas.

Peritoneum

- Serous membrane lining the abdominopelvic cavity
- It has two layers :
  - Parietal peritoneum: covering the abdominal wall
  - Visceral peritoneum: covering the surface of internal organs (viscera)
  - In between the two layers is a potential space called peritoneal cavity
  - Peritoneal cavity contain fluid to facilitate the frictionless movement of organs

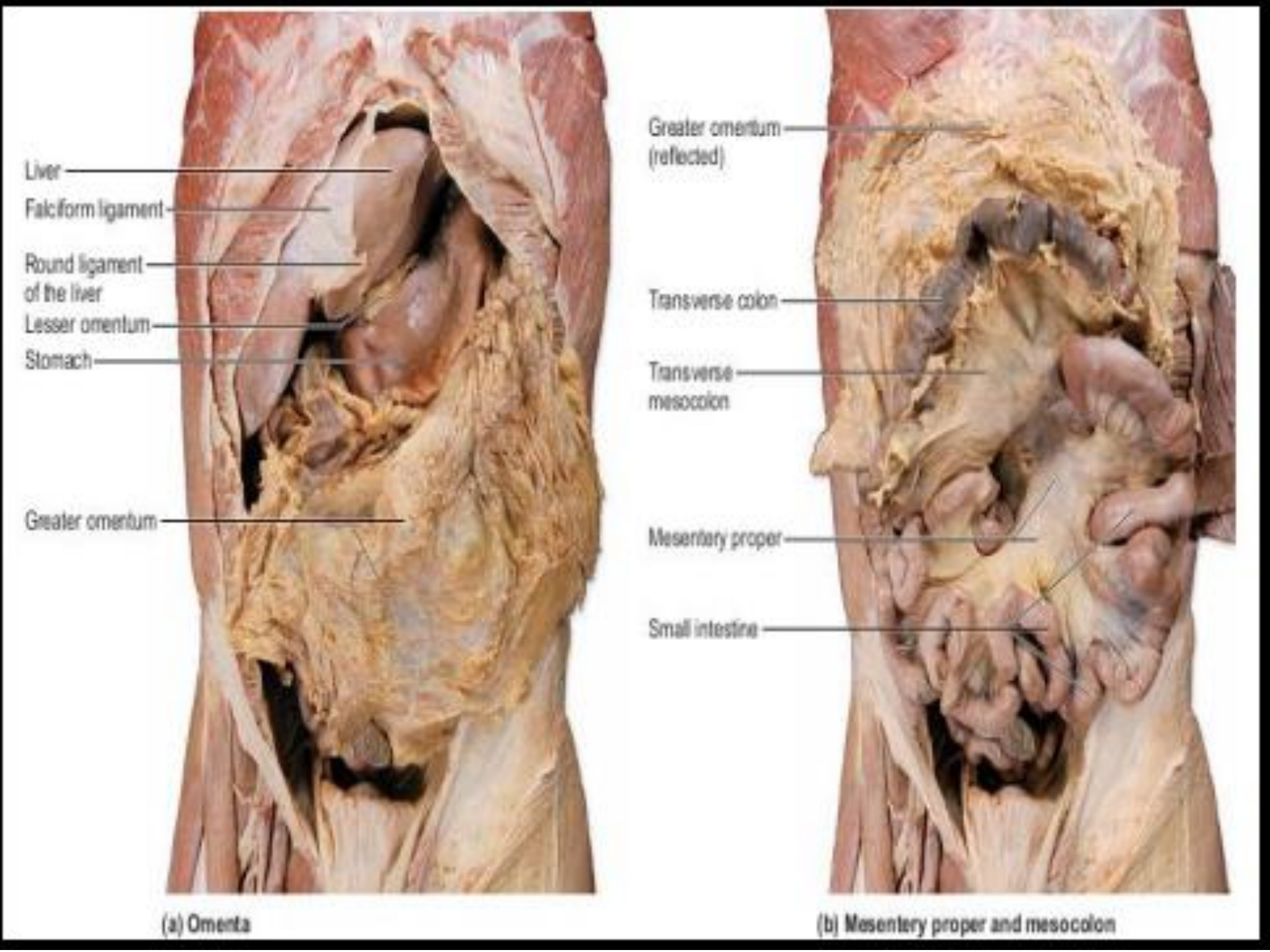
- Some of the abdominal organs are completely covered by visceral peritoneum- intraperitoneal organs. They include the stomach, part of the duodenum, the jejunum, the ileum, the cecum, the appendix, the transverse and sigmoid colon.

- Some of the organs lies posterior to the peritoneum and are called retroperitoneal organs. They include most of the duodenum, the pancreas, the ascending and descending colon of the large intestine, and the rectum.
- They have their anterolateral portions covered by peritoneum while posteriorly they lie directly against posterior abdominal wall

Mesenteries

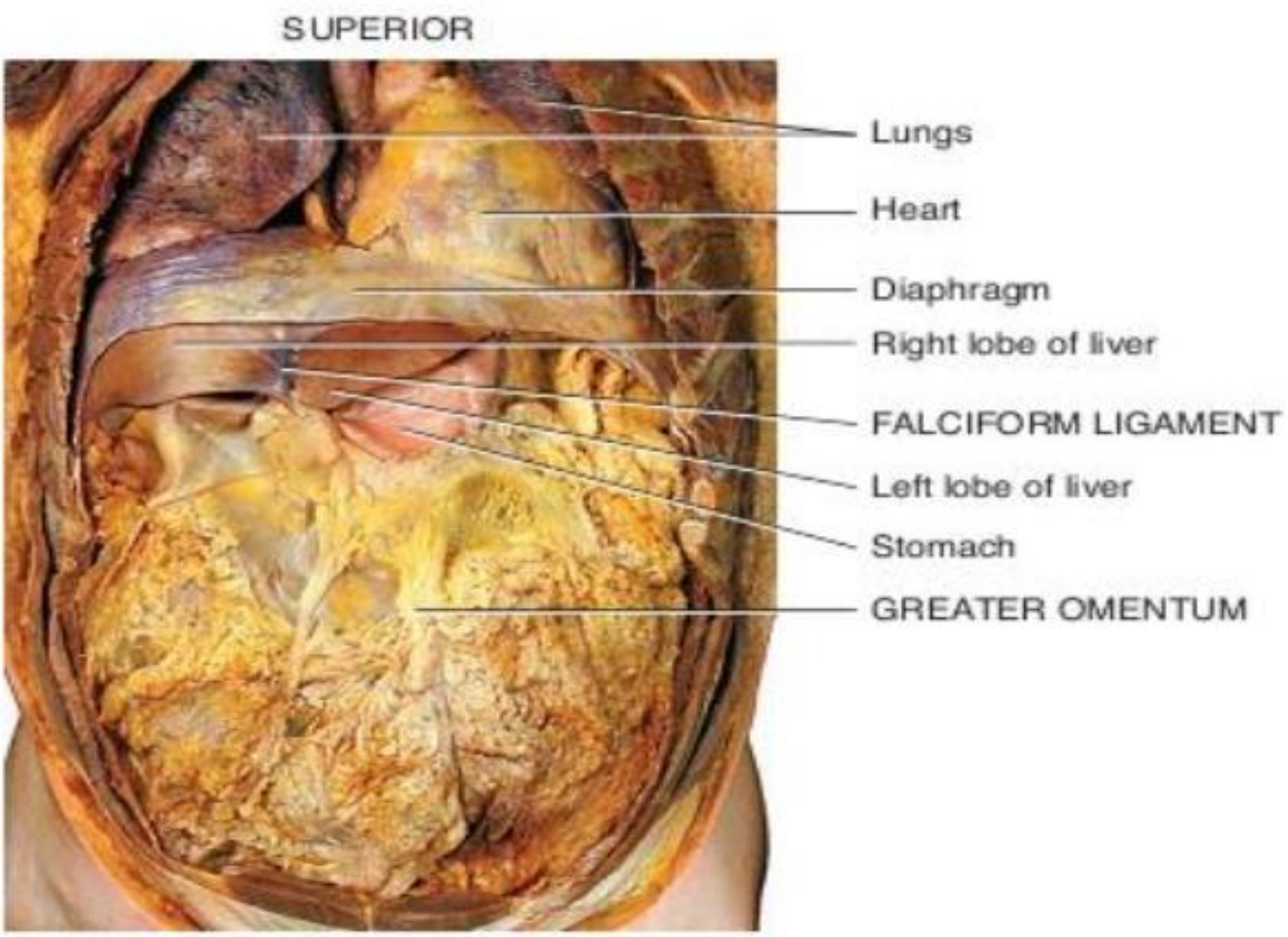
- Mesenteries are the double layered peritoneum present in the posterior abdominal cavity
- Mesentery perform the following functions
  - The mesentery supports the GIT by binding organs together and with abdominal wall
  - It provides passage for the nerves and vessels of the GIT
  - Enables the free peristaltic movement of the intestine

- There are several different types of mesenteries.
  - The greater omentum extends inferiorly like an apron from the greater curvature of the stomach and covers most of the abdominal organs. It often accumulates large amounts of adipose connective tissue.
  - The lesser omentum connects the lesser curvature of the stomach and the proximal end of the duodenum to the liver.
  - The mesentery proper is a fan-shaped fold of peritoneum that suspends most of the small intestine from the internal surface of the posterior abdominal wall.
  - Mesocolon is the peritoneal fold that attaches parts of the large intestine to the internal surface of the posterior abdominal

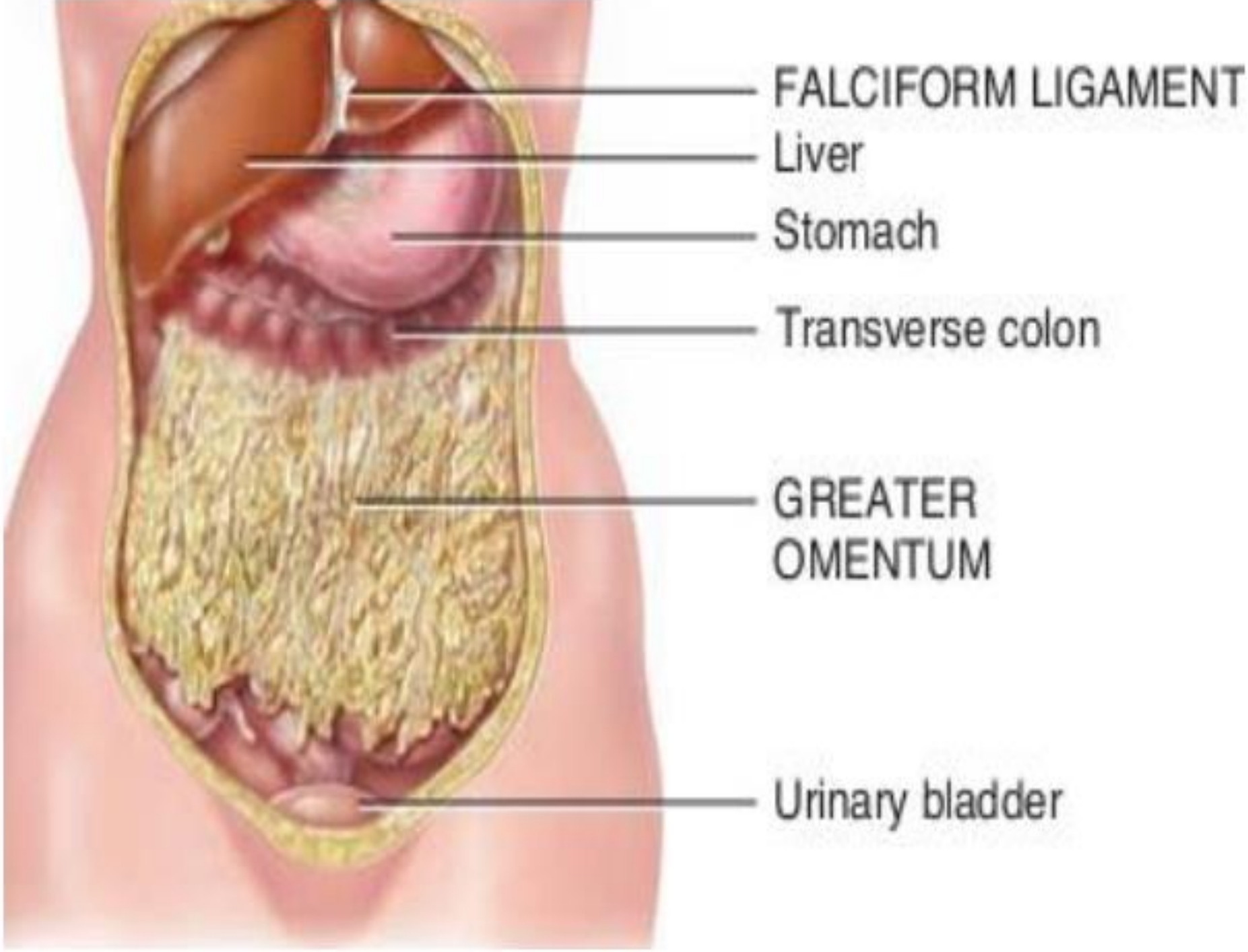


(a) Omenta

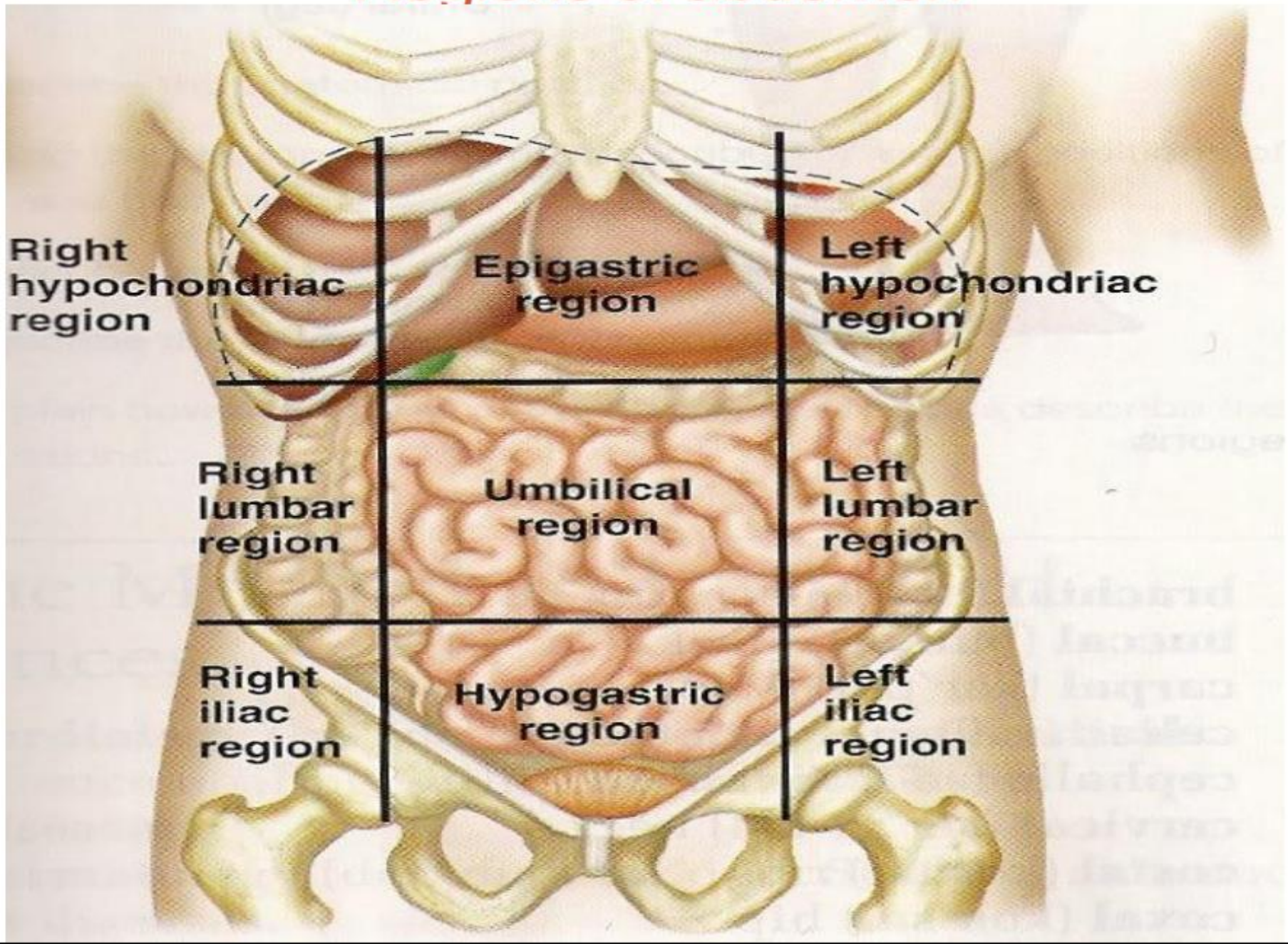
(b) Mesentery proper and mesocolon



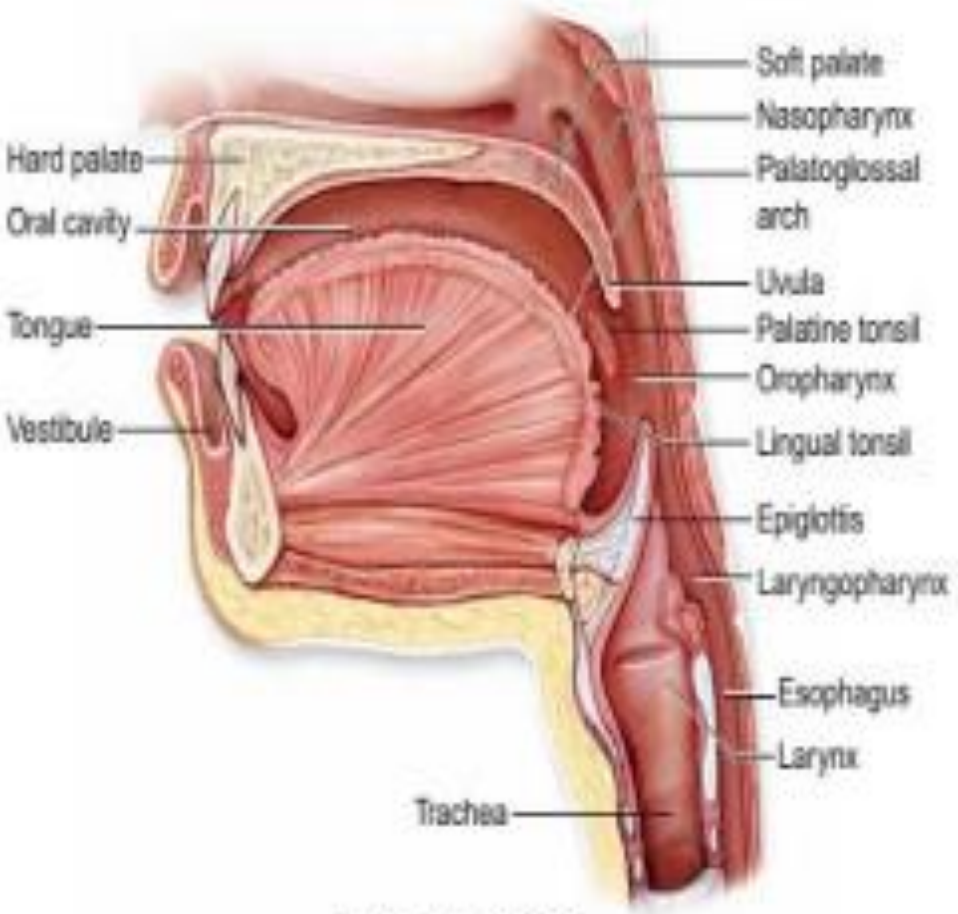
(e) Anterior view


FALCIFORM LIGAMENT
Liver
Stomach
Transverse colon
GREATER
OMENTUM
Urinary bladder

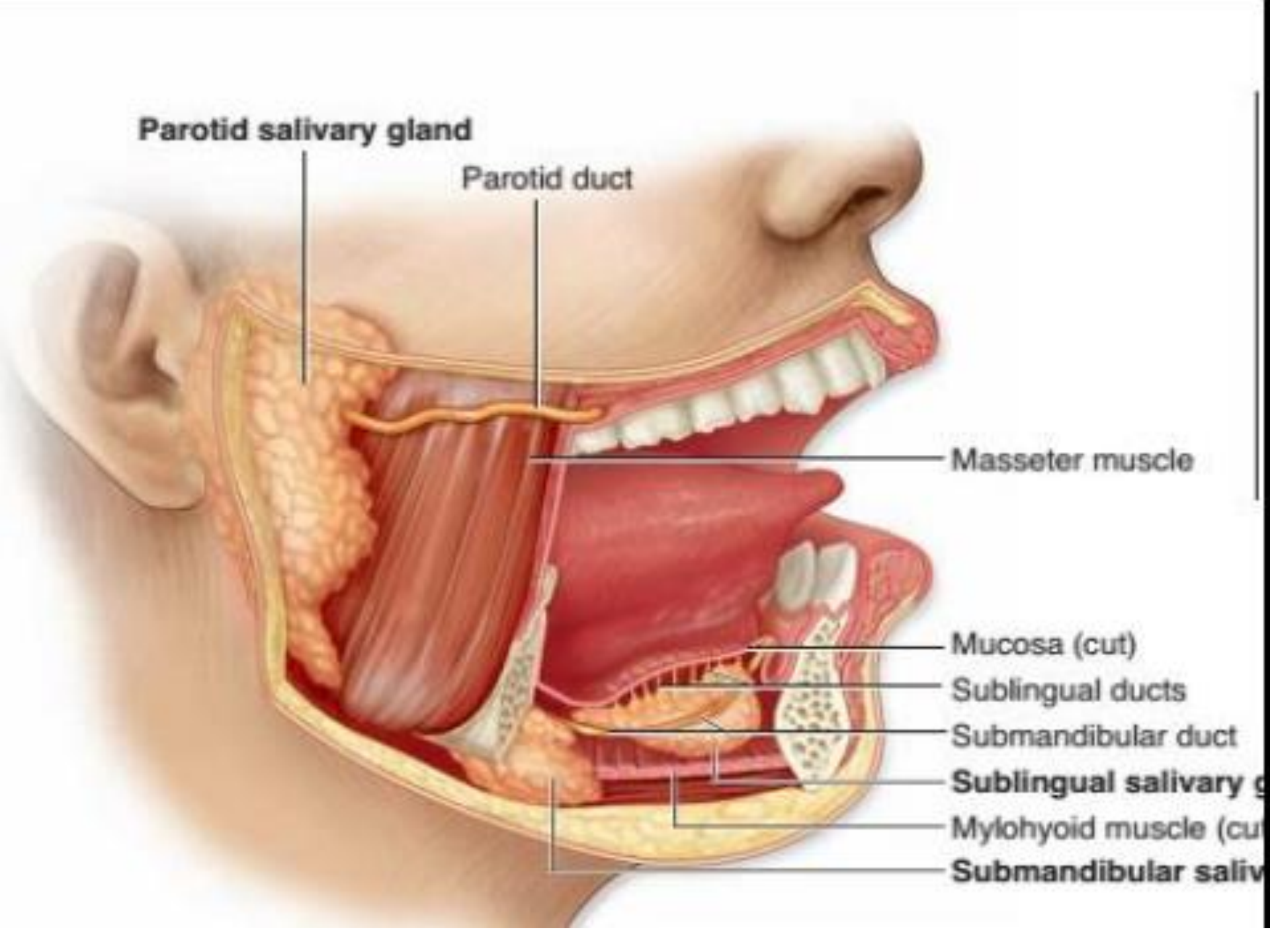
Regions of abdomen



(a) Oral cavity, anterior view



(b) Sagittal section


Parotid salivary gland
Parotid duct
Masseter muscle
Mucosa (cut)
Sublingual ducts
Submandibular duct
Sublingual salivary g
Mylohyoid muscle (cut
Submandibular saliv

ESOPHAGUS

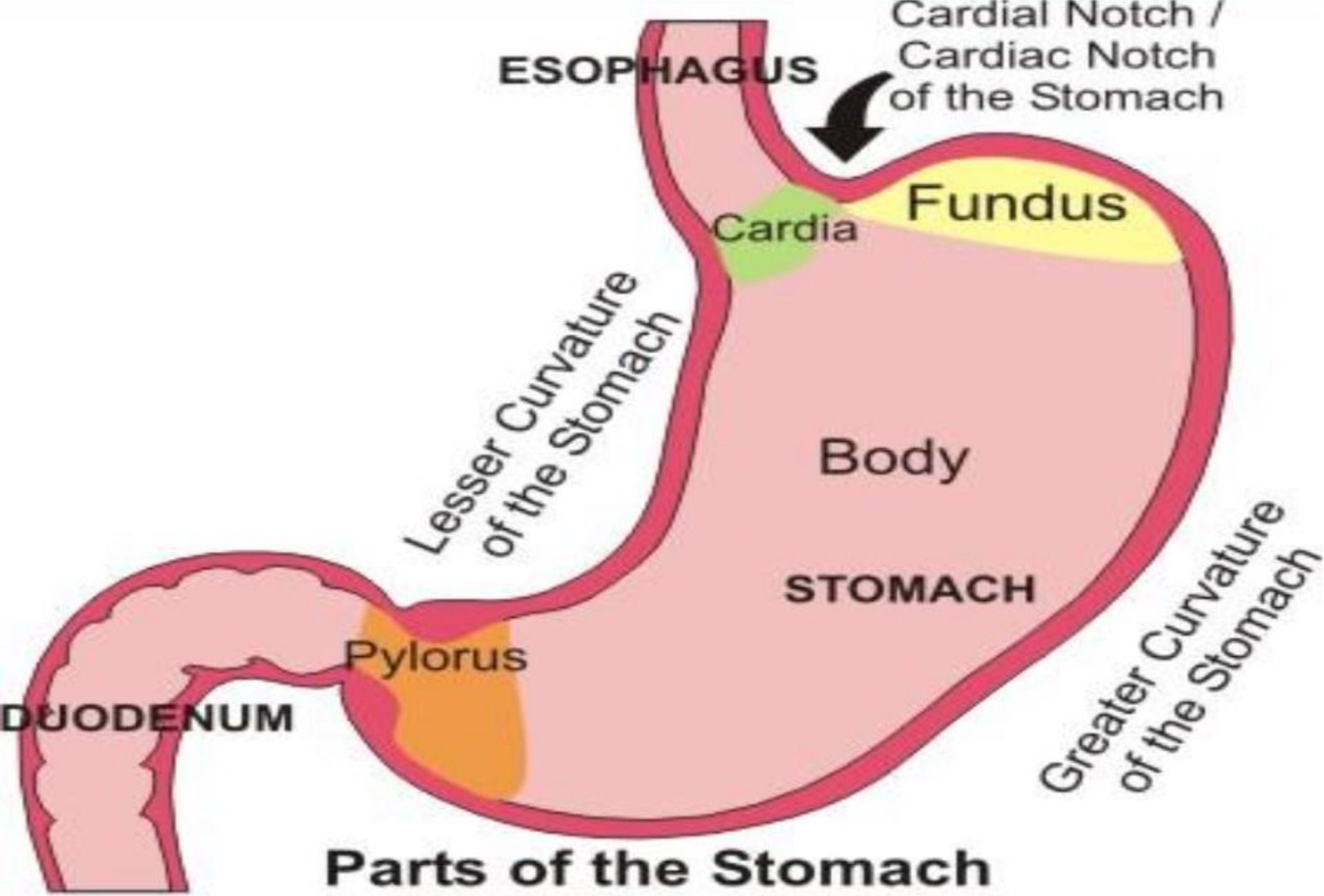
- The esophagus is a collapsible muscular tube, about 25 cm (10 in.) long, that lies posterior to the trachea
- Connects pharynx to stomach
- begins at the inferior end of the laryngopharynx, passes through the inferior aspect of the neck, enters the mediastinum anterior to the vertebral column. Then it pierces the diaphragm through an opening called the esophageal hiatus
- Histology- made up of four tunics (mucosa, submucosa, muscularis, adventitia)
- The muscluaris is different form other portions of GIT as the first one 3 portion of esophagus is made up of smooth muscles, the middle one 3 is made up of both smooth and skeletal muscles while the last one third is made up of smooth muscles
- At both ends the muscularis become more prominent making two sphincters – The upper esophageal sphincter made up of skeletal muscles and lower esophageal sphincter made up of smooth muscles

STOMACH

- J shaped muscular structure
- Holding organ of GIT
- Most distendable portion of GIT

Parts of stomach

- Divided into four regions
- Cardia: cranial end of stomach
  - Narrow upper region immediately below esophageal sphincter
  - Has prominent notch called as cardiac notch
- **Fundus**: dome shaped elevated portion to the left
  - In direct contact with diaphragm
- **Body**: large central portion
  - Has two borders: lesser curvature (medial, concave portion to the right)
  - Greater curvature (lateral, convex portion to the left)
- **Pylorus**: Funnel shaped terminal portion
- Has three parts : antrum; 1°' portion has a downward depression, inferior most portion of stomach. Antrum is followed by pyloric canal which leads to the pylorus. Pylorus connects stomach and duodenum. The junction is guarded by pyloric sphincter



Parts of the Stomach

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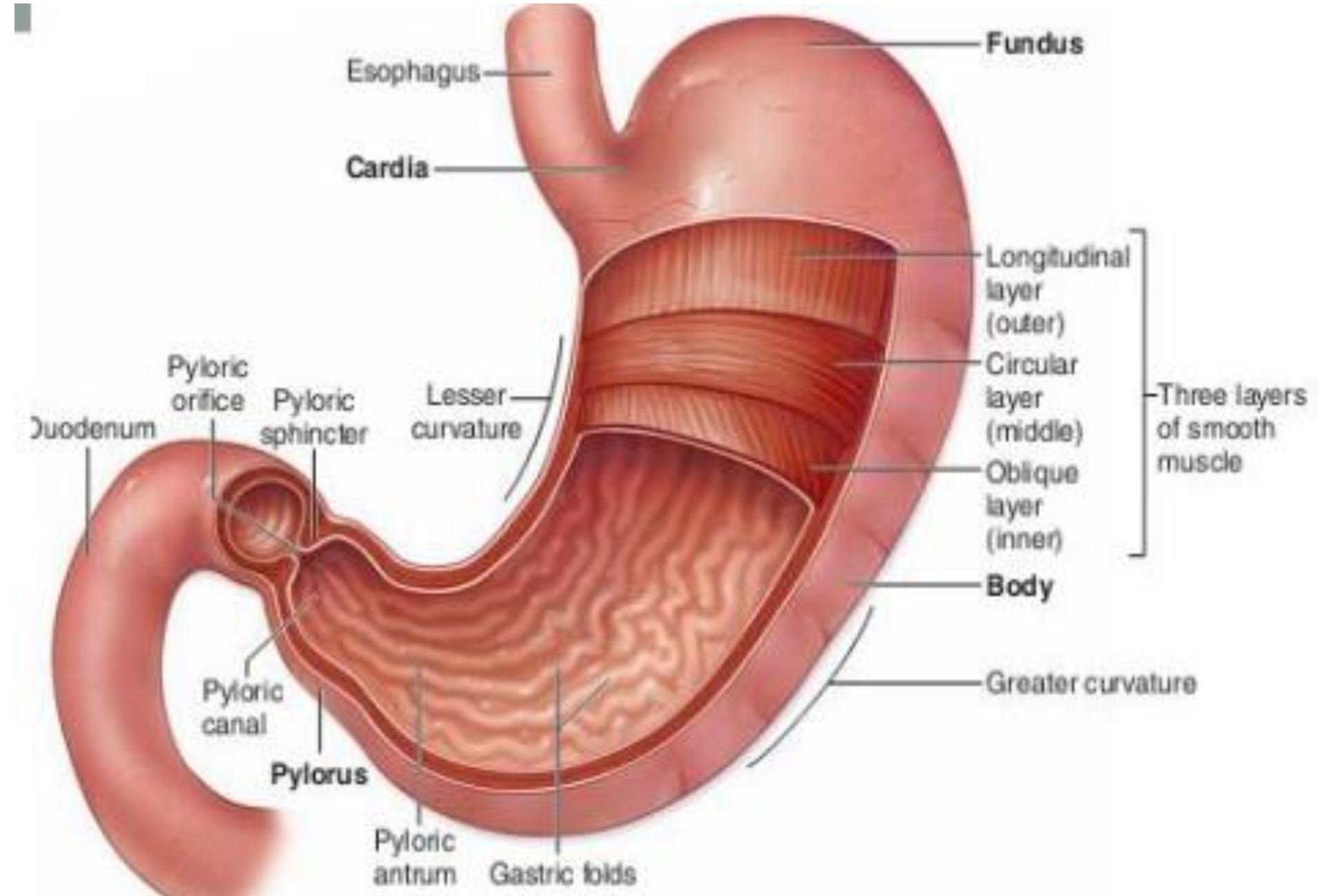
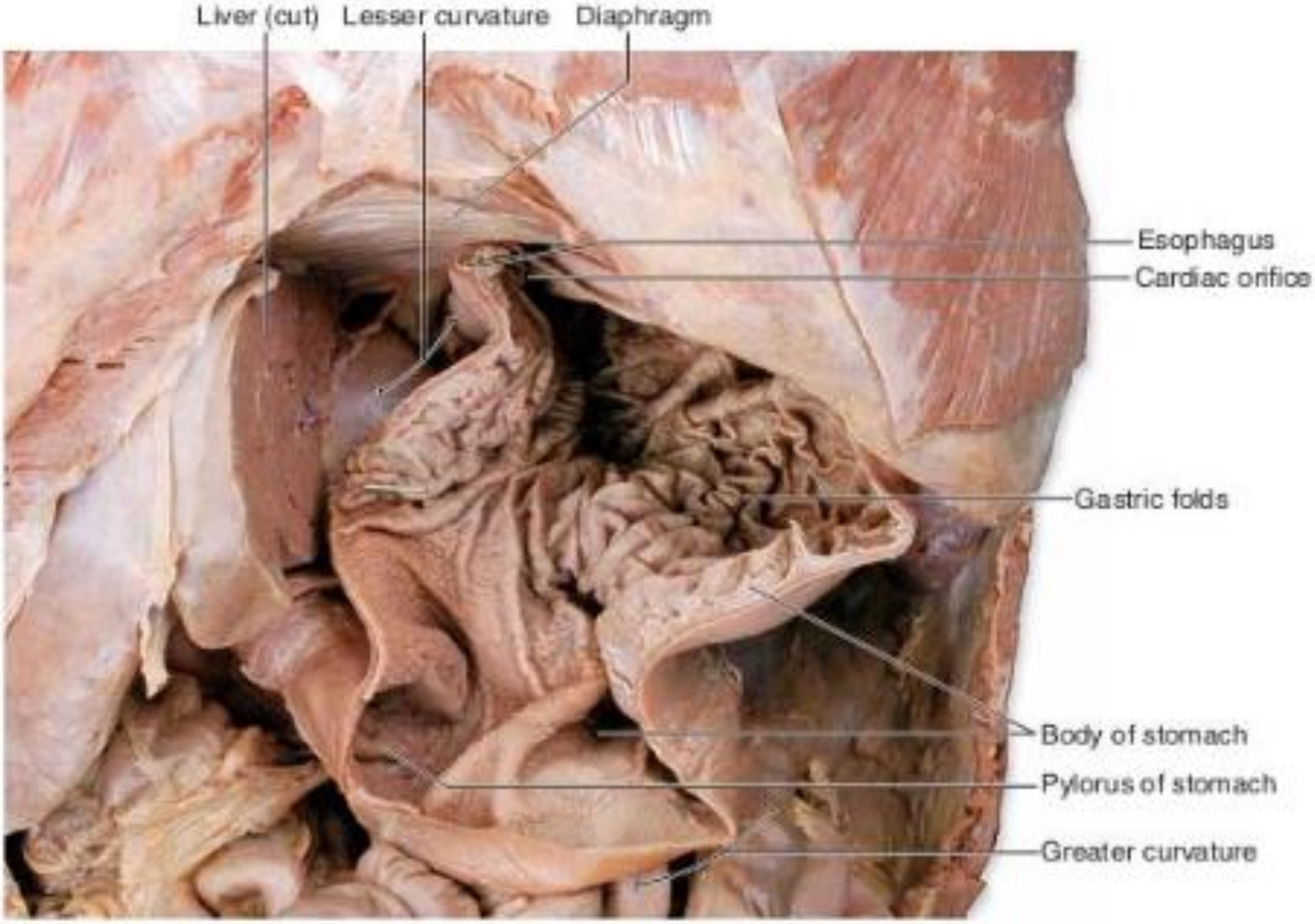
Position of stomach

- varies depending on amount of food, stage of digestion and body position
- cardia is situated left to the midline (2.5 cm), beneath 7\ costal cartilage
- Pylorus is situated right to midline (1cm) beneath the 1s lumbar vertebrae (at fed state it may go down to 2nd or 3 vertebrae)
- Anterio- superiorly it is in touch with diaphragm (fundus)
- On right side is liver
- On left is spleen



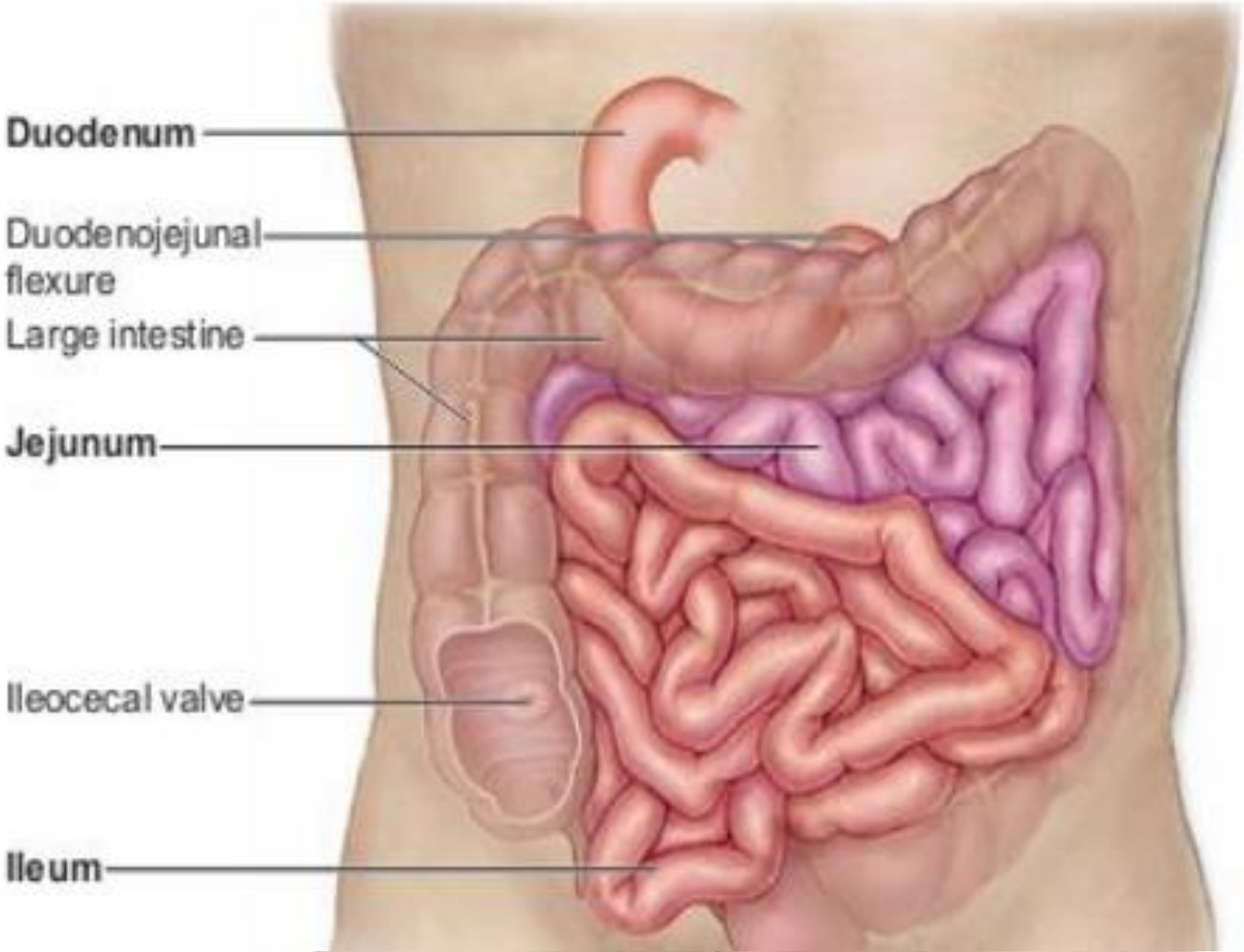
(a) Stomach regions, anterior view



(b) Gross anatomy of stomach (cut open)

Small intestine

- The small intestine is the portion of the GI tract between the pyloric sphincter of the stomach and the ileocecal valve that opens into the large intestine
- Called small intestine because of its small diameter as compared to large intestine
- Main organ of digestion and absorption of food – offers large surface area
- It is positioned in the central and lower portions of the abdominal cavity below stomach and liver in form of convoluted mass and is supported by the mesentery proper (except duodenum)
- The small intestine is approximately 3 m (12 ft) long and 2.4 cm (1 in.) wide in a living person. length approximately doubles in dead person because of muscle relaxation


Duodenum
Duodenojejunal flexure
Large intestine
Jejunum
Ileocecal valve
Ileum

Regions of small intestine

- Divided into three regions
  - Duodenum
  - Jejunum
  - Ileum
- **Duodenum**
- C-shaped tubular organ measuring about 25cm
- begins at the pyloric valve, arcs around the head of the pancreas and passes to the left, and ends at a sharp bend called the duodenojejunal flexure
- Except short portion near the stomach, the duodenum is retroperitoneal
- The duodenum receives the stomach contents, pancreatic juice, and bile.

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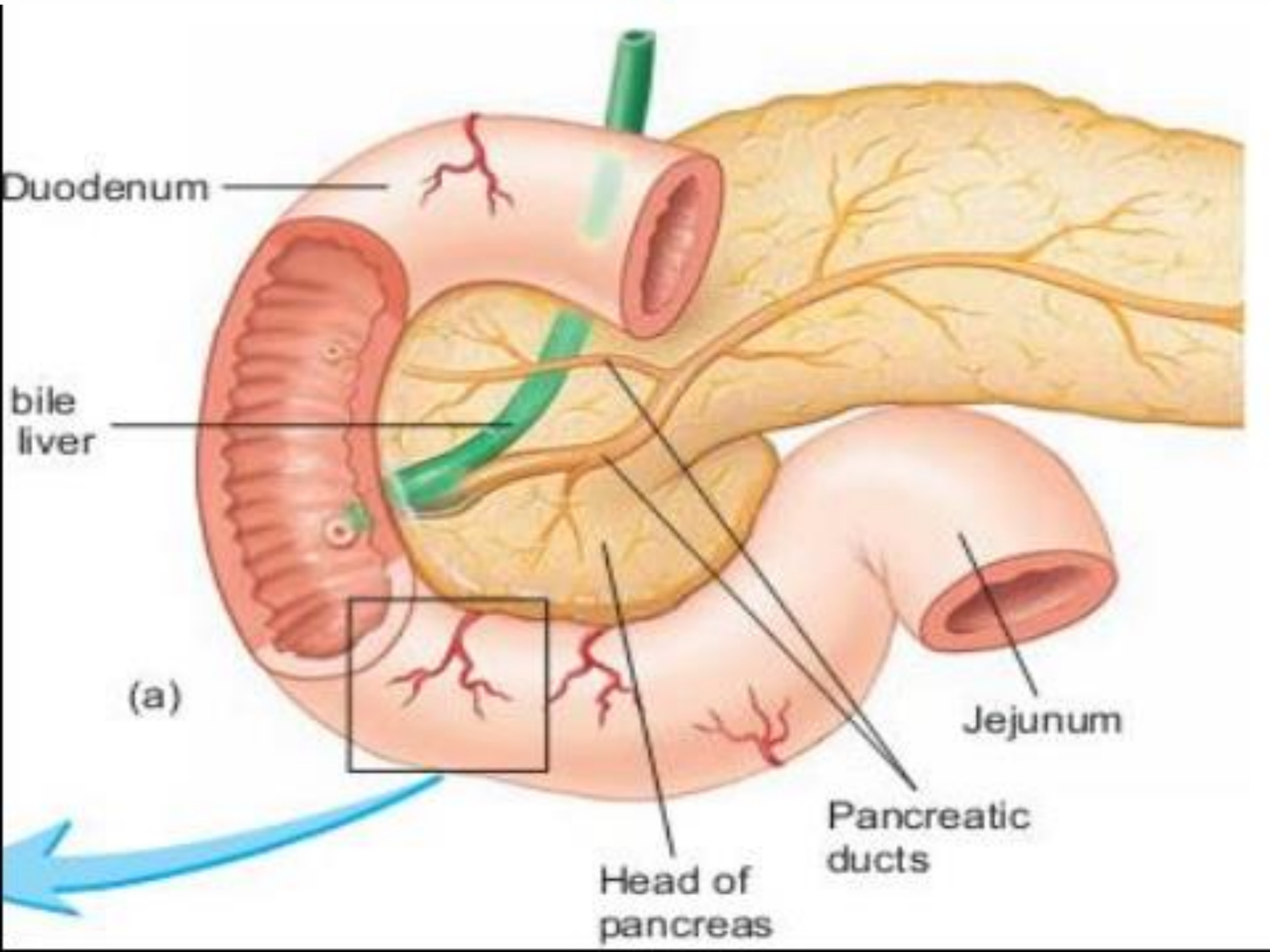
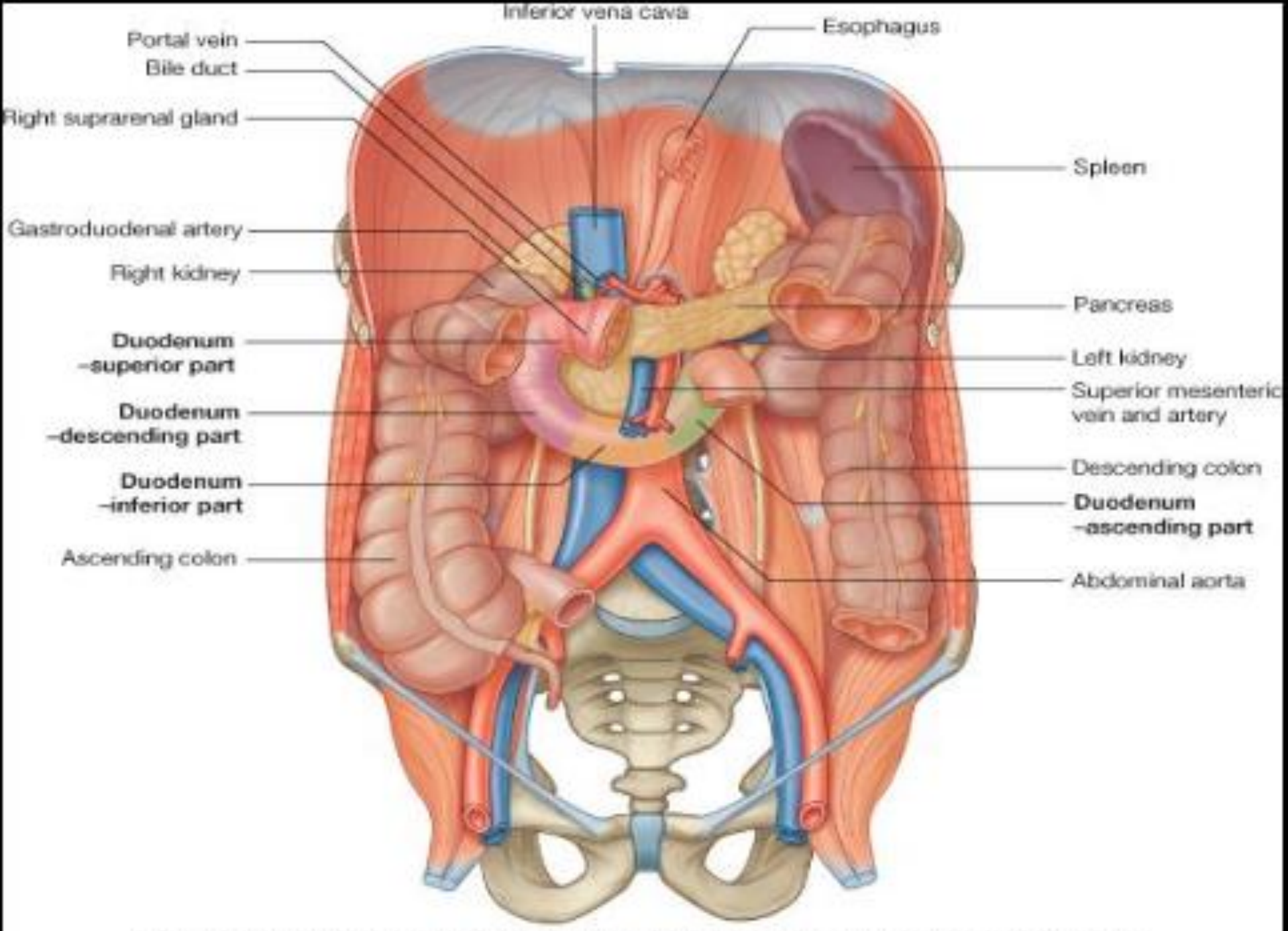
- Duodenum is subdivided into four parts
- First/ superior part: begins at pylorus, passes backwards and upwards to the right- 5cm long
- 2nd/ descending part: 8cm long descends downwards
- 3rd/ horizontal part:10 cm long, passes from right to left crossing the midline
- 4th/ ascending part: 2cm long, runs upward to the left ends by joining jejunum

- Half-way along the second portion enters common opening of the common bile duct and main pancreatic duct(of Wirsung) into the duodenum. The common opening is called the hepatopancreatic ampulla(ampulla of Vater), which pierces the duodenal wall and drains into the duodenum from an elevation called the duodenal papilla. The duodenal papilla can be opened or closed by the action of the sphincter of ampulla (of Oddi). The subsidiary pancreatic duct (of Santorini) opens into the duodenum a little above the papilla


Duodenum
bile
liver
(a)
Jejunum
Pancreatic
ducts
Head of
pancreas



- **Jejunum**
  - Middle portion of small intestine
  - About 2.5m long
  - Primary site of small intestine involved in digestion
  - Present intraperitoneal, suspended by mesentery proper
  - Jejunum ends at ileum. There is no well defined anatomic separation between jejunum and ileum

- **Ileum**
  - Last region of small intestine
  - 3.5 meter long
  - Present intraperitoneal, suspended by mesentery proper
  - Ends at ileocecal valve which control passage of material from small intestine into large intestine
  - The jejunum tends to lie at the umbilical region, the ileum in the supra-pubic region and pelvis

- Other than these structural modifications the small intestine has specialized cells which facilitate the process of digestion and absorption. These are:

  - Absorptive cells – specialized epithelial cells which absorb nutrients
  - Goblet cells – epithelial cells secreting mucus
  - Intestinal glands/ crypts of Lieberkühn – these are downward invagination of epithelial cells at the base of villi forming narrow pouches which opens into intestinal lumen through small openings. The intestinal glands contain following cells:
    - Absorptive cells
    - Goblet cells
    - Paneth cells- secrets lysozymes
    - Enteroendocrine cells- which may be S cells, CCK cells, and K cells, which secrete the hormones secretin, cholecystokinin and glucose-dependent insulinotropic peptide or GIP, respectively

Large intestine

- The large intestine forms a three-sided perimeter in the abdominal cavity around the centrally located small intestine
- Starts at the ileocecal junction and has length of approx. 1.5m and diameter of 6.5 cm
- The functions of large intestine is completion of absorption and formation and expulsion of feces
- It is partly located intraperitoneal while partly it is retroperitoneal.
- Large intestine is suspended by specialized mesentery called mesocolon

Parts of large intestine

- Structurally divided into four regions
  - Cecum
  - Colon
  - Rectum
  - Anal canal

- Cecum is the first portion of large intestine, present in the form of a small blind pouch about 6 cm long

- It is present in right lower quadrant of abdomen and extends inferiorly from **ileocecal valve** *(ileocecal valve is a fold of mucous membrane at the junction of the small intestine and large intestine that prohibits the backflow of chyme)*

- From the posteromedial region of cecum is attached a thin twisted tube measuring 8cm called vermiform appendix

- Appendix is lined with lymphatic nodules

- Appendix has no digestive function and is considered as remnant of an organ that was functional in our ancestors

- **Colon**
- Starts at the level of ileocecal valve and make a U shaped arch
- It is divided into four segment:

  - Ascending colon: The ascending colon extends superiorly from the cecum along the right abdominal wall to the inferior surface of the liver
  - From there it abruptly turns left forming hepatic flexure or right colic flexure

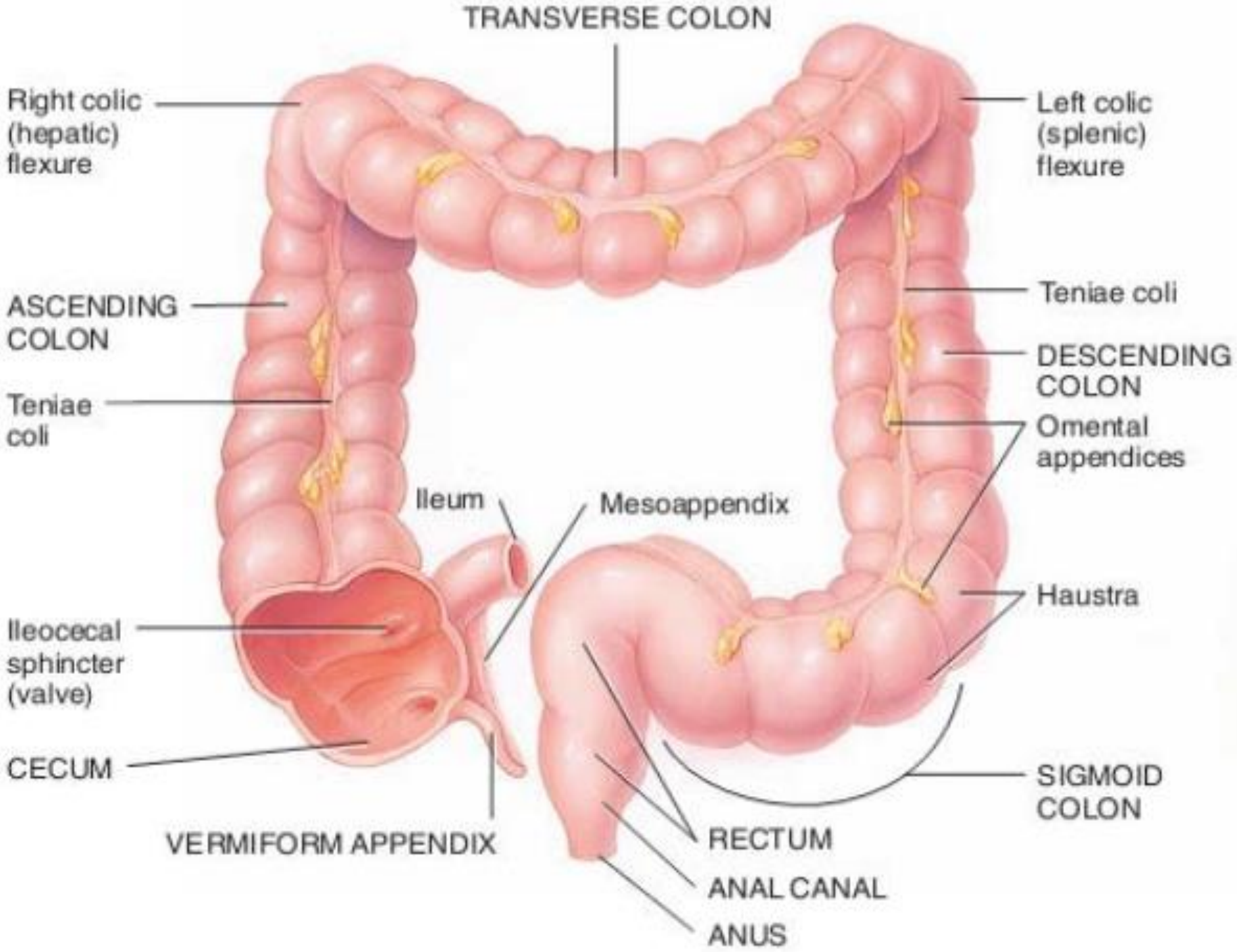
  - Transverse colon: The transverse colon originates at the right colic flexure continues across the abdomen to the left
  - At left upper quadrant beneath the spleen it take sharp bend inferiorly. The bend is called as splenic flexure or left colic flexure

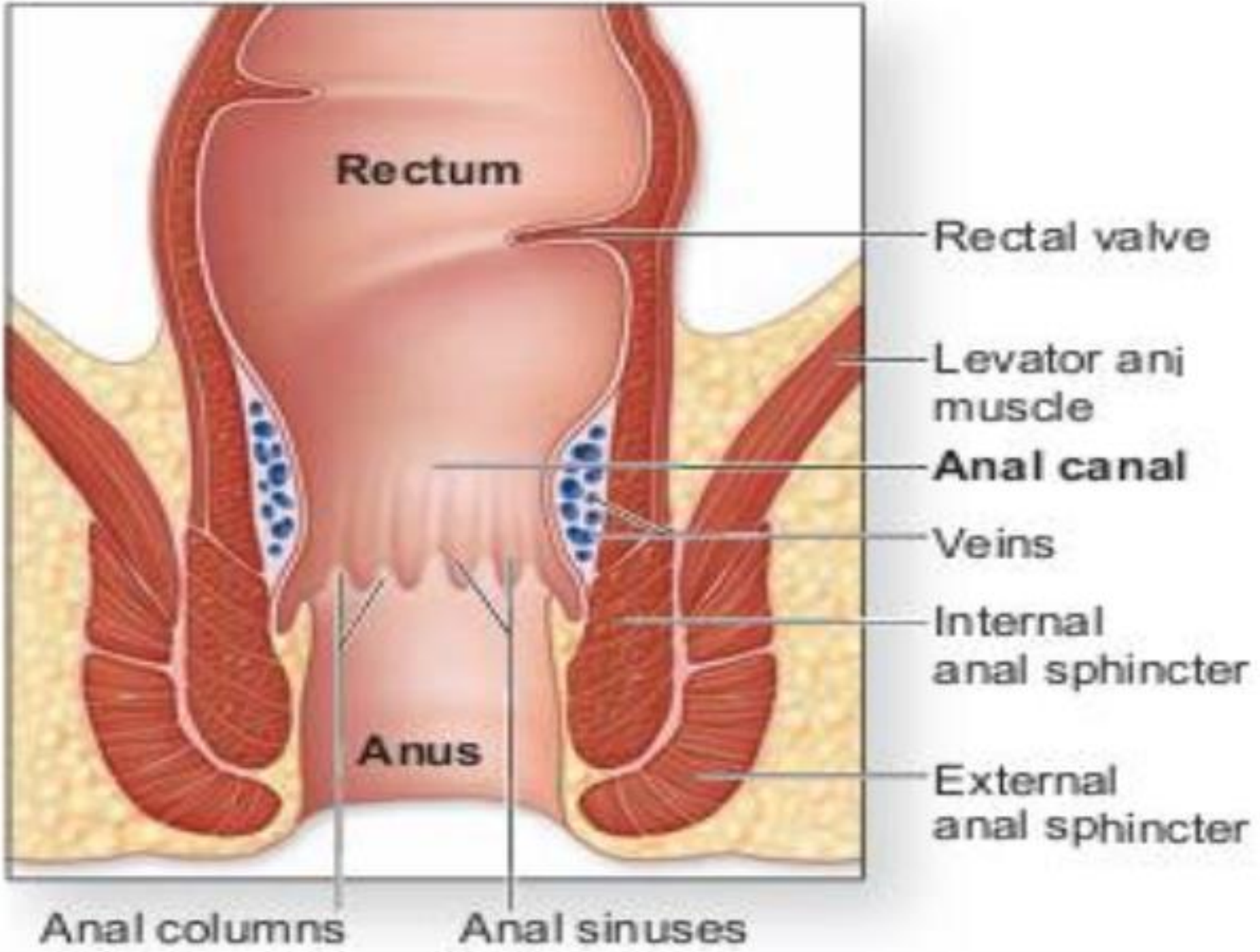
- Descending colon: Originates from left colic flexure and present on the left side of the abdominal cavity
- It reaches the pelvic region and ends at sigmoid colon

- Sigmoid colon :Sigmoid colon is an S shaped structure, starts with sigmoid flexure where the sigmoid colon takes inferiomedial curve into the pelvic cavity
- The ascending and descending portion of colon are retroperitoneal while transverse colon and sigmoid colon are intraperitoneal

- **Rectum:**
- The sigmoid colon ends at rectum at the level of 3 sacral vertebrae
- Rectum is 20 cm long and present in front of sacrum and coccyx

- **Anal canal** :
- The terminal 2-3 cm of rectum is anal canal
- The anal canal contain anal columns which are longitudinal folds of mucus membrane containing arteries and veins. Between the anal columns are anal sinuses which are small depressions from where mucus is released
- The anal canal open to exterior by anus which is the guarded by an internal anal sphincter (smooth muscles) and external anal sphincter (skeletal muscles)


TRANSVERSE COLON
Right colic (hepatic) flexure
Left colic (splenic) flexure
ASCENDING COLON
Teniae coli
DESCENDING COLON
Teniae coli
Omental appendices
Ileum
Mesoappendix
Haustra
Ileocecal sphincter (valve)
CECUM
SIGMOID COLON
VERMIFORM APPENDIX
RECTUM
ANAL CANAL
ANUS


Rectum
Rectal valve
Levator ani muscle
Anal canal
Veins
Internal anal sphincter
Anus
External anal sphincter
Anal columns
Anal sinuses

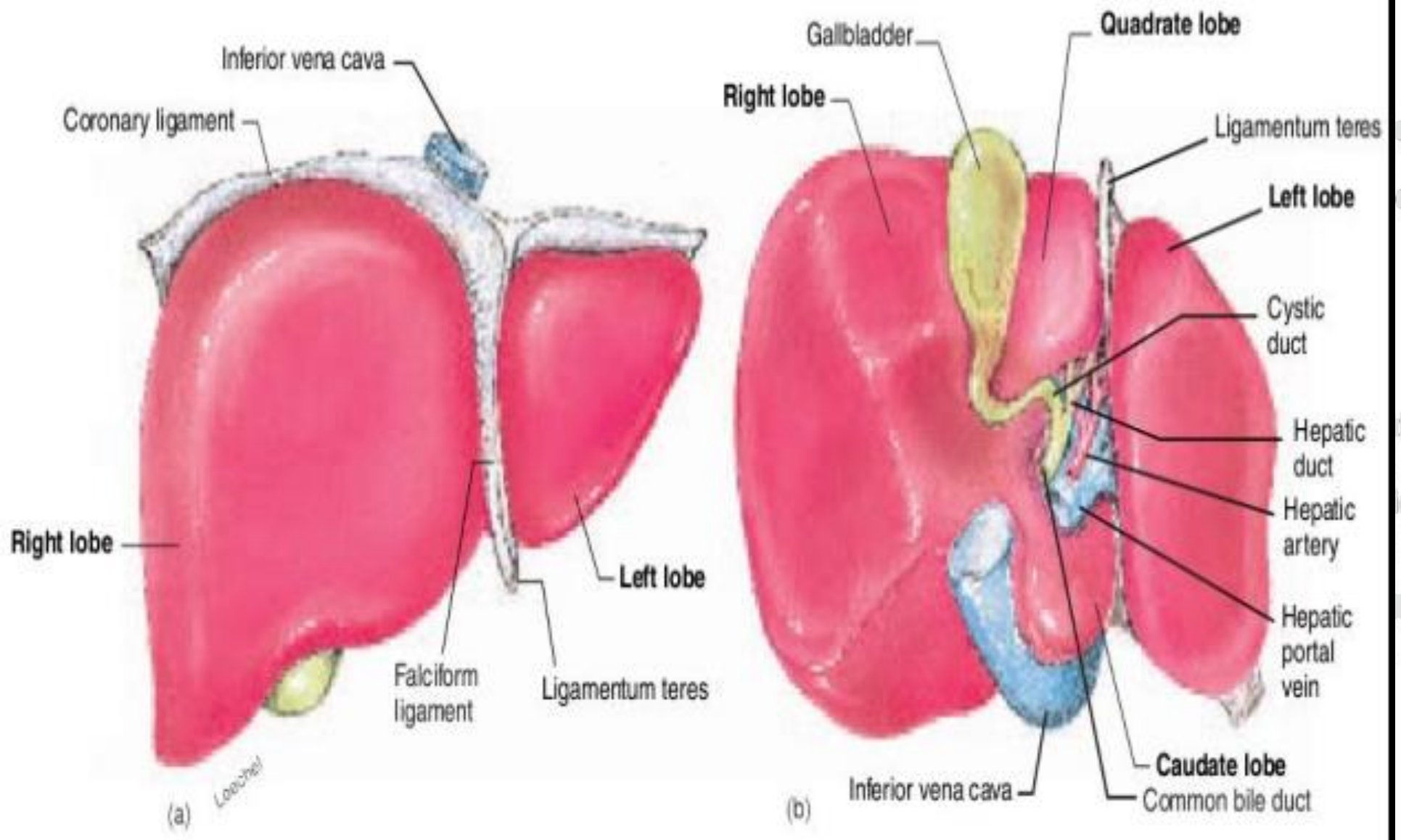
Liver

- Liver is the largest and heaviest organ of the body weighing about 1.4 kg

- The liver is inferior to the diaphragm and occupies most of the right hypochondriac and part of the epigastric regions of the abdominopelvic cavity

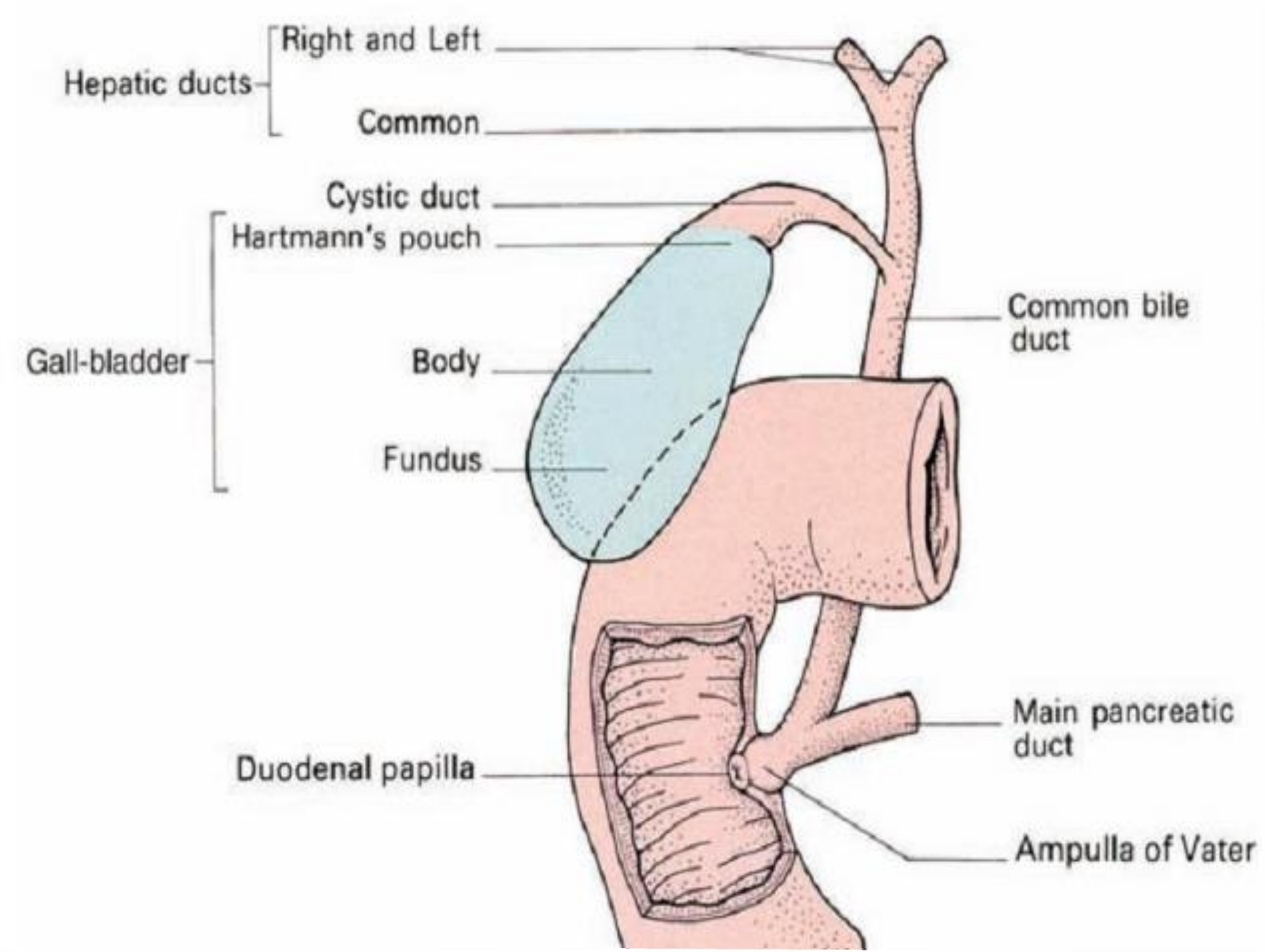
Gross anatomy of liver

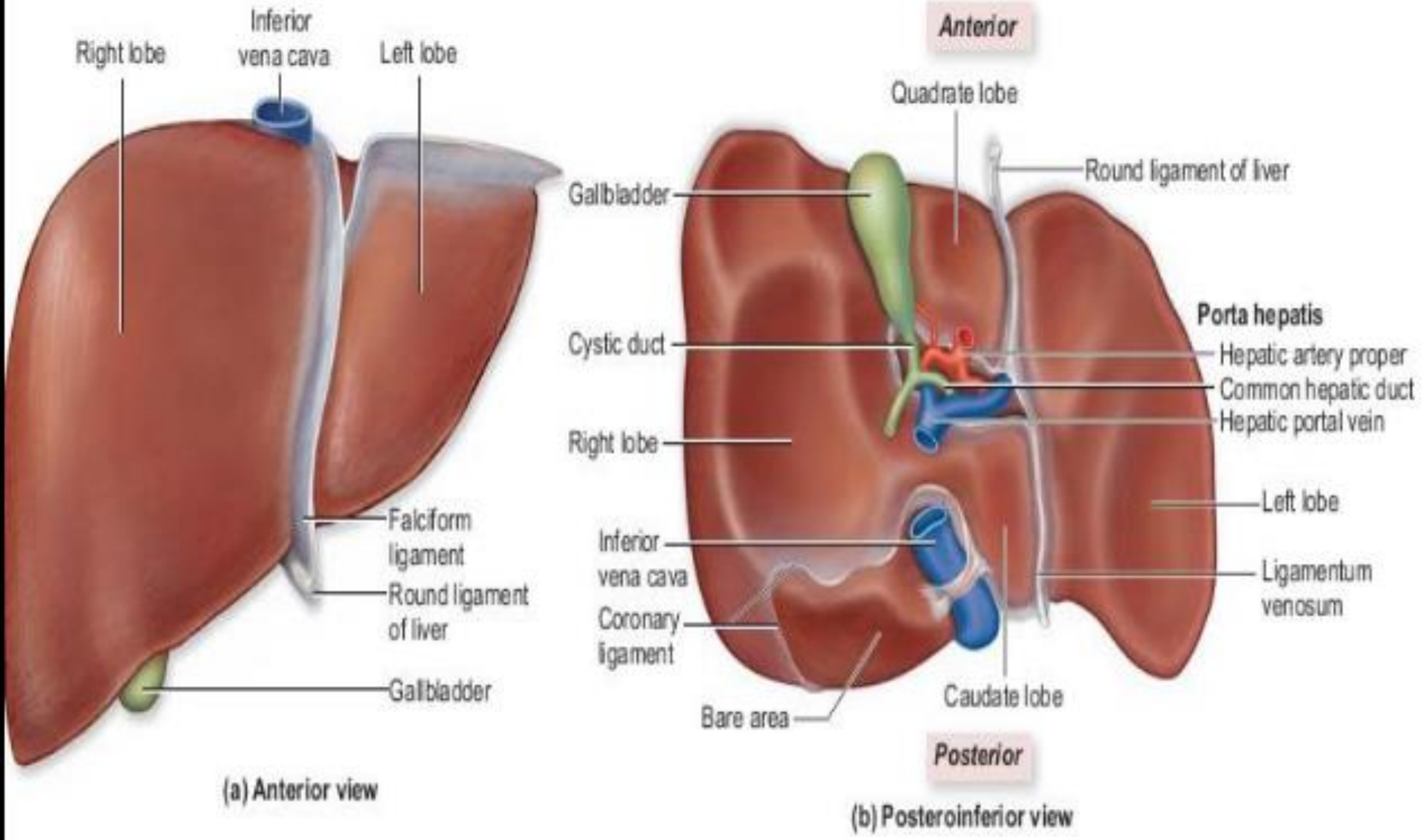
- Liver is covered by two layers
  - A layer of visceral peritoneum
  - A layer of dense connective tissue (deep to peritoneal layer)
- It is made up of four incompletely separated lobes:
  - Right lobe (the larger one) and Left lobe (the smaller one) are major lobes separated from each other anteriorly by falciform ligament (a fold of peritoneum that attach liver to anterior abdominal wall) and posteriorly by vertical groove.
  - Caudate lobe and quadrate lobes are minor lobes which are subdivision of right lobe. The caudate lobe is present adjacent to inferior venacava on superior right side of vertical groove and quadrate lobe is present adjacent to gallbladder on inferior right of vertical groove.
- The falciform ligament is attached to the diaphragm. Its free border extends inferiorly to the umbilicus.
- To the inferior free border of falciform ligament is attached teres (the round ligament) which is remnant of fetal of umbilical vein.
- The ligamentam teres crosses from inferior to posterior side of liver and goes up in the vertical groove where it becomes continuous with ligamentam venosum which is remnant of fetal ductus venosus.
- On the posterior side adjacent to the vertical groove is present porta hepatis where blood vessels, lymphatics and bile ducts enter and leave liver.


Inferior vena cava
Coronary ligament
Right lobe
Left lobe
Falciform ligament
Ligamentum teres
(a)
Gallbladder
Quadrate lobe
Right lobe
Ligamentum teres
Left lobe
Cystic duct
Hepatic duct
Hepatic artery
Hepatic portal vein
Caudate lobe
Inferior vena cava
Common bile duct
(b)

Gallbladder

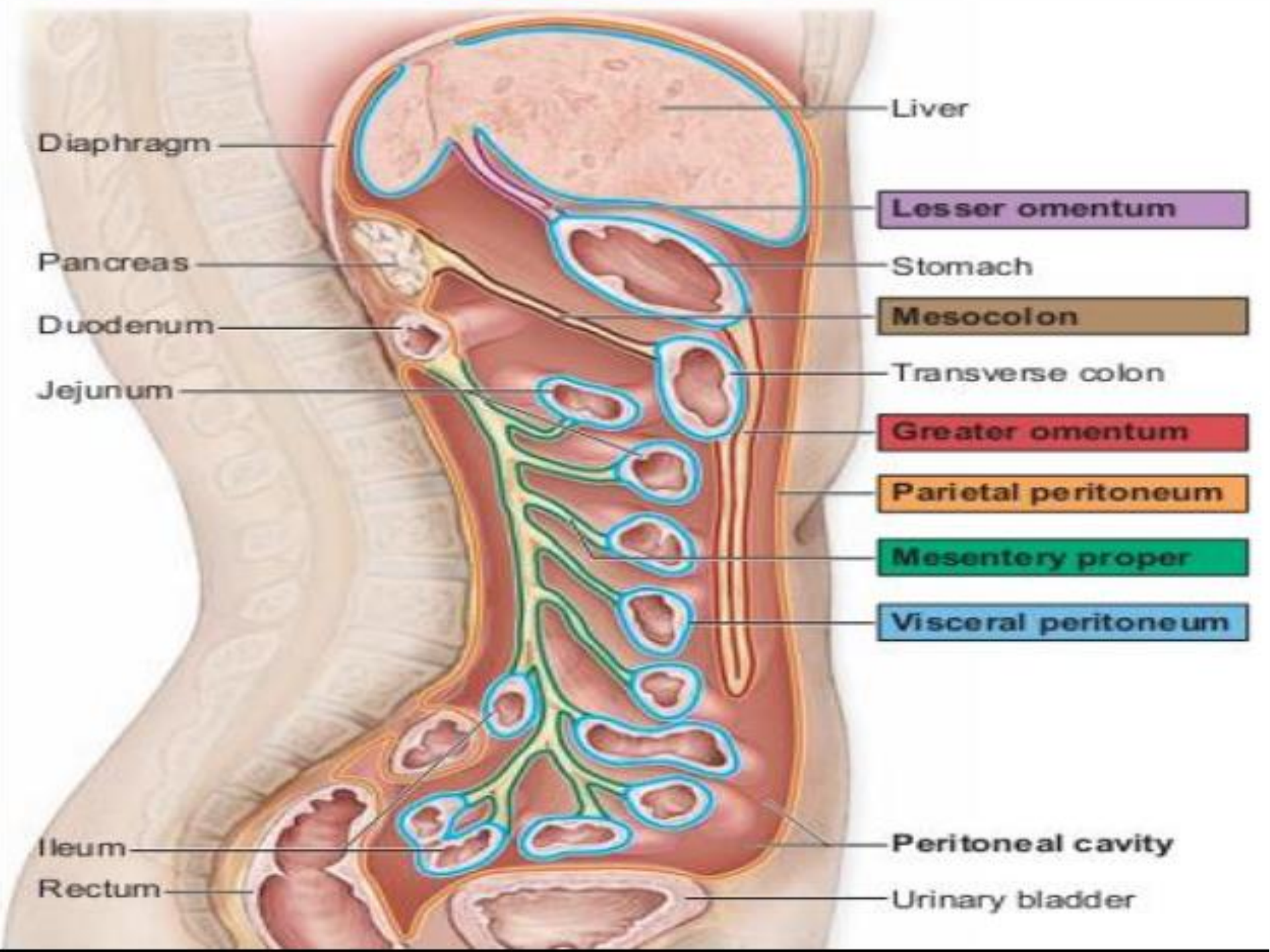
- The gallbladder is a saclike organ attached to the inferior surface of the liver about 8cm long and 4cm wide
- In dilated form it achieves the size of a pear
- stores and concentrates bile
- Has capacity of 35-50 ml
- The gallbladder wall has three tunics
  - an inner mucosa folded into rugae that allow the gallbladder to expand
  - a muscularis, which is a layer of smooth muscle that allows the gallbladder to contract
  - an outer covering of serosa
- The gallbladder has three regions: the neck, body, and fundus At the neck of the gallbladder, a sphincter valve controls the flow of bile into Common hepatic duct
- In dilated and pathological gall-bladders there is frequently a pouch present on the ventral aspect just proximal to the neck termed Hartmann's pouch in which gallstones may become lodged

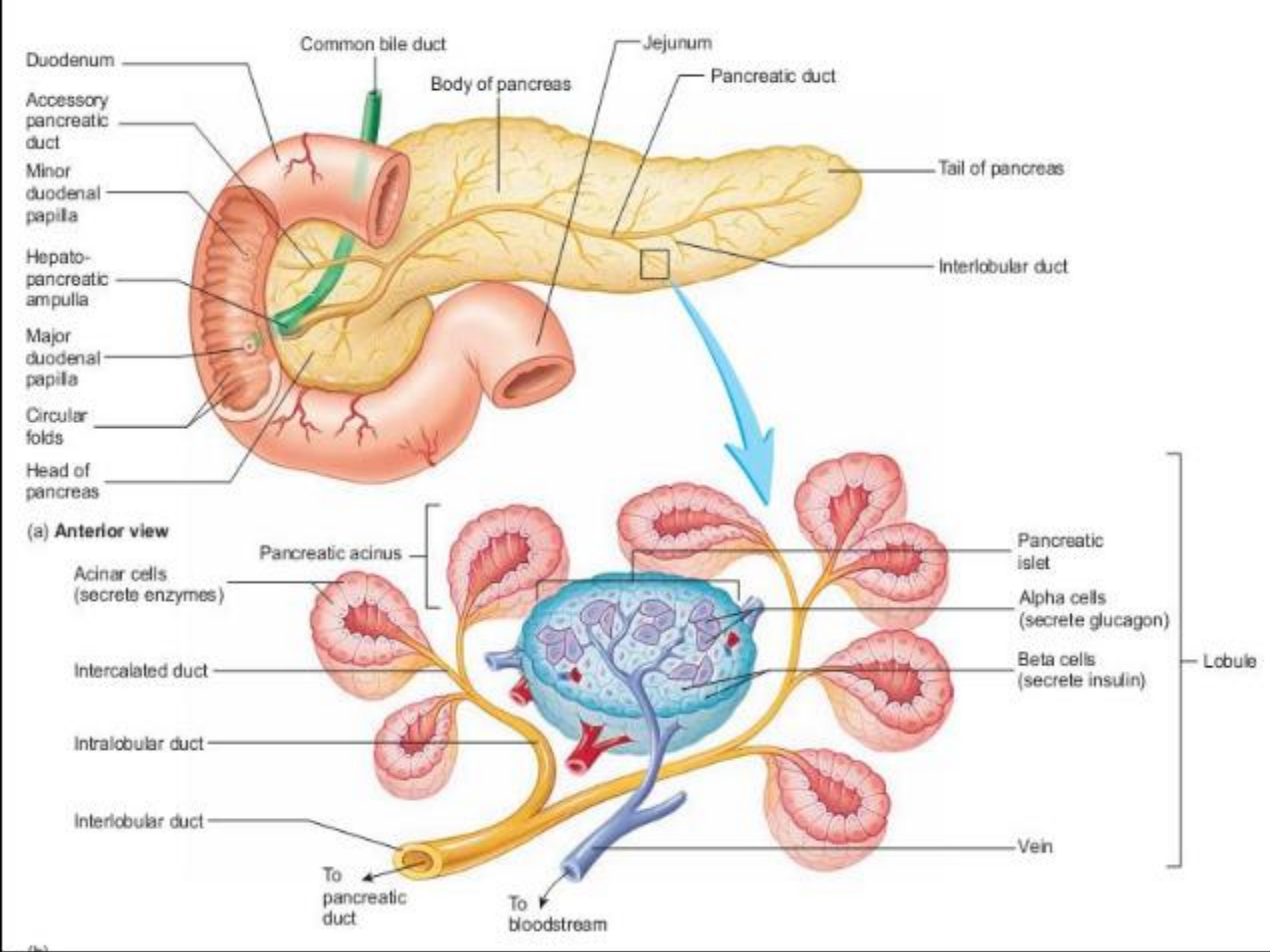

Hepatic ducts
Right and Left
Common
Cystic duct
Hartmann's pouch
Gall-bladder
Body
Fundus
Common bile duct
Main pancreatic duct
Duodenal papilla
Ampulla of Vater

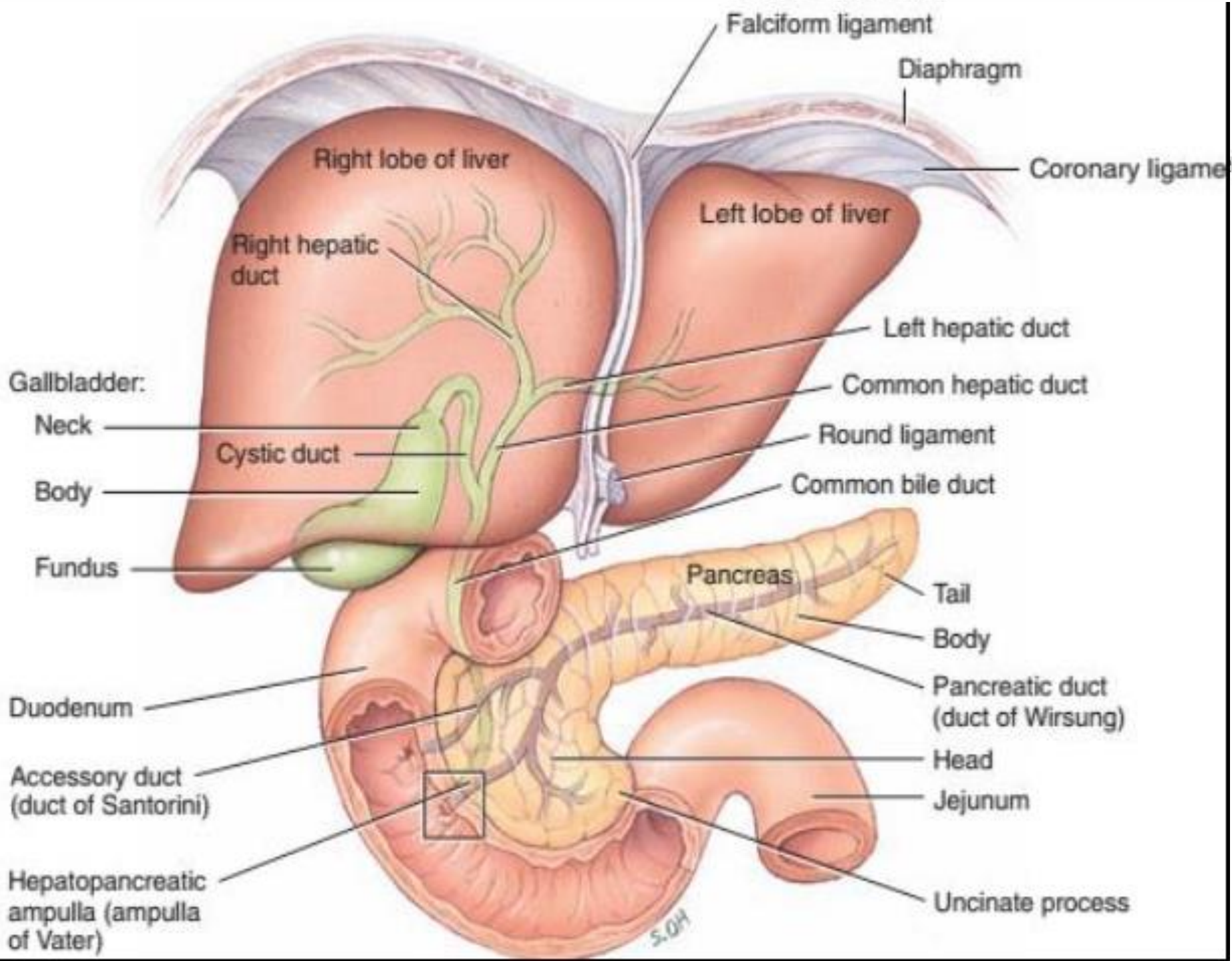

Right lobe
Inferior vena cava
Left lobe
Falciform ligament
Round ligament of liver
Gallbladder
(a) Anterior view
Anterior
Quadrate lobe
Round ligament of liver
Gallbladder
Porta hepatis
Cystic duct
Hepatic artery proper
Common hepatic duct
Hepatic portal vein
Right lobe
Left lobe
Inferior vena cava
Ligamentum venosum
Coronary ligament
Caudate lobe
Bare area
Posterior
(b) Posteroinferior view

Pancreas

- Pancreas is known as a mixed gland as it has both exocrine and endocrine functions
- The pancreas is located retroperitoneal, posterior to the greater curvature of stomach in the inferior part of the left-upper quadrant
- It extends from medial edge of duodenum to the left side of abdominal cavity touching the spleen
- It is about 12–15 cm (5–6 in.) long and 2.5 cm (1 in.) thick
- Pancreas consists of three portions:
  - Head- the expanded portion lying inside the C portion of duodenum
  - Body – the central portion present superior and left to head
  - Tail – the tapering portion that extends to spleen


Liver
Diaphragm
Lesser omentum
Pancreas
Stomach
Duodenum
Mesocolon
Transverse colon
Jejunum
Greater omentum
Parietal peritoneum
Mesentery proper
Visceral peritoneum
Peritoneal cavity
Ileum
Rectum
Urinary bladder


Duodenum
Common bile duct
Jejunum
Body of pancreas
Pancreatic duct
Accessory pancreatic duct
Minor duodenal papilla
Tail of pancreas
Hepato-pancreatic ampulla
Interlobular duct
Major duodenal papilla
Circular folds
Head of pancreas
(a) Anterior view
Pancreatic acinus
Pancreatic islet
Acinar cells (secrete enzymes)
Alpha cells (secrete glucagon)
Intercalated duct
Beta cells (secrete insulin)
Lobule
Intralobular duct
Interlobular duct
Vein
To pancreatic duct
To bloodstream


Falciform ligament
Diaphragm
Right lobe of liver
Coronary ligame
Left lobe of liver
Right hepatic duct
Left hepatic duct
Gallbladder:
Common hepatic duct
Neck
Round ligament
Cystic duct
Body
Common bile duct
Fundus
Pancreas
Tail
Body
Duodenum
Pancreatic duct (duct of Wirsung)
Head
Accessory duct (duct of Santorini)
Jejunum
Hepatopancreatic ampulla (ampulla of Vater)
Uncinate process