ANATOMY OF THE GIT/ DIGESTIVE SYSTEM

BY:JANET BONARERI MACHOGU
CLINICAL OFFICER.

LEARNING OBJECTIVES

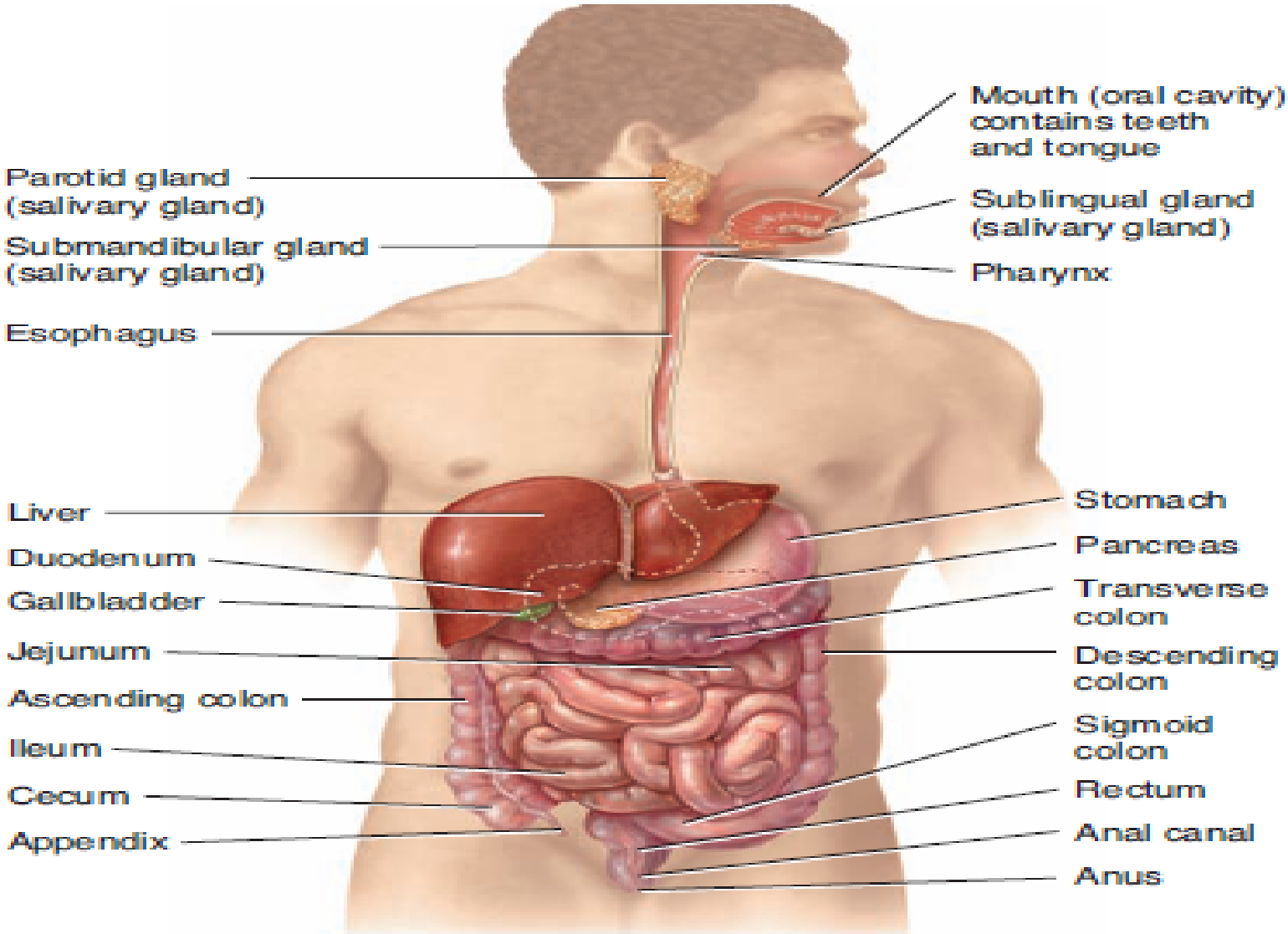
- By the end of these topic the students should be able to:
- Describe the organisation of the digestive tract.
- Describe the location and structure of the organs of the digestive system
- Describe the location and structure of the accesory organs of the GIT.
- Describe the blood and nerve supply to the GIT(organs and accesory organs)
- Identify the underlying organs in the 9 regions of the abdomen and relevant pain radiation from abdominal organs.

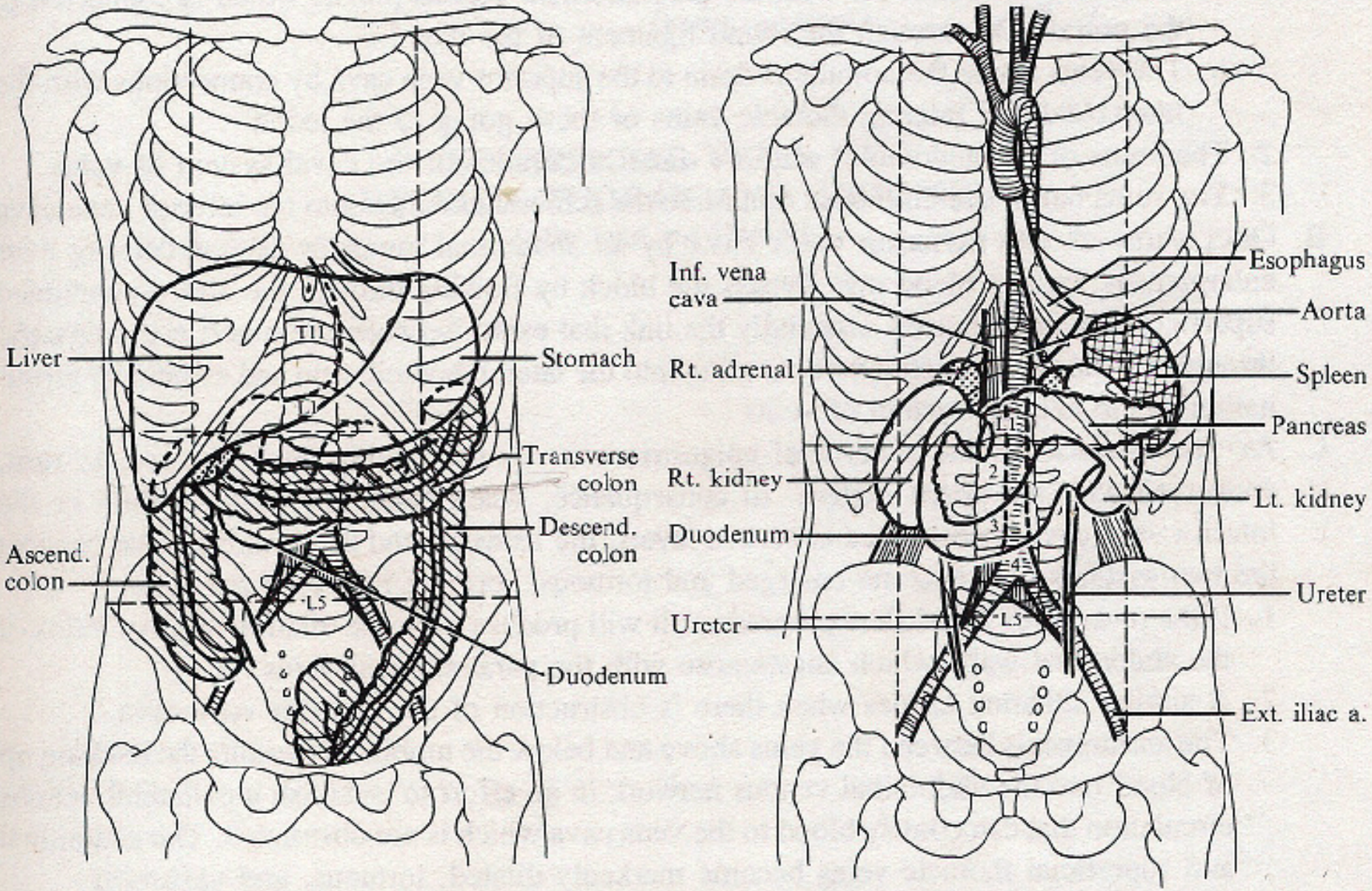
DIGESTIVE SYSTEM

Organisation of the digestive system

- Consists of a tubular passage(GIT) through which food is propelled and digested, and accessory organs of digestion
  - **Passage**;
  - About 30 ft. long from mouth to anus.
  - Consists of the mouth, pharynx, esophagus, stomach, small intestines, large intestines, rectum, anal canal and anus.
  - **Accessory organs**; teeth , tongue ,salivary glands, liver, gallbladder and pancreas .
- This components are found in the head, neck, chest, abdomen and pelvis.

ORGANS OF THE DIGESTIVE SYSTEM.





VISCERAL TOPOGRAPHY OF ABDOMEN AND THORAX

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,(btwn base of skull & soft palate)

oropharynx (middle part –btwn soft palate and border of epiglottis)

laryngopharynx(most distal part – btwn superior border of epiglottis and inferior border of the cricoid cartilage)

BLOOD AND NERVE SUPPLY TO THE PHARYNX

- **N/supply** –all pharyngeal mcls(superior , middle and inferior constrictor,palatopharyngeus, salpingopharyngeus) by vagus nerve(CN 10),

Stylopharyngeus by glossopharyneal nerve(CN9)

Branches from external laryngeal nerve and superior cervical ganglion

- **Blood supply-** branches of external carotid artery i. e ascending pharyngeal art, branches of facial art and branches of lingual and maxillary art.

OESOPHAGUS

- A collapsible muscular tube, about 25 cm (10 in.) long.
- Connects the throat with the stomach
- Lies posterior to the trachea.
- It begins at the inferior end of the laryngopharynx, passes through the inferior aspect of the neck, and enters the mediastinum anterior to the vertebral column.
- Pierces the diaphragm through an opening called the **esophageal hiatus**
- ends in the superior portion of the stomach
- Has the UES and LES(made up of muscle bundles)

Parts of the oesophagus

Its anatomically divided into **3 parts** i.e

- Cervical
- Thoracic
- Abdominal

It has **3 constrictions**

- ***Cervical constriction*** -pharyngoesophageal junction
- ***Thoracic (broncho-aortic) constriction*** -crossed by the arch of the aorta, the left main bronchus,
- ***Diaphragmatic constriction*** -where it passes through the esophageal hiatus of the diaphragm

Layers and histology of the oesophagus

- **Mucosa -**nonkeratinized stratified squamous epithelium, lamina propria
- **Submucosa** -(areolar connective tissue)

  -Contains numerous mucus glands(near the stomach)

- **Muscularis**-sup 1/3 skeletal mcl

-mid 1/3 -skeletal and smooth mcl

-lower 1/3 –smooth mcl

(inner circular outer longitudinal)

- Tunica adventitia –most superficial and attaches the esophagus to surrounding structures

Nerve and blood supply

- Innervated by the - vagus nerve , cervical and thoracic sympathetic trunk.
- Blood supply –**cervical portion -**supplied by the inferior thyroid artery

thoracic portion-bronchial and oesophageal branch of the thoracic artery

abd portion –ascending branches of the left phrenic and left gastric arteries

STOMACH

- J-shaped enlargement of the GI tract directly

inferior to the diaphragm in the abdomen between the esophagus and the small intestine

- The stomach is the **most dilated part** of the **alimentary canal**
- In the **supine position**, it is usually located in the left upper quadrant, where it occupies parts of the **epigastric**, **umbilical**, and **left hypochondriac** regions.
- very distensible organ and can hold 2-3 litres of food.

- Location-LUQ , L. hypogastrium, epigastric and umbilical regions.
- Its shape resembles a **J** when empty but is piriform when full. Its modified by the surrounding viscera.

STOMACH (CONT).

- Has two orifices;
  - 1. **Cardiac orifice-**communicates with the esophagus . situated behind the 7th left costal cartilage one inch from the edge of the sternum. (T11) .
  - **2.Pyrolic orifice-** opens to the duodenum. Half an inch to the right of the middle line along the trans-pyloric line. (L1). Demarcated by the pre-pyloric vein present on the anterior aspect of the 1st part of the duodenum.

STOMACH (CONT).

- Parts ; The stomach has four main regions: the cardia, fundus, body, and pyloric part
  - Fundus -highest part above the cardiac orifice.
  - Body- from the fundus to the line drawn from the incisura angularis to the corresponding point on the greater curvature.
  - Pylorus- Antrum, canal, orifice.

STOMACH (CONT).

- **2 curvatures**, lesser (right border), greater (left border).
- **2 surfaces**: ***Antero -superior*** covered by the peritoneum of the greater sac and ***Postero-inferior***- covered by the peritoneum of the lesser sac.

Layers and histology of the stomach

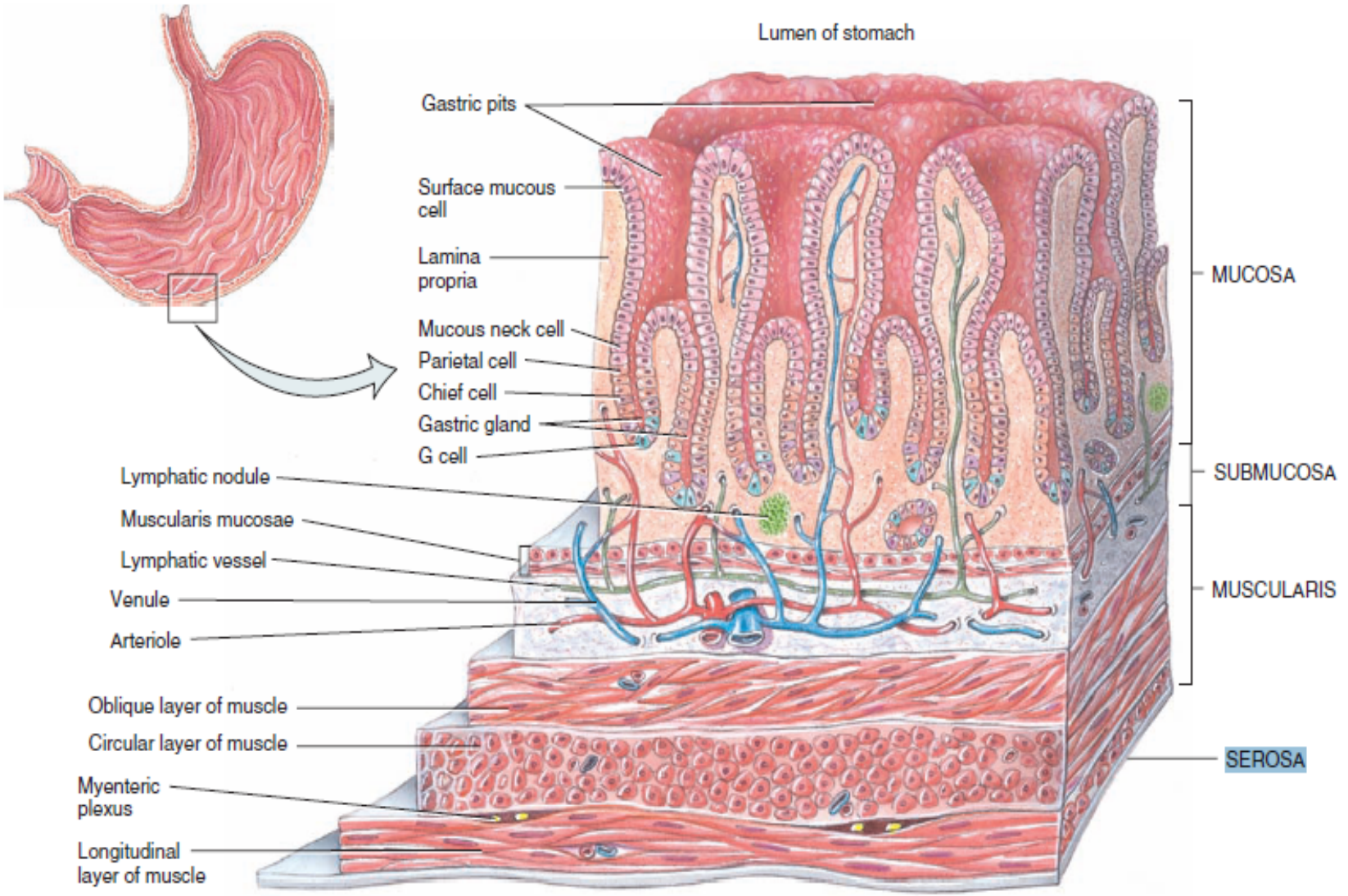
- MUCOSA -a layer of simple columnar epithelial cells (**surface mucous cells)**

contains a **lamina propria (areolar**

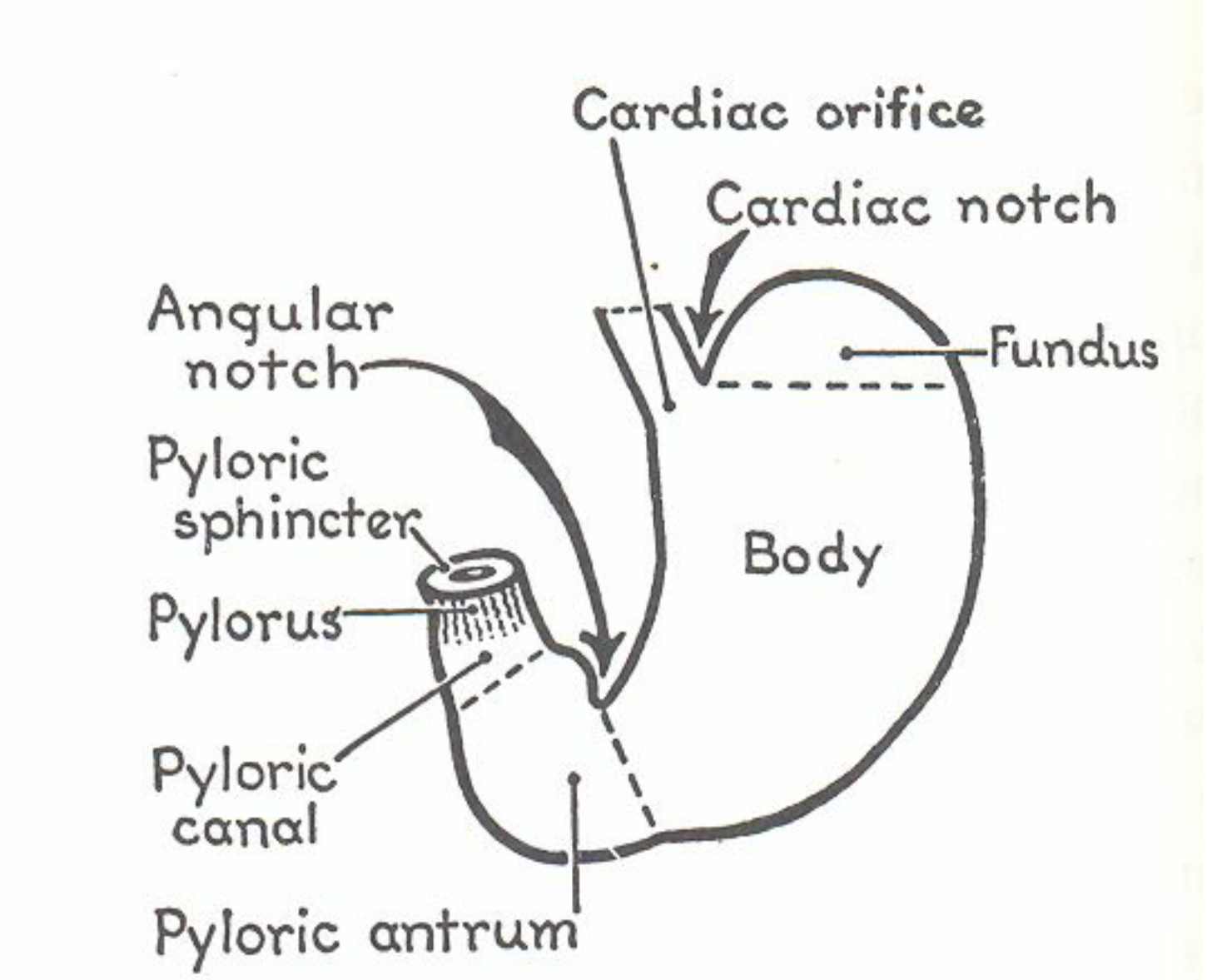
connective tissue) and exocrine glands

- SUBMUCOSA –areolar connective tissue
- MUSCULARIS – three layers of smooth muscles(outer longitudinal layer ,oblique and circular)
- SEROSA –simple squamous epithelium

(mesothelium) and areolar connective tissue



(a) Three-dimensional view of layers of stomach

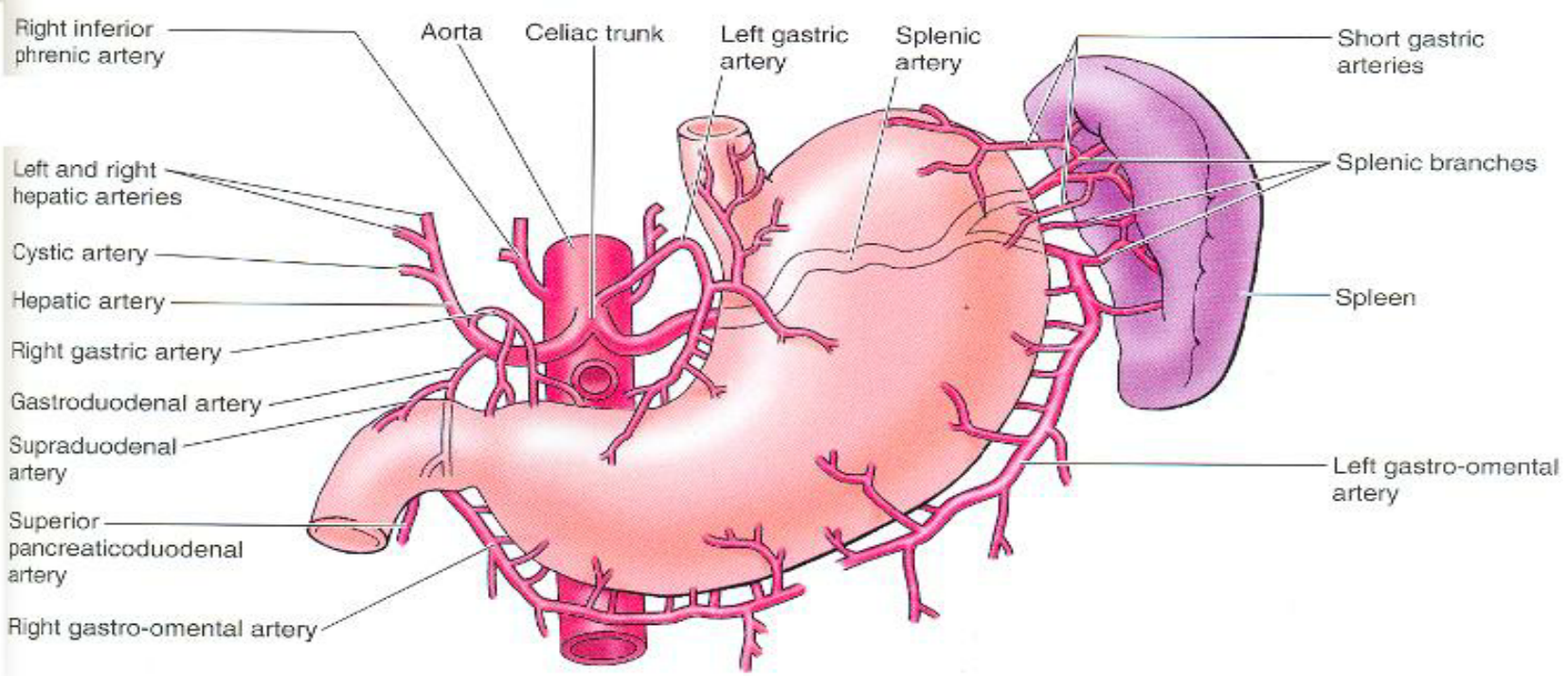

Cardiac orifice
Cardiac notch
Angular notch
Fundus
Pyloric sphincter
Body
Pylorus
Pyloric canal
Pyloric antrum

STOMACH CT;

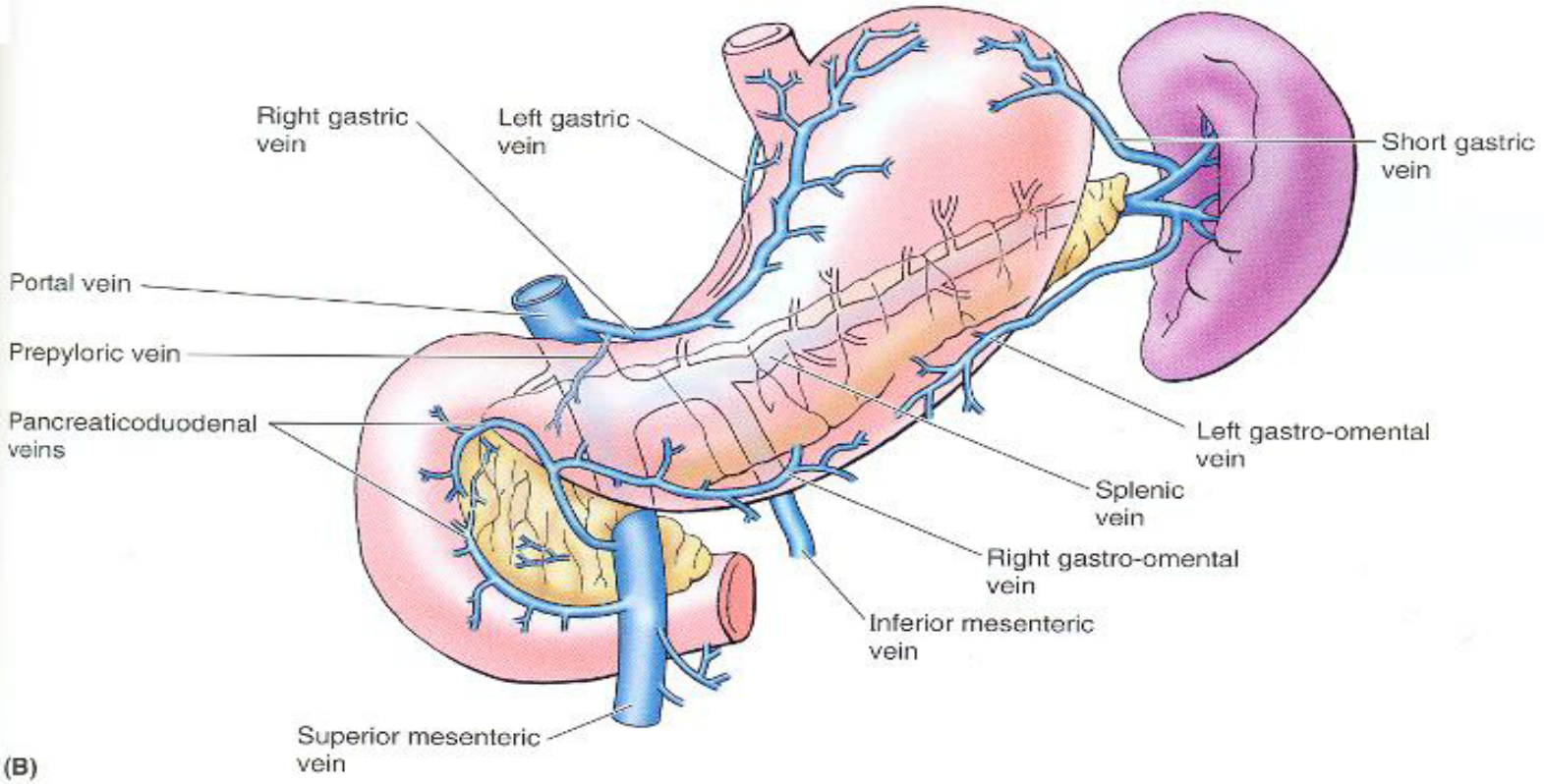
- ***Peritoneal folds (ligaments).***
  - Lesser omentum.
  - Greater omentum.
  - Gastrosplenic.
  - Gastrophrenic.
- ***Relations;***
  - **Anterior**- diaphragm, left 6-9th intercostal spaces, left lobe of the liver, quadrate lobe.
  - **Posterior** (stomach bed).-L. crus of diaphragm, L. suprarenal, upper L. kidney, splenic artery, anterior surface of the pancreas, L .colic flexure, transverse mesocolon and the speen.
- NB; All these structures are separated from the stomach by the cavity of the lesser sac except the spleen which is separated by the cavity if the greater sac.

BLOOD SUPPLY.

- Right gastric a.- common hepatic.
- Left gastric a- coeliac trunk.
- Right gastro- epiploic –gastro duodenal.
- Left gastro- epiploic – splenic.
- Short gastrics – splenic.
  - **Venous.**
- Right and left gastric veins –portal vein.
- Short gastric and left gastro- epiploic veins to the splenic vein.
- Right gastro- epiploic vein- superior mesenteric.
- Pre-pyloric vein connects the R.gastric to the r. gastro-epiploic vein. (marks the line of the pyloric orifice)


Right inferior phrenic artery
Aorta
Celiac trunk
Left gastric artery
Splenic artery
Short gastric arteries
Left and right hepatic arteries
Splenic branches
Cystic artery
Hepatic artery
Spleen
Right gastric artery
Gastroduodenal artery
Supraduodenal artery
Left gastro-omental artery
Superior pancreaticoduodenal artery
Right gastro-omental artery

(A)


Right gastric vein
Left gastric vein
Short gastric vein
Portal vein
Prepyloric vein
Pancreaticoduodenal veins
Left gastro-omental vein
Splenic vein
Right gastro-omental vein
Inferior mesenteric vein
Superior mesenteric vein

(B)

NERVE SUPPLY.

- **SYMPATHETIC;** From coeliac plexus.
- Vasomotor to gastric blood vessels.
- Pathway for pain fibres from the stomach.
- **PARASYMPATHETICS;** Derived from the vagus nerves which form the anterior and posterior gastric nerves on either side of the stomach as anterior and posterior gastric nerves.
- They have secretory and motor functions.
- Increase gastric motility and evokes the secretion of pepsin.

SMALL INTESTINES

- Consists of three parts i.e .the duodenum, jejunum, and ileum
- Circular folds increase the surface area for digestion and absorption in the small intestine.

THE DUODENUM

- This is the **1st part of the small intestine**.
- The duodenum follows a **C-shaped course** from the pylorus around the head and neck of the **pancreas** and is then continuous with the jejunum

- The duodenum is the shortest, widest and **most fixed part of the small intestine**.
- Forms a constant curve that encloses the head of the pancreas
- Important because it receives the **openings of the bile and pancreatic ducts**

THE DUODENUM CONT

- The mucosa of the duodenum is thrown into circumferentially arranged folds known as **plicae circulares**. -These increase the surface area to improve absorption.
- divided into **4 parts(** 1^{st} – 4^{th}.)

4 PARTS(1ST – 4TH.)

The Superior (1st) Part of the Duodenum

- 1st inch of the 1st part is This part is 2.5 to 5 cm long and is the **most movable part of the duodenum**
- The rest of the duodenum is retroperitoneal.

The Descending (2nd) Part of the Duodenum

- **8-10 cm long** and has **no mesentery** (it is retroperitoneal).
- The **common bile duct** and **main pancreatic duct** enter the **posteromedial wall** of this part of the duodenum

The horizontal (3rd) part of the duodenum

- about **10 cm long**
- is **retroperitoneal** and adherent to the posterior abdominal wall.

The Ascending (4th) Part of the Duodenum

- about **2.5 cm long**
- it meets the jejunum at the **duodenojejunal flexure**
- The duodenojejunal flexure is supported by a **fibromuscular band** called the **suspensory muscle** (ligament) **of the duodenum** (ligament of Treitz).

Arterial supply of the duodenum

- **Superior pancreaticoduodenal (**branch of gastroduodenal) **-** supply the proximal
- **inferior pancreaticoduodenal arteries (**branches of the superior mesenteric arteries–)
- Supply distal halves respectively
- The superior part of the duodenum may receive blood from: (1) the **supraduodenal artery**, (2) the right gastric artery, (3) the right gastro-omental artery, and (4) the **gastroduodenal artery**.

Nerve supply to the duodenum

- **Vagus** and **sympathetic nerves** via plexuses on the **pancreaticoduodenal arteries** (from the coeliac plexus).

JEJUNUM AND ILEUM.

- Extends from the duodenojejunal junction to the ileocaecal junction.
- Measures about 5-7m in length.
- Heavily coiled.
- Attached to the posterior abdominal wall by a mesentery about 15cm long.
- Most of the **jejunum lies in the umbilical region** of the abdomen, whereas the **ileum** occupies much of the **pubic** (hypogastric) and **right inguinal regions**.

ARTERIAL SUPPLY OF THE JEJUNUM AND ILEUM

- The arteries to the jejunum and ileum arise from the **superior mesenteric artery**, the 2nd of the **unpaired branches of the abdominal aorta**.
- ***Innervation of the Jejunum and Ileum***
- **superior mesenteric plexus**
- **sympathetic supply** is from the **greater splanchnic** and **lesser splanchnic nerves**
- **parasympathetic supply** is from the **posterior vagal trunk via the coeliac plexus**.

JEJUNUM VS. ILEUM.

- **JEJUNUM**
- Proximal 2/5th
- Wider diameter (4cm)

- Thicker wall
- More vascular (redder)
- More vascular arcades.
- Mesentery has less fat visible windows.
- Numerous and larger circular mucosal folds (plica circulares)
- Very few or absent mucosal lymphatic follicles.

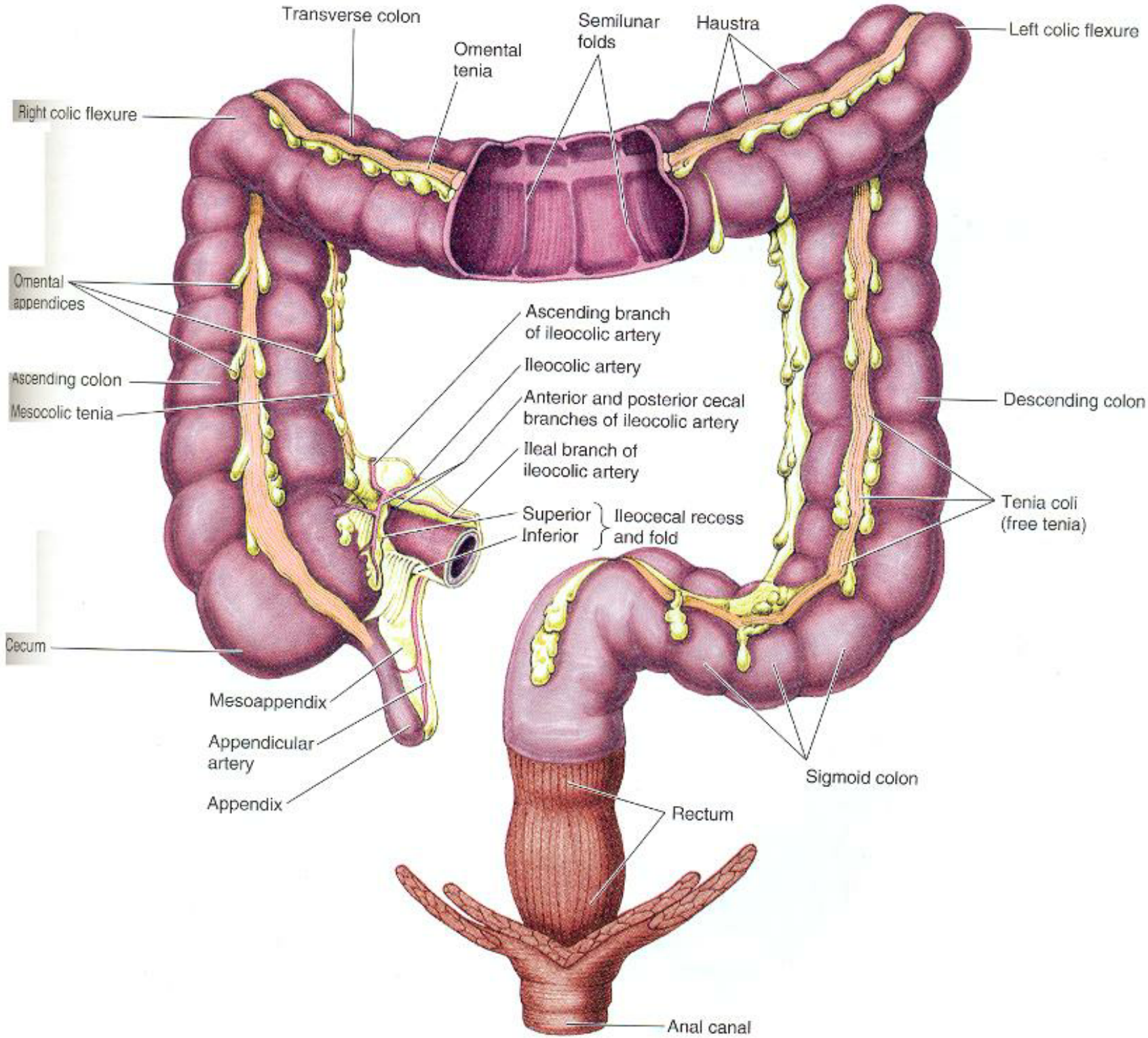
- **ILEUM**
- Distal 3/5th
- Narrower diameter (3.5cm)

- Thinner wall.
- Less vascular.
- Fewer vascular arcades.
- Mesentery has more fat hence no visible windows.
- Fewer and smaller mucosal folds.
- Numerous and large mucosal lymphatic follicles (peyers patches).

THE LARGE INTESTINES.

- Commences at the iliocaecal junction to the anus.
- About 1.5m long.
- Consists of the caecum, ascending colon, transverse colon, descending colon, sigmoid colon, rectum and anal canal.
- In its course it surrounds the small intestine within its curve.

- The vermiform appendix is a blind tube that springs from the posteromedial wall of the caecum 2cm below the ileum.


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

- Can easily be distinguished from the small intestine by:

1. **Taeniae coli**, three thickened bands of longitudinal muscle.
2. The **sacculations** of its walls between the taeniae, called **haustra**.
3. **Appendices epiploicae** (omental appendages), the small pouches of omentum filled with fat.

LARGE INTESTINES VS. SMALL INTESTINES.

- LARGE.
- Greater calibre
- More fixed.
- Longitudinal muscular coat is arranged in 3 bands called taenia coli.
- Presence of haustrations (since taenia are shorter than the circular muscles)
- Appendices epiploicae (fat filled peritoneal sacs found on the free surface of the colon except rectum, appendix, caecum.

- SMALL
- Smaller calibre
- Very mobile
- No taenia coli
- No haustrations
- No appendicies epiploicae

THE CAECUM

- **1st part of the large intestine** and is obviously continuous with the ascending colon.
- ileum **opens into its superior part** at the **ileocaecal junction**.
- caecum is a broad blind pouch and is **5 to 7 cm** in length.
- located in the **right lower quadrant**, where it lies in the **iliac fossa**, **inferior to** the ascending colon.
- completely covered by peritoneum and can be freely lifted.

ARTERIAL AND SUPPLY OF THE CAECUM AND APPENDIX

- Caecum is supplied by the **ileocolic artery** (anterior and posterior caecal arteries), a branch of the **superior mesenteric artery**.
- Appendix is supplied by the **appendicular artery** (branch of the antrior caecal artery), a branch of the **ileocolic artery**.

NERVE SUPPLY

- Nerves of the caecum and appendix are derived from the **coeliac** and **superior mesenteric ganglia**.

THE ASCENDING COLON

- Ascending colon varies from **12 to 20 cm in length**.
- Ascends on the **right side** of the abdominal cavity from the **caecum to the right lobe of the liver**.
- Turns left at the **right colic** (hepatic) **flexure**
- Has **no mesentery** and lies **retroperitoneally**
- **Covered by peritoneum anteriorly and on its side**

- Its separated from the muscles of the posterior abdominal wall by the **kidneys** and inferior by the **nerves of the posterior abdominal wall**
- Separated from the anterior abdominal wall by **coils of small intestine** and the greater omentum.
- The peritoneum on the lateral side of the ascending colon forms a trench or groove called the **right paracolic gutter**.

BLOOD SUPPLY/NERVE SUPPLY OF THE ASCENDING COLON

- Supplied by the **ileocolic and right colic arteries**, branches of the **superior mesenteric arteries**.

Innervation of Ascending Colon

- These nerves to the ascending colon are derived from the **coeliac** and **superior mesenteric ganglia**.

THE TRANSVERSE COLON

- **hangs down as a loop to a variable extent**.
- about **45 cm in length**
- the **largest and most mobile** part of the large intestine
- crosses the abdomen from the **right colic flexure** to the **left colic flexure**, where it bends inferiorly to become the descending colon
- **left colic flexure** lies on the inferior part of the **left kidney** and is **attached to the diaphragm** by the **phrenicocolic ligament**

- Left colic flexure is **more superior** and **more posterior** than the right colic flexure.

Arterial Supply of the Transverse Colon

- **middle colic artery**, a branch of the **superior mesenteric artery**.
- **left** and **right colic arteries**.

Innervation of the Transverse Colon

- Nerves from **superior mesenteric plexus** ,
- vagal nerve fibres **(both** transmit sympathetic.)
- Nerves from **inferior mesenteric plexus**.

THE DESCENDING COLON

- Is about **22 to 30 cm in length**
- descends from the **left colic flexure** into the **left iliac fossa**, where it is **continuous with the sigmoid colon**.
- the colon passes anterior to the lateral border of the **left kidney** as it descends
- related to the **diaphragm superiorly** and the quadratus lumborum muscle.

ARTERIAL SUPPLY

- **left colic** and **superior sigmoid arteries**, branches of the **inferior mesenteric artery**.

- ***Nerve supply***
- **sympathetic supply** from the **lumbar part of the sympathetic trunk** and the **superior hypogastric plexus**
- **parasympathetic supply** derived from the **pelvic splanchnic nerves**

THE SIGMOID COLON

- **S-shaped** loop of variable length (usually 40 cm).
- extends from the **pelvic brim** to the **3rd segment of the sacrum**, where it joins the rectum.
- usually occupies the **rectovesical pouch in males** and the **rectouterine pouch in females**.
- Faeces are usually stored in the sigmoid colon before defecation.

ARTERIAL SUPPLY

- **2 to 3 sigmoid arteries** branches of the **inferior mesenteric artery**.

Innervation

- **sympathetic supply** from the **lumbar part of the sympathetic trunk** and the **superior hypogastric plexus**
- **parasympathetic supply** is derived from the **pelvic splanchnic nerves**

THE RECTUM

- continuous with the sigmoid colon at the midpiece of the sacrum.
- length of about **12 cm**.
- joins the **anal canal** at the **anorectal junction, 2 to 3 cm** in front of the **coccygeal tip**
- covered by **peritoneum** on its **anterior surface and sides in the upper 1/3, anterior surface only** in the **middle 1/3** and is **not covered** in the **lower 1/3**.
- lower part of the rectum is dilated as the **rectal ampulla**.

THE ANAL CANAL

- about **4 cm long** in adults
- upper half of the anal canal is lined by **mucosa**, which is plum red due to the internal rectal venous plexus.
- lower half is lined with stratified squamous non-keratinising epithelium (continuous with the skin of the anus).
- lower half has **6 to 7 anal columns** which contains a terminal branch of the **superior rectal artery and vein**, these being largest at the **3, 7 and 11 o'clock positions**. (enlargement of this veins cause internal haemorrhoids)

THE LIVER.

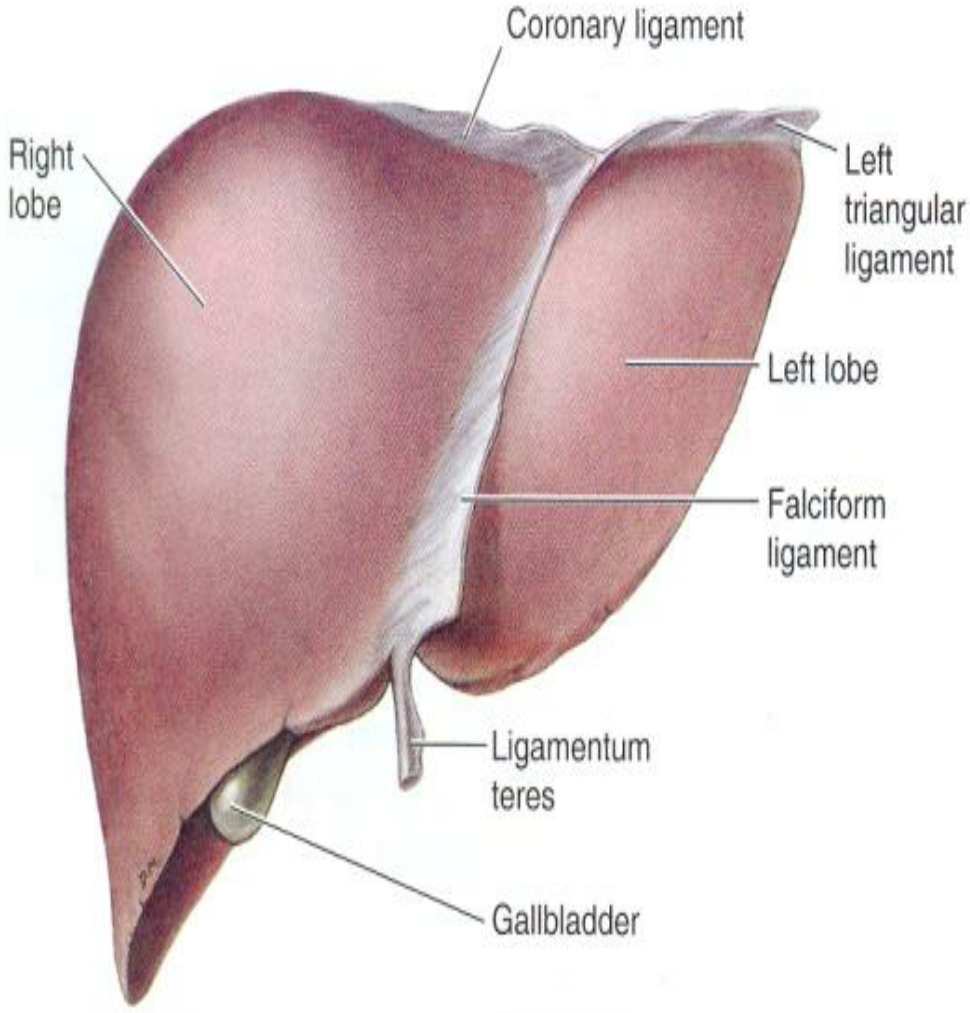
- Largest solid gland in the body.
- **huge glandular organ** belonging to the GI system
- Also largest abdominal organ
- Located in the right hypochondrium, epigastrium and left hypochondrium.
- Weighs 1.4-1.8kg (males) 1.2-1.4 (females)
- it **should not be palpable** below the **right costal margin i**n normal individuals.
- Its surrounded by the **Glisson's capsule** as a **strong connective tissue**.

LOBES

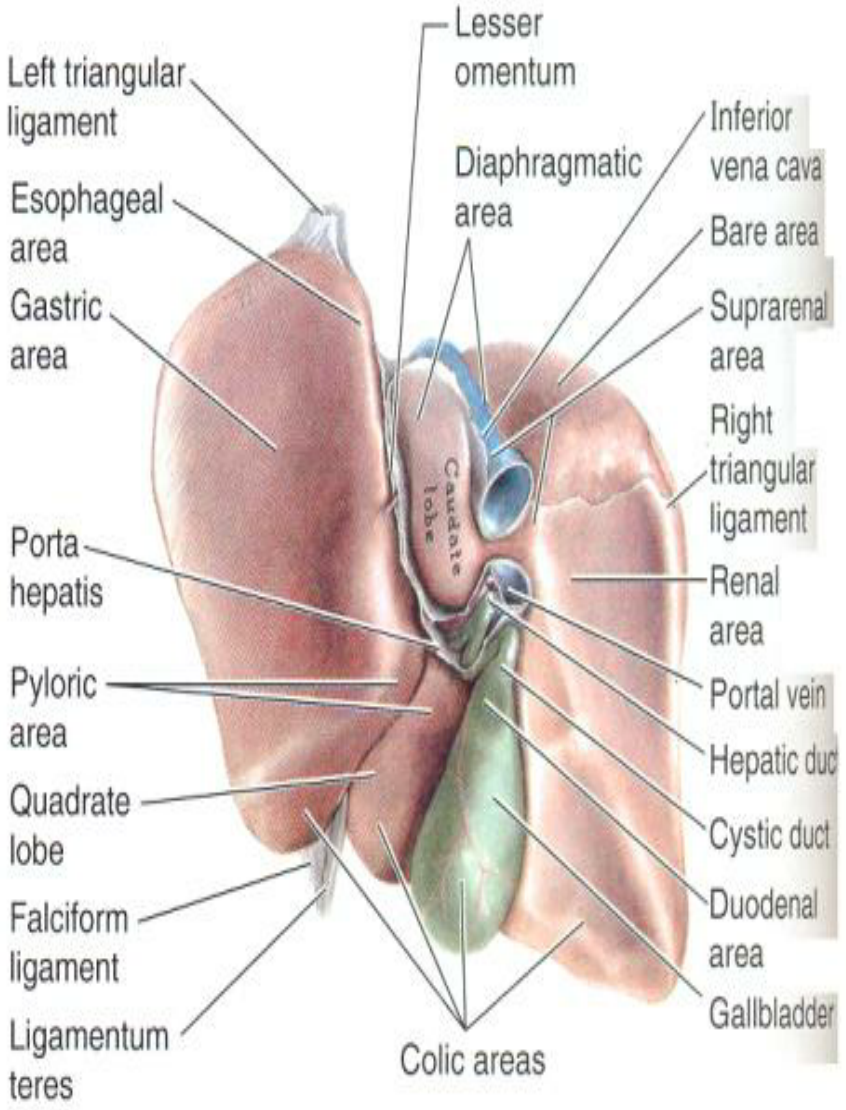
- **_right and left by;**
  - Falciform ligament.
  - Fissure for ligamentum teres.
  - Fissure for ligamentum venousus.
- The right lobe has two additional lobes; quadrate lobe and caude lobe.

PERITONEAL COVERINGS.

- The liver is covered by the peritoneum except in the following areas (bare areas);
  - Triangular area on the posterior surface.
  - The porta hepatis.
  - The fossa for the gall bladder.
  - The groove for the inferior venacava.
  - The lines along which the peritoneal folds meet the liver.
- **Peritoneal folds (ligaments);**
  - **1.** falciform ligament, connects the anterior abdominal wall to the anterior and superior surface of the liver.
  - 2. lesser omentum; connects the liver to the lesser curvature of the stomach.
  - 3. The coronary and triangular ligaments; between diaphragm and the posterior and superior surface of the liver.



(C) Diaphragmatic surface



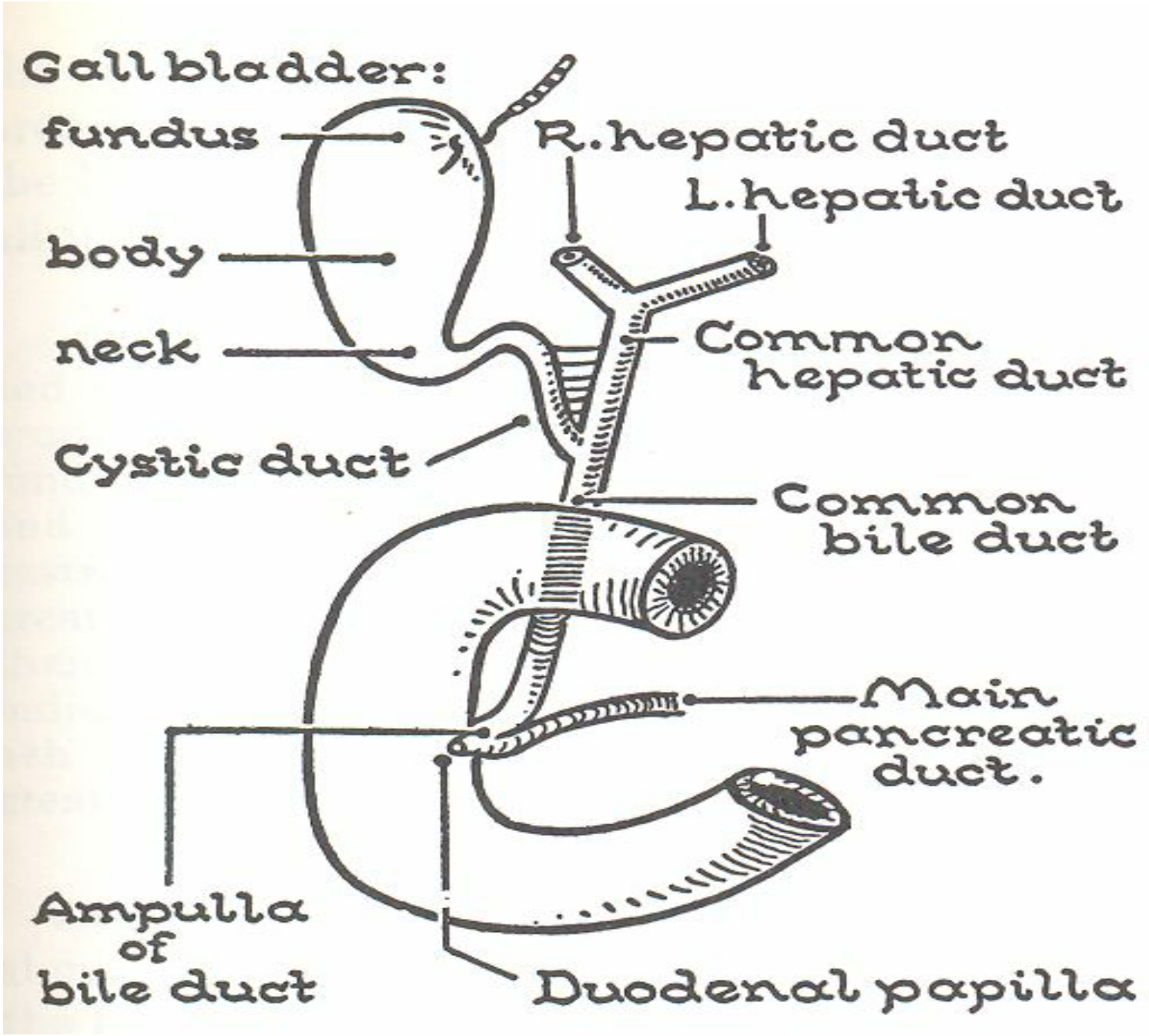
(D) Visceral surface

LIVER (CONT).

- **SURFACES;**
  - Anterior.
  - Posterior.
  - Right lateral.
  - Superior.
  - Inferior (visceral)
- **BLOOD SUPPLY;**
  - Hepatic artery.
  - Portal vein.
- Venous drainage is by the hepatic veins that drain into the inferior venacava.
- **LYMPHATICS;**
  - Porta hepatis.
  - Coeliac lymph nodes.
  - Thoracic duct for those that drain the bare areas.

THE EXTRA HEPATIC BILIARY TRACT.

- Consists of;
  1. The hepatic ducts.
  2. The common hepatic ducts.
  3. The gall bladder.
  4. The bile duct.(CBD)
- The common hepatic duct is formed at the porta hepatis by the union of the right and left hepatic ducts. It is then joined by the cystic duct to form the common bile duct.


Gall bladder:
fundus
body
neck
Cystic duct
R. hepatic duct
L. hepatic duct
Common hepatic duct
Common bile duct
Main pancreatic duct.
Ampulla of bile duct
Duodenal papilla

THE PANCREAS

- An **elongated** (12 to 15 cm), **soft, greyish-pink digestive gland**
- located in the **transpyloric plane**
- located in the **epigastric** and **left hypochondriac regions** and its right part lies across the bodies of **L1 to L3 vertebrae**.
- The pancreas is both an **exocrine and endocrine** gland
- It produces:

I. **Pancreatic juices** that enters the duodenum via the pancreatic ducts;
II. **Internal secretions** (glucagon and insulin) that enter the blood.

- The pancreas has a head, neck, body and tail.
- Its shape somewhat resemble an **inverted**, **curved tobacco pipe**.
- right side (head) lies **inferior** to the transpyloric plane while the left side (tail) lies **superior** to it.
- pancreas lies behind the omental bursa where it forms a major part of the **stomach bed**.

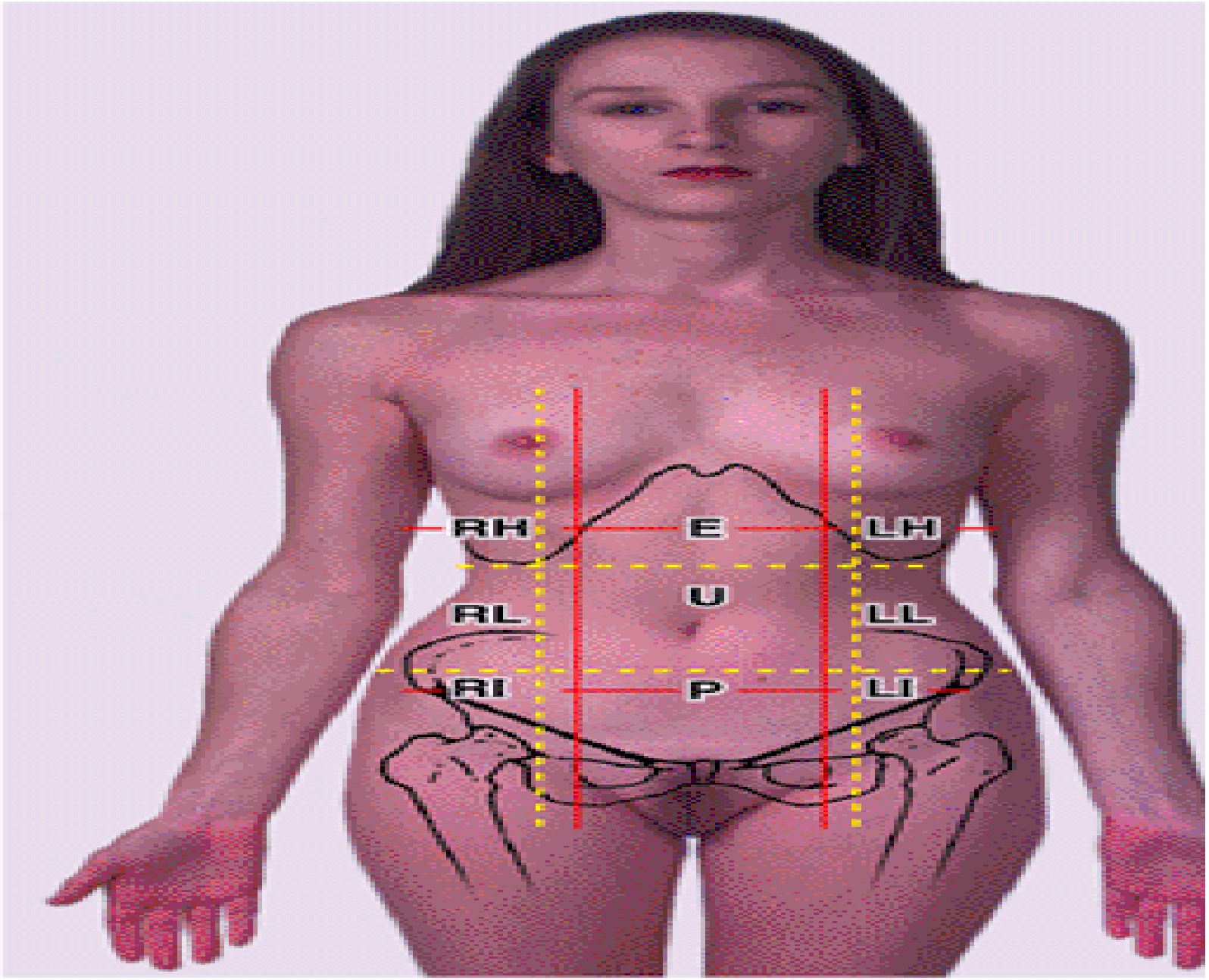
ARTERIAL SUPPLY OF THE PANCREAS

- Branches of **splenic artery** and the **pancreaticoduodenal arteries**.

- ***Innervation of the Pancreas***

vagus and the **splanchnic nerves**.

pain fibres are carried by the **splanchnic nerves**.



(A) Abdominal regions

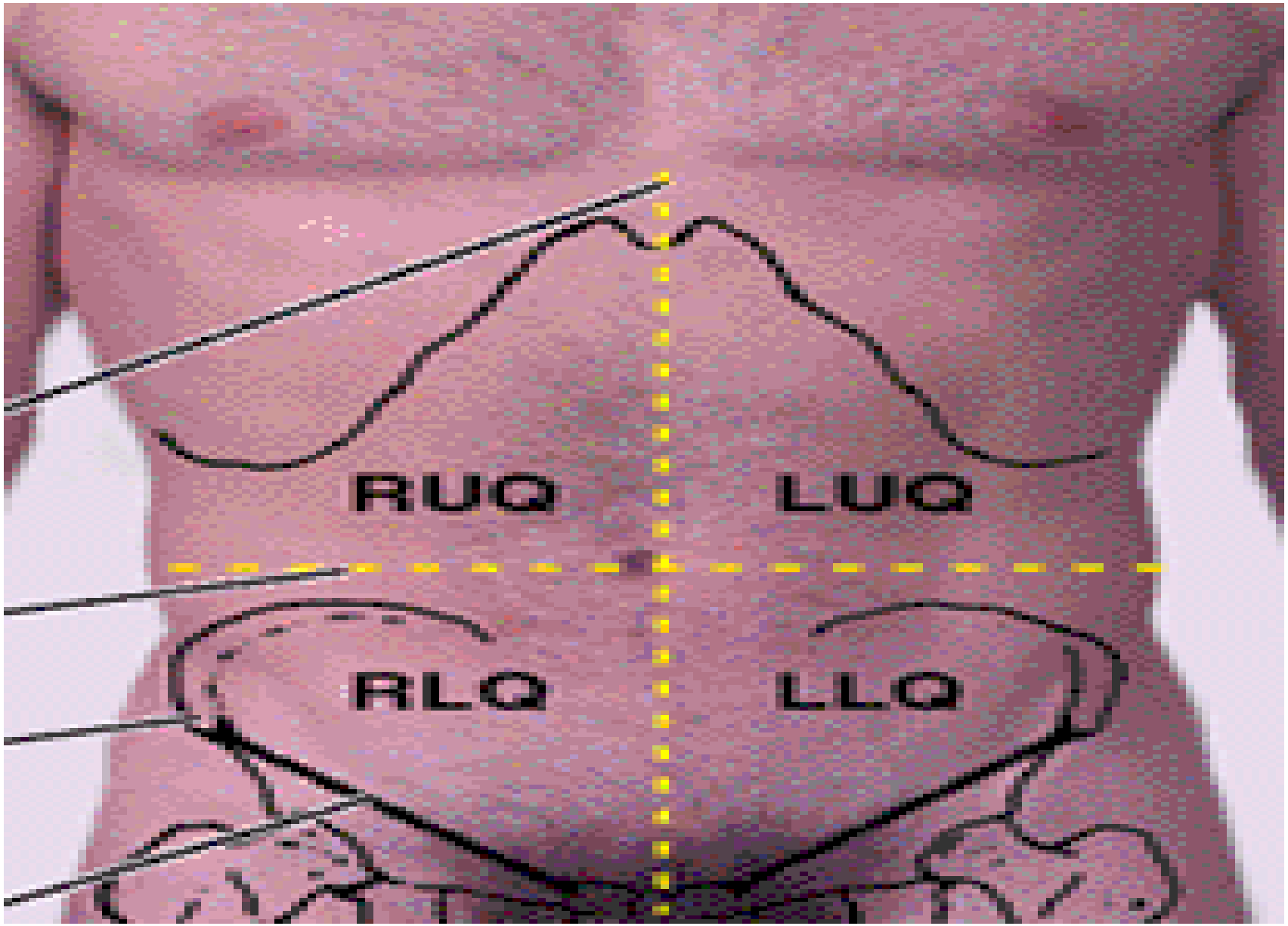
Key

Abdominal Regions:

RH	Right hypochondriac
RL	Right lateral (lumbar)
RI	Right inguinal (groin)
E	Epigastric
U	Umbilical
P	Pubic (hypogastric)
LH	Left hypochondriac
LL	Left lateral (lumbar)
LI	Left inguinal (groin)

Abdominal Quadrants:

RUQ	Right upper quadrant
LUQ	Left upper quadrant
RLQ	Right lower quadrant
LLQ	Left lower quadrant


RUQ
LUQ
RLQ
LLQ

Right upper quadrant (RUQ)
Liver: right lobe Gallbladder Stomach: pylorus Duodenum: parts 1-3 Pancreas: head Right suprarenal gland Right kidney Right colic (hepatic) flexure Ascending colon: superior part Transverse colon: right half

Left upper quadrant (LUQ)
Liver: left lobe Spleen Stomach Jejunum and proximal ileum Pancreas: body and tail Left kidney Left suprarenal gland Left colic (splenic) flexure Transverse colon: left half Descending colon: superior part

Right lower quadrant (RLQ)
Cecum Vermiform appendix Most of ileum Ascending colon: inferior part Right ovary Right uterine tube Right ureter: abdominal part Right spermatic cord: abdominal part Uterus (if enlarged) Urinary bladder (if very full)

Left lower quadrant (LLQ)
Sigmoid colon Descending colon: inferior part Left ovary Left uterine tube Left ureter: abdominal part Left spermatic cord: abdominal part Uterus (if enlarged) Urinary bladder (if very full)

REFERRED PAINS