

L (4) – The Small Intestine.

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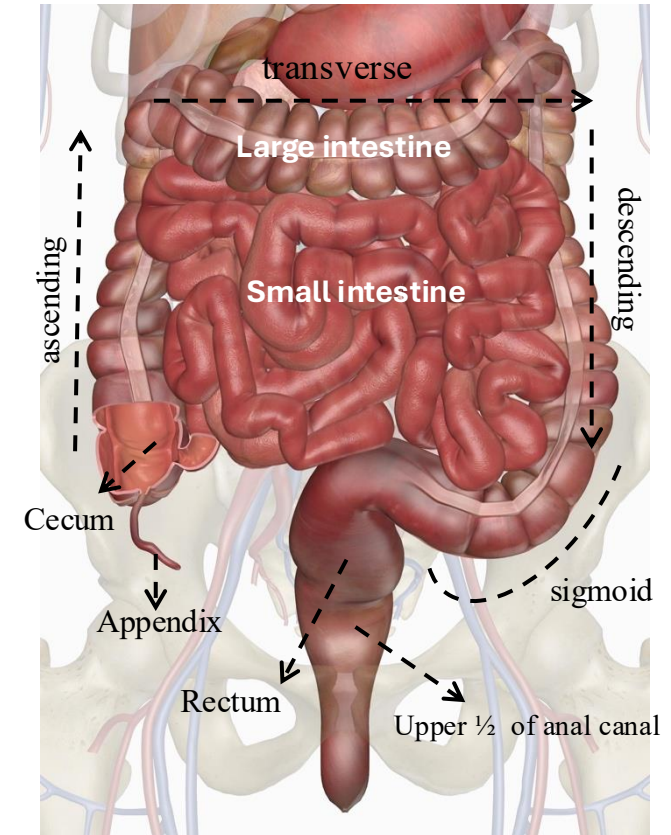
1- Intestines

General comparison: - to be discussed in detail -

Feature	Small Intestine	Large Intestine
Length	6 meters	1.5–2.5 meters
Diameter (thus, the name)	Narrower(small)	Wider(large)
Location	Central, in the umbilical region	Peripheral, “frame” surrounding the small intestine
Main Parts	Duodenum, Jejunum, Ileum	Cecum, Appendix, Colon (ascending, transverse, descending, sigmoid), Rectum, Upper ½ of anal canal
Function	- Complete digestion and absorption of nutrients	- Water absorption - Feces formation

Today’s lecture

Next lectures



2- Small intestine

Small intestine is divided into 3 main parts:

Fixed part
(no mesentery):

(1)

DUODENUM

TO STOMACH

Free (movable) part
(with mesentery):

- NEXT SLIDE -

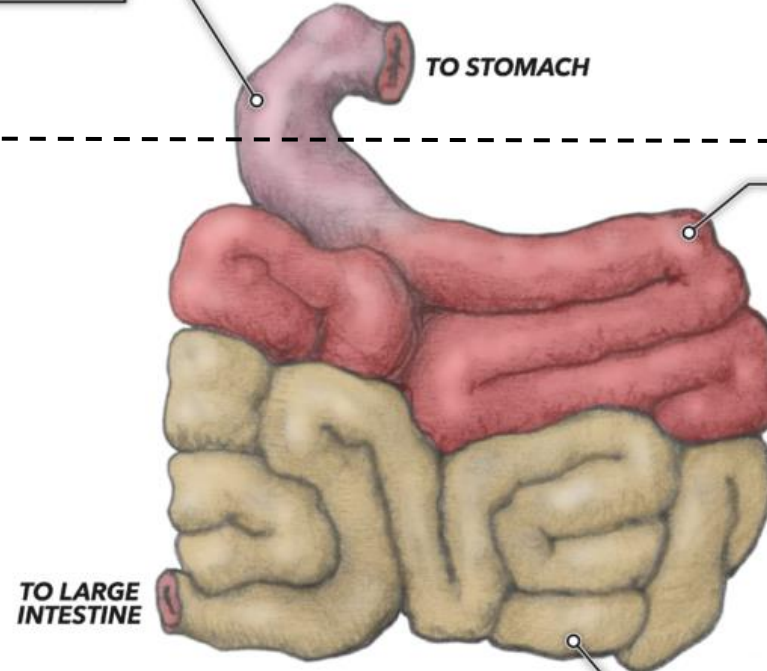
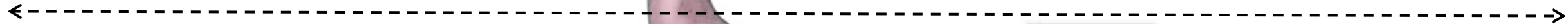
JEJUNUM

(2)

TO LARGE
INTESTINE

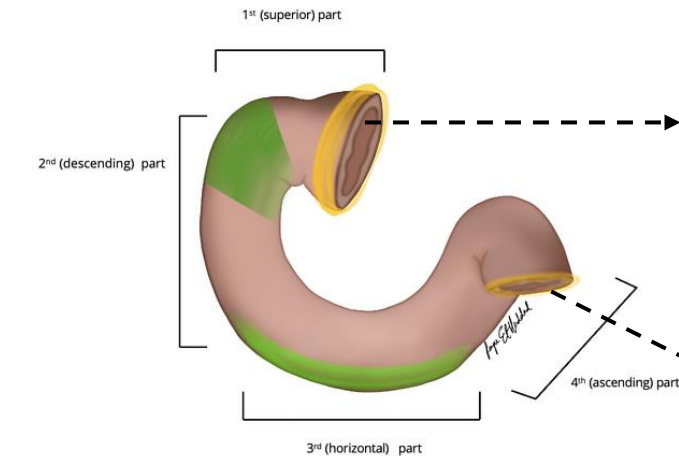
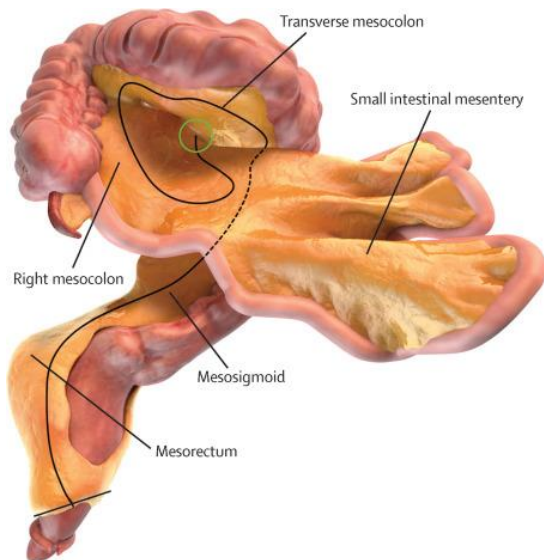
ILEUM

(3)



2- Small intestine Mesentery!

- Mesentery is double layer of visceral peritoneum suspends the small intestine (particularly the **jejunum and ileum**) from the posterior abdominal wall, resulting in:
 - Making jejunum and ileum **intraperitoneal** structures. (totally covered by visceral peritoneum)
 - **Mobility** of jejunum and ileum.
- Unlike jejunum and ileum, **duodenum** has NO mesentery making it:
 - **Retroperitoneal** structure (behind & partially covered by parietal peritoneum) except **1st & last inch**.
 - Immobile/ **fixed** organ



Surface is covered by
peritoneum
Intraperitoneal

1st → Because: it is attached to lesser omentum on its upper border, the greater omentum on its lower border, and the lesser sac posterior to it.

last → duodenal jejunal junction

2- Small intestine

➤ Relate to Histology

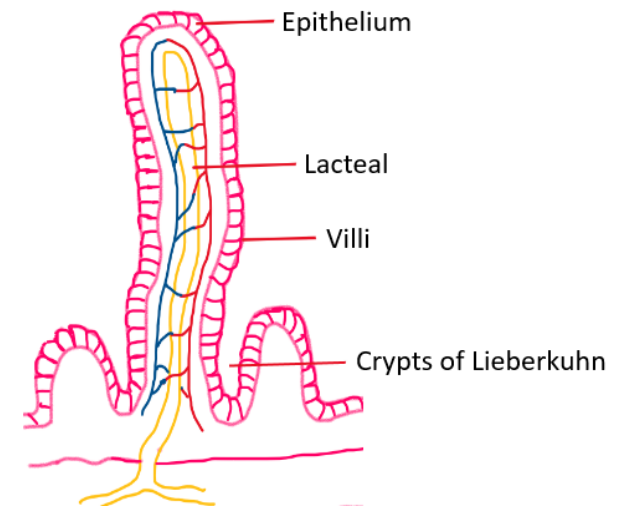
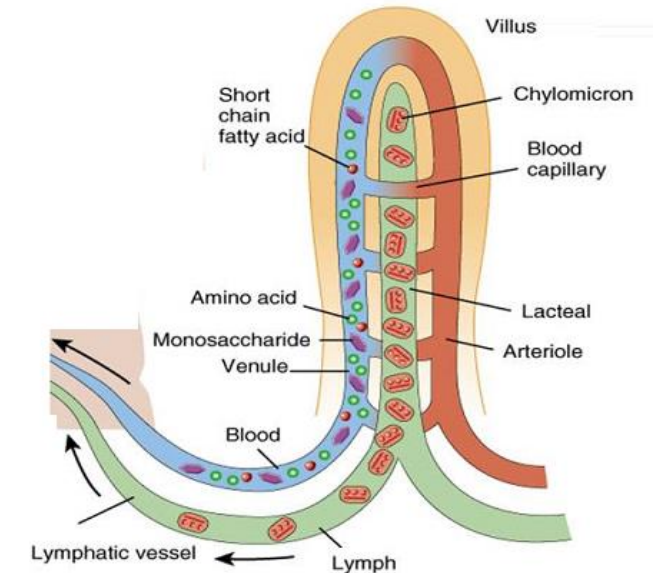
The intestinal epithelium of the small intestine is made up of **simple columnar** cells with **goblet cells**, and it has two primary structures:

1. Villi:

1. **Finger-like projections** that extend into the lumen to increase the surface area for absorption.
2. **Microvilli** line the surface of the villi, further amplifying the surface area for nutrient absorption.
3. Each villus contains:
 1. **Veins and arteries** for blood supply.
 2. A **lymphatic vessel (lacteal)** for absorption of fats.
 3. **Smooth muscle** for movement and contraction.
 4. Lined by **microvilli** to further enhance absorption.

2. Crypts of Lieberkühn (Secretory Glands):

1. **Indentations** in the epithelium between the villi that form secretory glands.
2. These glands secrete digestive enzymes, mucus, and hormones that aid in digestion and absorption.



3- Duodenum

- **The Duodenum is about 10 inches (25cm) in length.**
- **It joins the stomach to the jejunum**

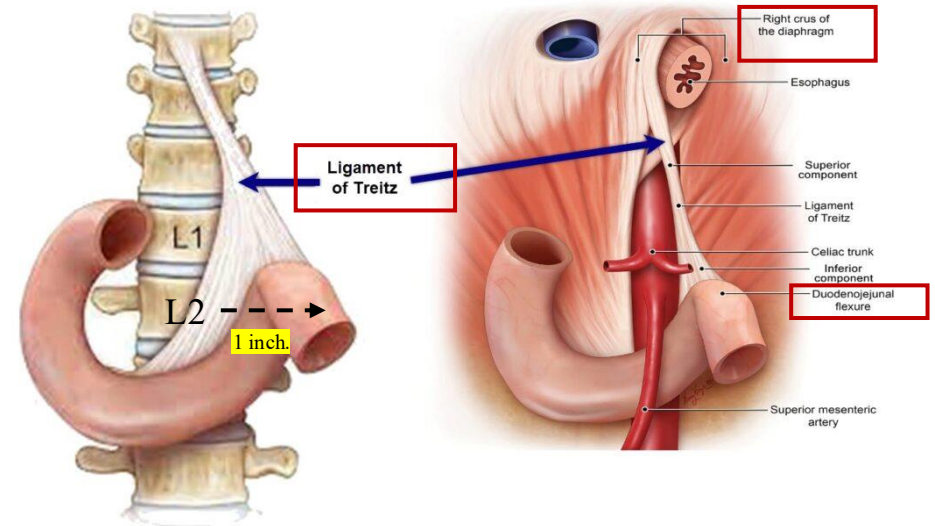
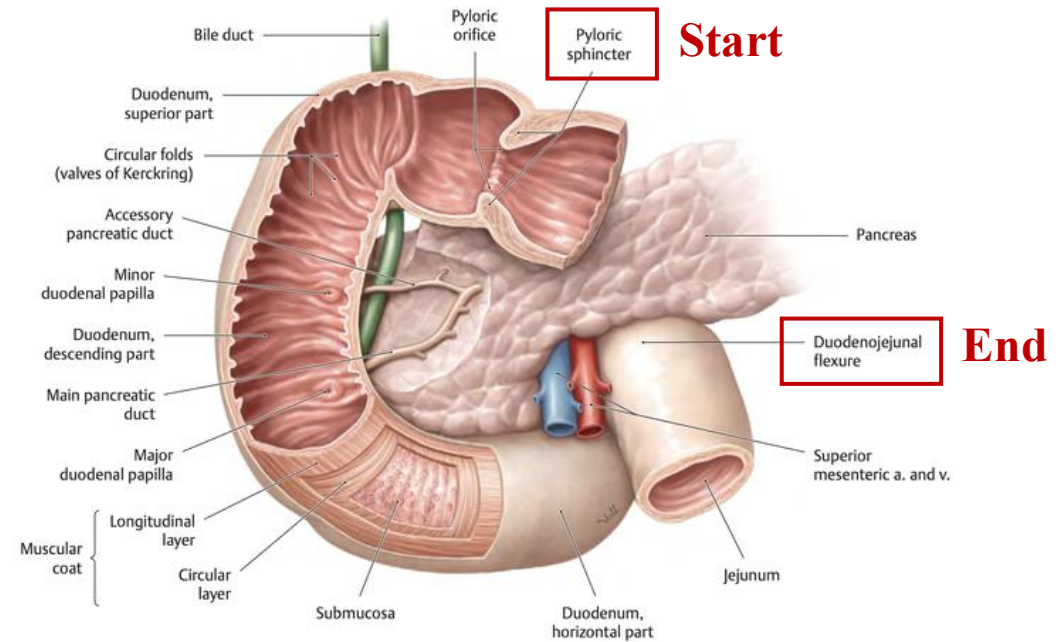
- **Start:**

Begins at the **pyloric sphincter**, marking the end of the **stomach**.

- **End:**

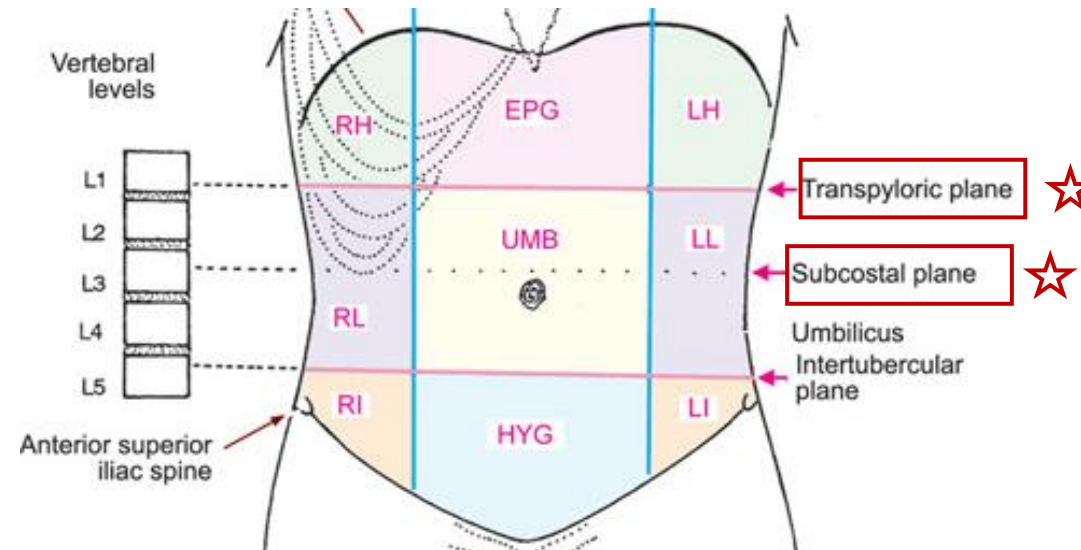
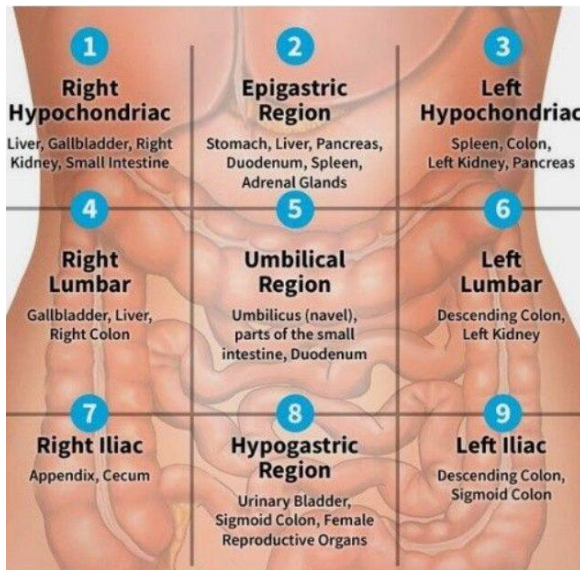
Ends at the **duodenojejunal junction**, which is located:

- At the level of the **second lumbar vertebra (L2)**.
- Approximately **1 inch** to the left of the midline.
- Attached to the **ligament of Treitz** (*suspensory ligament of the duodenum*), which connects the duodenojejunal flexure to the **right crus of the diaphragm**.



3- Duodenum

- The **ligament of Treitz** is an important 😊 **surgical landmark** used to identify the **end of the duodenum** and the **beginning of the jejunum**.
- Surgeons rely on it during abdominal procedures to **locate the proximal jejunum**.
- Recall: Jejunum and ileum are intraperitoneal and freely movable, as they are not fixed to the posterior abdominal wall. So, During a **midline incision**, surgeons often bring **the mesentery along with the jejunum and ileum** outside the abdomen to gain **better access to the posterior body compartments**, then return them afterward.
- The duodenum is situated in the **epigastric and umbilical regions**.



4- Duodenum concavity

- The **duodenum** is a **C-shaped, concave** tube.
- Its **concavity** is directed toward the **left and backward**.

Structures Within the Concavity of the Duodenum:

1.Head of the Pancreas

- Imbedded in the concavity.

2.Common Bile Duct and Pancreatic Duct

- These two ducts **merge & pierce the medial wall** of the **2nd** part of the duodenum at the:

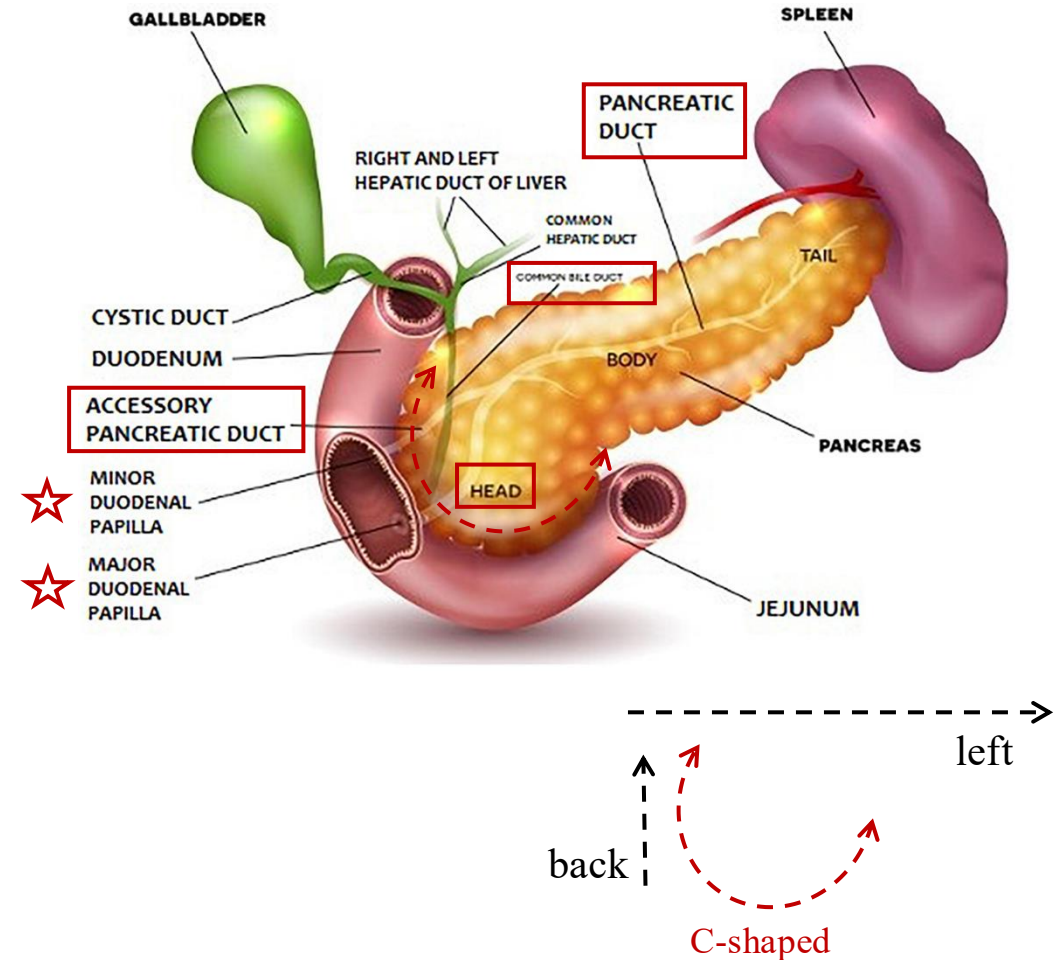
- **Major Duodenal Papilla**
- This papilla causes a bulge called the **Ampulla of Vater**

3.Accessory Pancreatic Duct (if present)

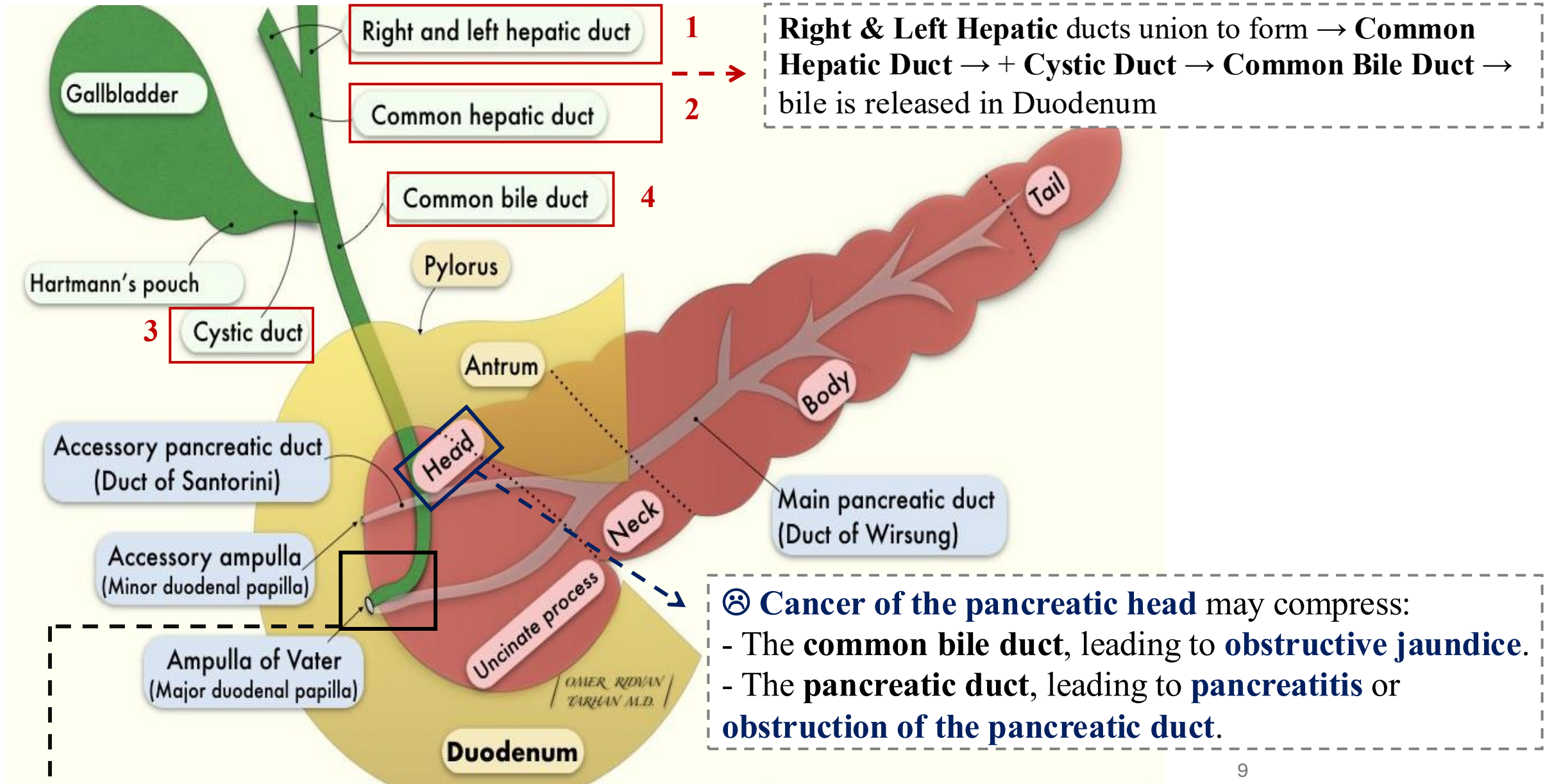
- Opens separately into the **2nd part of the duodenum** at the:
- **Minor Duodenal Papilla**

Function:

- These ducts release **pancreatic enzymes** and **bile** into the duodenum, which is essential for the **chemical digestion of food**.



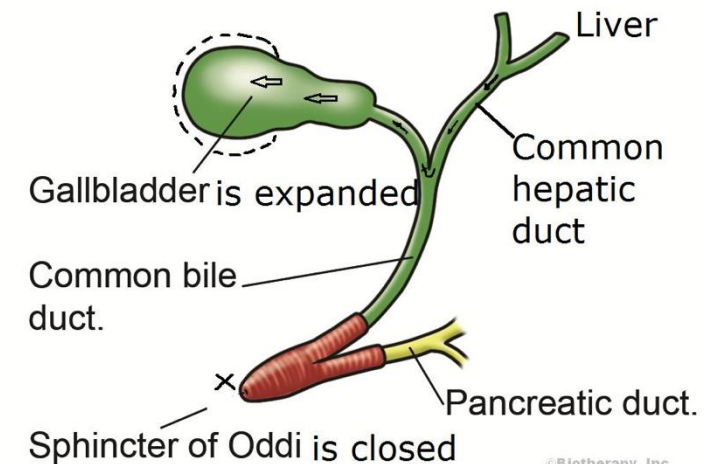
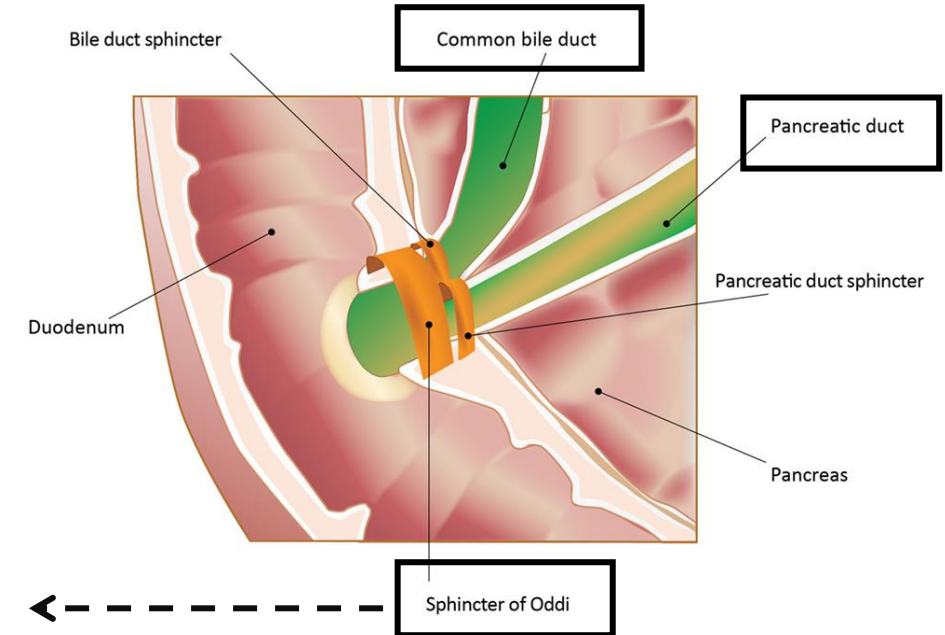
4- Duodenum concavity



4- Duodenum concavity

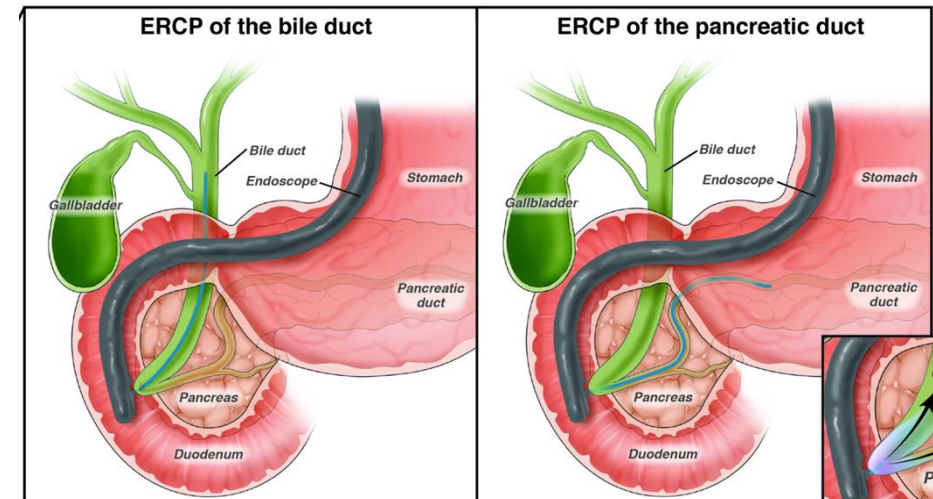
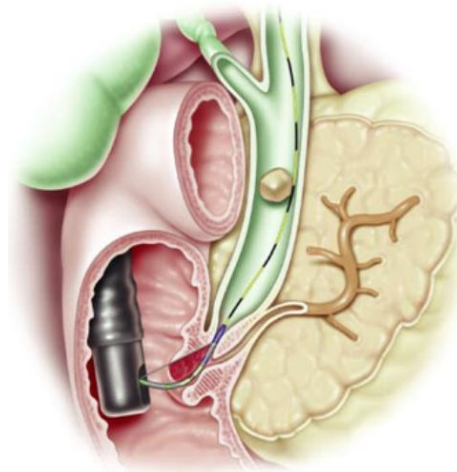
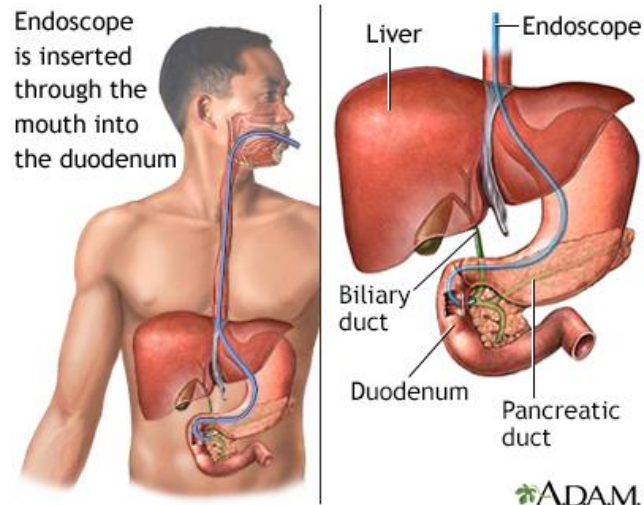
▪ Sphincter of Oddi:

-	Details
Structure	Circular smooth muscle surrounding <u>terminal</u> parts of: <ul style="list-style-type: none"> • Common bile duct. • Main pancreatic duct.
Location	Terminal portion of the ducts as they open into the 2nd part of the duodenum (at the major duodenal papilla).
Function	Regulates the flow of bile & pancreatic secretions into the duodenum.
State at Rest	Normally contracted to prevent premature secretion.
Stimuli to Relax	<ul style="list-style-type: none"> • Neural: Vagus nerve & Enteric Nervous System (ENS) • Hormonal: Mainly Cholecystikin (CCK) once bolus reaches duodenum.



4- Duodenum concavity

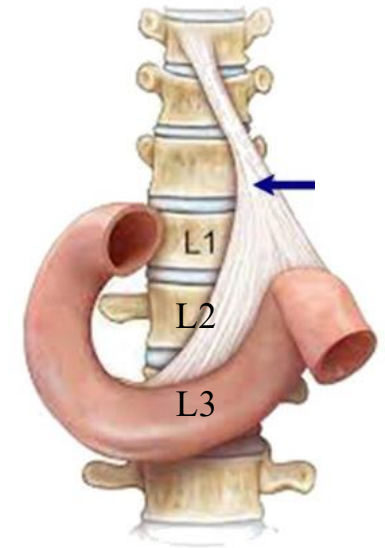
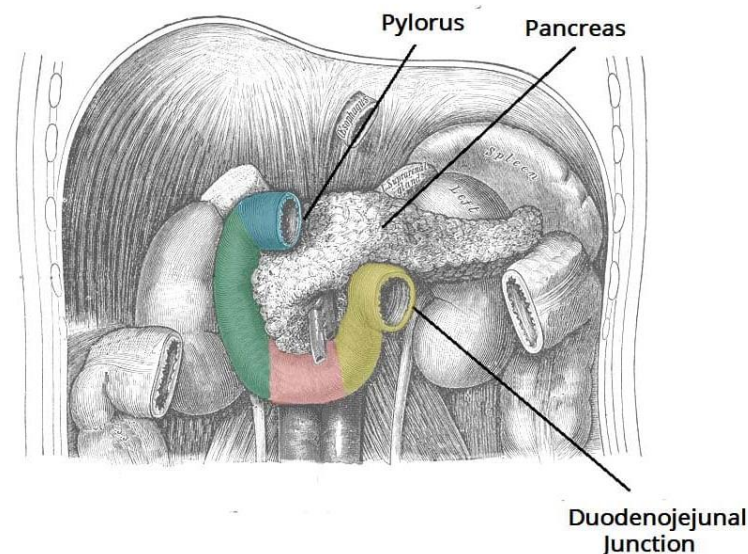
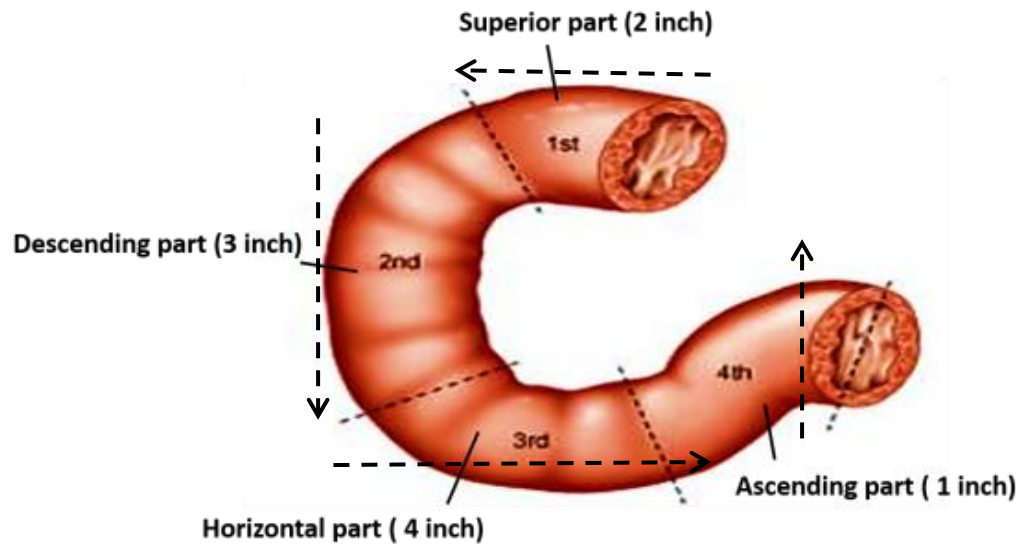
- In the past, treating **cholecystitis** (gallbladder stones) or **common bile duct stones** (obstructive jaundice) required open surgery, resulting in long hospital stays (7–10 days) and complications like bleeding and infection.
- Today, a less invasive procedure called 😊 **ERCP (Endoscopic Retrograde Cholangiopancreatography)** is commonly used, which is:
 - A flexible endoscope is passed through the **mouth** → **esophagus** → **stomach** → **duodenum**.
 - The **major duodenal papilla** is accessed, and the **sphincter of Oddi is incised** to allow access to the bile or pancreatic duct. Obstructions are removed using a small basket and flushed into the duodenum to be naturally passed in stool. This procedure allows for same-day discharge, typically within 6 hours.
 - **ERCP** is also effective in treating **pancreatic duct obstructions**, such as those caused by pancreatitis.



5- Duodenum parts

- The duodenum is divided into 4 anatomical parts

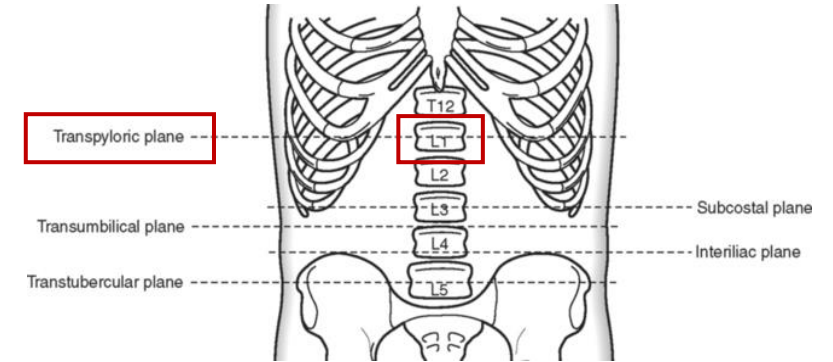
Part of Duodenum	Orientation	Length	Level – lumbar vertebrae
1st	Horizontal	2 inches	From L1
2nd	Vertical (downward)	3 inches	Along L1 to L3
3rd	Horizontal	4 inch	Crosses at L3
4th	Vertical (upward)	1 inch	From L3 up to L2



6- 1st part of the Duodenum

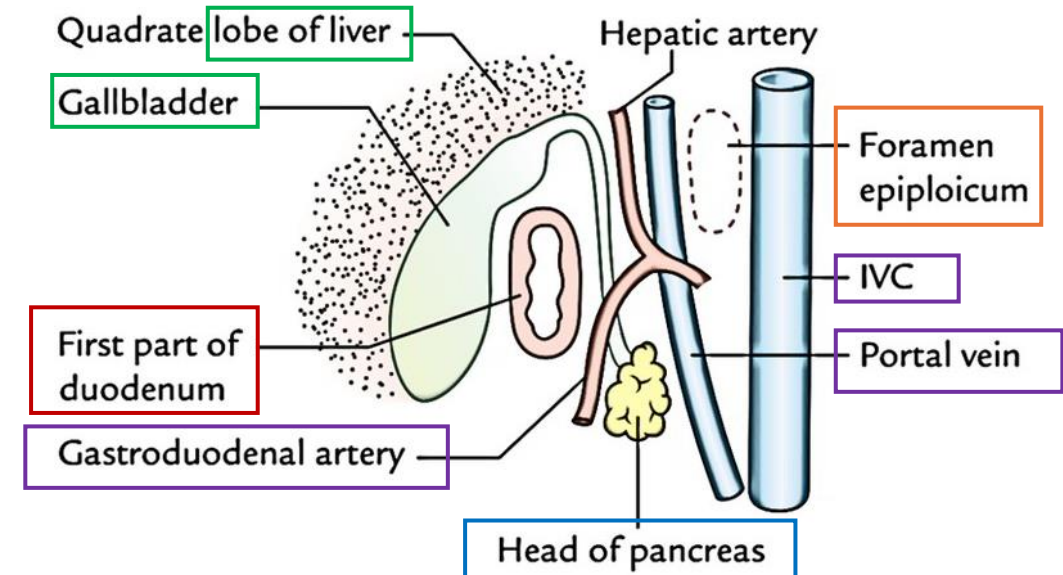
Start Point:

- Begins at the **pyloroduodenal junction**.
- Located at the **transpyloric line** (around L1 vertebral level)
- **Runs upward and backward, 1 inch to the right of the midline**



Anatomical Relations of the 1st Part of the Duodenum:

-	Structures Related
Anterior*	- liver - Gallbladder
Superior*	- Epiploic foramen
Posterior*	- Lesser sac - Gastroduodenal artery - Common bile duct - Portal vein - Inferior vena cava (IVC)
Inferior*	- Head of the pancreas



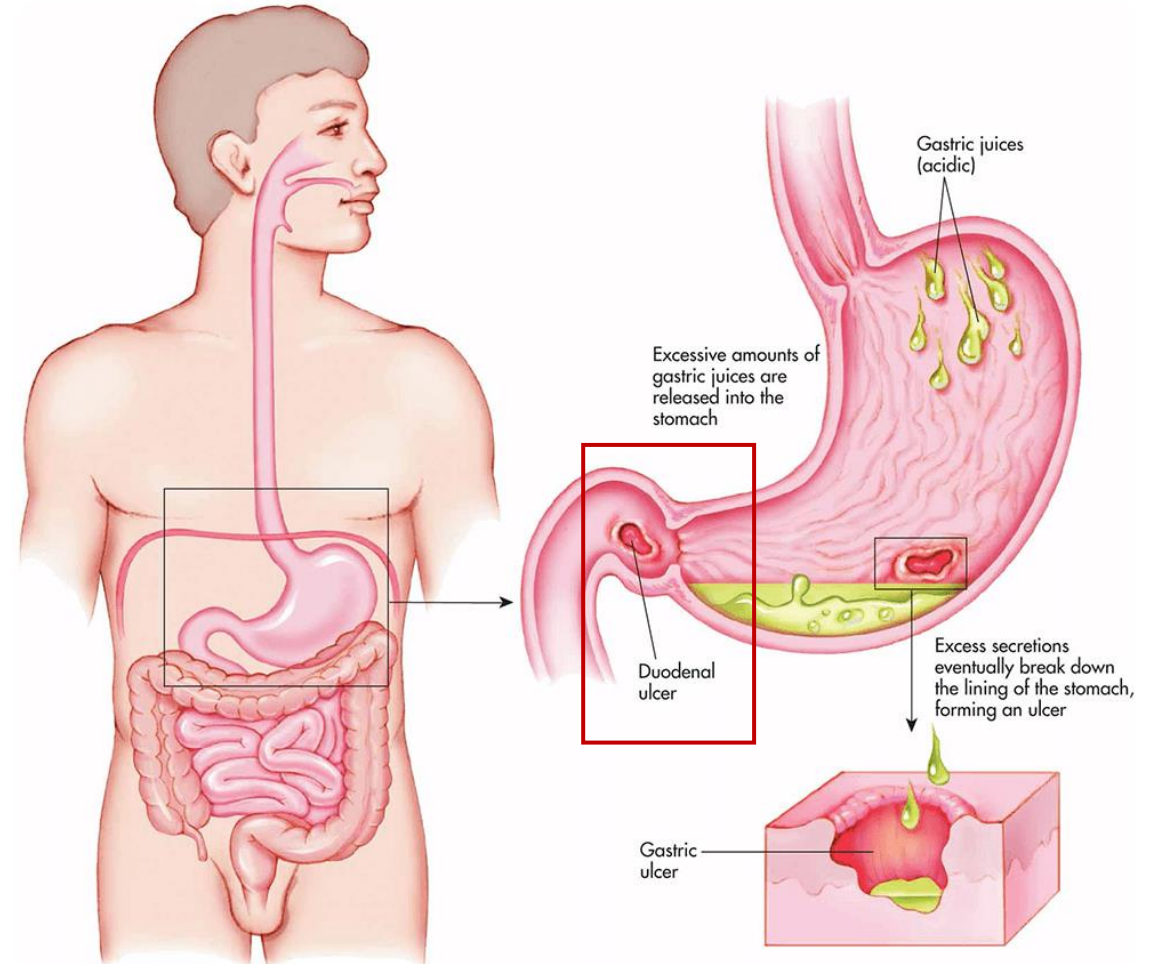
6- 1st part of Duodenum

➤ Relate to Pathology

The ***first part of the duodenum** is the most common site for ☹ **peptic (duodenal) ulcers**.

* Recall L(3): Why? Because This region is the first to receive highly acidic chyme from the stomach, making it more vulnerable to acid damage.

In cases where the ulcer **perforates posteriorly**, it can damage important structures that lie behind the duodenum. The **gastrooduodenal artery** is the most affected structure. If it is eroded, it can lead to **life-threatening hemorrhage**. Other important **posterior structures** that may also be compromised include the **portal vein, common bile duct, and inferior vena cava (IVC)**.



7- 2nd part of Duodenum

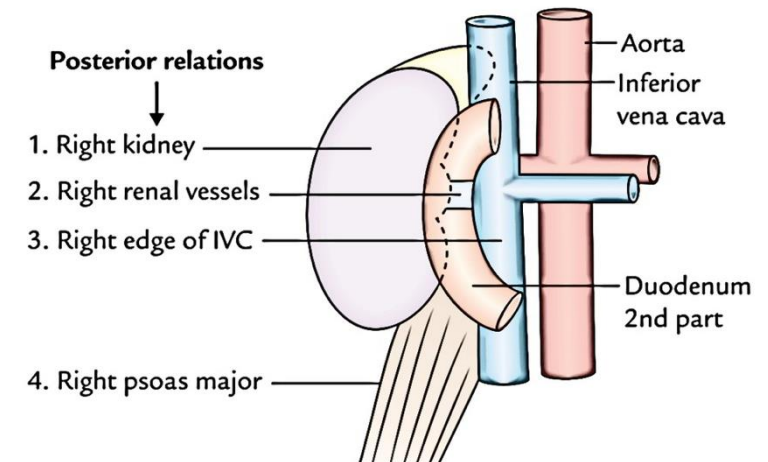
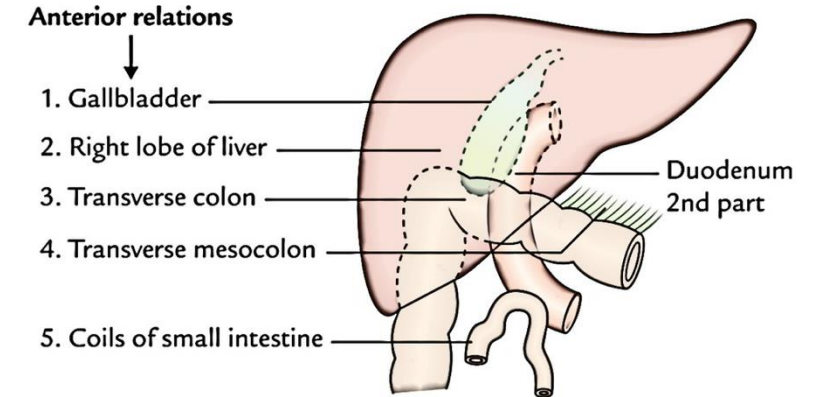
Start/End Points:

- Starts **below the right lobe of the liver**
- Ends between **L3–L4 vertebrae**

Anatomical Relations of the 2nd Part of the Duodenum:

	Structures Related
Anterior	<ul style="list-style-type: none"> - Fundus of gallbladder - Right lobe of liver - Transverse colon - Ileum (small intestine) coils
Posterior	<ul style="list-style-type: none"> - Hilum of right kidney (near L3- L4) - Right ureter
Right (Lateral)	<ul style="list-style-type: none"> - Ascending colon - Right Colic/Hepatic flexure - Right lobe of liver
Left (Medial)	<ul style="list-style-type: none"> - Head of pancreas - Bile & Pancreatic duct

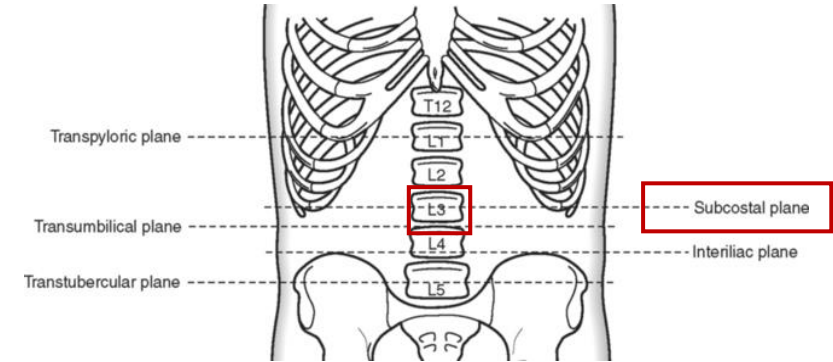
• **The importance of the 2nd part** : it receives the secretion of common bile duct and the pancreatic duct via the **major duodenal papilla**, making it crucial for **fat digestion**.



8- 3rd part of Duodenum

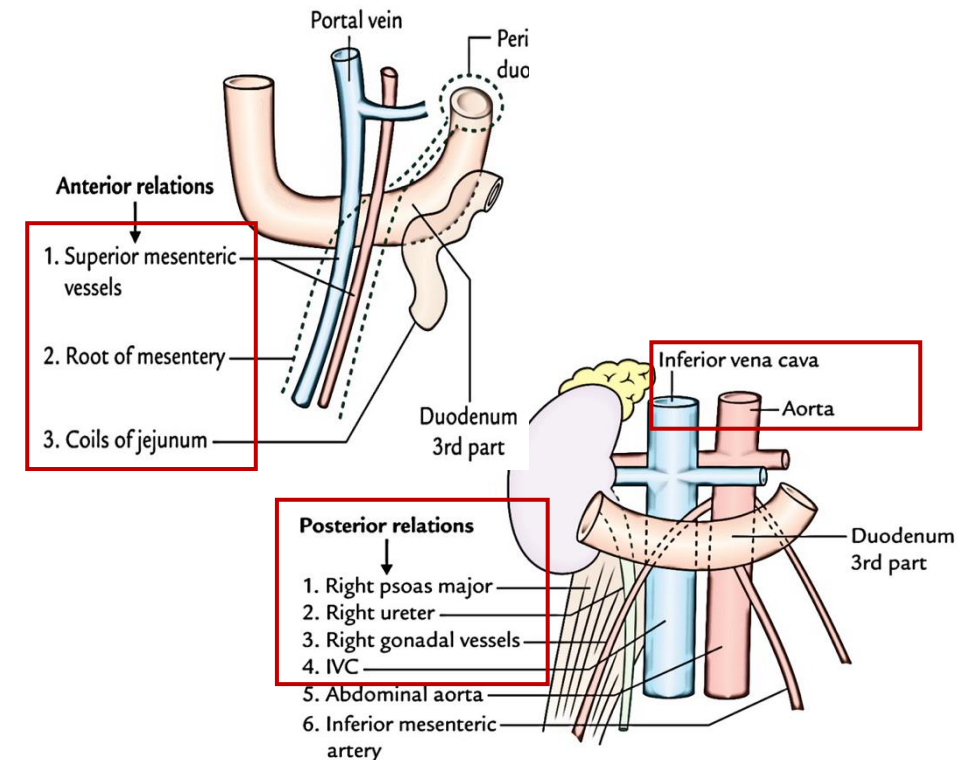
Start/End Points:

- Found at the level of the **subcostal plane**, crossing **L3** vertebrae.
- Crosses important retroperitoneal structures, including the **inferior vena cava (IVC)**, **abdominal aorta**, and **right psoas major muscle**.



Anatomical Relations of the 3rd Part of the Duodenum:

	Structures
Anteriorly	<ul style="list-style-type: none"> - Root of the mesentery of small intestine - Superior mesenteric vessels - Coils of jejunum
Posteriorly	<ul style="list-style-type: none"> - Right ureter - Right psoas muscle - Aorta - Inferior vena cava (IVC)
Superiorly	<ul style="list-style-type: none"> - Head of the pancreas
Inferiorly	<ul style="list-style-type: none"> - Coils of jejunum



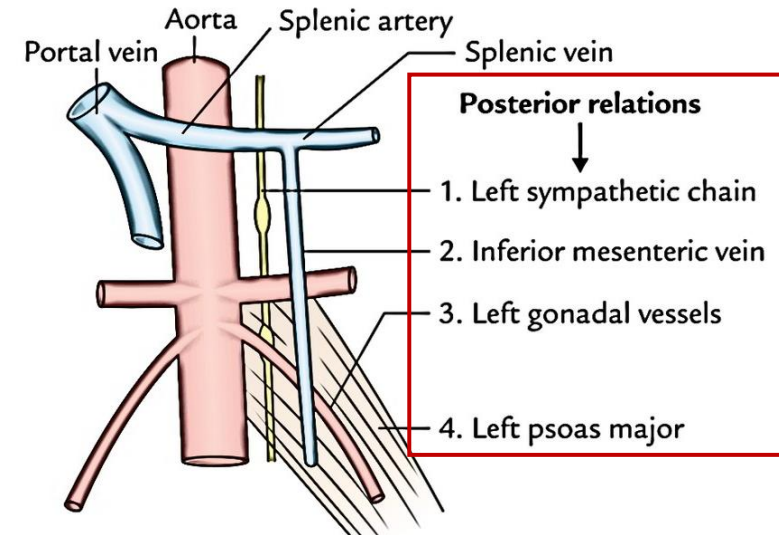
9- 4th part of Duodenum

Start/End Points:

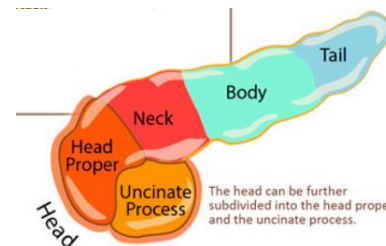
- Ends: at the **duodenojejunal junction (flexure)**.
- This flexure is **held in place by the ligament of Treitz**, which is attached to the **right crus of the diaphragm** (forming the **duodenal recess**).

Anatomical Relations of the 4th Part of the Duodenum:

	Structures Related
Anterior	<ul style="list-style-type: none"> - Beginning of the root of the mesentery - Coils of jejunum
Posterior	<ul style="list-style-type: none"> - Left psoas major - Left sympathetic chain - Margin of the aorta
Superior	<ul style="list-style-type: none"> - * Uncinate process of the head of pancreas



* Uncinate process: an extension that rises from the head of pancreas within the duodenal concavity

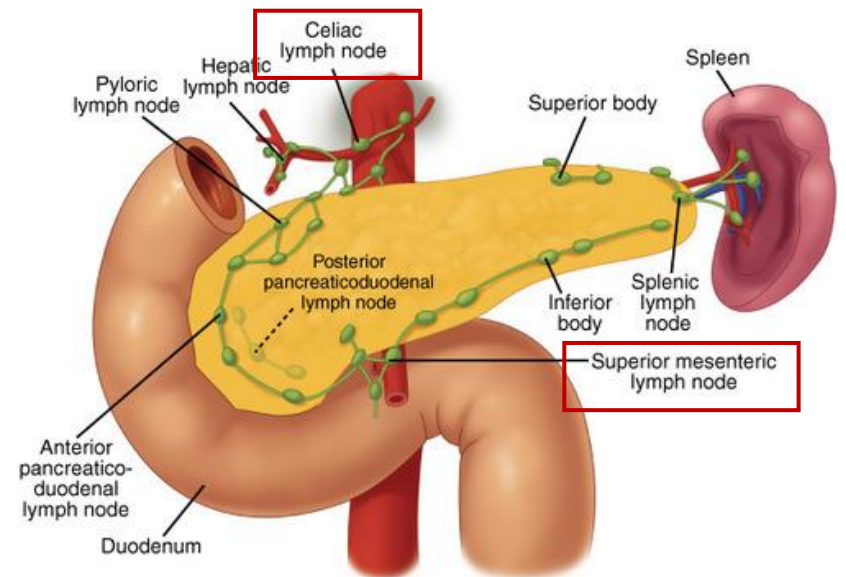
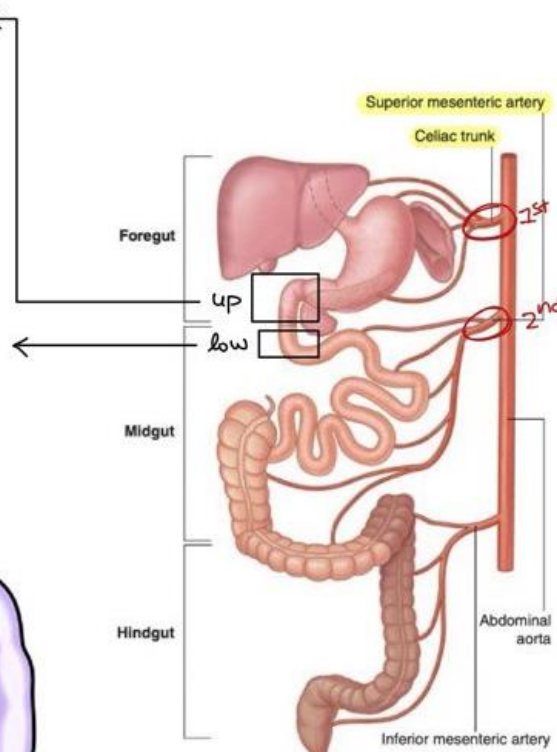
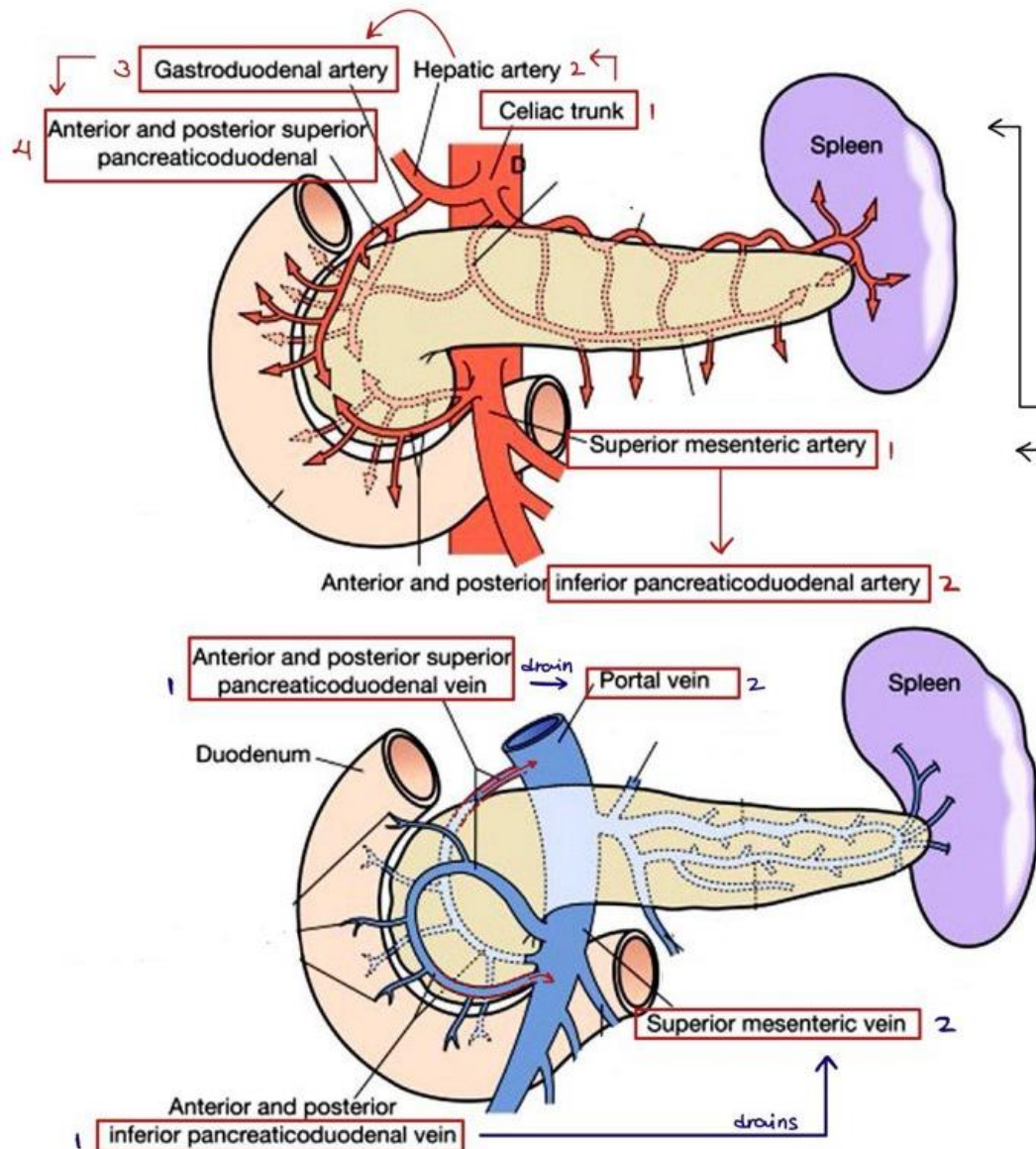


10- Blood & lymphatics supply of the Duodenum

- The duodenum is embryologically divided into two parts by the major duodenal papilla :

Feature	Upper Half (Above Ampulla of Vater)	Lower Half (Below Ampulla of Vater)
Embryological Origin	Foregut	Midgut
Arterial Supply	celiac trunk → gastroduodenal artery → Superior pancreaticoduodenal artery	superior mesenteric artery → Inferior pancreaticoduodenal artery
Venous Drainage	Superior pancreaticoduodenal vein → Portal vein	Inferior pancreaticoduodenal vein → Superior mesenteric vein
Lymphatic Drainage	Follows arteries → drains upward → Celiac lymph nodes	Follows arteries → drains downward → Superior mesenteric nodes

10- Blood & lymphatics supply of the Duodenum



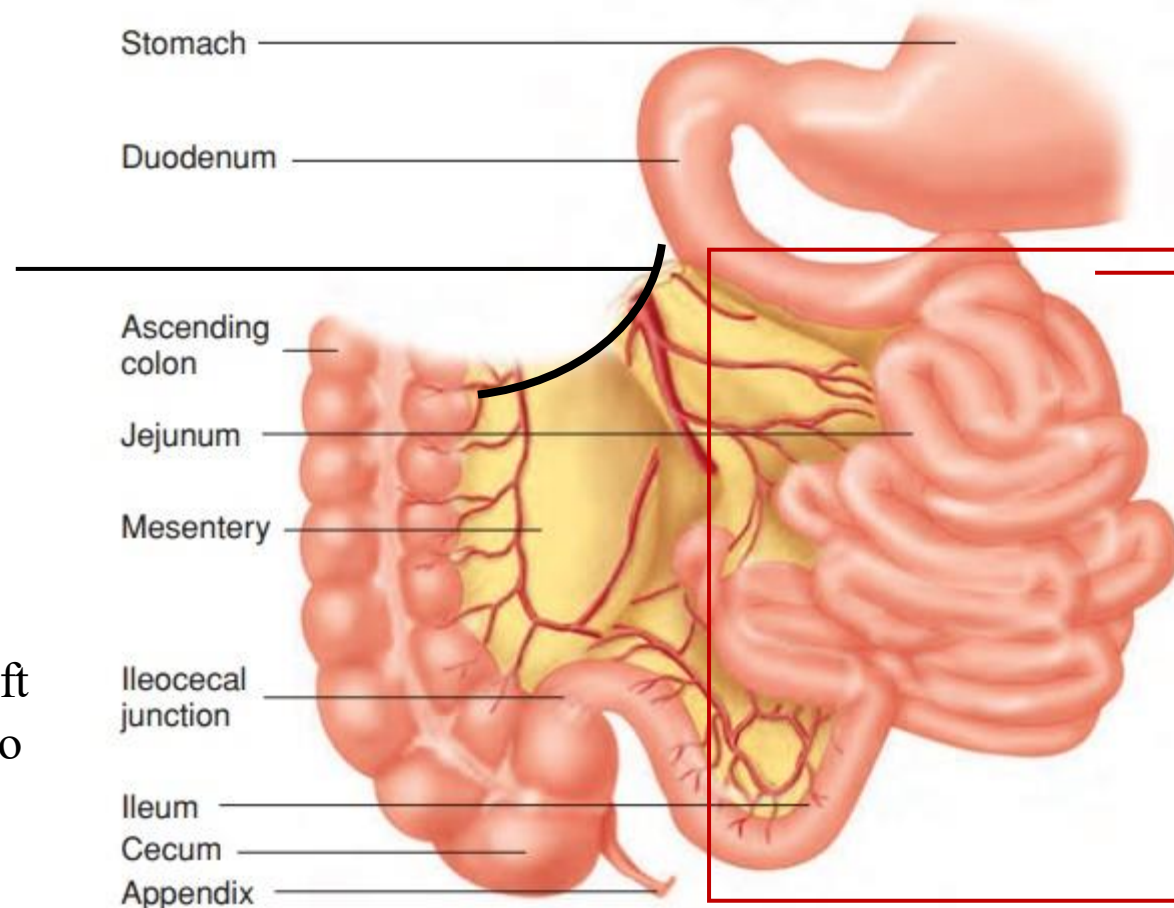
11- The mesentery

- It is a fan-shaped fold consisting of two layers of peritoneum attached to the abdominal cavity. Recall slide (2)
- Contents: (1) The branches of the superior mesenteric vessels, (2) lymph nodes, (3) plexus of nerve & (4) Fats

ROOT OF THE MESENTERY



- Attached to the posterior abdominal wall, about 6 inch!
- Originate from the left side at L2, one inch to the left, to the region Infront of right sacroiliac joint.



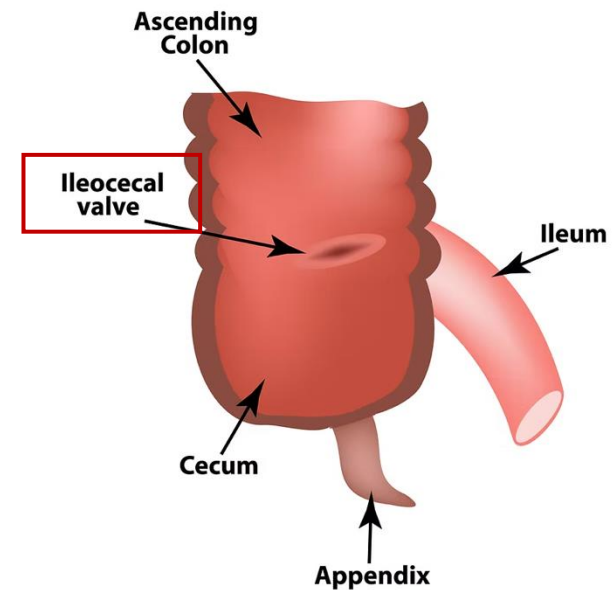
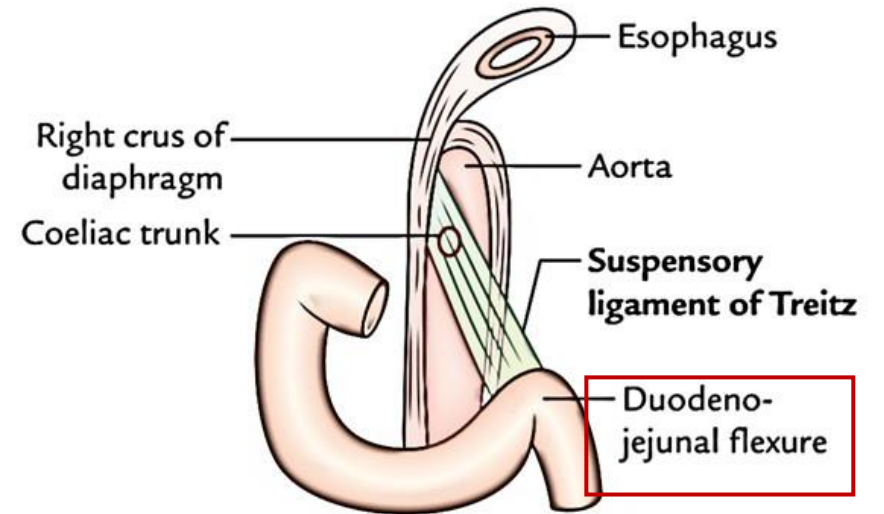
FREE EDGE OF THE MESENTERY



- Contains both jejunum & ileum, about 6 m!

12- Jejunum & Ileum

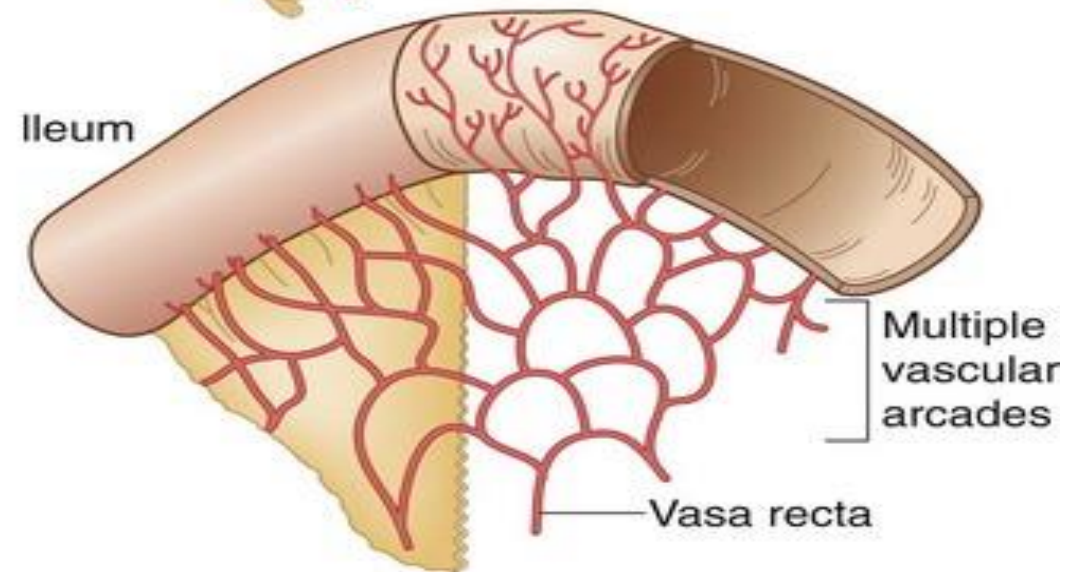
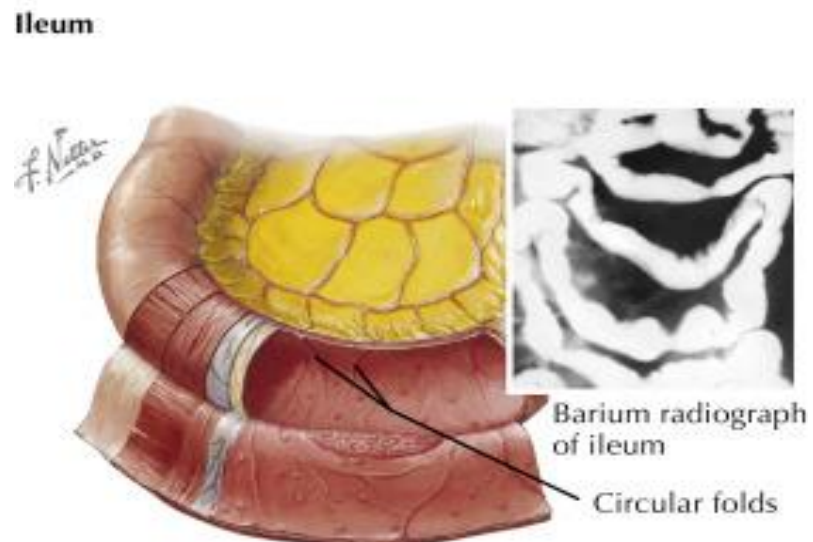
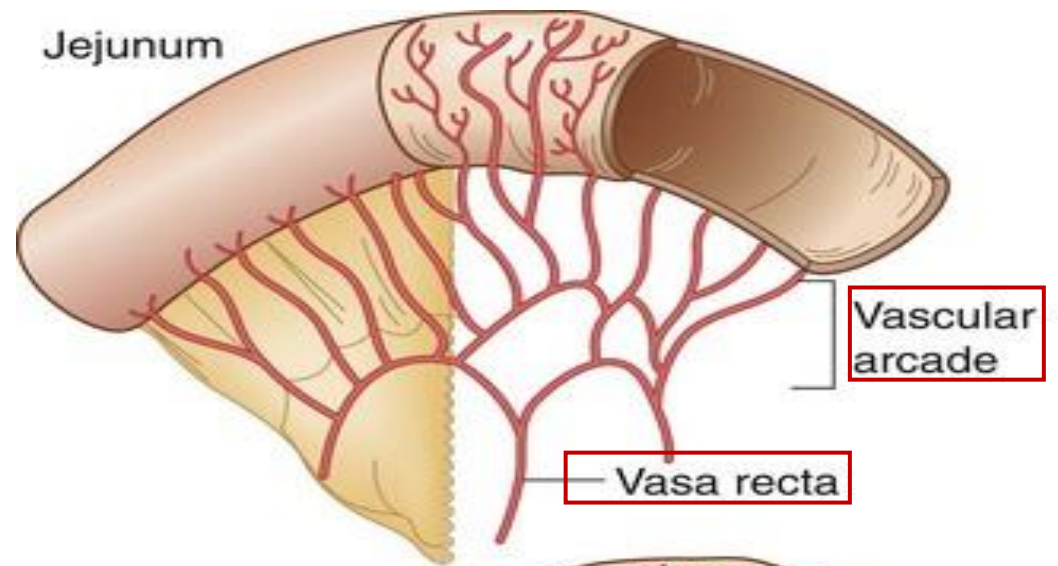
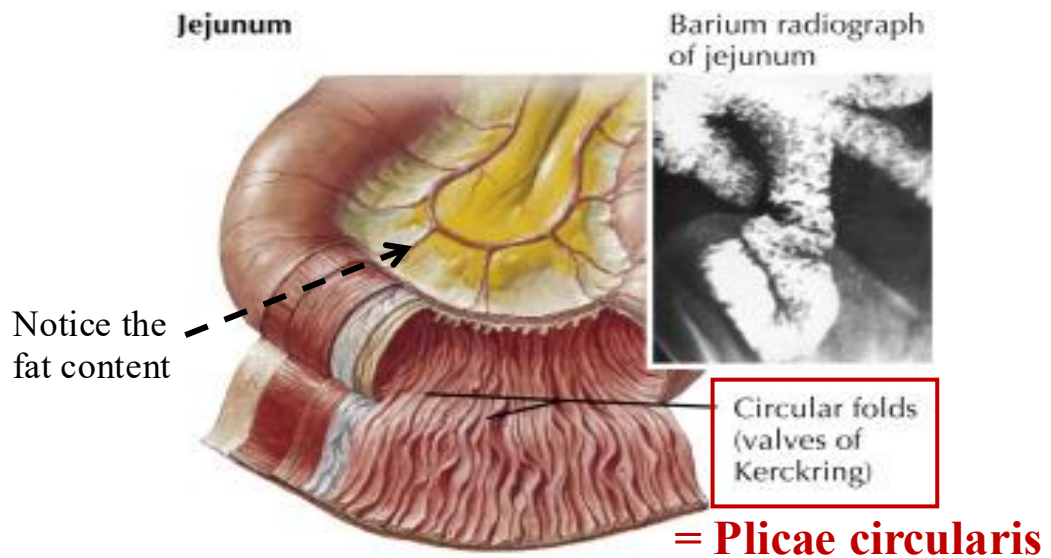
- The jejunum and ileum measure about 20 ft (6 m) long
- **Jejunum:**
Begins at the **duodenojejunal flexure**, attached to the **ligament of Treitz**. Located at the level of the beginning of the mesenteric root.
- **Ileum:**
The ileum ends at the **ileocecal junction**, located in the right iliac fossa. At this junction, a **physiologic valve** is formed by mucosal folds, not by muscular thickening, and therefore it is not a true anatomical valve. It helps prevent the backflow of colonic contents into the ileum. This function is aided by the tension of the cecum pulling on the valve opening, which promotes closure and maintains one-way flow from the small intestine to the large intestine.



12- Jejunum & Ileum

Note: There is no specific landmark to distinguish between Jejunum & Ileum

Feature	Jejunum	Ileum
Position	Upper part of the peritoneal cavity, below the left side of transverse mesocolon	Lower abdomen and pelvis
Length	Proximal 2/5 of small intestine	Distal 3/5 of small intestine
Diameter	Wider	Smaller
Wall Thickness & Color	Thicker wall, redder (more vascular → more absorption)	Thinner wall, paler (less vascular)
Villi	Numerous ☆	Fewer
Plicae Circularis	Prominent	Less prominent
Mesenteric Fat	Less fat	More fat
Arcades	Simple, long vasa recta	Complex, short vasa recta
Lymphoid Tissue	Few or no Peyer's patches	Many Peyer's patches ☆ (aggregated lymphoid follicles)

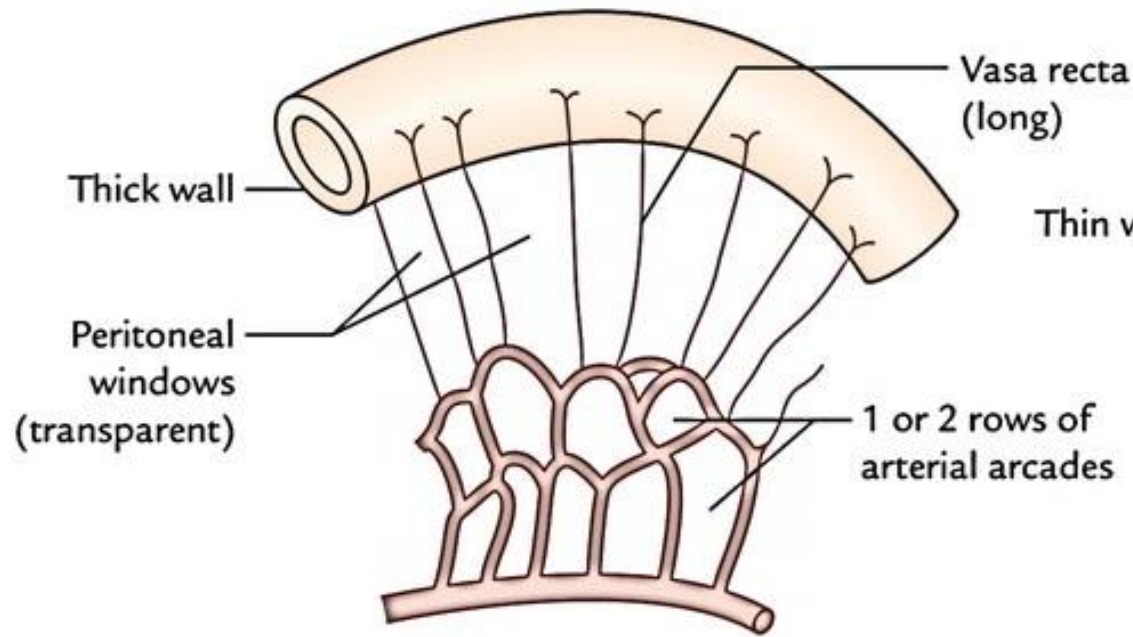


*** Plicae circularis**
(the permanent enfolding of the mucous membrane & submucosa) Resembles the Rugae in the Stomach

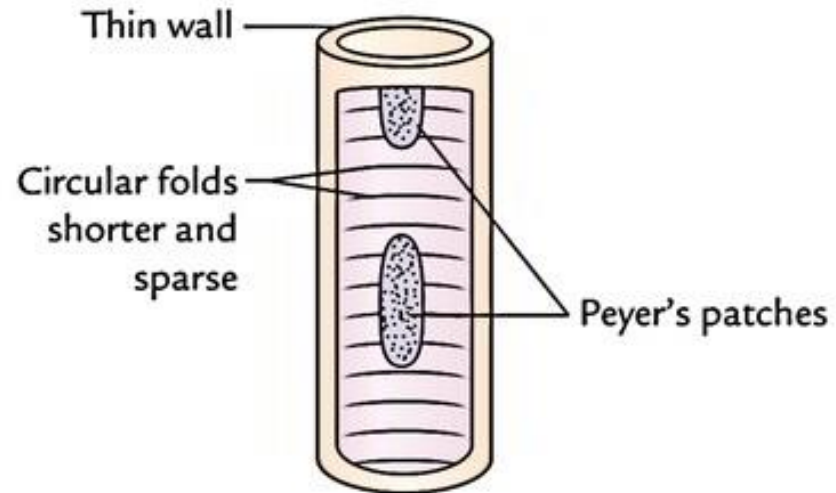
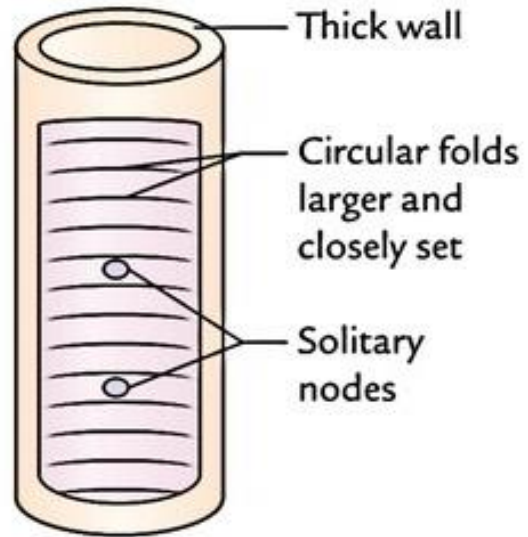
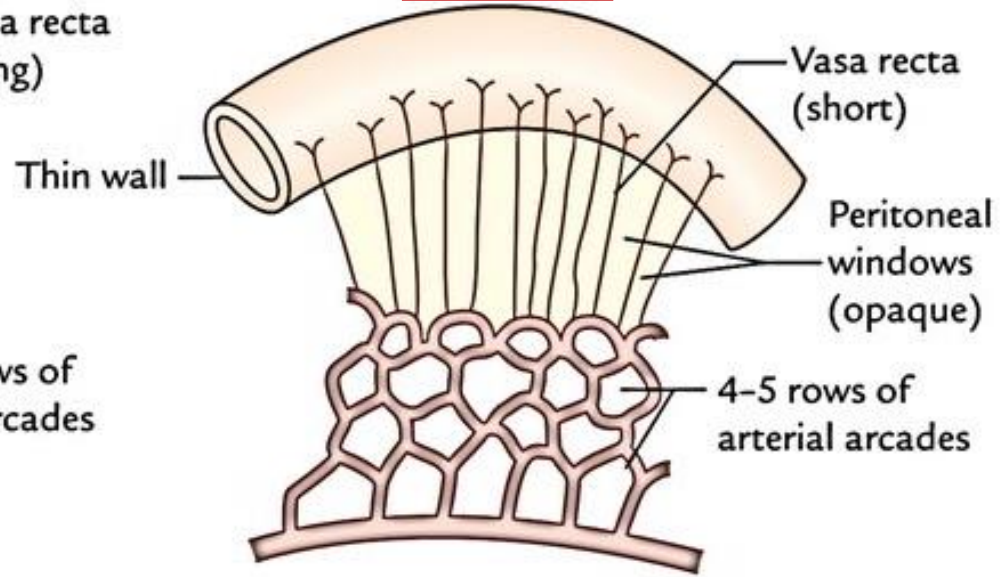
*** Arcades & vasa recta**

Arcades are interconnected branches of the SMA that form window-like loops in the mesentery. These arcades give rise to straight vessels called vasa recta."

Jejunum



Ileum



13- Blood supply & lymphatics of Jejunum & Ileum

Arterial Supply

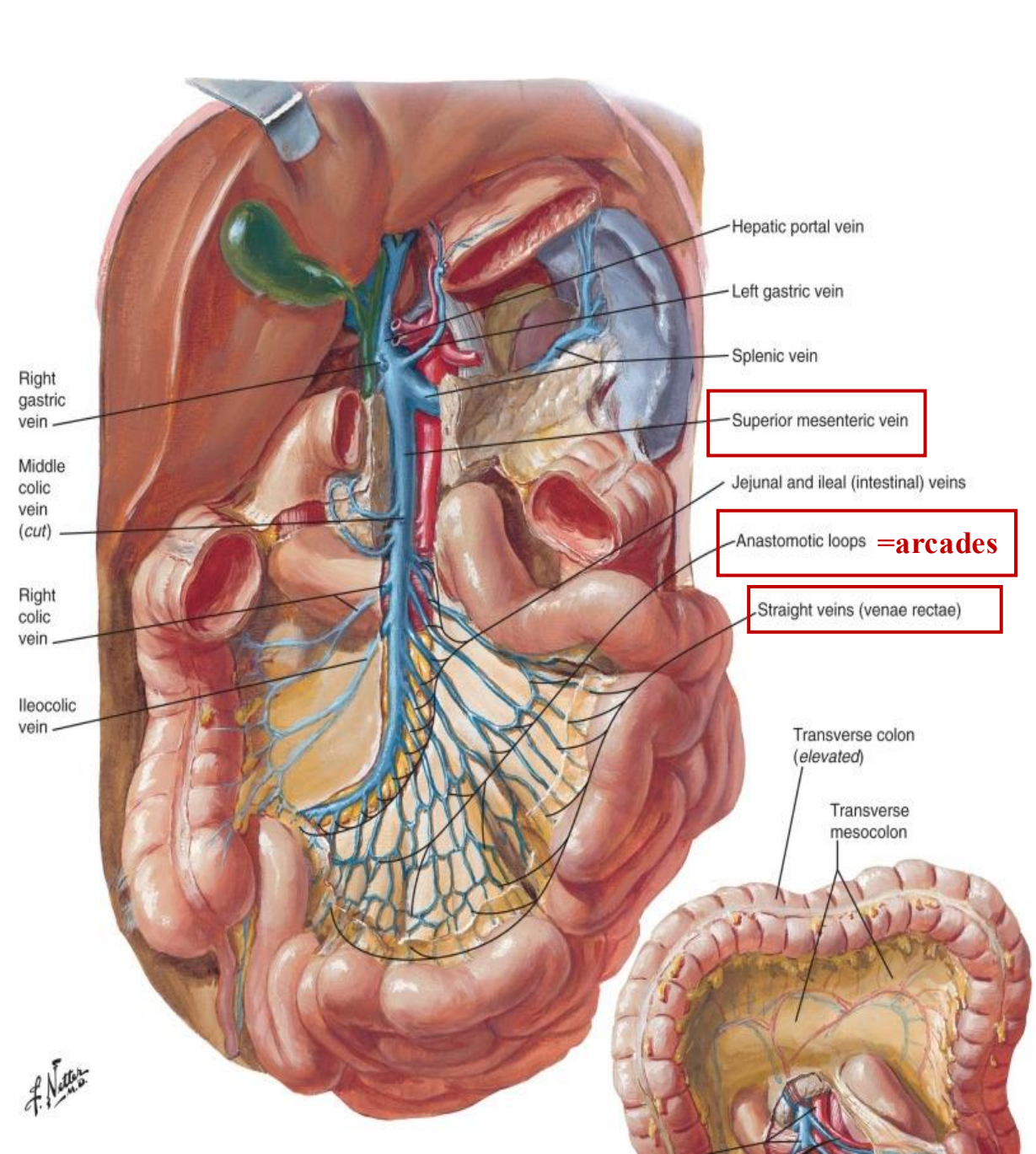
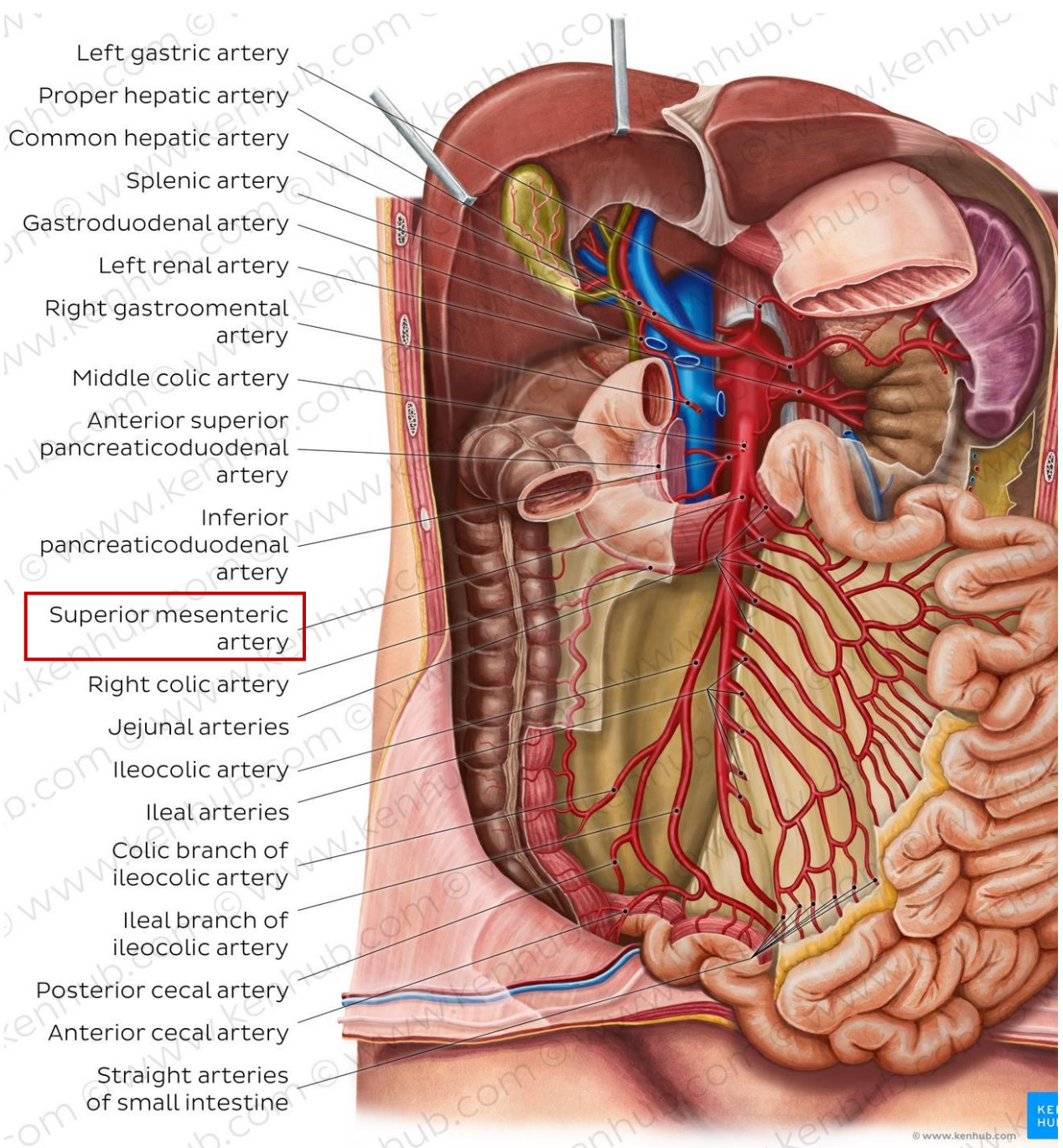
- Branches of the **Superior Mesenteric Artery (SMA)**.
- These branches form **arterial arcades** (loop-like structures).
- Arcades give rise to **Vasa Recta** (straight arteries that supply the intestinal wall).

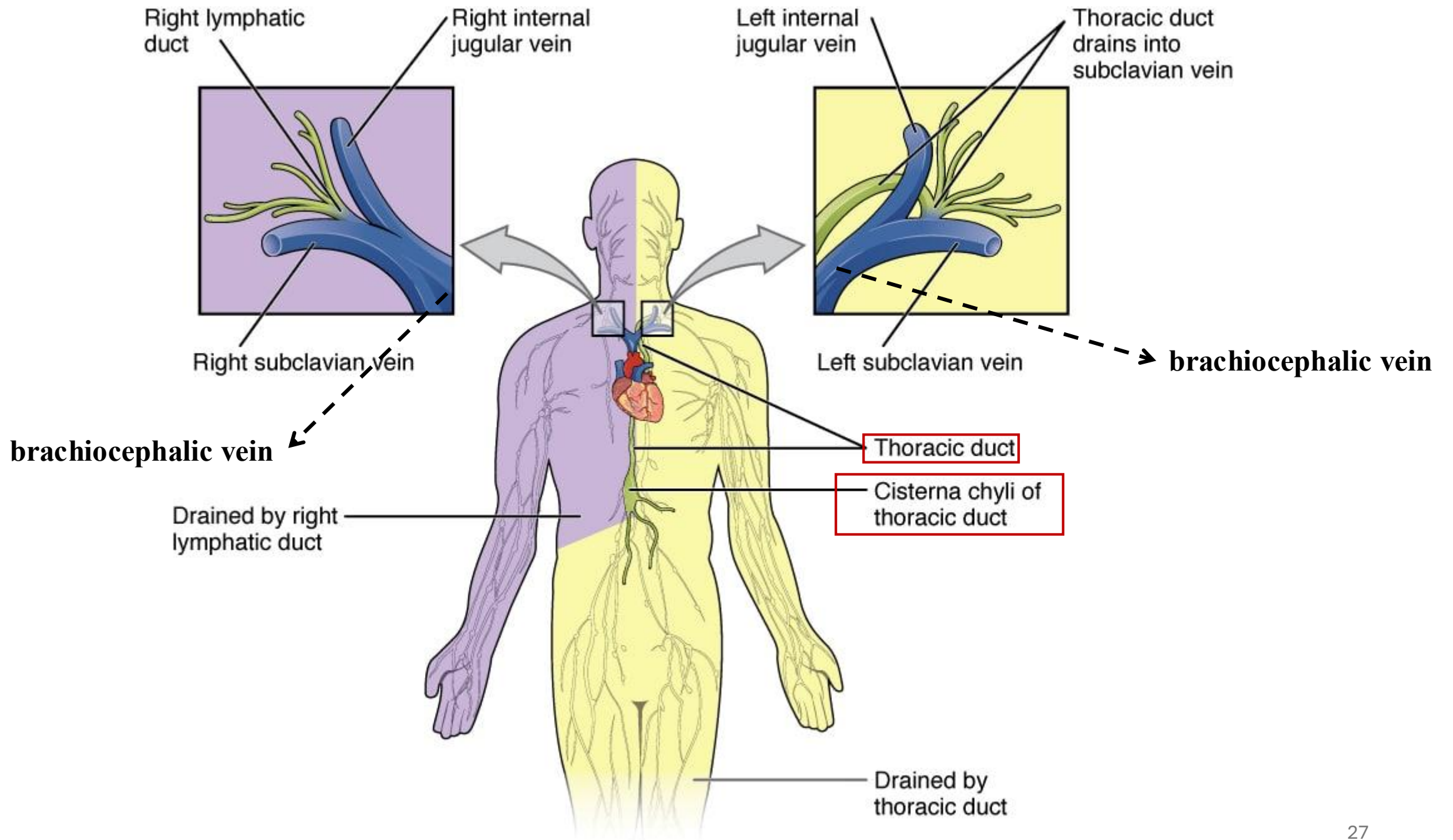
Venous Drainage

- **Veins correspond** to the branches of the SMA.
- These are **tributaries of the Superior Mesenteric Vein (SMV)**.
- Ultimately, they **drain into the SMV**, which joins the splenic vein to form the **portal vein**.

Lymphatic Drainage

- **Terminal drainage:** Into **superior mesenteric lymph nodes** (located at the origin of SMA)
- All the lymphatics of the lower limb, the pelvis and the abdomen drain in the **cisterna chyli** (a lymphatic sac that is present at the aortic orifice of the diaphragm) → The **thoracic duct** arises from the Cisterna Chyli → and eventually empties into the **venous angle at the level of the left brachiocephalic vein**.



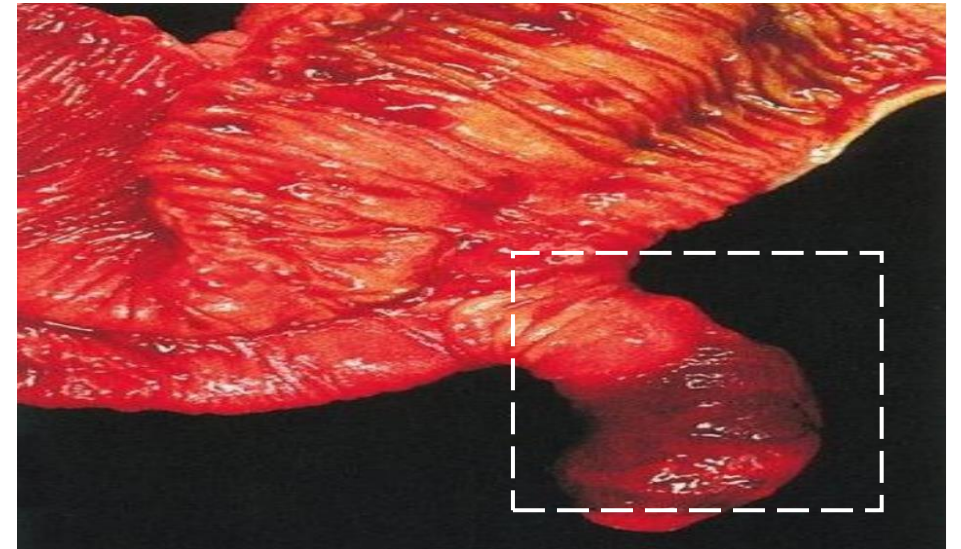


14- Congenital anomaly

➤ Relate to Pathology

☹ Meckel's Diverticulum:

- A congenital anomaly of the ileum.
 - **Cause:** Remnants of the **vitelline duct** from embryonic development. (failure to obliterate after birth.)
 - **Contents:** Can contain **gastric** or **pancreatic** tissue
 - Present in **2%** of the population.
 - Located **2 feet** from the **ileocecal junction**.
 - Measures approximately **2 inches** long.
- } Rule of "2"
- Common site for infection, inflammation, and ulceration. If it ruptures, it can cause **peritonitis**.
 - Due to its similar shape, size, and location, inflamed or infected Meckel's diverticulum may mimic **appendicitis**.



15- Nerve supply of the small intestine

Aspect	Upper Half (Above Ampulla of Vater)	Lower Half of duodenum (Below Ampulla of Vater) & Jejunum & Ileum
Sympathetic Origin	Thoracic spinal cord	
<i>Preganglionic fibers descend through the diaphragm.</i>		
Sympathetic Ganglion	Celiac ganglion	Superior mesenteric ganglion
Sympathetic Pathway	Greater splanchnic nerves → Celiac plexus	Lesser splanchnic nerves → Superior mesenteric plexus
<i>Postganglionic fibers reaches the organ.</i>		
Function	↓ Motility, ↓ secretion, Vasoconstriction , ↑sphincter tone	
Parasympathetic Origin	Vagus nerve (Cranial nerve X)	
Parasympathetic Synapse	In the enteric plexuses (myenteric & submucosal)	
Function	↑ Motility, ↑ secretion, ↓ sphincter tone	

