


SURGICAL ANATOMY OF SMALL INTESTINE

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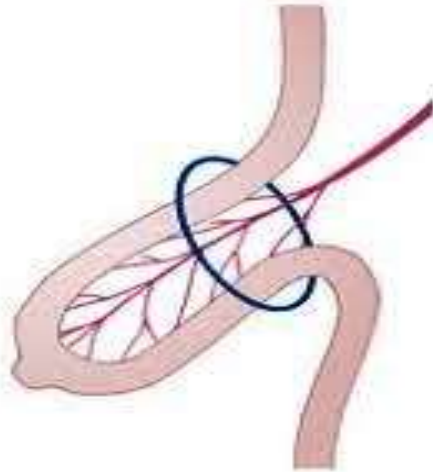
- 
- Small intestine develops from the distal part of the foregut and the midgut by 5th week of intraembryonic life.
 - The developing gut tube is differentiated into pre-arterial segment and post-arterial segment by superior mesenteric artery which acts as an axis around which rotation of gut takes place.

Rotation of gut

- **1st rotation** – 90 anticlockwise
 - site – umbilical opening
 - result – pre arterial segment to Rt side
 - post arterial segment to Lt side

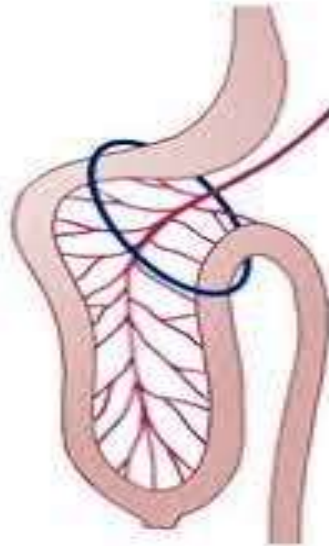
 - **2nd rotation** – 90 anticlockwise
 - site – umbilical opening
 - abdominal cavity
 - result – there is enormous increase in the pre arterial segment and is referred to as physiological hernia which is reduced by 10th week of IUL.
- sub pyloric / midline caecum

First stage

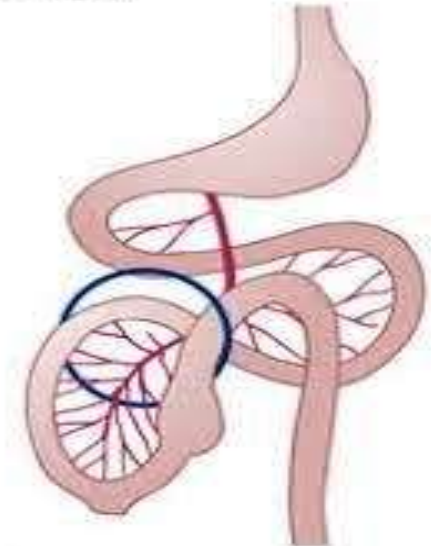


A 6 weeks' gestation

Second stage

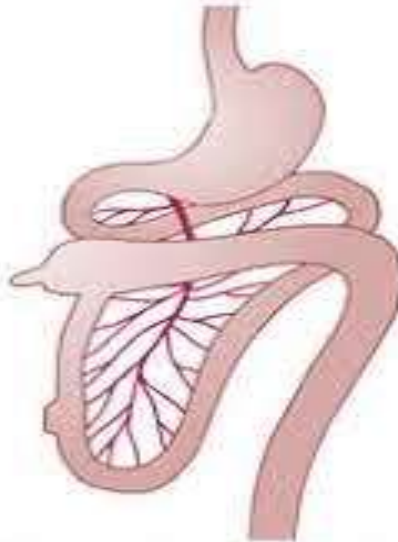


B 8 weeks' gestation

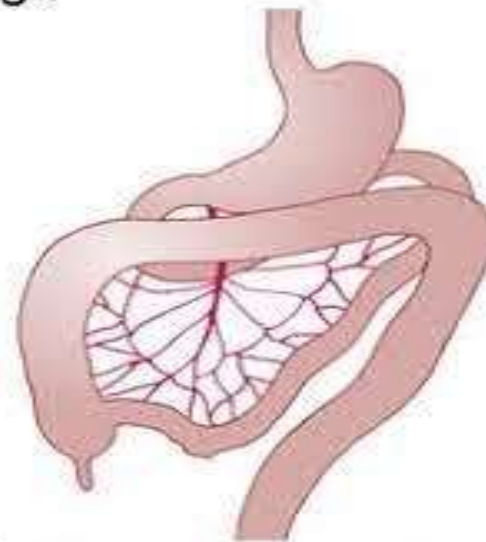


C 9 weeks' gestation

Third stage



D 11 weeks' gestation



E 12 weeks' gestation

➤ **3rd rotation** – 90 anticlockwise

site – abdominal cavity

result – sub pyloric caecum



sub hepatic caecum



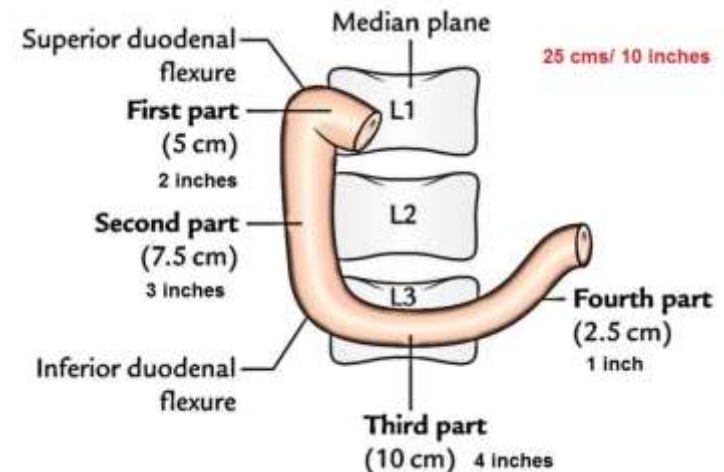
Rt iliac fossa

- Herniation takes place by **6th week**.
- Reduction of hernia by **10th week**.
- Total rotation **270 anticlockwise**.
- The development of the duodenum is completed by rotation, fixation (zygosis) and axial rotation.

- The small intestine extends from the pylorus to the ileocaecal junction.
- Its about 6 meters long.
- The upper of the intestine is the fixed part called the duodenum measures about 25 cm in length.
- The lower part of the intestine is mobile and very long convoluted tube.
- The upper $\frac{2}{5}$ of the mobile intestine is known as jejunum.
- The lower $\frac{3}{5}$ of the mobile intestine is known as ileum.

DUODENUM

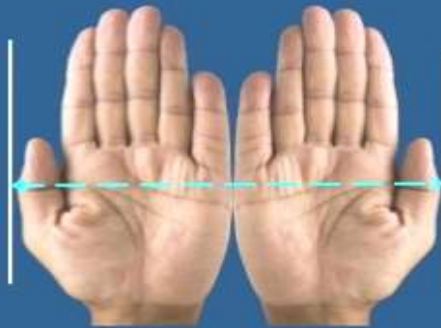
- 25 cm long
- C – shaped bend
- Embraces the head of pancreas in the C – shaped loop.
- Lies above the level of umbilicus opposite first, second and third lumbar vertebrae.
- Divided into 4 parts
 - first 5 cm (superior part)
 - second 7.5 cm (descending part)
 - third 10 cm (horizontal part)
 - fourth 2.5 cm (ascending part)



DUODENUM

Du-deka-dactulos (L)

Length of Duodenum = width of 12 fingers



10 in /
25 cm



Hierophilus 300 BC

- Fixed part of small intestine.
- Devoid of mesentery.
- Retroperitoneal.

➤ **First Part :-**

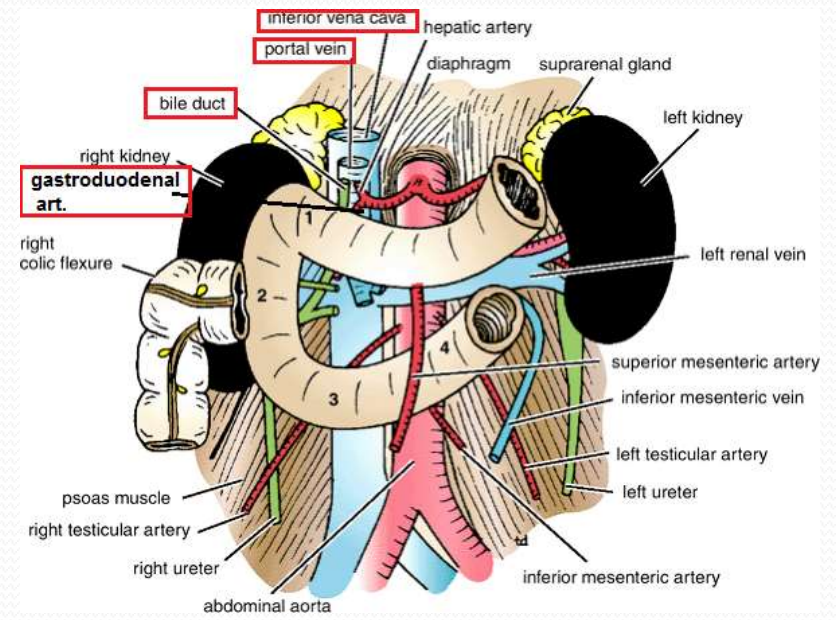
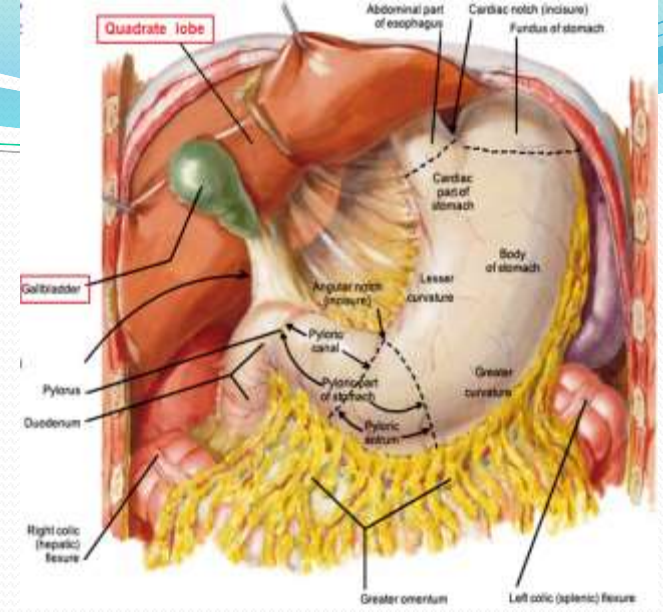
- The first part begins at the pylorus, and passes backwards, upwards and to the right to meet the second part at the superior duodenal flexure.

➤ **Peritoneal Relations :-**

- 1) The proximal 2.5 cm is movable. It is attached to the lesser omentum above, and to the greater omentum below.
- 2) The distal 2.5 cm is fixed. It is retroperitoneal. It is covered with peritoneum only on its anterior aspect.

➤ Visceral Relations

- **Anteriorly:** Quadrate lobe of liver, Gall bladder.
- **Posteriorly:** Gastroduodenal artery, Bile duct, Portal vein and IVC
- **Superiorly :** Epiploic foramen.
- **Interiorly :** Head and neck of the pancreas.



➤ **Second Part :-**

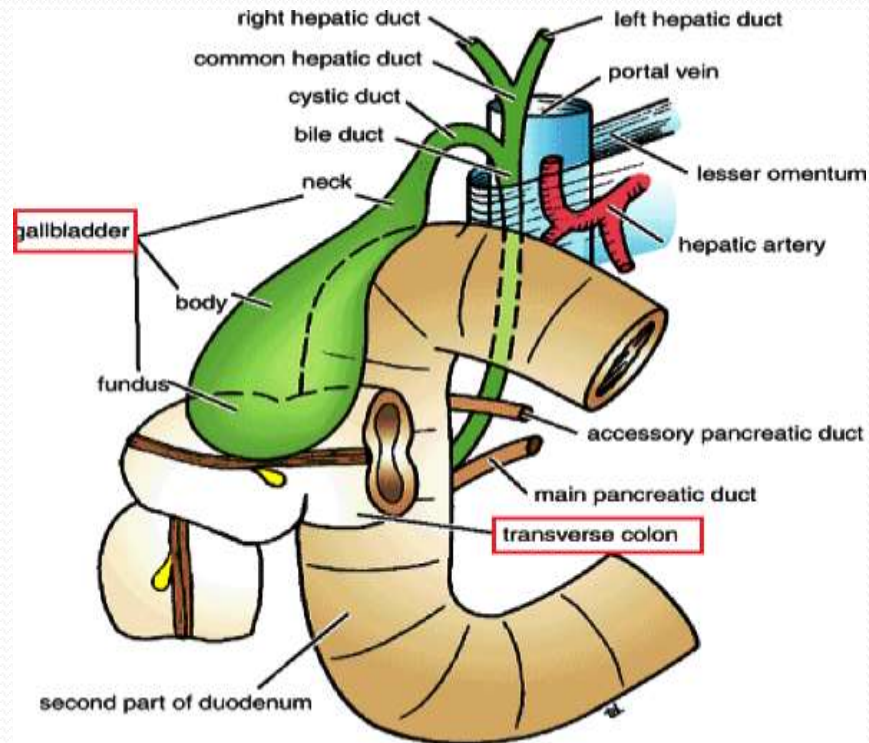
- Course This part is about 7.5 cm long.
- It begins at the superior duodenal flexure, passes downwards to reach the lower border of the third lumbar vertebra, where it curves towards the left at the inferior duodenal flexure, to become continuous with the third part.

➤ **Peritoneal Relations :-**

- It is retroperitoneal and fixed. Its anterior surface is covered with peritoneum, except near the middle, where it is directly related to the colon.

➤ Visceral Relations

- Anteriorly :
 - a. Right lobe of the liver;
 - b. Transverse colon,
 - c. Root of the transverse mesocolon,
 - d. Small intestine .



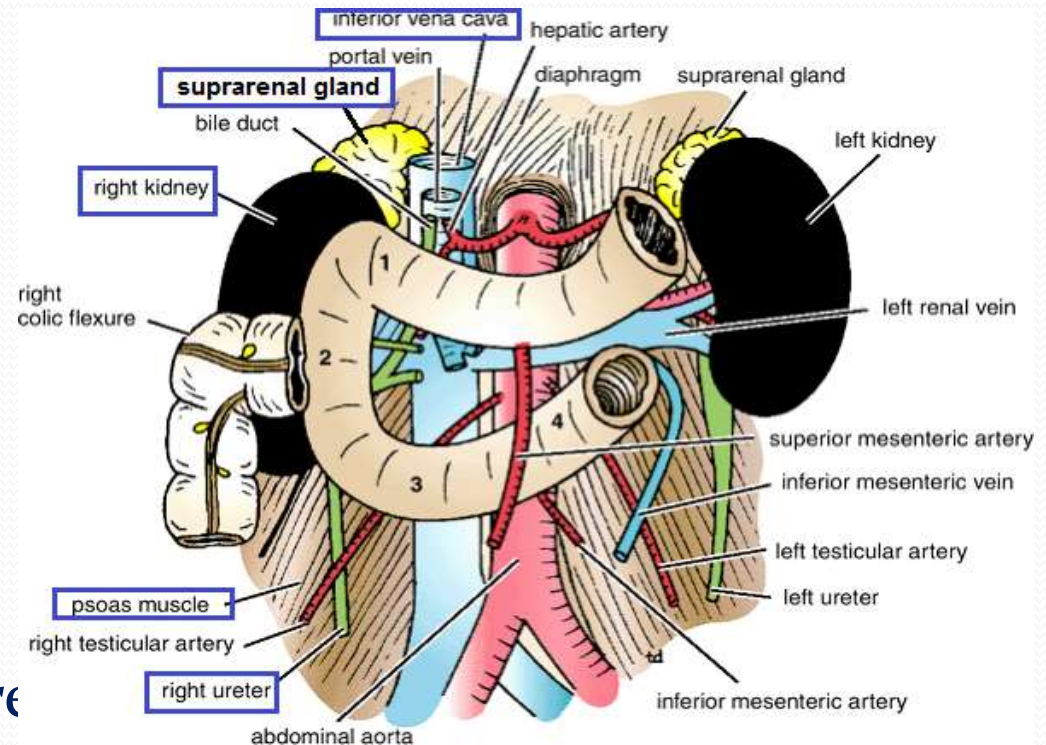
- **Posteriorly:**

- Anterior surface of the right kidney near the medial border,
- Renal pelvis of right ureter
- Right renal vessels,
- Right edge of the inferior vena cava,
- Right psoas major.

- **Medially :**

- Head of the pancreas,
- Bile duct and
- Pancreatic duct

- **Laterally :** Right colic flexure



➤ The interior of the second part of the duodenum shows the following **special features**.

- 1) The major duodenal papilla is an elevation present posteromedially, 8 to 10 cm distal to the pylorus. The hepatopancreatic ampulla opens at the summit of the papilla.
- 2) The minor duodenal papilla is present 6 to 8 cm distal to the pylorus, and presents the opening of the accessory pancreatic duct .
- 3) Plica circularis – permanent mucosal folds. They are also called as valves of Kerkring.

➤ **Third Part :-**

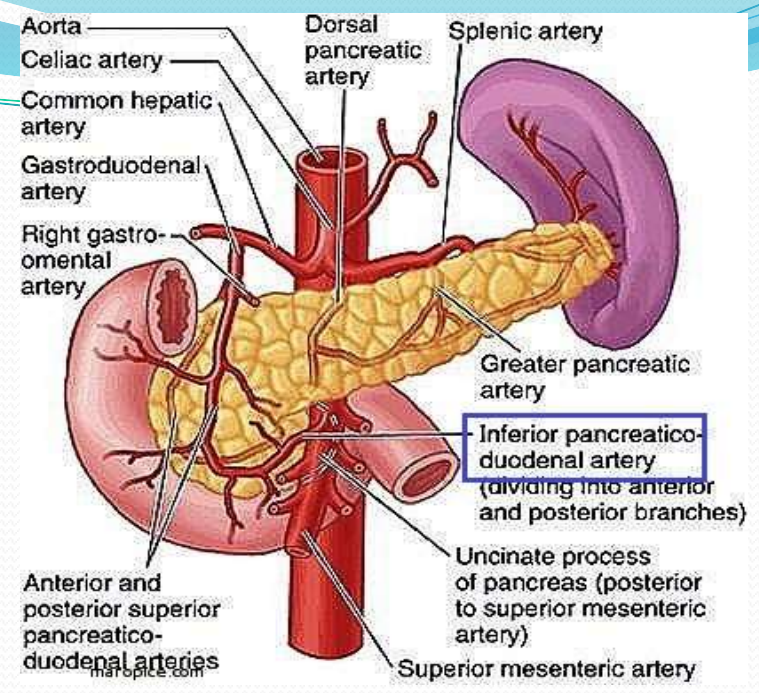
- Course This part is about 10 cm long. It begins at the ! inferior duodenal flexure, on the right side of the lower border of the third lumbar vertebra. It passes almost horizontally and slightly upwards in front of the inferior vena cava, and ends by joining the fourth part in front of the abdominal aorta.

➤ **Peritoneal Relations :-**

- It is retroperitoneal and fixed. Its anterior surface is covered with peritoneum, except in the median plane, where it is crossed by the superior mesenteric vessels and by the root of the mesentery.

➤ Visceral Relations

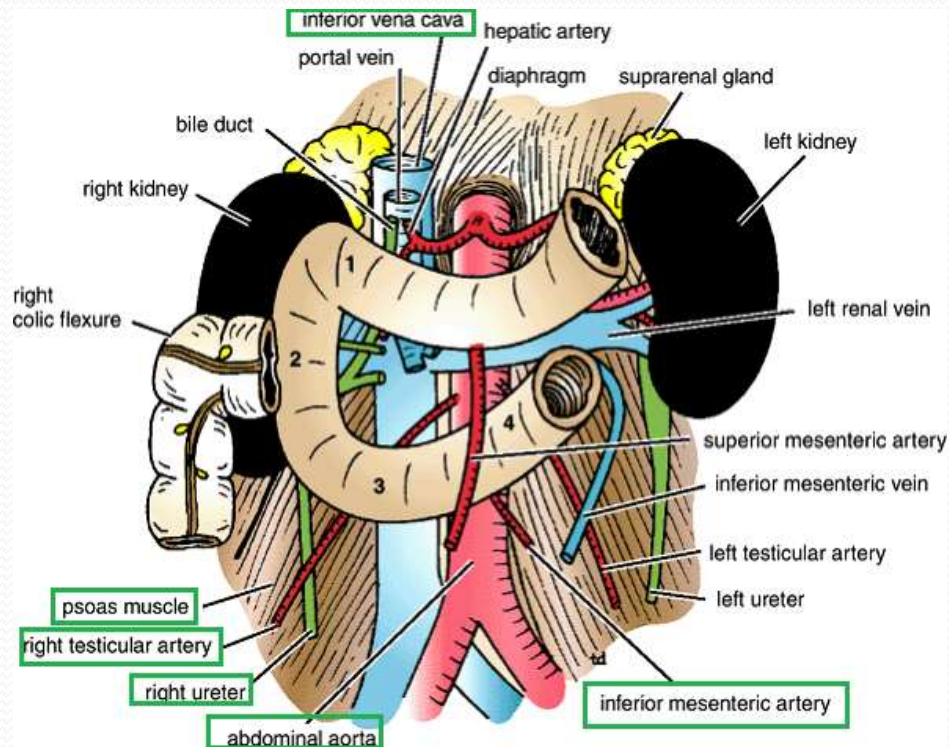
- Anteriorly :
 - a. Superior mesenteric vessels
 - b. Root of mesentery.



- Superiorly : Head of the pancreas with uncinete process
- Inferiorly : Coils of jejunum

- **Posteriorly:**

- a. Right ureter,
- b. Right psoas major,
- c. Right testicular or ovarian vessels,
- d. Inferior vena cava,
- e. Abdominal aorta with origin of inferior mesenteric artery.



➤ **Fourth Part :-**

- Course This part is 2.5 cm long. It runs upwards on or immediately to the left of the aorta, up to the upper border of the second lumbar vertebra, where it turns forwards to become continuous with the jejunum at the duodenojejunal flexure.

➤ **Peritoneal Relations**

- It is mostly retroperitoneal, and covered with peritoneum only anteriorly. The terminal part is suspended by the uppermost part of the mesentery, and is mobile.

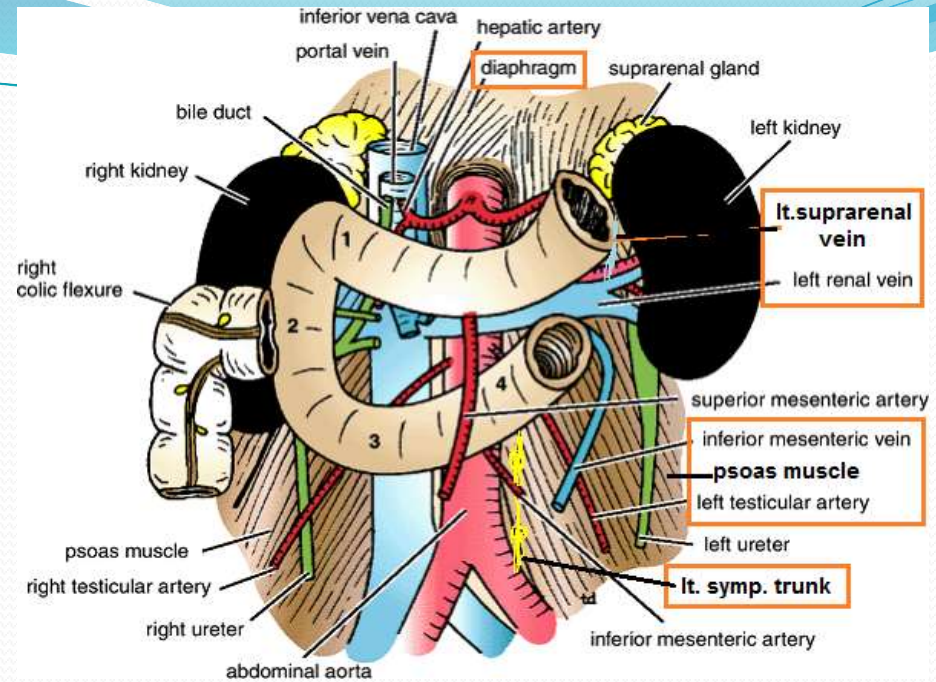
➤ Visceral Relations

- Anteriorly :
 - a. Transverse colon,
 - b. Transverse mesocolon,
 - c. Lesser sac, and
 - d. Stomach.



- **Posteriorly :**

- Left sympathetic chain,
- Left psoas major,
- Left renal vessels,
- Left testicular vessels, and
- Inferior mesenteric vein.



- **To the right:**

Attachment of the upper part of the root of the mesentery

- **To the left:**

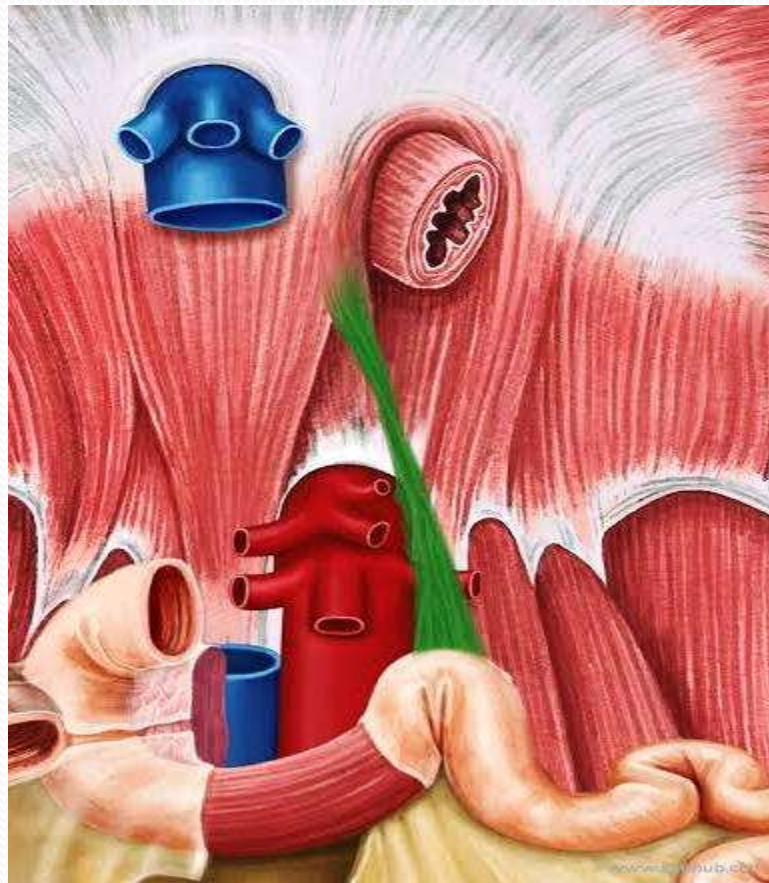
- Left kidney and
- Left ureter.

- **Superiorly :** Body of pancreas

LIGAMENT OF TREITZ

- This is a fibromuscular band which suspends and supports the duodenojejunal flexure.
- Arises from the right crus of the diaphragm, close to the right side of the oesophagus, passes downwards behind the pancreas, attached to the posterior surface of the duodenojejunal flexure and 3rd and 4th part of the duodenum.
- It is made of
 - striped muscle fibers in its upper part
 - elastic fibers in its middle part
 - plain muscle fibers in its lower part

- Its contraction increases the angle of the duodenojejunal flexure.
- Sometimes it is attached only to the duodenojejunal flexure, then its contraction may narrow the angle of duodenojejunal flexure, causing partial obstruction of the gut.

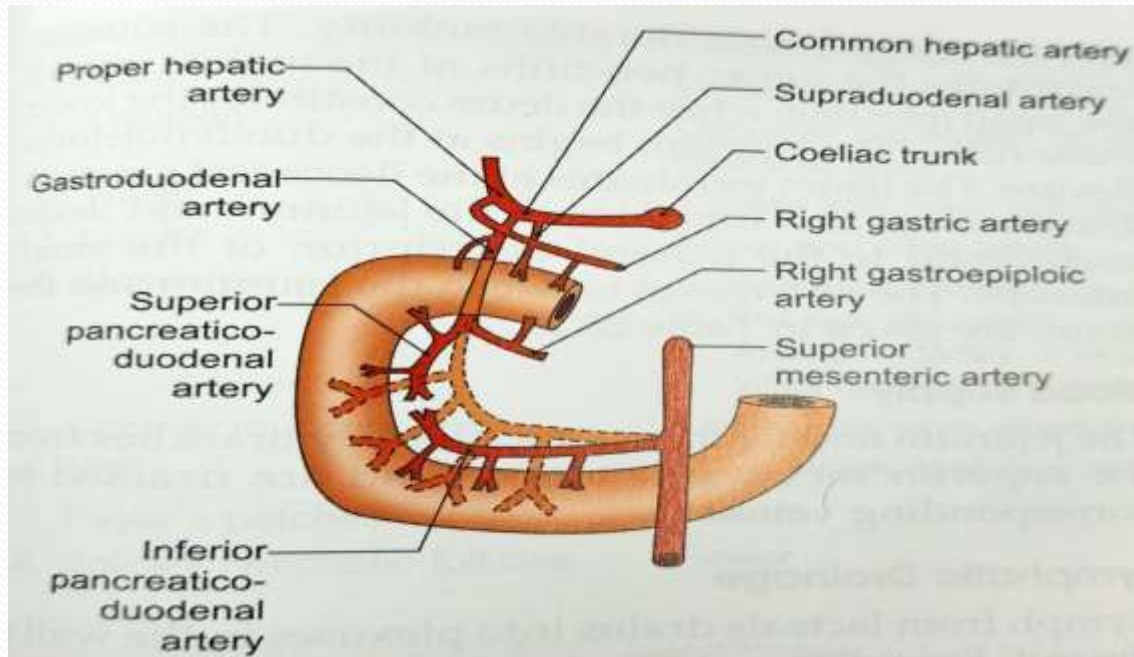


➤ Arterial Supply

- The duodenum develops partly from the foregut and partly from the midgut.
- The opening of the bile duct into the second part of the duodenum represents the junction of the foregut and the midgut.
- Upto the level of the opening, the duodenum is supplied by the superior pancreaticoduodenal artery,
below it by the inferior pancreaticoduodenal artery .

- The first part of the duodenum receives additional supply from:

- a. The supraduodenal artery of Wilkie, which is usually a branch of the hepatic artery;
- b. The retroduodenal branch of the gastroduodenal artery;
- c. Some branches from the right gastroepiploic artery.



➤ Venous Drainage

- The veins of the duodenum drain into the splenic, superior mesenteric and portal veins.

➤ Lymphatic Drainage

- Most of the lymph vessels from the duodenum end in the pancreaticoduodenal nodes present along the inside of the curve of the duodenum, i.e. at the junction of the pancreas and the duodenum.
- From here the lymph passes partly to the hepatic nodes, and through them to the coeliac nodes; and partly to the superior mesenteric nodes and ultimately via intestinal lymph trunk into the cisterna chyli.
- Some vessels from the first part of the duodenum drain into the pyloric nodes, and through them to the hepatic nodes.
- Some vessels drain into the hepatic nodes directly.
- All the lymph reaching the hepatic nodes drains into the coeliac nodes.

Duodenum - Nerve supply

Sympathetic nerves are derived from coeliac and sup. Mesen. Plexuses.

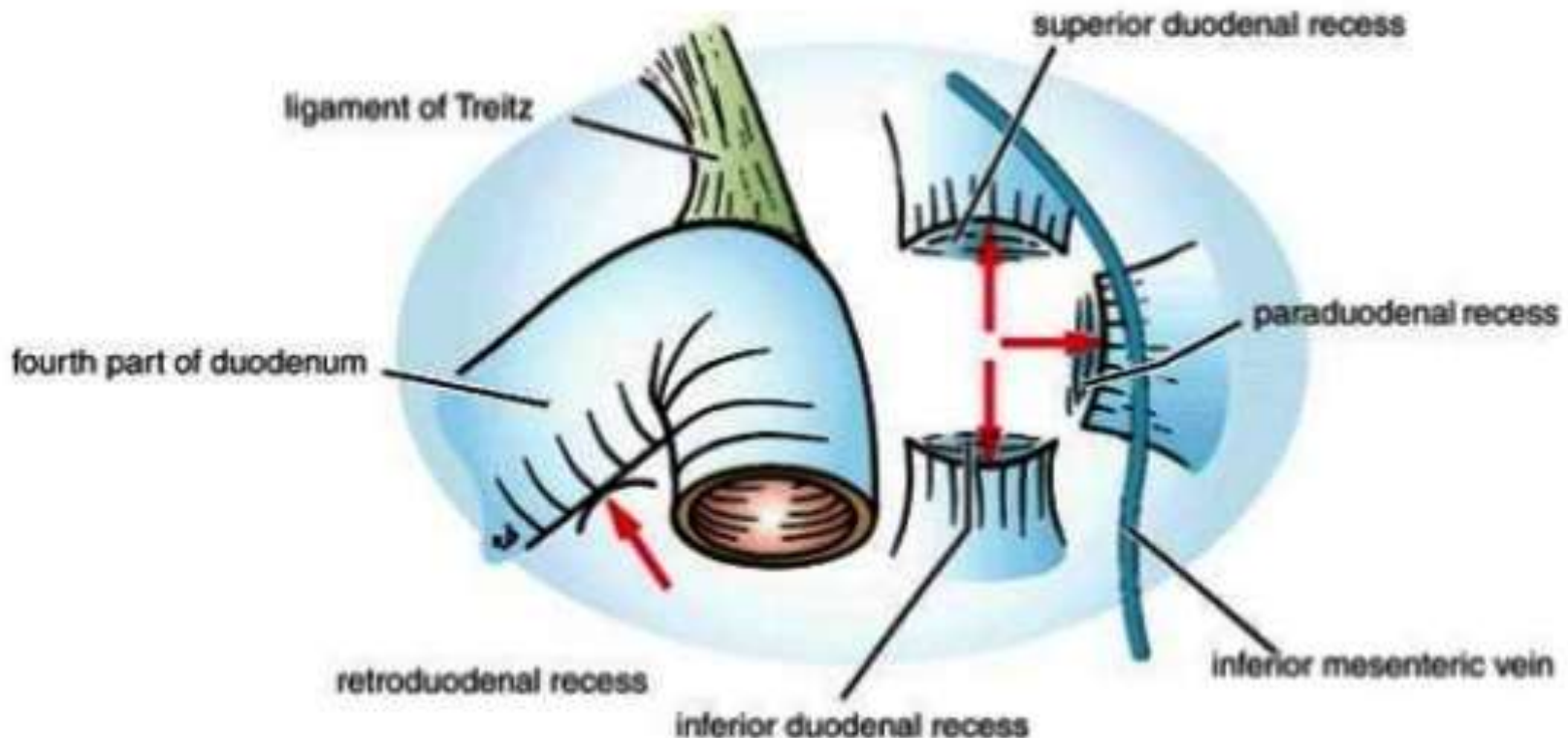
Preganglionic fibres come from T6 to T9 segments of spinal cord.

Parasympathetic are derived from both vagus nerves .

The myenteric (Auerbach's plexus) & Meisner's plexuses
Act as post ganglionic neurons for parasympathetic fibres
only.

Duodenal Recesses

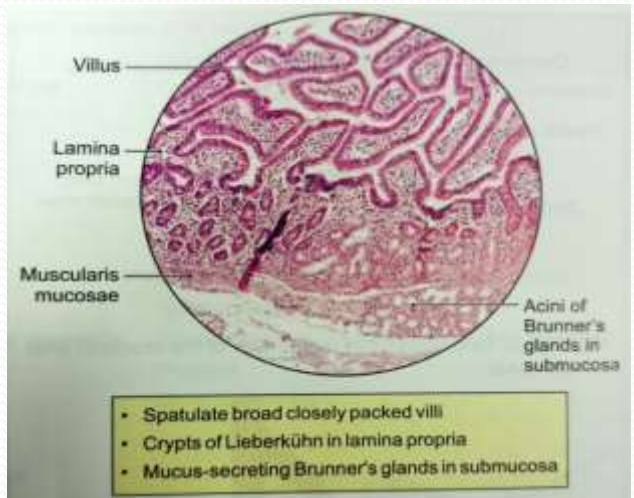
Close to the duodeno-jejunal junction, four small pocket like pouches of peritoneum -**Internal hernia**.



Inferior mesenteric vein in the peritoneal fold, forming the **paraduodenal** recess.

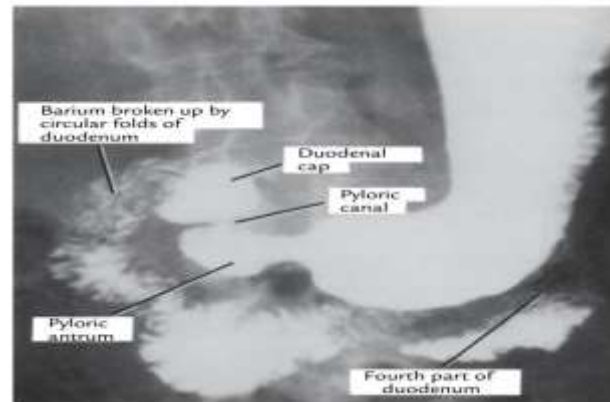
HISTOLOGY OF DUODENUM:-

- Mucous membrane: Shows evaginations in the form of villi and invaginations to form crypts of Lieberkuhn.
- Lining of villi is of columnar cells with microvilli.
- Muscularis mucosae comprises two layers:-
- Submucosa is full of mucus secreting Brunner's glands.
- The muscularis externa comprises outer longitudinal and inner circular layer of muscle fibres.
- Outermost layer is mostly connective tissue.



➤ CLINICAL ANATOMY

- 1) In the skiagrams taken after giving a barium meal, the first part of the duodenum is seen as a triangular shadow called the duodenal cap. Rest of the duodenum appears as feathery appearance due to permanent mucosal folds.



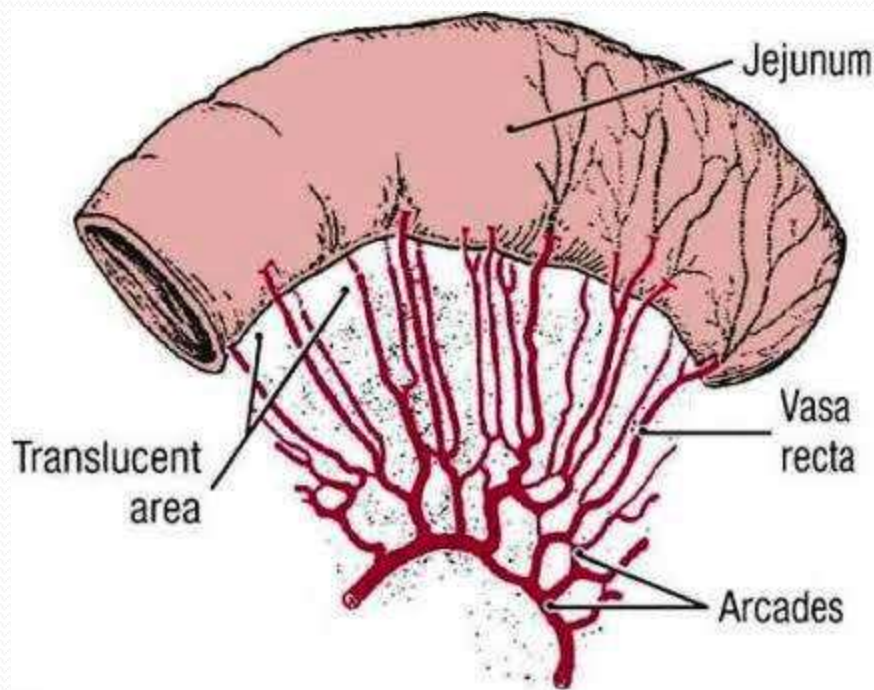
- 2) The first part of the duodenum is one of the commonest sites for peptic ulcer, possibly because of direct exposure of this part to the acidic contents reaching it from the stomach. The patient is usually an overbusy young person with a tense temperament. The ulcer pain located at the right half of epigastrium is relieved by meals and reappears on an empty stomach.

- 3) The first part of duodenum is overlapped by the liver and gall bladder, either of which may become adherent to, or even ulcerated by a duodenal ulcer.
- 4) Duodenal diverticula are fairly frequent. They are seen along its concave border, generally at points where arteries enter the duodenal wall.
- 5) Congenital stenosis and obstruction of the second part of the duodenum may occur at the site of the opening of the bile duct. Other causes of obstruction are
 - (i) an annular pancreas;
 - (ii) pressure by the superior mesenteric artery against the abdominal aorta
 - (iii) contraction of the suspensory muscle of the duodenum
- 6) Duodenal carcinoma.

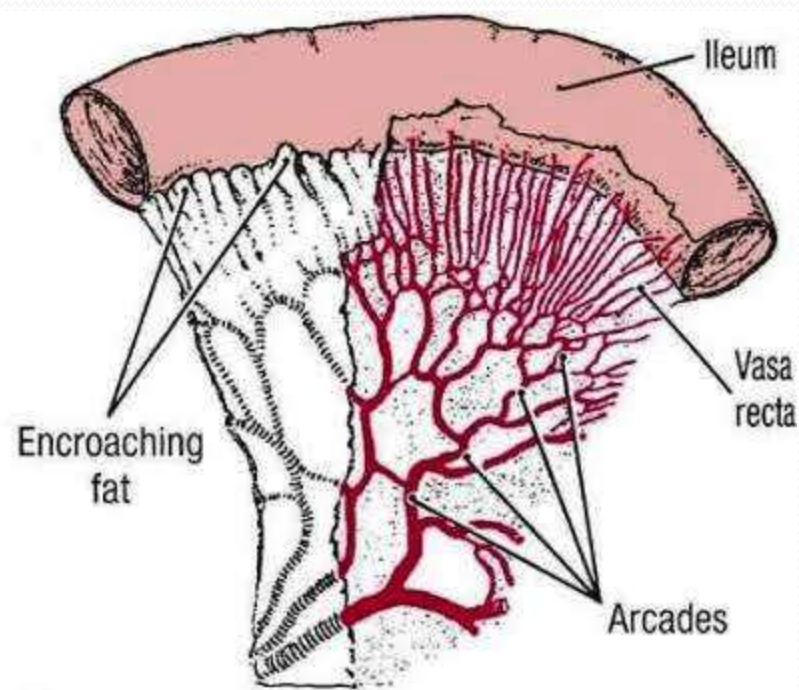
JEJUNUM AND ILEUM

- The jejunum and ileum are suspended from the posterior abdominal wall by the mesentery and, therefore, enjoy considerable mobility.
- The jejunum constitutes the upper two-fifths of the mobile part of the small intestine, while the ileum constitutes the lower three-fifths. The jejunum begins at the duodenojejunal flexure.
- The ileum terminates at the ileocaecal junction.
- The structure and functions of the jejunum and ileum correspond to the general description of the small intestine.

Feature	Jejunum	Ileum
1. Location	Occupies upper and left parts of the intestinal area	Occupies lower and right parts of the intestinal area
2. Walls	Thicker and more vascular	Thinner and less vascular
3. Lumen	Wider and often empty	Narrower and often loaded
4. Mesentery	<ul style="list-style-type: none"> a. Windows present b. Fat less abundant c. Arterial arcades, 1 or 2 d. Vasa recta longer and fewer 	<ul style="list-style-type: none"> a. No windows b. Fat more abundant c. Arterial arcades, 3 or 6 d. Vasa recta shorter and more numerous
5. Circular mucosal folds	Larger and more closely set	Smaller and sparse
6. Villi	Large, thick (leaf-like) and more abundant	Shorter, thinner (finger-like) and less abundant
7. Peyer's patches	Absent	Present
8. Solitary lymphatic follicles	Fewer	More numerous



A



B

➤ **Blood Supply of jejunum and ileum**

- Supplied by the branches from the superior mesenteric artery, and are drained by corresponding veins.

➤ **Lymphatic Drainage**

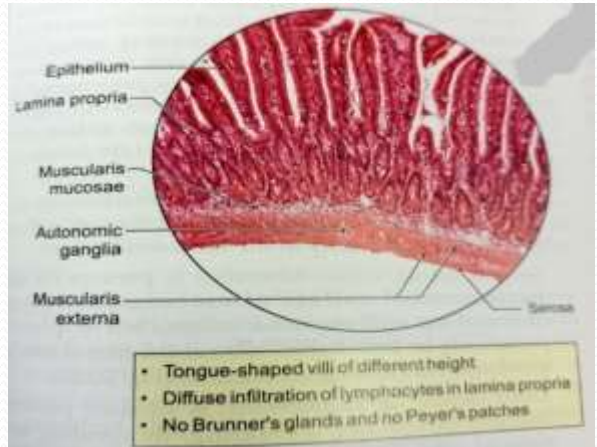
- Lymph from lacteals drains into plexuses in the wall of the gut.
- From there it passes into lymphatic vessels in the mesentery.
- Passing through numerous lymph nodes present in the mesentery, and along the superior mesenteric artery, it ultimately drains into nodes present in front of the aorta at the origin of the superior mesenteric artery.

- **Nerve supply** – sympathetic nerves from T9 to T11 spinal segments
-- parasympathetic is from vagus.

HISTOLOGY

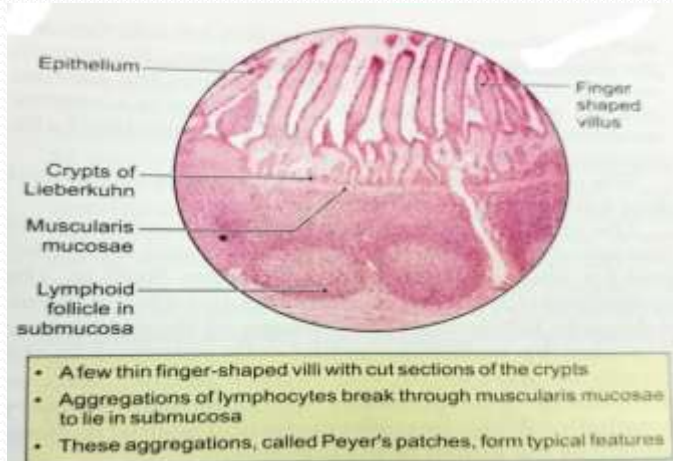
Jejunum

- The villi here are tongue-shaped.
- No mucous glands or aggregated lymphoid follicles are present in the submucosa.
- Muscularis externa is same as in duodenum.
- Outermost is the serous layer.



Ileum

- The villi are few, thin and finger like.
- Collection of lymphocytes in the form of Peyer's patches in lamina propria extending into the submucosa is a characteristic feature.



➤ CLINICAL ANATOMY

- 1) Meckel's diverticulum may cause intestinal obstruction.
- 2) Occasionally it may have small regions of gastric mucosa/pancreatic tissue.
- 3) Acute inflammation of the diverticulum may produce symptoms that resemble those of appendicitis.
- 4) It may be involved in other diseases similar to those of the intestine.

➤ ANOMALIES

1) NON ROTATION OF THE GUT

1st rotation is normal

2nd and 3rd rotation abnormal

Reduction of hernia

Small Intestine to Rt side

Large Intestine to Lt side

2) REVERSE ROTATION OF THE GUT

1ST rotation is normal

180 clockwise rotation

post arterial segment returns to abdominal cavity before pre arterial segment.

Transverse colon overlapped by small intestine and superior mesenteric artery.

3) MALROTATION OF THE GUT

1st and 2nd rotation normal

3rd rotation is abnormal

subpyloric/midline/epigastric caecum

4) Malrotated caecum + ladd bands leads to **volvulus**.

5) Failure of reduction of physiological hernia leads to **omphalocele**.

6) Recurrence of hernia from the defect in the anterior abdominal wall leads to **Gastroschisis** – usually associated with intestinal obstruction.



THANK YOU