

Duodenum:

-General features:

-The duodenum pursues a C shaped course, it measure 10(25 cm) Inches in length. Concave retroperitoneal organ, the concavity tilts backward and to the right.

-The head of pancreas (it's tail extends from an area nearby the spleen in the left hypochondriac region)is present within the duodenal concavity (the duodenum curved around the head of pancreas to the left and backward).

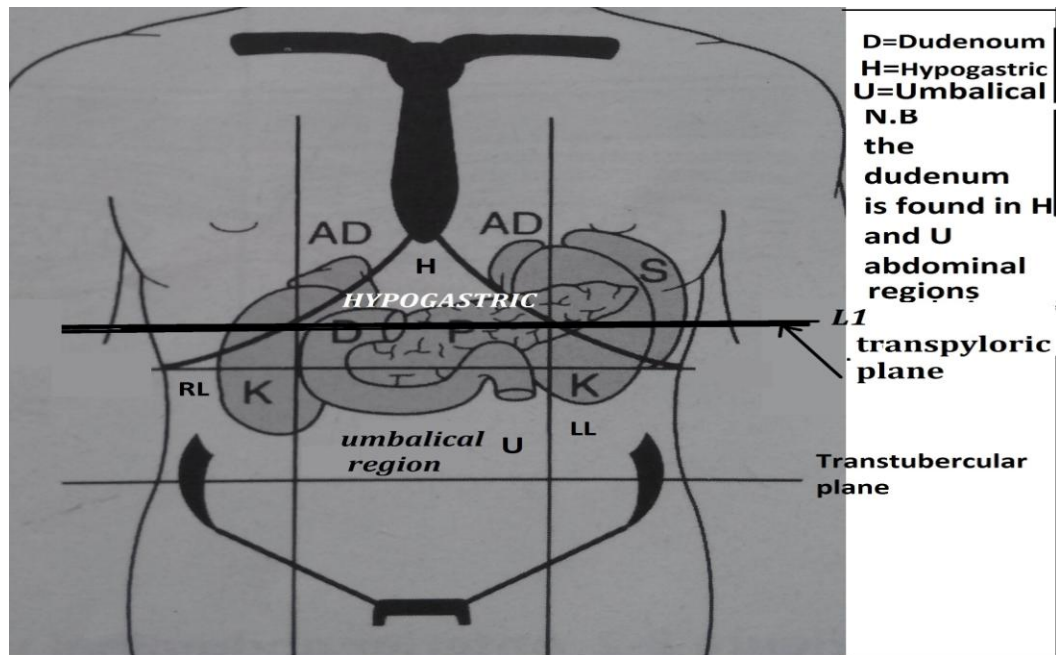
- It has a special description because it is retroperitoneal organ.

-The retroperitoneal organ is important surgically Because they are immobile (Fixed)while intraperitoneal organs are mobile but the duodenum which is a retroperitoneal and with its first and the last intraperitoneal inches is a fixed organ so that, it is not mobile and you can't move it during surgery like jejunum (connected to the free border of mesentery) which is movable , you can move it during surgery like gastrojejunostomy *connecting the jejunum with the stomach*.

- Right hepatic duct unites with left hepatic duct forming common hepatic duct. Then they become united with cystic duct coming from the gallbladder forming the common bile duct that pass behind the first part of the duodenum together with the gastroduodenal artery that is also present posteriorly to the first part of the duodenum, the first inch precisely, Here at this site, in case of peptic ulcer it might form erosion and bleeding of the gastroduodenal artery.

-N.B. Venous drainage of duodenum ends in portal vein that is formed behind the neck of pancreas considered as important landmark where the superior mesenteric vein joins the splenic vein to form the portal vein.N.B parts of pancreas are head, Body and the tail. Head contains a part called uncinata process of pancreas. Over the tail you will find the tortuous splenic artery.

-The duodenum situated in the umbilical and epigastric abdominal regions represents a connection between the stomach pylorus and jejunum. (D) (In Pic 1)



-Duodenum receives the opening of pancreatic duct and common bile duct that opens into ampulla of vater at the second part of duodenum.

-general notes about different parts of the duodenum:

1-1st part ascending upward and backward toward the liver and gallbladder.

2-second part: descending part (vertical Part): it passes in front of the hilum of the right kidney; it descends downward from a level where the liver is located till it reaches L3 lumbar vertebra. The liver is anterior and above the 2nd part of the duodenum.

3-Third part (horizontal part: it crosses the midline or the vertebral column because it is present in the posterior abdominal wall.

4th part (last inch) : it is mobile because it is attached to jejunum. surrounded by paraduodenal pouches. The ligament of Treitz which is attached to the right crus of diaphragm located within this region at the duodenojejunal junction.

-The 4th part is important clinically, it is surrounded by paraduodenal pouches, the internal hernia might be developed within it . In addition, ligament of Treitz present here which is considered as an important landmark indicated the site duodenojejunal junction.

-it is a retroperitoneal organ except in its first inch and the last inch. Why?

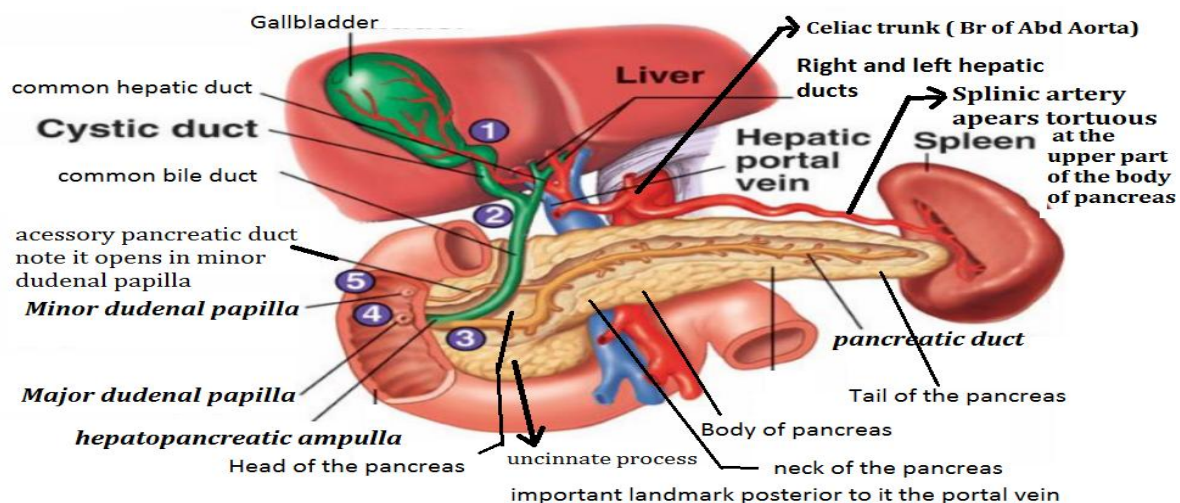
-- The first inch is intraperitoneal because it is attached to greater omentum and lesser omentum so it moves. (heiye aslan jayeh mn eshy in embryology called duodenal cap making it retains the mesentery and remains intraperitoneal
بس هاد الكلام ما قالو الدكتور اللي بعد القوس

-- The last inch is intraperitoneal (4th part of duodenum), because it is attached to the jejunum which is intraperitoneal and has a mesentery (so movable) and it is located just after last inch end. Here the peritoneum gives an extension changing the retroperitoneal duodenum into intraperitoneal at the 4th part.

Here are three important structures within duodenum: (look at pic 2)

- **Ampulla of vater:** A bulge at the medial side of the second part of the duodenum represents the union of pancreatic and common bile duct .it is surrounded by a muscular valve called sphincter of Oddi. The ampulla opens in the major duodenal papilla in the second part
- **Sphincter of oddi:** A valve surrounding the ampulla, remains closed except if the gall bladder is under stimulation. When the gall bladder is stimulated, the sphincter of oddi will be opened in order to allow the concentrated bile from gall bladder to reach the duodenum (at the second part).
- **Duodenal Papillae:** they are orifices (openings) in the second part of duodenum. There are 2 papillae :
 - 1) Major duodenal papilla (Major orifice) for ampulla of vater.
 - 2) Minor duodenal papilla for the accessory pancreatic duct if present and it is located superiorly *1 inch above the major one* to the main pancreatic duct.(this is occurred when the pancreas got two ducts.

((Pic 2 showing Most of structures mentioned))



pic 2

***Clinical NOTE:**

-ERCP technique: it is a newly created technique; physician inserts a gastroscope “endoscope” orally (through the mouth) and then it goes retrogradely (1) down the pharynx, into the stomach through the pyloric sphincter till it reaches the sphincter of Oddi in the duodenum, then, he makes a cut in the sphincter of oddi by the endoscope blade. Then the endoscope will be able to go through the common and pancreatic bile duct and pancreatic duct

--Jaundice: yellowish pigmentation of skin and sclera as a resulted from bile presence in the blood coming from obstructed biliary duct. Stones present in the common bile duct might lead to obstruction as well as mud formed there caused by thickened layer of secretions closing the sphincter.

-In the past physicians used to make open operations in order to access the common bile duct but this manner is no longer used because of problems generated by this kind of operations. Nowadays, they are using endoscope in order to access the common bile duct, then if there is stones accumulation, they place a basket to remove these stone and then placing them in the duodenum to be excreted with stool .in case of mud accumulation in common bile duct, injection of saline is efficient to open the duct again and during 6 hours the jaundice will disappear.

- ERCP stands for (Endoscopic retrograde cholangiopancreatography), Retrograde means going from the oral cavity toward the lower GI organs .Cholngio- prefix means related to bile duct.

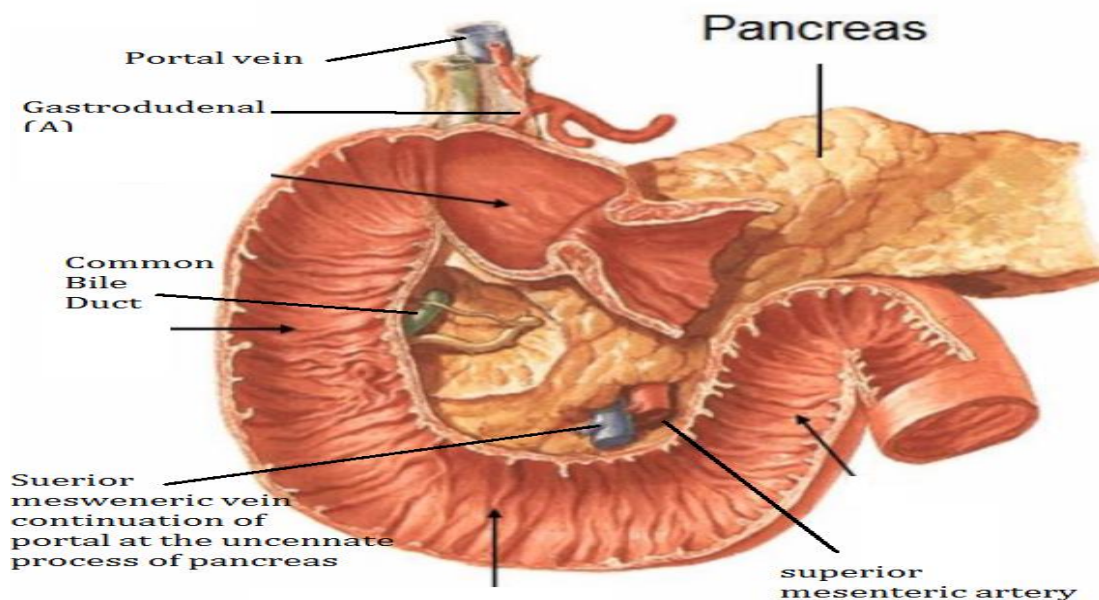
****Parts of duodenum and their relations:**

- The duodenum embryonically divided into upper half and lower half.
- Sphincter of Oddi “ Major duodenal papilla” considered as important landmark between the upper half which follows the foregut and the lower half which follows the midgut. Since the foregut is supplied by celiac artery and the midgut is supplied by the superior mesenteric artery, the duodenum is supplied by branches of both arteries. (the blood supply is mentioned later in this sheet)
- ****Site of duodenum:**
 - It is situated in the epigastric and umbilical regions and it is divided into 4 parts.

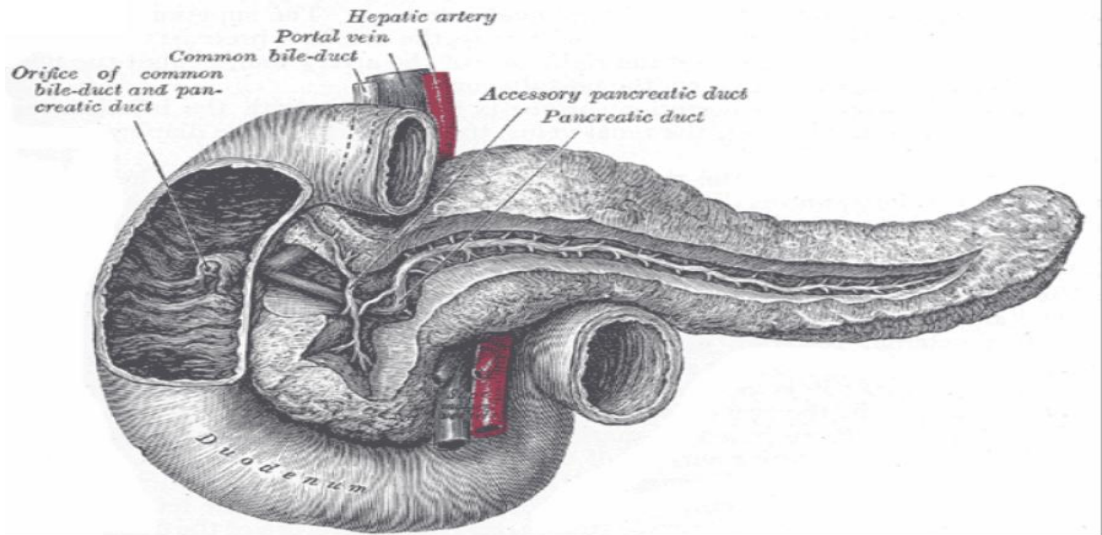
******Parts of duodenum and their relations :****1) First part of the duodenum:**

- The first part is 2 inches and divided into 2 parts.first inch intraperitoneal and second inch which is not.

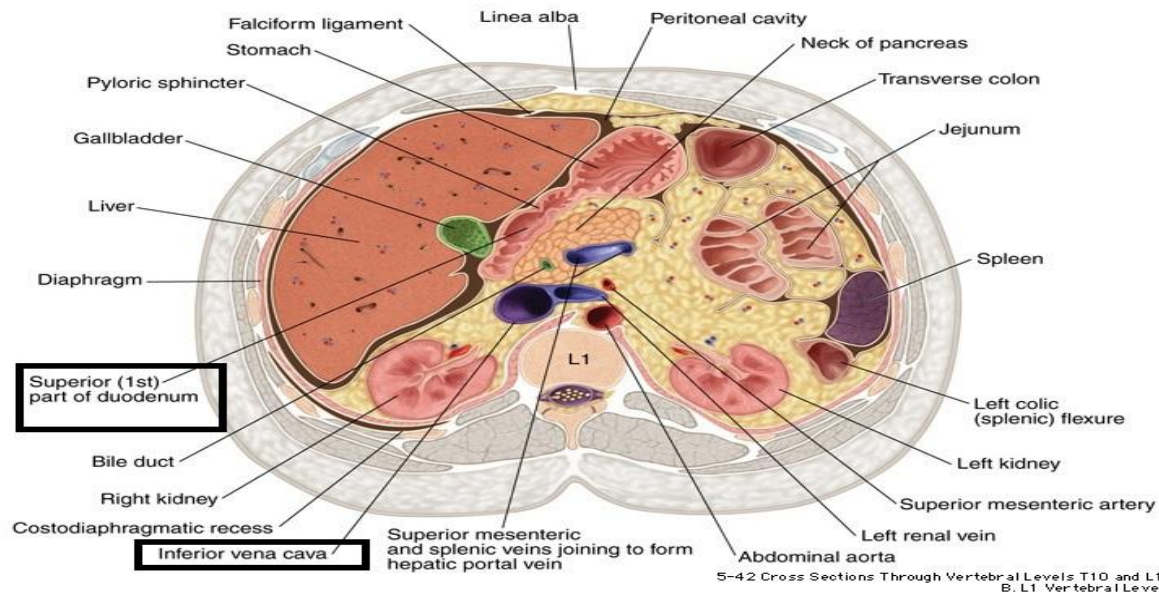
- It is located at the level of L1 at the same level of transpyloric line (refer to pic1).it is named "transpyloric "as it crossed by the pylorus of the stomach ,it also cross the first part of the duodenum, fundus of gall bladder ,the 9th costal cartilage and related also to hilum of both kidneys.
- NB the right kidney located at lower level than the right kidney so that one hilum located above and other located below the transpyloric line . (See picture No 1 how it cross the duodenum).
- It begins from the pylodudenal junction after the pyloric sphincter.
- Runs upward and backward toward the liver and gallbladder at the level of 1st lumbar vertebra.
- Relations of the first part of the duodenum :
 - Posterior relation: (Pic 3(A+B) + picture 4)
 - 1-The lesser sac (here we didn't mention the first part of duodenum as anterior relation of the lesser sac in lecture 5 but we did mention the posterior wall of stomach and may be as the duodenum located just after the stomach it is considered as that
 - . 2- The common bile ducts 3- IVC (most posteriorly. 4- Gastrodudenal artery 5-portal vein



pic3 (A)^



Pic (3 B) hepatic artery , common bile duct and portal vein as post relation

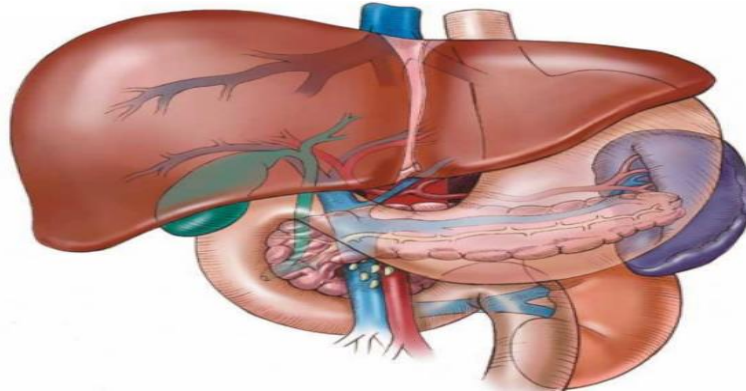


Pic 4

وبعد تمحيص لتوضيح الأنثريور والبوستيريو ستركتشرز بشكل أفضل قررت ابحت عن كروس سكشن وفكرت بعدين ب كروس سيكشن علفيل ال وان فيرتبرا لانو الفيرست بارت عالترانس بايلوريك بلاين علفيل ال 1 وللأسف ايضا مش كتير فادت الا الاتفيريور فينا كافا ذا موست بوستيوريور

_anterior relation: (pic 5)

1- quadrate lobe of the liver 2) Gall Bladder



(pic 5)

-Superior relation: (pic 6)



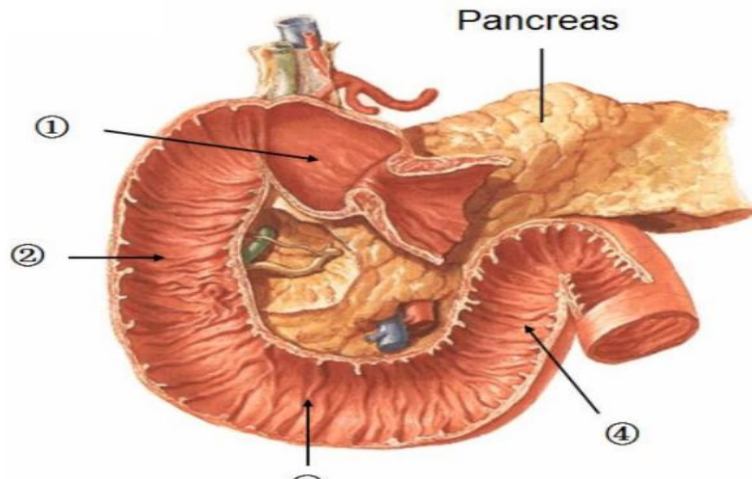
(pic 6)

- Epiploic foramen

Inferiorly >> head of the pancreas

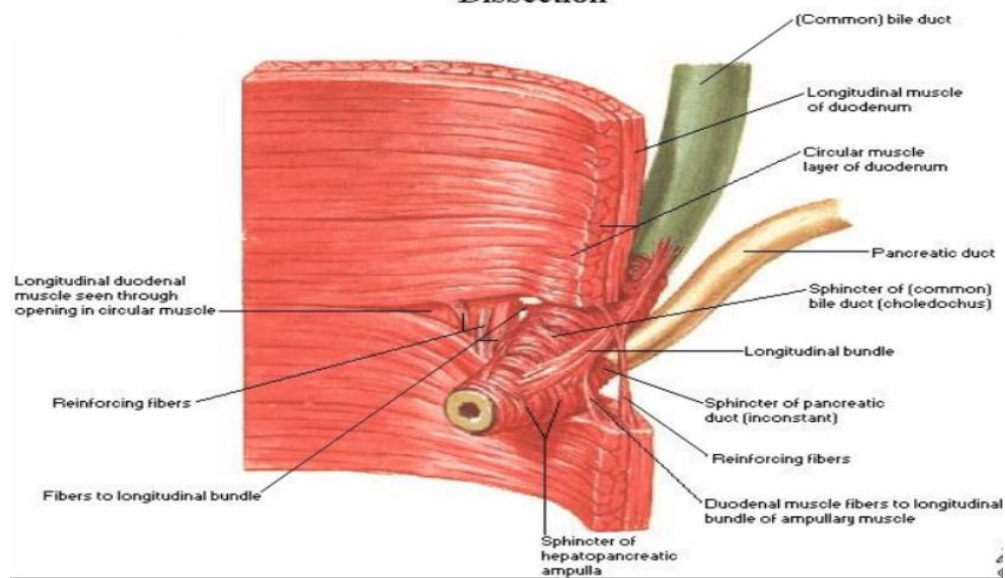
**** Second part of the duodenum:**

- It is 3'' inch vertical part located at the right side cross the hilum of the kidney and right ureter.
- It descends downward vertically reaching the third lumbar (L3) vertebra and in some people it reaches (L4) vertebrae .
- The bile duct and main pancreatic duct divides the 2nd part into upper half which follows the foregut and lower half follows the midgut.
- The accessory pancreatic duct which opens into the minor duodenal papilla is usually located 1 inch above the main duodenal papilla(Primary)
- In pic 6 the second part represented by no (2). 1st part number 1. 3rd part no (3) 4th part no (4).



Pic (6)

- In pic (7) , this is the sphincter of Oddi. Note the presence of the circular muscle. The sphincter of oddi often is contracted. The contraction is the mechanism which aid in making the bile more concentrated in the gallbladder because of retrograde passage of diluted bile to become concentrated. When it opens? When there is stimulation with contraction of the gallbladder.



- Remember in ERCP, we used the gastroscope which has with a small blade to cut the sphincter of oddi smooth muscle in order to reach the common bile duct and the pancreatic duct realasing the stones or mud accumulation there. While in the past the doctors used to make a cut in the duct itself which made several disasters like inflammations and infections so that ERCP is a great soloution.The smooth muscle within sphincter of Oddi after we cut it using the gastroscope blade it will be regenerated and sometimes we make a stich (غززة) there to facilitate healing.
- There are some variation between people the surgeon should identify it like separated openings, the pancreatic duct has its own opening and the common bile duct as well and each

one of them has its sphincter. Sometimes the junction occurred before the sphincter of Oddi forming hepatopancreatic duct (one Duct) .

- Pic 8 shows the of the lumen During ERCP operation . of ampulla of vater lumen



■ Relation of the second part of the duodenum

-Anteriorly look at pic9

- The gallbladder (fundus)
- Right lobe of the liver
- Transverse colon and mesocolon
- coils of small intestine. (Coils of Jejunum)

-Posteriorly

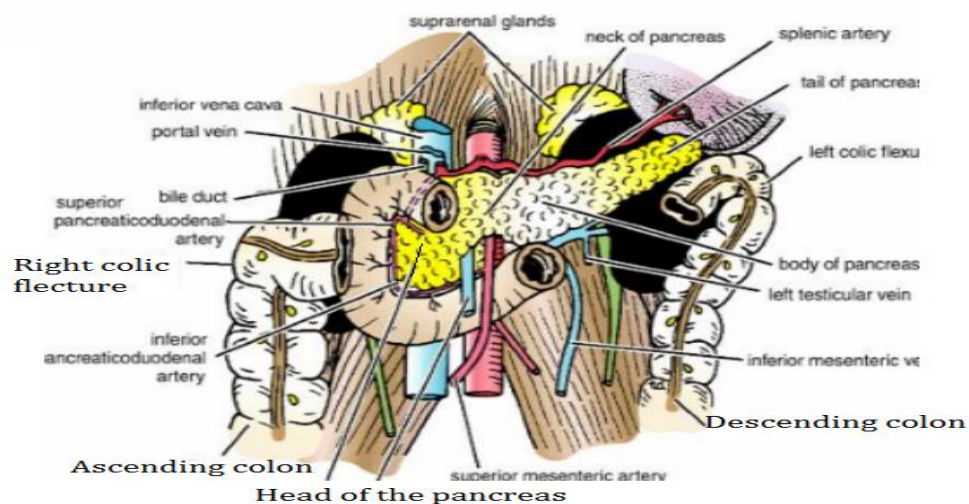
- Hilum of Rt. Kidney (kidney is the black structure in pic 9) -
- Rt. Ureter.

-Laterally (look at pic 9)

- Right colic flexure
- Ascending colon
- Right lobe of the liver.

-Medially (look at pic 9)

- Head of pancreas.
- Bile and pancreatic ducts.



**** Third part of duodenum: (refer to pic 6)**

-it is a horizontal part length 4 inches, runs in front of the vertebral column from the right to the left

• Coils of jejunum lies anterior to the 3 rd part .

■ **Third part relations :**

Anteriorly:

- The root of the mesentery of the small intestine, the superior mesenteric Vessels contained within the mesentery .coils of jejunum

-N.B the root of mesentery beginning at the level of L2 to the left side, descending obliquely till the right sacroiliac joint

Posteriorly:

-The right ureter and the right psoas muscle
- the inferior vena cava and the aorta
- inferior mesenteric vessels

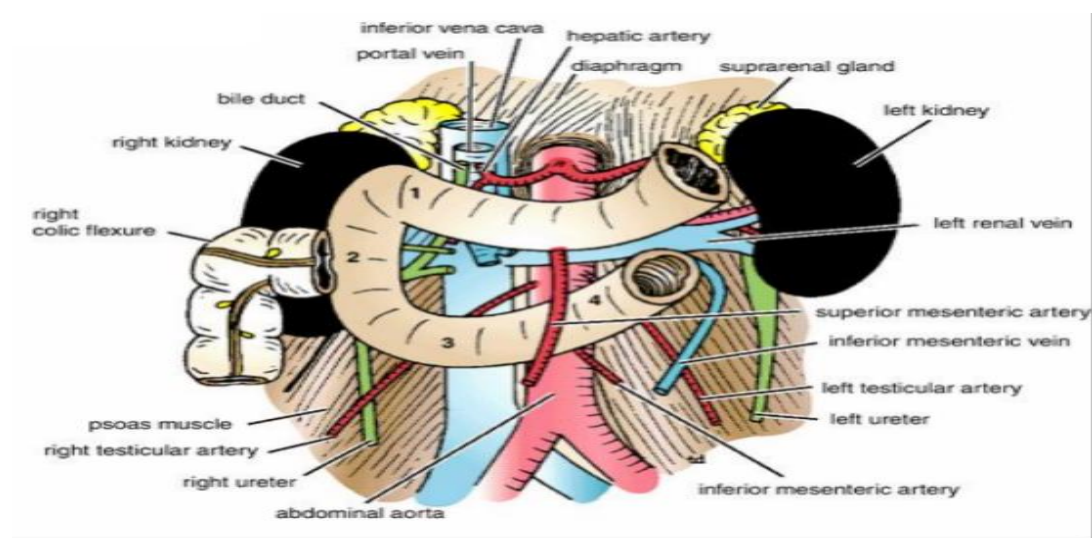
Superiorly:

The head of the pancreas and "uncinate process"

Inferiorly:

Coils of jejunum

-Third part relations shown in pic (10)



****4th part of the duodenum ;**

• 1" inch long, Runs upward and End in the duodejejunal junction at the level Of the 2nd Lumbar vertebrae 1 inch to the left (upward to the left), in this region located the ligament of Treitz holding the flexure "junction in its position and considered as important landmark for surgeons located near the opening of jejunum, in this region, the surgeon can diagnose the internal hernia looking for paradudenal pouches if there is small intestine inside it in order to close this pouch which makes the disadvantage.

****Relation of the 4th part : (look at picture 11)**

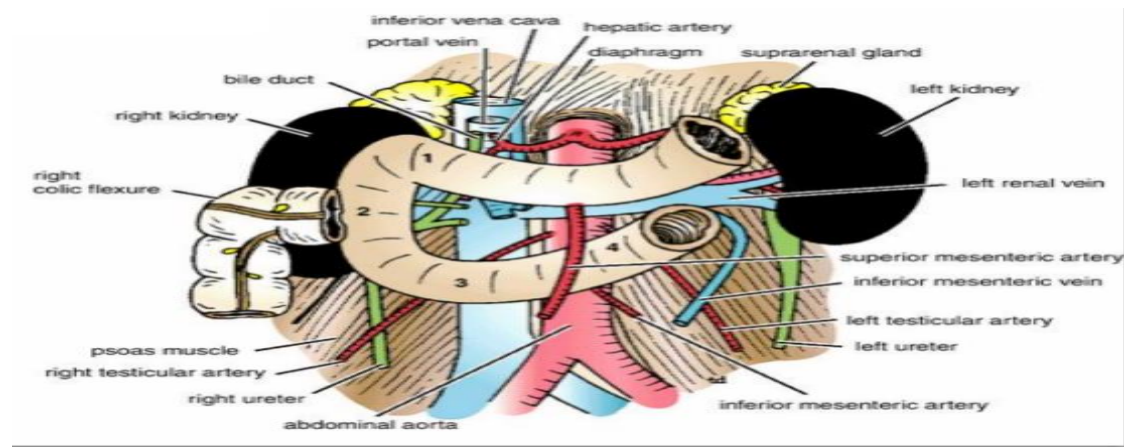
Ant. - The beginning of the root of the mesentery and coils of the jejunum.

Post.

- Lt. Psoas major, the sympathetic chain and left margin of the aorta.

Sup.

- Uncinate process of the pancreas.



PIC 11

**** Blood Supply of the duodenum :**

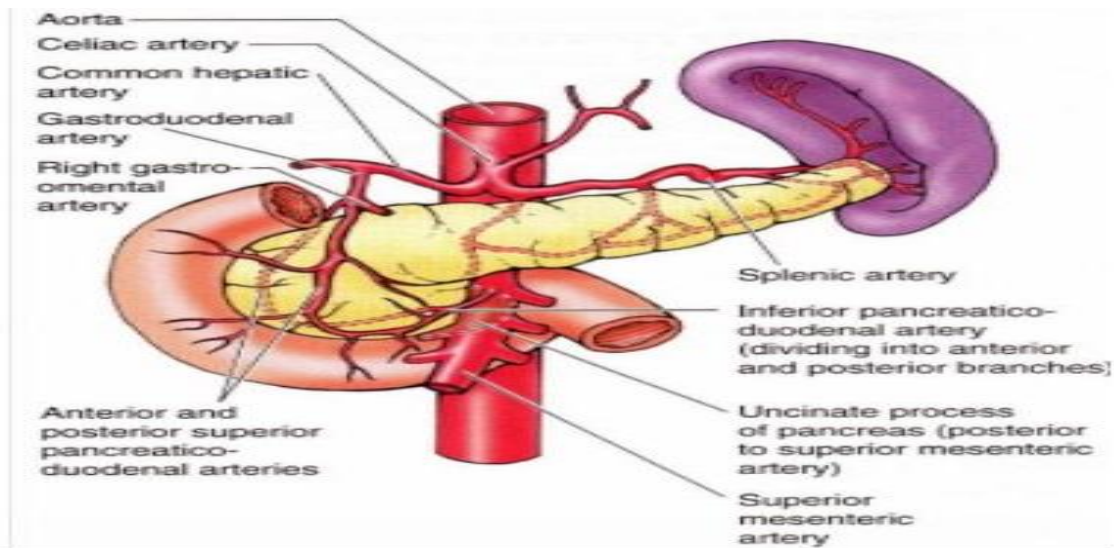
The duodenum divided into 2 halves concerning blood supply:

-1st: The upper half of the duodenum (1st part and upper half of the second part):

- It is supplied by the superior pancreaticoduodenal artery which is a branch of gastroduodenal artery. note here that the gastroduodenal artery is a branch of common hepatic artery which is in turn a branch of celiac trunk that formerly said it is mainly supplies the foregut.
- (Celiac trunk → common hepatic artery → gastroduodenal artery → superior pancreaticoduodenal artery).

-2nd half (lower half) (the lower half of second part of the duodenum, third part and fourth part)

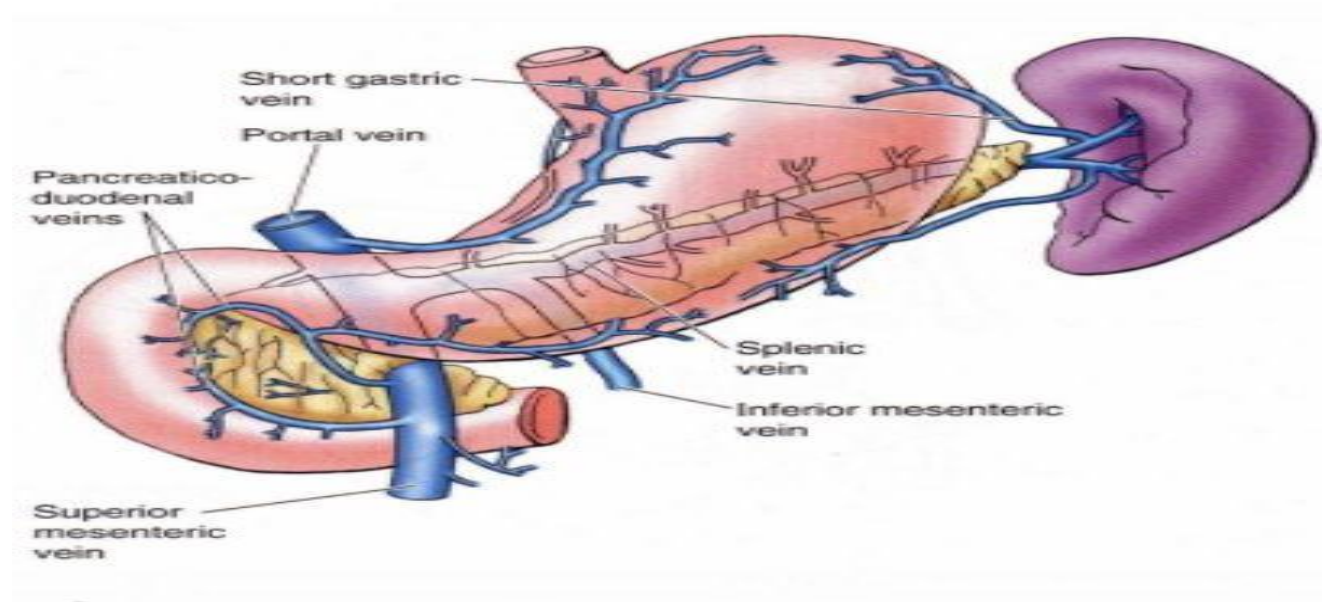
- Lower half is supplied by inferior pancreaticoduodenal artery which is a branch of superior mesenteric artery which is a branch of abdominal aorta
- Look at pic number 12 it shows the arterial supply of duodenum
-



pic 12

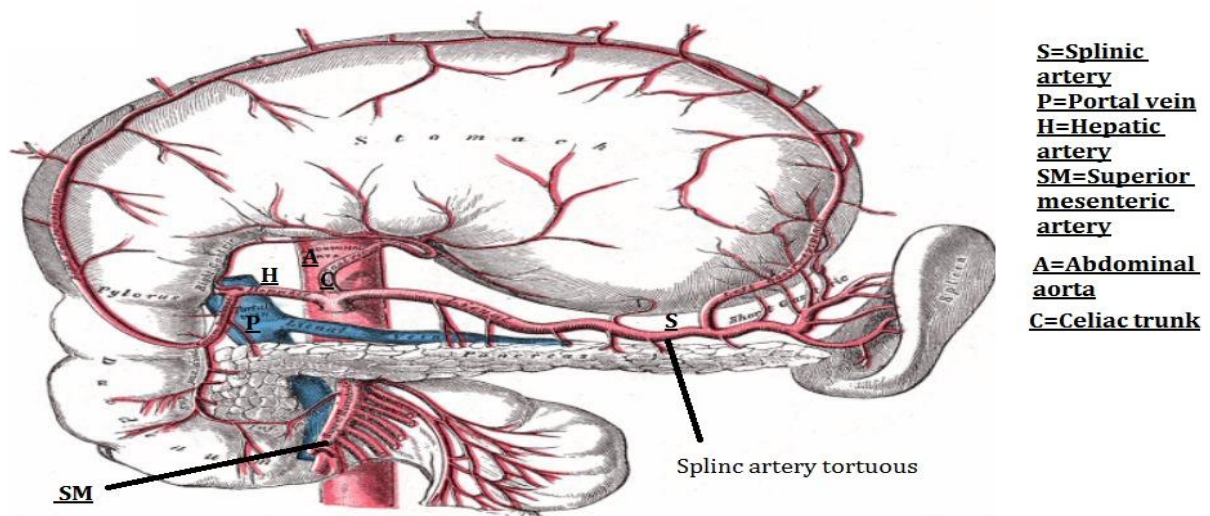
****Venous drainage of duodenum :**

- The venous drainage of the duodenum must drain into the portal vein.
- The superior pancreaticoduodenal vein drains into the portal vein directly while the inferior pancreaticoduodenal drains mainly the superior mesenteric vein that unites with splenic forming the portal vein. In some cases, the superior and inferior pancreaticoduodenal veins drain into the superior mesenteric vein that unites with splenic vein forming the portal vein behind the neck of the pancreas. Remember that the inferior mesenteric vein drains into the splenic vein or sometimes it joins the junction between the superior mesenteric and the splenic.
- Pic 13 shows the venous drainage of the duodenum. In pic 14 and 15 look for the overall blood supply of the duodenum.
- Remember ,The superior and inferior gastric drains directly into the portal vein



Pic 13 (venous drainage)

- Notes concerning this pic , Pic (14)
 - The splenic artery is tortuous.
 - N.B. The superior mesenteric artery giving jejunal and ileal arteries which are forming the arcades and vasa recta



Pic14

**** Lymphatic drainage of the duodenum:**

The Lymph vessels follow the arteries so :

- At the upper half → Pancreaticoduodenal nodes drain upward into the celiac lymph nodes around the celiac trunk
- Lower half → pancreaticoduodenal nodes drains downward into the superior mesenteric nodes around the origin of the superior mesenteric artery

**** Nerve Supply Of the duodenum:**

A-Sympathetic nerve

B-parasympathetic nerves from:

- The sympathetic supply comes from nerves in thorax and making synapse with celiac or superior mesenteric ganglia. the sympathetic nerves going for the upper half comes from the celiac while for lower half of duodenum comes from the superior mesenteric ganglia
- The parasympathetic making synapse in the myenteric ganglia (wall of the duodenum).
- The parasympathetic fibers comes as preganglionic neuronal cell bodies (from the celiac and superior mesenteric) without relay. It makes relay (synapse) in myenteric plexus. So be careful in the slides its written that parasympathetic innervations comes from the superior mesenteric plexus and celiac plexus but we are talking about the preganglionic neurones

- **Jejunum and Ileum**

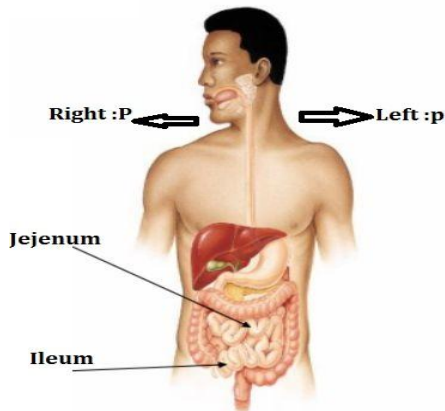
- Location and Description:

- The jejunum and ileum are intraperitoneal organs measure about 20 ft. (6 m) long (the length of free edge of the mesentery they are present within.

- Remember that the mesentery has a root attached to the posterior abdominal wall extends from L2 into the right sacroiliac joint. it measures around 15 cm or (6 inches) in length and measures around 8 inches in breadth (Root till the free edge) .The free edge measures around 6 M or 22 ft. in length .
- The jejunum begins at the duodenojejunal junction (flexure) where the ligament of Treitz is present. important landmark indicated the beginning of jejunum .
- The ileum ends at the ileocecal junction. so ileum opens into the cecum at the right iliac fossa. Here there is no sphincter but folding of mucosa inside the cecum closing the opening between ileum and cecum (in physiology it is considered as physiological sphincter) .so that, any passage of material from cecum is restricted (prevented) to go back to ileum but it goes from the cecum into the ascending colon.
- Again by other words, coils of jejunum and ileum are freely mobile and Are attached to the posterior abdominal wall via a fan-shaped fold of peritoneum known as the mesentery of the small intestine.

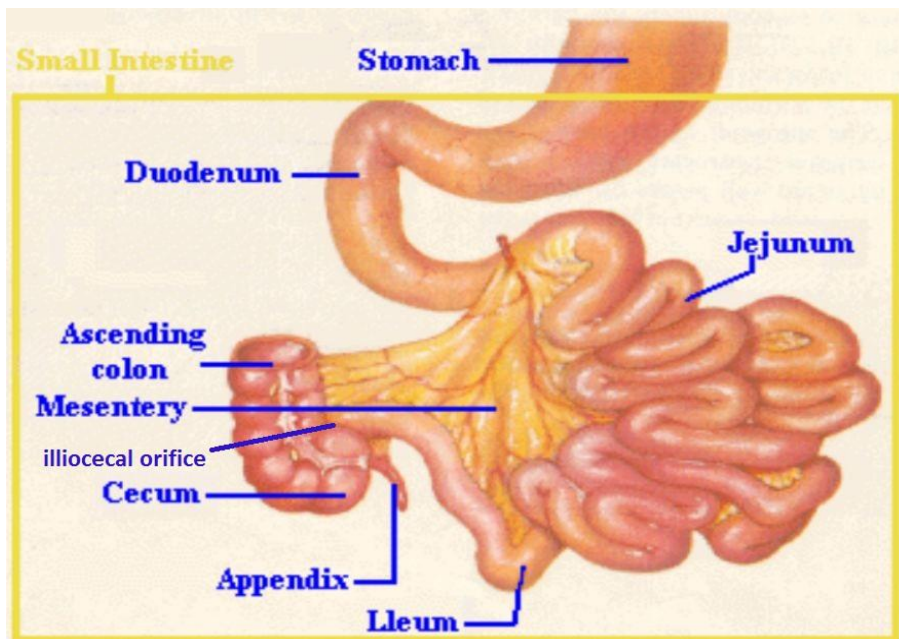
- The jejunum located at the upper and to the left side of the abdomen

ileum located at the lower right side of the abdomen "right iliac fossa." Look at pic 15 distinguish between right and left directions: P



pic 15

- see the structures in pic 15 (Ileum And not Lieum :p)



pic 16

- Both jejunum and ileum are found in the umbilical region, surrounded by ascending colon, descending colon and transverse colon (coils of small intestine are found in umbilical region) .
- The histology of small intestine shows the presence of villi " finger like projections" and crypts of Lieberkühn.

****Mesentery of the small intestine (it is just to sum up what's mentioned before**

-Fan -shaped fold of the peritoneum

-The long free edge of the fold encloses the mobile intestine.

- The short root of the fold is continuous with the parietal peritoneum on the posterior abdominal wall

- Along a line that extends downward and to the right from the left side of the second lumbar vertebra to the region of the right sacroiliac joint

**** Content of the mesentery:**

-The branches of the superior mesenteric artery and vein

- Lymphatic vessels & lymphatic nodes

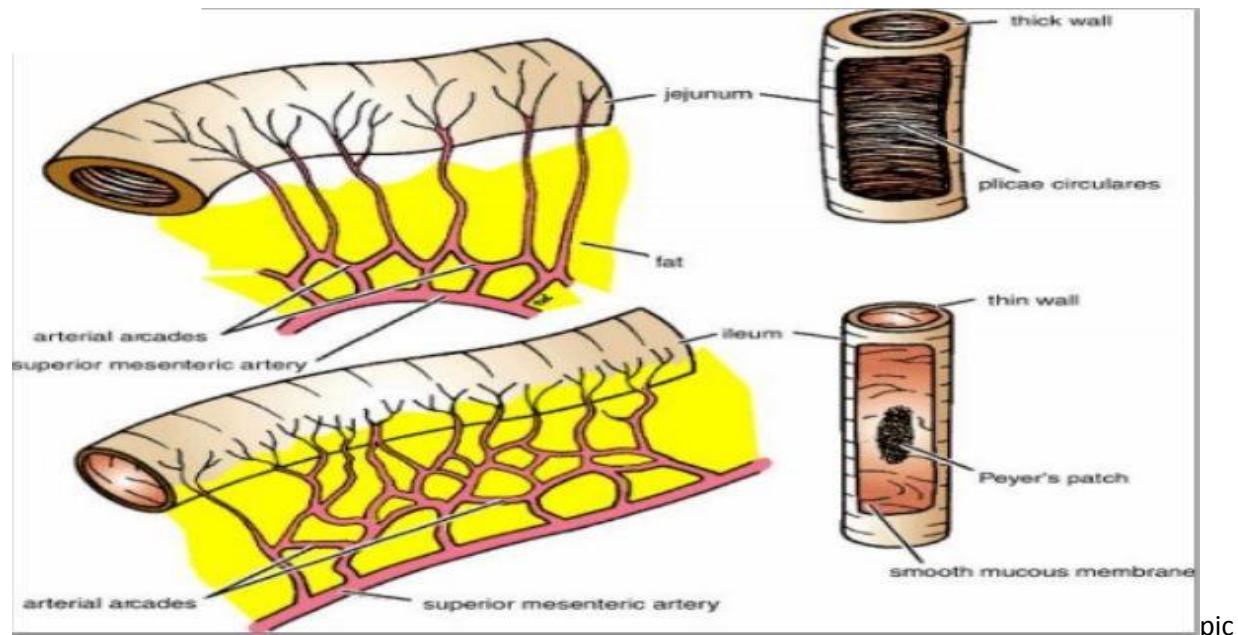
- Nerves

**** Differences Between jejunum and ileum :**

	Jejunum	ileum	Notes
length	Proximal 2/5 th of small intestine	Distal 3/5 th	
Diameter	Wider	Smaller	
wall	Thicker and reddish	Thinner & less redder	
Fat in mesentery	- the fat is deposited near the root - Less in amount	- the fat is deposited throughout mesentery - Big amount	
Arcades in mesentery	-simple ,only one or two arcades	Complex (numerous)	
Lymphatic follicles	No or few	Aggregations of lymphoid tissue (Payer's patches) are present in the mucous membrane in the lamina propria of the ileum	
site	in the upper part of the peritoneal cavity below the (left) side of the transverse mesocolon	in the lower part of the cavity and in the pelvis	Look here the jejunum is in the left
Plicae circularis(the permanent enfolding of the mucous membrane& submucosa	They are: 1- larger 2- more numerous 3- closely set	they are: 1- smaller 2- more widely separated 3- in the lower part they are	

		Absent.	
villi	Numerous	Less numerous	

-in pic (17) ,in the Upper part, the jejunum with no peyer's patches. Presence of circular folds "pilcae circularis more than that of ileum, arcades are simple and long vasa recta.The lower portion (ileum).Note the presence of peyer's patches, complicated arcades and short vasa recta. Less pilcae circularis



17

****Blood supply of Jejunum & Ileum**

Arteries:

- The arterial supply is from the ileal and jejunal arteries that are branches of the superior mesenteric artery.
- The intestinal branches arise from the left side of the artery and run in the mesentery to reach the gut.
- They anastomosis with one another to form a series of Arcades.
- The lowest part of the ileum is also supplied by the ileocolic artery which is a branch of the lower part of superior mesenteric artery.ileocolic artery supplies the ileum and the colon as its name indicates and gives Anterior and posterior cecal arteries, posterior cecal artery gives appendicular artery.

****Venous Drainage:**

- The veins correspond to the branches of the superior mesenteric artery

-Drain into the superior mesenteric vein and drain finally into the portal vein.

****Lymphatic Drainage of jejunum & ileum**

• The lymph vessels pass through many Intermediate mesenteric nodes to reach finally the superior mesenteric nodes around the origin of the superior mesenteric artery. They drain into the superior mesenteric lymph node as they follow the midgut.

***** Nerve Supply of jejunum & Ileum**

-The nerves are derived from:

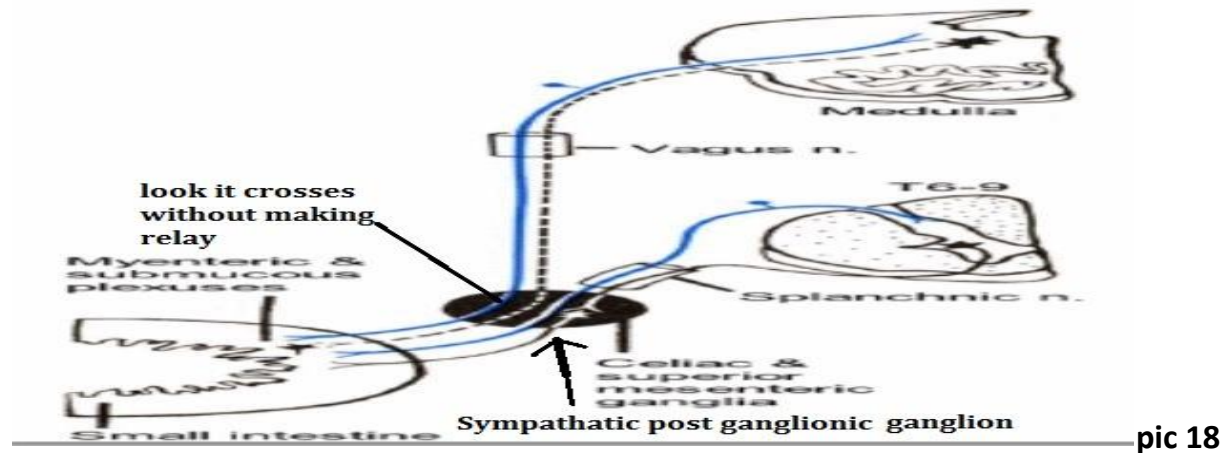
1-the sympathetic arise from the superior mesenteric ganglia)

2-parasympathetic from (vagus CN X) – which supplies the whole jejunum, ileum and large intestine till the later third of transverse colon

** refer to pic 18.

- Parasympathetic: Vagus nerve arises from the medulla oblongata descending downward and cross the celiac and superior mesenteric ganglia without making relay (synapse) but synapse with myenteric plexus.it supplies the smooth muscles and glands.
- Sympathetic, preganglionic neuronal cell bodies come from the chest through the splanchnic nerves (T6-T9) making relay and synapse with post-ganglionic neuronal cell bodies located in celiac and superior mesenteric ganglia. Finally it goes to sphincters supplying them.

Nerve supply for small intestine



Congenital anomaly of small intestine

-Meckel's Diverticulum:

-remnants of vitelline duct that present only in embryo, it is located between umbilicus and ileum. It must be obliterated just like the processus vaginalis. If it is not obliterated it will develop problems like congenital anomaly of ileum in 2 % of people. It is present 2 feet away from ileocecal junction. It measures 2 inches in length. It contains gastric or pancreatic tissue. The pain associated with its inflammations is just like that accompanied by appendicitis; severe pain at the right iliac fossa but when we open surgically we find it normal appendix so that we go 2 feet away from the ileocecal junction to find Meckel's diverticulum.

has a problem.

- What are the complications or diseases associated with Meckel's diverticulum? - Infection like gastritis, pancreatitis, hemorrhage or perforation and developing peritonitis.

في غرفة الدراسة ...

خير السجّاتين أناك يسجن هواك , يمنعك شرود الذهن , الخروج للشارع أو الشرفة , ويعذك بمجد آتٍ خارج أسوار الغرفة ...

"الفيلسوف أنا "