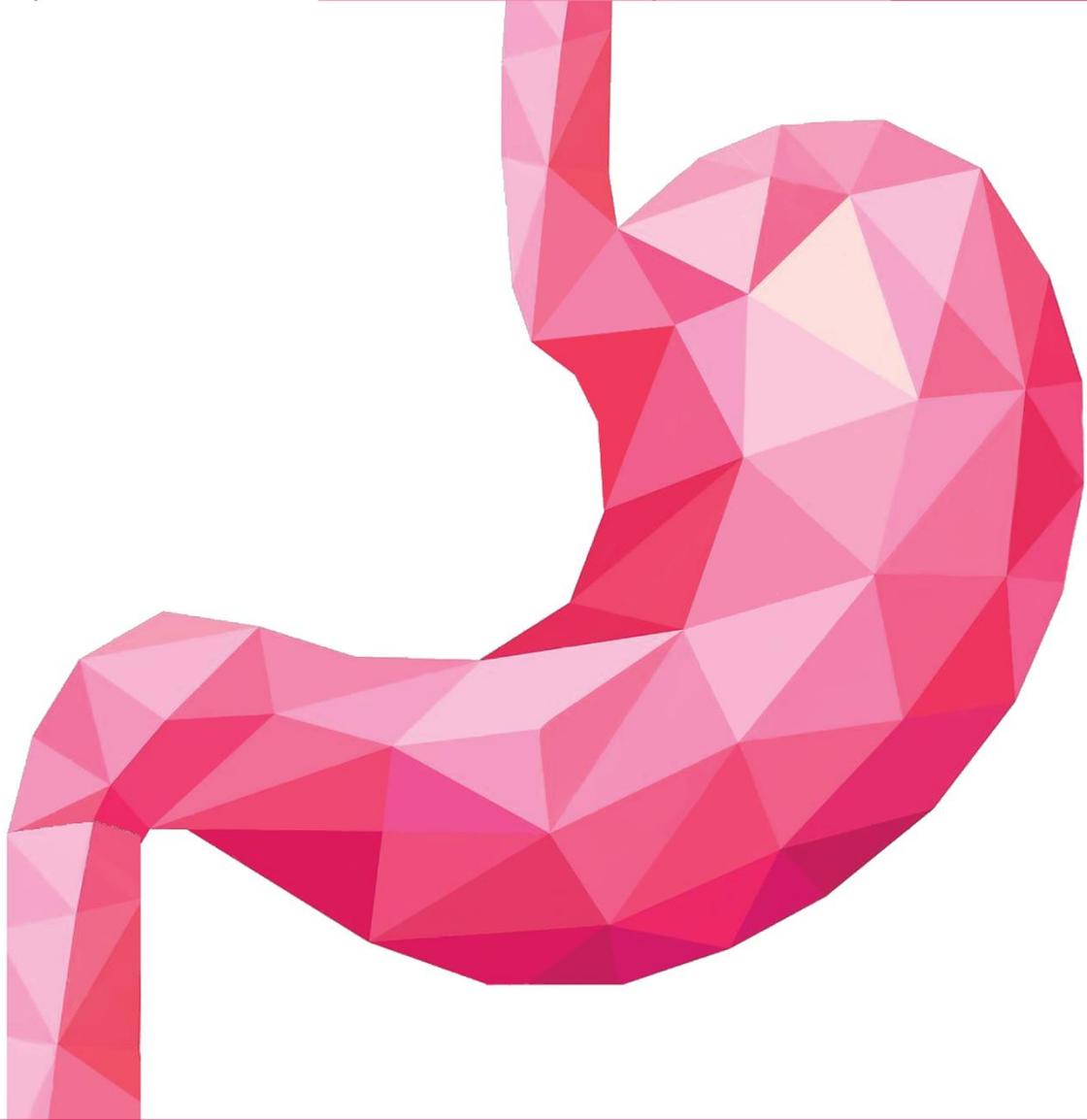




GIS 8

ANATOMY



Done by: Reema Ayman

Scientific Correction: Noor Adnan

Gramatical Correction: Noor Adnan

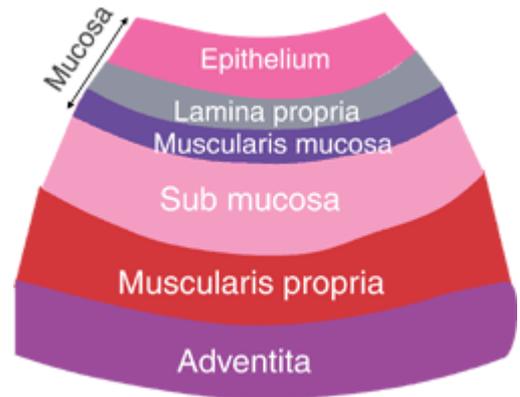
Doctor: Mohammad Al-Mohtaseb

Small Intestine

last lecture we talked about the first part of small intestine which is the [duodenum], now we will continue with the remaining parts, but before we start we need a quick recap for the most important points.

QUICK RECAP:

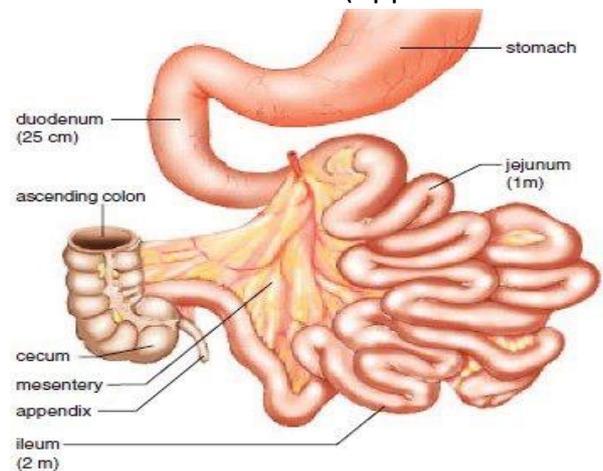
- ✓ The **GI tract** has **four layers**: the innermost **layer** is the mucosa, underneath is the submucosa, followed by the muscular layer and finally, the outermost **layer** - the adventitia or serosa.
- ✓ The structure of these **layers** varies, in different regions of **the digestive system**, depending on their function.
- ✓ The **peritoneum** is a thin serous membrane consisting of 1- **Parietal peritoneum** (lines the ant. Abdominal wall)
2- **Visceral peritoneum** (covers the viscera)
- ✓ **omentum vs mesentery**:
OMENTA: Two-layered fold of peritoneum that extends **from stomach to adjacent organs**, while the **MESENTERY**: Two-layered fold of peritoneum that **attach the intestines to the posterior abdominal wall**. (keep this in mind, we will need it in this lecture)
- ✓ Intraperitoneal organs >> they are almost totally & completely covered with visceral peritoneum.
- ✓ Retroperitoneal organs >> organs that lie on the posterior abdominal wall, behind the peritoneum and they are partially covered by peritoneum on their anterior surfaces only.
- ✓ Interperitoneal organs >> Such organs are not completely wrapped by peritoneum and part of its surface is attached to the abdominal walls or other organs and not the peritoneum.



Now starting with our lecture

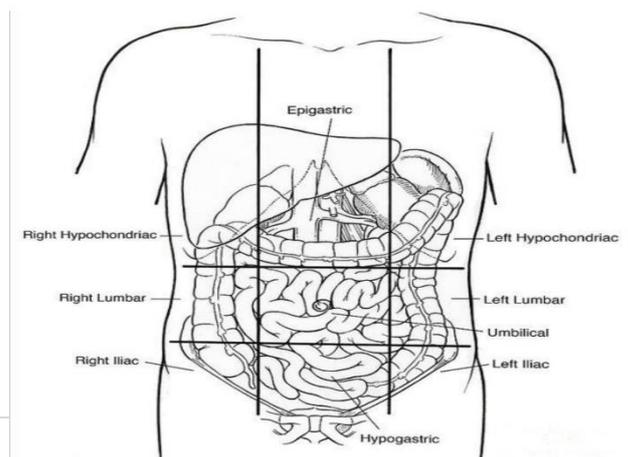
- ✓ I will start with short comparison and at the end of the lecture there will be a table summarize everything.
- ✓ The small intestine is 3 parts: Duodenum, jejunum and ileum.
- ✓ The **duodenum** is **retroperitoneal** organ except the first and last inches are intraperitoneal, while **the jejunum and ileum** are **intraperitoneal** and the coils of jejunum and ileum are freely mobile and are attached to the posterior abdominal wall by a fanshaped fold of peritoneum known as the mesentery of the small intestine.

- ✓ The mesentery means two layer of peritoneum extending from the post. Abdominal wall , the jejunum and ileum lie in the free edges of the mesentery and since (The jejunum and ileum measure about 20 ft (6 m) long) so the free edge of the mesentery is about 6 m long while the duodenum is 10 inches (25 cm).
- ✓ Regarding the physiology: the main function of duodenum is complete the digestion of fat since it receives the common bile duct and pancreatic duct , while the jejunum and ileum their function is absorption of nutritive materials .
- ✓ Our food is either carbohydrates, proteins, or fat and the digestion process turns them into glucose, amino acids, or fatty acids respectively. This simple material is the one that's absorbed in small intestine and they all have to go firstly to the liver by portal vein before entering the systemic circulation.
- ✓ The jejunum begins at the duodenojejunal flexure (ligament of treitz that's attached to the right crus of diaphragm) and located in the upper part of the peritoneal cavity below the left side of the transverse mesocolon (upper to the left).
- ✓ The ileum is located in the lower part of the cavity and in the pelvis (lower to the right) and ends at the ileocecal junction where the cecum begins (remember that cecum is located in the right iliac fossa) , the ileum has opening to the cecum called ileocecal opening and in physiology its called valve while in Anatomy called opening because there is no circular smooth muscle there.
- ✓ There is no specific and certain landmark to tell that here the jejunum ends and here the ileum starts , actually the change is gradual from one to another , the upper 2/5 is the jejunum & the lower 3/5 is the ileum but also you can find other resources tell the upper 3/5 is the jejunum & the lower 2/5 is the ileum , so up to now we know that (the jejunum >>(upper to the left) and the ileum (lower to the right & the cecum is located in the right iliac fossa and the end of the ileum is located there (ileocecal junction)) , since there is no sharp landmark , we refer to some distinctive features in their wall, diameter, and mesentery in order to differentiate between them.



Location

Small intestine (jejunum and ilium) is located in umbilical region surrounded by large intestine so it's internal to large intestine.



Histology

As we said previously , the GI tract has 4 layers: mucosa, submucosa, muscular layer and serosa or adventitia (depending if the organ is intraperitoneal or retroperitoneal , so If intraperitoneal >> serosa which is simple squamous epithelium while If retroperitoneal >> adventitia which is connective tissue , now As small intestine (jejunum & ileum) are intraperitoneal (completely covered by peritoneum) , so it's wall contain serosa not adventitia.

Regarding the mucosa :

The **mucosa of the duodenum** contains leaf shaped villi (fingerlike projection) , and in the submucosal layer of duodenum , there is certain gland called duodenal (or Brunner's) glands which secrete alkaline secretion to neutralize the acidity of the stomach .

While the **mucosa of (jejunum & ileum)** contains villi and micro villi on the surface of villi to increase the surface area for absorption.

As we said in the recap , the mucosa consists of 3 layers (lining epithelium, lamina propria, and muscularis mucosa which consists of 2-3 bands of smooth muscle) , *the Lamina propria is : loose type of connective tissue that contains connective tissue cells (fibroblasts, smooth muscle cells) and contains artery, vein, and lymphatic vessels , the lamina propria actually penetrates the core of the intestinal villi , it also has **lacteal** which is a blind lymphatic vessel and responsible for absorption of fat.

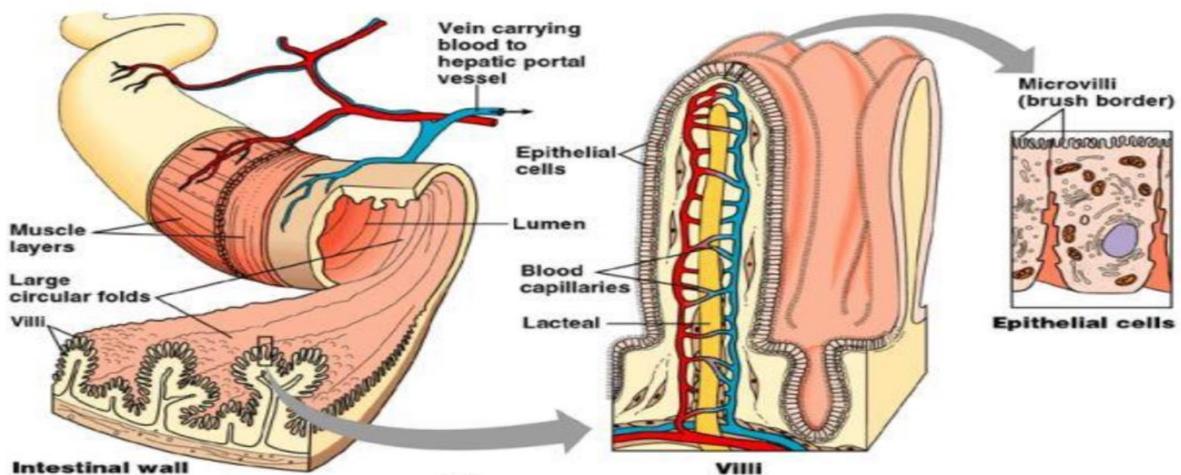
Regarding the Lining epithelium :

The absorptive cells have simple columnar epithelium with goblet cells (in stomach it's just simple columnar without goblet cells) and its function is absorption and hence the name .

Now the Glands known as (intestinal crypts/ intestinal glands/ crypts of Lieberkühn)>> Have the same lining epithelium but its function is secretion (since they are glands so secretion) .

At the base of the glands there's paneth cells which is bactericidal cells (to kill the bacteria) and not found in large intestine.

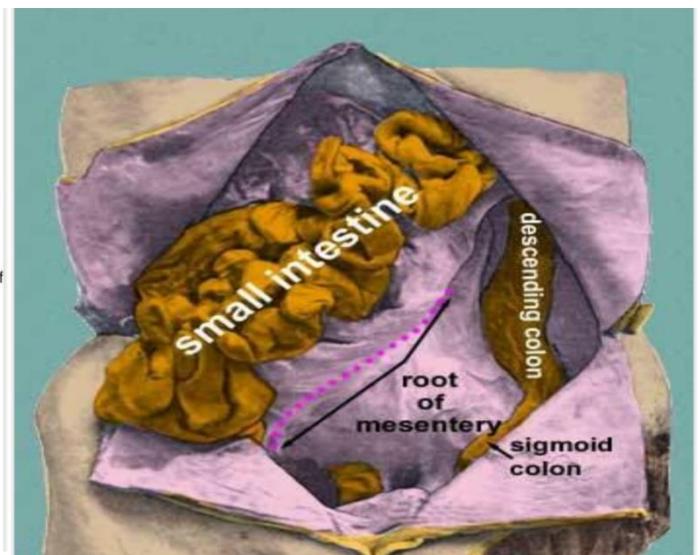
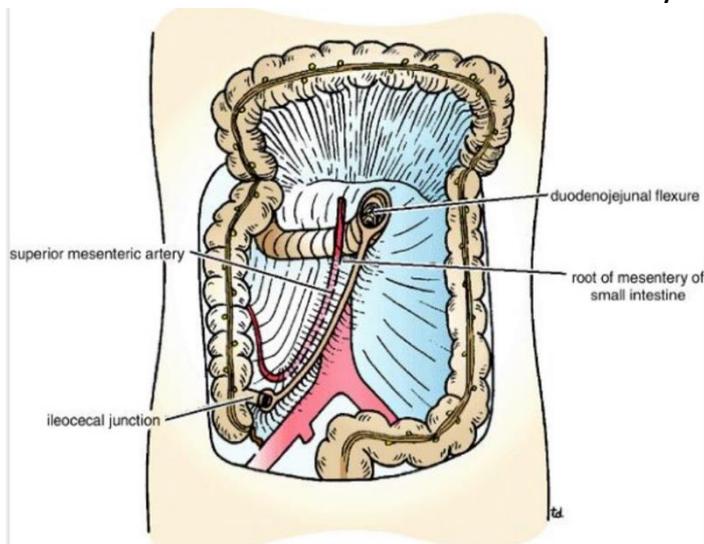
- ✓ To remember the structure : look at your finger , the upper half is villi and the lower half is the glands)



Mesentery of the small intestine:

- ✓ fan-shaped fold of peritoneum.
- ✓ Formed by parietal peritoneum on posterior abdominal wall starting from the left side at the level of L2 at duodenojejunal flexure and descends obliquely downwards to the right side in front of right sacroiliac joint ending at ileocecal junction.
- ✓ In the figure note the root of the mesentery (remember its 6 inches (15 cm) long while the free edge that's attached to small intestine is 6 meters long) .
- ✓ Slides : 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

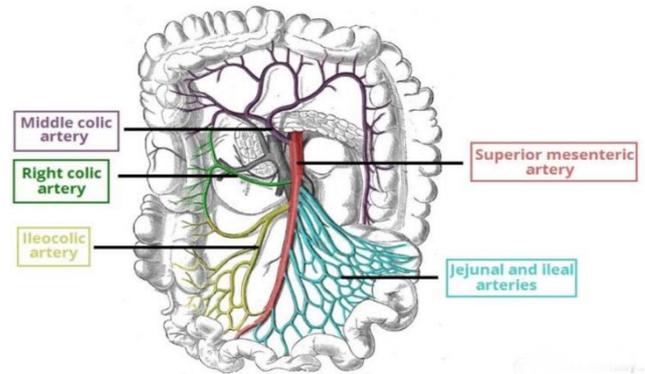
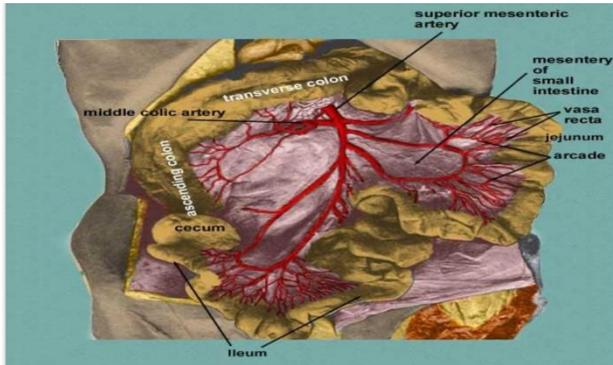
- ✓ Regarding the **Contents of the mesentery** : (means between the 2 layers of peritoneum) we have :
 - 1-Superior mesenteric artery which forms arcades and vasa recta when reaching jejunum and ileum.
 - 2-Superior mesenteric vein and its tributaries.
 - 3-Nerves: sympathetic and parasympathetic.
 - 4-Fat which is more in mesentery of ileum.



Blood supply of Jejunum & Ileum:

- ✓ They are considered part of the midgut, so they are supplied from the superior mesenteric artery
- ✓ The superior mesenteric artery gives jejunal and ilial arteries (The intestinal branches arise from the left side of the artery and run in the mesentery to reach the gut.)
- ✓ they gives branches that anastomose with one another to form a series of arcades.

- ✓ At the end of superior mesenteric artery, it gives a branch called ileocolic artery that supplies end of ileum, cecum (by ant. And post. cecal arteries), beginning of ascending colon, and appendix.



Venous drainage:

- ✓ The artery gives branches, while the vein has tributaries that all come together to form the big vein.
- ✓ Tributaries of superior mesenteric vein unite all together to end into superior mesenteric vein which ends behind the neck of pancreas by meeting and uniting with the splenic vein forming the portal vein (so the portal vein: begins behind the neck of pancreas and ends in the liver).

Lymphatic drainage of jejunum & ileum:

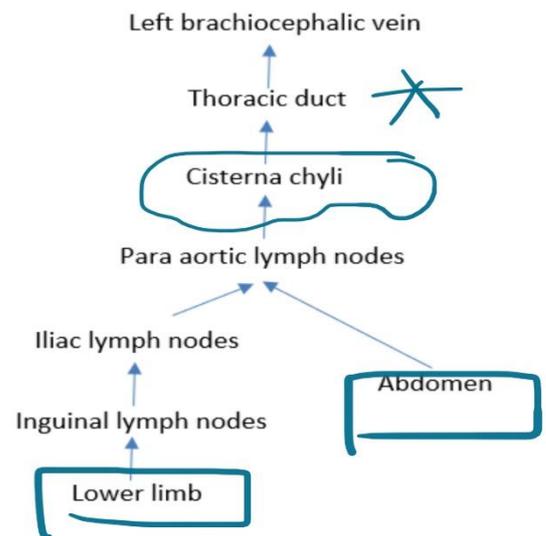
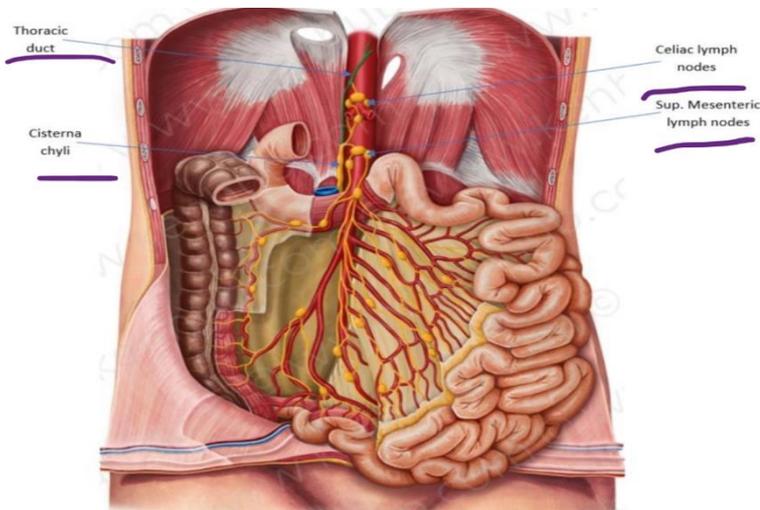
There are many lymph nodes located around different structures:

- ✓ Around the Celiac trunk >> called celiac lymph nodes & drains foregut.
- ✓ Around the superior mesenteric artery >> called superior mesenteric lymph nodes > drains midgut.
- ✓ Around the inferior mesenteric artery >> called inferior mesenteric lymph nodes > drains hindgut.
- ✓ The lymph vessels pass through many intermediate mesenteric nodes & finally reach the superior mesenteric nodes around the origin of the superior mesenteric artery.

Pathway of lymphatic drainage:

- ✓ The **Lower limb** drains into the inguinal lymph nodes then into iliac lymph nodes and then para aortic lymph nodes, while the **abdomen** drains directly into para aortic lymph nodes, and then all the lymph is collected in cisterna chyli (like a sac of lymph) in the right side of aortic opening in diaphragm then the thoracic duct (main lymphatic duct in the body) starts from cisterna chyli and ascends in chest receiving lymphatic drainage from chest and opens in the **beginning of left brachiocephalic vein** that's formed by union of **left internal jugular** and **left subclavian veins**.
- ✓ The importance of lymphatics is the absorption of fat and its destination is to the venous blood.

Those two figures for lymph nodes and lymphatic drainage:

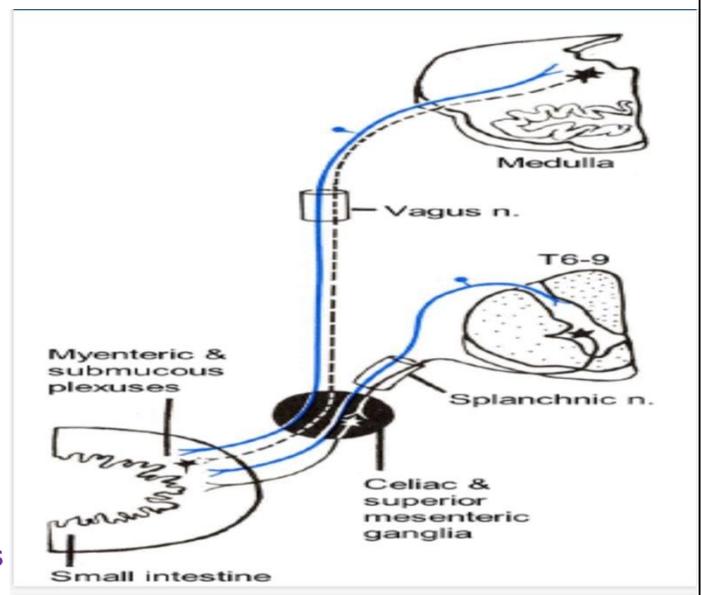


Nerve Supply of jejunum & Ileum :

- ✓ The nerves are derived from the **sympathetic and parasympathetic (vagus)**.
- ✓ Nerves from the superior mesenteric plexus.
- ✓ **Sympathetic** In GI, it innervates two things :
 1. blood vessels >> causing vasoconstriction .
 2. sphincters >> causing contraction of the sphincter like pyloric sphincter and sphincter of oddi.
- ✓ **Parasympathetic :**
- ✓ Remember 1973 >> the cranial nerves that carry with them parasympathetic innervation , here in the GI tract , by vagus with its gives parasympathetic innervation to the lateral 1/3 of transverse colon (innervates fore gut and midgut while hind gut gets parasympathetic innervation from sacral nerves #2,#3,#4).

Regarding this figure about the sympathetic and Parasympathetic innervation :

- ✓ First of all, remember that the sympathetic is originating from T1-L2 (thoracolumbar)
- ✓ The spinal cord is divided into segments , Originating from the segments spinal nerves, From the lateral horn of the segment , the Sympathetic nuclei are located , from their The preganglionic sympathetic fibers are originated in accompany with spinal nerves,
- ✓ For the small intestine , The nuclei of T6-T9 gives nerve fibers called preganglionic sympathetic fibers which accompany with spinal nerves forming **splanchnic nerves** and synapse in **celiac ganglia** around the origin of **celiac trunk** and **superior mesenteric ganglia** around the origin of **superior mesenteric artery**.
- ✓ Splanchnic nerve: Spinal nerve that carries preganglionic sympathetic fibers.
- ✓ The lumbar spinal nerve (#1) synapse in **inferior mesenteric ganglia** around the origin of **inferior mesenteric artery**. After synapsing, the post ganglionic sympathetic nerves go to the organ (foregut, midgut, or hindgut)

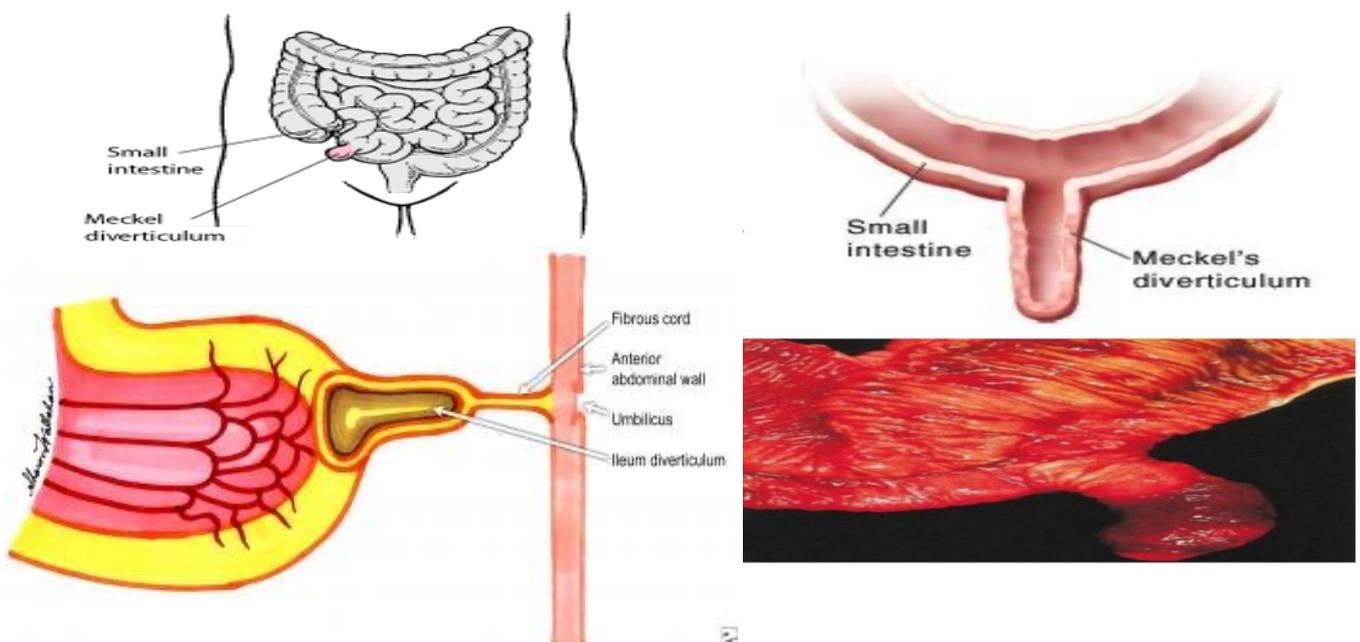


- ✓ Vagus nerve (cranial nerve #10) originates from **vagal nucleus in medulla oblongata** and then descends from brain through neck and thorax around esophagus as **right and left vagal nerves** on the right and left of esophagus respectively.
- ✓ It crosses the diaphragm around esophagus and enter the abdomen. Around the stomach, the right vagal nerve becomes posterior and the left vagal nerve becomes anterior.
- ✓ Then it passes in the ganglia (without synapsing or interruption) it will continue to synapse in the wall of the organ (in the myenteric plexus of stomach and small intestine) and give **short** post ganglionic fibers (short since it near the organ) which go to the **glands** (as a secretomotor) & to **smooth muscles** (which responsible for peristaltic movement).

Congenital anomaly of small intestine

Meckel's Diverticulum:

- a congenital anomaly of the **ileum**
 - ✓ small abnormal plugging in the wall of **ileum**.
 - ✓ Vitelline duct: A duct between umbilicus and ilium that should undergo **obliteration and fibrosis** before birth and closes completely . But if it stayed open for any reason , secretion of ilium will exit from umbilicus.
 - ✓ Some times it's obliterated but forms a small diverticulum **comes from the ileum** that contains either gastric or pancreatic tissue, and usually causes inflammation that's similar to appendicitis with the same symptoms (severe pain in the right iliac fossa) , the surgeon thinks its appendicitis but after opening at that area , you will find normal appendix , but you will see this small plugging (Meckel's diverticulum)
 - ✓ Complications: Inflammation/ Perforation which can cause peritonitis/ Bleeding.
 - ✓ Note the rule of **2**:
- Present in **2%** of people
- **2** feet from ileocecal junction
- **2** inch long
- contains gastric **or** pancreatic tissue (**2** options)
- Remains of vitelline duct of embryo



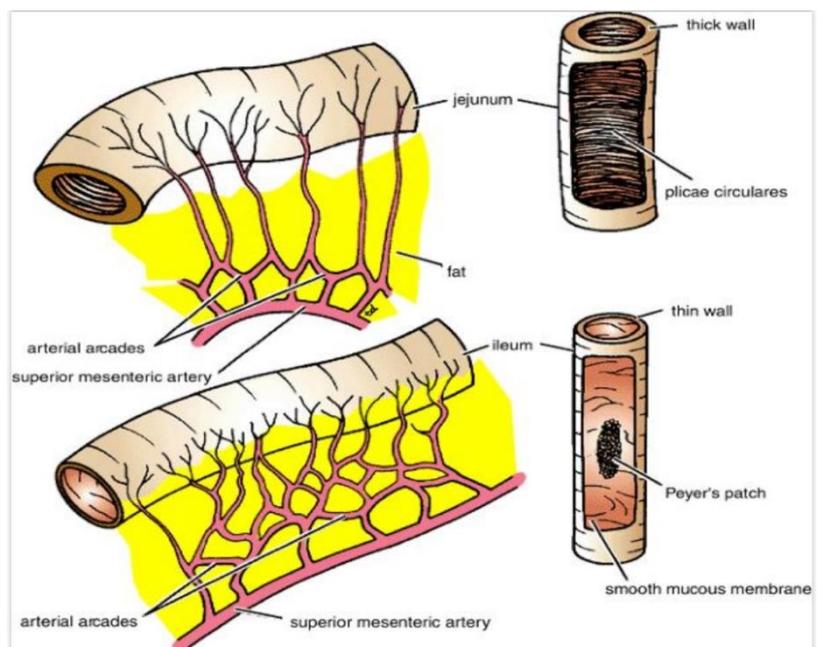
Difference between Jejunum & Ileum

	jejunum	Ileum
length	Proximal 2/5	Distal 3/5
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
wall	thicker wall & redder	Thinner & less redder
Arcades in mesentery	- simple, only one or two arcades - with long infrequent branches - Long vasa recta	numerous short terminal vessels arise from a series of three or four or even more Arcades - Short vasa recta
Fat in mesentery	- the fat is deposited near the root - it is scanty near the intestinal wall - Less in amount → appear window	- the fat is deposited throughout mesentery - Big amount - No window appear

Difference between Jejunum & Ileum

	jejunum	Ileum
Diameter	wider	smaller
villi	numerous	Less numerous
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.
Lymphatic follicles	No or few	Aggregations of lymphoid tissue (Peyer's patches) are present in the mucous membrane

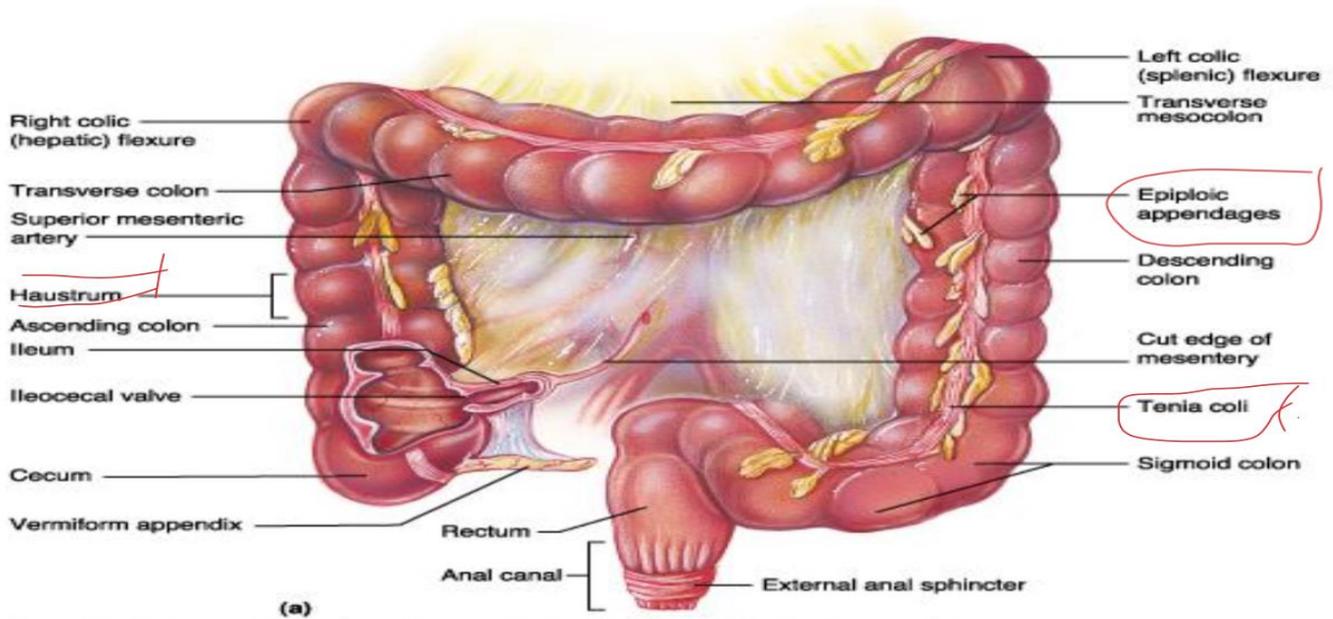
All the features that's discussed before:
Check them here (regarding the fats Distribution and vasa recta and arcades)



Large Intestine

- ✓ The diameter of large intestine is larger than the small intestine.
- ✓ The length of small intestine (jejunum and ileum) is 6m while the large intestine is 1.5-2.5m.
- ✓ Regarding the function :
 - 1- The small intestine mainly for absorption of nutritive material.
 - 2- The large intestine for : absorption of water , formation of feces (stool).

Anatomy of the Large Intestine



Some specific features (note the colored parts in the figure):

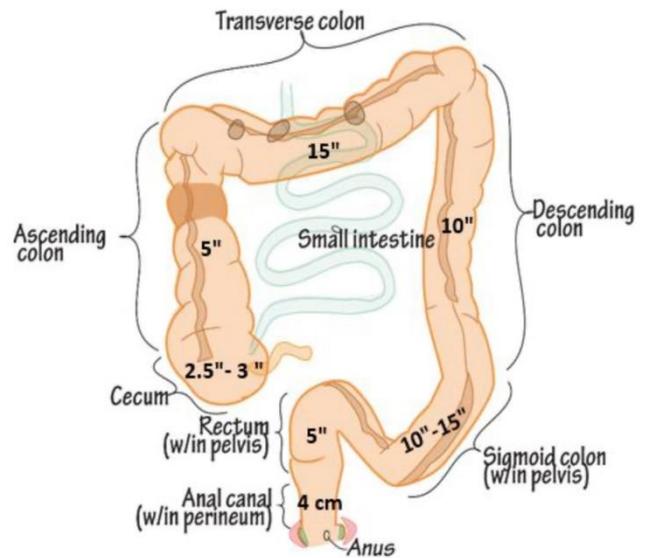
- 1- Sacculatation or haustra.
- 2- Tenia coli : three separate bands or longitudinal ribbons of smooth muscle originate from outer longitudinal muscle.
 - ✓ Found all over large intestine except appendix and rectum.
 - ✓ It's found only on one side and that's why its contraction causes the formation of sacculatation/ haustra.
 - ✓ -It's a landmark for the base of appendix, so when appendix is retrocecal we track tenia coli until reaching the cecum ,it ends and indicates the base of appendix.
- 3-tags of fats (Appendices epiploica): (adipose structures protruding from the serosal surface of the colon).
 - ✓ Found all over large intestine except appendix, Cecum and rectum.
 - ✓ Sometimes needed for energy.

The parts & their lengths:

- ✓ Extends from ileocecal valve to anus
- ✓ **Length** = 1.5- 2.5m = 5 feet
- ✓ **Regions**
 - Cecum = 2.5- 3 inch
 - Appendix= 3-5 inch
 - Colon
 - Ascending= 5 inch

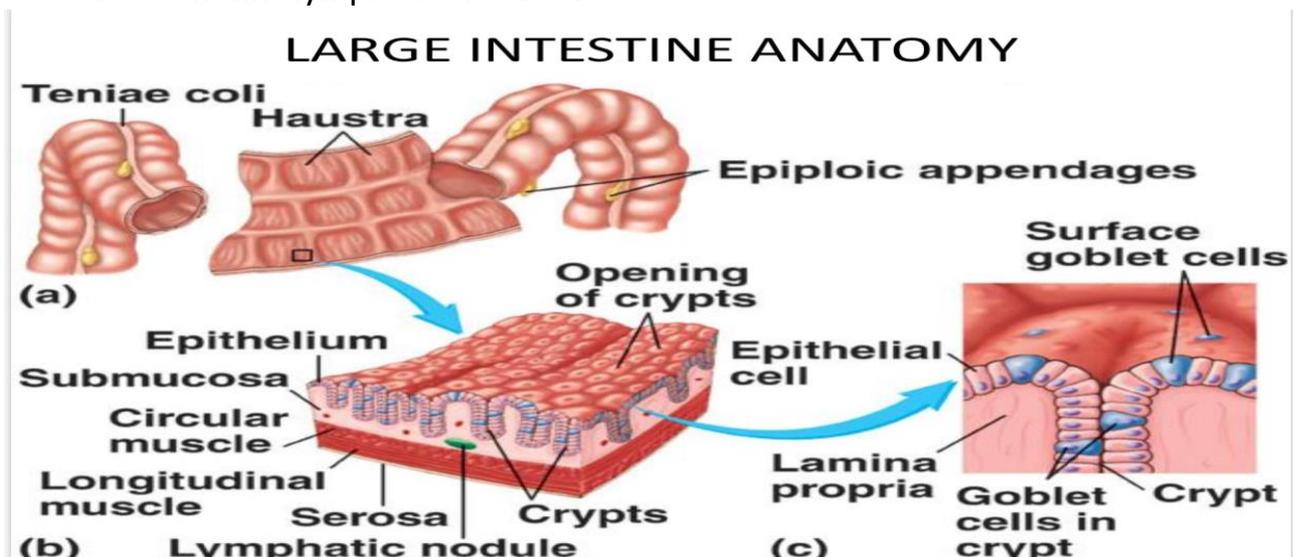
Then notes the right colic (or hepatic , because of the liver) flexure .

- Transverse= 15 inch
- Then notes the left colic or (splenic because of the spleen) flexure.
- Descending= 10 inch
 - Sigmoid colon = 10 – 15 inch
 - Rectum= 5 inch
 - Anal canal= 4 cm



Histology

- ✓ The layers of large intestine are similar to those of the small intestine.
- ✓ The large intestine has no villi (it has straight surface).
- ✓ The lining epithelium of large intestine is the same as the small intestine (simple columnar epithelium with goblet cells, same as small intestine but with numerous goblet cells, because they are needed for lubrication of hard pieces of stool).
- ✓ The Glands (crypts of Lieberkühn) on base but doesn't have paneth cells but contains lymphatic nodules.



CECUM:

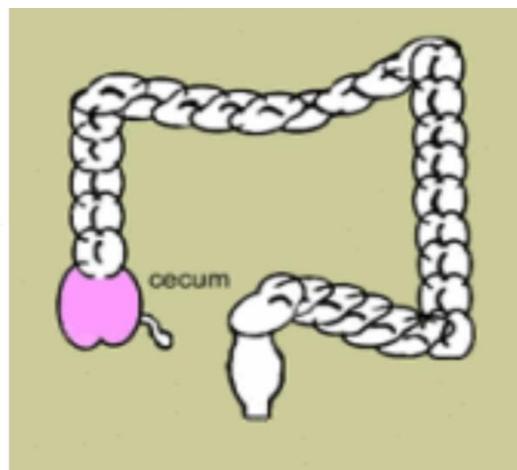
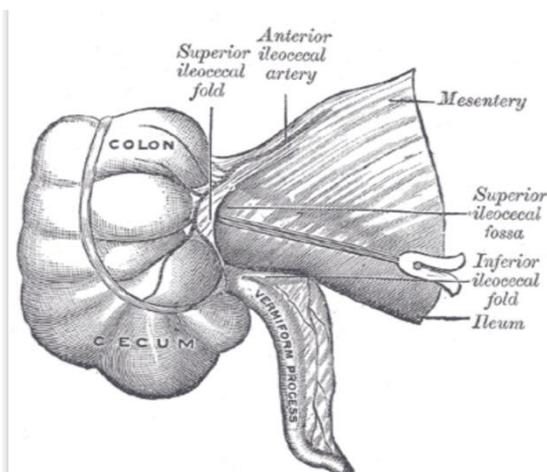
- ✓ It is a blind-ended pouch.
- ✓ Location: situated in the right iliac fossa, above the lat ½ of inguinal ligament lying above iliacus muscle and psoas major muscle.
- ✓ Size: It is about 3 inch in diameter.

- ✓ Regarding the peritoneum:

There are many hypotheses about the covering peritoneum of cecum:

 1. first : the Cecum is covered by peritoneum and can have short mesentery. (the one we rely on)
 2. second :the Cecum is fixed to the right iliac fossa and covered by peritoneum from all directions except an area posteriorly without peritoneum.
- ✓ Slides: Completely covered with peritoneum and it possesses a considerable amount of mobility, although it does not have a mesentery.
- ✓ So we said its (Cecum is fixed to the right iliac fossa , and Completely covered with peritoneum and can have short mesentery).
- ✓ The cecum has three opening to the structure that's attached with :
 - 1- **Superiorly**: Ascending colon .
 - 2- **posteromedial** surface is the appendix, 1 inch below ileocecal valve .
 - 3- **medially**: Ileum (what specializes ileocecal opening is the presence of mucosal fold on it that closes the ilium when the pressure inside the cecum increases, so no regurgitation of material from cecum to ilium happens.) Ileocecal opening is considered physiologically a valve but anatomically it's an opening because there's no circular smooth muscle around it (discussed previously in this sheet).
- ✓ The presence of peritoneal folds in the vicinity of the cecum creates :
 - The superior ileocecal recesses
 - The inferior ileocecal recesses
 - The retrocecal recesses.

The retrocecal recesses>> These recesses can form internal hernia & common site for appendix to be hidden there.
- ✓ The longitudinal muscle is restricted to three flat bands, the taenia coli, which converge on the base of the appendix and provide for it a complete longitudinal muscle coat.
- ✓ It has tenia coli on it but there's no appendices epiplolca.



Relations of cecum

- Anteriorly:
 - Coils of small intestine, specifically ileum.
 - the greater omentum
 - the anterior abdominal wall in the right iliac region where we test the patient's cecum.
- Posteriorly:
 - The psoas major and the iliacus muscles.
 - the femoral nerve.
 - and the lateral cutaneous nerve of the thigh passing to the anterior superior iliac spine.
 - external iliac vessels in iliac fossa passing below inguinal ligament to give femoral artery.
- Postero- medially: The appendix is commonly > retrocecal common.

Blood Supply of cecum Arteries:

Anterior and posterior cecal arteries >> a branch of Superior mesenteric artery.

Venous drainage:

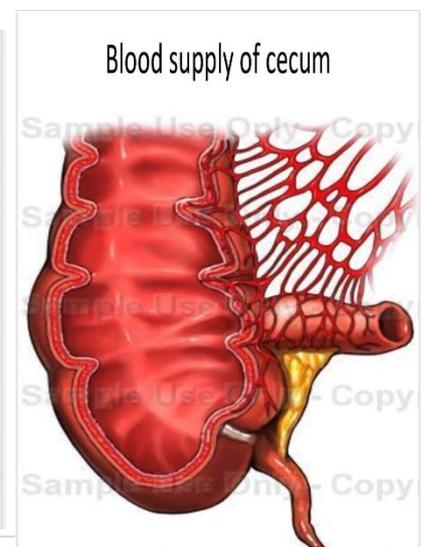
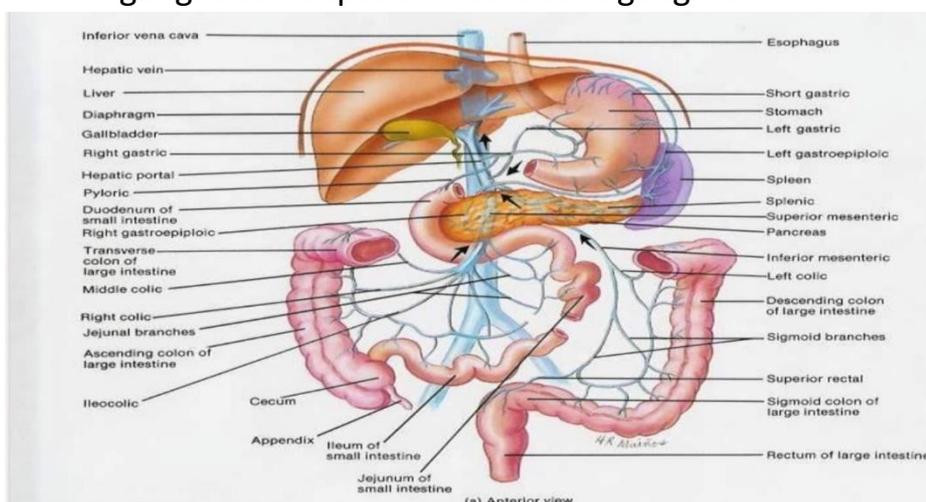
The veins correspond to the arteries (anterior and posterior cecal veins) and drain into the superior mesenteric vein.

Lymphatic Drainage of cecum :

- The lymph vessels pass through several mesenteric nodes & finally reach the superior mesenteric **nodes**.

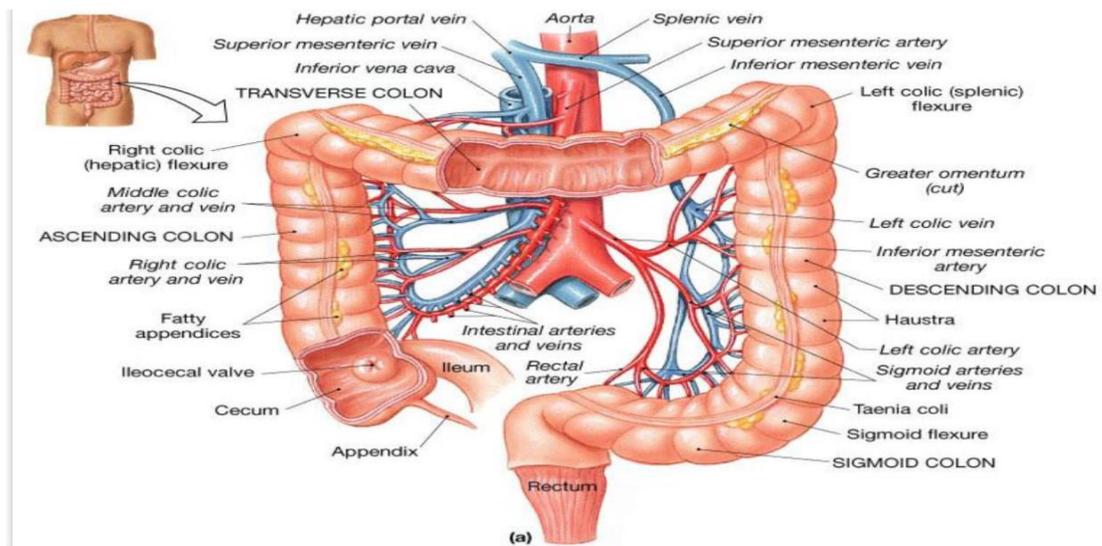
Nerve Supply of cecum :

- slides : Branches from the sympathetic and parasympathetic (vagus) nerves form the superior mesenteric plexus.
- Parasympathetic: from vagus nerve.
- Sympathetic: from greater splanchnic nerve (T6-T9) that synapses in celiac ganglia and superior mesenteric ganglia.



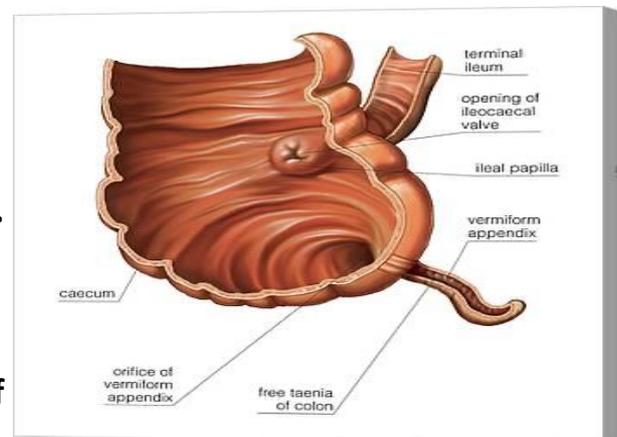
In this figure :

- ✓ Note the abdominal aorta and the inferior vena cava.
- ✓ Note the **inferior** mesenteric artery At the L3
- ✓ Note also the superior mesenteric artery & its branches jejunal and ilial Intestinal arteries and veins and The ileocolic
- ✓ Relation between mesenteric arteries and veins (either superior or inferior) : Arteries are medial and veins are lateral.



Ileocecal Valve

- ✓ A rudimentary structure
- ✓ consists of two horizontal folds of mucous membrane.
- ✓ Project around the orifice of the ileum.
- ✓ The valve plays little or no part in the prevention of reflux of Cecal contents into the ileum.
- ✓ The circular muscle of the lower end of the ileum (called the ileocecal sphincter by physiologists) serves as a sphincter and controls the flow of contents from the ileum into the colon.
- ✓ The smooth muscle tone is reflexly increased when the cecum is distended; the gastrin hormone, which is produced by the stomach , causes relaxation of the muscle tone.



(to remember that after many years : sheet 8 in day 8 quarantine)

We defeat the corona , because we are the decisions we make , we can do that and pass these hard days)