GI
ANATOMY

 # 8

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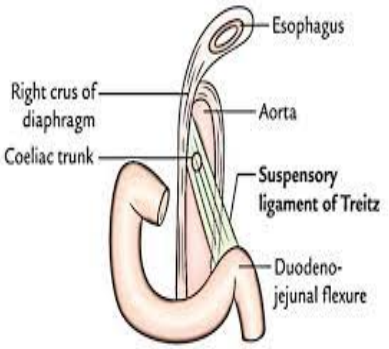
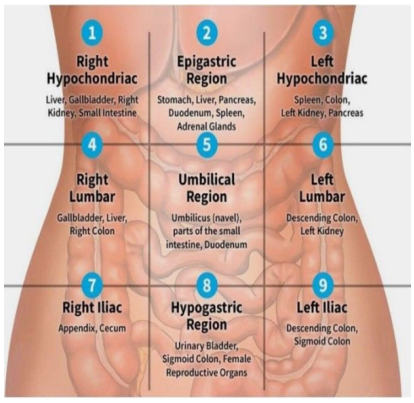
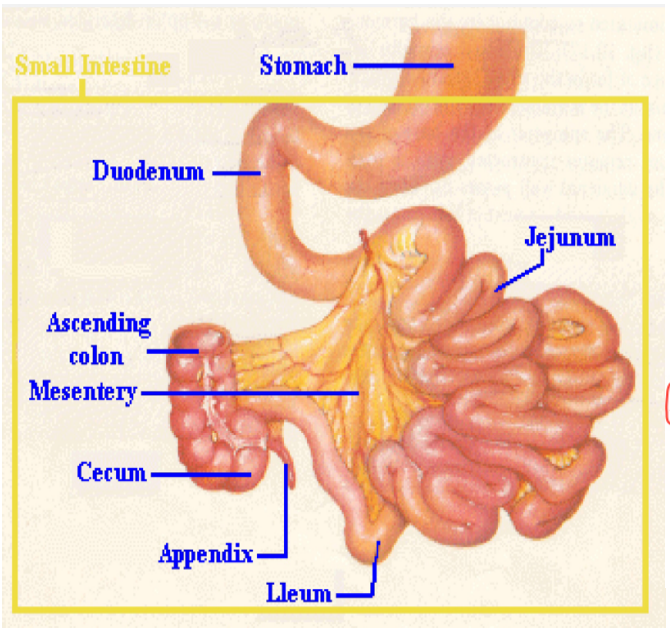
In this color are important information the doctor focused on.

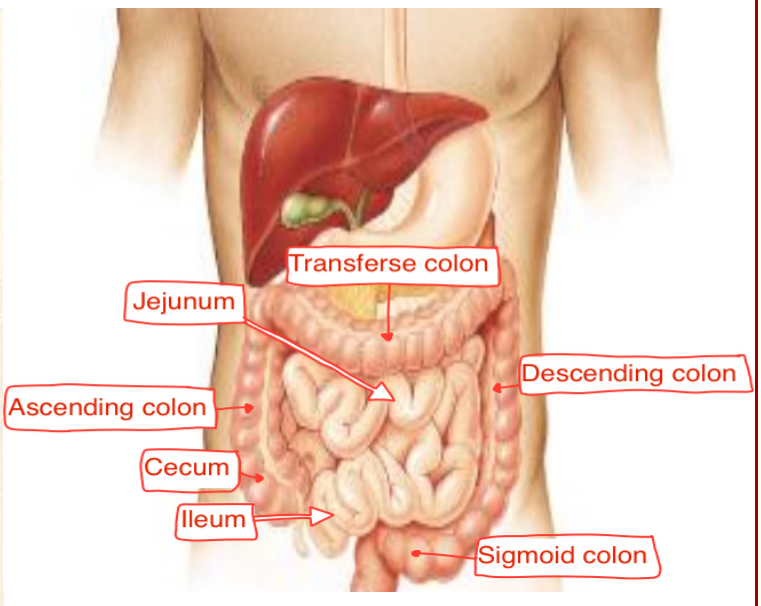
JEJUNUM AND ILEUM

- The jejunum and ileum measure about 20 ft (6 m) long.
- The upper two fifths is the jejunum & the lower 3/5 is the ileum, and both are intraperitoneal organs, unlike the duodenum which is retroperitoneal except the first and last inch are intraperitoneal.
- jejunum and ileum are found in the free edge of the **mesentery**, which is composed of two layers of peritoneum extending from the posterior abdominal wall to the abdominal cavity containing: blood vessels (from the **superior mesenteric arteries and veins)**, lymph nodes and autonomic nerves.
- The jejunum begins at the **duodenojejunal flexure** and **ligament of Treitz** (an important landmark that separates between the duodenum and jejunum).
- The ileum ends at the **ileocecal junction** into the cecum.
- Each has distinctive features.There is a gradual change from one to the other. The coils of jejunum and ileum are freely mobile and are attached to the posterior abdominal wall by a fan-shaped fold of peritoneum known as the mesentery of the small intestine.
- The small intestine, jejunum and ilium, are located in the **umbilical region** surrounded by large intestine, the jejunum is always upper to the left while the ilium is lower to the right.

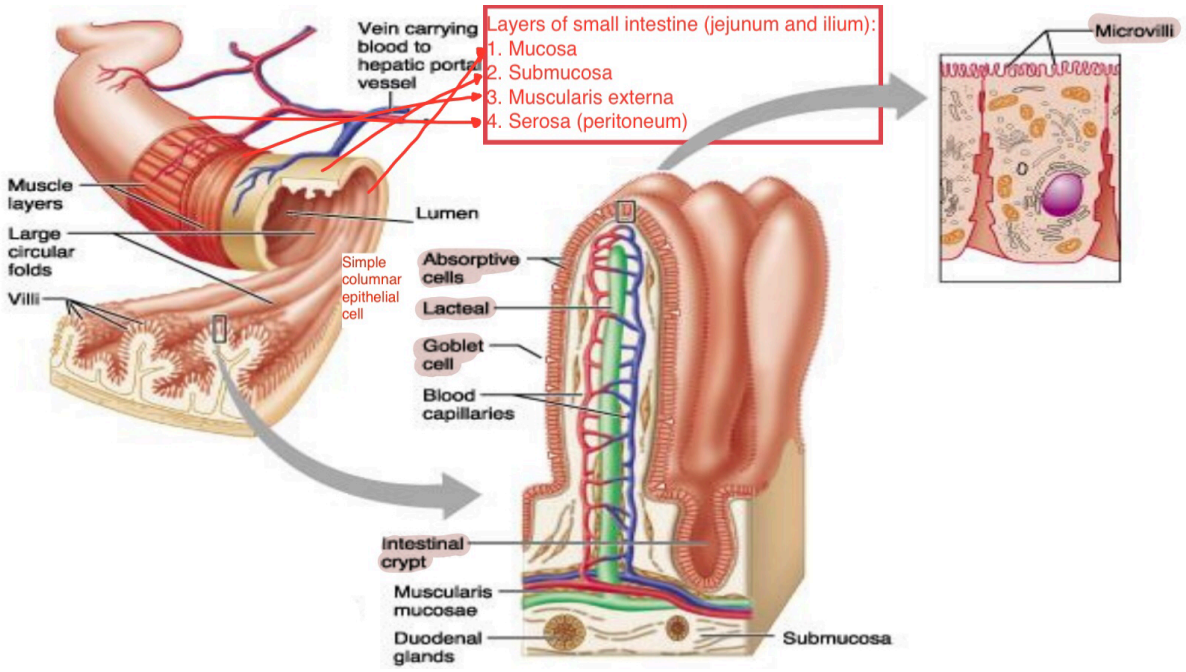








STRUCTURE OF THE VILLI IN THE SMALL INTESTINE:



Layers of small intestine (jejunum and ilium): mucosa, submucosa, muscularis externa, serosa (peritoneum, mesothelium).

Small intestine's function it to absorb digested material into the portal vein going to the liver, that's why on their folds of mucosa they have finger like projections called **villi** to increase the surface area of absorption.

▪ The lining epithelium of the small intestine is **simple columnar epithelium with goblet cells (unlike the stomach which doesn't have goblet cells) and it's function is absorption,** and because of that it's called **"absorptive cell".** The upper finger like projections or halves are called **villi,** and they are composed of:
A vein, artery, smooth muscle, lacteal (blind or closed lymphatic vessel) for the absorption of fat.

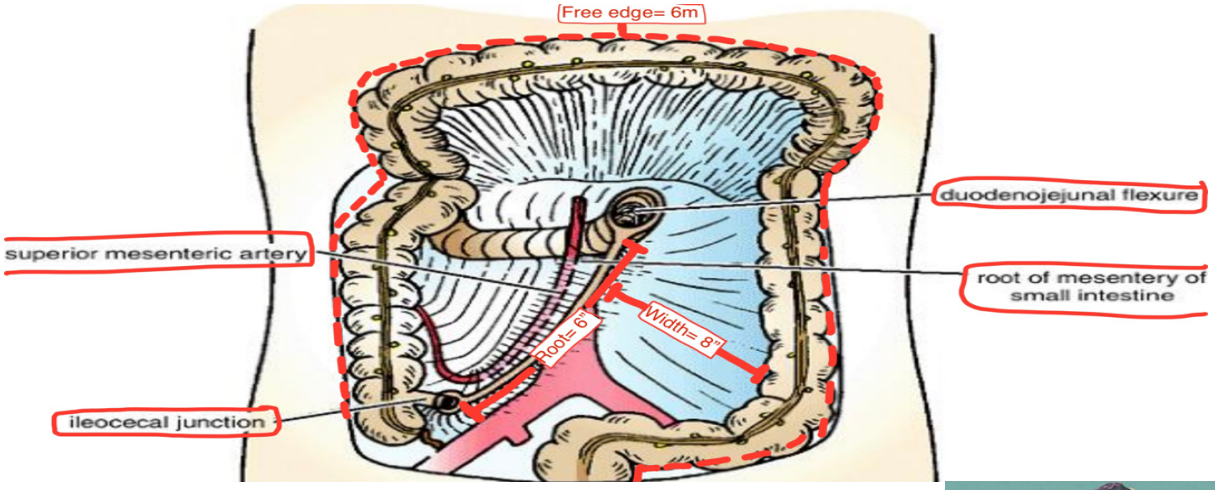
▪ And the lower pits or halves are forming **glands which are also called: intestinal glands or crypts of Lieberkühn** (after the person who discovered them), **they have the same lining epithelium as the villi, but their function is secretion** that helps in the absorption process.

▪ The lining also includes **microvilli for further increase in the surface area for absorption** forming a brush surface on the surface of small intestine.

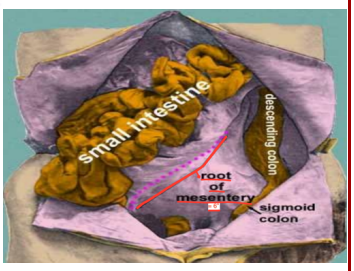
- **Villi and microvilli both increase the surface area for absorption.**

MESENTERY OF THE SMALL INTESTINE:

- **fan-shaped** fold of two layers of peritoneum (between them are blood vessels, lymphatic nodes and autonomic nerves).
- The long free edge of the fold encloses the mobile intestine.
- **The root** of the mesentery (**6 inches**, 15 cm) is its attachment to the posterior abdominal wall, **starts** at the **duodenojejunal junction** exactly at **L2 one inch to the left,** and **ends** at **ileocecal junction in front of right sacroiliac** joint.
- **The breadth, width** (العرض) is about **8 inches.**
- **The free edge is 6 meters.**



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 (the doctor didn't mention this).



CONTENTS OF THE MESENTERY:

1- Superior mesenteric artery which gives 12-15 branches forms arcades and vasa recta when reaching jejunum and ilium.
2- Superior mesenteric vein and its tributaries that ends in the portal vein to the liver (portal vein is formed by the superior mesenteric and splenic veins behind the neck of pancreas).
3- Lymphatic vessels and lymph nodes which end in the superior mesenteric lymph nodes.
3- Nerves: sympathetic and parasympathetic.
4- Fat which is more in mesentery of ilium.

- This table is sooo important don’t تأووته .

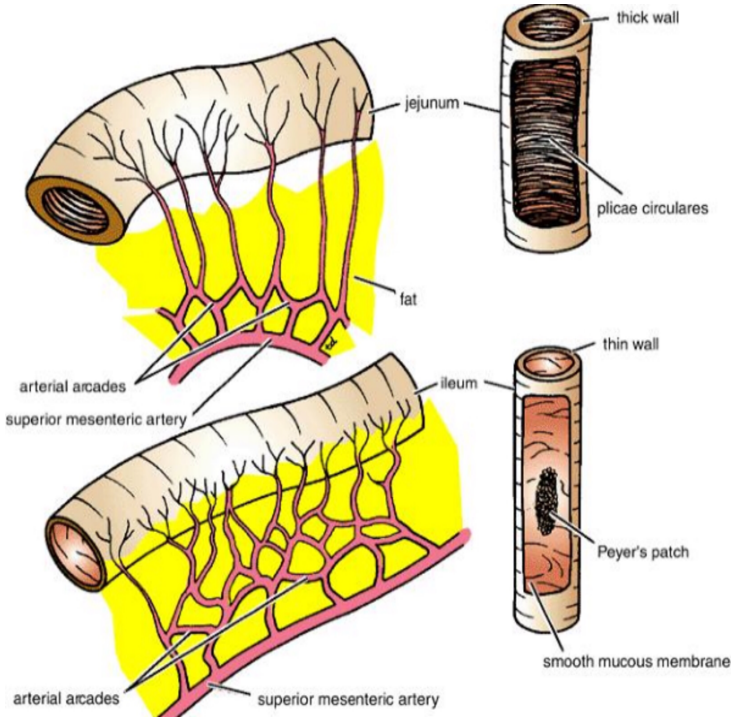
Difference between Jejunum & Ileum

	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 vase recta	numerous short terminal vessels arise from a series of three or four or even more Arcade - Short vase 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
Diameter	wider	smaller
villi	numerous	Less numerous
Plicae circularis(the permanent enfolding of the mucous membrane& submucosa It is folding of the submucosa through the mucosa like the ruge in the stomach.	They are: 1- larger 2- more numerous 3- closely set	they are: 1- smaller or absent 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

▪ **Peyer's patches** are lymphatic nodules or follicles, it's present in the **ilium,** and little or non in the jejunum.

▪ **Plicae circularis** is the folding of submucosa through the mucosa present in the **jejunum**, and not really obvious in the ilium.

- **Plicae circularis, simple arcades, long vasa recta, thick, redder, less fat ⇨Jejunum.**
- **Peyer's patches, complicated arcades, short vasa recta, thin, less redder, more fat ⇨Ilium.**



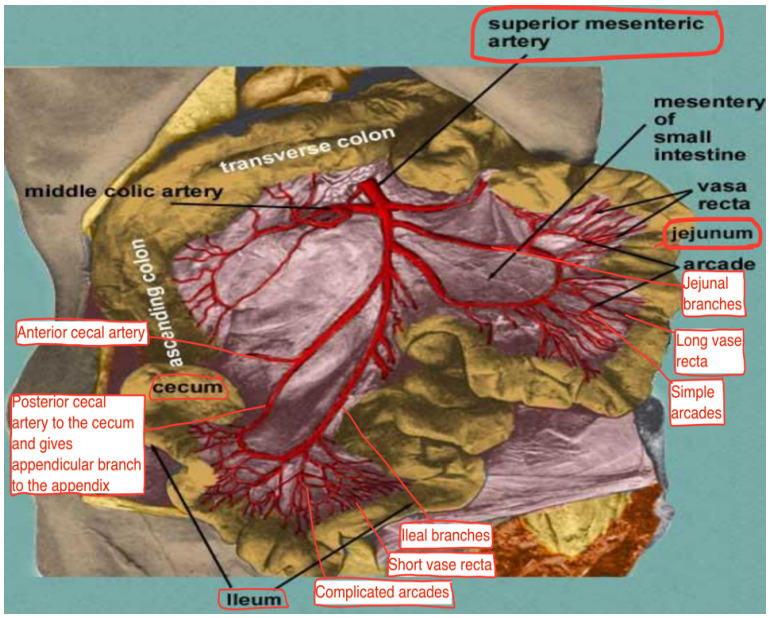
BLOOD SUPPLY OF JEJUNUM & ILEUM

• The arterial supply is from branches of the **superior mesenteric artery** (jejunal and ileal branches that forms arcades and **end as vasa recta**).

• The cecum is supplied by the **anterior and posterior cecal arteries** that are branches from **the superior mesenteric artery**, the **posterior cecal artery** also gives a branch called **appendicular artery** to supply the appendix.

• 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.

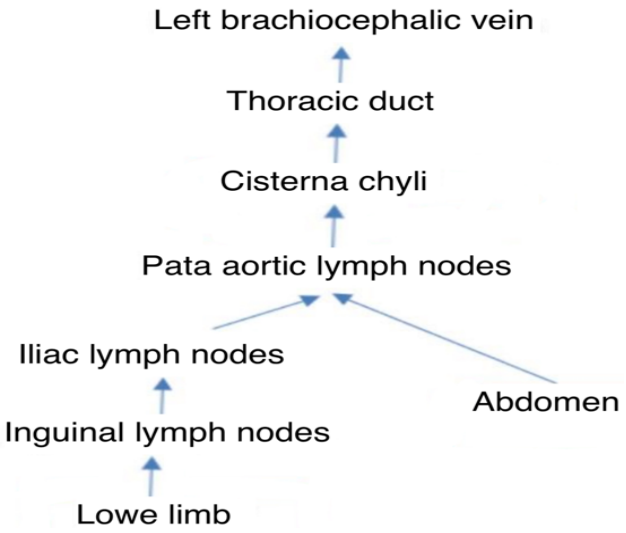
• The veins represented by tributaries that correspond to the branches of the superior mesenteric artery and they drain into the superior mesenteric vein which then drain into the portal vein to the liver.

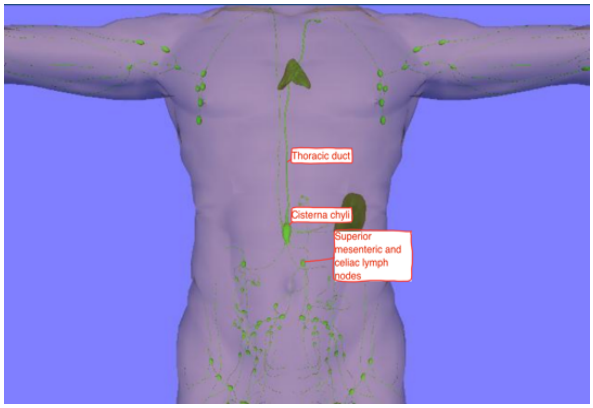


LYMPHATIC DRAINAGE OF JEJUNUM & ILEUM

• The lymph vessels pass through many intermediate mesenteric nodes. Finally reach the superior mesenteric nodes→ around the origin of the superior mesenteric artery.

Because jejunum and ilium are midgut, their lymphatics drain into the **superior mesenteric lymph nodes**→ which then drain into **celiac lymph nodes**→ then to **cisterna chyli** (a sac of lymph behind and to the right side of the opening of the abdominal aorta, it's the drainage site of the small intestine through the superior mesenteric lymphatic and the stomach through celiac lymph nodes)→ the to the **thoracic duct** (the main lymphatic duct for the abdomen and the left side of the thorax)→ finally opens into **the beginning of the left brachiocephalic vein** (the meeting point of the internal jugular with the subclavian vein).





NERVE SUPPLY OF JEJUNUM & ILEUM

The small intestine has sympathetic and parasympathetic innervation:

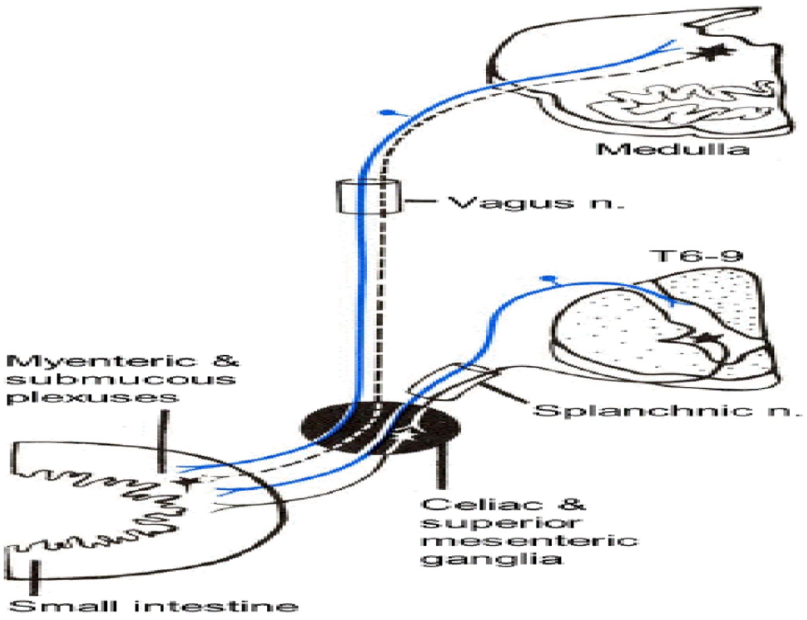
•sympathetic innervation:

Originate from the **lateral horn of the 6th to 9th thoracic segments of the spinal cord**→ forming **splanchnic nerve** which is preganglionic sympathetic fiber→ that synapse in the **superior mesenteric ganglia or celiac ganglia (sympathetic ganglia)**→ and continues as **celiac plexus or superior mesenteric plexus** which contain postsynaptic sympathetic fibers that are distributed with the blood supply, along with branches of the celiac or superior mesenteric arteries.

• **Parasympathetic innervation:**

Originate from **medulla oblongata**→ forming preganglionic parasympathetic fibers that run in the **vagus nerve**→ then forms a plexus of nerves that **pass through the superior mesenteric or celiac ganglia** without synapsing→ then synapse in the **myenteric plexus or the enteric plexus** in the wall of small intestine (between the external outer longitudinal and the inner circular smooth muscle).

▪ **The celiac plexus or superior mesenteric plexus contains both postsynaptic sympathetic fibers (from splanchnic nerve) and presynaptic parasympathetic fibers (from vagus nerve).**



CONGENITAL ANOMALY OF SMALL INTESTINE

Meckel's Diverticulum:

The word diverticulum describes the small bulge of the small intestine.

• a congenital anomaly of the **ileum**.

• It is remains of **vitelline duct** of embryo.

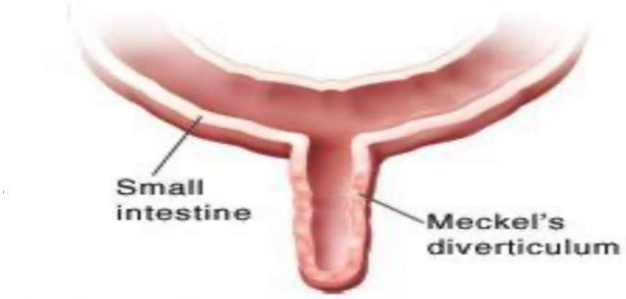
Vitelline duct: a gastrointestinal duct that should undergo obliteration before birth and close completely. But if it stayed present and open in the embryo, it forms **Meckel's Diverticulum.**

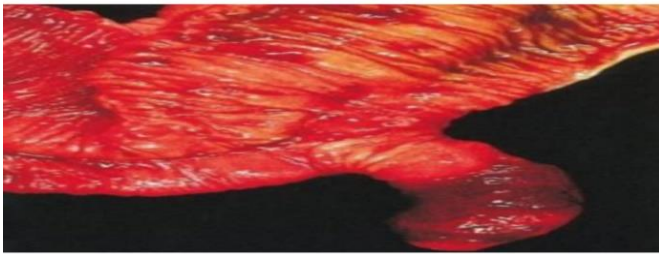
• Present in 2% of people, 2 feet from iliocecal junction, 2 inch long (222).

• contains gastric or pancreatic tissue can secrete gastric or pancreatic secretions.

• The importance of this structure is that in case of its **inflammation**, its clinical presentation is **similar to appendicitis** with the same symptoms (severe pain in the right iliac fossa, the site of appendix and ilium too), the

surgeon thinks it's appendicitis, but after opening at that area 2 feet from the iliocecal junction they will find 2 inches long Meckel's Diverticulum. It's treated the same way as the appendicitis, which is removing it by strangulation through tight stitches.





- **Its complications it that it can get perforated and form ulcers or cause peritonitis and it might cause bleeding.**

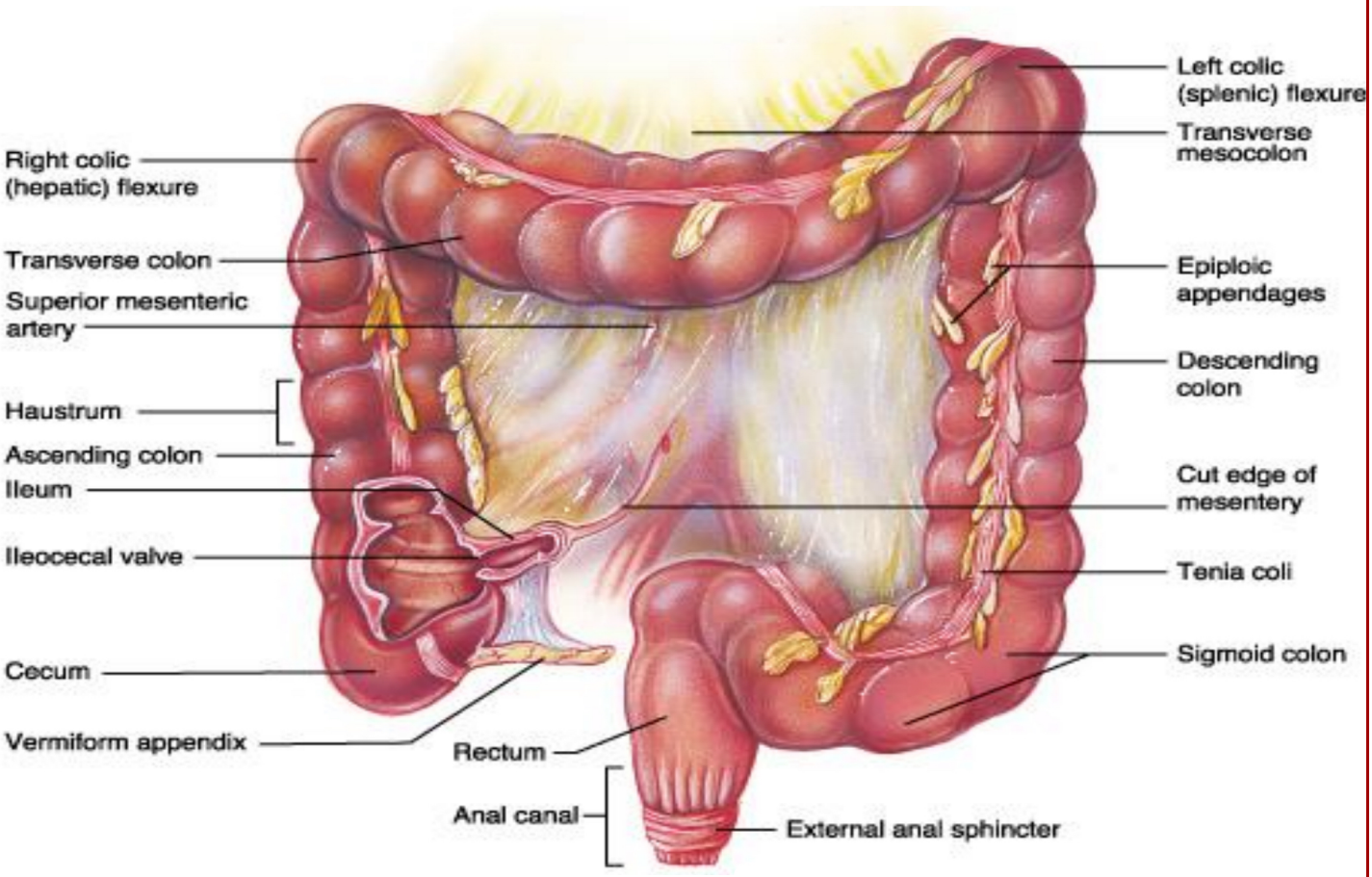
LARGE INTESTINE

- The large intestine is composed of: appendix, cecum, ascending colon, transverse colon, descending colon, sigmoid colon, rectum and anal canal.
- The large intestine extends from **ileocecal valve** to **anus.**
- The junction between the **ascending** and **transverse colon** is called **right colic flexure** or **hepatic flexure**.
The junction between the **transverse** and **descending colon** is called **left colic flexure** or **splenic flexure**, it is attached to it the **phrenicocolic ligament,** which separates the upper abdomen from the lower.
(usually the splenic flexure in the **left** is higher than the hepatic one in the **right**).
- 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** (**shorter** than the small intestine).
- The function of the large intestine is: **absorption of water,** and **formation of feces.**
- **Specific features of the large intestine:**

1- Sacculation= haustra or haustration (تكيسات) (not present in the small intestine).

2- Taenia coli: three separate longitudinal ribbons or bands of smooth muscle descend downwards until it reaches the appendix (found all over the large intestine except appendix and rectum).

3- Tags of fat (epiploic appendices or appendices epiplolca) adipose structures protruding from the serosal surface of the colon) → except appendix, cecum and rectum.

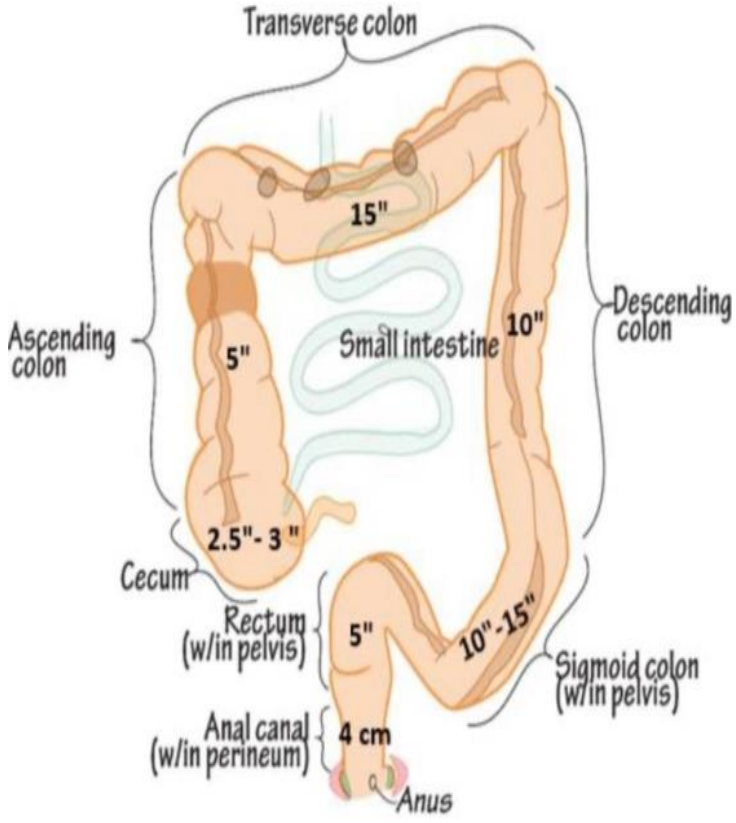


The doctor said we should memorise all those numbers ')

Length of large intestine= 1.5- 2.5m = 5 feet

Length, size of its regions:

- **Cecum = 2.5-3 inch**
- **Appendix= 3-5 inch**
- **Colon:**
  - **Ascending= 5 inch**
  - **Transverse= 15 inch**
  - **Descending= 10 inch**
  - **Sigmoid colon= 10-15inch**
- **Rectum= 5 inch**
- **Anal canal= 4 cm**

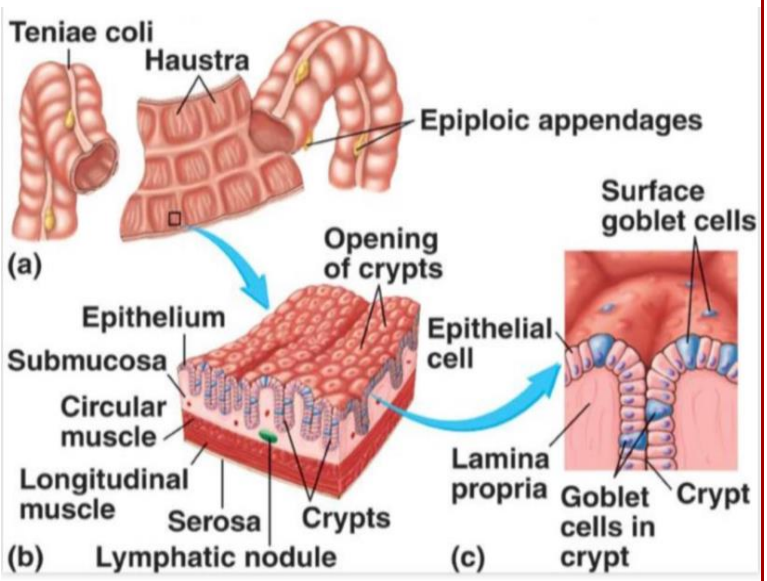


HISTOLOGY

- 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 their function is different, they are needed for lubrication of hard pieces of stool).



- The Glands (crypts of Lieberkühn) on the base are similar to the small intestine, but differ in the type cells, the large intestine **don't have paneth cells** which is present in the small intestine.

CECUM

• It is a blind-ended bounded pouch.

• Site: situated in the **right iliac fossa** as a pouch, above the **lateral half of inguinal ligament.**

• Size: It is about **2.5- 3 inch** in diameter.

• Completely covered with peritoneum (cecum is an intraperitoneal organ, but it's fixed in the right iliac fossa and forms a fold of peritoneum, which makes recesses).

• The presence of peritoneal folds in the vicinity of the cecum creates:

- The superior ileocecal recesses.

- The inferior ileocecal recesses.

- The retrocecal recesses.

The common side of the appendix is retrocecal.

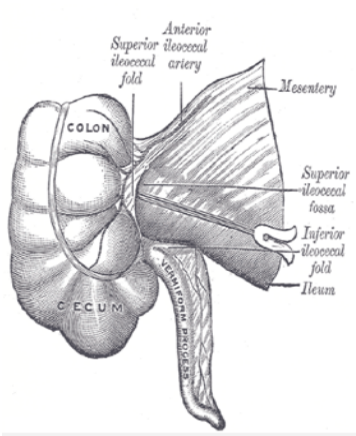
• It possesses a considerable amount of mobility, although it does not have a mesentery.

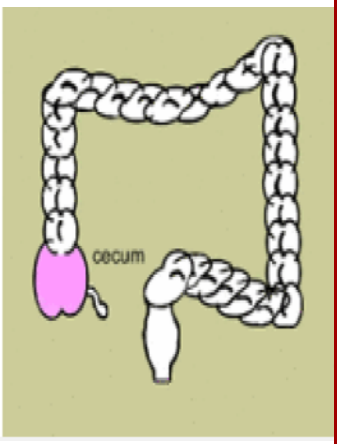
•The cecum is attached to (the openings of the cecum):

1 - **Ascending colon** superiorly.

2 - posteromedially surface is the **appendix** , 1 inch below ileocoecal valve.

3 - medially to the **Ileum**.





• The cecum always has **intracecal pressure** inside, which does in two things:

- Helps the materials from the ilium to ascend upwards when they reach the cecum.
- Also helps in the closure of the iliocecal valve (which is a physiological or functional valve not anatomical, the smooth muscles there aren't thickened. But there is a fold of mucosa around the opening, this fold with the intracecal pressure close the ilium so that when the materials reach the cecum they can't go back to the ilium).

• The longitudinal muscle is restricted to three flat bands, the **taenia coli,** which converge on the base of the appendix (a way to find the appendix when you can't see it) and provide for it a complete longitudinal muscle coat.

RELATIONS OF CECUM:

• **Anteriorly**:

- Coils of small intestine (ilium mostly).

- The greater omentum (which extends in the greater sac).

- The anterior abdominal wall in the right iliac region (cecum can be palpated because of its relation to the anterior abdominal wall).

• **Posteriorly**:

- The psoas and the iliacus muscles (together they form iliopsoas muscle).

- The femoral nerve.

- The lateral cutaneous nerve of the thigh.

- External iliac vessels forming the femoral artery.

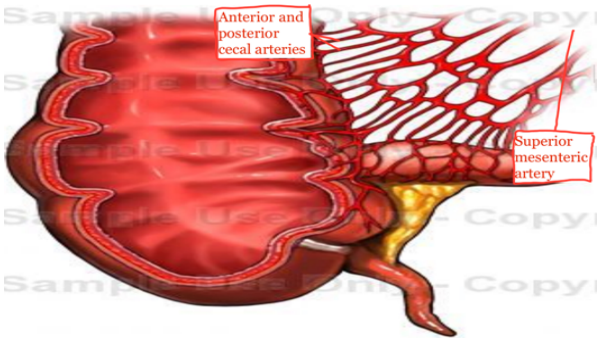
- Posteromedially → The **appendix** is commonly retrocecal.

• **Medially**:

- Small intestine (ileum).

Arterial Supply of cecum:

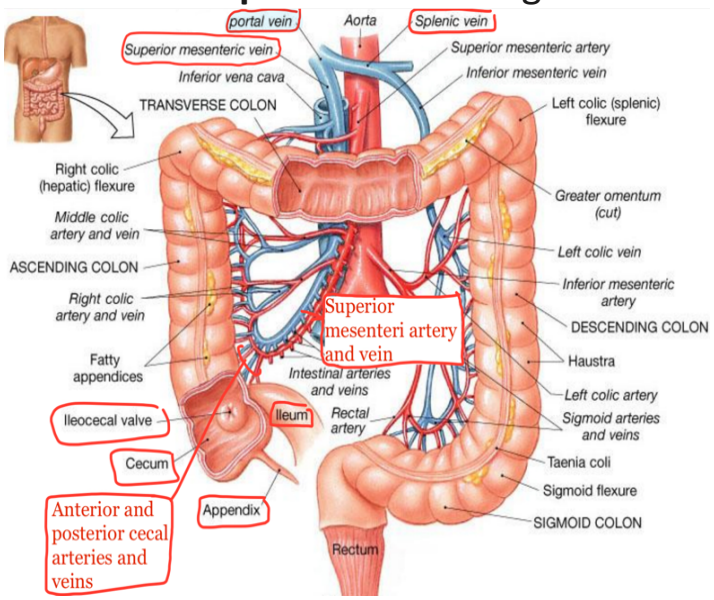
Anterior and posterior cecal arteries >> a branch of Superior mesenteric artery.

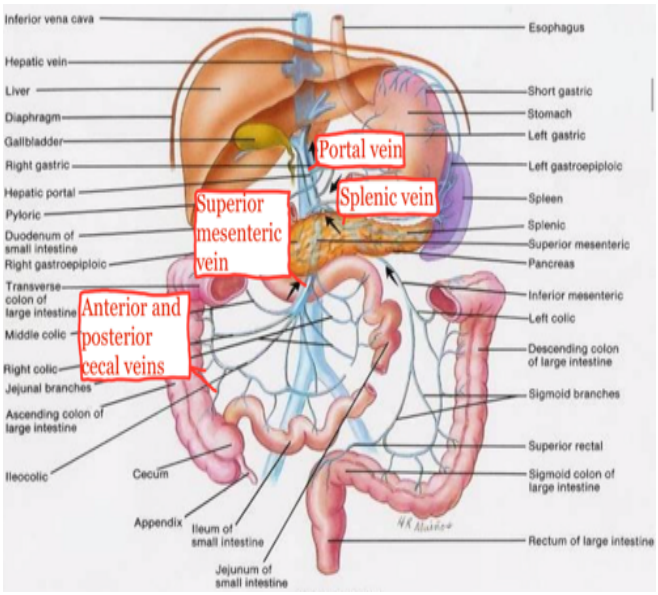


Venous drainage:

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

Anterior and posterior cecal veins→ superior mesenteric vein→ superior mesenteric vein joins the splenic vein behind the neck of pancreas to form→ **the portal vein** that goes to the liver.





Lymphatic Drainage of cecum:

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

Nerve Supply of cecum:

Branches from the sympathetic and parasympathetic (vagus) nerves form the superior mesenteric plexus.

-Parasympathetic: from vagus nerve to the glands and smooth muscles (peristaltic movements).

-Sympathetic: from splanchnic nerve to the blood vessels and sphincter.

ILEOCECAL VALVE

• A rudimentary structure (physiological not anatomical sphincter).

• consists of **two horizontal folds of mucous membrane which works as a valve to prevent the regurgitation of materials.**

• Nerves and hormones affect this valve.

• 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 (the doctor didn't read any of this).

APPENDIX

It's really important because it's infected a lot and its treatment always is appendectomy.

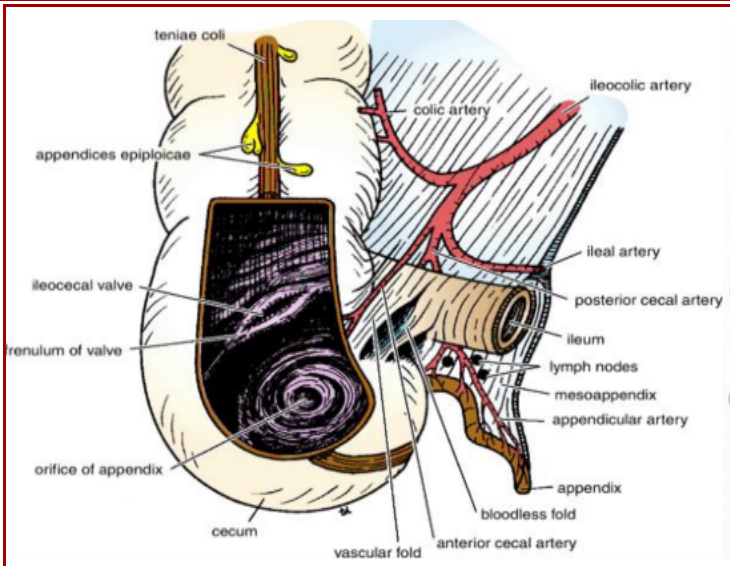
• It is a very narrow, muscular tube.

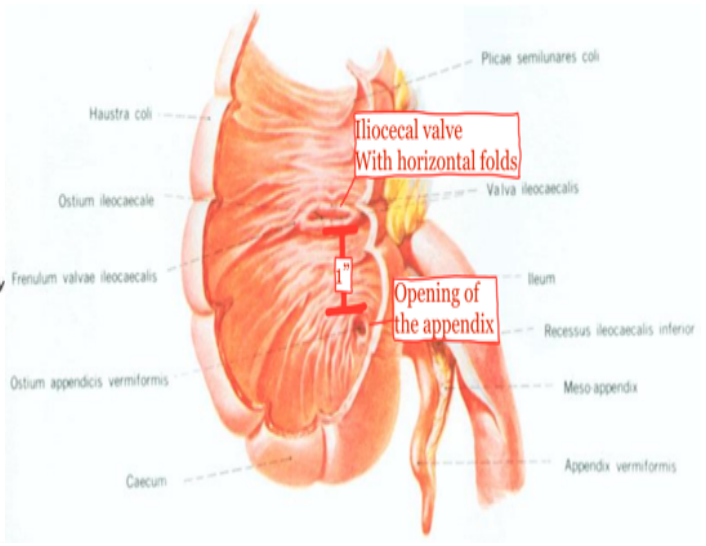
• **containing a large amount of lymphoid tissue, it is present in the GIT, but has no role in digestion, it is important for the immunity, that is why in children it is important, but there is no problem in removing** it because we have other lymphoid organs that can compensate.

• It varies in length **usually from 3 to 5 inch** (**2 -22 cm**) it expands when infected that's why it has a wide range of length, in some people it could be as short as 2cm, and in others 20.

• The base is attached to the posteromedial surface of the cecum, **about 1 inch (2.5 cm) below the ileocecal junction.** The remainder of the appendix is free.

• **Peritoneum**: **It has a complete peritoneal covering** (intraperitoneal organ), which is attached to the mesentery of the small intestine by a short mesentery of its own, **the mesoappendix.** The mesoappendix contains the appendicular vessels, nerves and appendicular lymph nodes.





• Position:

- The appendix lies in the right iliac fossa, and in relation to the anterior abdominal wall.

1- **Retrocecal in retrocaecal recess behind cecum→** in **74%** of people.

2- **pelvic**: in pelvis related to right Ovary and uterine tube→ in **21%** of people.

3- **Subcaecal**: below cecum→ in 3.5%

4- **Preileal**: in front of ileum where it meets the cecum→ 1%

4- **Postileal**: behind the ileum where it meets the cecum→ 0.5%

(the doctor didn't read the last 3 percentages he just said that they are low).

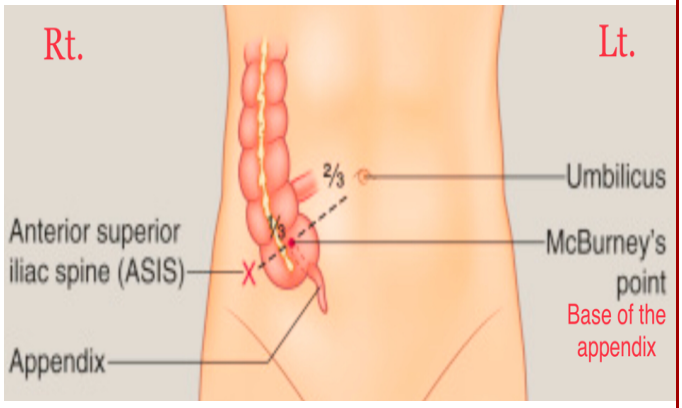
• Surface anatomy of appendix= McBurney's point

- McBurney's point : is the base of the appendix is situated one third of the way up the line joining the right anterior superior iliac spine to the umbilicus.

- McBurney's incision: The incision that is done for appendectomy, it passes through the McBurney's point parallel to the inguinal ligament, this was only done in the past.

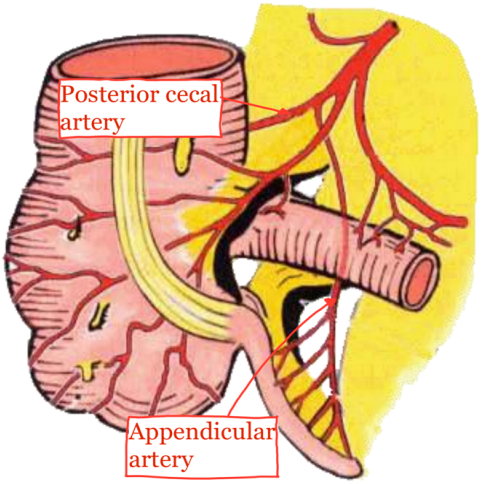
Now, appendectomy is done by the endoscope through an incision around the umbilicus.

- To reach the appendix during operation follow the taenia coli which converge toward the appendix.



Blood Supply of appendix

Arteries of appendix



• The **appendicular artery** is a branch of the **posterior cecal artery** (iliocecal artery) which descends behind the ileum.

• Appendicular artery runs in free margin of the mesoappendix.

• In appendectomy the most important step is doing **2 ligations of the appendicular artery and 2 ligations for the appendicular vein**, then we cut between every two ligations to prevent bleeding, the second step is doing **circular stitching around the base of the appendix,** after that the two ends of the suture are pulled and tied to make the base of the appendix small, then it's cut.
And voilà you are a mini surgeon now✨

Veins of appendix

• The **appendicular vein** drains into the posterior cecal vein then to the superior mesenteric vein.

Lymphatic Drainage of appendix

• The lymph vessels drain into one or two nodes lying in the mesoappendix → eventually into the superior mesenteric nodes.

Nerve Supply of appendix

• The appendix is supplied by the **sympathetic and parasympathetic (vagus) nerves from the superior mesenteric plexus.**

• Afferent nerve fibers concerned with the conduction of visceral pain from the appendix accompany the sympathetic nerves and enter the spinal cord at the level of the 10^{th} thoracic segment.

• The peritoneum over the appendix is innervated by the **10^{th} intercostal nerve (T10)** = **skin of umbilicus** sensory for the skin around the appendix.

• **T10** innervates both the **appendix** and the **skin around the umbilicus**, that's why in case of appendicitis, the pain starts at first around the umbilicus then it concentrates in the right iliac fossa.

CLINICAL NOTES

• Acute appendetitis is uncommon in the two extremes of life.

• **Appendetitis→ can cause thrombosis of appendicular artery→ gangrene in the appendix** (just one artery for appendix)→ perforation→ left paracolic gutter.

The appendix has mesoappendix and it is situated away from other organs, because of that its artery can have thrombosis in case of appendicitis. That is why **the only solution for appendicitis is appendectomy not antibiotics,** since it has a very narrow lumen and when it gets infected, the lumen closes and ruptures causing peritonitis.

• While in **acute cholecystitis** (inflammation of the gallbladder)→ **no gangrene** happens (more than one artery supplies the gallbladder).

If the gallbladder gets inflamed, the result won't be gangrene like the appendix, because the gallbladder receives its blood supply directly from the liver with short arteries.

PAST PAPERS

wrong about Meckel's diverticulum:

a. represents the remains of the vitelline duct.
b. occurs in 2% of subjects.
c. it lies 2 inches from the iliocecal junction.
d. the lining mucosa may contain acid secreting cells.
e. its pain may be confused with pain from appendicitis.

About appendix , which is wrong:

a. Common site is retrocecal.
b. Rare to be associated with gangrene.
c. Supplied by a branch from superior mesenteric artery.
d. Intraperitoneal.
e. Base found at McBurney's point.

Appendix, all correct except:

a. it's a derivative of the midgut.
b. opens into posteromedial aspect of the cecum.
c. lamina propria is rich in lymphatic nodule and crypts of lieberkuhn.
d. its base corresponds to McBurney's point.
e. blood supply from anterior cecal artery through the appendicular artery.

Select the wrong statement concerning the small intestine:

a. superior mesenteric vessels course anterior to third part of duodenum.

b. root of mesentery extends from left side of 2nd lumbar to right sacroiliac joint.

c. Jejunum has complex arterial arcades while ileum has simple arcades.

d. Bile duct and common pancreatic duct has close relation lo 2nd part of duodenum.

e. jejunum and ileum form an elongated mobile intraperitoneal tube.

Wrong statement about mesentery of small intestine:

a. Contains jejunal and ileal branches of superior mesenteric artery and vein.

b. suspends the small intestine from the posterior abdominal wall.

c. Root of mesentery directed from L1 to right sacroiliac joint.

d. Broad and a fan-shaped.

Wrong about mesentery:

a. jejunum has wide diameter compered to ileum.

b. in the jejunum there are simple arcades and short vasa recta.

Meckel's diverticulum all the following statement are correct EXCEPT:

a. Occurs in the anti mesenteric branch of the ileum.

b. May contain gastric mucosa.

c. It is situated 2 feet from the ileocecal junction.

d. It represents a persistent of vitelline duct.

e. May communicate with bladder.

C
B
E
C
C
B
E

V2

In page 9: right and left where switched.

V3

In page 13: in the image to the left, instead of “hepatic portal vein”, it’s “<u>portal vein</u>”. As the doctor said there is no such thing as hepatic portal vein. It is ether portal vein which goes to the live from the intestines, or hepatic vein which goes out of the liver to IVC.