

# The Large Intestine

The large intestine is composed of many parts including:

1. Cecum.
2. Appendix.
3. Colon [Ascending, Transverse, Descending and Sigmoid].
4. Rectum.
5. Anal Canal.

**General Facts:** (everything will be repeated in a more organized matter later on)

1. Cecum: There is a fold within the mucosa along with internal pressure preventing the backflow or regurgitation of food from the cecum back into the ileum. This is a **PHYSIOLOGICAL** sphincter and **NOT** an anatomical sphincter.
2. The Ascending colon continues up to the transverse colon, and located between the two colons we have the right colic flexure/hepatic flexure. Making an impression on the visceral surface of the liver.
3. Between the transverse and descending colons, we have the left colic flexure/splenic flexure which makes an impression on the visceral surface of the spleen (The splenic flexure is higher up than the right colic flexure).
4. The descending colon ends at the inlet of the pelvis/brim of the pelvis.

The large intestine is divided into the midgut and the hindgut:

- **Midgut:** Medial 2/3 (this includes the cecum, ascending colon and the medial 2/3 of the transverse colon)
- **Hindgut:** Lateral 1/3 (this includes the lateral 1/3 of the transverse colon and the descending)

**Blood Supply of midgut:** the superior mesenteric artery and its branches

**Blood supply of hindgut:** the inferior mesenteric artery and its branches

**The venous drainage is the corresponds with its arteries.** After collecting its branches from the large intestine (hindgut), the Inferior mesenteric vein ends as the splenic vein.

Splenic vein + superior mesenteric vein (mid gut collection) → portal vein

## Lymphatics

- For the Mid Gut: Superior mesenteric lymph nodes → located near origin of superior mesenteric artery
- For the Hind Gut: Inferior mesenteric → located near origin of inferior mesenteric artery

## Nerve supply:

- For the Mid Gut: Sympathetic AND Parasympathetic from the VAGUS for the mid gut
  - Sympathetic from the superior mesenteric ganglia/plexus → both sympathetic and parasympathetic.
- For the hind gut (lateral 1/3) the parasympathetic receives innervations from S2, S3 and S4.
  - Sympathetic is received from the superior and inferior mesenteric ganglia.

## Relations:

- Anteriorly: Mostly the anterior abdominal wall, Greater Omentum plus the coils of small intestine.
- Posteriorly: Posterior abdominal wall.

### **Length:**

- Cecum: 2.5-3 inches
- Appendix: 3-5 inches (from 2-22cm) During times of inflammation the appendix can expand up to 22cm!
- Colon:
  - Ascending= 5 inches
  - Transverse= 15 inches
  - Descending= 10 inches
  - Sigmoid colon = 10 – 15 inches there may be variation in individuals
- Rectum=5 inches
- Anal Canal=4 cm

### **How can we differentiate between the Small and Large intestine?**

- General length of the ENTIRE Large Intestine is 1.5m-2.5m, while that of the Small Intestine is 5-6m.
- Diameter of the Large intestine is larger than that of the Small intestine
- Taenia coli (found ONLY in the Large intestine): 3 longitudinal bands of smooth muscles from the outer most muscular layer (longitudinal muscles) that stretches across the large intestine and reaches up until the base of appendix. [It is NOT found on the appendix or the rectum] so it's a landmark for base of appendix .
- appendices Epiploca (tags of fat) attached to serosa of the Large Intestine as well as sacculations/haustrations.
  - The Fatty tags are not found on the cecum, appendix or rectum.

### **Histology (Basic Concepts)**

Goblet cells are found between the simple columnar cells that make the surface lining. Goblet cells are VERY abundant!!! Crypts of Lieberkühn present containing glands , yet there are NO or very little Paneth's cells present.

### **Cecum**

Blind ended pouch or blind sac found in right iliac fossa.

Completely surrounded by peritoneum , supposed to be fixed with posterior abdominal wall in the right iliac fossa but this peritoneum gives it some mobility also ; that's why around cecum we can find paracolic pouches or recesses

- If it is loose, this indicates that there is a fold of peritoneum in that area, forming a large pouch similar to the retrocecal pouch.

There are 3 openings within the cecum:

- Upwards towards the ascending colon
- Medially: towards the ileum
- Posteromedially: ileocecal valve + appendix (the appendix is found 1 inch below the ileocecal valve)

Peritoneum folds and recesses can be **retrocecal** (the appendix may be located here)

- These recesses can cause serious problems such as: INTERNAL HERNIA!! An increase in intrabdominal pressure (due to many causes for example: flipping and twisting) → intestines lodged within the recess →

with excessive activity and flipping → cut off blood supply → strangulated hernia → Urgent and mandatory operation must be done due to gangrene .

Other recesses include the inferior ileocecal and superior ileocecal recesses.

mesoappendix is important as it connects the appendicular artery and take away the appendicular vein.

### **Relations to the Cecum:**

- Anteriorly:
  - Coils of small intestine
  - the greater omentum
  - the anterior abdominal wall in the right iliac region
- Posteriorly:
  - The right psoas and the right iliacus muscles
  - the lateral cutaneous nerve of the thigh .
  - the femoral nerve
  - External iliac vessels → go towards the femoral triangle (deep to inguinal ligament)
- Posteromedially: the appendix (usually retrocecal)
- Medially: Small intestine( ileum)

### **Blood Supply**

#### **Arteries**

- Branches of the Superior Mesenteric artery: ileocecal artery → Anterior and posterior cecal arteries
  - The Posterior cecal artery gives off a branch called the appendicular artery(supplies the appendix)
  - The superior mesenteric artery generally supplies the entire mid gut by arachids and vasa recta.

#### **Veins**

Anterior and posterior cecal veins → superior mesenteric vein → portal vein → liver

- superior mesenteric vein lies lateral to the superior mesenteric artery

#### **Lymph Drainage**

Superior mesenteric lymph nodes

#### **Nerve Supply:**

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

#### **Ileocecal valve:**

Physiological sphincter. Formed from the folds within mucosa of the cecum. Remains closed due to pressure from the cecum. 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.

## **Appendix**

- Appendix is parallel to the right inguinal ligament.
- Length: 3-5inches (2-22cm) great variation in length
- The Base is located 1 inch below the ileocecal valve posteromedially

- The appendix is engulfed within a fold of peritoneum known as MESOAPPENDIX. It contains the appendicular artery
- Vein: Appendicular vein ends in posterior cecal vein and continues to the superior mesenteric vein
- Lymphatics: Appendicular lymph nodes to the superior mesenteric lymph nodes
- Nerve supply T10, and skin around umbilicus.

#### **Position of the Appendix:**

- 74% retrocecal ( common position )
- 21%: Hanging in the pelvis. PR examination( perirectal examination ) are done to test for presence of appendix in pelvis. Place index finger within the anal canal and press on abdomen. If severe pain follows, the appendix is in the pelvis
- 3.5%: Subcecal(below cecum)
- 1%: Preileal (in front of the ileum)
- 5%: Postileal(behind the ileum)

#### **Clinical Applications:**

Appendicitis (inflammation of the appendix) is very serious matter, and there is no delaying its procedure. You cannot treat it with antibiotics or sedation (pain relievers).

Once the patient has been under observation and the diagnosis is 50-60% accurate, once you are appendectomy or appendicectomy must be done.

The appendix is a very narrow lumen and thus consequently obstruction is common!! Infection of the appendix may occur → inflammation → engorgement: due to increase of fluid accumulation → obstruction → Expansion and may lead to rupture. So instead of the appendicitis being localized it will spread up into the peritoneum and cause peritonitis.

The appendix is Lymphoid tissue. If removed, it will not decrease immunity because there are other compensatory lymphoid tissue, for example the tonsils, adenoids...

We can find around it greater omentum to localize it ; some complication occur if it wasn't treated as the greater omentum made a localization to the infection it can be converted to appendicular mass or abscess or the infection will spread to pelvis , morison pouch (sub-hepatic) or sub-diaphragmatic on the right side , BUT it won't reach the left side due to ligament between diaphragm and left colic flexure ; so it might reach to the left pelvic but won't reach the left sub-diaphragmatic .

Pain is usually localized in the right iliac fossa. In the beginning, pain starts out around the umbilicus, and this is due to the fact that the appendix is innervated from the **T10 spinal nerve (and also T11)** and this nerve gives a dermatome to skin around the umbilicus .

Diagnosis of Appendicitis is usually done by measuring the amount of WBC's. This measurement is called: WBC Count

- Normally: 4-10,000 WBC/ mm<sup>3</sup>
- Acute appendicitis: 20,000-40,000 WBC/ mm<sup>3</sup>

Yet the pain in the right iliac fossa is **NOT exclusive** just for appendicitis!! Women during their menstruation or during ovulation(from the RIGHT OVARY) will feel similar severe pain.

Differential diagnosis (being able to differentiate appendicitis from menstruation) is very important. The patient will be under observation under 24hrs for confirmation whether it is appendicitis or just menstrual pain.

Other Clinical Tests that can be performed to confirm Appendicitis: [For your own information]

- Bed examination tenderness in the right iliac fossa (Rebound)
- Pain on the right side when pressing on the left (Rovsing's sign)
- Use of Barium stain: injected through the anus and travels towards the cecum. If the dark stain of the barium reaches the appendix → normal and no obstructions If not → signs of obstruction → appendicitis.

### Surface anatomy

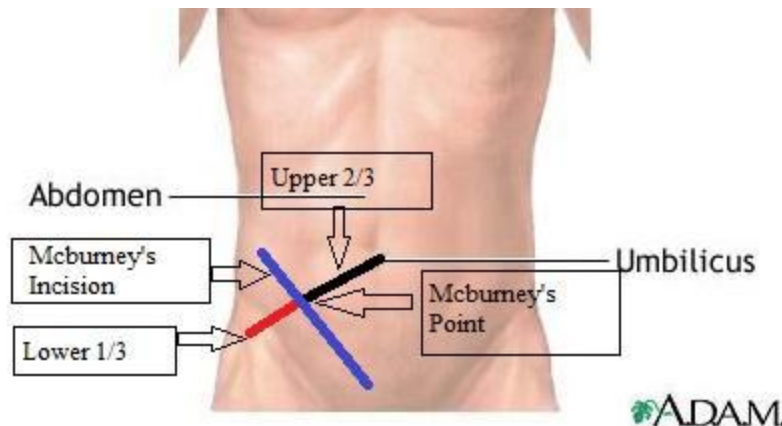
McBurney's Point: landmark for base of appendix. Draw a line from the umbilicus to the right anterior superior iliac spine. Upper 2/3 and lower 1/3. This point leads to the base of the appendix.

McBurney's incision: parallel to inguinal ligament and crosses through McBurney's point.

To reach the appendix via McBurney's Incision:

Open skin → superficial fascia → Separate the muscle fibers; NO cutting because the incision is parallel to muscle → Go through external oblique, internal oblique, transversus abdominis → extraperitoneum fat, parietal → base of appendix,

***If the greater omentum is seen, this may be an indication of appendicitis.***



### Appendicectomy

- Ligation of appendicular artery and vein And cut
- Circular stitch around base of appendix, needle and thread around the base
- Pull both ends of the and close off appendix and the base enters the cecum.
- Ligate and cut off the appendix.

Cholecystitis: inflammation of the gallbladder.

Appendicitis: inflammation of the appendix

What is the difference between the two?

- In appendicitis, there is a possibility of the appendices to become GANGRENOUS because it only has ONE arterial supply!!! (appendicular artery)

- While in cholecystitis, the Gallbladder DOES NOT become gangrenous, because it is imbedded in **visceral surface of the liver**, and the liver may give the gallbladder direct blood supply. If there was a block in the cystic artery that supplies the gallbladder, there will still be another blood supply source.

### **Ascending Colon: (5inches long)**

- Begins from the right iliac fossa(end of the cecum - at iliac crest-) and ends at the visceral surface of the liver (right colic flexure) and has taenia coli, sacculations and epiploic appendices.
- Its peritoneum is fixed in the posterior abdominal wall. Thus the peritoneum covers the ascending colon anteriorly and on both sides. There are gutters on the right and left side, which are grooves that spread fluids and infections.

#### **Relations to the Ascending Colon:**

- Posteriorly:
  - Iliac crest and cecum
  - psoas ( far a bit ), iliacus, quadratus lumborum, origin of transversalis abdominis(from the right side)
  - Lower pole of the right kidney
  - femoral nerve, lateral cutaneous nerve of the thigh and the iliohypogastric(L1) and ilioinguinal(L1)
- Anterior:
  - Coils of small intestine,
  - The greater omentum,
  - The anterior abdominal wall

#### **Blood supply:**

- Superior mesenteric artery → ileocolic artery → right and middle colic arteries.
- Middle colic (mainly for transverse colon) supplies the upper part of the ascending colon.
- The MAIN blood supply is the Right Colic artery.
- Anastomosis is found between the colic arteries.

**Veins** are corresponding to their arteries and end as the superior mesenteric vein.

\*\*Right colic gives the most medial part of the transverse colon.

#### **Lymph:**

The lymphatic vessels and lymph nodes spread along the colic blood vessels and empty into the superior mesenteric lymph nodes.

#### **Nerve Supply:**

Sympathetic and parasympathetic (vagus nerves from the superior mesenteric plexus)

### **Transverse Colon: 15 inches**

-Most important section of the large intestine!!

-Completely surrounded by mesentery.

-**Mobile**, needed for surgeries when there is a tumor in the colon or the rectum, anal canal.

>>>>Colostomy → If there's cancer rectum or colon (esp. old age ) we should remove cancer ,lymph node and effected organs and when we reach the transverse colon , as it has mobility they open a cut in the anterior abdominal ( right or left iliac foca ) and they fix the transverse colon in the anterior abdominal wall .

**Mesentery:** hangs downwards and is suspended by mesocolon which attaches onto the anterior border of the pancreas as well as to the greater curvature of the stomach. The greater curvature of the stomach gives off two layers of peritoneum, and surrounds the transverse colon completely, then it goes backwards as the mesocolon and attaches to the anterior border of the pancreas.

>>Short mesentery: the transverse colon would be BEHIND the stomach

>>>Long mesentery: the transverse colon would be BELOW the stomach. May reach the pelvis.

**Phrenicocolico ligament:** connected from the left colic flexure to the diaphragm, and is found above the spleen. It separates the supracolic space from the infracolic space.

**\*\*The Mesocolon contains the middle colic artery, lymph nodes and vessels and a significant amount of fat.**

#### **Relations to the Transverse Colon:**

- Anteriorly:
  - The greater omentum
  - The anterior abdominal wall (umbilical and hypogastric regions)
  - Sometimes the small intestine\*\* \*\*depends on length of mesentery
- Posteriorly:
  - The second part of the Duodenum (the transverse colon crosses the vertical part of the duodenum.)
  - The head of the pancreas
  - The coils of the jejunum and ileum\*\* \*\*depends on length of mesentery

#### **Blood supply:**

Medial 2/3: Middle colic artery from the superior mesenteric

Lateral 1/3: Left colic artery from the **inferior mesenteric artery.**

\*\*Veins correspond with their arteries.

#### **Lymphatics:**

- The medial 2/3 drain into the colic nodes and then into the superior mesenteric.
- The lateral 1/3 drains into the colic nodes and then into the inferior mesenteric.

#### **Nerve:**

- The medial 2/3 are innervated by sympathetic(coming from the thoracic spinal nerves T6-9) and vagal nerves through the **superior mesenteric plexus**
- The lateral 1/3 is innervated by sympathetic AND parasympathetic pelvic splanchnic(S2, S3, S4) nerves through **the inferior mesenteric plexus.**

### **Descending colon: 10 inches**

Begins from the left colic flexure and ends at the inlet of the pelvis or the pelvic brim and continues as the sigmoid colon.

Has all the general characteristics of the Large intestine: Taenia coli, sacculations, epiploic appendices,

**Similar to ascending** → peritoneum is anterior and comes on both sides → fixation to posterior abdominal wall → medial and lateral paracolic gutters.

**Relations to the Descending Colon:**

- Anteriorly:

- Coils of small intestine
- the greater omentum
- the anterior abdominal wall

- Posteriorly:

- The lateral border of the left kidney
- the origin of the transversus abdominis muscle (from the left side)
- the quadratus lumborum, the iliacus, the left psoas
- the iliac crest
- The iliohypogastric and the ilioinguinal nerves, the lateral cutaneous nerve of the thigh, the femoral nerve

**Blood Supply:** Inferior mesenteric artery. Branches off the anterior surface of the abdominal aorta at the level of L3!! [Where did we first mention this artery? I'll give you a hint: it's the most important part of our large intestine] Inferior mesenteric artery gives 2 branches:

1. Left Colic Artery
  2. Sigmoidal Artery → to the sigmoid colon and gives branches to the lower part of the descending colon.
- \*\*\*The inferior mesenteric artery ends as the Superior rectal artery, and continues on towards the rectum.  
>>>Inferior rectal vein → inferior mesenteric vein.

**Lymphatics:** colic lymph nodes → inferior mesenteric lymph nodes [Where are the inferior mesenteric lymph nodes located? We mentioned it on the first page]

**Nerves:** Sympathetic ( chest , abdomen , pelvis ) and parasympathetic S2, S3 S4 from the pelvic splanchnic through inferior mesenteric plexus.