In this last lecture, we will talk about the sigmoid colon, rectum, and anal canal.

**Sigmoid colon**

It has a mesentery called pelvic mesocolon or sigmoidal mesocolon connected to the sigmoid colon, rectum, and upper part of the anal canal (upper 2 cm).

Why did we say upper part of anal canal?

Because the anal canal is divided to two parts: upper 2 cm, and lower 2 cm (4 cm in total). The upper 2 cm follow the rectum, their epithelium is simple columnar, they originate from the endoderm, sensitive for stretch (autonomic innervation), and their lymphatic drainage goes to the inferior mesenteric lymph nodes (preaortic). Whereas the lower 2 cm are completely different, their epithelium is stratified squamous, they originate from the ectoderm, sensitive to pain, touch and temperature (somatic innervation from S4), and their lymphatic drainage goes to the inguinal lymph nodes in the femoral triangle.

The sigmoid colon is 10-15 inches (25-38 cm) long.

Begins as a continuation of the descending colon on the left side of the pelvic brim (iliac crest) it goes to the right and ends mid sacrum in front of the third sacral vertebra where it continues with the rectum.

It has parts: The root has an inverted V shape and thus has a lateral limb, medial limb, and a free edge.

The free edge contains the end of the sigmoid, the lateral limb contains the lower left colic artery, and the medial edge contains the superior rectal artery.

One of the characteristics of the sigmoid colon is that it has very long appendices epiploicae. The sigmoid colon is attached to the posterior pelvic wall by a fan-shaped sigmoid mesocolon which makes it mobile and hangs down in the pelvic cavity in the form of a loop.

Attachments of the root of mesocolon:

- At middle piece of sacrum
- Bifurcation of left common iliac artery
- Middle of left external iliac artery
Relations of sigmoid colon:

- Left: left external iliac vessels, lateral wall of pelvis, and vas deference in males or ovary in females.
- Right: small intestine
- Superior: coils of small intestine
- Inferior: urinary bladder in males, uterus in females
- Posterior: rectum, sacrum, lower coils of terminal part of ileum, sacral plexus, left piriformis muscle, left external iliac vessels, left ureter, and left internal common iliac artery.

The sigmoid colon usually occupies the rectovesical pouch in males and the rectouterine pouch in females.

**PR examination** (per rectal examination)

An internal examination where the physician slips a lubricated finger into the rectum through the anus and palpates the inside for a short time. Structures around the anal canal and lower third of rectum can be sensed.

In females, the physician can sense only the vagina anteriorly.

In males, the prostate, vas deference, seminal vesicles and urinary bladder can be sensed.

PR examination is a must for male patients of an old age because the prostate in males over 50 becomes hypertrophic. When examining a normal prostate it feels soft but if it is hypertrophic it feels hard. When the patient is asked if he uses the bathroom at night he would say he uses it 4-6 times and that he lacks the force of the urine flow while urinating. This means that the prostate is hypertrophic and compresses the urethra. The patient should be treated or else the urine would move from the bladder to the kidney causing it to become hypertrophic and thus loses his kidney.

**Blood supply of sigmoid colon**

Sigmoid arteries from the inferior mesenteric artery. The most superior sigmoid artery anastomoses with the descending branch of the left colic artery.
Veins opposite to the arteries. Sigmoid veins drain into the inferior mesenteric vein which terminates when reaching the splenic vein, which goes on to form the portal vein.

Note that the artery lies medial to the vein. Arteries are inside and veins are outside.

The inferior mesenteric artery branches to the left colic artery, sigmoidal arteries and continues as the superior rectal artery.

**Lymphatic drainage of sigmoid colon**

The lymph drains into nodes along the course of the sigmoid arteries to the inferior mesenteric nodes (preaortic).

**Nerve supply of sigmoid colon**

The sympathetic and parasympathetic nerves from the inferior hypogastric plexuses. Sympathetic from L1 and L2.

The parasympathetic supply is derived from the pelvic splanchnic nerves S1, S2, S3.

**The Rectum**

The rectum is about 5 in. (13 cm) long. It begins mid sacral in front of the third sacral vertebra as a continuation of the sigmoid colon and ends 1 inch beyond the tip of the coccyx by piercing the pelvic diaphragm and become continuous with the anal canal. The lower part of the rectum is dilated to form the rectal ampulla. The rectum deviates to the left, but it quickly returns to the median plane.

Looking anteroposterior to the rectum we can see that it follows the anterior concavity of the sacrum.

Looking at it laterally looks like number 4 in Arabic ‘٤’ meaning that there are two concavities on the left and one on the right.

The puborectalis portion of the levator ani muscle forms a sling at the junction of the rectum with the anal canal and pulls this part of the bowel forward, producing the anorectal angle. It defines the junction between the rectum and anal canal, and is very important in defecation.
It takes origin from the pubis and goes posteriorly to wrap around the rectoanal junction and back to the pubis like the letter ‘U’.

One of the features of the rectum is the presence of transverse and longitudinal mucosal folds. There are three transverse folds: upper, lower, and middle.

The transverse folds are called **Houston’s valve**: were upper fold projects from right, middle fold projects from anterior and right wall, and lowest fold projects from left wall

The longitudinal folds are called anal columns and form anal sinuses and anal valves at their ends. Below them is a line called pectinate line separating upper and lower parts of anal canal.

At both sides of the rectum and anal canal is the **ischiorectal fossa** (wedge-shaped) which is filled with fat to provide space for the rectum and anal canal during defecation.

There are three external anal sphincters (subcutaneous, superficial, and deep) which are voluntary and one internal sphincter just below the submucosa which is involuntary. The external sphincter is more important than the internal sphincter in the prevention of incontinence (lack of voluntary control over defecation).

In the wall of obturator internus fascia is the pudendal canal on the lateral side of ischiorectal fossa, it is crossed by the internal pudendal vessels and pudendal nerve which gives the inferior rectal nerve supplying the sphincters.

During operations in this area, an abscess called perianal abscess may form in the ischiorectal fossa also known as the dirty region. This abscess needs to be drained and you should be careful with the nerve going to the external sphincter from S4 (inferior rectal nerve) if cut, voluntary control is lost causing incontinence.

If an abscess forms chances of recurrence are high because it is a dirty area, it can open outside and we call it perianal sinus or it can open to the anal canal and we call it perianal fistula. In the case of perianal fistula, stool is joined with pus and blood.

**Structures at the level of anorectal junction**

Puborectalis, internal sphincter, deep part of external anal sphincter.
Any trauma or damage to this area may cause incontinence.

The rectum in relation to the peritoneum is divided into thirds, upper third is covered anteriorly and on both sides, middle third is covered anteriorly, and lower third is devoid of the peritoneum.

**Relations of the rectum**

- Posteriorly: - The rectum is in contact with the sacrum and coccyx - the piriformis muscle - Coccygeus muscle - levatores ani muscle - the sacral plexus - the sympathetic trunks and anococcygeal body.

- Anteriorly:
  1. In the male
     The upper two thirds of the rectum - It is covered by peritoneum - It is related to the sigmoid colon and coils of ileum that occupy the rectovesical pouch.

     The lower third of the rectum - It is devoid of peritoneum - It is related to the posterior surface of the bladder - to the termination of the vas deferens - the seminal vesicles on each side - to the prostate and the perineal body

  2. In the female
     The upper two thirds of the rectum - It is covered by peritoneum - It is related to the sigmoid colon and coils of ileum that occupy the rectouterine pouch (pouch of Douglas).

     The lower third of the rectum - It is devoid of peritoneum - It is related to the posterior surface of the vagina and perineal body.

     The perineal body and anococcygeal body are fibrous connective tissue which can be sensed. Perineal body gives attachment to the perineal membrane or urogenital diaphragm and it lies between the vagina and anal canal.

**Histology of rectum**

- Rectal epithelium is simple columnar epithelium with the upper half of anal canal with few goblet cells.

- It forms columns transverse and columns longitudinal

- has crypts of Lieberkühn
- muscularis externa, outer longitudinal and inner circular
- lacks tenia coli

**Blood supply of rectum**

**Arterial supply**

We have internal and external iliac arteries, the internal gives anterior division and posterior division.

Superior rectal artery, a continuation of inferior mesenteric artery. The anterior division of internal iliac artery gives the middle rectal artery and pudendal artery which gives inferior rectal artery.

Rectum and upper half of anal canal supplied by superior rectal artery, middle rectal artery supplies the junction between the rectum and anal canal while inferior rectal artery supplies the lower half of anal canal.

The superior rectal artery - It is a direct continuation of the inferior mesenteric artery and is the chief artery supplying the mucous membrane. It enters the pelvis by descending in the root of the sigmoid mesocolon and divides into right and left branches, which pierce the muscular coat and supply the mucous membrane. They anastomose with one another and with the middle and inferior rectal arteries.

The middle rectal artery - It is a small branch of the internal iliac artery and It is distributed mainly to the muscular coat.

The inferior rectal artery - It is a branch of the internal pudendal artery in the perineum. It anastomoses with the middle rectal artery at the anorectal junction.

**Venous drainage**

The veins of the rectum correspond to the arteries.

The superior rectal vein is a tributary of the portal circulation and drains into the inferior mesenteric vein.

The middle rectal vein drains into the internal iliac vein to the inferior vena cava.
Inferior rectal vein drains into the internal pudendal veins which drain into the internal iliac vein to the inferior vena cava, the union between the rectal veins forms an important portal systemic anastomosis.

The hemorrhoidal plexus (or rectal venous plexus)

It surrounds the rectum, and communicates in front with the vesical venous plexus in the male, and the uterovaginal plexus in the female.

A free communication between the portal and systemic venous system is established through the hemorrhoidal plexus.

Hemorrhoids or Piles

The term hemorrhoids refers to a condition in which the veins around the anus or lower rectum are swollen, tortuous and inflamed.

Hemorrhoids may result from

1- Straining to move stool.
2- Other contributing factors include aging, chronic constipation or diarrhea, and anal intercourse.
3- Congenital weakness of the venous walls
4- Portal hypertension
5- Cancer in the rectum
6- Superior rectal vein is the most dependent
7- Pregnancy but after pregnancy, it disappears
8- Food irritation like eating chili

Two types:

1- Hemorrhoids are both inside and above the anus (internal)
2- Under the skin around the anus (external).

Hemorrhoids (piles) arise from congestion of internal and/or external venous plexuses around the anal canal.

Internal hemorrhoids (piles) occur higher up in the anal canal, out of sight. Bleeding is the most common symptom of internal hemorrhoids, and often the only one in mild cases. Varicosities of the superior rectal vein.
Painless because this area is sensitive to stretch not to pain, touch, or temperature

Lies in the anal columns at 3, 7, 11 o’clock (lithotomy position).

Sometimes, internal hemorrhoids will come through the anal opening when straining to move your bowels. This is called a prolapsed internal hemorrhoid; it is often difficult to ease back into the rectum, and is usually quite painful.

Undergoes three stages:

The first stage – it stays high which means during defecation no discomfort at all

The second stage – during defecation it comes out through the anus and returns back after defecation.

The third stage – after defecation it remains outside through the anus and can cause bleeding.

**External hemorrhoids** are visible-occurring outside the anus. They are basically skin covered veins that have ballooned and appear blue. When inflamed they become red and tender. Inferior rectal vein, thrombosis is common. Very painful.

When a blood clot forms inside external hemorrhoid, it often causes severe pain. This thrombosed external hemorrhoid can be felt as a firm, tender mass in the anal area, about the size of a pea.

**Lymphatic drainage of the rectum**

The rectum and upper part of anal canal drain into the pararectal nodes and then the inferior mesenteric lymph nodes.

The lower half of anal canal drains into the superficial inguinal lymph nodes deep in the femoral triangle.

**Nerve supply of rectum**

The nerve supply is from the sympathetic and parasympathetic nerves from the inferior hypogastric plexuses.

Parasympathetic from S1, S2, and S3.
Sympathetic from L1 and L2 splanchnic nerves
The rectum is sensitive only to stretch.

**Anal Canal**

We covered most of it previously.

It is the terminal part of the large intestine. It is situated below the level of the pelvic diaphragm and lies in the anal triangle of the perineum. The anal canal is 3.8 cm long, it extends from the anorectal junction to the anus.

The anorectal junction is marked by the forward convexity of the perineal-flexure of the rectum, the anus is the surface opening of the anal canal, situated about 4 cm below and in front of the tip of the coccyx in the cleft between the two buttocks.

As we said it is divided into two parts, upper 2 cm and lower 2 cm (4 cm total).

Lower part is below the pectinate line, the White line further divides the lower part of anal canal to upper and lower parts. The upper part of lower anal canal (1 cm) has stratified squamous non keratinized epithelium while the lower part of lower anal canal (1 cm) has stratified squamous keratinized epithelium.

**The anorectal ring** is a muscular ring present at the anorectal junction formed by the fusion of puborectalis, internal anal sphincter and deep external anal sphincter, which can be felt during rectal examination.

In the book, the anal canal is divided into three parts but we divide it into two parts only upper and lower.

We mentioned the anal sinuses, anal valves, and pectinate line.

**Relations of anal canal**

Anteriorly

In male

Perineal body - membranous urethra - bulb of penis.

In female

Lower end of the vagina and perineal body.
Posteriorly
Anococcygeal ligament - tip of the coccyx
Laterally - ischiorectal fossae.

**Musculature of the anal canal:**

1. Internal anal sphincter is involuntary in nature, it is formed by the thickened circular muscle coat of this part of the gut.

2. The external anal sphincter is under voluntary control & has three parts: subcutaneous, superficial and deep parts.

Subcutaneous part lies below the level of internal sphincter and surrounds the lower part of the anal canal.

The superficial part is elliptical in shape and arises from the terminal segment of the coccyx and anococcygeal ligament, the fibers surround the lower part of the internal sphincter and are inserted into the perineal body. The deep part surrounds the upper part of the internal sphincter and is fused with the puborectalis.

All anal sphincters do not have a bony attachment except the superficial external anal sphincter.

**Blood supply of anal canal**

**Arterial supply**
The part of the anal canal above the Pectinate line is supplied by the superior rectal artery, while the part below the pectinate line is supplied by the inferior rectal artery.

**Venous drainage**
Internal rectal venous plexus drains into superior rectal vein.
The lower part of the external rectal venous plexus is drained by inferior rectal vein into the internal pudendal vein.
The middle part by the middle rectal vein into the internal iliac vein
Upper part by the superior rectal vein into the inferior mesenteric vein.
The anal veins are arranged radially around the anal margin. They communicate with the internal rectal plexus and with the inferior rectal vein.

We talked about hemorrhoids previously, nothing to add here.

Surgical classification of hemorrhoids is omitted, we are not asked to know it.

**Anal fissure** - A thin slit-like tear in the anal tissue, an anal fissure is likely to cause itching, severe pain, and bleeding during bowel movement.

An elongated ulcer is formed - It is extremely painful - Its site is in the midline, either posterior or interiorly to the superficial part of the external anal sphincter (no support).

Can be caused when a hard piece of stool enters the anal sinus (pocket shaped) with straining can form a longitudinal ulcer by disrupting the mucosa.

Extremely painful, the patient goes immediately to the doctor for surgical treatment.

**Perianal abscess**

Its most common cause is fecal trauma to the anal mucosa, which might spread to the sub mucosa.

It’s a complication of the anal fissure, located in relation to the external anal sphincter, anal fistula may rise as a result of the spread or inadequate treatment of the anal abscess.

**Lymphatic drainage of anal canal**

Lymph vessels from the part above the pectinate line drain into the internal iliac nodes. Vessels from the part below the pectinate line drain into superficial inguinal nodes.

**Nerve supply of anal canal**

Above the pectinate line, the anal canal is supplied by autonomic nerves (inferior hypogastric plexus and pelvic splanchnic).

Below the pectinate line, it is supplied by somatic (inferior rectal) nerves. Painful as a result of high sensation
The external sphincter is supplied by inferior rectal nerve a branch of the fourth sacral nerve.

**The anal triangle**

Anterior - perineal membrane

Posterior - the tip of the coccyx

On each side by: The ischial tuberosity, the sacrotuberous ligament, overlapped by the border of the gluteus maximus muscle, and ischiorectal fossa.

In the midline - The anus, or lower opening of the anal canal.

Contents of anal triangle

Some components of the anal triangle include:

- Ischioanal fossa
- Sacrotuberous ligament
- Sacrospinous ligament
- Pudendal nerve
- Internal pudendal artery and internal pudendal vein
- Anal canal
- Muscles
  - Sphincter ani externus muscle
  - Gluteus maximus muscle
  - Obturator internus muscle
  - Levator ani muscle
  - Coccygeus muscle

The skin around the anus is supplied by the inferior rectal (hemorrhoidal) nerve.

**Lymphatic drainage of anal triangle**
The lymph vessels of the skin drain into the medial group of the superficial inguinal nodes.

**Ischiorectal Fossa**

The ischiorectal fossa (ischioanal fossa) is a wedge-shaped space located on each side of the anal canal. The base of the wedge is superficial and formed by the skin. The edge of the wedge is formed by the junction of the medial and lateral walls. The medial wall is formed by the sloping levator ani muscle and the anal canal. The lateral wall is formed by the lower part of the obturator internus muscle, covered with pelvic fascia.

**Contents of Fossa**

The ischiorectal fossa is filled with dense fat which supports the anal canal and allows it to distend during defecation.

- The pudendal nerve
- Internal pudendal vessels are embedded in a fascial canal
- The pudendal canal, on the lateral wall of the ischiorectal fossa
- On the medial side of the ischial tuberosity, the inferior rectal vessels and nerve cross the fossa to reach the anal canal.

**The pudendal canal**

**Structure**

The pudendal canal (also called Alcock's canal) is an anatomical structure in the pelvis formed by the obturator internus fascia

Runs in the lateral wall of the ischiorectal fossa

Ends in the deep perineal pouch

Its contents

Internal pudendal artery

Internal pudendal veins

Pudendal nerve

These vessels and nerve cross the pelvic surface of the obturator internus.