

Digestive System

University of Jordan
Faculty of Medicine
Batch of 2013-2019



Slide Sheet Handout Other

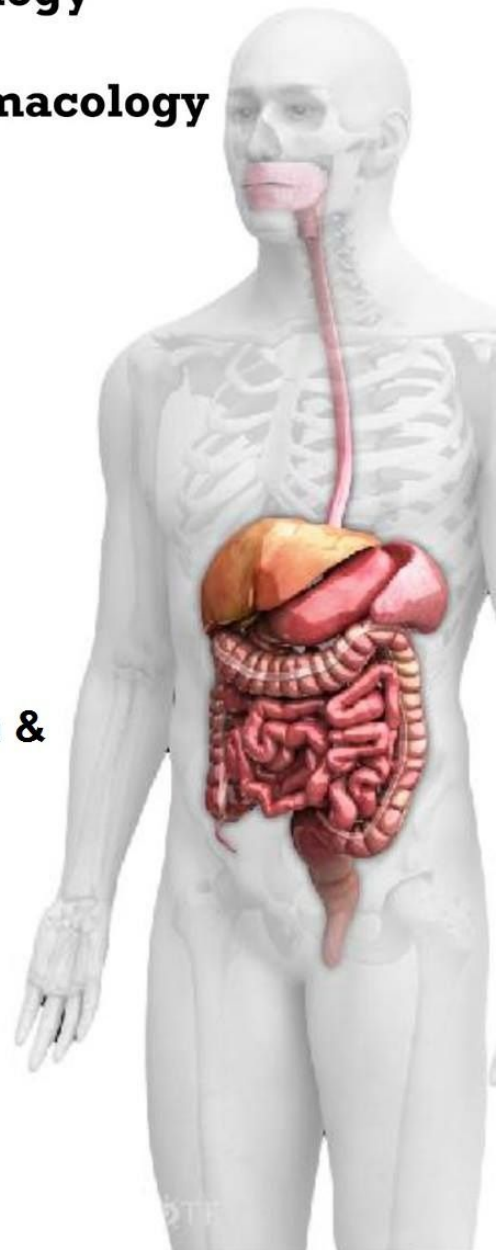
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Sheet #: 13

Done by: Muhannad Haddadin & Ali Khresat

Date: April 21, 2015

Price:



Pelvic Colon, rectum and anal canal

Note: This sheet contains the extra information written in the slides , keep in mind that the doctor was just skipping some slides without saying any word about them.

The doctor started by saying that the rectum and anal canal are one of the most important subject because many clinical problems are related to them .Also this part of the material was not included in the midterm exam so it will have many marks in the final (bl a5eer bteeji kol el as2leh 3l mouth)

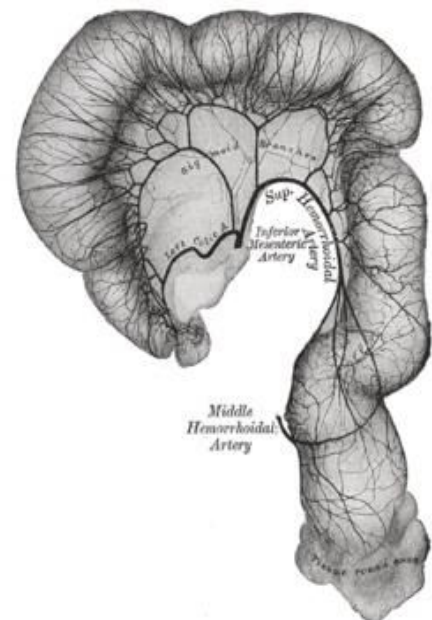
*Pelvic mesocolon starts of the pelvic brim (inlet of the pelvis) in the left side as a continuation of the descending colon, continues till the upper part of anal canal and it includes:

1. Sigmoid colon
2. Rectum
3. Upper part of anal canal

Sigmoid colon

General characteristics about the sigmoid colon

- 1- It is a continuation to descending colon, it's length is about 10-15 inches and it starts from the pelvic brim at the left iliac fossa and ends on the mid of the sacrum (in front of the 3rd sacral vertebrae), and it ends as the rectum. It is a large part of the colon in the pelvic cavity.
- 2- It is completely intraperitoneal, and it has mesentery called **sigmoidal mesocolon**, which is fan-shaped, connecting the sigmoid colon to the posterior abdominal wall.
- 3- ***Appendices epiploica** (Omental appendages)



are very numerous in the sigmoid colon and it also contains taenia coli, these taenia coli disappear at the rectum.

Sigmoid mesocolon

It is fan shaped and composed of

- 1- Free edge which contains the sigmoid colon
- 2- Root : has an inverted V-attachment which is the attachment of the mesocolon in the pelvis

The root of the mesentery has a lateral limb and medial limb, the lateral limb is the attachment of the mesentery to the adventitia of left external iliac artery and the bifurcation of common iliac artery , while the medial limb moves medially to attach to the mid of the sacrum (S3)

Contents of the root: lateral limb contains lower left colic artery, while the medial limb contains the continuation of inferior mesenteric artery which is called superior rectal artery.

Relations of the sigmoid colon

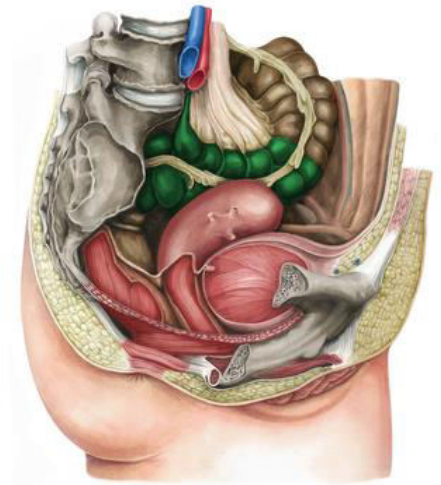
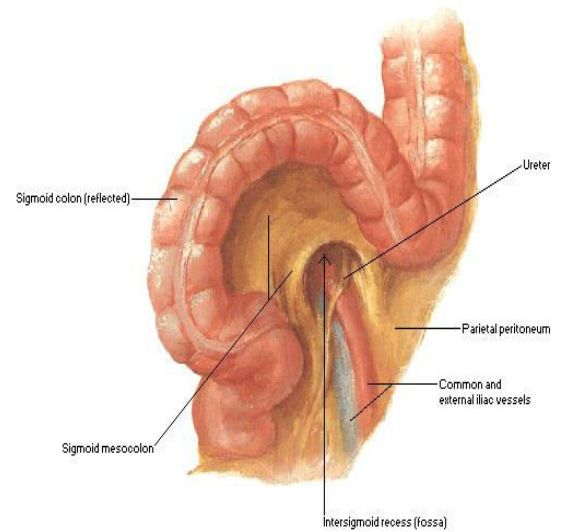
Right side and superiorly: coils of small intestines

Left side:

- 1- Wall of the pelvis related to Left external iliac vessels
- 2- Left Vas deferens in males and left ovary in female

Inferiorly: Urinary bladder in males and Uterus in females

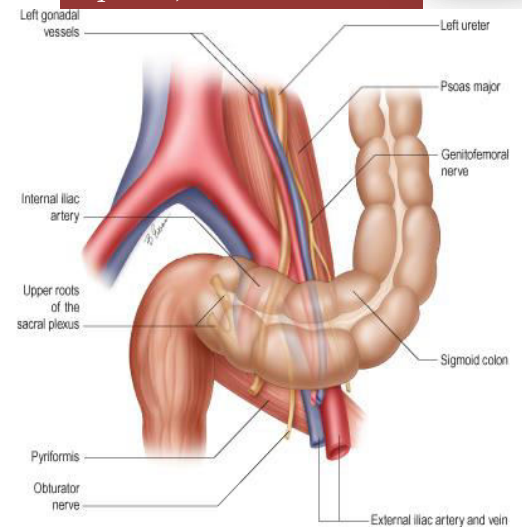
Mesenteric Relations of Intestines
Sigmoid Colon Reflected



April 19, 2015

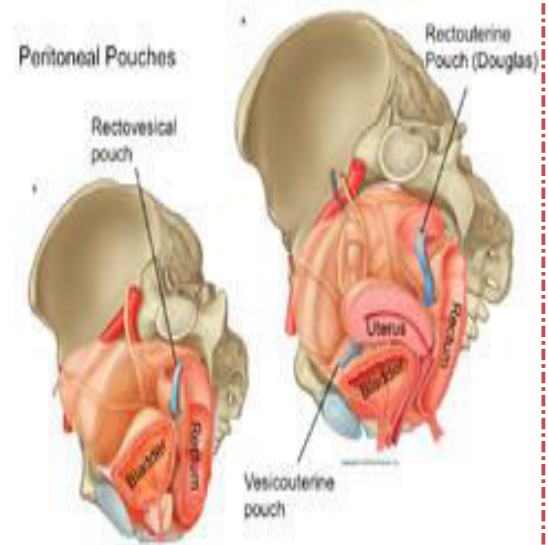
Posteriorly:

- 1- **Rectum**
- 2- Sacrum and coccyx
- 3- Coils of small intestines
- 4- Sacral plexus
- 5- Left external iliac vessels, left common iliac vessels and left piriformis muscle
- 6- Left ureter



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Important note: the peritoneum becomes retroperitoneum when it reaches the rectum covering the anterior and left side of the upper third of rectum and then the anterior of middle third forming a pouch called **Rectovesical pouch** in males above the seminal vesicle and ejaculatory duct, while in females it forms **Douglas pouch** (rectouterine pouch). The sigmoid colon usually occupies the rectovesical pouch in males and Douglas pouch in females.



Blood supply, venous drainage, lymphatic drainage of the sigmoid colon

Branches from the inferior mesenteric artery which include sigmoidal branches called lower left colic arteries.

*the most superior sigmoidal artery anastomose with the descending branch of left colic artery

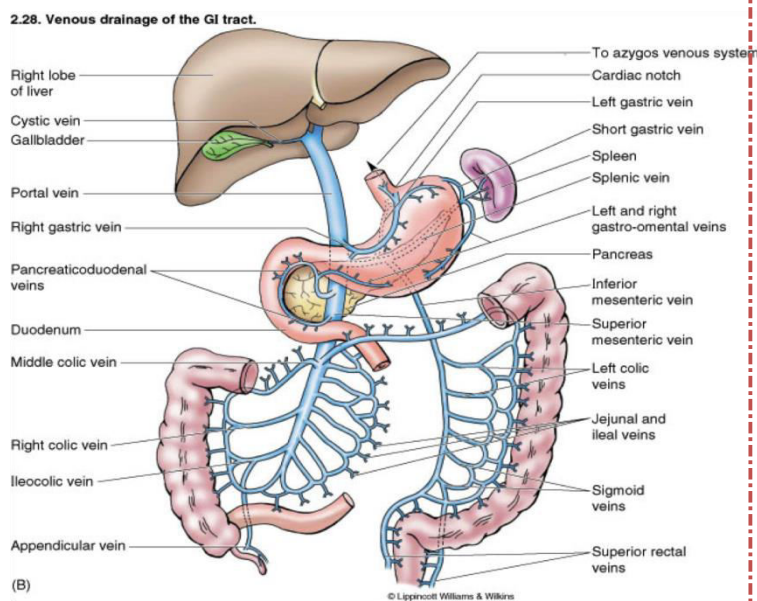
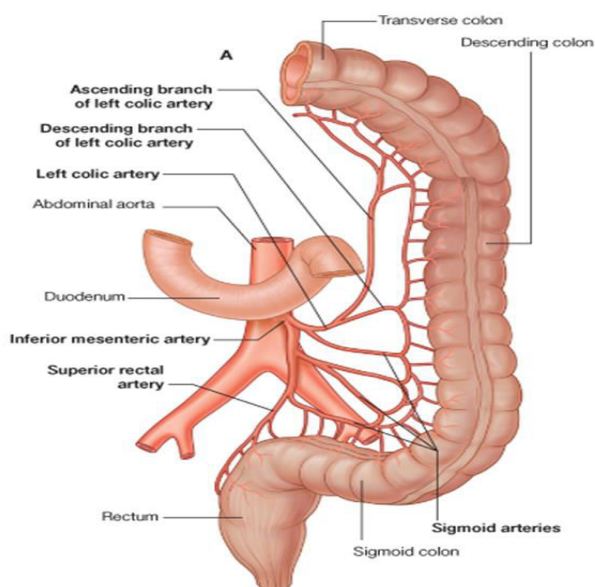
Sigmoidal veins and left colic veins drain the sigmoid colon then they drain to inferior mesenteric vein which ultimately drain in the splenic vein and then in the portal vein.

Lymph vessels that drain the sigmoid colon follow the sigmoidal arteries to drain in the inferior mesenteric lymph nodes.

Note: main branches of inferior mesenteric artery are: superior rectal arteries, sigmoidal arteries and left colic arteries. Left colic artery has an upper part supplying the descending colon and lower part supplying the sigmoid colon.

Nerve supply of the sigmoid colon

Sympathetic nerves from the **lumbar sympathetic chains (L1+L2)** and parasympathetic nerves from **pelvic splanchnic nerves (S2+S3+S4)** form **inferior hypogastric plexus** which supplies the sigmoid colon.



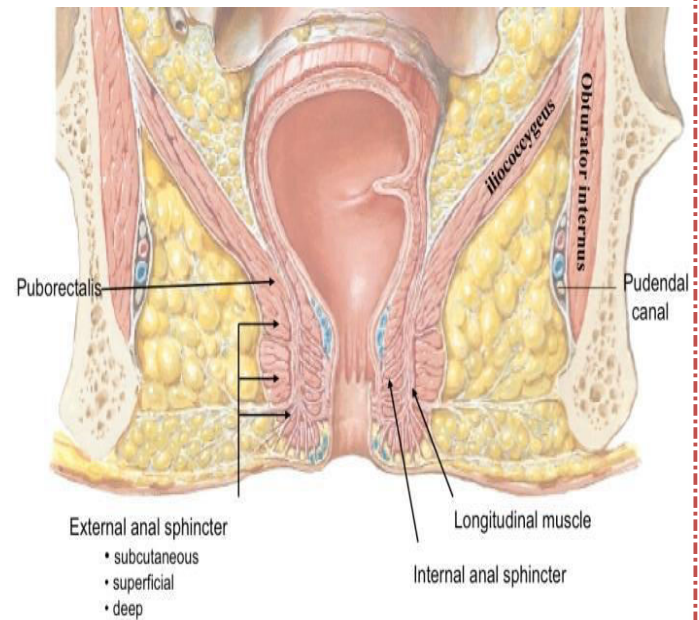
Rectum

General characteristics of the rectum

- 1- It is about 5 inches in length ,starts as a continuation of the sigmoid colon from the mid of sacrum (in front of S3) , it ends 1 inch beyond the tip of coccyx piercing the pelvic diaphragm and becoming continuous with the anal canal
- 2- It is directed downwards and posterior beyond the tip of coccyx

3- The lower part of the rectum is dilated to form the **rectal ampulla** which acts as a reservoir of stool, and this stool will be defecated through anal canal.

4- The landmark between the rectum and the anal canal is **puborectalis muscle** which is a part of levator ani muscle, this muscle forms a sling around the anorectal junction separating between the rectum and anal canal. The action of this muscle is that it pulls the puborectal junction forwards and it forms angulation around the anorectal junction (**Important**)



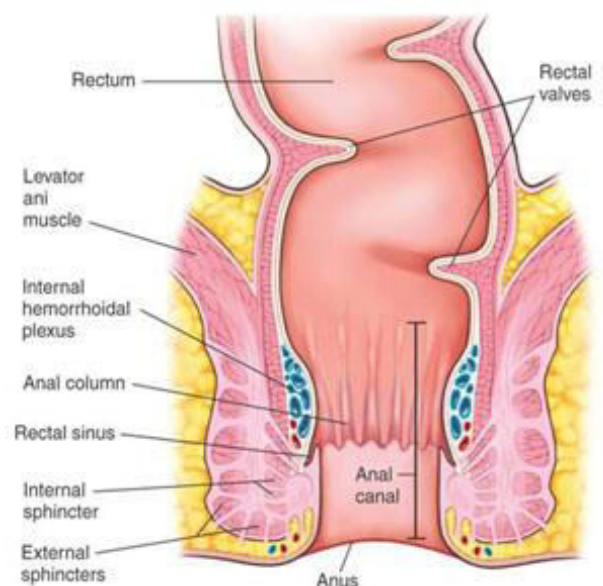
5- The rectum follows the anterior concavity of sacrum so it is concaved anteriorly. Looking at the rectum on the right side we find 2 concavities and 1 concavity of the left side forming the shape of number 4 in Arabic.

6- The rectum is directed downwards and backwards at the anorectal junction

Mucosal folds in the rectum

The rectum has transverse folds of mucosa called Houston valves or rectal valves and they are 3 in number:

- 1- Upper transverse fold projecting from the right wall
- 2- Middle transverse fold projecting from anterior and right wall
- 3- Lowest fold projecting from the left wall



In addition to the transverse folds, the rectum has longitudinal folds of mucosa that form anal columns, and these columns terminate as anal valves and anal sinuses.

Peritoneum of the rectum

According to the peritoneum covering, the rectum is divided into 3 thirds:

- 1- Upper third : covered by peritoneum on the anterior and lateral surface
- 2- Middle third :covered by peritoneum on the anterior surface only forming rectovesical pouch in males and douglas pouch in females
- 3- Lower third: devoid of peritoneum

Relations of the rectum

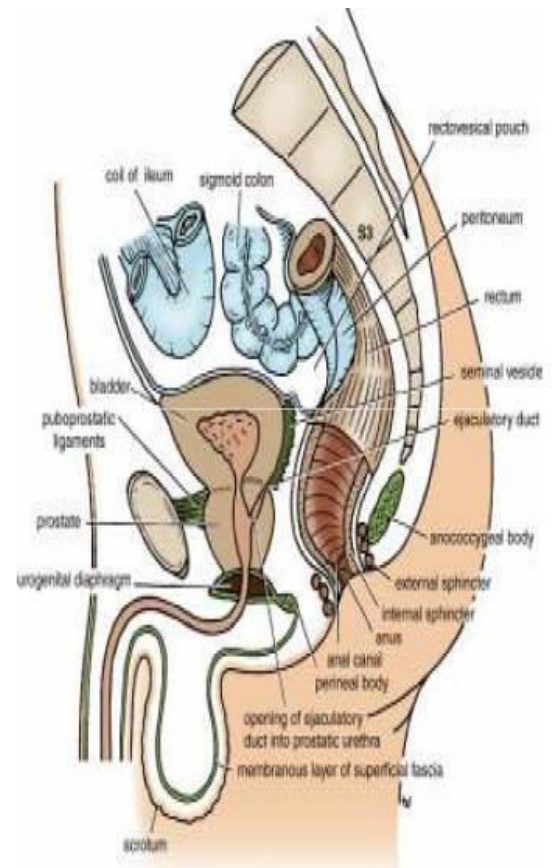
Posteriorly

- 1- Sacrum and coccyx
- 2- Piriformis ,coccygeus , levator ani muscles
- 3- Sacral plexus (which emerges from the anterior sacral foramina) and sympathetic trunk

Anteriorly in males:

Upper two thirds: are related to peritoneum anteriorly, coils of ileum, sigmoid colon and rectovesical pouch

Lower third: related to seminal vesicles, prostate, lower end of vas deferens and the posterior surface of urinary bladder



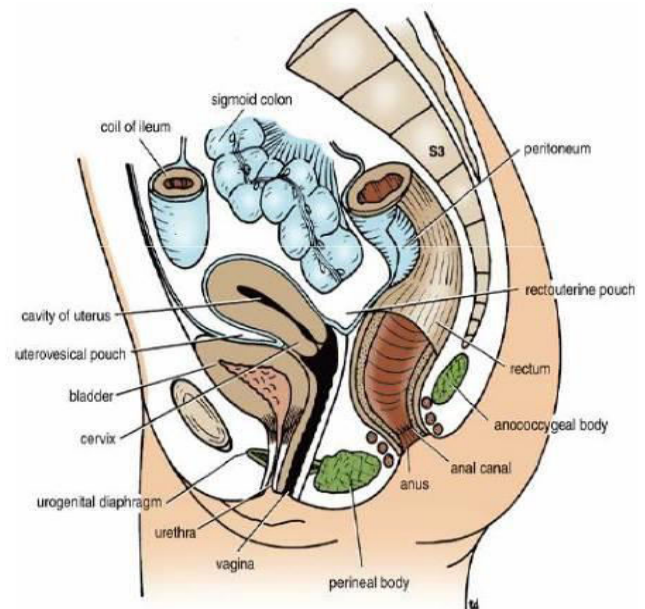
Note: Nowadays there is a law in the emergency room, if any male come to the emergency room and his age is above 50 you must do **bare rectal examination**

which means to put your index in the anal canal and rectum then press toward the anterior abdominal wall, you will feel the prostate (**mainly**) and if it was hypertrophic you will feel it. This examination is necessary because prostatic hypertrophy could be malignant.

Anteriorly in females:

Upper two thirds: the same as in males but the pouch here is called Douglas pouch or rectouterine pouch

Lower third: devoid of peritoneum and related to the posterior surface of the vagina



Histology of the rectum

The lining epithelium in the rectum and anal canal becomes stratified squamous non-keratinized epithelium because of friction, and at the lower end of anal canal it becomes stratified squamous kertanized epithelium with hair follicles and sebaceous glands.

Muscular coat of the rectum :

1- Outer longtuduinal layer : the rectum has no taenia coli (but *the taenia coli of the sigmoid colon come together so that the longtuduinal fibers form a broad band on the anterior and posterior surface of the rectum). Appendices epiploica are also absent.

2-Inner circular layer : form internal anal sphincter which is autonomic which is less important than the external anal sphincter which is voluntary ,Damage in the external anal sphincter causes **incontenence** which means that defecation will be out of your control

*The inner circular layer in addition to the mucosa of the rectum form rectal transverse folds (upper , middle , lower)

Blood supply of the Rectum

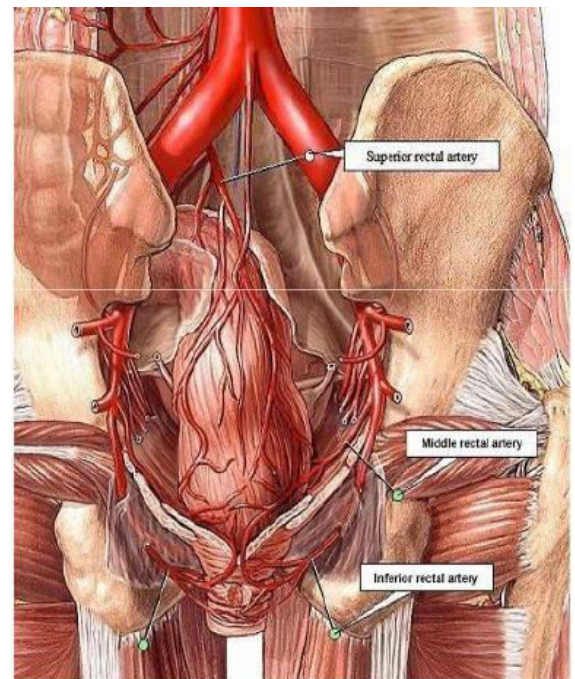
The rectum is supplied from:

- 1- Superior rectal artery : it is a continuation of inferior mesenteric artery, it is the chief artery that supplies the mucous membrane of the rectum. It passes deep to that mucosa and divides to anterior and posterior divisions and continues till the upper half of anal canal, which means it supplies the rectum and upper half of anal canal

*superior rectal artery enters the pelvis by descending in the medial limb of the root of sigmoid mesocolon and divides to right and left branches that pierce the muscular coat and supply the mucous membrane

- 2- Middle rectal artery : branch from internal iliac artery and distributed to the muscular coat
- 3- Inferior rectal artery : branch from internal pudendal artery (which is a branch from the internal iliac artery) in the perineum

*right and left divisions of the superior rectal artery anastomose with the middle and inferior rectal arteries. Also middle rectal artery and inferior rectal artery anastomose at the anorectal junction.



Venous drainage of the rectum

- 1- Portal drainage : superior rectal vein drain the mucous membrane of the rectum and terminates in the inferior mesenteric vein -> Splenic vein -> Portal vein
- 2- Systemic drainage : middle and inferior rectal veins drain into internal iliac vein which drains to inferior vena cava

*The union of these rectal veins form an important **Porto-systemic anastomoses**

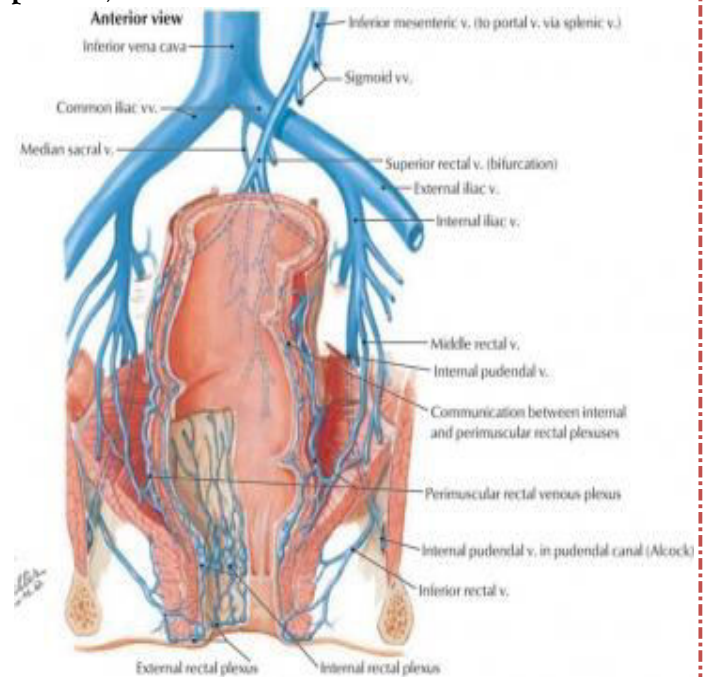
One of the complications of portal hypertension is the formation of hemorrhoids or piles and it forms between superior and inferior rectal veins.

Venous plexus of the rectum (hemorrhoidal plexus)

superior rectal + middle rectal + inferior rectal veins connect together and form venous plexuses in the rectum, and because the superior rectal drains in the portal vein while the middle and inferior rectal veins drain in the IVC, there is a free porto-systemic anastomoses that leads to the formation of hemorrhoids in case of portal hypertension

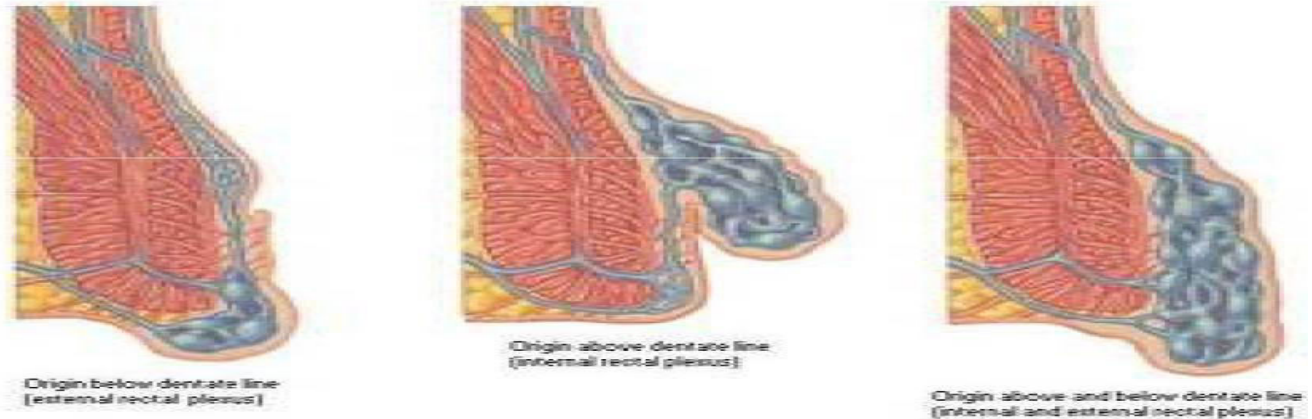
Note : In addition to portal hypertension , Pregnancy might also cause hemorrhoids because in pregnancy there is a pressure exerted on pelvic veins that leads to congestion in the rectal veins leading to **internal Hemorrhoids** and after pregnancy they will be gone without medical intervention .

From slides: Rectal venous plexus communicates with vesical venous plexus in males and Uterovaginal plexus in females.



Hemorrhoids: are tortuous, dilated rectal veins and they could be superior, middle, inferior; this dilatation will lead to congestion and piles or hemorrhoids

Rectal plexus & Hemorrhoids



Lymphatic drainage of the rectum

Upper part of the rectum drains into para-rectal lymph nodes then into inferior mesenteric lymph nodes

Lower part of the rectum follows the middle rectal artery to internal iliac lymph nodes (while the lower half of anal canal drains to superficial inguinal lymph nodes)

Nerve supply of the rectum

Innervated through inferior hypogastric plexus of nerves containing sympathetic (from lumbar sympathetic chains) and parasympathetic from (S2-S4 Splanchnic nerves)

Rectum is sensitive to stretch which means it is innervated by autonomic nervous system

Anal canal

General characteristics of the anal canal

- 1- It is a continuation of the rectum ,4 cm in length divided into upper 2 cm and lower 2 cm and they are separated by the terminal part of anal columns (anal sinuses ,anal valves)
- 2- It starts from the anorectal junction which is determined by puborectalis which is part of levator ani muscle (landmark), and terminates at the anus.
- 3- The mucosa of the lower part of the rectum forms longitudinal folds of mucosa and these folds form anal columns in the upper 2 cm of anal canal. These anal columns terminate as anal valves and sinuses between the 2 halves of the anal canal
- 4- Anus is the opening of the anal canal situated 4 cm below and in front of the tip of the coccyx in the cleft between the 2 buttocks

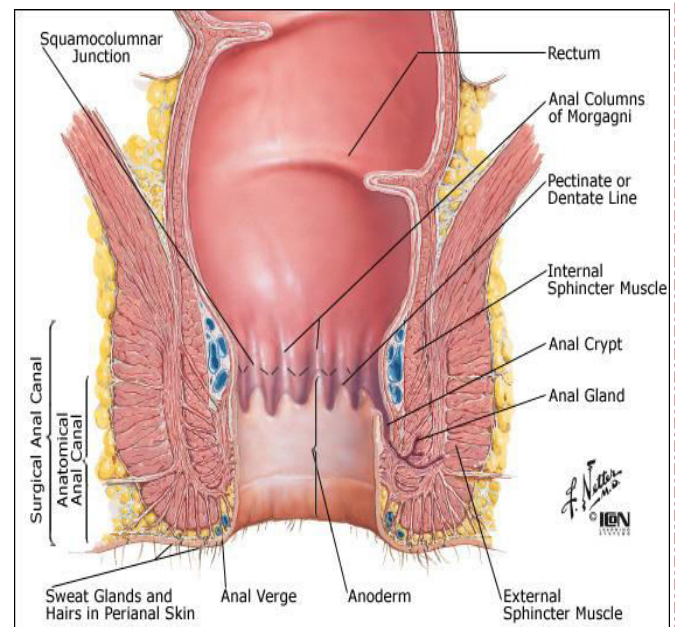
Sphincters of the anal canal

Internal anal sphincter :it is an autonomic sphincter formed from the inner circular layer of muscularis externa , it starts from the puborectal junction and descends downwards beneath the mucosa and it is involuntary in nature

External anal sphincter (important)

Made by **skeletal muscle**, it is voluntary in nature ,divided into 3 parts: subcutaneous, superficial and deep parts.

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



Superficial part: elliptical in shape and arises from the terminal segment of the coccyx and anococcygeal ligament, the fibers surround the lower part of the internal anal sphincter and are inserted into the perineal body .

Deep part: surround the upper part of the internal sphincter and it is fused with puborectalis muscle

Important note: There is overlap by 3 muscles at the anorectal rectal junction which are puborectalis muscle, internal anal sphincter and deep part of external anal sphincter

The external anal sphincter is innervated by inferior rectal nerve which comes from S4. If this nerve was damaged this will lead to a medical condition called **incontinence** and the defecation will become out of control .This is very important in order to stay cautious during surgery in this area not to damage the inferior rectal nerve.

Anorectal ring

It is a muscular ring at the anorectal junction, formed by the fusion of puborectalis muscle, deep part of external anal sphincter and internal anal sphincter, it can be felt during bare rectal examination

Interior of anal canal

- Anal canal is divided into upper 2 cm and lower 2 cm, anorectal junction is located at the end of anal columns (anal valves and anal sinuses).

What are the differences between the upper half and the lower half? (Important).

1) The mucosa of the upper half is simple columnar epithelium, whereas the mucosa of lower half is stratified squamous epithelium. Stratified epithelium has 2 types: if it was above the white line it will be non-keratinized, below the white line it'll be keratinized; it has skin, hair follicles and sebaceous glands.

2) Upper half is sensitive to stretch only. On the other hand, lower half is sensitive to pain, touch and temperature, it's very sensitive. Upper half is supplied by autonomic, lower half is supplied by inferior rectal nerve and perineal branch of S4.

3) Embryologically, upper half is endodermal in origin, whereas the lower half is ectodermal in origin.

4) Upper half has a lymphatic drainage with rectum, to lymph nodes around aorta and common iliac vessels. Lower half has a lymphatic drainage to superficial inguinal lymph nodes (with scrotum).

At the lower end we have folds, valves and anal sinuses, all these structures together form a transverse line called pectinate line, it's different from white line which is found between the lower 2 cm, above white line it's non-keratinized, while below the line it's keratinized. Further description of white and pectinate lines is found below from slides.

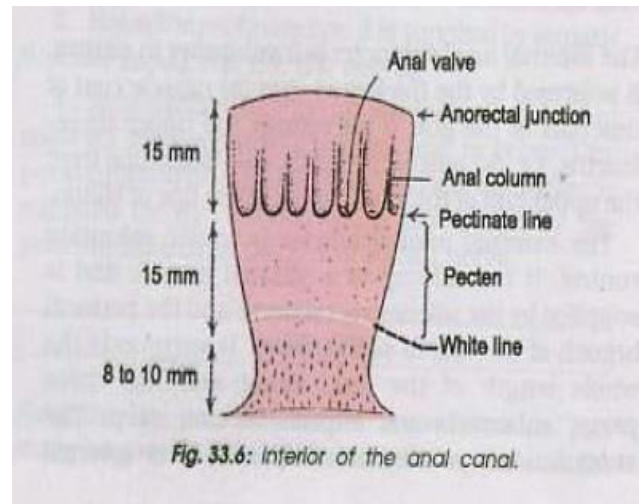


Fig. 33.6: Interior of the anal canal.

*White line: a landmark for the intermuscular border between internal and external anal sphincter muscles. This line represents the transition point from non-keratinized stratified squamous epithelium to keratinized stratified squamous epithelium in the anus.

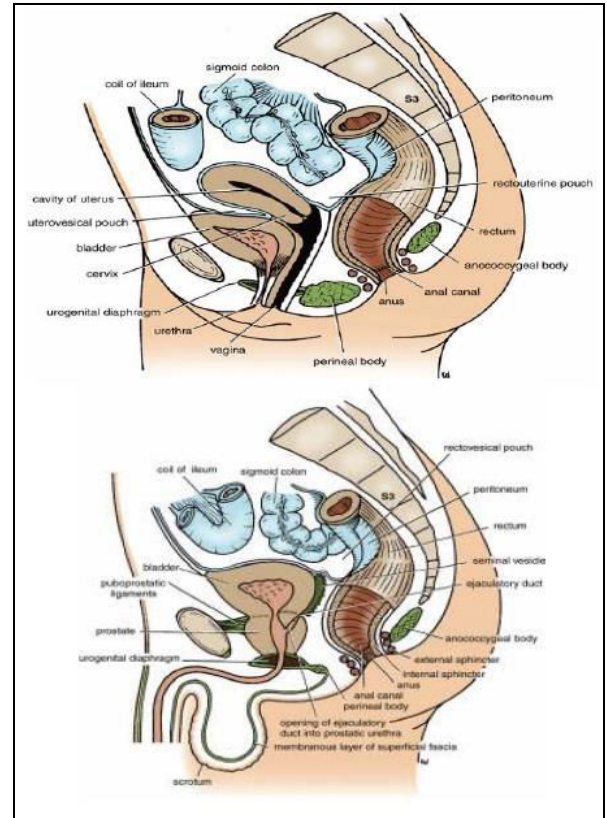
*The lower ends of the anal columns are united to each other by short semilunar folds of mucous membrane; these folds are called the anal valves. Above each valve there is a depression in the mucosa which is called the anal sinus, the anal valves together form a transverse line that runs all round the anal canal. This is pectinate line.

Relations of anal canal:

Anteriorly: in males: perineal body, membranous urethra & bulb of penis. In females: lower end of vagina

Posteriorly: anococcygeal ligament (raphe) and tip of the coccyx.

Laterally: (on both sides): ischiorectal fossae.



Internal anal sphincter is involuntary and it's found deeply and upwards, (*It is formed by the thickened circular muscle coat of this part of the gut), whereas the external sphincter has 3 parts:

- 1) Subcutaneous: below the skin surrounding lower part of anal canal.
- 2) Superficial: it is elliptical in shape and arises from the terminal segment of the coccyx and anococcygeal ligament, the fibres surround the lower part of the internal sphincter and are inserted into the perineal body.
- 3) Deep: it surrounds the upper part of the

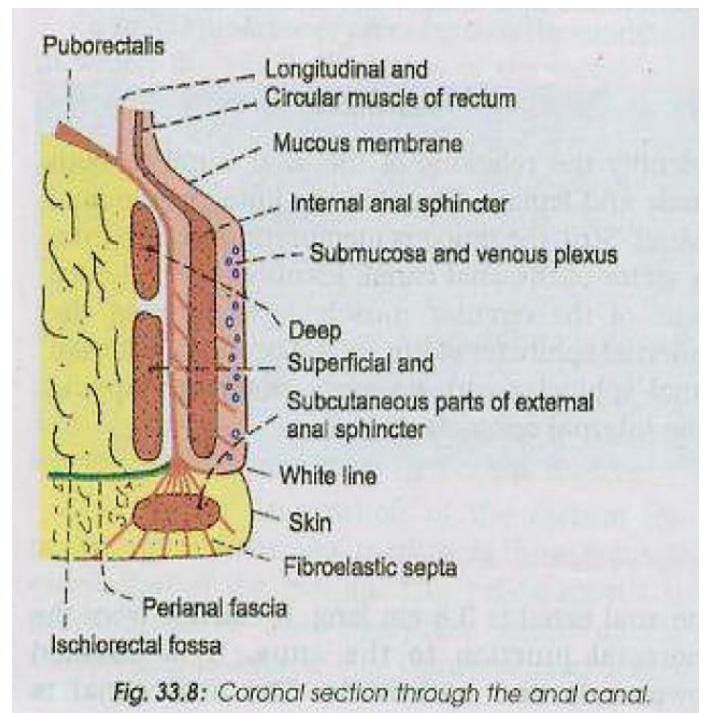


Fig. 33.8: Coronal section through the anal canal.

internal sphincter (it overlaps the internal sphincter) and is fused with the puborectalis.

Puborectalis muscle forms the anorectal ring, and part of the anorectal ring is puborectalis, internal sphincter and deep part of external sphincter.

Blood supply of anal canal:

Anal canal takes its blood supply from branches of superior rectal artery for the part above pectinate line, the part below pectinate line is supplied by middle and inferior rectal arteries but mainly from inferior rectal.

Venous drainage of anal canal:

Upper part into the superior rectal vein (portal drainage), lower half into middle and inferior rectal veins (systemic drainage), they end into inferior vena cava.

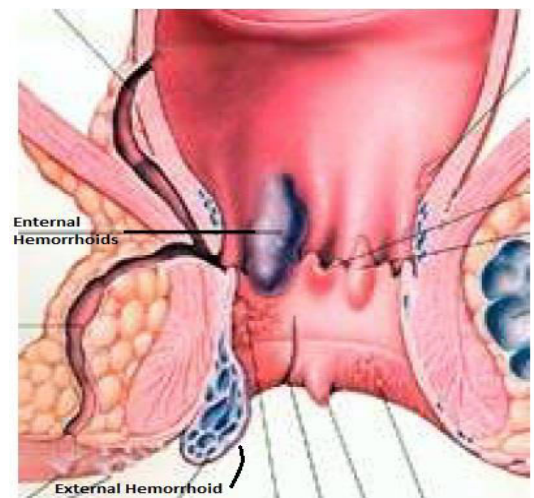
*Venous drainage is explained in slides: internal rectal venous plexus drains into superior rectal vein, the lower part of the external rectal venous plexus is drained by inferior rectal vein into the internal pudendal vein, the middle part by the middle rectal vein into the internal iliac vein, upper 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.

Anal Hemorrhoids:

2 types: internal and external.

Internal hemorrhoid: branches from superior rectal vein, it's located in the upper part of anal canal

External (inferior) hemorrhoid: in the lower part and involves branches of inferior rectal vein.



What are the differences between these 2 types?

1) External (inferior): is painful, and if you put your finger on it you feel tenderness (usually you can find them subcutaneously and they are tender), it might develop thrombosis and infection, and rupture can occur and that results in bleeding (blood with stool). They develop in the inferior rectal veins.

2) Internal is painless (no pain), it's found in the upper part (branches of superior rectal vein), it usually stays in the upper part. They develop into the superior rectal veins.

Internal hemorrhoid has 3 stages:

1) First stage: during defecation it stays in the anal canal.

2) Second stage: if it was enlarged, during defecation it passes into the anal orifice outside, and at the end of defecation it returns back to the anal canal.

3) Third stage: after defecation it stays outside the anal canal.

Pregnant women at the end of pregnancy might have piles (hemorrhoids) outside the anal orifice, but after delivery these hemorrhoids disappear without any medical intervention.

These hemorrhoids are structures with engorgement and dilatation and tortuosity of rectal veins.

Causes of hemorrhoids: 1) Congenital weakness of the venous walls. 2) Superior rectal vein is the most dependant and valveless. 3) Chronic constipation and cough. 4) Pregnancies. 5) Portal hypertension. 6) Cancer in the rectum.

People who eat a lot of spicy food might have hemorrhoids (they cause irritation of mucosa).

If you put the patient in the lithotomy position (from medicine.net: lithotomy position is the position in which the patient is on their back with their hips and knees flexed and the thighs apart. The position is often used for vaginal examinations and childbirth), and if you consider the anal orifice as if it was like a clock, you can see that the hemorrhoids are mostly located at number 3, 7 and 8; these hemorrhoids are the most apparent hemorrhoids.

Surgical Classification of Hemorrhoids (slide 48 with cover) is not included.

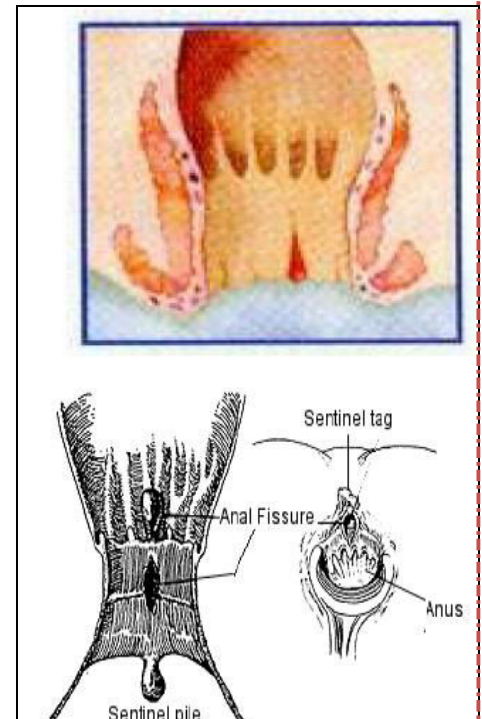
Anal fissure: a slit in the mucosa which results from constipation and hard pieces of feces, when these pieces reach the anal valves and sinuses and with straining, they slough off the mucosa causing ulcers. These ulcers are longitudinal in shape and are found in the longitudinal folds of mucosa. These anal fissures cause severe pain and are treated by surgery.

*An anal fissure is likely to cause itching, pain, and bleeding during a bowel movement.

*Its site is in the midline, either posterior or anteriorly to the superficial part of the external anal sphincter (no support).

Perianal abscess: mostly in the ischioanal fossa, on both sides of anal canal, they might appear as complication of anal fissure. The treatment of these abscesses is drainage.

PR examination: to put your index in the anal canal and rectum. In the female the vagina lies anteriorly, while in the male the urinary bladder and the superior vena cava, ampulla vas deferens, prostate. The sacrum and the coccyx lie posteriorly, while the ischiolateral fossae lie laterally.



Lymphatic drainage of anal canal:

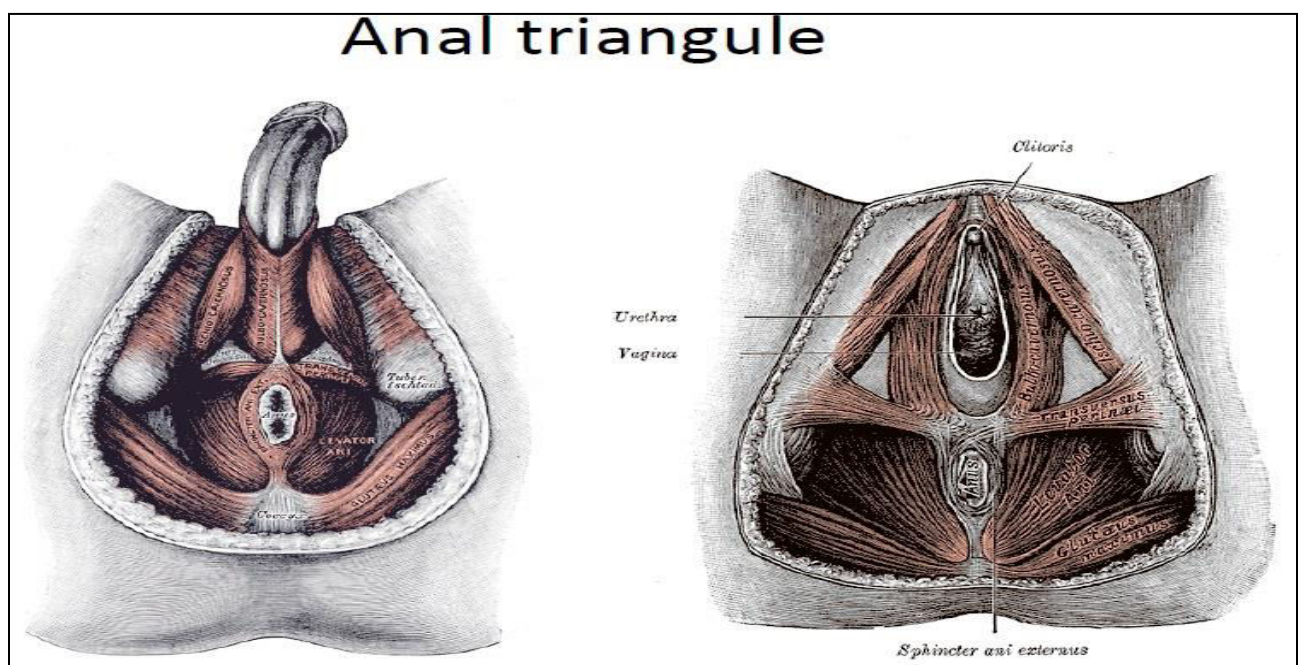
Upper half follows the rectal lymphatic drainage *(into the internal iliac nodes), whereas the lower half has lymphatic drainage into superficial inguinal lymph nodes.

Nerve supply of anal canal:

Upper half is supplied by autonomic *(inferior hypogastric plexus and pelvic splanchnic), it's sensitive to stretch

Lower half is sensitive to pain, touch and temperature. It's supplied by inferior rectal nerve and perineal branch of S4.

Perineum is divided into urogenital triangle and anal triangle; between these 2 triangles we have perineal body and 2 ischial tuberosities.



Contents of anal triangle: Some components of the anal triangle include: Ischioanal fossa, Sacrotuberous ligament, Sacrospinous ligament, Pudendal nerve and its branches, Internal pudendal artery and Internal pudendal vein, Anal canal. Muscles:

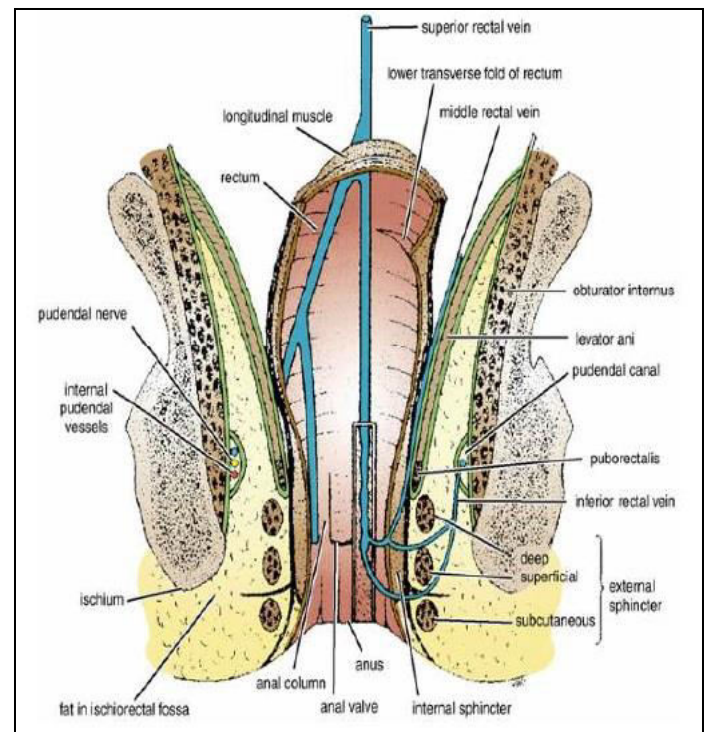
Sphincter ani externus muscle, Gluteus maximus muscle, Obturator internus muscle, Levator ani muscle, Coccygeus muscle.

Skin around anus is supplied by inferior rectal (hemorrhoidal) nerve.

Lymphatic drainage of the triangle into the superficial inguinal lymph nodes *(medial group).

Ischiorectal fossa:

The ischiorectal fossa (ischioanal fossa) is a wedge-shaped space located on each side of the anal canal. It has an apex located between levator ani and obturator internus muscles, so obturator internus muscle and its fascia (green in color) and at its end there is the pudendal canal, so this canal is located at the lateral wall of the ischiorectal fossa, and it's formed by obturator internus fascia, inside this canal you find internal pudendal vessels and pudendal nerve. The base of this fossa is skin around anal canal.



So laterally we said that we have obturator internus muscle and its fascia, medially we have levator ani muscle and its fascia.

The following structures pass through this fossa: inferior rectal vessels and nerve, branch from S4, they come from pudendal canal crossing to anal sphincter and anal canal.

Pudendal nerve is found in the pudendal canal and it gives branches in the ischioanal fossa.

The fossa has a large amount of fat, one of its advantages is dilation of rectum and anal canal during defecation, but it has a disadvantage that it might have common infections and abscess formation because this area is considered a dirty area.

Pudendal canal

The pudendal canal (also called Alcock's canal) is an anatomical structure in the pelvis formed by the obturator internus fascia, it's located on the lateral wall of ischioanal fossa, it ends in deep perineal pouch (in perineum there are 2 pouches superficial and deep pouches).

Contents of pudendal canal: Internal pudendal artery, internal pudendal veins, Pudendal nerve. These vessels and nerves cross the pelvic surface of the obturator internus.

