

ANATOMY "GI"

"Final Edition"

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Mixed gland ← **Liver** → Right hypochondrial + epigastric + extends to Lt hyp

≈ 1.5-2 Kg (1/50 → adults / 1/20 in children)

- * Functions:**
- 1) meta
 - 2) Detox with kidney
 - 3) Bile exocrine
 - 4) synthesis of hormones & clotting factors (Albumin, Globulin, thrombin, prothrombin) + fibrinogen → endocrine
 - 5) Heparin synthesis → anticoagulant
 - 6) activation of (vit D)
 - 1) Glycogen storage & vitamins like (vit K)

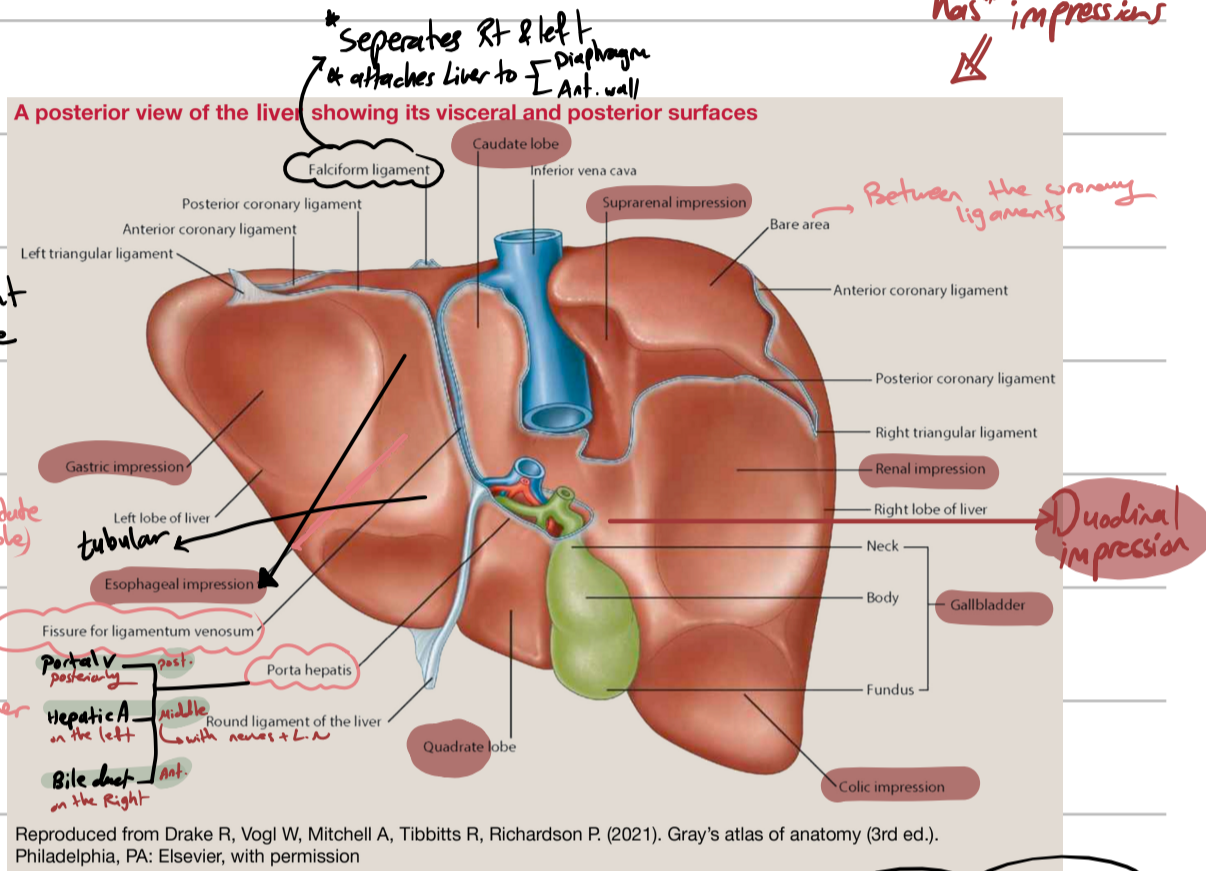
- * Surfaces of liver:**
- 1) Anterior
 - 2) Posterior
 - 3) Right
 - 4) Superior (Diaphragmatic)
 - 5) visceral (postero-interior) has * impressions

Impressions:

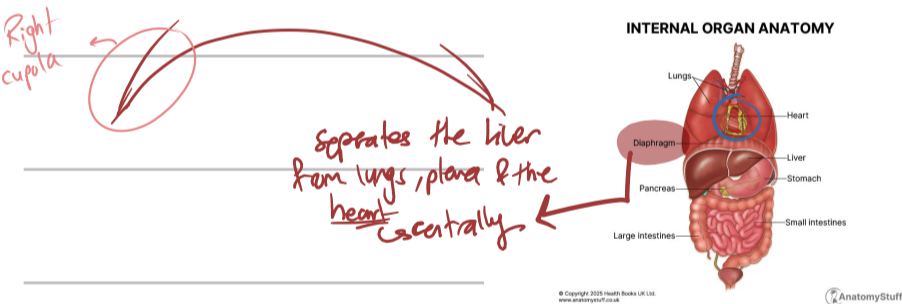
- 1) Esophageal
- 2) Gastric → left lobe
- 3) Renal & supra renal
- 4) Duodinal & pyloric
- 5) Colic → Right lobe
- 6) Gall Bladder

other:

- IVC (Rt) → not on visceral! [on superior posterior] connecting umbilical vein to IVC
- Ligamentum venosum (between caudate and left lobe) was a duct in embryo
- tubular omentum (medial to Gastric & lateral to left of porta hepatis)
- porta hepatis (hilum to liver)
- ligament teres (round ligament) (extends between the umbilicus & Right Branch of portal vein (page 13))
- lesser omentum



*** All the surfaces are covered by diaphragm EXCEPT the visceral**



*** Regarding Liver Borders**

inferior ⇒ 9th rib, it's sharp
superior ⇒ pushes the diaphragm to 5th costal cartilage

* The common Bile duct descends either behind OR through the heart at pericard then to the 2nd part of duodinum

* looking Anteriorly to liver we can see:-
Rt & Lt lobes + falciform + teres + fundus of bladder

*** On the superior surface ⇒ Bare area** between the layers of coronary ligament
groove for IVC which (2-3) hepatic vein drain directly to it

Anatomical Lobes: Right, Left, **Quadrate**, **caudate** → near the IVC

Regarding this, teres & venosum
separates the quadrate from left lobe
separates caudate from left lobe

left to the Gall bladder
considered part of Rt lobe

*** NOTE:** caudate + Quadrate physiologically relate to Left lobe (drain to left hepatic duct + supplied by Lt. artery)

*** Riedel's Lobes** - Normal extension of Rt. lobe downward could reach the iliac crests

*** Relations:** 1] Ant: - Diaphragm + lung & pleura + Abd wall costal cartilages (7, 8, 9) + xiphoid

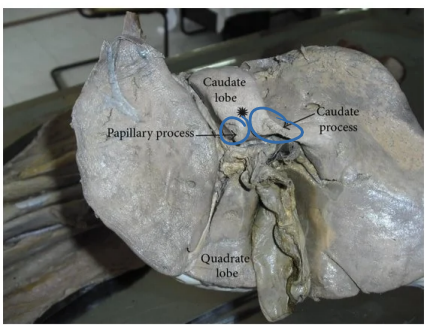
2] Post: - Kidney + suprarenal + flexure + T. colon + esophagus
fundus + duodinum + IVC + gall bladder + diaphragm

*** caudate** ⇒ on the Right: IVC
" " Left: venosum

inf: porta hepatis

*** Quadrate** ⇒ Ant: Ant margin of liver
Right: G. bladder

sup: porta hepatis
left: teres



* Blood supply :- H. Artery prop + Portal vein (75-80%)
 (20-25% in porta. II)
 s. mesent. neck ← splenic
 hepatic veins → IVC → Rt. atrium
 Rt. ← cystic Artery
 Lt.

* Segmental anatomy :- 8 specific segments each with its own Blood supply + drainage + Biliary duct (Hepatic duct)
 (important in surgery (cirrhosis))

* Calot's triangle :- Bounded by
 1) cystic duct
 2) common hepatic duct
 3) cyst artery → post to the
 important during cholecystectomy (Ligation artery + vein + cystic duct)

* Lymphatic drainage :- Liver → Hepatic L.N in porta → celiac trunk
 * Nerve supply
 sym → hepatic (celiac) plexus
 para → vagus

* ERCP ⇒ relieving obstruction in pancreatic + common bile duct (takes 30 min, patient can leave in 6 hrs)

Gall Bladder
 has muscles for contraction
 40-60ML MAX
 fundus + Body + neck
 cck is what causes it to contract & sphincter of oddi to relax
 There is a bulge (Hartman's pouch) stones commonly collect here

* Blood supply → cystic artery from Rt. h. A & drain into cystic vein to Rt PORTAL vein
 * Lymph :- Gall Bladder ⇒ cystic L.N ⇒ Hepatic L.N
 cly li ⇒ celiac

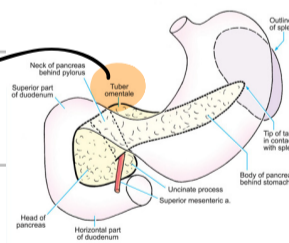
cholelithiasis treatment → cholecystectomy
 common Bile duct → 10cm
 1st part: above
 2nd part: behind Duodenum
 3rd part: below

Pancreas
 also contains uncinata process (leftward + behind the superior mesenteric vessels)
 Head in the concavity of duodenum
 Neck behind it Portal is formed
 Body
 Tail ending until spleen
 mixed Gland (Mainly exocrine)
 endocrine portion
 a Glucagon
 insulin
 Delta cells

* Retroperitoneal located in epigastric + left hypochondriac

Regarding to the Body: 3 surfaces
 Ant (covered by peritoneum + Post (curta + origin of + inf (narrow) + covered by peritoneum of greater omentum)
 3 Borders
 sup (splenic artery) + Ant (transverse + inf Mesocolon)

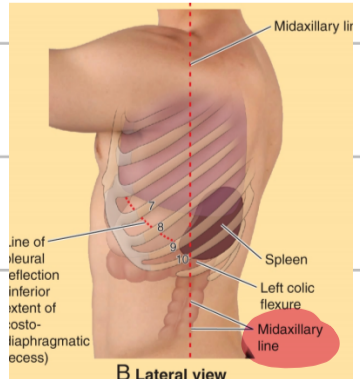
is where the Ant. surface of the body joins the neck



Notes: 1] while splenectomy ⇒ we fear to accidentally cut the pancreatic tail
 2] Blood supply ⇒ splenic Artery + superior & inf pancreaticoduodenal
 drainage to sup. mesenteric + portal vein
 3] pancreatic cancer ⇒ common in the head → compression on the Bile duct ⇒ jaundice

Borders: upper & lower sharp notches
 Surfaces
 visceral facing inward has 4 impressions: + stomach + left colic flexure + left kidney
 Diaphragmatic (costal) outward facing 9, 10, 11 ribs
 Blood Reservoir + lymphatic system
 * Spleen → left hypochondriac region (under 9, 10, 11 ribs)
 (intra peritoneal (ligaments with: stomach, ala, diaphragm + left kidney)

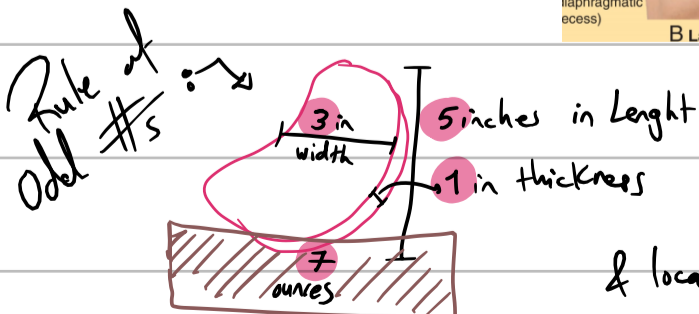
contains the hilum splenic artery & vein enters (branches before) exit



* it has 2 ends
 Post/upper → 4cm lateral to post midline
 Ant/lower → Reaches down to mid-axillary line

* Lymph's splenic L.N ⇒ celiac
 (in the Hilum)

Regarding Nerve Supply ⇒ Sympathetic



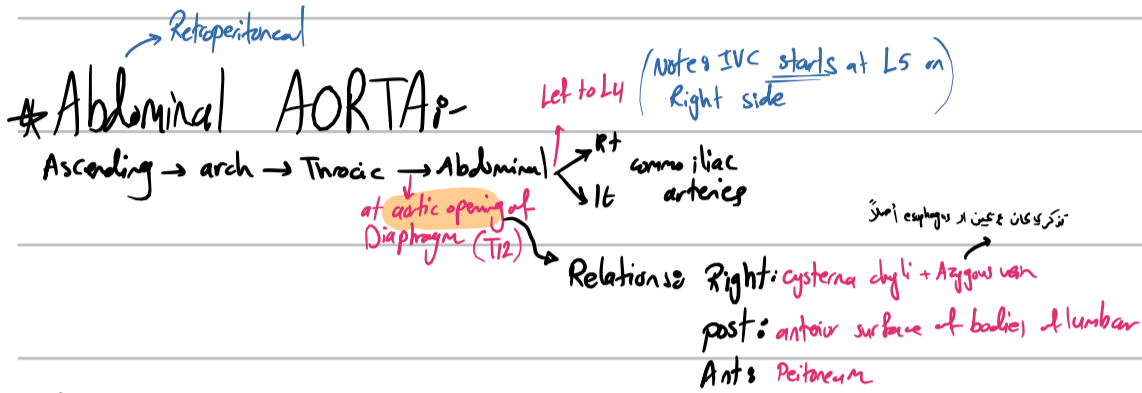
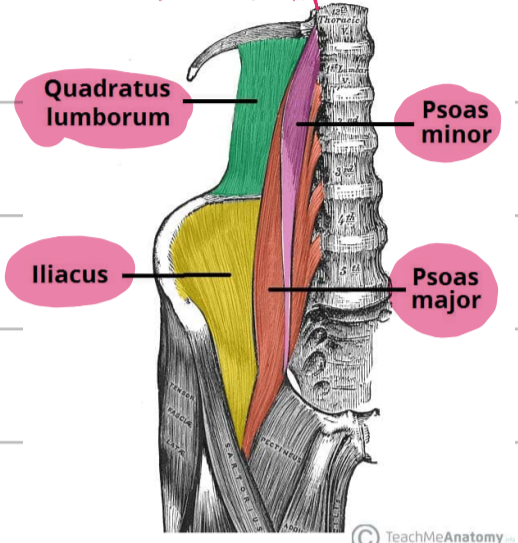
Posterior Ab. wall

When looking anteriorly - ① skeletal structures: ⑤ Lumbar vertebrae & hip bone & 12th rib in upper part
 ② Muscular: psoas major & minor (absent in some) & iliacus & origin of transversus abdominis & quadratus lumborum & Diaphragm (opening of aorta abdominalis)

Key muscles:
 ① psoas major
 Body + T. processes of lumbar → lesser trochanter
 Nerve: T12 + L1 + L2 + L3
 Flexion of hip & thigh

② Quadratus lumborum
 iliolumbar ligament → 12th rib + T. process of upper lumbar
 (between iliac crest & 5th lumbar)
 Nerve: T12 + L1 + L2 + L3
 fixation of 12th rib + aids in Respiration & lateral flexion of trunk

③ iliacus
 iliac fossa → lesser trochanter
 Nerve: femoral .N
 Flexion of hip



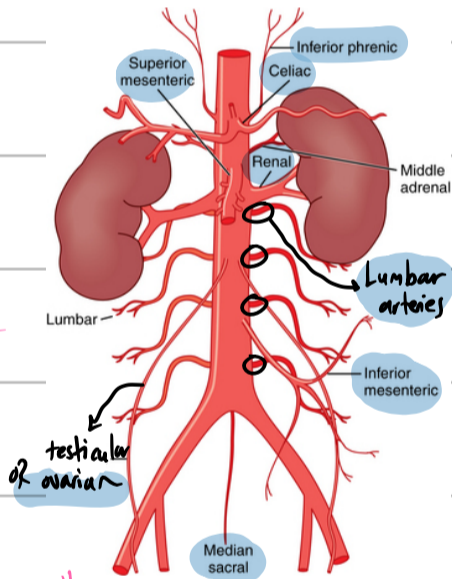
Relations of Ab. aorta

- Ant (5 things): - pancreatic Body + splenic vein + 3rd part of duodenum + coils of intestine + left Renal vein (crosses to reach IVC)
 ↳ very important clinical case ⇒ **Nutcracker syndrome**
 [When sup. mesenteric artery compresses the left renal vein it leads to its obstruction and back flow of blood to left gonadal vein (cause it drains into L-renal) causing varicosely. This doesn't happen in Rt side cause Rt. gonadal vein directly drain into IVC]
- Right (3 things): - Beginning of azygos vein + IVC + cysterna chyli
- Left (1 thing): - left sympathetic trunk

Branches of Ab. aorta

single (unpaired)

- celiac trunk (T12) ⇒ foregut
- sup. mesenteric (L1) ⇒ midgut
- inf. mesenteric (L3) ⇒ hindgut
- Median sacral artery → descends from the Bank of bifurcation at L4

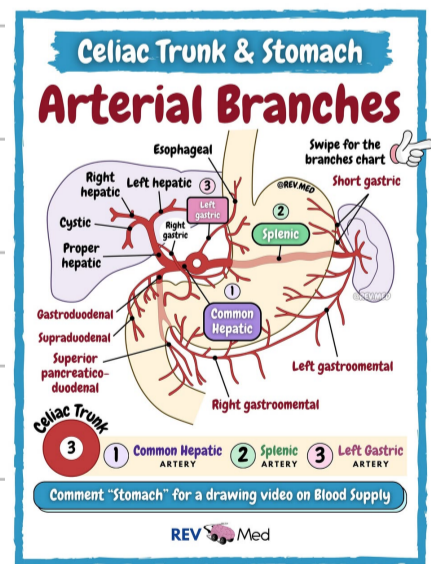


paired

- testicular & ovarian Arteries (L2) → front & 1 pair
- Lumbar Arteries → posterior/lateral & 4 pairs (Run between psoas & lumbar vertebrae)
- Inferior phrenic Arteries → arise as soon the aorta enters the abdomen (give superior suprarenal arteries)
- Middle suprarenal
- Renal (Rt is longer than the Lt because the aorta is positional toward the left)

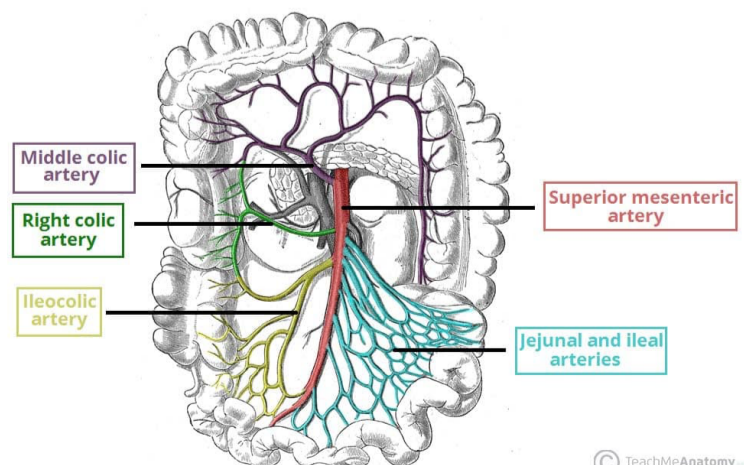
Celiac trunk (1cm and gives:)

- Left Gastric → lower 1/3 of esophagus & lesser curvature
- splenic → runs on upper border of pancreas into the splenic hilum (gives short gastric (Gastro splenic ligament) pancreatic (ant & post) left gastroepiploic)
- Common hepatic
 - Right Gastric
 - Gastroepiploic
 - Right Gastro epiploic
 - superior pancreaticoduodenal
 - Proper hepatic → right (carries cystic artery) left



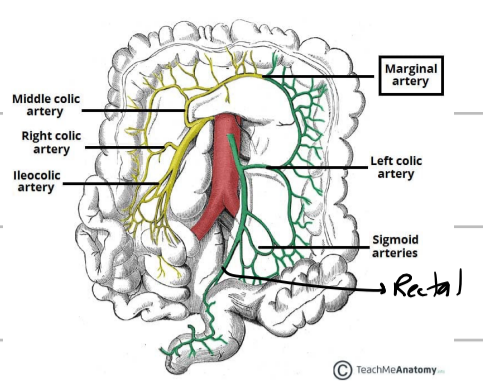
Sup. mesenteric (upper border of L1 / Lower Border of L2)

- inferior pancreaticoduodenal (Lower 1/2 of duo & pancreas)
 - Middle colic (to Transverse colon and divides to Right colic → Asc colon, left colic)
 - ileocolic (Ilium + gives Ant & post cecal Arteries) ↳ gives appendicular
 - Jejunal & ileal Branches (arise from left side)
- superior anastomose with Right colic
 inferior ↳ the end of superior mesenteric



veins are positioned laterally to their arteries

inf. Mesenteric (L3) — left colic (Lateral 1/3 of T. colon + D. colon)
 sigmoid branches (sigmoid colon)
 ↳ terminal continuation of inf. mesenteric
 Superior Rectal (Rectum + upper 1/2 of Anal canal)

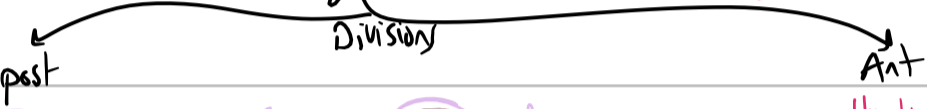


Notes: Marginal Artery → connecting superior + inferior mesenteric branches along the inner border of colon
 ↓
 Protection against ischemia

Iliac Arteries: (at the inlet of pelvis / pelvic brim → each common iliac divides into internal & external iliac arteries)

External iliac artery → behind the inguinal ligament → enters the lower limb as femoral artery
 ↳ before leaving it gives 2 branches along medial border of psoas major:
 - inf. epigastric artery (Medial to it direct hernia / lateral is the indirect inguinal) ↳ enters the rectus sheath deep to the muscle
 - Deep circumflex iliac artery (goes to iliac crest to supply muscles of abd. wall)

Internal iliac artery (enters the pelvis to supply pelvic organs + gluteal region)



superior Gluteal Artery (greater sciatic foramen) **ABOVE** piriformis → Gluteus maximus

- obturator artery (travels with the nerve through obturator canal to medial thigh)

inferior gluteal (greater sciatic **BELOW** piriformis → gluteal region)

- ilio-lumbar → ilio-lumbar ligament

- umbilical Artery [Distal is obliterated to form MEDIAL umbilical ligament (Note that Median ligament is named urachus)
 proximal part gives superior vesical artery → upper bladder]

- lateral sacral Arteries through sacral foramina
 ↳ post for Rectum & sigmoid

- inferior vesical

- vaginal & uterine ↳ tortuous - Artery to vas deferens

- Middle Rectal & internal Pudendal ⇒ Terminal Branches
 ↳ gives inf. rectal

veins of Post. Abd wall

↳ it pierces the diaphragm at (T8) → Right atrium

IVC forms by union of 2 common iliac veins at L5 below & behind Right iliac artery

Regarding Pelvic veins ⇒ Deeper than Arteries (That's why during pregnancy women might develop varicose in the legs & hemorrhoids in anal region)

It ascends on Right side of aorta. Sympathetic chain at the edge behind the Right side of it

Ant. relations: 1st & 3rd duodenum & head of pancreas & foramen of Winslow & portal vein & coils of intestines & Bile duct (forming the port wall)

- Tributaries:
- 1] Hepatic veins (2 or 3)
 - 2] suprarenal veins (Rt & Lt) direct ↳ goes to Lt renal then IVC
 - 3] testicular / ovarian (Rt OR Lt) Direct ↳ into Lt renal in a right angle (90°) ↳ cause of varicocele in scrotum
 - 4] 5 lateral abdominal [4 lumbar ↳ inf. phrenic
 - 5] 3 veins [2 common iliac ↳ median sacral

Portal systems:

portal vein is 5cm (ends in Porta hepatis to Rt & Lt)



Head of Medusa

- portal tributary
- systemic tributary
- clinical presentation

- Tributaries:
- 1] splenic vein
 - 2] superior mesenteric
 - 3] Rt & Lt gastric
 - 4] superior pancreaticoduodenal
 - 4] cystic vein
 - 5] paraumbilical

Portosystemic Anastomoses: (5 locations)

- ↳ Lower 1/3 of esophagus: esophageal branches of left Gastric esophageal veins (drain to Azygos) ↳ esophageal varices ⇒ fatal hematemesis
- ↳ Rectum & anal canal: Superior Rectal vein, middle & inferior rectal veins (drain to internal iliac) ↳ internal Hemorrhoids (PILES)
- ↳ umbilicus: paraumbilical veins, superficial epigastric veins (drain to femoral & external iliac) ↳ Caput Medusae (veins radiating outward around the umbilicus) ↳ like a star & head of medusa
- ↳ Retroperitoneal: colic veins (Rt, middle, Lt), Renal / suprarenal / lumbar ↳ Rarely symptomatic
- ↳ intrahepatic (fetal): left portal vein, IVC connected by ductus venosus

Pelvic colon → the part of large intestine situated in the pelvic cavity [Sigmoid, Rectum, Anal canal]

Sigmoid Colon [intra peritoneal] 10-15 inches (if asked in cm remember that 1 inch = 2.54 cm)
 ↳ has its own mesentery (sigmoid mesocolon) + remarkable appendices epiploicae (the largest)

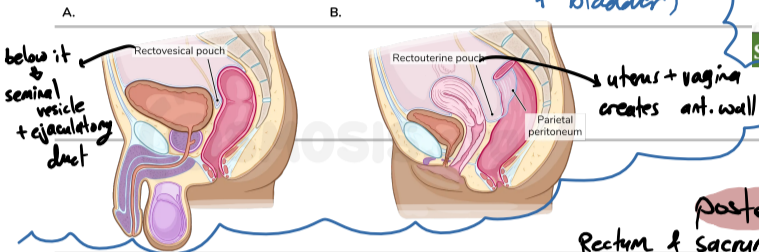
its course → Begins at the pelvic brim (on left side) then traverses to reach the midline in front of the middle part of Sacrum then continues as Rectum [part of it goes out to the Rectum]

Anatomical parts: ① Lateral Limb (contains the left colic. A) ② Medial Limb (contains continuation of inf. mesenteric A which subsequently becomes superior rectal artery) ③ Free margin (contains the whole length (38cm) of sigmoid) ④ Root (Mesenteric attachment)

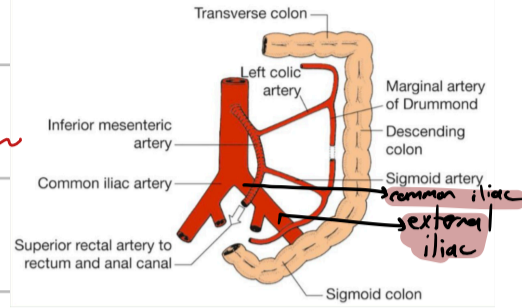
Notes: Pelvic pouches In Both Sexes:-

Females → Recto-uterine pouch (Douglas) contains sigmoid + coils of small intestine

Males → Recto-vesical pouch (between Rectum & bladder)



Regarding the Root:- it begins from the middle part of sacrum then courses toward the left common iliac artery then ends in the adventitia of left external iliac artery

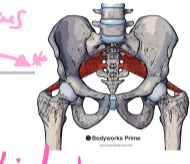


Relations

left: external iliac vessels, left ovary or vas deferens & lateral pelvic wall

Right & superior: coils

inferior: - makes → bladder females → uterus

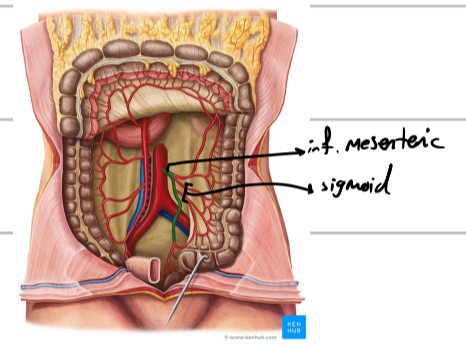


Vascular supply [since it a hindgut organ → inf. mesenteric branches → sigmoid arteries] then inf. mesenteric continues as superior rectal

a rule regarding sup & inf mesenteric veins & arteries: Arteries are MEDIAL to corresponding veins

lymphatic: inf. mesenteric L.N → sup. mesenteric L.N → celiac L.N → cisterna chyli → Thoracic duct

innervation: sym from L1 & L2 → synapse at inf. mes. ganglia → postganglionic travel through inf. mes. plexus [hypogastric plexus] para from S2+S3+S4 via pelvic splanchnic nerves

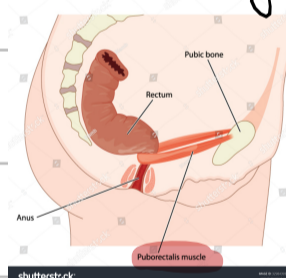
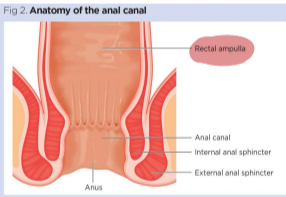


its course → begins in front of the midline of middle part of sacrum and ends 1 inch beyond the coccyx

Rectum → 5 inches

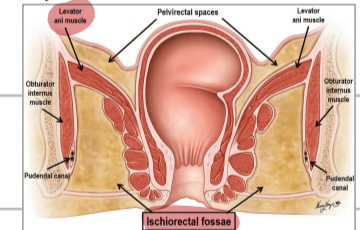
↳ it shares the same blood supply + drainage + lymphatics + innervation as upper 1/2 of anal canal

Ampulla of the Rectum → dilatation of terminal rectal end acts as stool Reservoir



Notes: At the anorectal junction → sling of puborectalis muscle [part of levator ani muscle] it loops around the junction in an U-shape important in defecation & maintaining fecal continence

On lateral sides of Rectum & anal canal → ischio-rectal fossa contains fat → provide a cushion for physical dilatation during defecation
 ↳ highly susceptible of infection → perianal abscesses



curvatures & concavity: - Anteriorly ⇒ concave (semicircle)

these external concavities are created by internal transverse folds
 laterally [Rt ⇒ 1 concavity, Lt ⇒ 2 concavities]

however the lower 1/2 is derived from ectoderm

Rectum + upper 2cm of anal canal ⇒ Simple columnar with Goblet (Derived from endoderm)

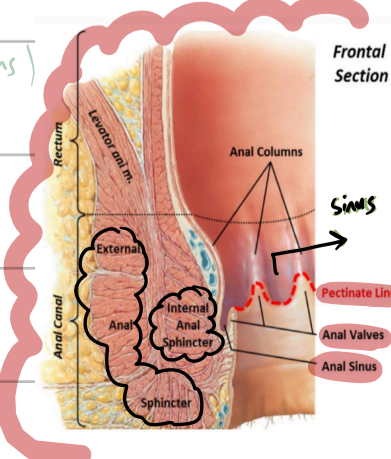
Regarding the mucosal folds [transverse (upper, middle, lower) on the left, on the right anteriorly & from the RE, longitudinal (Rectal columns that continue to the upper 2cm of anal canal and become anal columns)]

Pectinate Line → Border separating upper from lower anal canal

↳ above it simple columnar, below it stratified squamous non-keratinized then the last 1cm becomes Real skin (Keratinized)

As you see in the picture the inferior ends of anal columns are joined together by anal valves
 ↳ above each valve → small pocket (sinus)

The continuous zigzag line formed by the valves is the PECTINATE



Anal sphincters - internal involuntary & continuation of the inner circular layer (Autonomic innervation)

External (More important) Voluntary (skeletal) composed of 3 parts (Deep, superficial, subcutaneous) ^{and supplied by these vessels} Innervated by inferior Rectal nerve (Derived from Somatic Symplex)

NOTE - Per-Rectal Examination (PR) [Inserting a finger in the canal + Rectum] and palpate anteriorly located structures

In males \Rightarrow bladder, seminal vesicle, vas deferens, **Prostate**
 in case of Malignancy \leftarrow normally is soft \downarrow very hard
 in older age >50 , fibrosis might occur

In females \Rightarrow posterior surface of vagina

Rectum is divided into
 upper 1/3 covered ant+on sides with peritoneum
 middle 1/3 covered anteriorly (this is what forms the pelvic pouch)
 lower 1/3 Desoid of peritoneum

Relations of Rectum

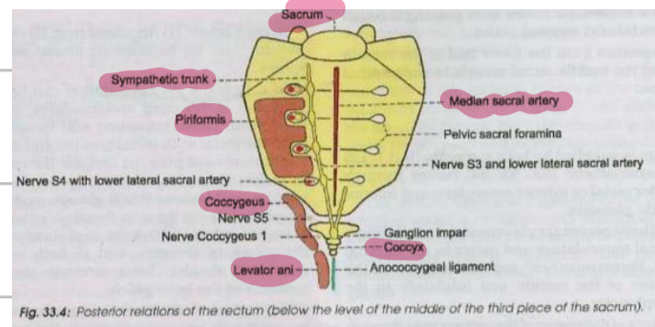
posterior:-

Sacrum & coccyx + piriformis + levator ani + coccygeus muscles
 + sacral plexus + sympathetic chain + lateral sacral arteries
 ?? it should be Median

anterior

Male:-
 upper 2/3 Recto vesical pouch (sigmoid + coils)
 lower 1/3 bladder + seminal + vas. D
 perineal body + membranous + bulb of penis + urethra
 just ant. to anal canal

Female:-
 Douglas pouch
 vagina
 perineal body + urethra + vagina



Blood supply - Rectum + upper anal \rightarrow superior Rectal artery (continuation of inf. mesenteric)
 lower anal \rightarrow middle Rectal (from internal iliac) + inf. rectal (from internal pudendal which itself is from internal iliac)] There is a significant anastomosis

venous drainage - sup. Rectal \rightarrow inf. mesenteric \rightarrow portal circulation
 middle & inf. Rectal
 internal iliac + internal pudendal \rightarrow then to systemic circulation

SO, in the case of portal hypertension, this portosystemic connection will be engorged \Rightarrow hemorrhoids

Types **Hemorrhoids (Piles)**
 internal (painless) \Rightarrow only felt when they reach 4th stage + palpate outside the anus
 external (painful) \leftarrow somatic nerve S4 sense pain, touch, temperature

causes:
 1] congenital weakness in vein's walls
 2] \uparrow pressure on anal canal (coughing + constipation)
 3] \uparrow portal tension
 4] pregnancy & Rectal cancer

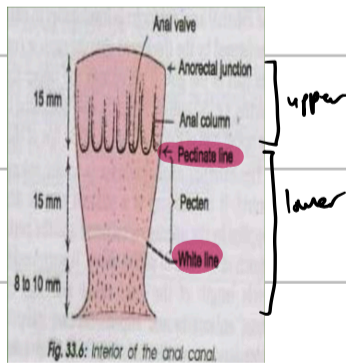
lymphatic drainage - Rectum & upper canal \rightarrow Para-aortic L.N (inf. mesenteric \rightarrow sup. ... \rightarrow celiac)
 lower canal \rightarrow superficial inguinal L.N (femoral triangle)

Nerves - Rectum + upper canal \rightarrow Autonomic [Para S2, S3, S4 pelvic splanchnic Symp L1, L2] ONLY sensitive to stretch
 lower canal \rightarrow [S4] somatic Carries Pain

we already discussed pectinate line \leftarrow **Anal canal** \rightarrow 4cm (3.8cm exact)

the white line separates the lower anal canal into non-keratinized & keratinized ^{true skin appendages}

AT ano-rectal Junction, muscles - Puborectalis
 internal sphincter
 Deep part of external sphincter
 injury in these \Rightarrow cause incontinence



Note:- External anal sphincter:-
 Deep \rightarrow related to ano-rectal junction
 superficial \rightarrow ONLY part that has attachment subcutaneous \rightarrow under the skin directly

Relations:- anteriorly discussed
 post:- tip of coccyx + ano coccygeal ligament (body)
 lateral: sphincter complex

Anal fissure :- hard pieces of stool can collect in the sinuses causing pressure leading to longitudinal ulcer that extends to the lower anal canal (innervated by S4) and causes pain \Rightarrow surgical treatment

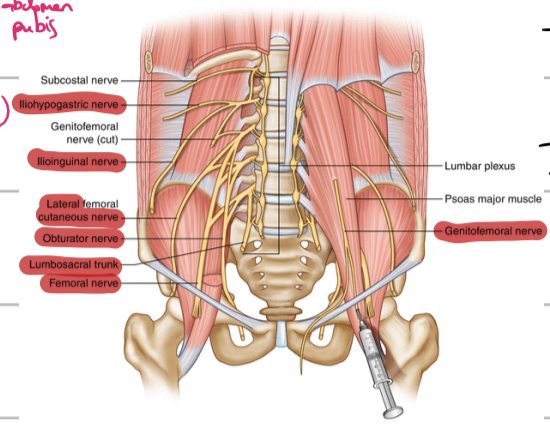
Perianal abscesses: Occurs in ischio-rectal fossa (any abscess mandates drainage) **Highly Recurrent**

ant. rami of L1, L2, L3 upper L4 → **Lumbar & Sacral plexuses** → lower L4, L5, sacral nerves

lumbosacral trunk → lower L4 + L5 that links them together

Lumbar plexus: forms in psoas major, its terminal branches:-

- 1] lateral to psoas
 - iliohypogastric (L1) → skin of lower abdomen above symphysis pubis
 - ilioinguinal (L1) → scrotum
 - lateral cutaneous N of thigh (L2, L3)
 - femoral N (L2, L3, L4) → lower limb post. division



2] Medial to it → obturator (L2, L3, L4) → muscles of medial thigh
lumbosacral trunk

3] through the psoas → Genitofemoral (L1, L2) (Ant to muscle)

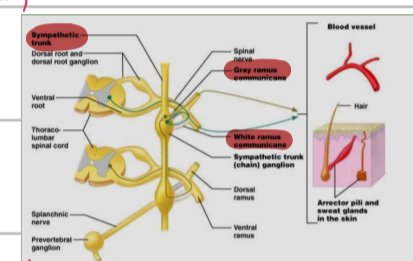
Note: Cremasteric Reflex: Afferent from medial compartment of thigh via femoral branch to L1 + L2
Efferent: through genital branch causing contraction of the muscle.

ANS: Sympathetic chain (from atlas to coccyx) Contains 25 ganglia

- cervical (3: sup. middle, inf.)
- Thoracic (10-12)
- Abdominal/lumbar (4-5)
- Pelvic/Sacral (4-5)
- coccygeal (1)

We know that sympathetic fibres origin (Thoracolumbar) → 14 nuclei (12 Thoracic + 2 lumbar)

White Vs Gray Rami → 31 pairs = # of spinal nerves
carry postganglionic fibers to (B.V./Glands/arrector pili muscle)
14 pairs carry presynaptic fibers away from spinal cord, their fate: synapse at the same level, go up or down & synapse, bypass (splanchnic nerves)



Pathway of Preganglionic Fibers
The sequence is:
1. Cell body in lateral horn
2. Axon exits via ventral root
3. Joins the spinal nerve
4. Enters the sympathetic chain through the white ramus communicans

In Abdomen → Preganglionic nerves bypass the chain & synapse in pre-vertebral ganglia (pre-aortic)
celiac plexus (foregut)
Sup. mesenteric plexus (midgut)
inf. mesenteric plexus (hindgut)
each plexus of these is mixed (sym + parasymp)

Splanchnic Nerves ORIGINS:

- 1] Greater splanchnic N (T5 - T9) → pierces the 16th & 18th crura of diaphragm to celiac ganglia
- 2] Lesser splanchnic N (T9 + T10) → sup. mes. ganglia
- 3] Lowest splanchnic N (last thoracic ganglia) → with renal plexus to suprarenal gland
- 4] lumbar splanchnic Nerves (L1 + L2) → inf. mes. ganglia

