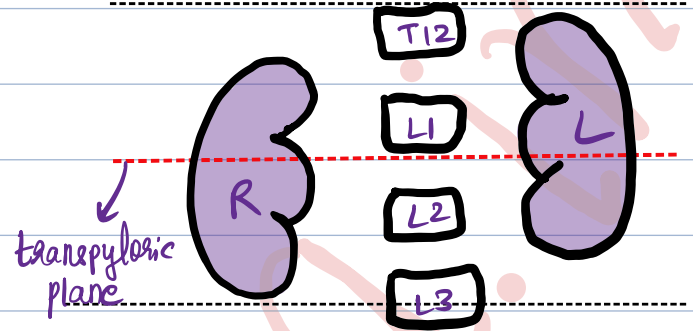


Kidneys: bean-shaped, reddish brown

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Location: → on PAW

- one on each side of vertebral column
- retroperitoneal
- level of T12 - L3
- right kidney is slightly lower than left one due to presence of liver on right side
- Left kidney is nearer to median plane
- long axes are slightly oblique - upper ends of both kidneys are nearer to each other than lower poles.
- transpyloric plane passes through upper part of hilum of right kidney & lower part of hilum of left kidney



Length ⇒ 11 cm

Width ⇒ 6 cm

Thickness ⇒ 3 cm (AP)

Weight ⇒ 150g ♂ ; 135g ♀

- External Features:
- 2 poles (upper & lower)
 - 2 borders (medial, lateral)
 - 2 surfaces (anterior, posterior)
 - 1 hilum

Upper Pole: thick & round

↳ related to suprarenal gland

Lower pole: thin & pointed

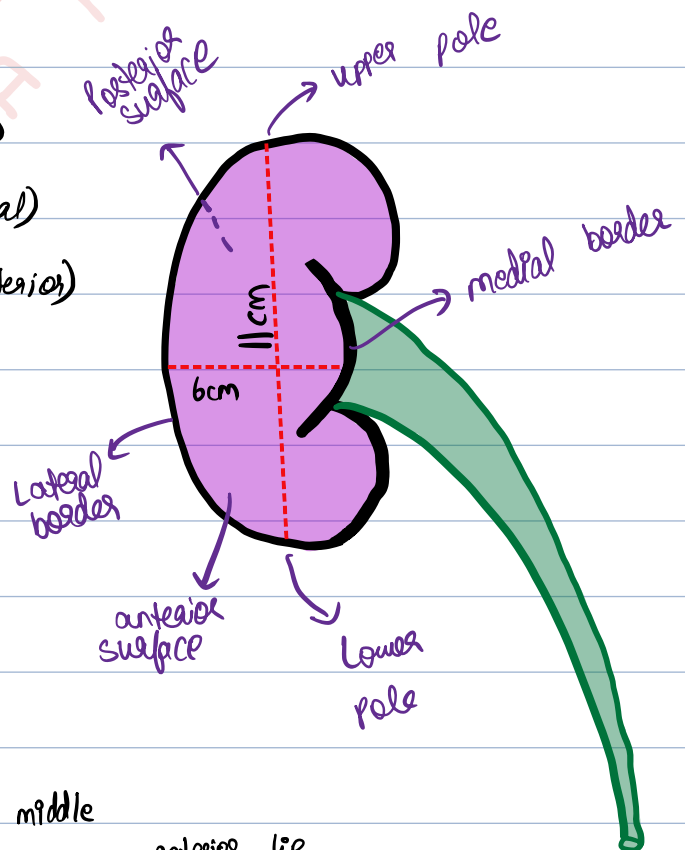
Anterior surface: convex; faces anterolaterally

Posterior surface: flat; faces posteromedially

Medial border: convex near both poles & concave in middle

↳ presents a vertical fissure in middle part ⇒ hilum

Lateral borders: convex



Hilum: it transmits from forward to backward:

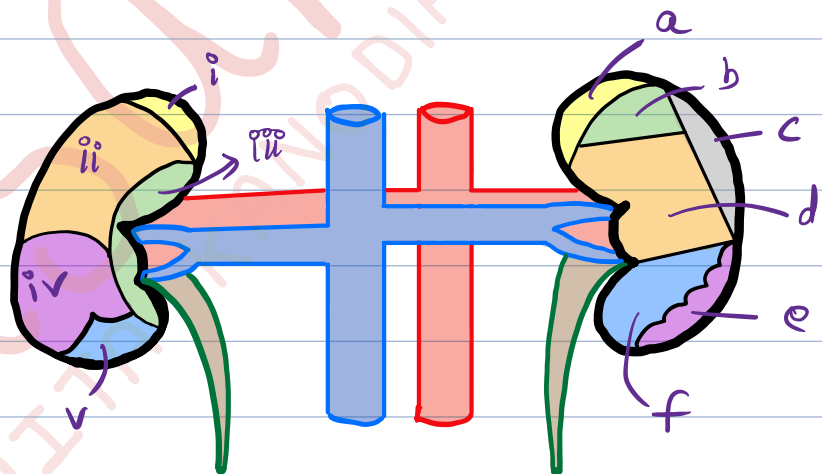
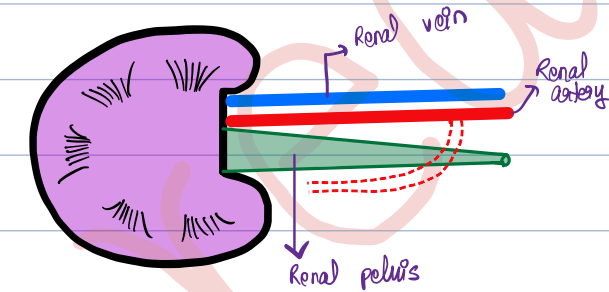
- (i) Renal vein
- (ii) Renal artery
- (iii) Renal pelvis
- (iv) Subsidiary branch of renal artery

→ Hilum also transmits lymphatics, nerves

Relations:

- Anterior: Right
- Right suprarenal gland (i)
 - Right lobe of liver (ii)
 - 2nd part of duodenum (iii)
 - Hepatic flexure (iv)
 - Jejunum (v)

- Left
- Left suprarenal gland (a)
 - spleen (c)
 - stomach (b)
 - pancreas & splenic vessels (d)
 - Splenic flexure (e)
 - Jejunum (f)



Posterior:

4 muscles: Diaphragm, quadratus lumborum, psoas major, transversus abdominis

3 nerves: Subcostal N. (T12), iliohypogastric (L1), ilioinguinal (L1)

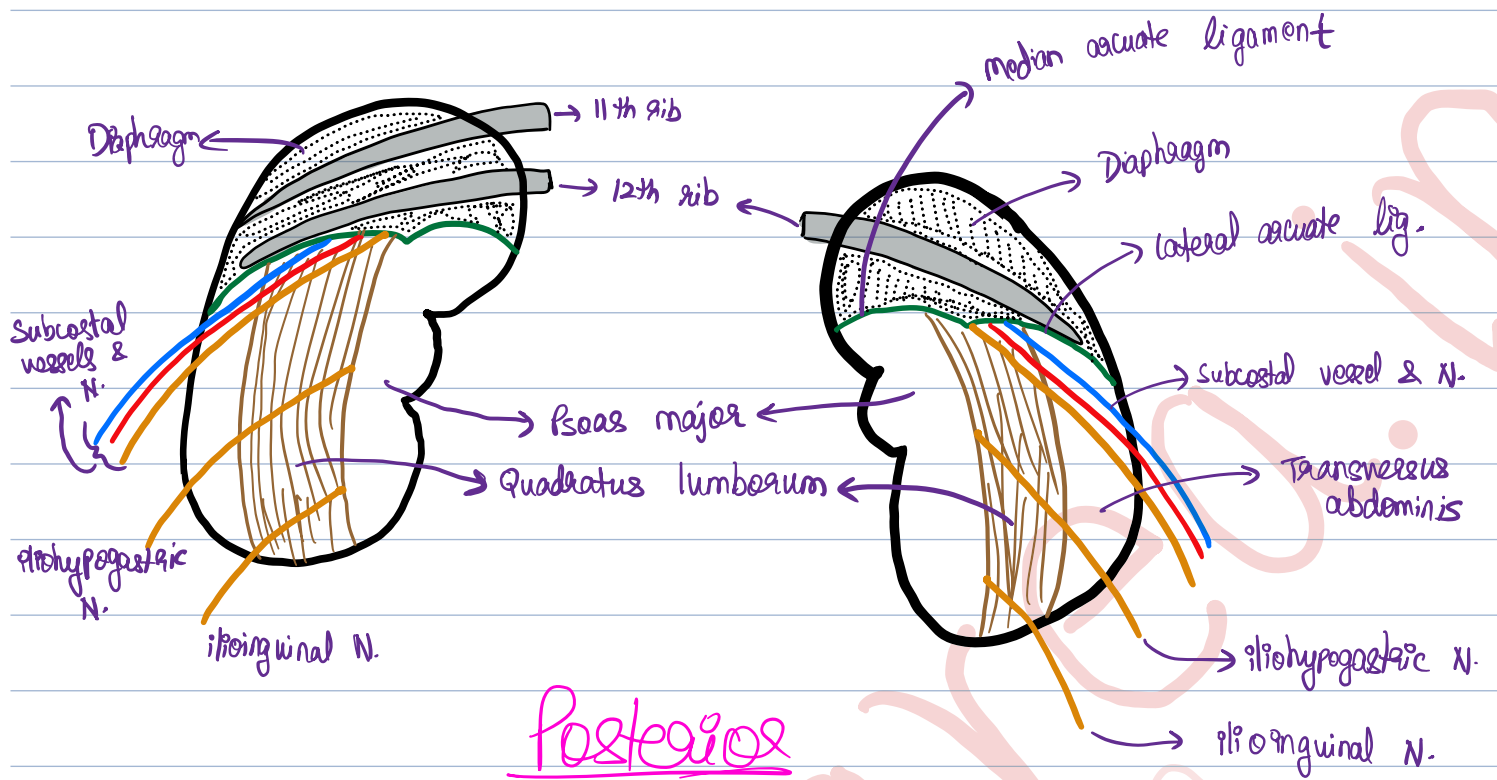
1 or 2 ribs: Right ⇒ 12th rib

Left ⇒ 11th & 12th ribs

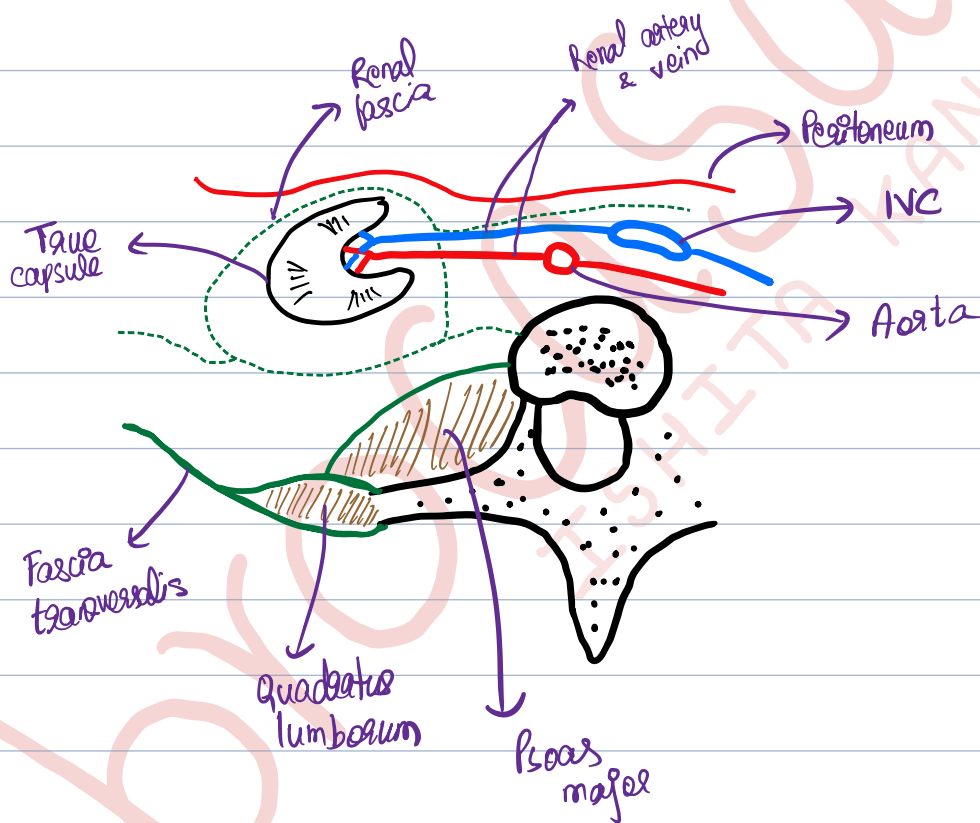
(∴ costodiaphragmatic recesses extend posterior to kidney)

Capsules: 4 capsules from within outward - fibrous/true capsule

- perineal/perinephric fat
- renal fascia/false capsule
- paranephric fat



Posterior



Fibrous/Tare Capsule: formed by condensation of fibrous tissue of peripheral part of organ

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↳ readily stripped off from surface of normal kidney

→ If kidney is inflamed, this capsule $\Rightarrow$ firmly adherent to kidney

$\therefore$ cannot be stripped off

Perinephric/Perirenal Fat: adipose tissue which fills space between

loosely fitting renal fascia around kidney & suprarenal gland

→ in chronic debilitating diseases, depletion of perinephric fat

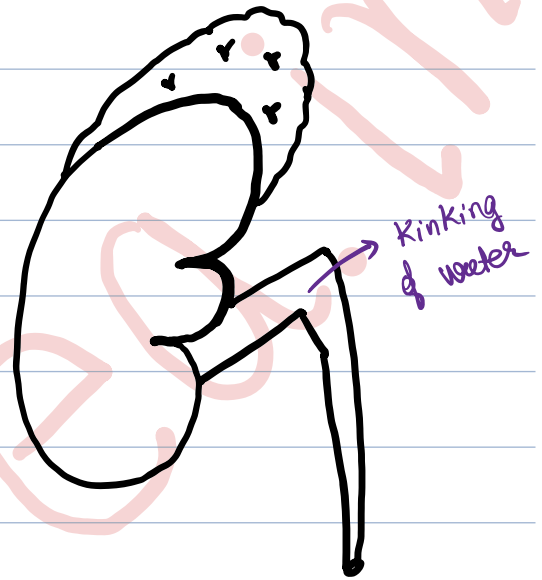
can cause downward displacement of kidney $\Rightarrow$ kinking of ureter

(Fascia of Gerota)

Renal Fascia (True Capsule): fibroareolar sheath

↳ 2 layers - ill defined anterior layer (fascia of Todd)

- well defined posterior layer (fascia of Zuckerkandl)



Extensions -

two layers fuse &

Superiorly $\Rightarrow$ become continuous with diaphragmatic fascia

Inferiorly $\Rightarrow$ anterior layer is lost in extraperitoneal tissue of iliac fossa

$\Rightarrow$ posterior layer blends with fascia iliaca

Laterally $\Rightarrow$ 2 layers fuse & become continuous with fascia transversalis

Medially $\Rightarrow$ anterior layer emerges with connective tissue surrounding IVC & Aorta

$\Rightarrow$ posterior layer is attached to fascia of psoas major & quadratus lumborum

Pararenal/Paranephric Fat: layer of fat outside renal fascia

↳ fills paravertebral gutter & forms cushion for kidney

Macroscopic Structure:
↳ kidney proper
↳ renal sinus

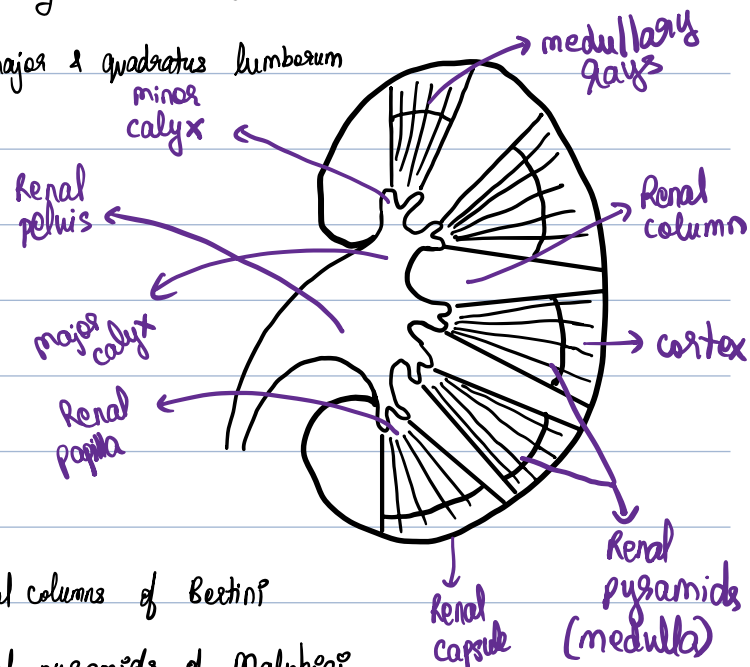
Kidney Proper:
↳ outer cortex
↳ inner medulla

→ cortex $\Rightarrow$ below renal capsule

$\Rightarrow$ extends between renal pyramids as renal columns of Bertin

→ medulla $\Rightarrow$ 5-11 dark conical masses called renal pyramids of Malpighi

$\Rightarrow$ apices of renal pyramids forms renal papillae which invaginate minor calyces



→ pelvis of ureter is continuous with the minor calyces via major calyces

Microscopic Structure:

→ each kidney $\Rightarrow$ 1-3 million uriniferous tubules $\begin{cases} \text{nephron} \\ \text{collecting duct} \end{cases}$

Nephron: structural & functional unit of kidney

- ↳ - glomerulus
- PCT
- loop of Henle
- DCT

Collecting tubule: begins from DCT

↳ many collecting tubules unite $\Rightarrow$ collecting duct of Bellini $\Rightarrow$ open in renal papilla

Arterial Supply: renal arteries (branch of aorta at level of intervertebral disc b/w L1 & L2)



RRA is slightly longer than LRA



both RRA & LRA divide into AD & PD near the hilum



AD $\Rightarrow$ apical, upper, middle, lower segments

PD $\Rightarrow$ posterior segment

These branches are called segmental arteries



after supplying renal sinus, segmental arteries divide into



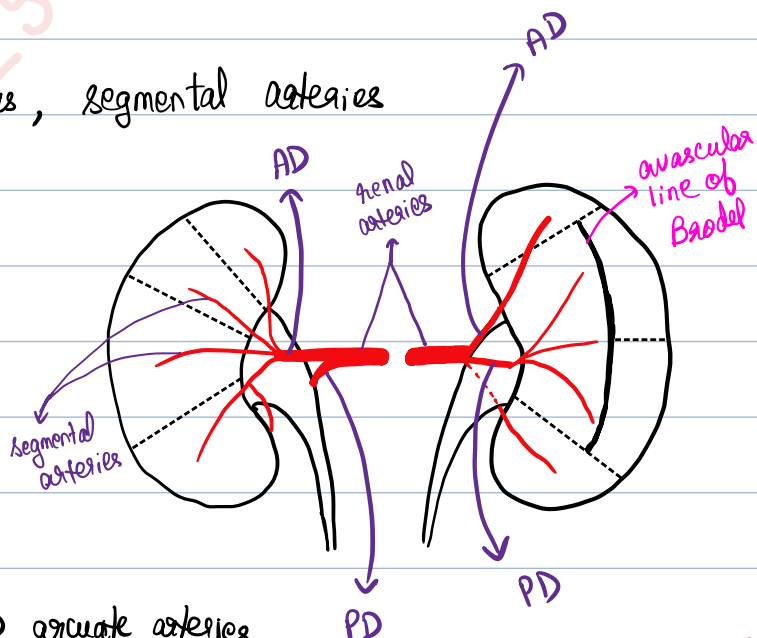
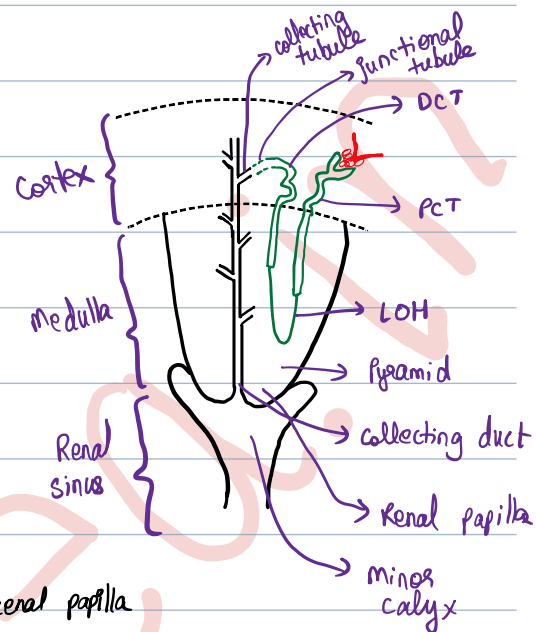
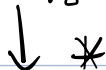
lobar arteries

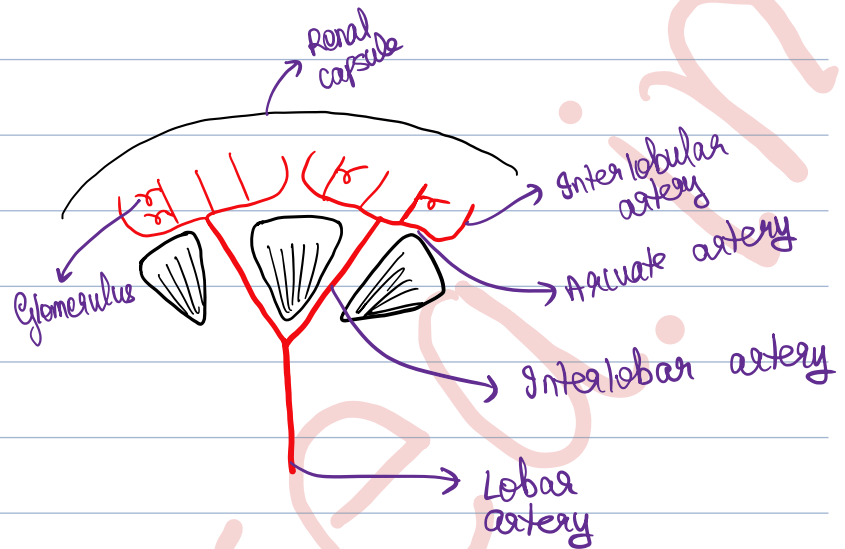
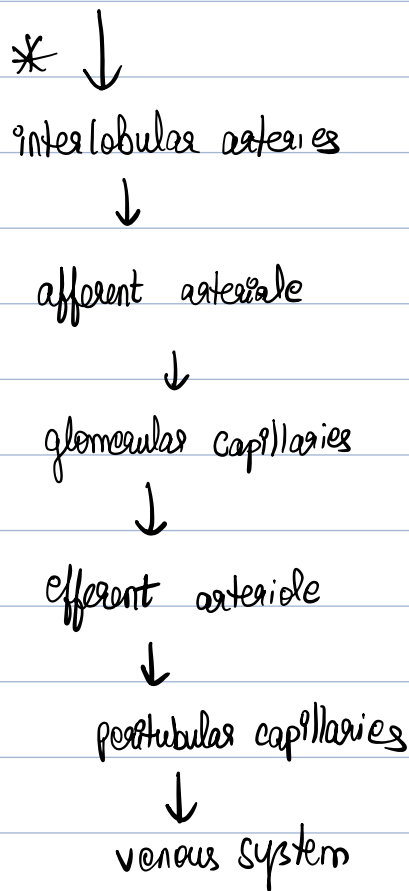


interlobar arteries



at base of renal pyramid $\Rightarrow$ arcuate arteries



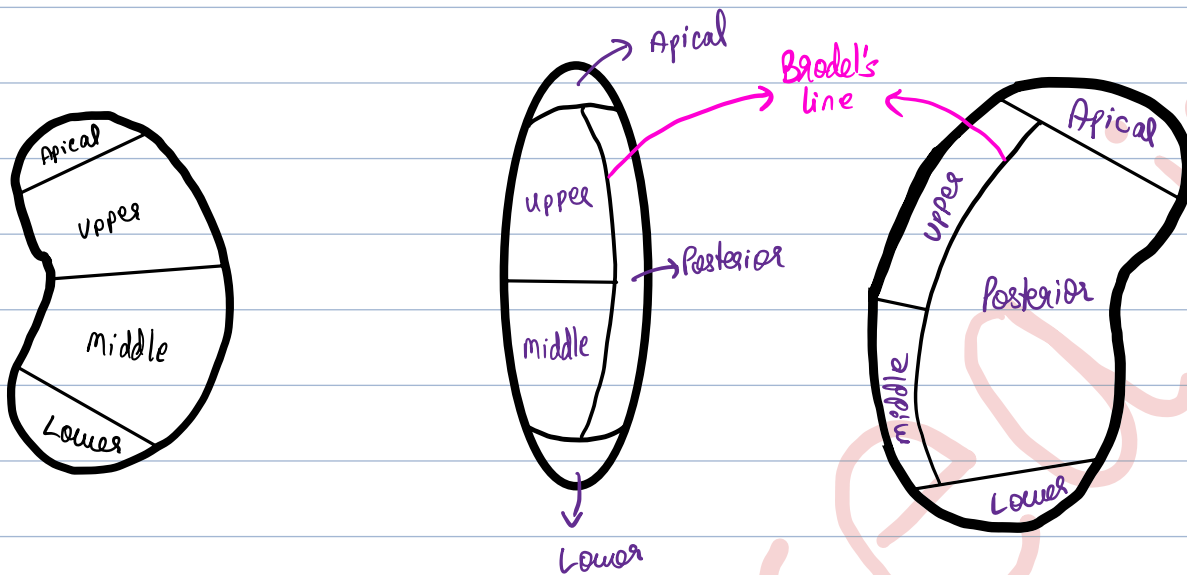


Vascular Segments (Acc. to Graves)

- each kidney has 5 anatomical segments based on distribution of branches of renal artery
- each segment has its own artery & in between segments, there is no anastomosis
- junction between areas supplied by AD & PD ⇒ Baodel's line (functional avascular plane)

⇓
on posterior aspect of kidney at junction of lateral $\frac{1}{3}$ & medial $\frac{2}{3}$.

∴ Baodel's line is a suitable site for surgical incision to remove renal stones (nephrolithotomy)



Venous Drainage: by renal veins which follow the artery

Lymphatic Drainage: para-aortic (lumbar) lymph nodes at level of L2

Nerve Supply: renal plexus of nerves which reach kidney along with renal artery
 ↳ renal plexus = sympathetic & parasympathetic

Sympathetic: T10 - L1

Parasympathetic: both vagus nerves

Development: Kidney has two components — excretory & collecting

→ excretory component (Nephron) ⇒ from metanephros (metanephric cap)

→ Collecting system (collecting tubules & ducts, calyces, renal pelvis, ureter)

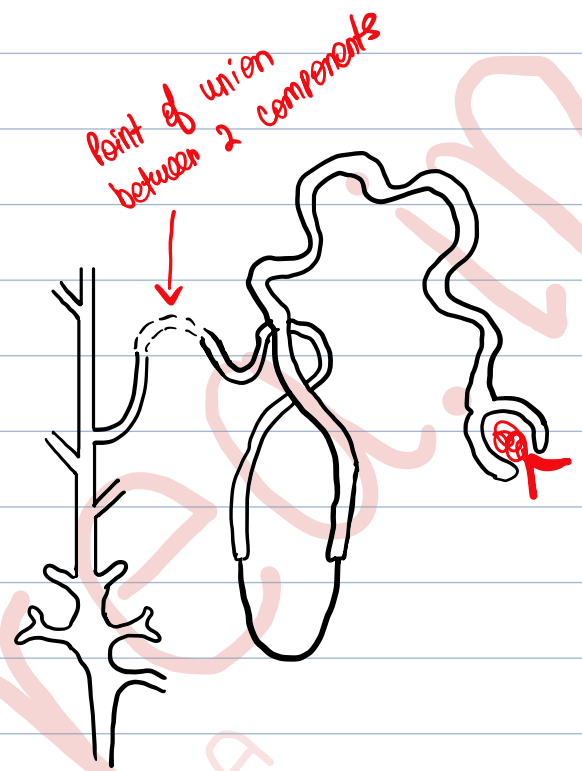
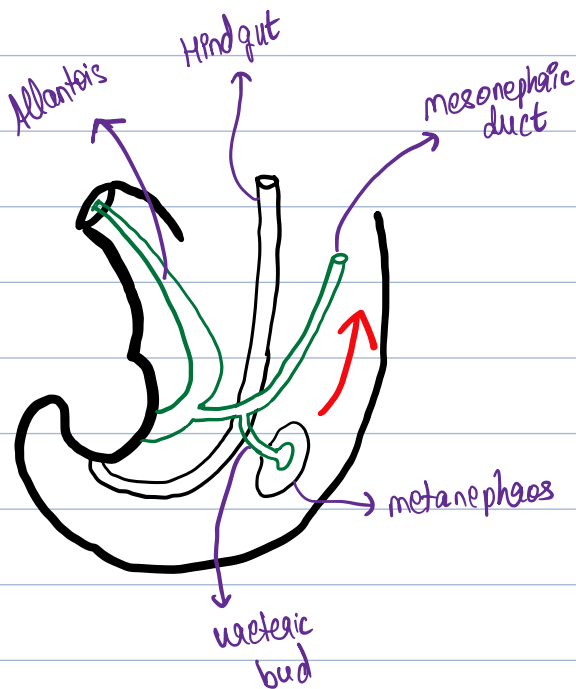
↓

from urogenital bud

→ initially kidney develops in pelvis & is supplied by internal iliac artery

→ it ascends up to adult position gaining new arterial supply

→ older arteries degenerate



Applied Aspect:

Congenital anomalies:

Lobulated kidney: persistence of foetal lobulation in adult kidney

Absent artery: persistence of one of the foetal arteries

Congenital polycystic kidney: formed if luminal continuity between nephrons & collecting duct fails to establish

→ glomeruli continue to excrete urine which accumulates in tubules due to lack of outlet

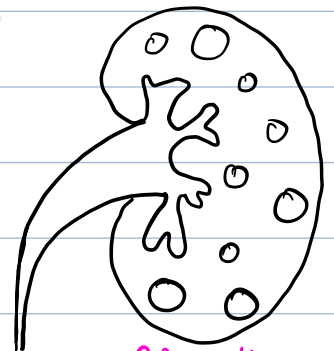
→ ∴ tubules undergo cystic enlargements

Horseshoe kidney: occurs due to fusion of lower poles of kidneys.

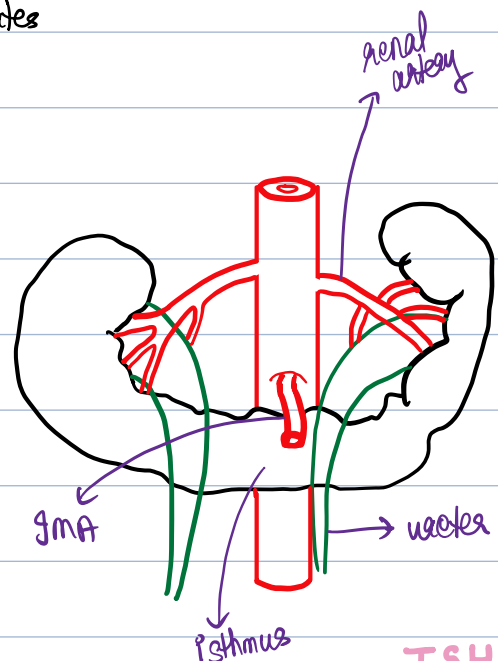
→ ureters pass anteriorly to isthmus

→ SMA passes anterior to isthmus which limits ascent of kidneys.

→ occurrence: 1 in 800



Poly cystic



Renal Agenesis: ureteric buds fail to develop

- unilateral renal agenesis is common
- physician must never assume that a patient has 2 kidneys
- occurrence: 1 in 500

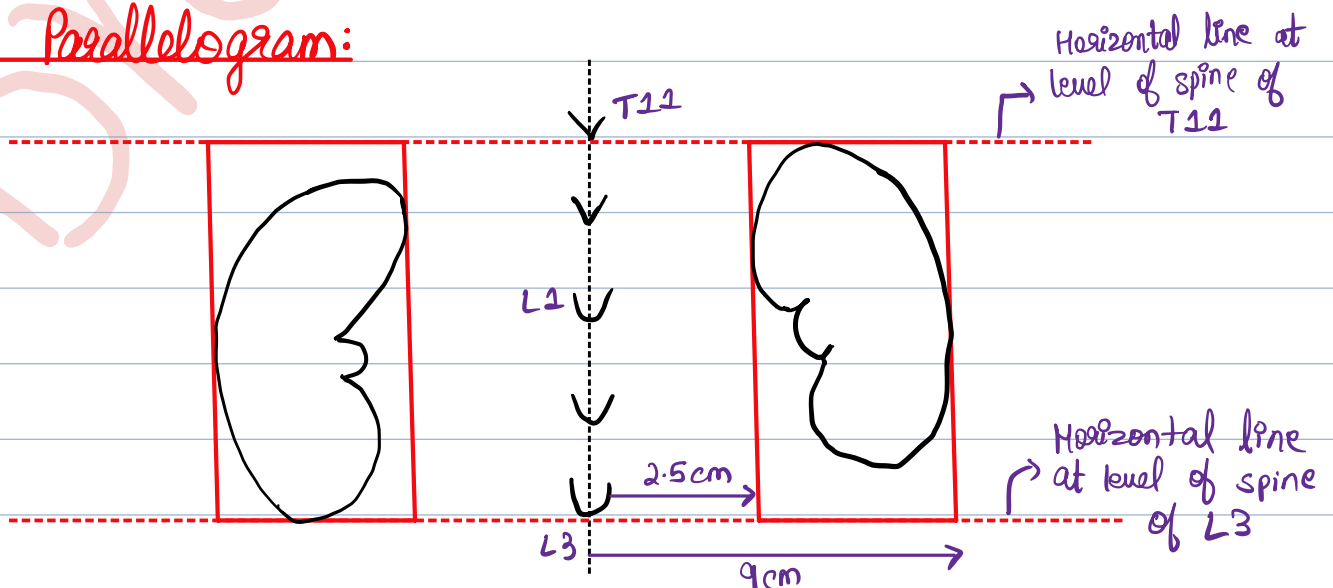
Renal/Ureteric Colic: due to stone in kidney/ureter

- sudden onset & felt in loin & radiates downward & forward to groin
- renal pain occurs due to stretching of renal capsule or due to spasm of smooth muscles in renal pelvis
- afferent fibres pass through renal plexus & enter T12 segment $\therefore$ pain is often referred along subcostal nerve to flank & AAW & along ilioinguinal N. (L1) into groin.

Murphy's punch sign: medical test in which tenderness is elicited by tapping in renal angle during inspiration

- test positive $\Rightarrow$ perinephric abscess / renal stone, etc.
- renal angle $\Rightarrow$ between lower border of 12th rib & outer border of erector spinae.

Morris's Parallelogram:



Thoracolumbar Fascia (TLF):

↳ deep fascia on back of trunk

→ binds the long extensor muscle of vertebral column to posterolateral surface of vertebral bodies

Lumbar part of TLF: in lumbar region

↳ 3 strong layers ⇒ anterior, middle, posterior

→ 3 layers fuse to form dense aponeurotic sheath which gives origin to IO & TA muscles

Attachment of anterior layer:

Medially: transverse process of L1

Laterally: to 12th rib, in front of quadratus lumborum

Below: iliac crest

→ kidney lies in front of TLF which blends with renal fascia

Attachments of middle layer:

Above: - 12th rib

- transverse process of L1

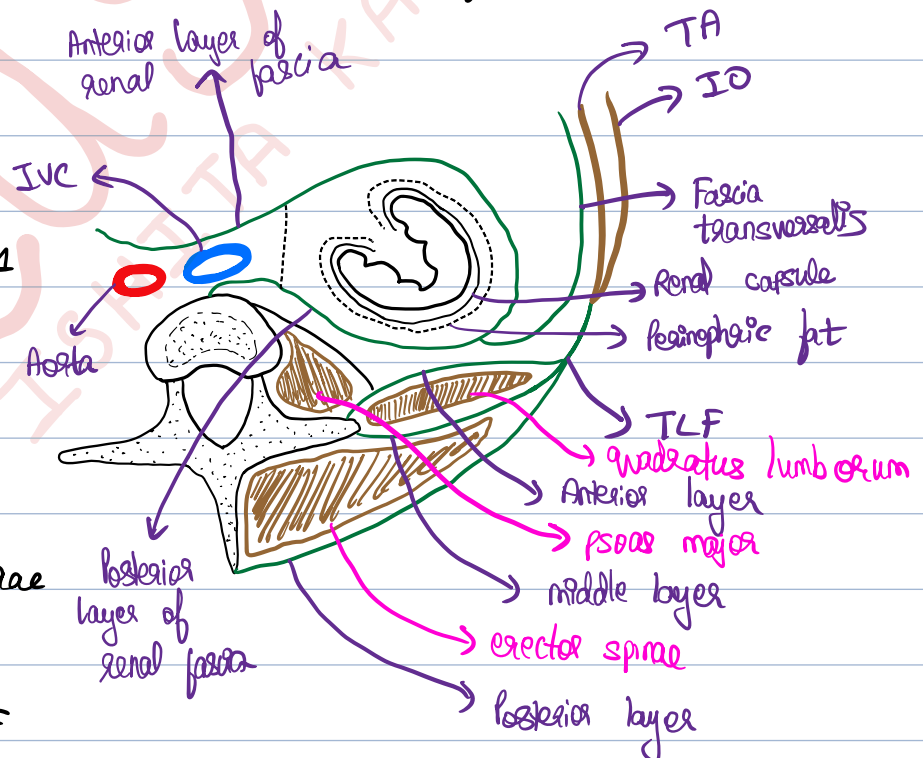
Below: iliac crest

Attachments of Posterior Layer:

Medially: spines of lumbar vertebrae

Below: iliac crest

Above: thoracic part of TLF



Thoracic Part of TLF:

Medially: spines of thoracic vertebrae

Laterally: angles of ribs

Above: extends into cervical region