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GROSS ANATOMY OF THE KIDNEY

Batch- 28 (2019)

Additional readings

- <https://www.earthslab.com/anatomy/kidneys/>



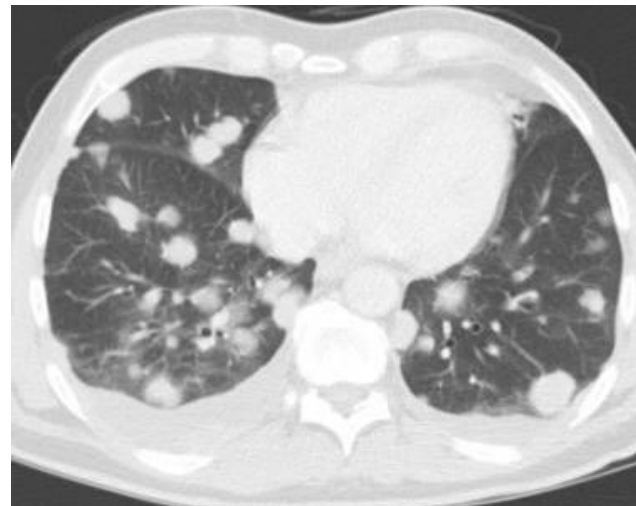
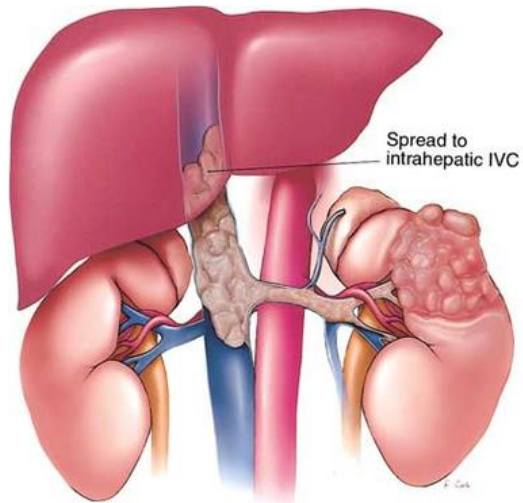
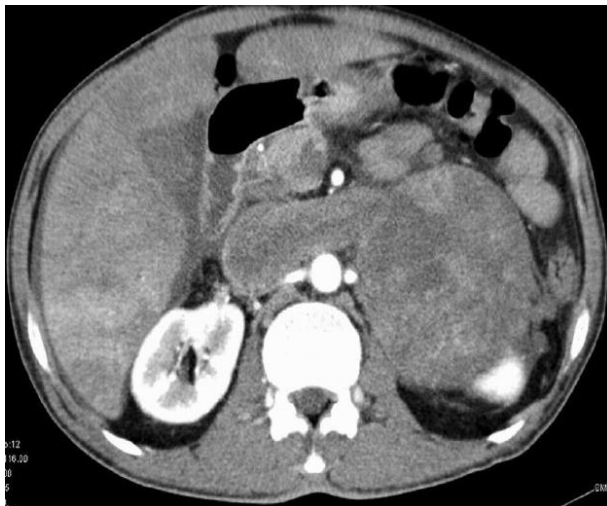
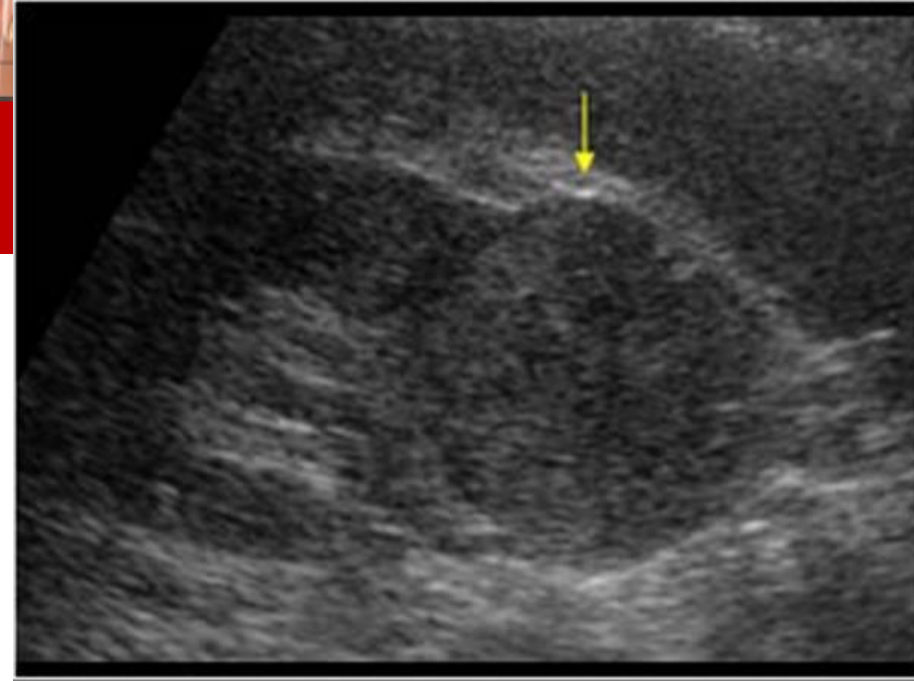
Clinical Case

- 23 Year old gentleman presented to a general practitioner with a history of gross red colour urine for 3 days.
- He did not complain any abdominal pain (**Painless haematuria**)
- Urine full report was performed (UFR)
 - UFR- Field full red blood cells (RBC)
- He was referred for a ultrasound scan.



Clinical Case

- USS abdomen –
 - Low echogenic mass in lower pole of the L/kidney
 - No renal ,ureteric or bladder calculi
 - No hydronephrosis or hydroureter
 - No bladder masses
- Then he was referred to a contrast enhanced CT (CECT) abdomen to further evaluate the renal mass





Amazing facts about kidneys

- The blood flow in kidneys is higher than the blood flow in heart, liver and brain
- Exactly half of one single kidney is capable of doing the job that is performed by two kidneys together
- Each individual kidney consists of at least 1 million and up to 2 million nephrons
- In a single hour, kidneys receive around 56 L of blood





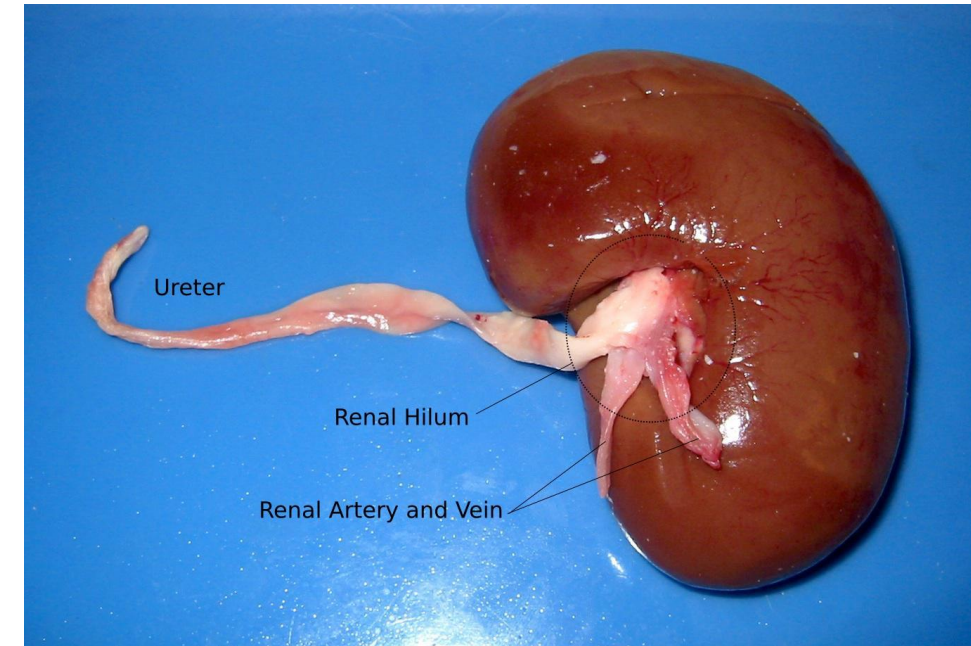
Amazing facts about kidneys

- If the nephrons in both kidneys are taken out and placed end to end horizontally, they will cover a distance of 16 kilometers
- The entire blood in the body gets filtered around 400 times in a day through the kidneys
- The first ever kidney transplant was conducted by Yuri Voronoy, a Russian surgeon in year 1933. The transplant failed.
- The first ever successful kidney transplant was conducted by Dr. Joseph E. Murray in December 1954



Introduction

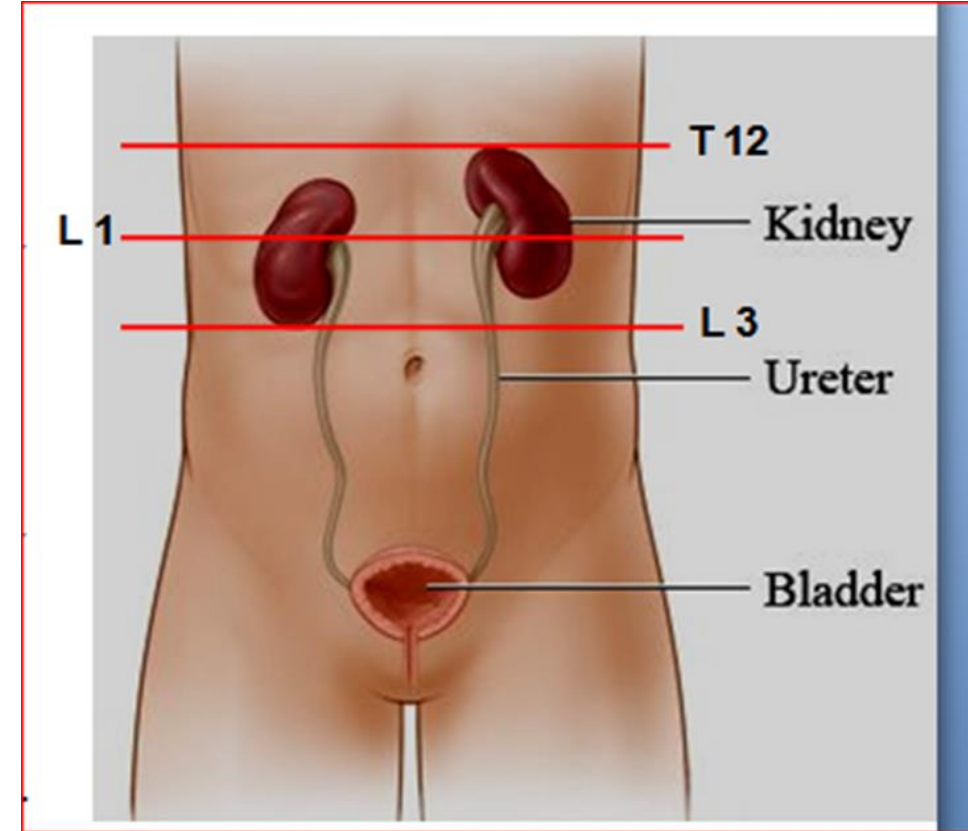
- Pair of excretory organ
- Wt. App – 150 g
- Bean shape
- Brown in colour
- Lies in retroperitoneum in paravertebral gutter.
- In the region of posterior abdomen.
- Lies between **T-12** and **L3** vertebral bodies.





Introduction

- Length 10-11 cm
- Left kidney may be 1.5 cm longer than right
- Rarely right kidney is >1 cm longer than left.
- Upper poles are more medially located
- Lower poles are more laterally located.
- Right kidney lies lower position than left due to Liver



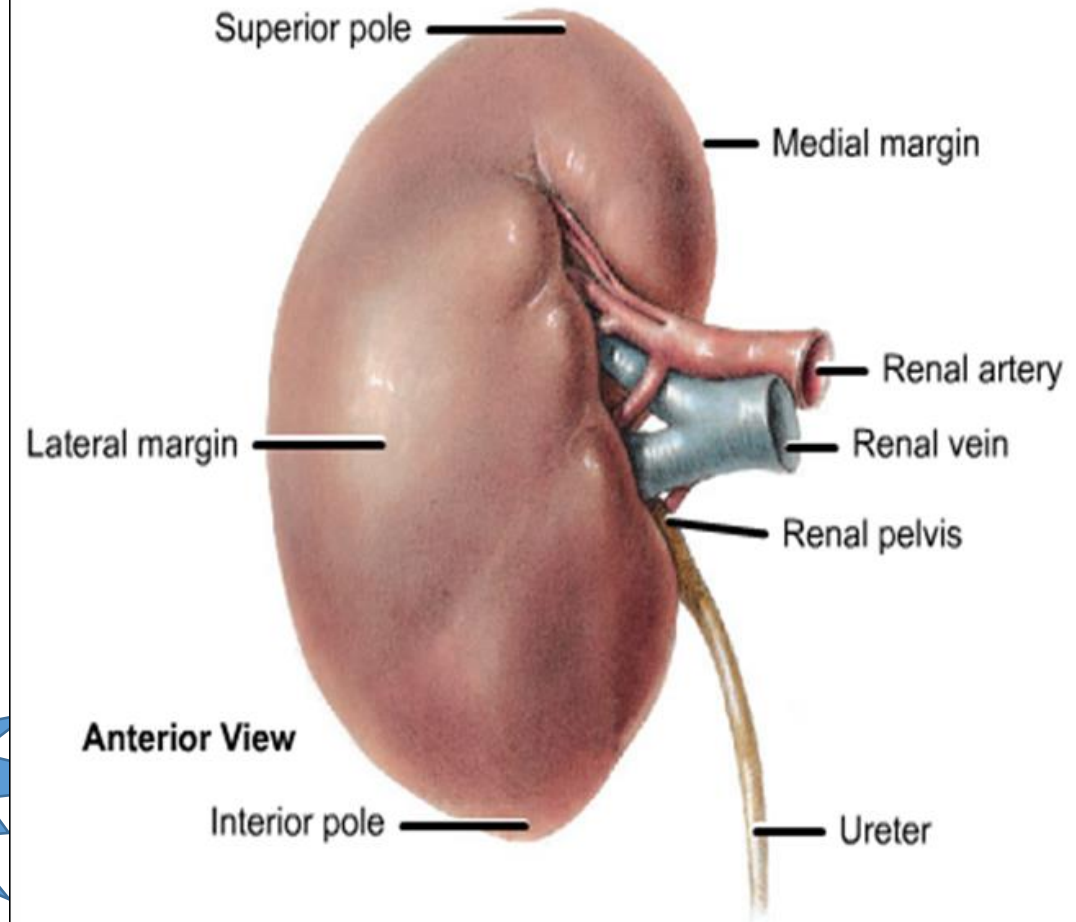


Renal hilum

- Medially located; Middle 1/3 of the kidney.
- Narrow slit,
- Renal hilum contains,
 - Renal vein
 - Renal artery
 - Renal pelvis/ureter
 - Renal nerves and lymphatics
- Renal pelvis continuous as the ureter

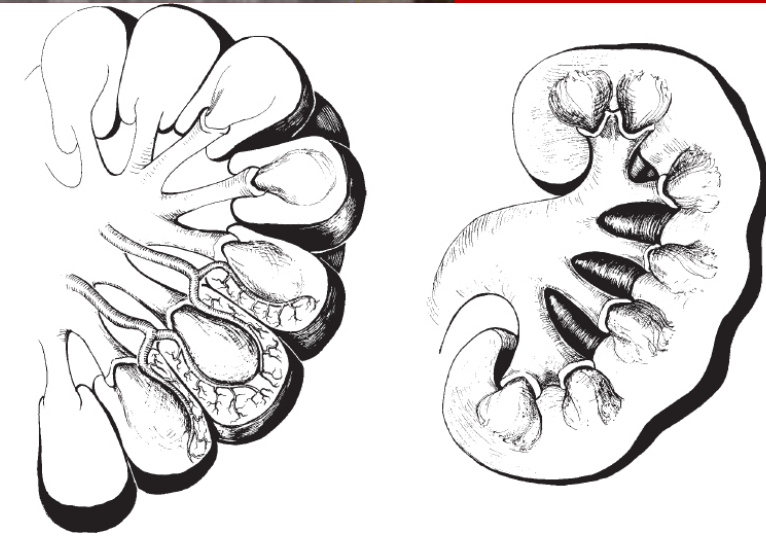
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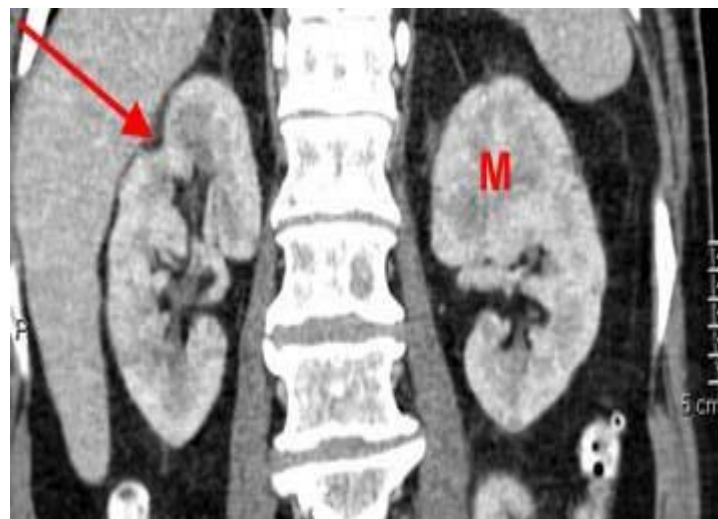
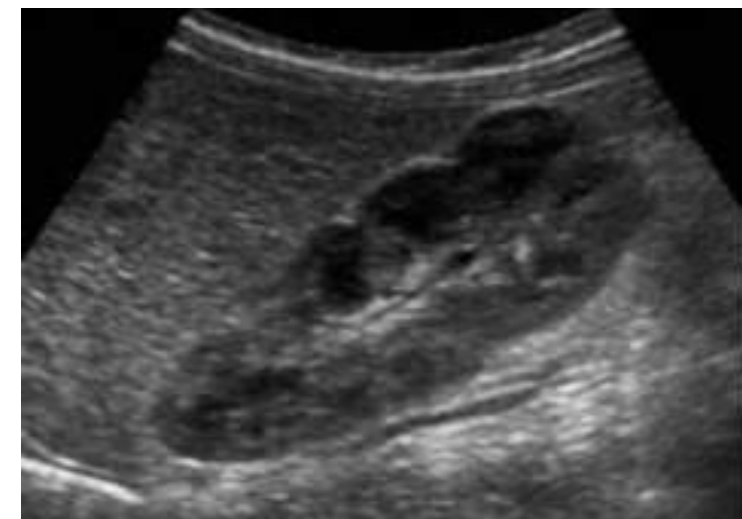
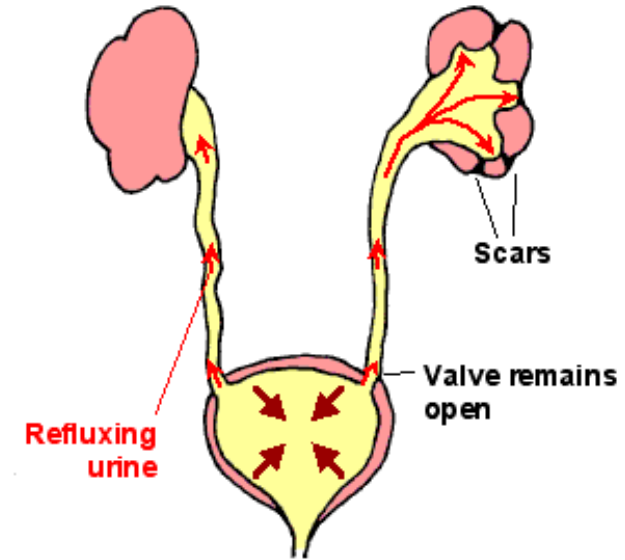
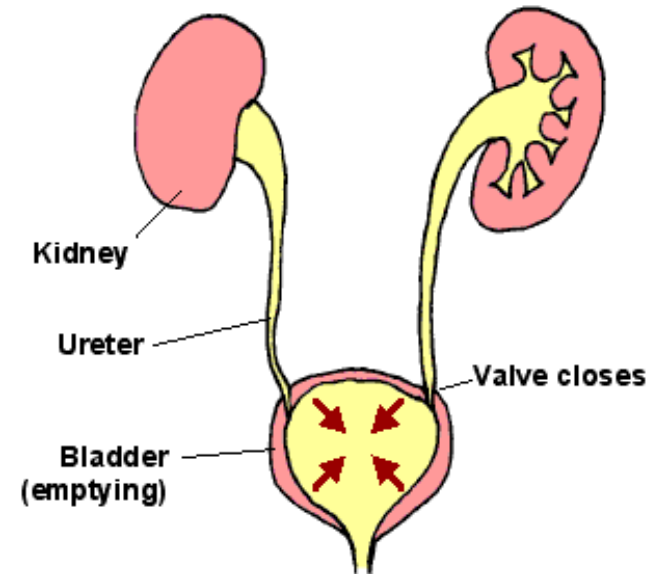
Fetal lobulations

- In fetus, kidneys are made up of about 12 lobes.
- After birth, lobes are fused.- **MCQ**
- In adults, smooth outer surface.
- In adults fetal lobulations still may persist – normal variant - **MCQ**
- Not to be confused with renal scarring
- **Renal scarring** -After healing a renal infection (ex:-pyelonephritis) - irregular outer appearance





Fetal lobulations vs scarring



Normal

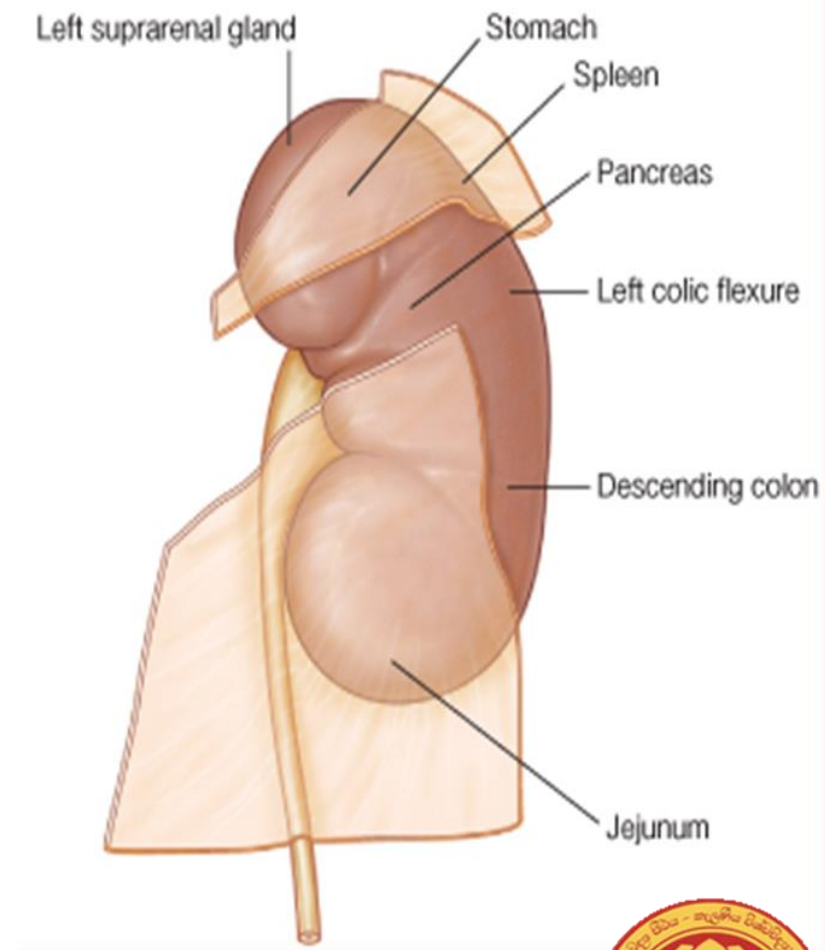
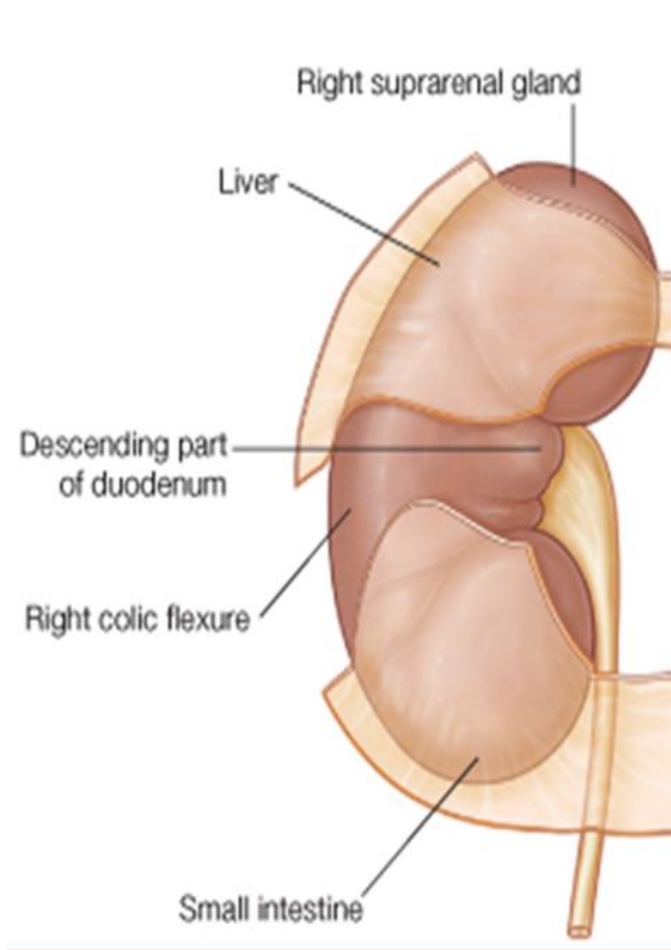
Reflux





Relations

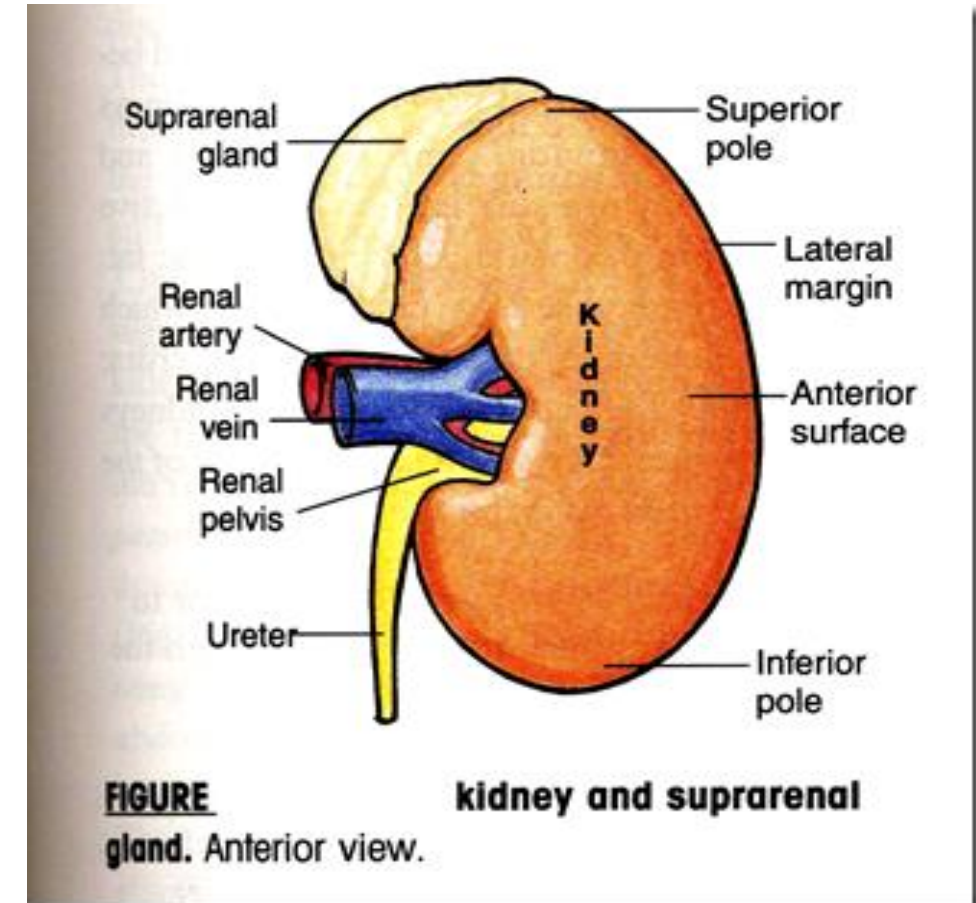
- Anterior surface has numerous relations
- Some structures are directly contact with kidneys
- Some structures are separated by the peritoneum





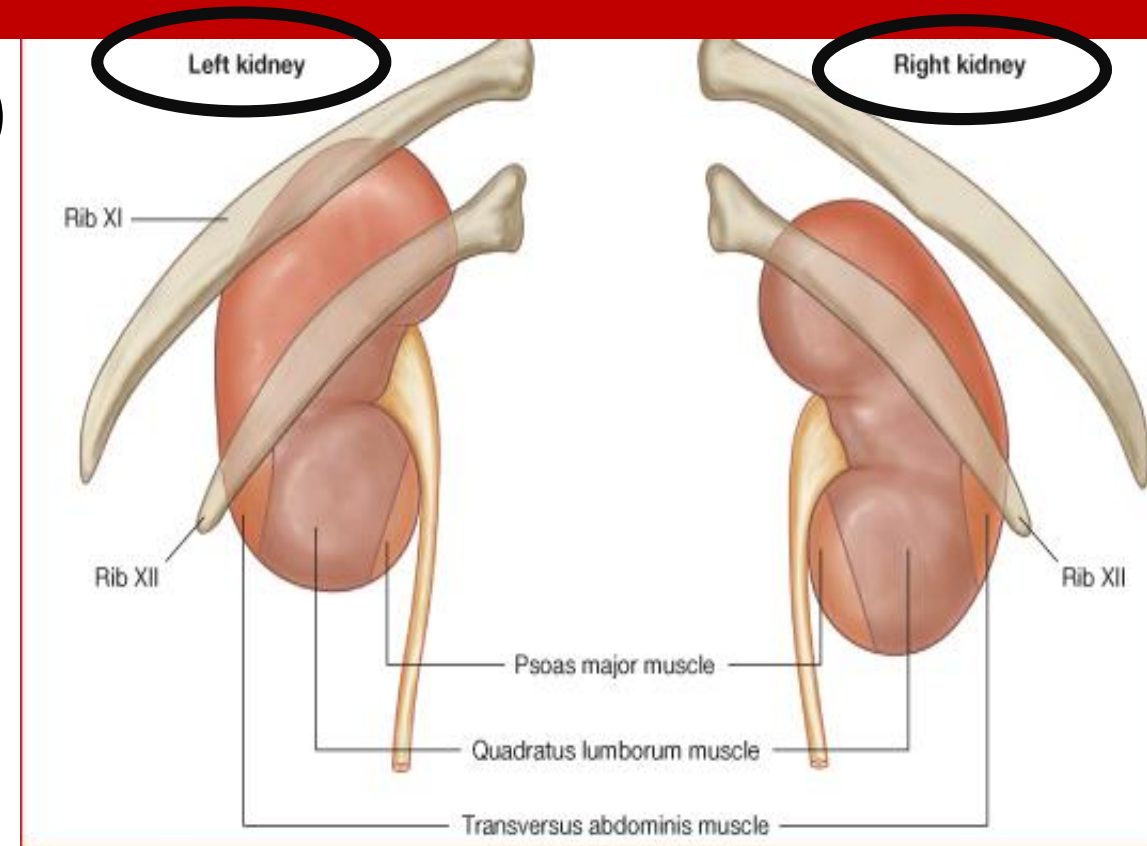
Relations common to both kidneys

- Upper pole contains suprarenal glands (adrenal glands)
- Lower pole 2.5 cm above the iliac crest
- medial border
 - suprarenal glands
 - ureter below the hilum

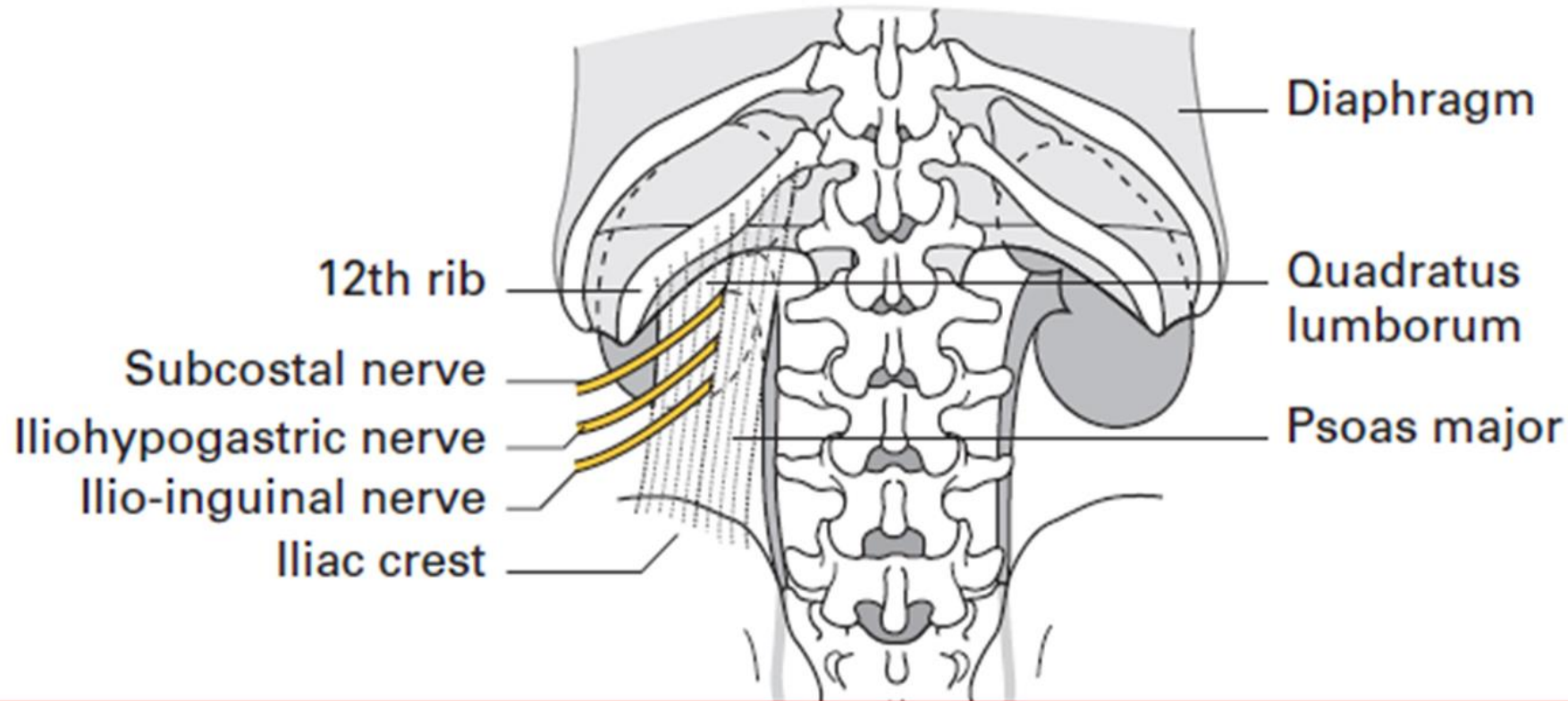


Posterior relations

- Superiorly diaphragm (separates the pleura)
- Muscles medial to lateral
 - Psoas major
 - Quadratus lumborum
 - Transversus abdominis
- Ribs
 - posterior to right kidney – 12th rib
 - Posterior to left kidney - 11th and 12th ribs- MCQ
- Nerves: subcostal, iliohypogastric, ilioinguinal



Posterior relations



Ribs-11 and 12 for left and 12th for right

Muscles- 3 muscle

Nerves- 3 nerves

Diaphragm

Remember





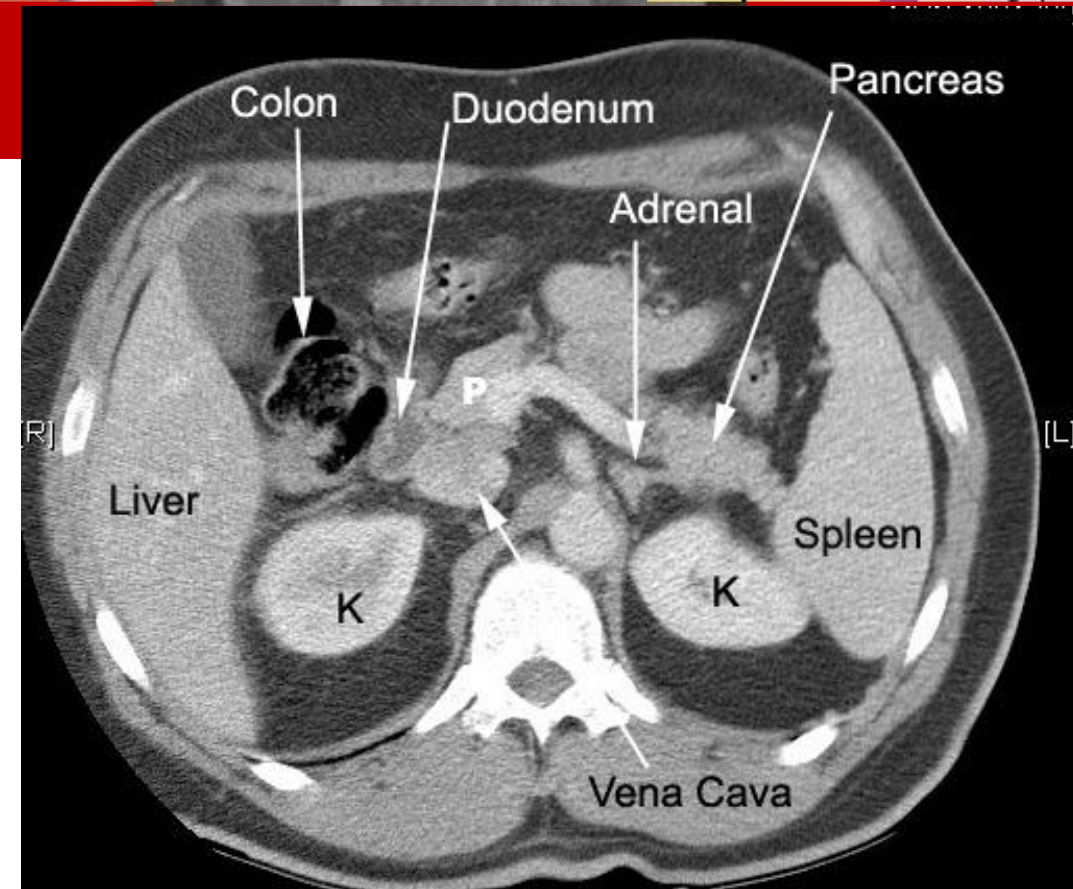
Anterior relations right kidney

- Right suprarenal glands (small portion)
- Liver
- 2nd part of duodenum

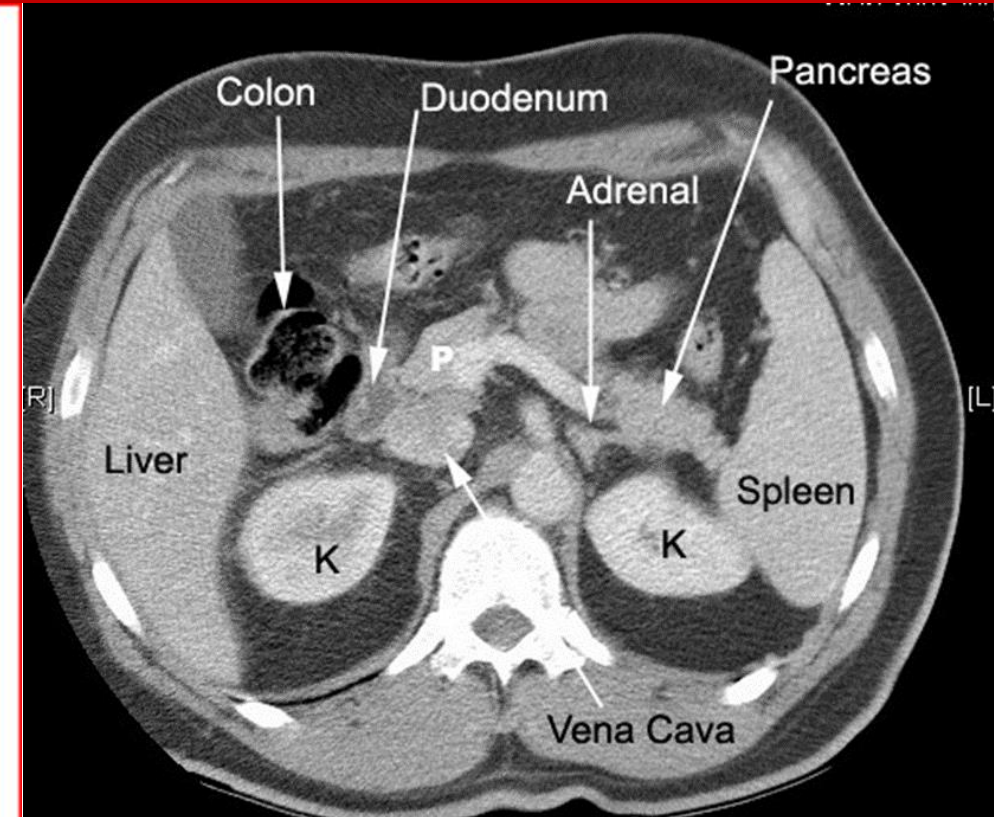
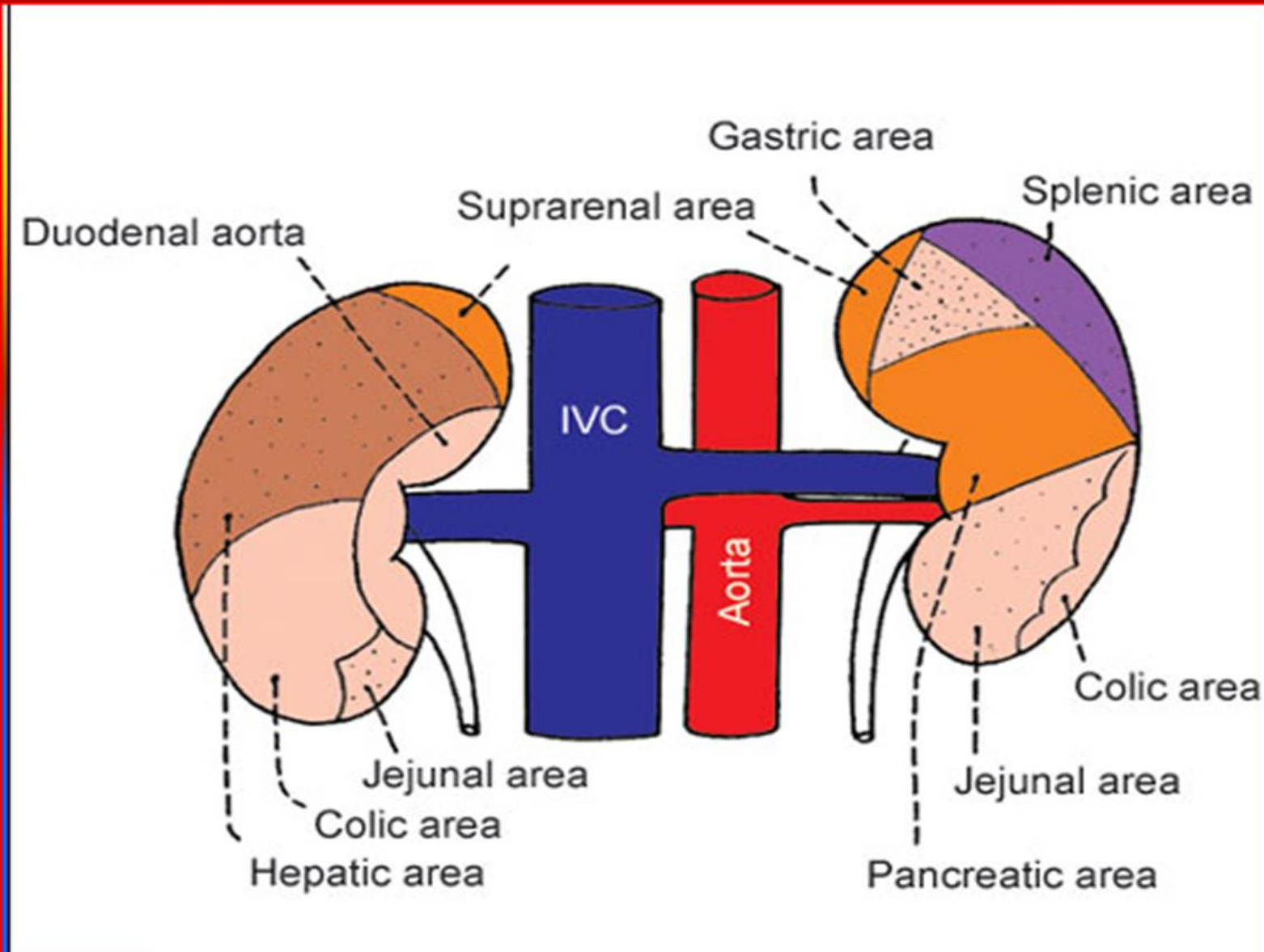
Clinical importance-

— may occasionally puncture during nephrectomy

- Hepatic flexure of colon
- Small intestinal loops



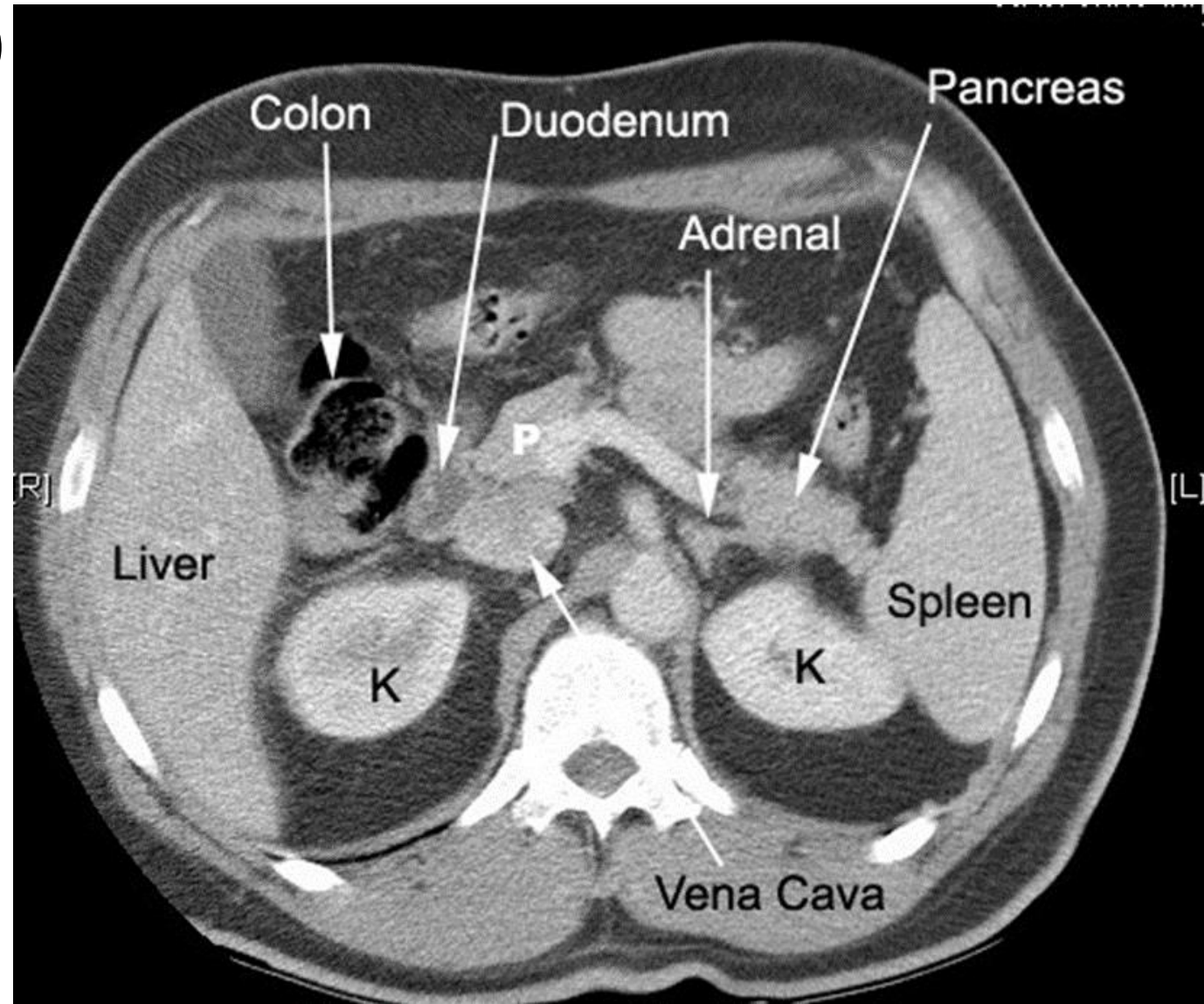
Anterior relations





Anterior relations left kidney

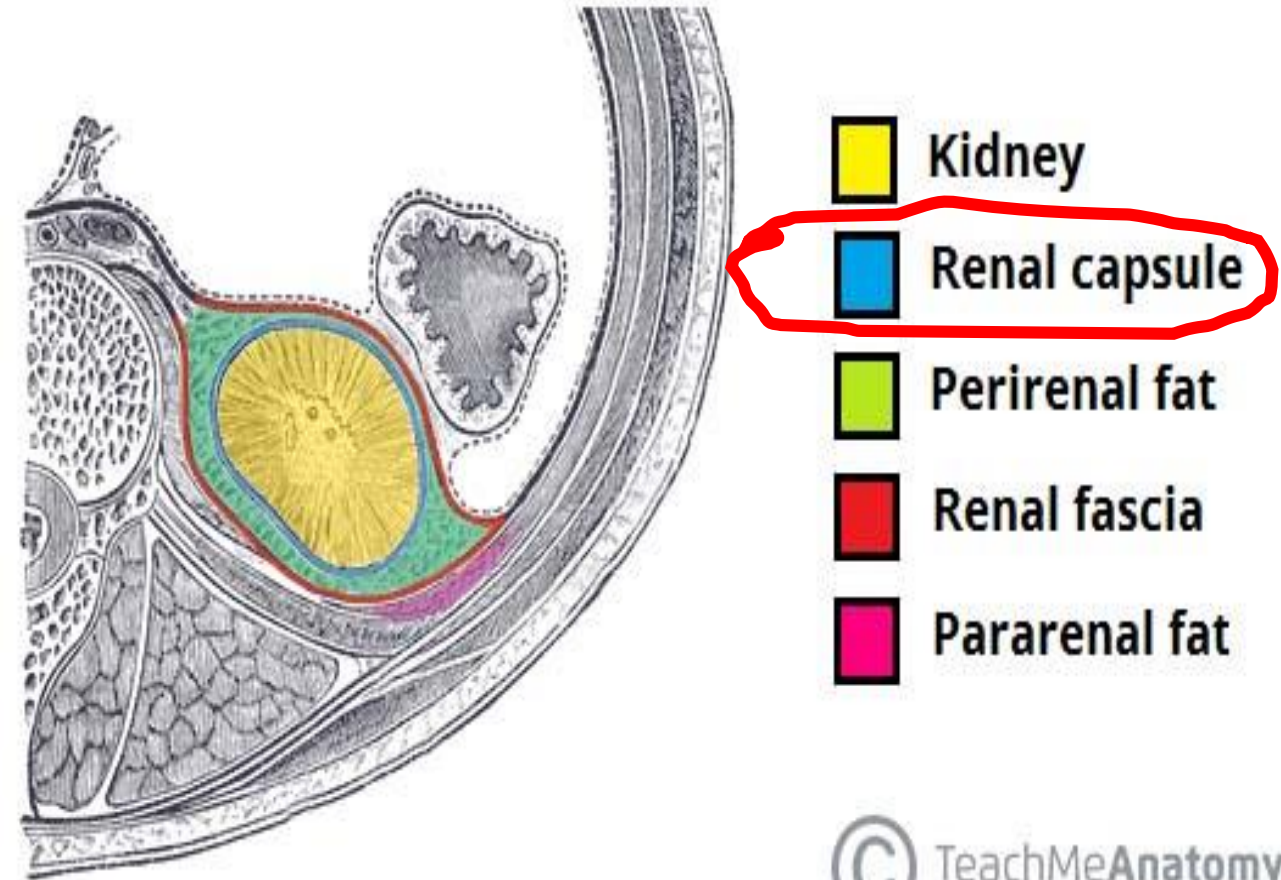
- Left suprarenal gland (small portion)
- Stomach
- Spleen
- Pancreas and its vessels
- Splenic flexure of colon
- Descending colon
- Intraperitoneal jejunal loops



Coverings of kidney

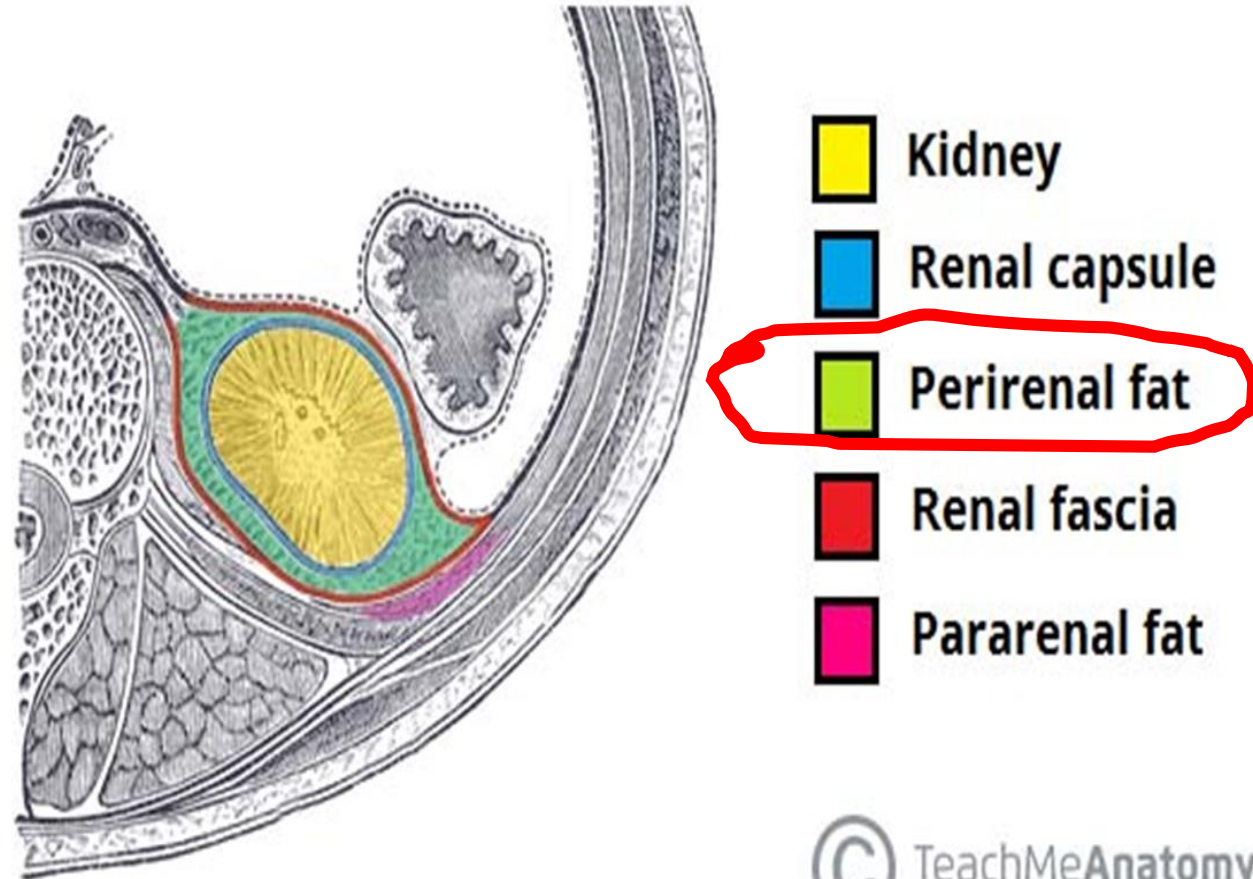
- Fibrous capsule

- Thin membrane
- Closely attached to the kidney
- But can be easily stripped off
- It is pain sensitive
- In pyelonephritis –it stretches and get flank pain
- Called renal angle tenderness

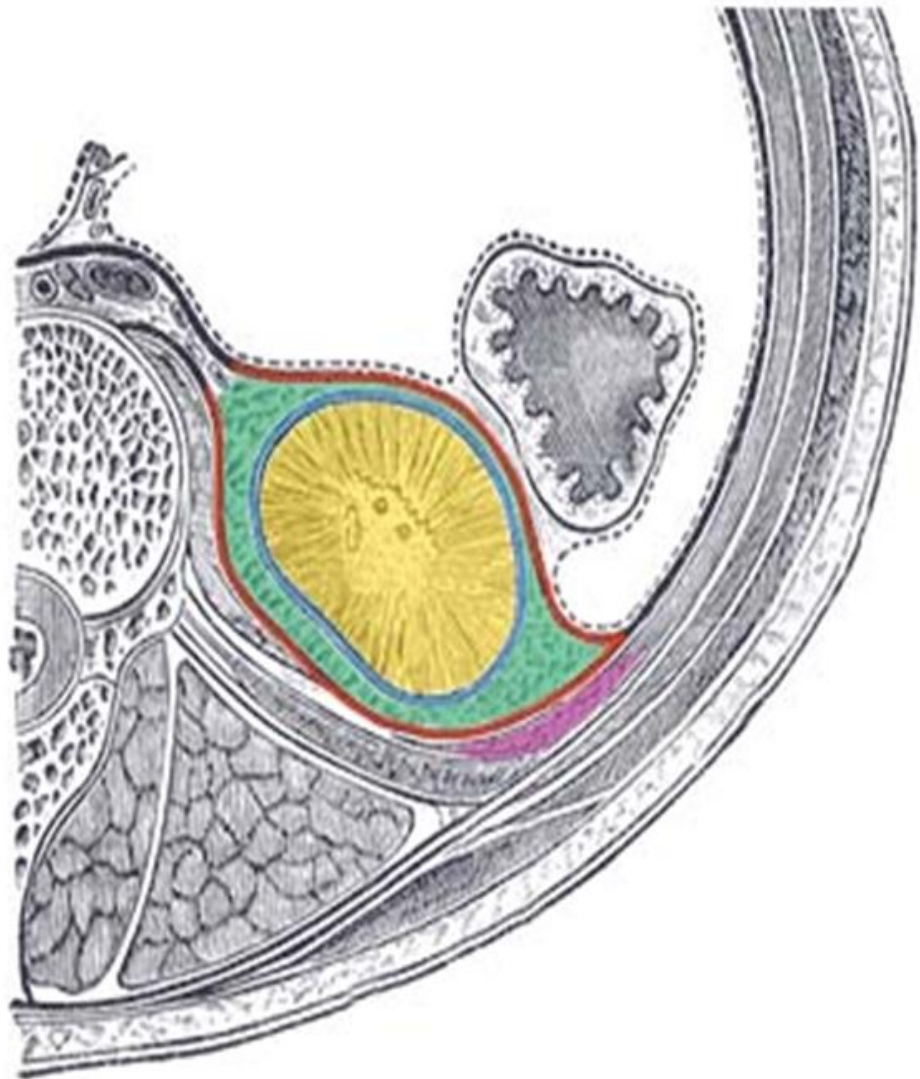



Coverings of kidney

- Perirenal/ Perinephric fat
 - Fat layer outside the fibrous capsule
 - Completely covers the kidney



Coverings of kidney



-  Kidney
-  Renal capsule
-  Perirenal fat
-  Renal fascia
-  Pararenal fat



Coverings of kidney

- Renal fascia
 - Covers the Perirenal fat
 - Has 2 layers
 - **Posterior layer - fascia of Zuckerkindall** • **Anterior layer – Gerota’s fascia**
 - Laterally 2 layers fused and continuous with transversalis fascia
 - Medially –anterior layer continuous with hilar vessels and fuse with connective tissue of IVC and aorta
 - Medially posterior layer continuous with fascia covering the psoas major
 - Inferiorly 2 layers not fuse – Open : Allows descend of kidneys

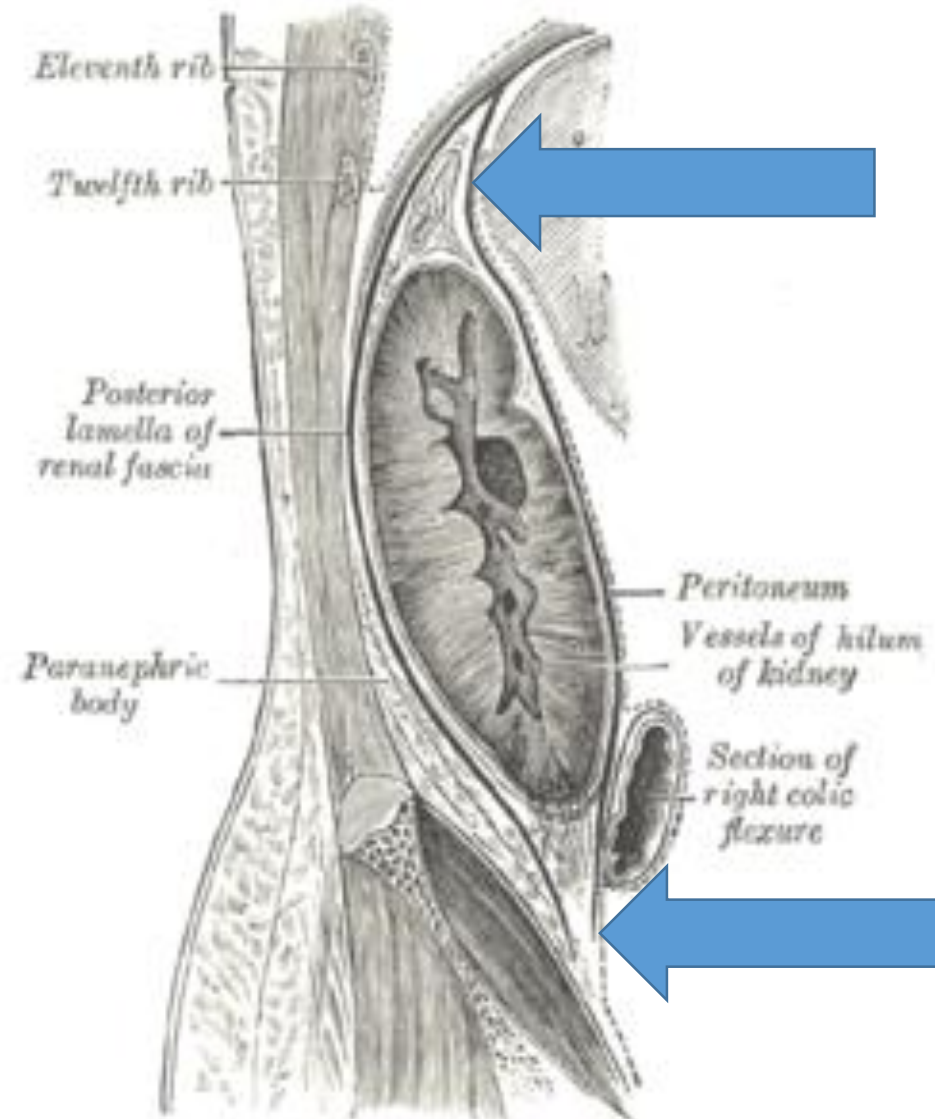




Coverings of kidney

Renal fascia

- Superiorly renal fascia fuse above the adrenal gland and blends with fascia covering diaphragm





Coverings of kidney

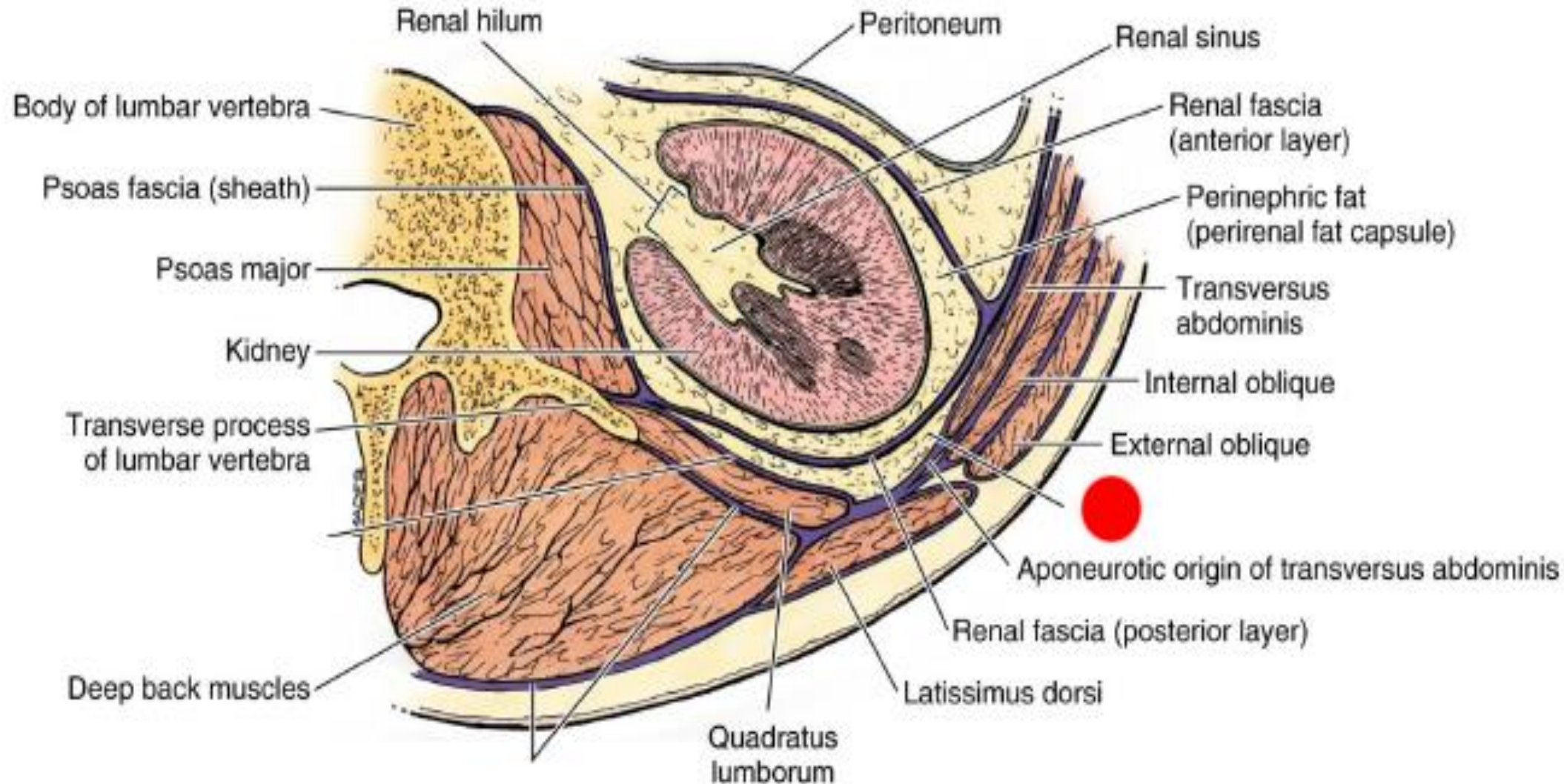
Pararenal fat /paranephric fat

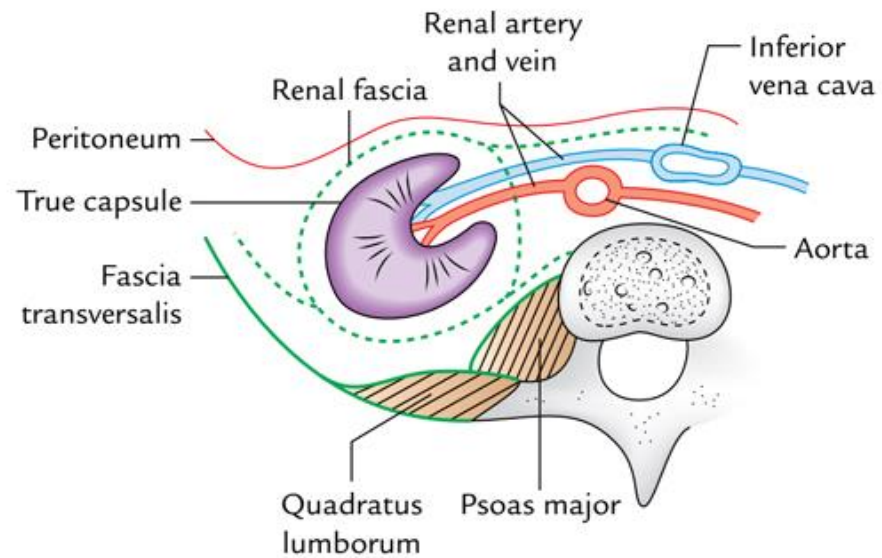
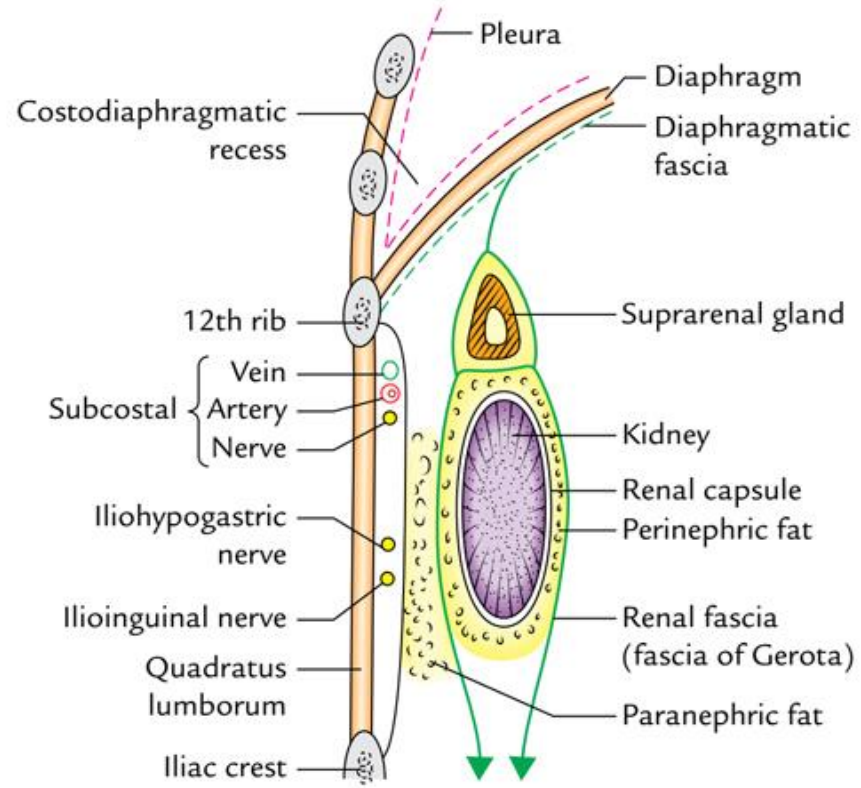
- Fat layer outside the renal fascia
- Thickness is more, towards posteriorly and towards the lower pole
- Fills the paravertebral gutter.
- Act as a cushion.
- Posteriorly called-posterior pararenal space.
- Anteriorly called –Anterior pararenal space.B/W renal fascia & peritoneum





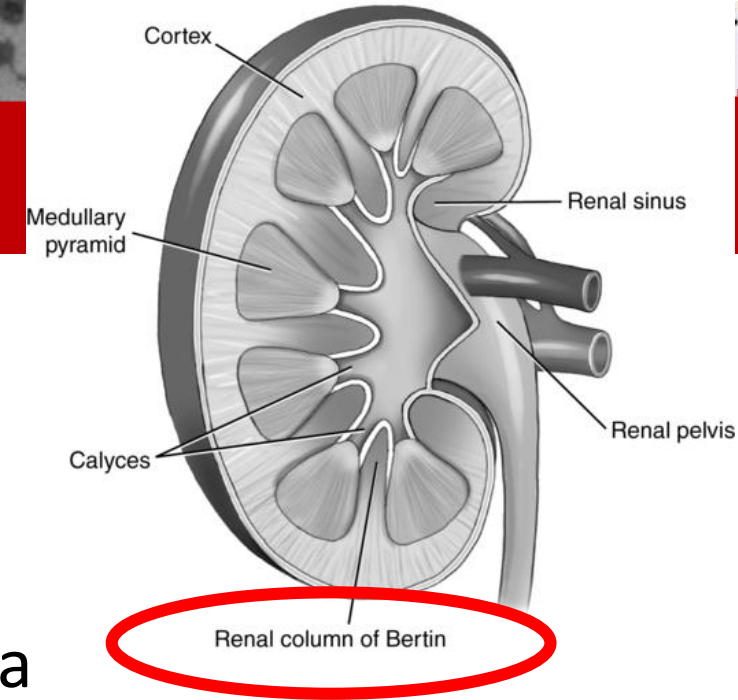
Coverings of kidney

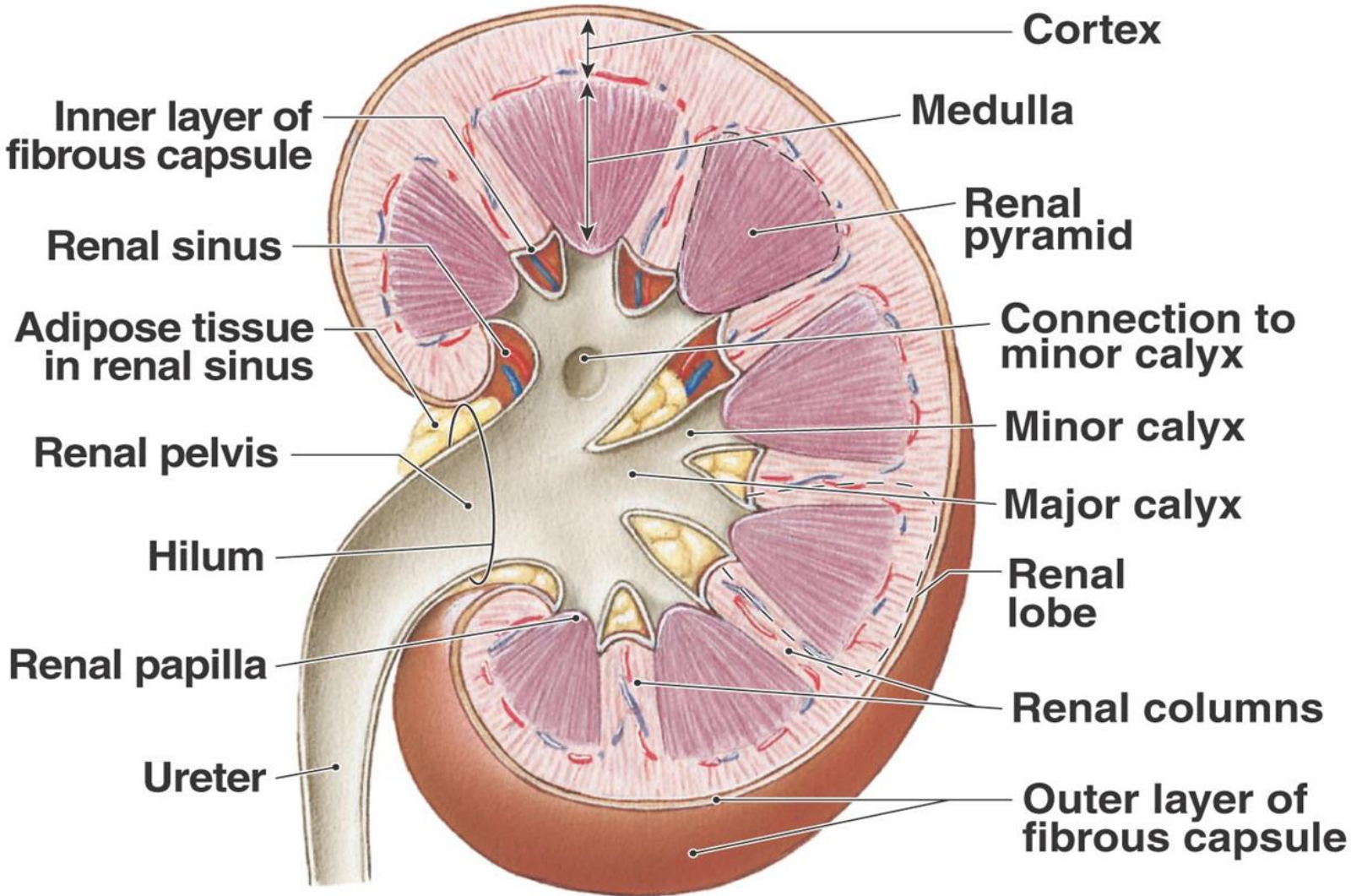




Renal Structure

- Outer 1/3 –Renal cortex –Pale
- Inner 2/3 –Renal Medulla – Dark
- Columns of renal cortical tissue extends in to renal medulla
- Called “Columns of Bertin”
- This separates renal medulla in to several “pyramids”
- Pyramids are triangular in shape





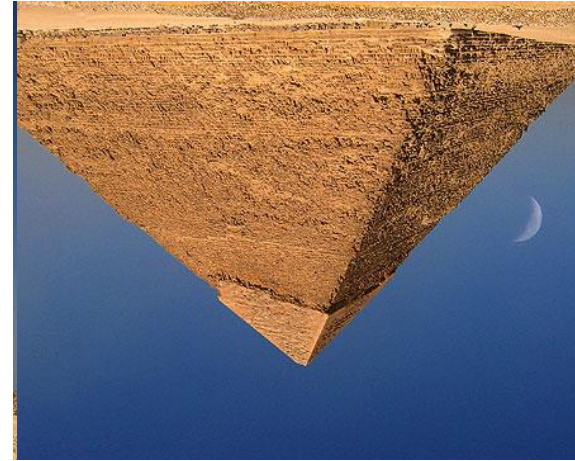
(a) Frontal section of left kidney, anterior view

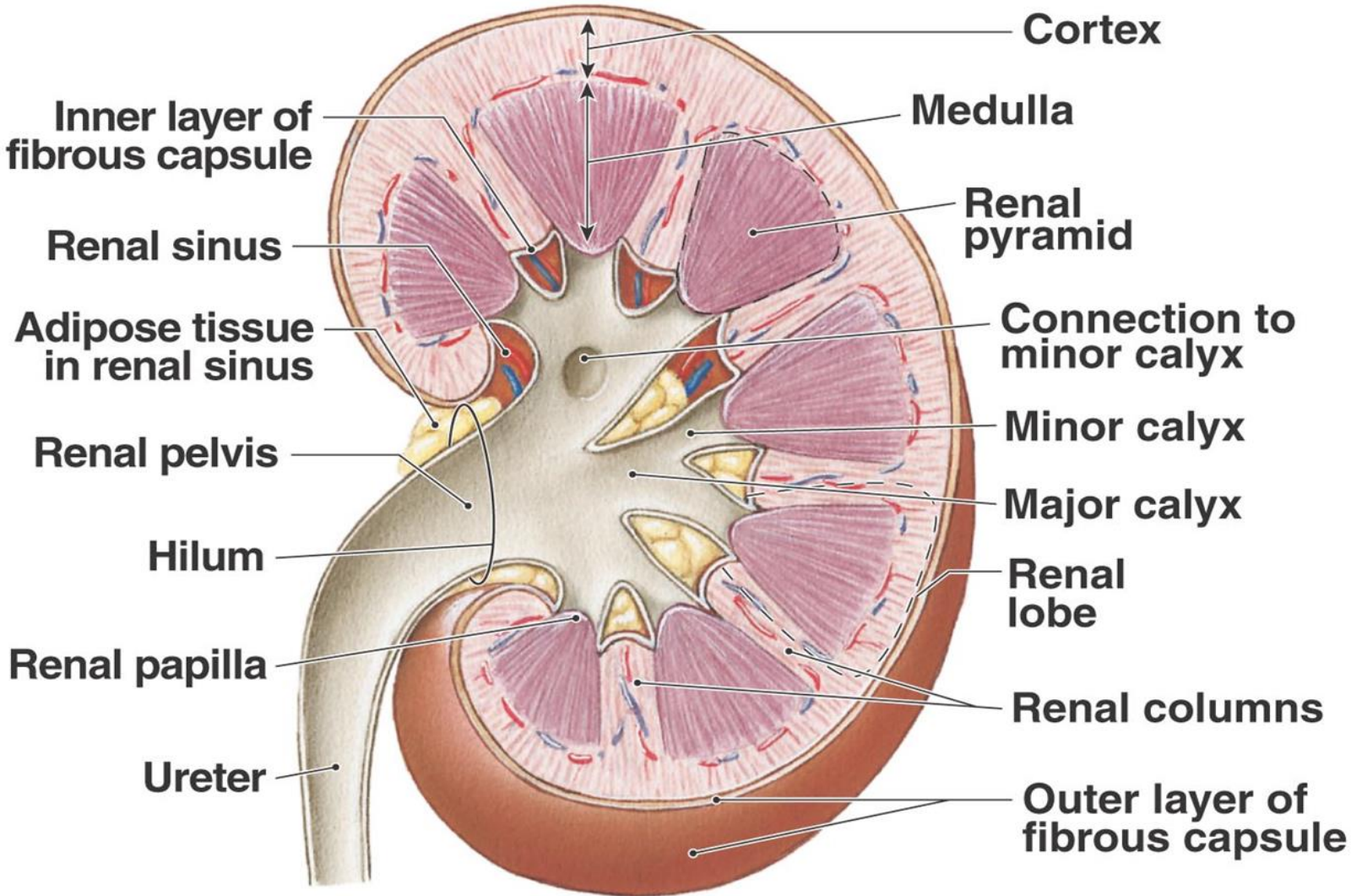




Pyramids and Calyces

- Base directs outward
- Apex directs inward, towards renal sinus
- Apex is rounded –Called Renal papilla.
- Renal papilla projects in to minor calyx
- 2-3 minor calyces join & form major calyx.
- 2-3 major calyces communicate with renal pelvis through infundibulum
- Generally 7 pairs of minor calyces . 7 Ant and 7 Post





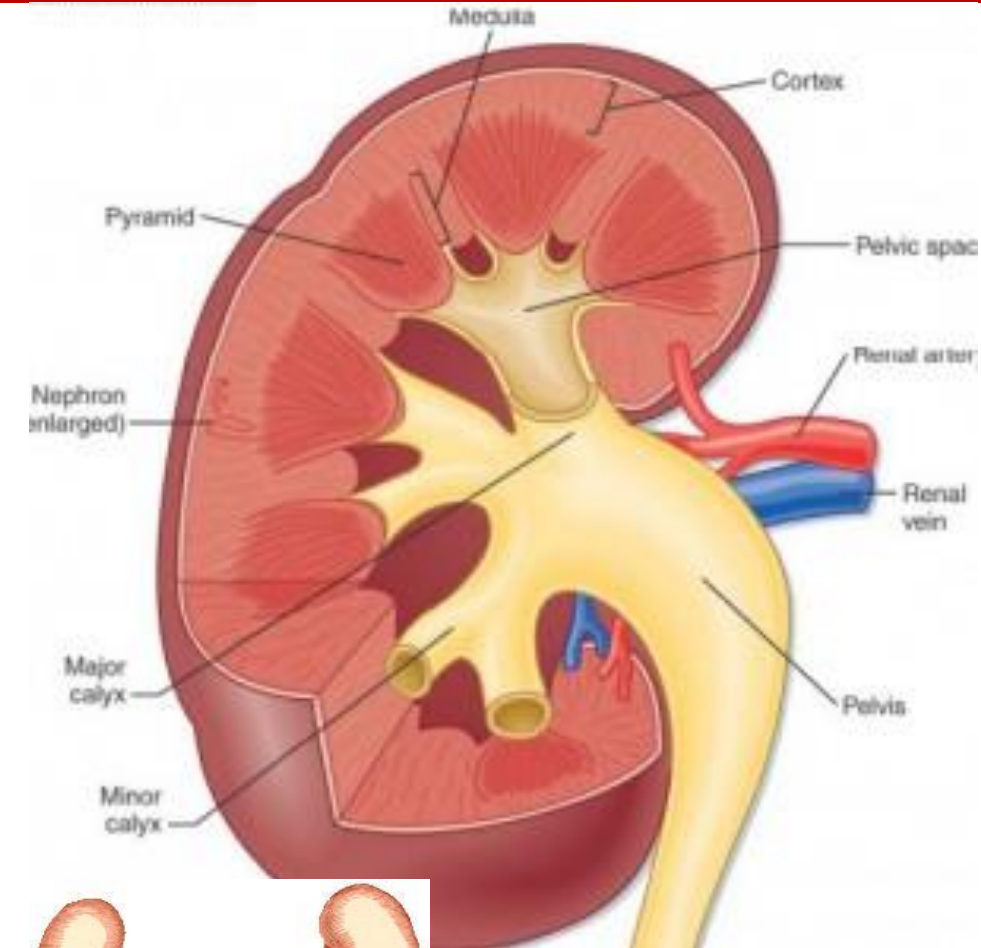
(a) Frontal section of left kidney, anterior view





Renal Pelvis

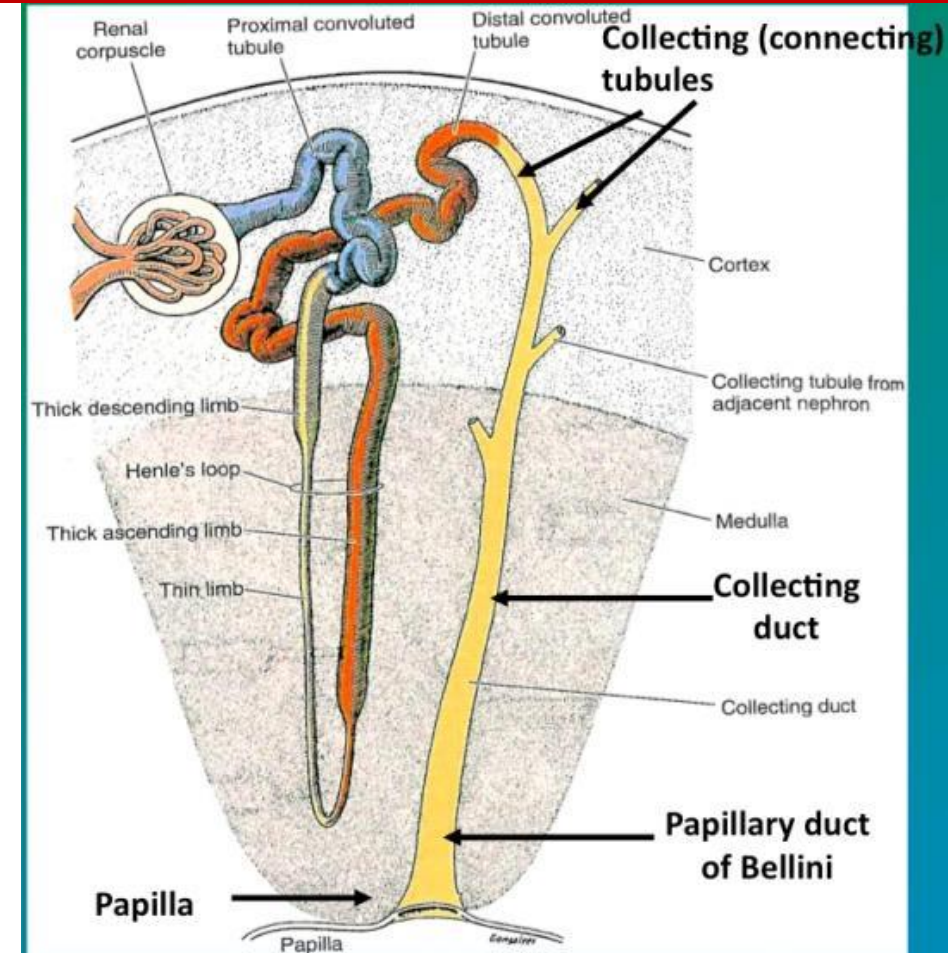
- Funnel shape
- Embedded in the renal sinus /hilum fat
- Outer end communicate with the ureter.
- Considerable variations in the arrangement.
- “Extrarenal Baggy Pelvis”
 - Renal pelvis completely outside the kidney.

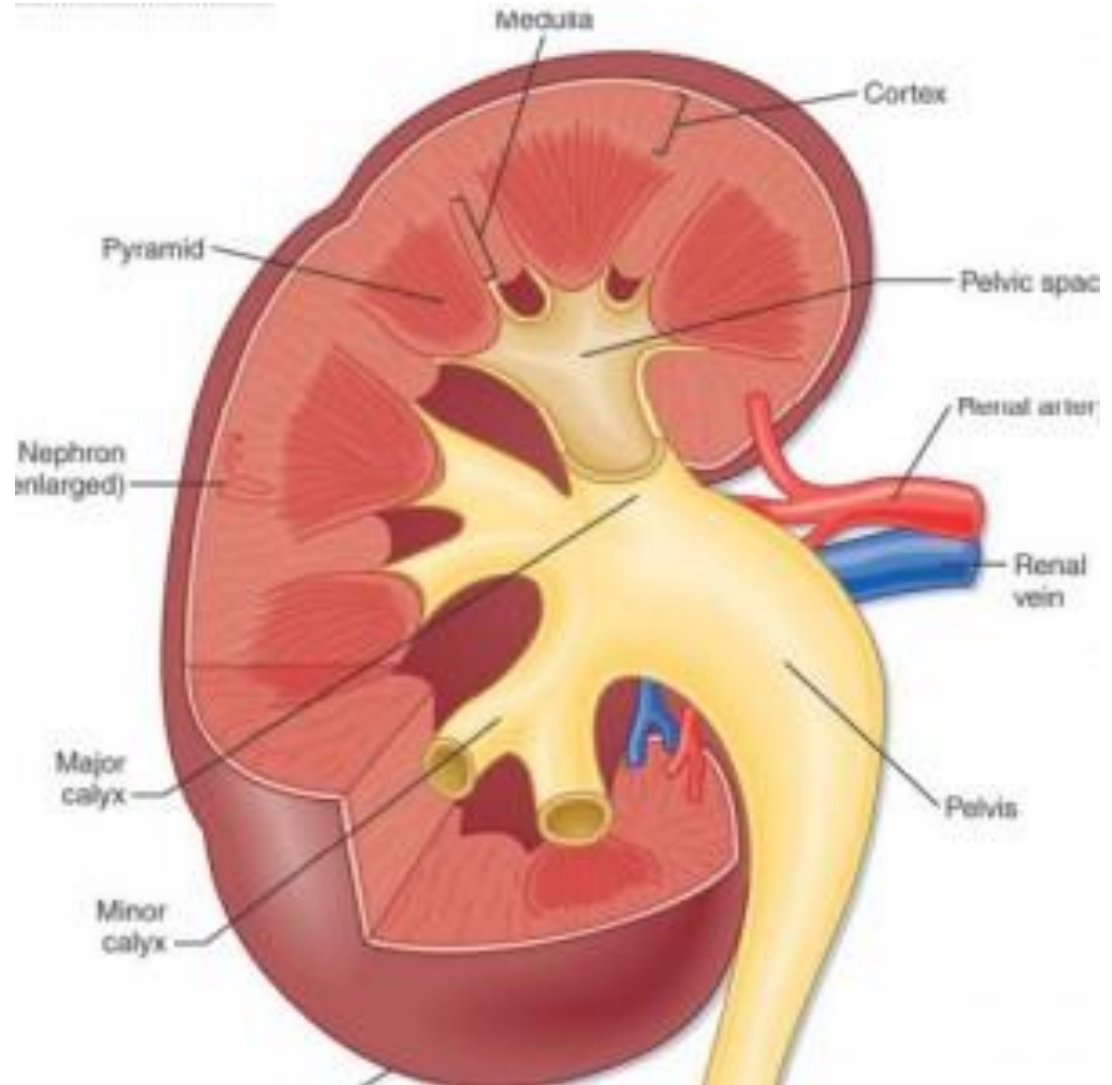
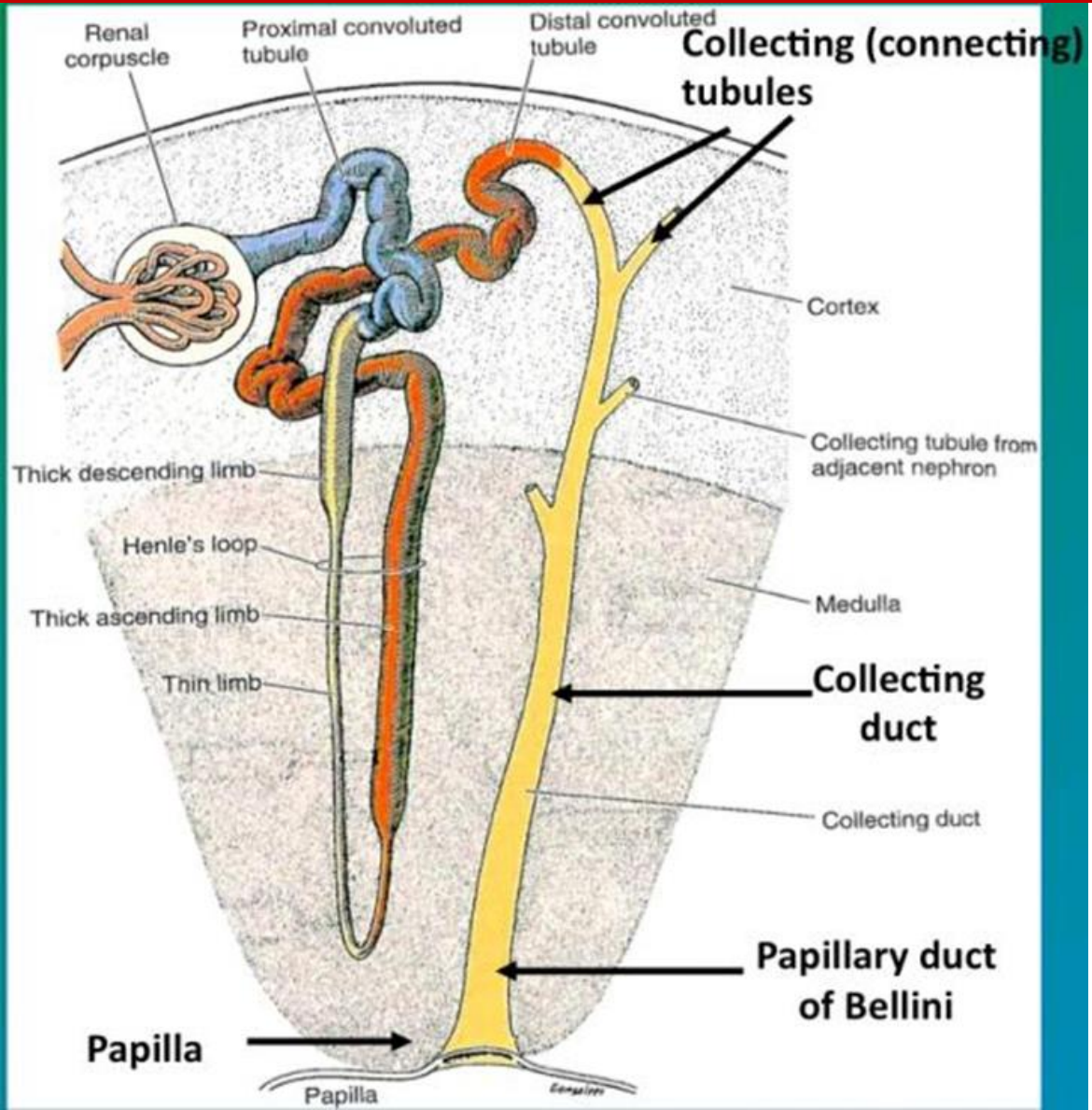




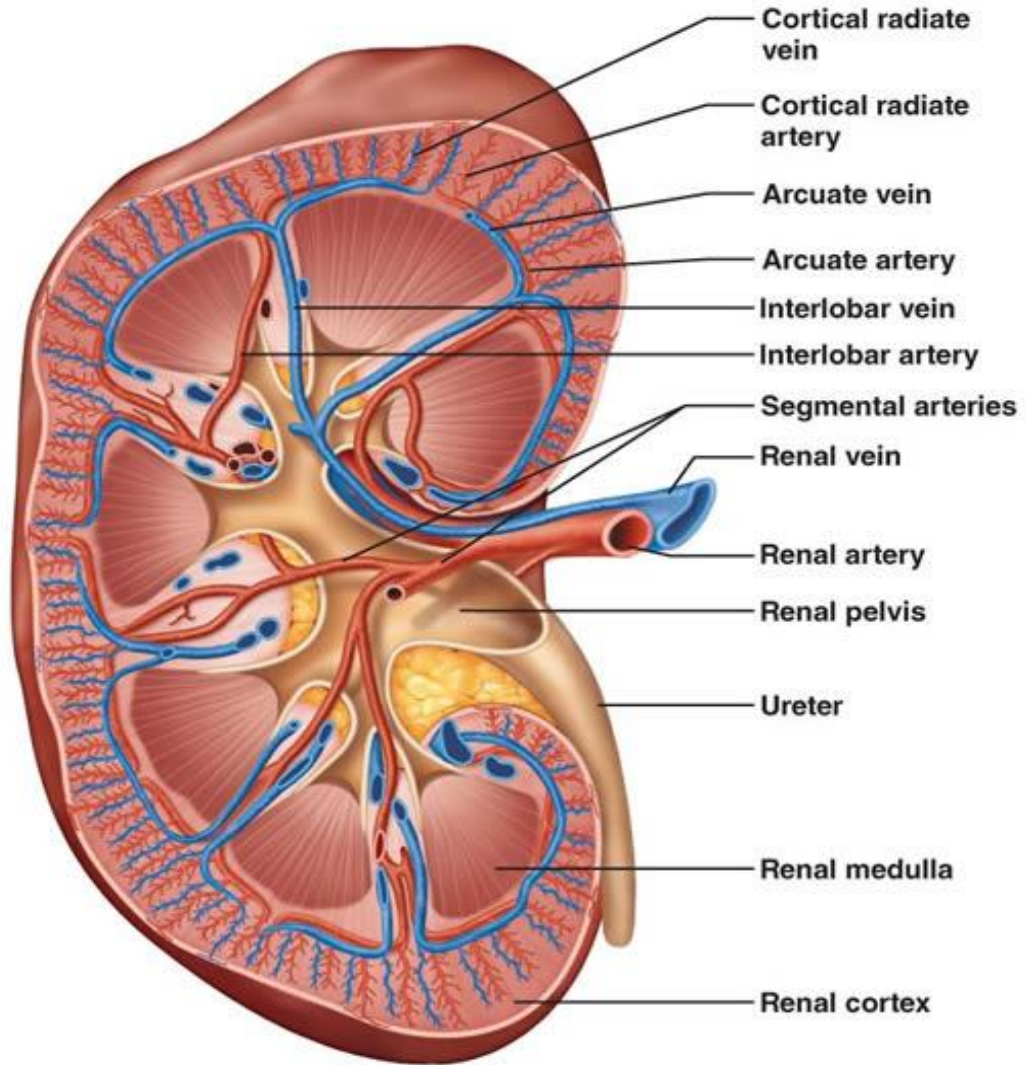
Nephron

- Is the basic structural and functional unit
- Millions in one kidney.
- Distal end of nephron –open to collecting duct.
- Multiple collecting ducts unite ➡ Ducts of Bellini
- **Ducts of Bellini** passes through renal papillae
- Renal papillae opens to minor calyces



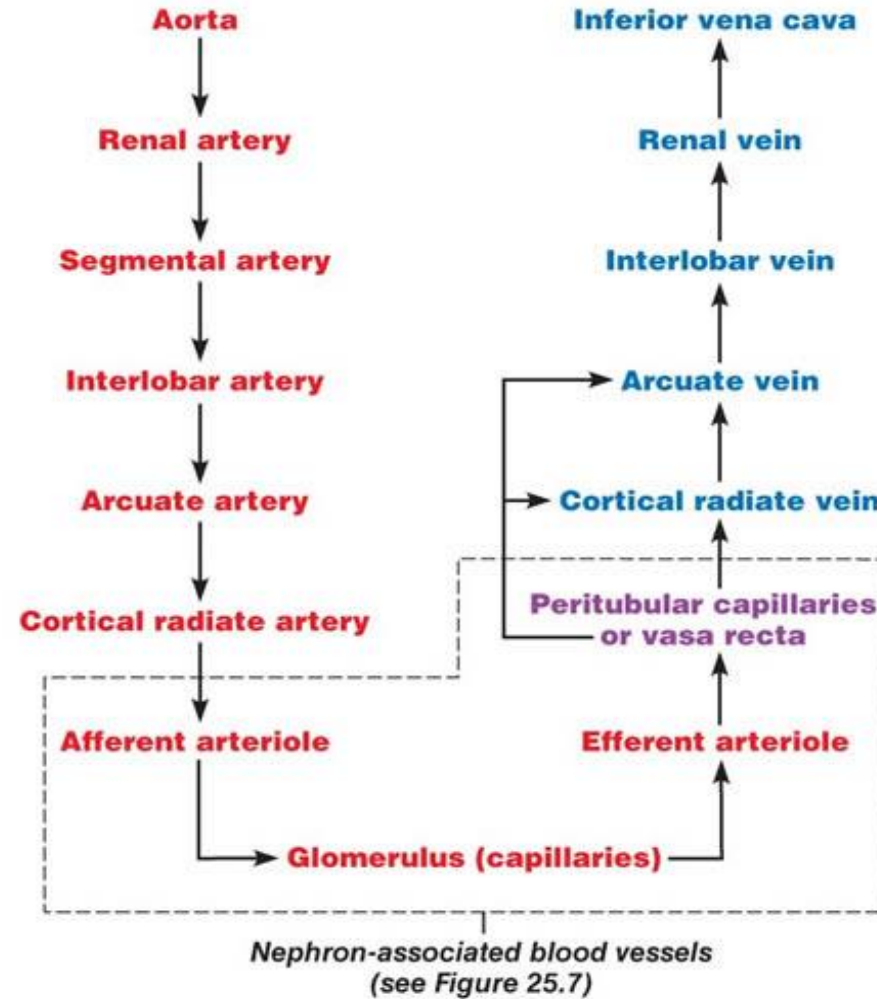


Blood supply



(a) Frontal section illustrating major blood vessels

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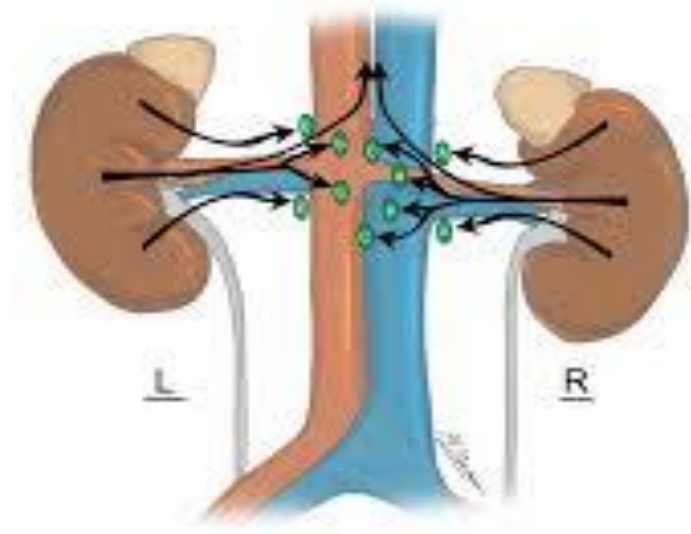
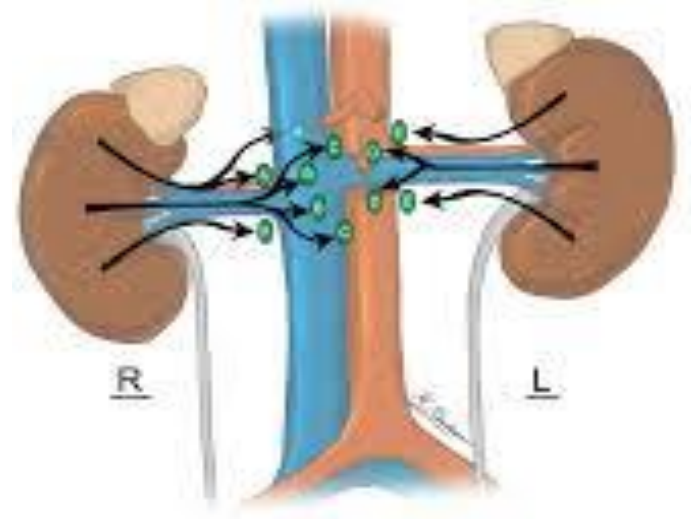
(b) Path of blood flow through renal blood vessels



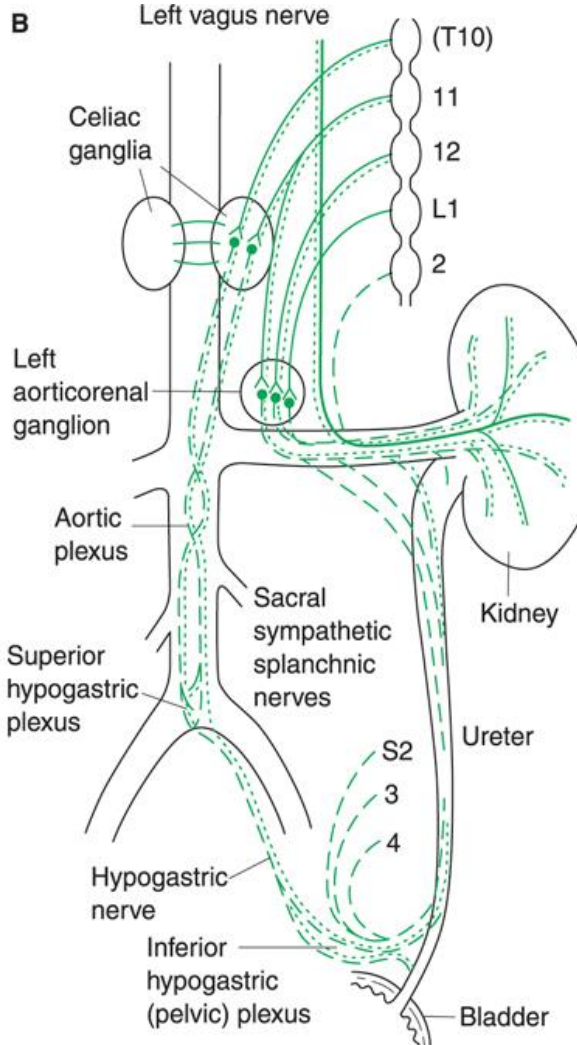
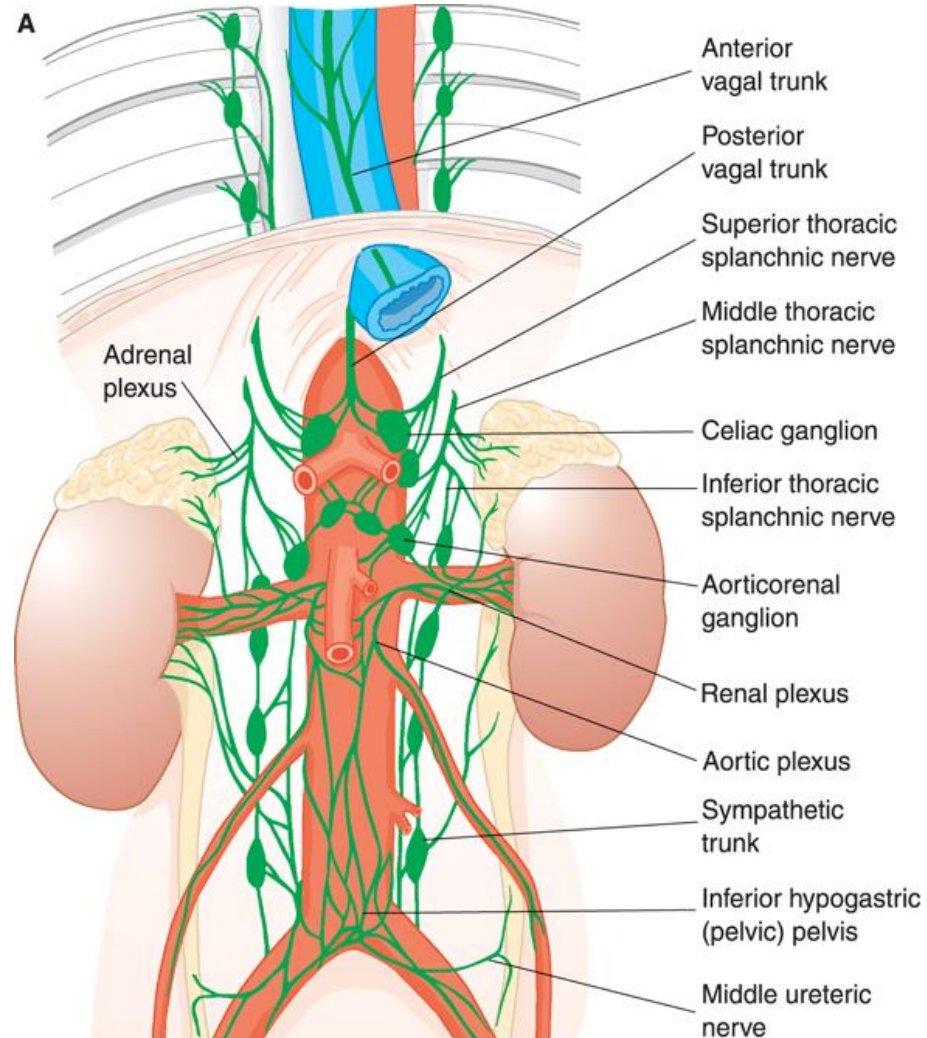


Lymphatic Drainage

- Drain to Paraaortic nodes (PAN)
- Around origin of renal arteries (L-2 level)

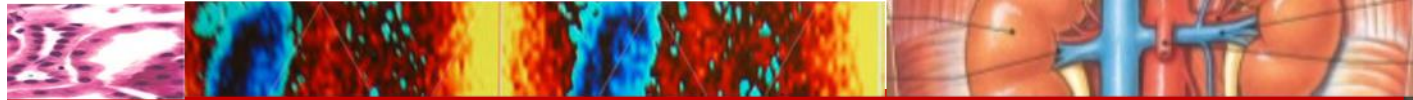


Nerve Supply



- Supply by renal plexus
- Contain Sympathetic fibers (T10 – L1)
- Mainly vasomotor fibers.





Trauma to kidney

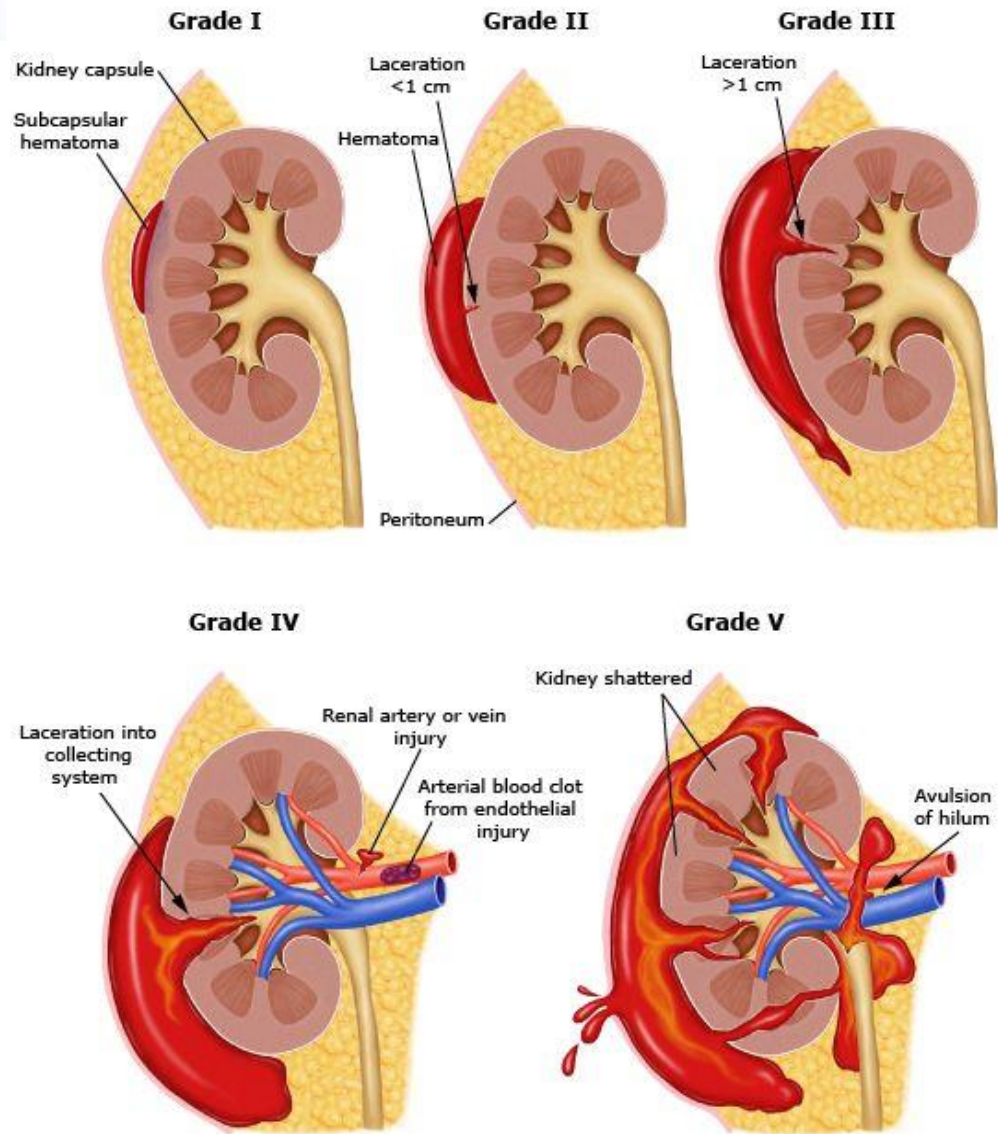
- Common in RTA
- Trauma to back (Kick)



Eg : Rugby, During fighting

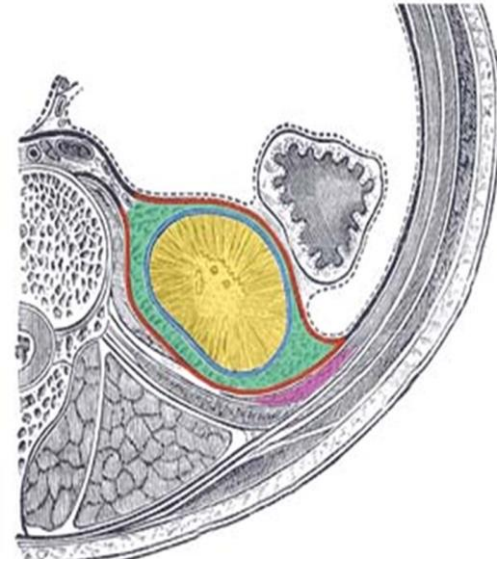
- Rupture of posterior ribs may injure the kidney
- Kidney damage vary from simple contusion ➡ shattered kidney





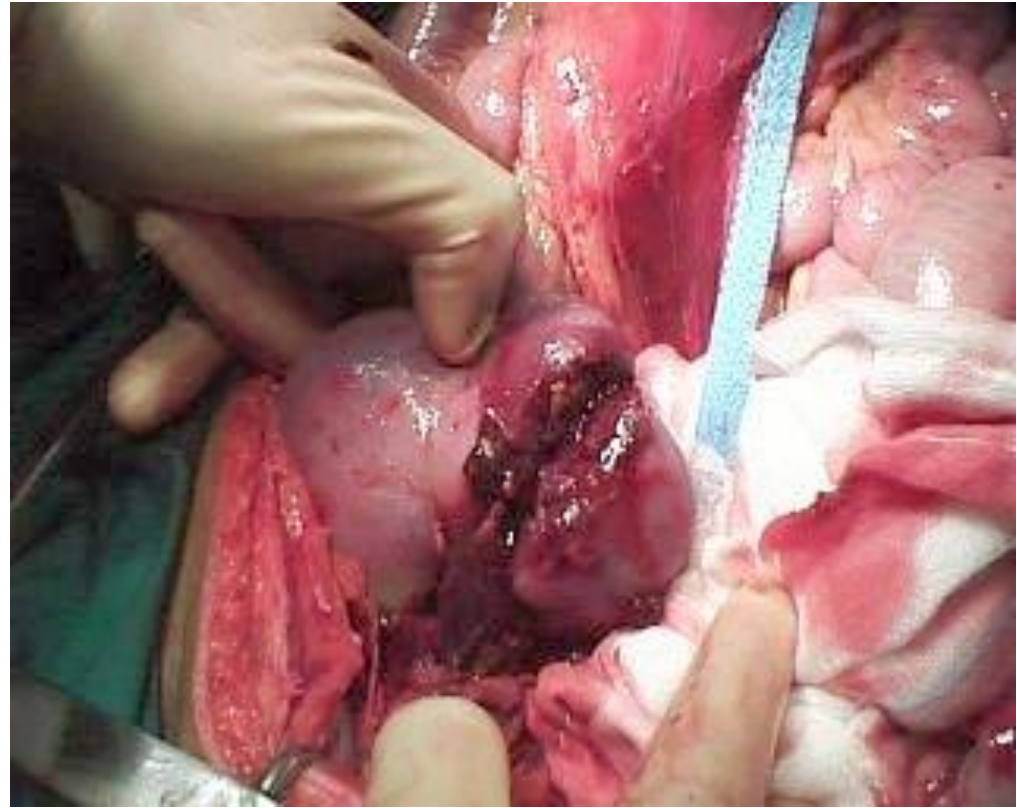


- Blood accumulate in Perirenal space → Distend renal fascia
↓
Blood collect in pelvis



- Blood can't cross the mid line due to mid line attachment of renal fascia

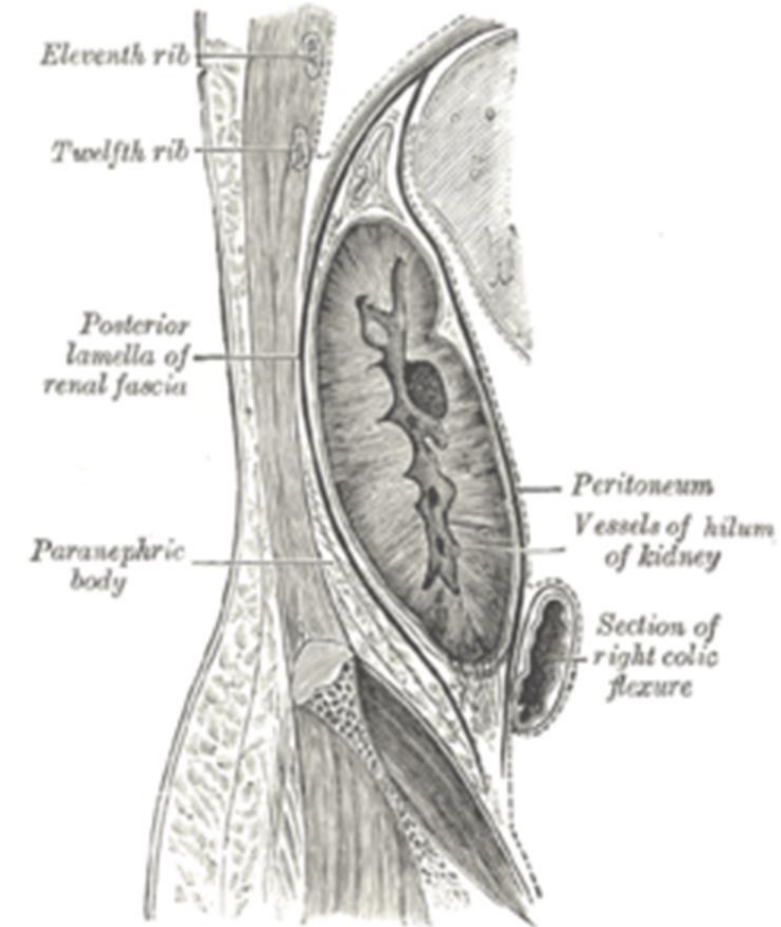







Perinephric /Perirenal abscess.

- Intrarenal abscess may rupture into perinephric space.
- Can distend renal fascia
- Pus may accumulate in pelvis.

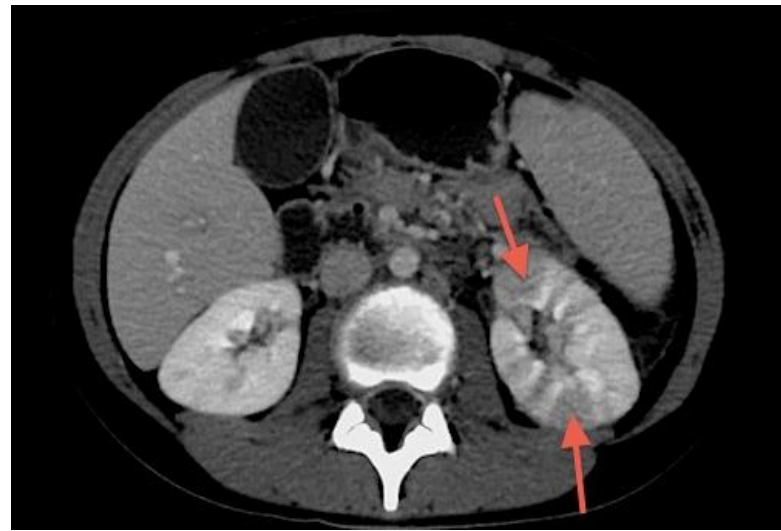
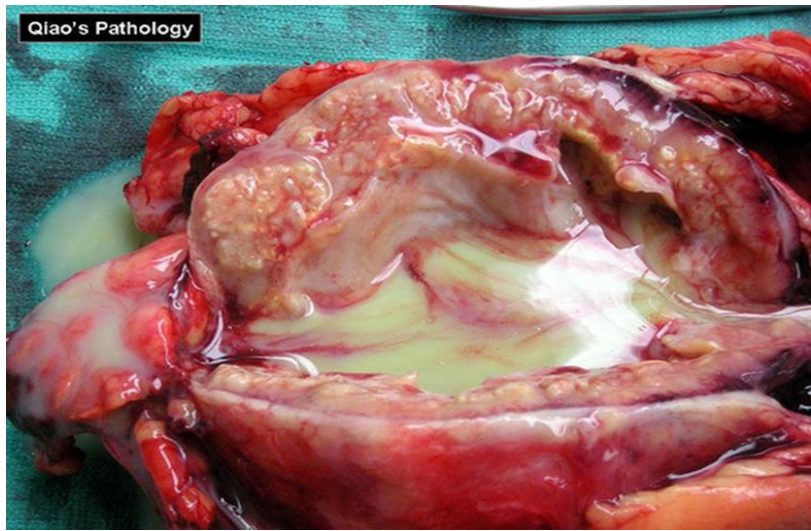
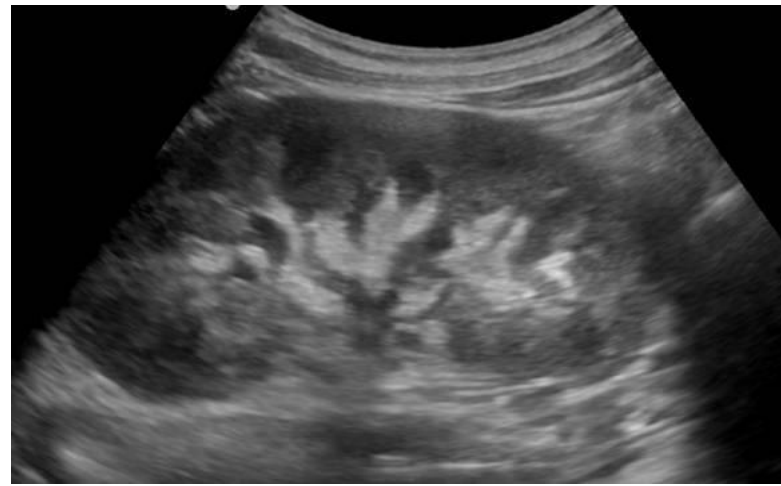




Pyelonephritis

- Inflammation of the kidney tissue, calyces and renal pelvis.
- Commonly caused by bacterial infection.
- “Pyelitis”  inflammation of the pelvis and calyces.
- **Pyelitis together with nephritis** is collectively known as pyelonephritis.
- Predisposing factors are Diabetes, Renal stones etc.
- High fever with chills, dysuria, renal angle tenderness.

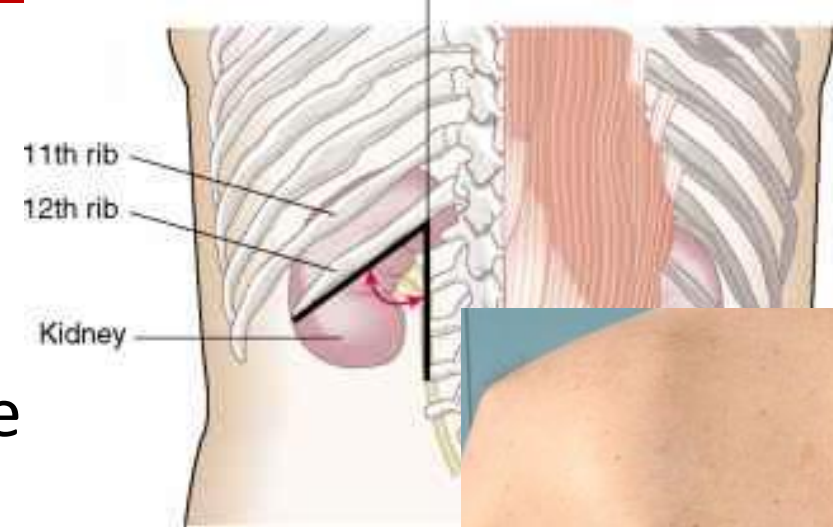






Renal angle.

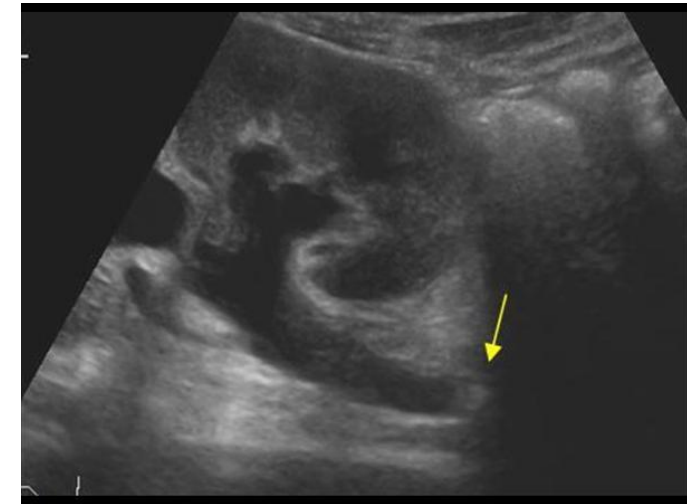
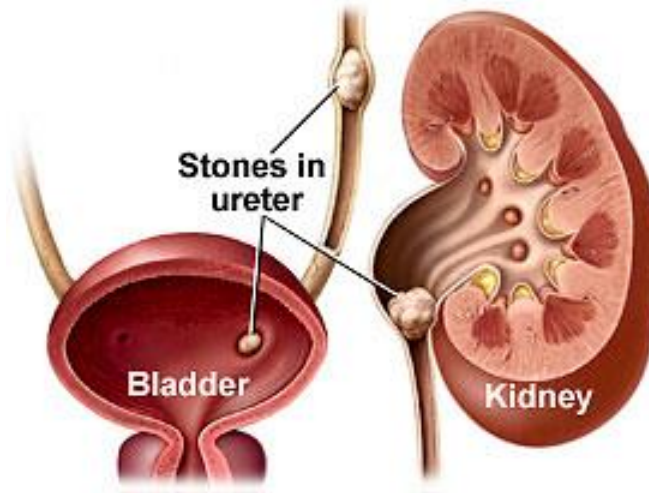
- Angle between lower border of 12 th rib
and outer border of erector spinae muscle
- Overlies the lower part of the kidney.
- Tenderness on kidney can demonstrate
by applying pressure over the area.





Renal stones.

- Also called renal calculi
- Male >Female.
- Common between 20- 60Y
- Ureteric calculi → May cause severe pain
- Intrarenal calculi :Caliceal calculi



Renal pelvic calculi -Branch type –Staghorn calculi

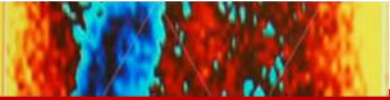
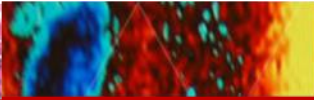




Removal of renal stones.

- During surgical exploration of kidney- 12th rib may be resected.
- Pleura may be damaged as close relation to the 12th rib
- When 12th rib absent or too small , 11th rib may be mistaken for 12th
- Chances to damage the pleura is higher in this case.
- Alternative to surgical options- Extracorporeal shock wave lithotripsy (ESWL)





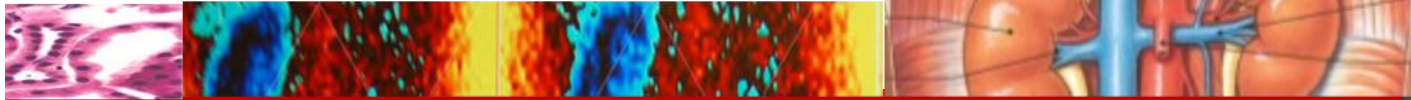
Palpable Kidney

- When kidneys are enlarged can palpate bimanually
- “Ballotable kidneys”
- Eg: Polycystic kidney disease, Renal Tumours etc..



Dennis et al: Mechanisms of Clinical Signs.
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Renal Tumors



- Most tumors arise from proximal tubular epithelium
- May present as Haematuria, loin pain or feeling as a mass.
- Slow growing tumors
- Can invade surrounding fat, fascia
- May enter into renal vein → IVC → R/Atrium → R/ventricle → Pulmonary artery
- Rx- Surgical removal





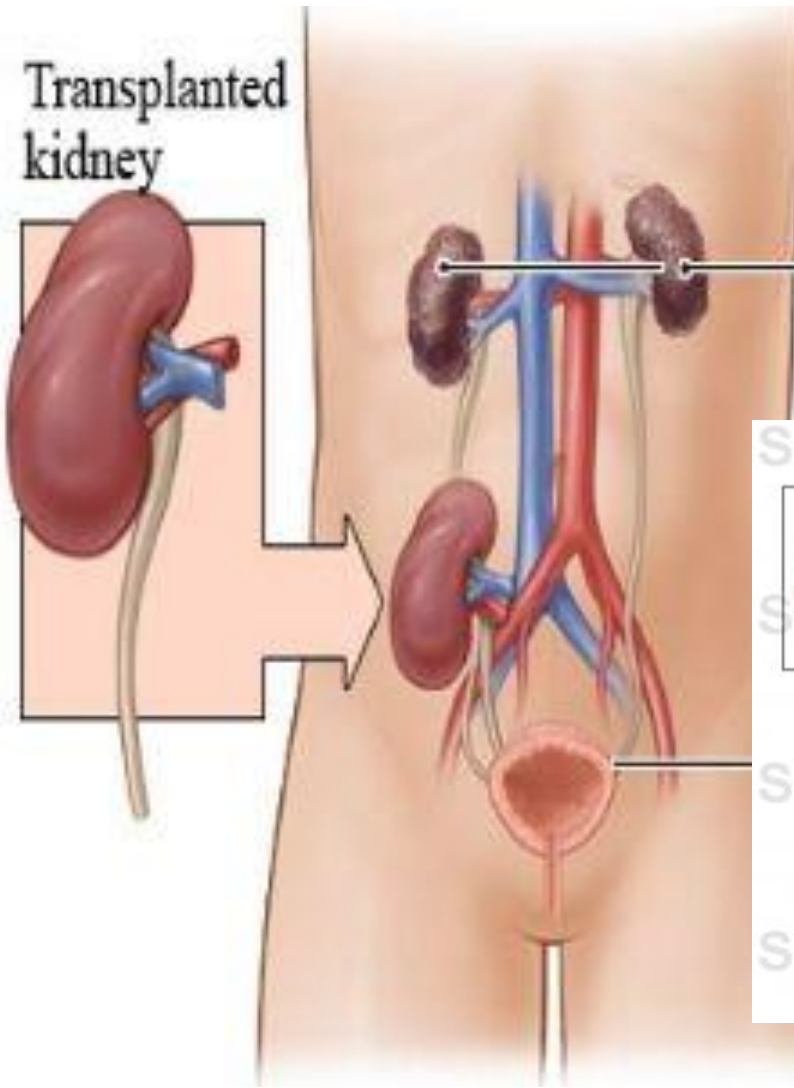
Renal Transplant

- Done for end stage renal failure (ESRF)
- Kidney obtained from either living or diseased donor
- Ureter is also harvested.
- Ideal place to transplant is right or left iliac fossa.
- End to end anastomosis of renal artery to external iliac artery & vein
- Ureter is implanted to bladder.



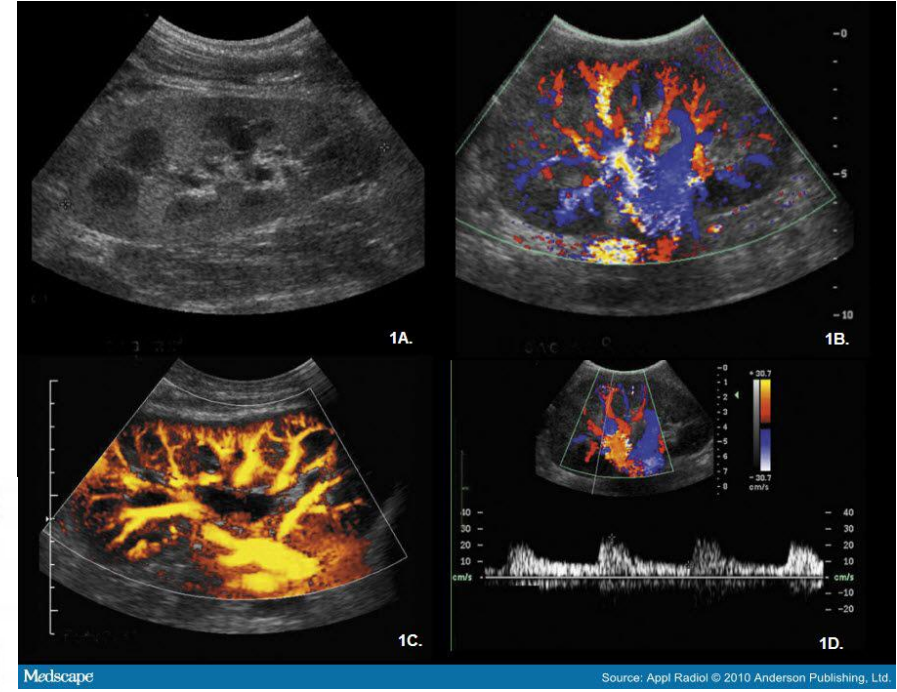
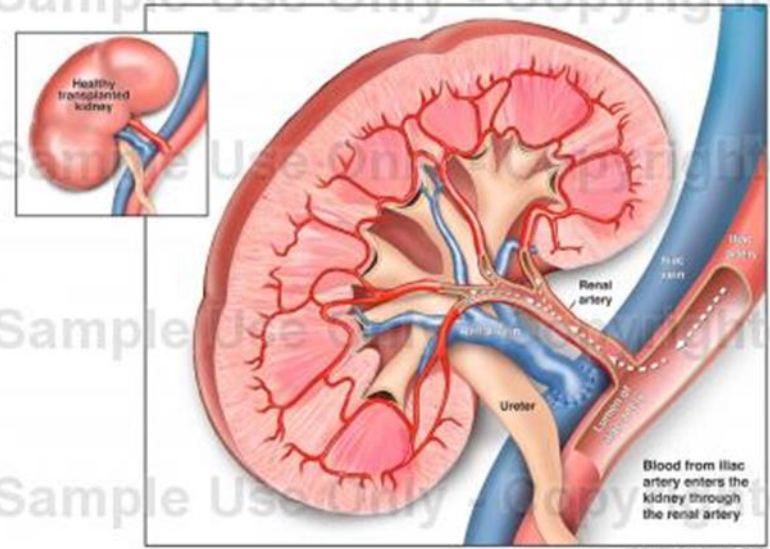


Renal Transplant



Diseased kidneys

Optimal Post-operative Condition of Renal Transplant





Why iliac fossa is ideal ?

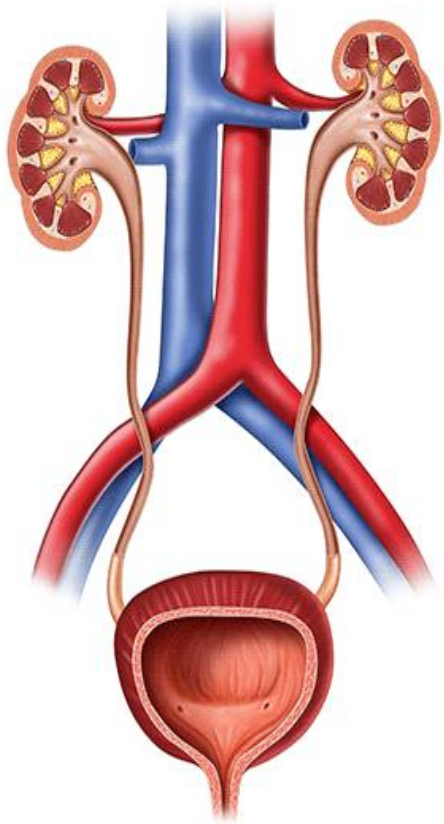
- New space can be created without disturbing other structures
- Transplanted kidney is close to the anterior abdominal wall
 - Post transplanted ultrasound /duplex can be performed easily
 - Can do biopsy easily



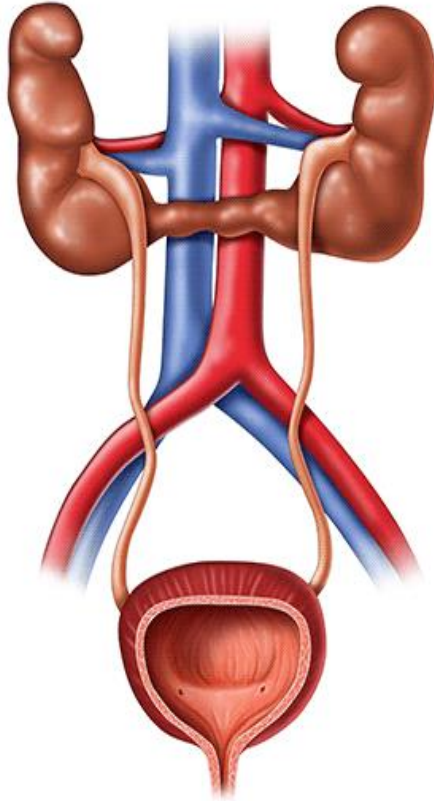


Horseshoe kidney

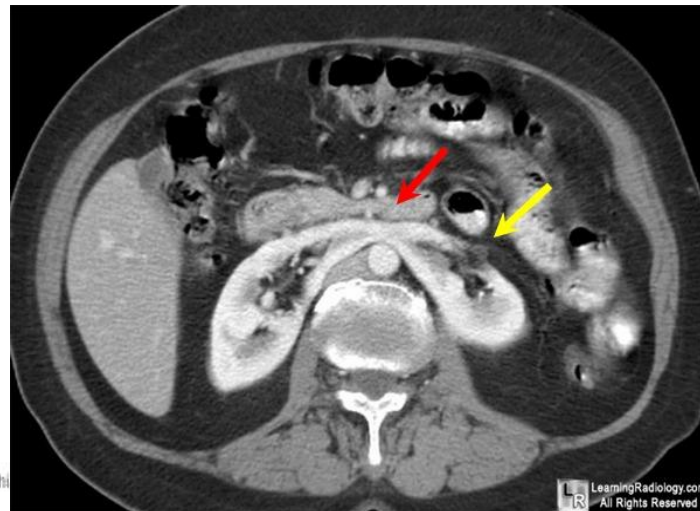
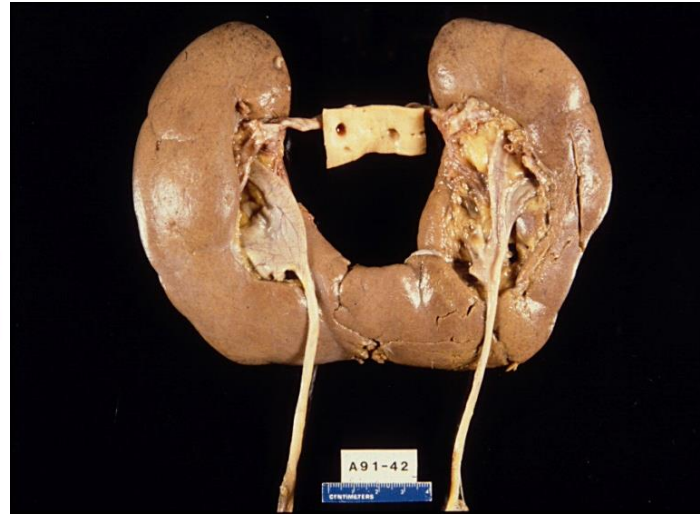
Normal System



Horseshoe Kidney



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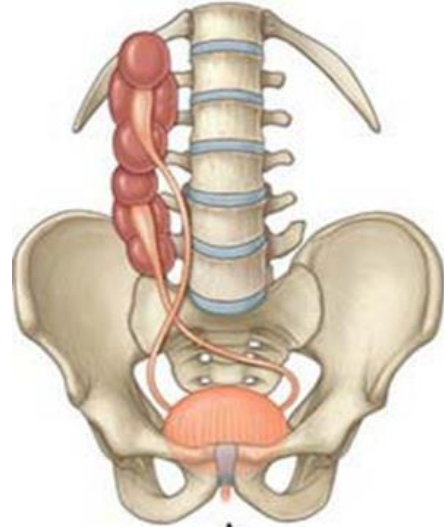


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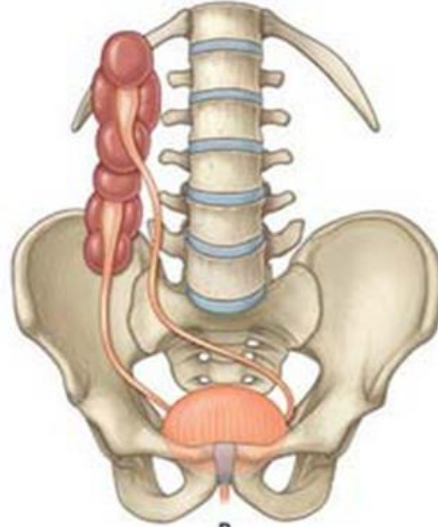




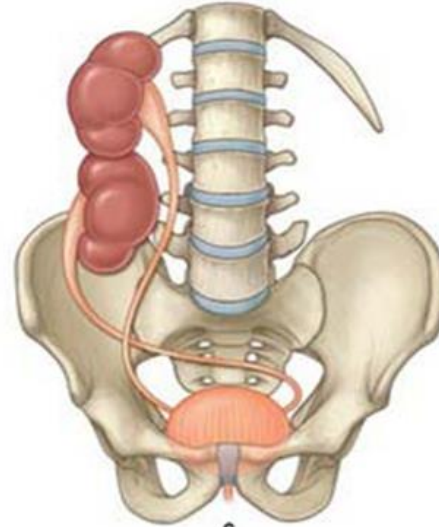
Crossed renal ectopia



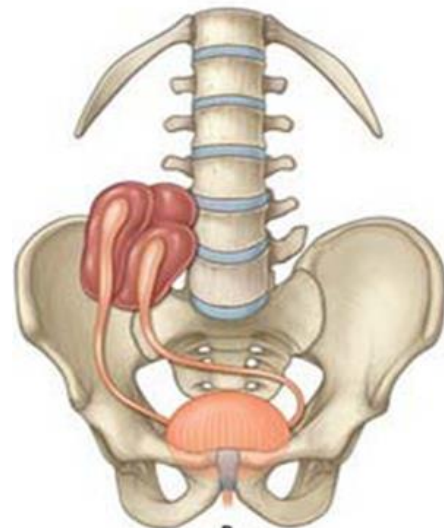
A
Unilateral fused kidney
(inferior ectopia)



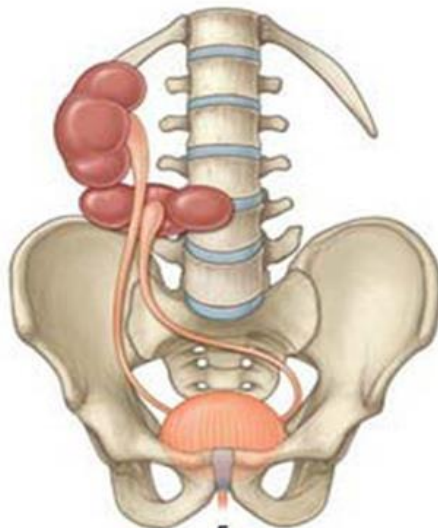
B
Unilateral fused kidney
(superior ectopia)



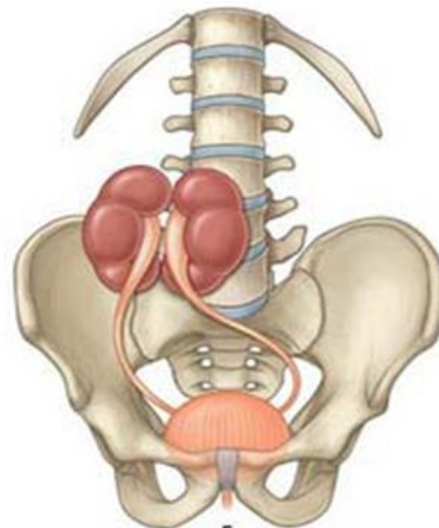
C
Sigmoid or S-shaped kidney



D
Lump kidney



E
L-shaped kidney



F
Disc kidney





THANK YOU !!.....

