Abdominal Organs

THE KIDNEYS

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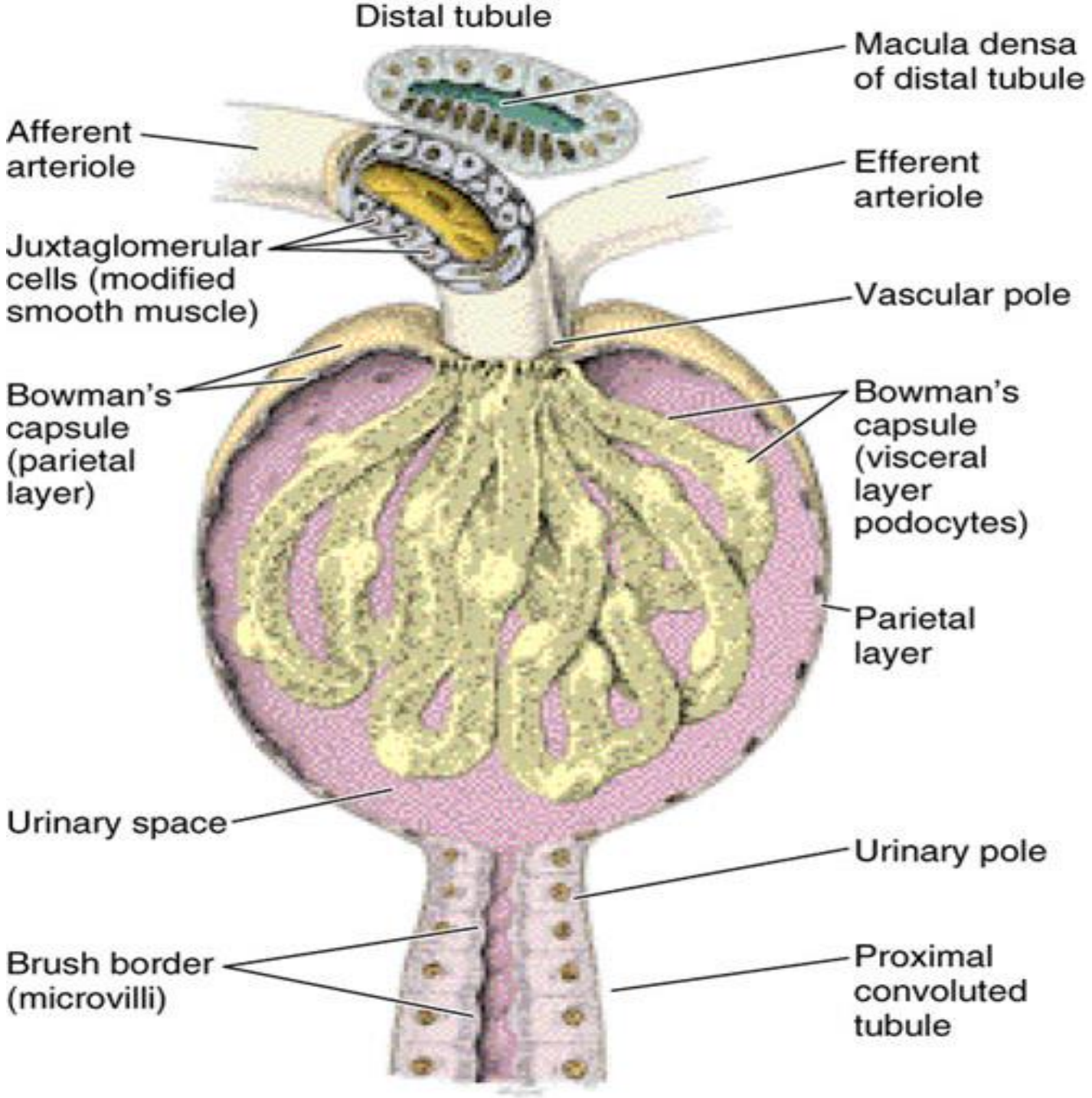

Distal tubule
Macula densa of distal tubule
Afferent arteriole
Efferent arteriole
Juxtaglomerular cells (modified smooth muscle)
Vascular pole
Bowman's capsule (parietal layer)
Bowman's capsule (visceral layer podocytes)
Parietal layer
Urinary space
Urinary pole
Brush border (microvilli)
Proximal convoluted tubule

THE KIDNEYS

- Functions ,
- clinical notes
- Gross anatomy
- Microscopic anatomy,

The kidneys serve a No. of important FUNCTION:

1. Maintaining **fluid & electrolyte balance**
2. Maintaining **acid –base balance**

3- J.G.A Produce **rennin** (an *enzyme* converting a polypeptide in blood, **angiotensinogen**, to **angiotensin I** whose actions include the:

(***1)elevation of blood pressure and (2)stimulation of aldosterone release*** from the adrenal cortex, increasing *resorption of sodium ions* from the distal convoluted tubules),vital role in **controlling BP**

5- Erythropoietin ,affecting RBC production

5- Calcium metabolism ,(absorption)by converting of vit.D to active form dihydroxy vit.D.

- **Erythropoietin**, also known as **erythropoetin** or **erthropoyetin** or **EPO**, is a glycoprotein hormone that controls erythropoiesis, or red blood cell production. It is a cytokine (protein signaling molecule) for erythrocyte (red blood cell) precursors in the bone marrow. Human EPO has a molecular weight of 34 kDa.

Importance of EPO

- Also called **hematopoietin** or **hemopoietin**, it is ***produced by interstitial fibroblasts in the kidney*** in close association with peri-tubular capillary and tubular epithelial tubule. It is also produced in **peri-sinusoidal cells in the liver**. In addition to erythropoiesis, erythropoietin also has other known biological functions. For example, it plays an important role in the brain's response to neuronal injury.[1]

- **Problems with erythropoietin**
- Individuals can suffer from having too much erythropoietin in the blood or from having an erythropoietin deficiency. ***High levels*** *of the hormone often occur when the body experiences chronic* ***low levels of blood oxygen*** *or if tumors produce the hormone. When this occurs, the patient will develop a high red blood cell count, which is called* ***polycythaemia***.

- This can produce few symptoms, but sometimes will **produce itching, dizziness**, **joint pain, and fatigue.**
- Low levels of erythropoietin occur when someone is suffering from chronic kidney diseases. Low red blood cell counts cause anemia; symptoms include fatigue, **shortness of breath, increased heart rate, and dizziness**

-] EPO is also involved in the wound healing process.[2]
- When exogenous EPO is used as a performance-enhancing drug, it is classified as an erythropoiesis-stimulating agent (ESA). Exogenous EPO can often be detected in blood, due to slight differences from the endogenous protein, for example, in features of posttranslational modification.

increase of blood pressure (may be associated with –

-renal disease,

-juxtaglomerular cells hypertrophy); they contain renin within their granules, an enzyme converting a polypeptide in blood, angiotensinogen, to angiotensin I.

- *This is converted by other enzymes (notably in the lungs) into angiotensin II, a polypeptide whose actions include the elevation of blood pressure and stimulation of aldosterone release from the adrenal cortex, increasing resorption of sodium ions from the distal convoluted tubules.*

juxtaglomerular apparatus determining the final concentration of the urine.

Renin secretion may be controlled by at least three factors):

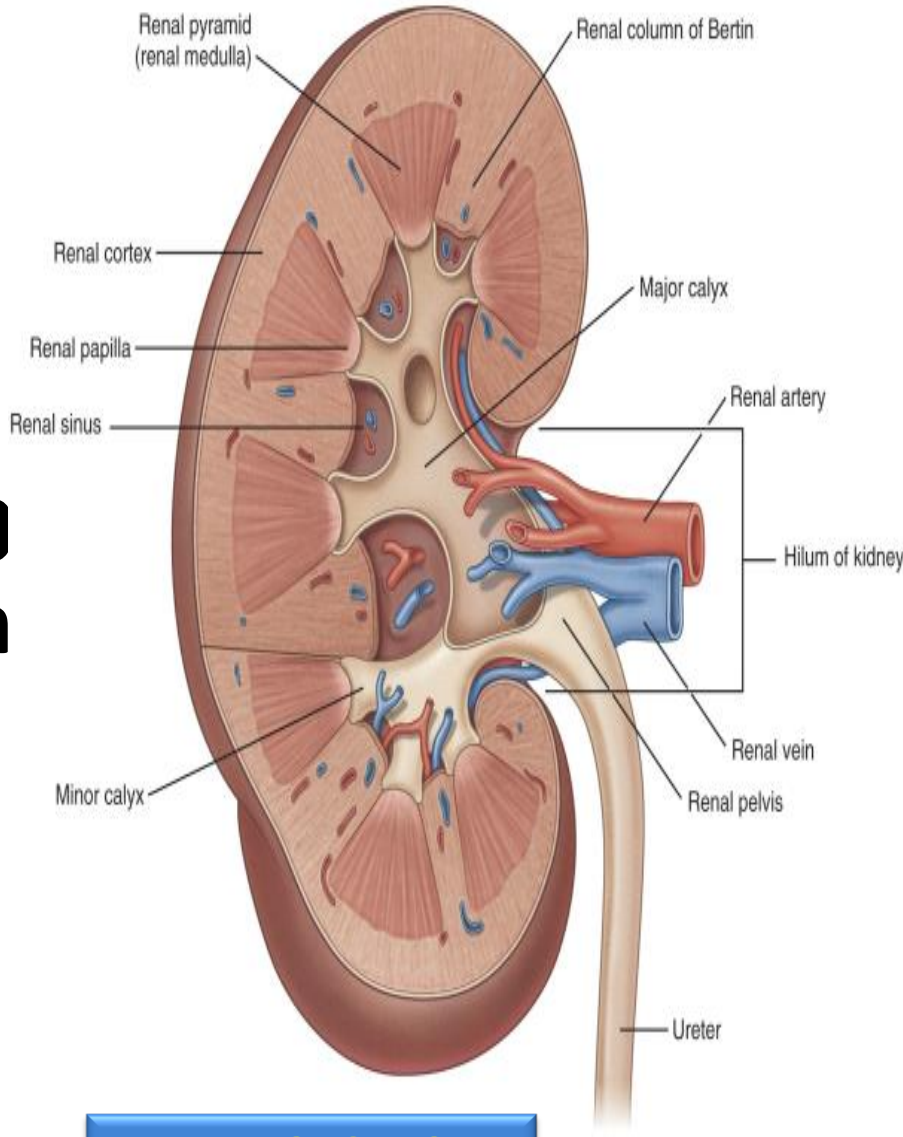
- ***1- the activity of the macula densa cells which react to changes in fluid passing them in the distal tubules;***

2- pressure in glomerular arterioles affecting the secretory activity of their granule cells;

- *stimulation by sympathetic fibers ending* ***near juxtaglomerular cells.***

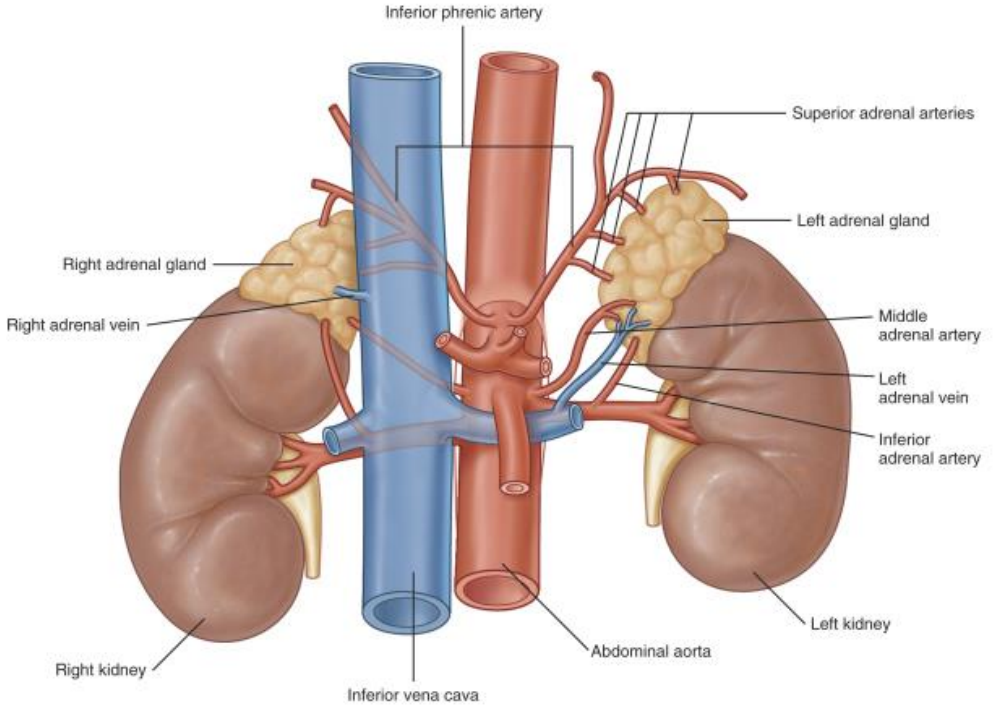
GROSSLY

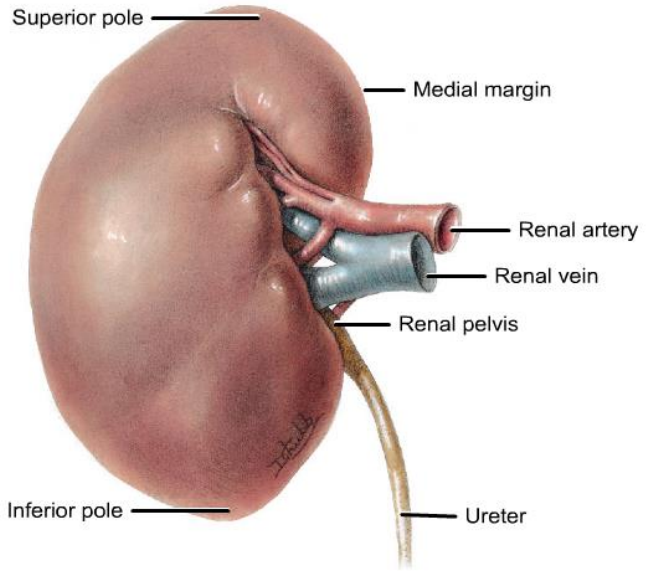
- **The kidney are bilaterally paired reddish brown organs ,bean shape .**
- **Each kidney weighs 150 gm in male & 135 gm in female.**
- **The kidney generally measured 10-12 cm vertically ,5-7 cm transversely,& 3cm in antero-posterior dimension.**



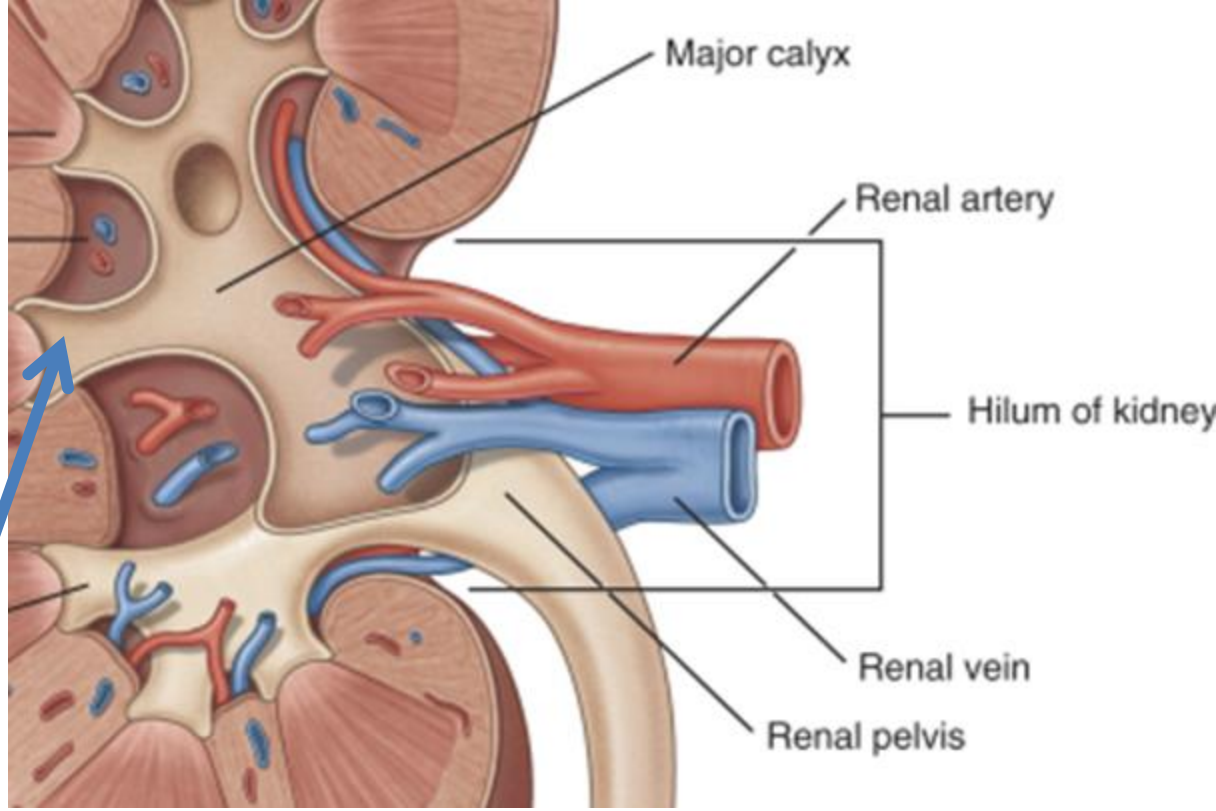
cm 3-6-12
2.5-5-10

- Because of compression by the liver, the right kidney shorter & wider.
- In children, the kidneys relatively larger & possess more prominent fetal lobation ,which disappear by first year of life ,occasionally persist into adulthood.

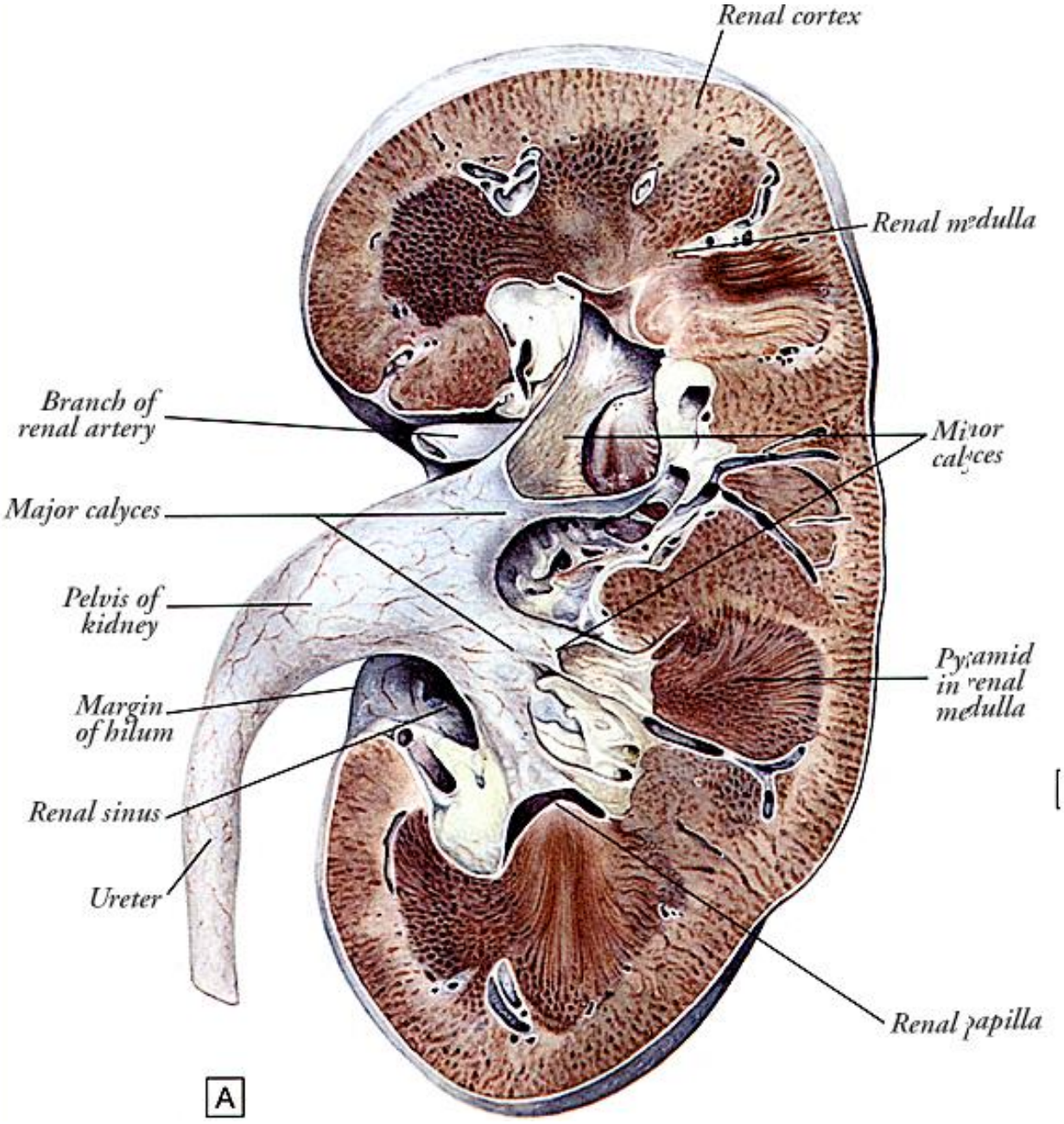




Renal sinuses: space in hilum contain renal pelvice (2-3 major calyces then each form 2-3 minor cal.) minor calyx receive one papilla.

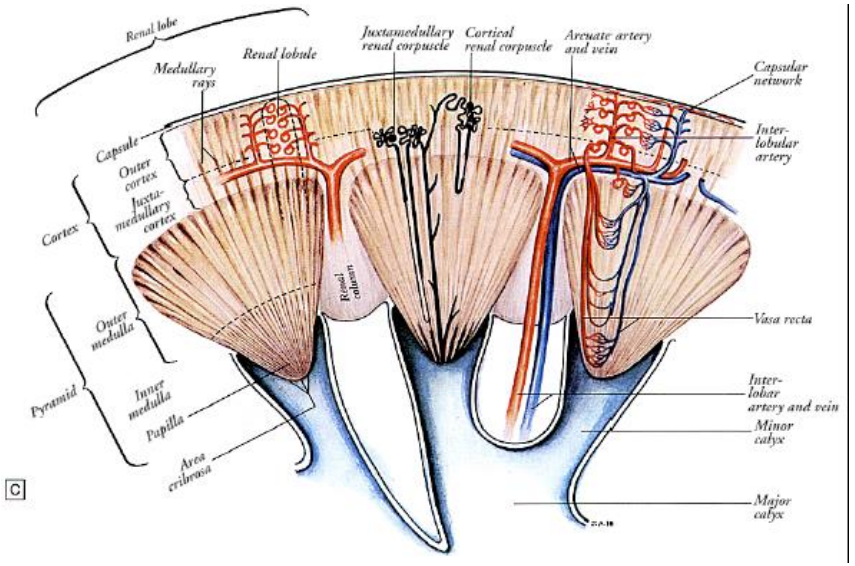


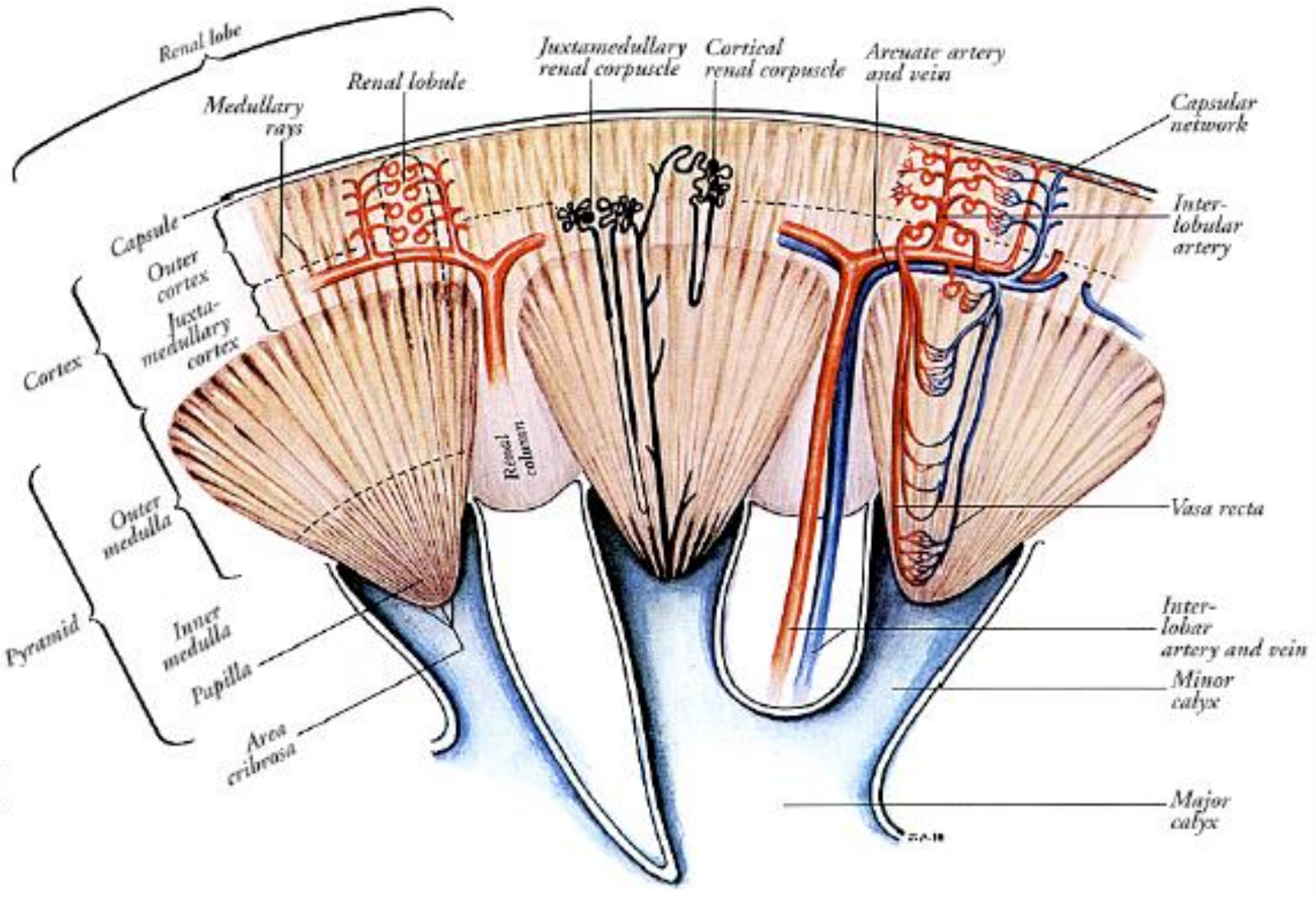
- Renal pyramid dozen in no (<12).


Renal cortex
Renal medulla
Branch of renal artery
Minor calyces
Major calyces
Pelvis of kidney
Pyramid in renal medulla
Margin of hilum
Renal sinus
Ureter
Renal papilla
A

The kidney divided in to cortex & medulla

- the medullary areas are pyramidal,more centrally located & separated by section of cortex the segments of cortex called **columns of *bertin.***
- The renal medullas are multiple,distinct,conically shaped area, darker than cortex.
- The same structures also called ***pyramids***
- .



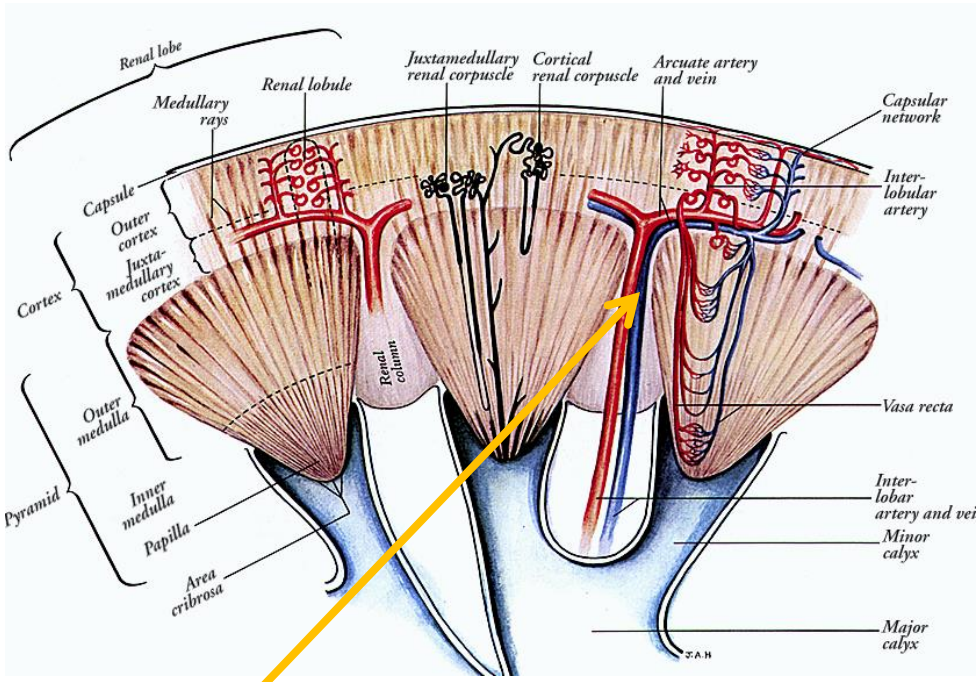

Renal lobe
Medullary rays
Renal lobule
Juxtamedullary renal corpuscle
Cortical renal corpuscle
Arcuate artery and vein
Capsular network
Capsule
Outer cortex
Juxta-medullary cortex
Cortex
Inter-lobular artery
Renal column
Outer medulla
Vasa recta
Pyramid
Inner medulla
Papilla
Area cribrosa
Inter-lobar artery and vein
Minor calyx
Major calyx
C

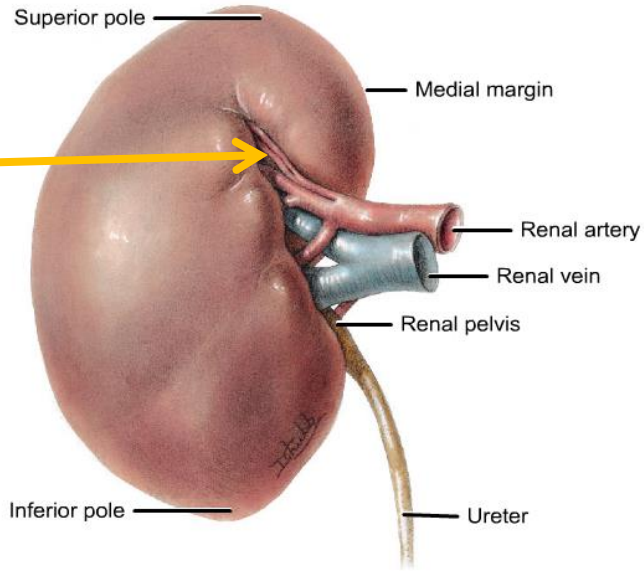
The pain, spasmodic and agonizing [illegible], is referred to cutaneous areas innervated from spinal segments which supply the ureter, mainly T11–L2. It shoots down and forwards from the loin (side of the human body below the rib cage to just above the pelvis)

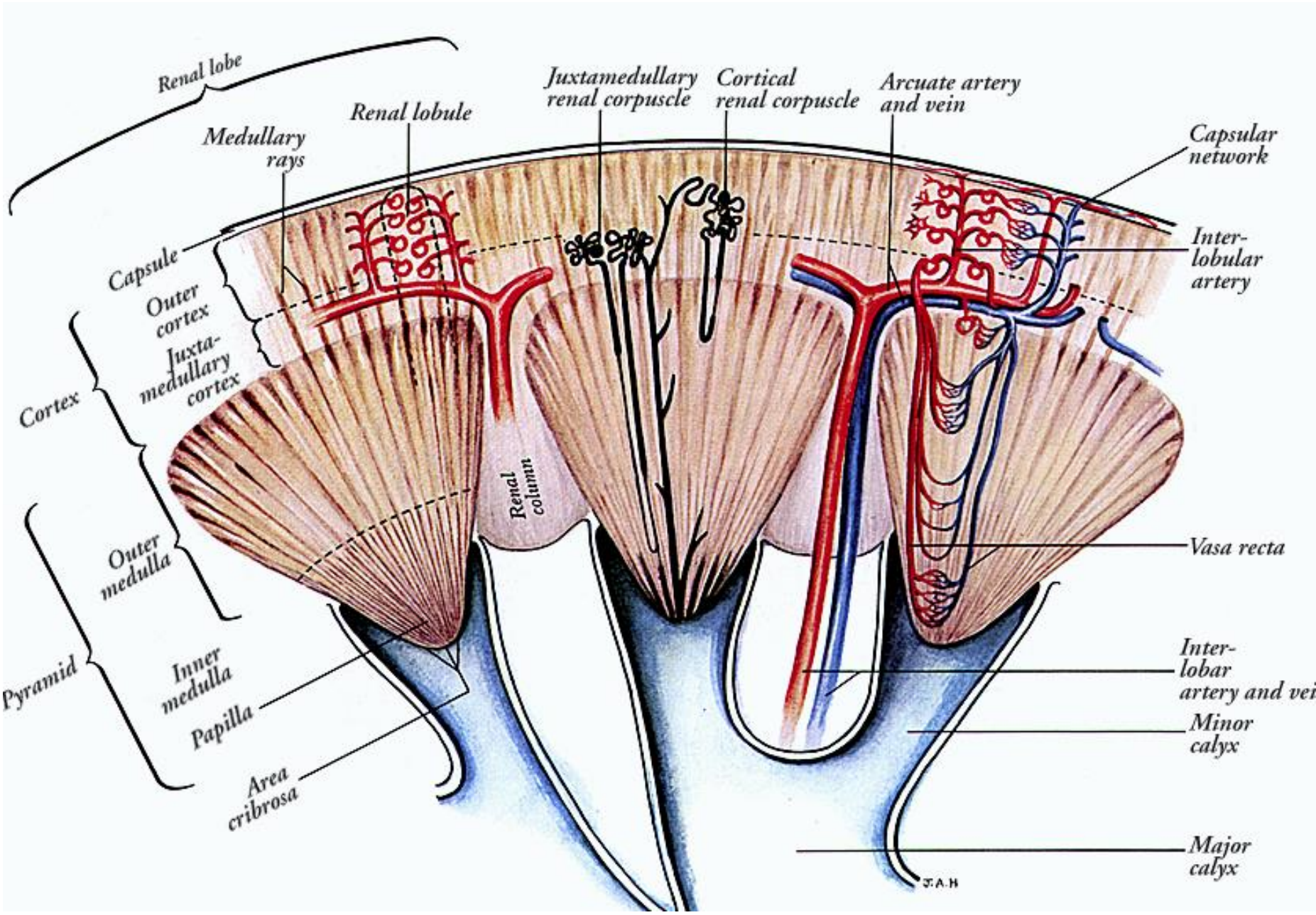
to the groin (between the abdomen and the thigh)and scrotum or labium majus and may extend into the proximal anterior aspect of the thigh(ilioiguinal)and projection to the genitofemoral nerve (L1, 2); the cremaster (which has the same innervation) may reflexly retract the testis.

- ***RENAL CORTEX: is*** **lighter in color than the medulla & not only cover the renal pyramid peripherally but also extends between pyramids (columns of BERTIN) themselves .**

through these columns the renal vessels traverse from renal sinus to peripheral cortex



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Cortical renal corpuscle
Arcuate artery and vein
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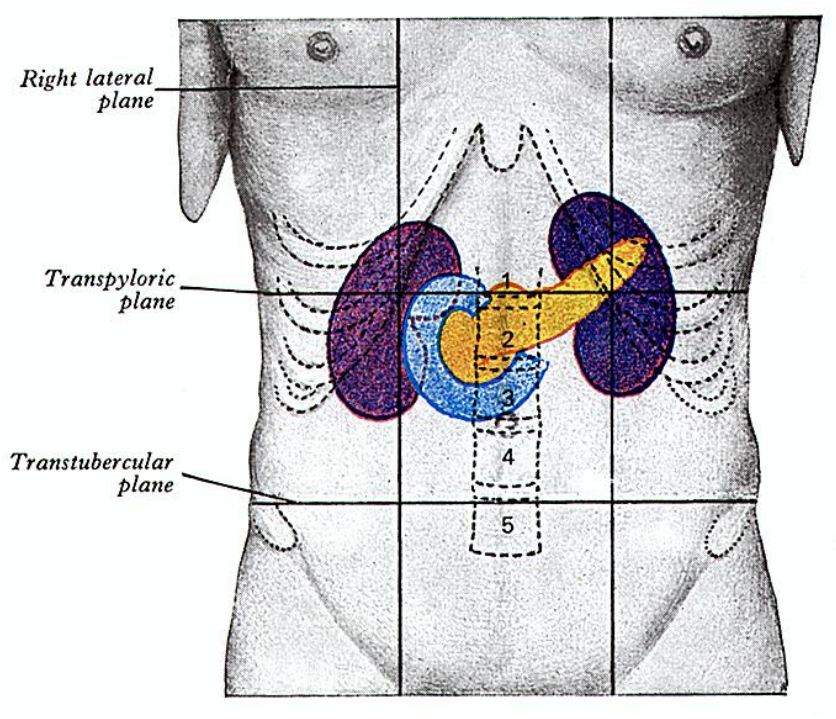
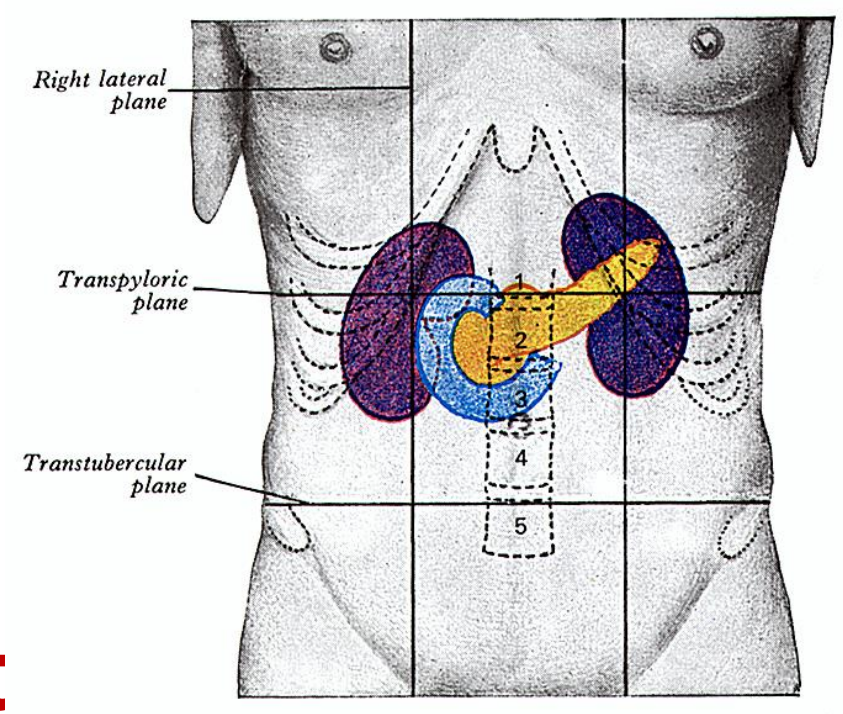
Vasa recta
Pyramid
Inner medulla
Papilla
Inter-lobar artery and vei
Minor calyx
Area cribrosa
Major calyx
F.A.H

Renal surface projects

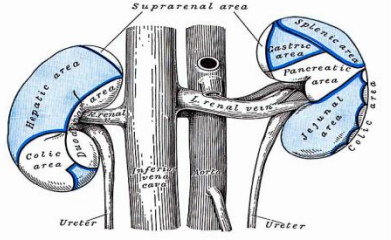
- ***Anterior surface***: hilar centre at transpyloric plane, medial to tip of 9th costal cartilage(left hilar just above the plane & right just below)
- ***Posterior surface:*** the hilar centre opposite the lower border of spinous process of L1

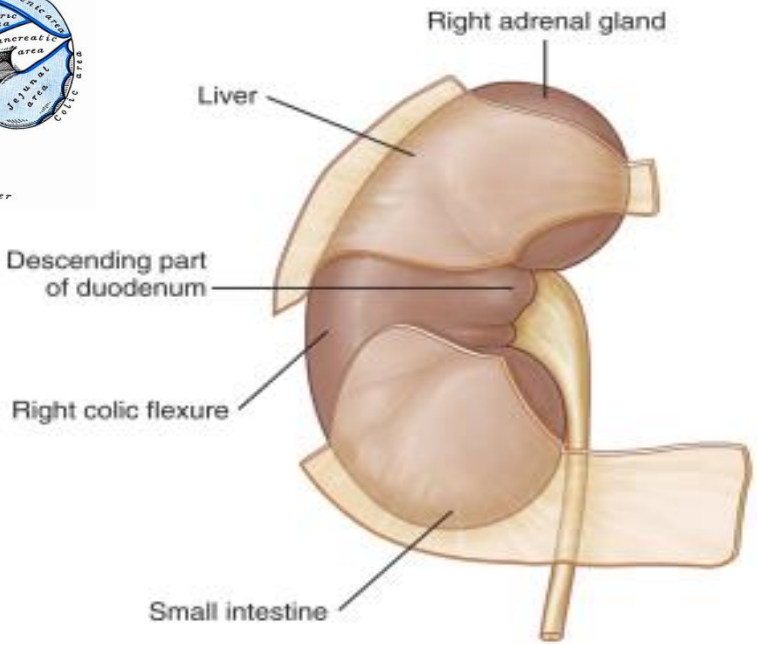


- The kidneys are 2.5cm lower in standing than recumbent position
- They ascend & descend a little with respiration
- **Right kidney 1.25 cm lower than left because right lobe of liver**



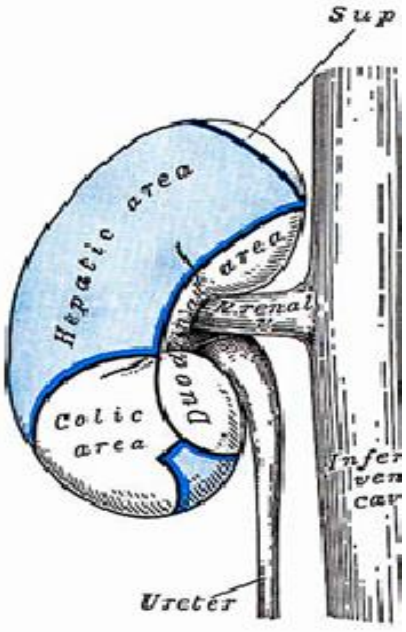
Renal relations





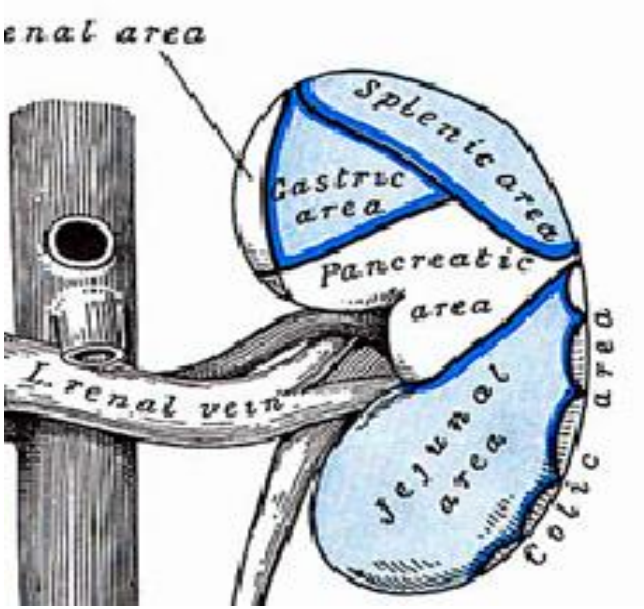
- ***Anterior surface of right kidney***:
- **Superior pole:- contacts the suprarenal gland ,large area belc this ;right lobe of live**
- **Medial area: 2nd part of duodenum.**
- **Inferiorly contact with right colic flexure laterally & small intestine medially,**

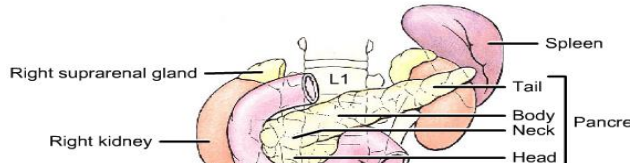
The area of contact with liver & small intestine cover by peritoneum, but suprarenal duod. & colic area devoid peritoneum.

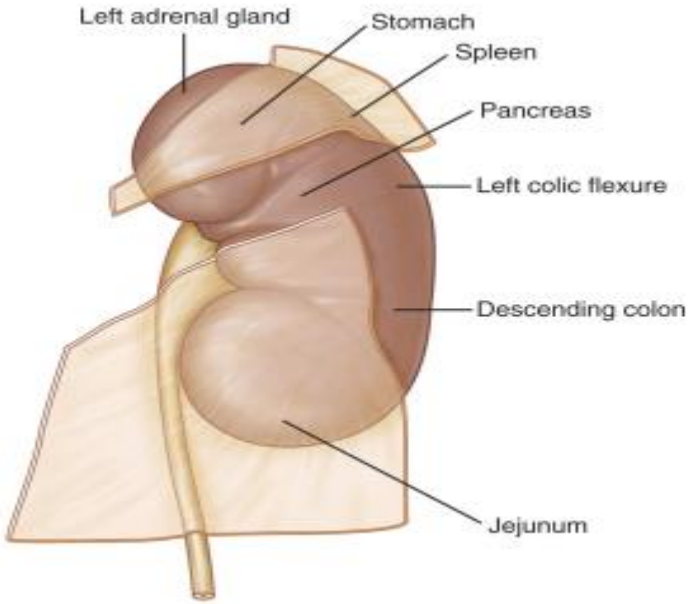


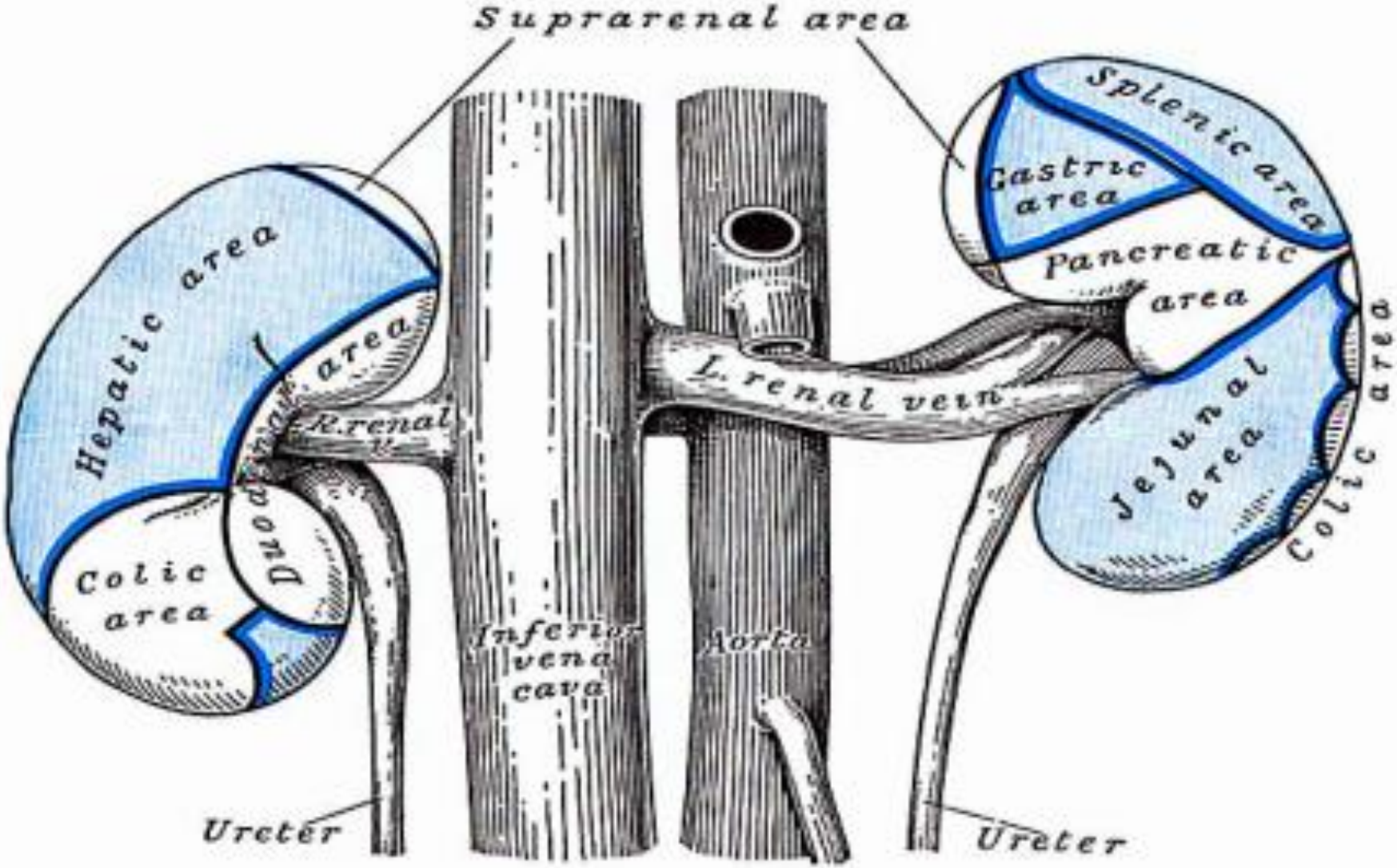
- ***Anterior surface of left :***
- superior pole: L. SUPRARENAL GLAND,
- lateral half related to spleen,
- central area: pancreatic body & splenic vessels, stomach,
- lateral region: L. colic flexure & beginning of descending colon,
- Medial :coils of jejunum.

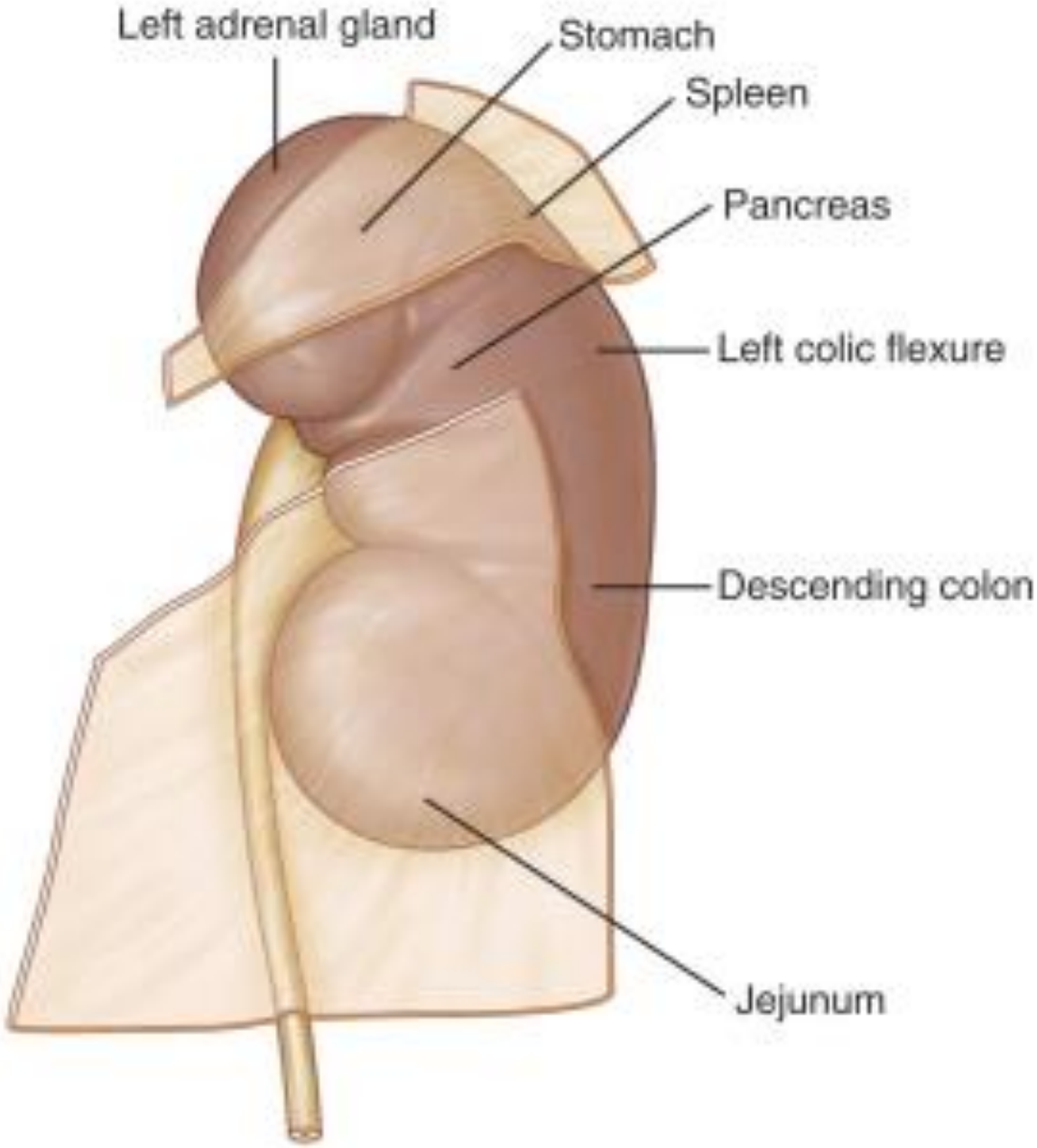
The gastric area, spleen & jejunal area are cover with peritoneum.
The suprarenal ,pancreatic & colic area are devoid of peritoneum.





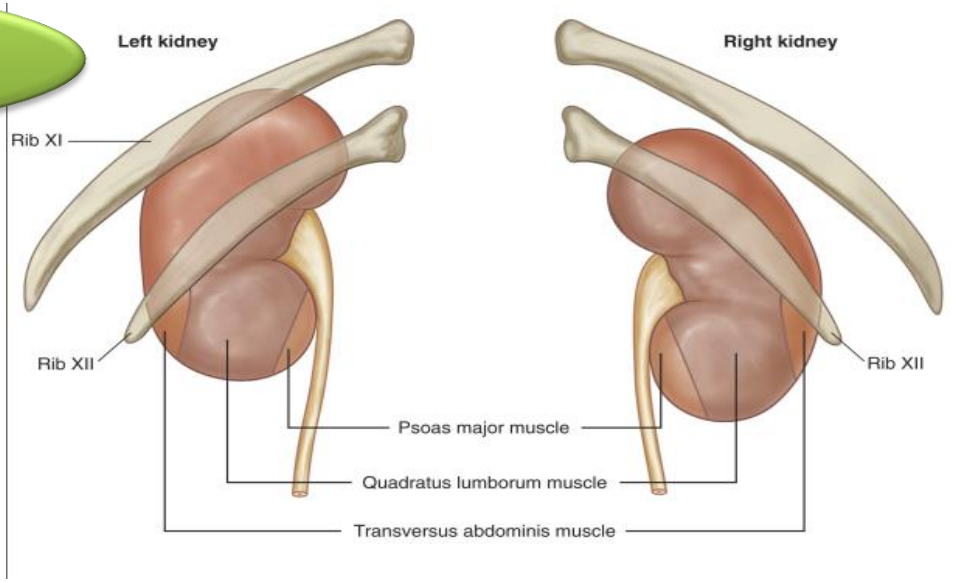


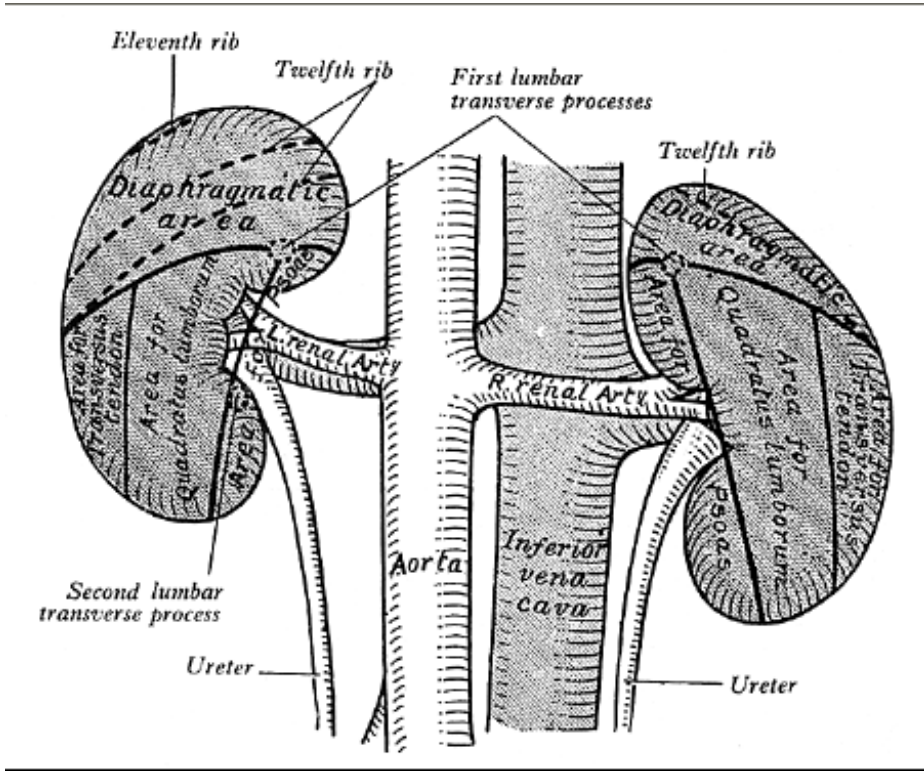

Suprarenal area
Splenic area
Gastric area
Pancreatic area
Hepatic area
Duodenal area
R. renal v.
L. renal vein
Jejunal area
Colic area
Colic area
Inferior vena cava
Aorta
Ureter
Ureter


Left adrenal gland
Stomach
Spleen
Pancreas
Left colic flexure
Descending colon
Jejunum

Posterior surface

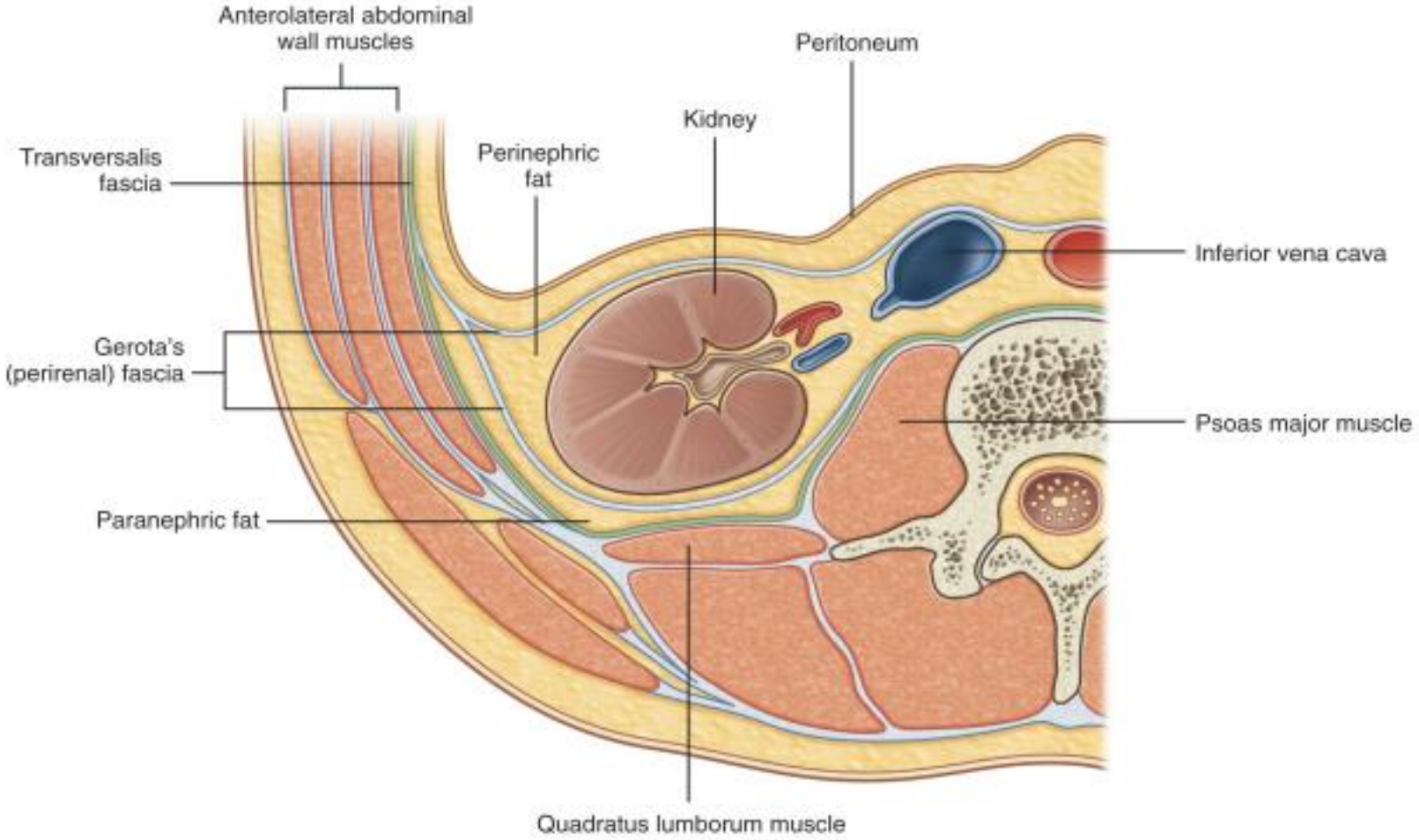
- Posteromedial is embedded in fat & devoid of peritoneum.
- It is Anterior to diaphragms & to the medial & lateral arcuate ligament ,psoas major ,quadratus lumborum & aponeurotic tendon of transversus abdominis ,to subcostal vessels & subcostal. iliohypogastric & ilioinguinal nerve .
- The upper pole of R. kidney is level with 12th rib ,that of L. kidney with 11th & 12th ribs.





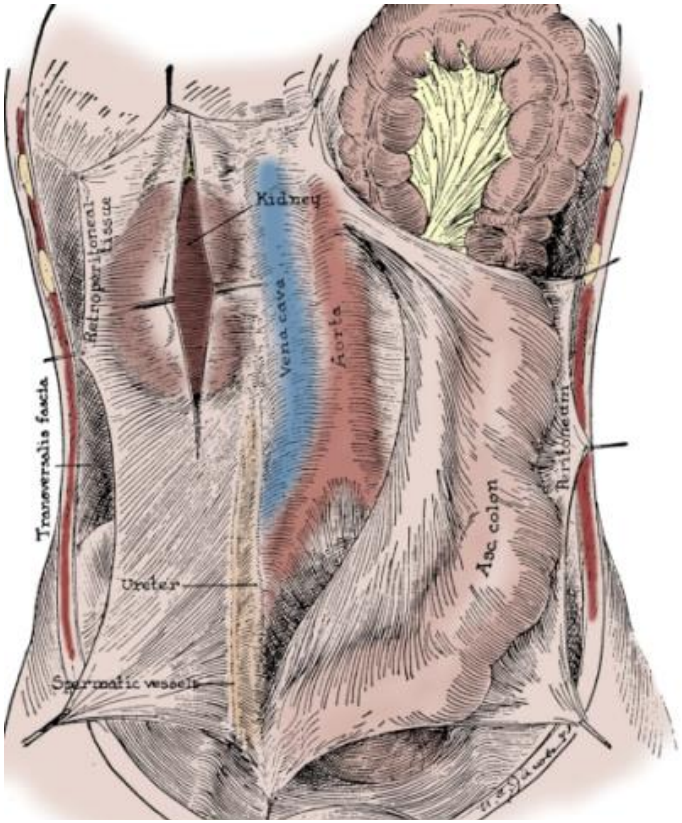
Covering of kidney

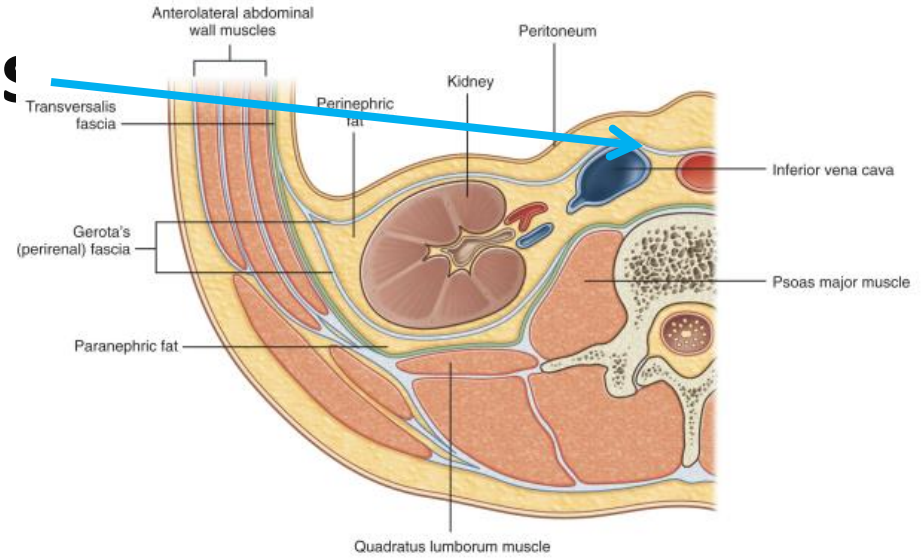
1. Fibrous capsule : closely attached to outer surface.
2. Perirenal fat :around the renal capsule .



3. perirenal fascia (gerotas fascia): enclose kidney &suprarenal gland & continuous laterally with fascia transversais,the fascia enclose kidney on 3 sides: Superiorlly, medially& laterally.

Medially it extend acros midline to fuse with contra lateral side.

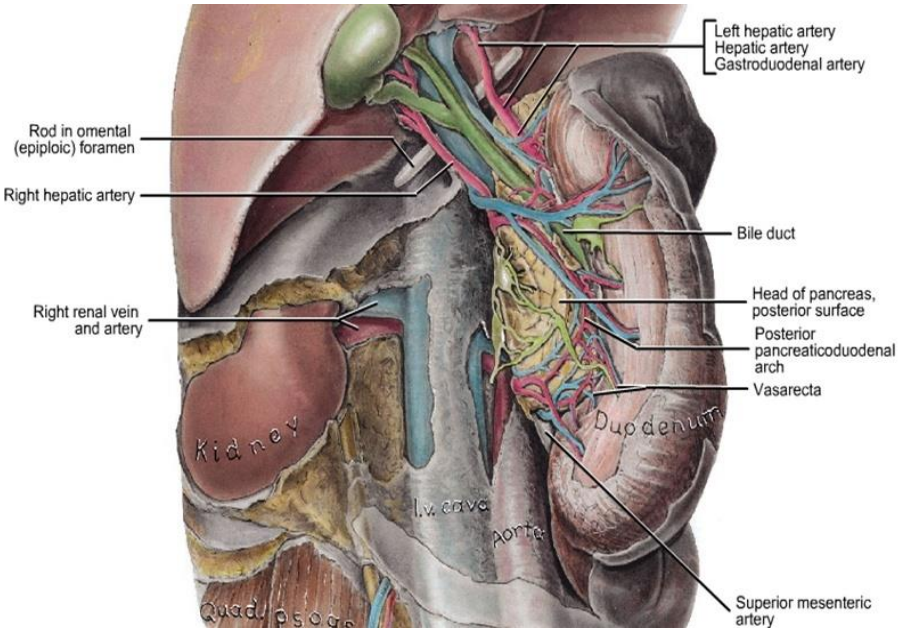




Inferiorly not closed & remain an open potential space.

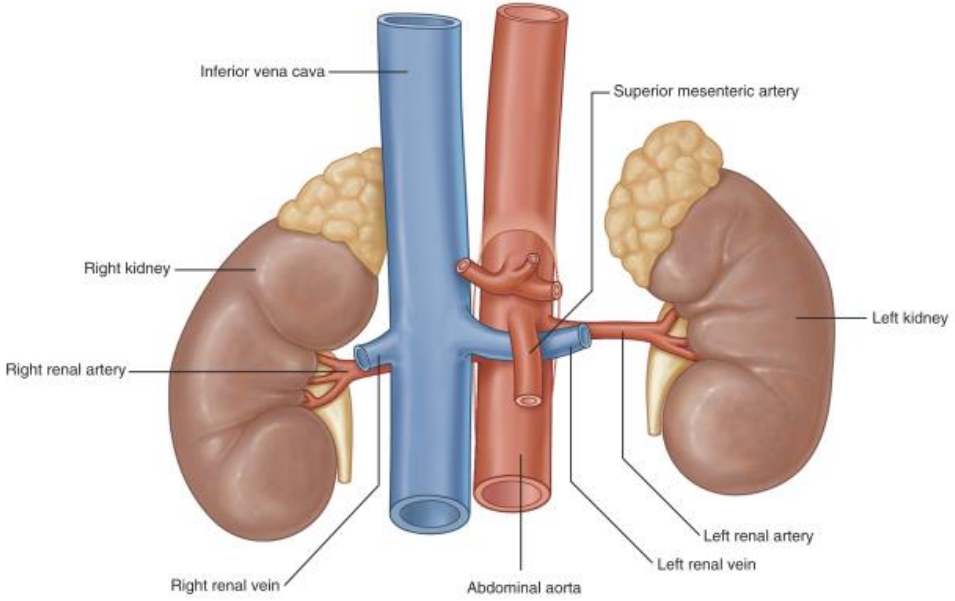
Gerotas fascia serves as an anatomical barrier to spread of malignancy .

4.Pararenal fat :continuous with retro peritoneal fat (extra peritoneal fat.



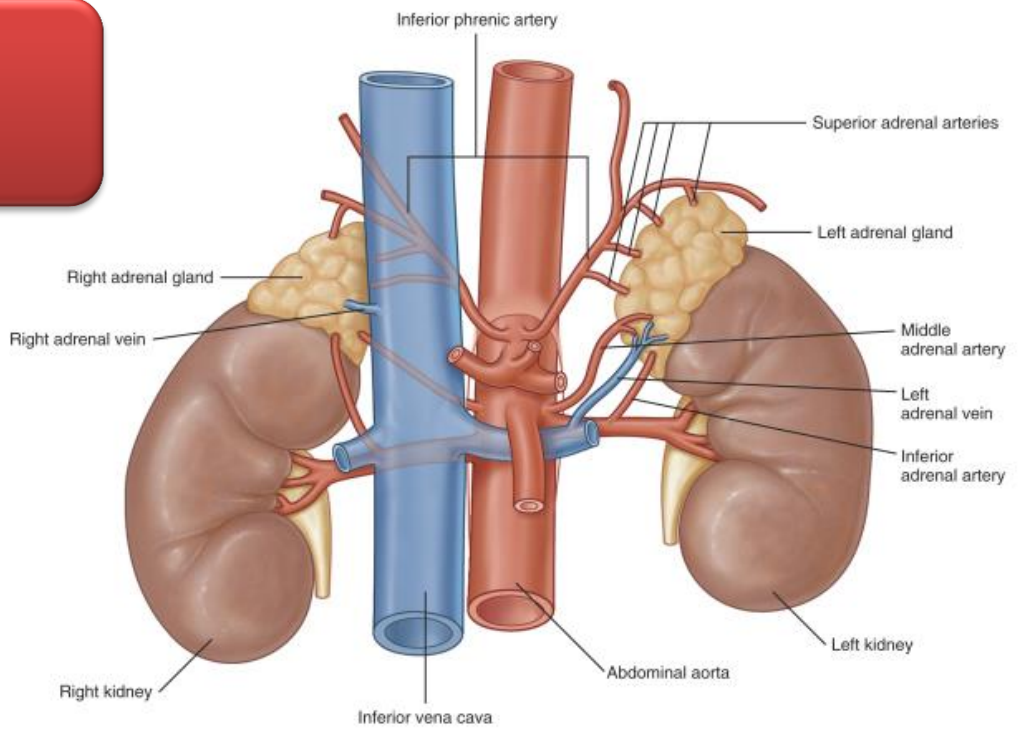
Renal vasculature

- **Classically consist of single artery & single vein that enter the kidney via the renal hilum.**
- **The artery & vein are branch from aorta & IVC, just below Superior mesenteric artery at level of L2.**
- **The vein anterior to artery , renal pelvis & ureter located posterior to vascular structure**



Renal artery

- **Right renal retry: leaves aorta & progresses with caudal slope under IVC toward the R. kidneys.**
- **Left renal artery: courses directly laterally to the L. kidney.**
- **Both renal artery move posteriorly as they enter kidneys**
- ***Both artery have branches to respective (adrenal gland, renal pelvis & ureter).***



- The renal artery splits into 4—5 ,thes are renal segmental artery.
- ***The 1st & most constant branch is posterior segmental branch ,which separate from renal artery before enters renal hilum*** .
- Typical 4 anterior branch from superior to inferior are (apical, upper, middle, lower)

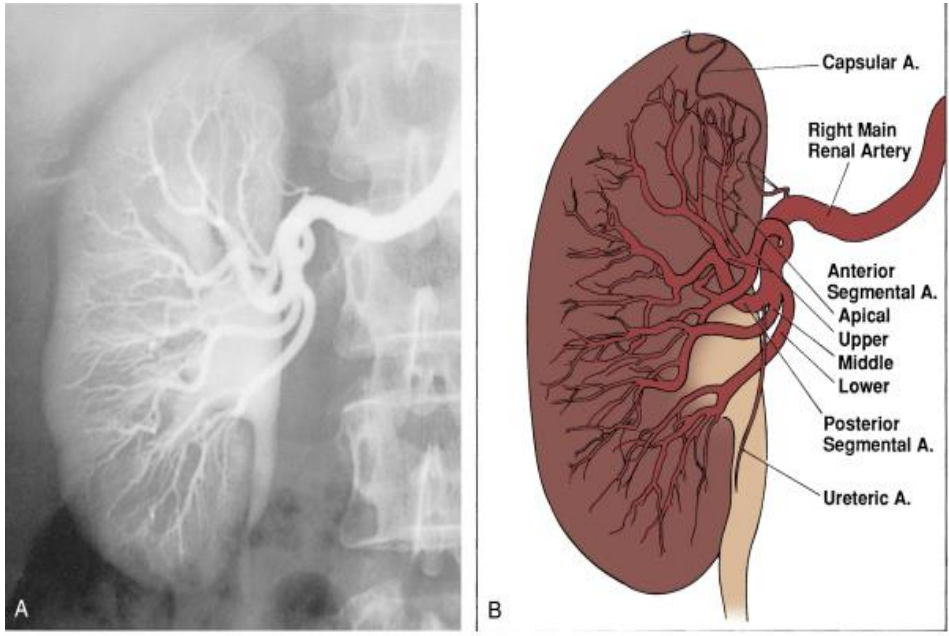
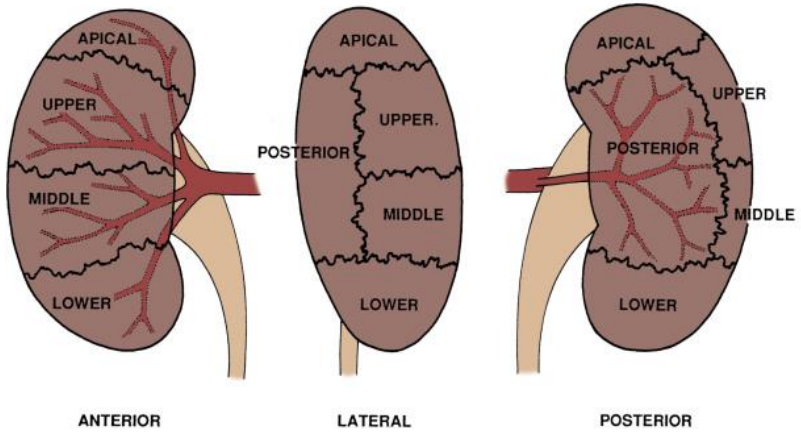
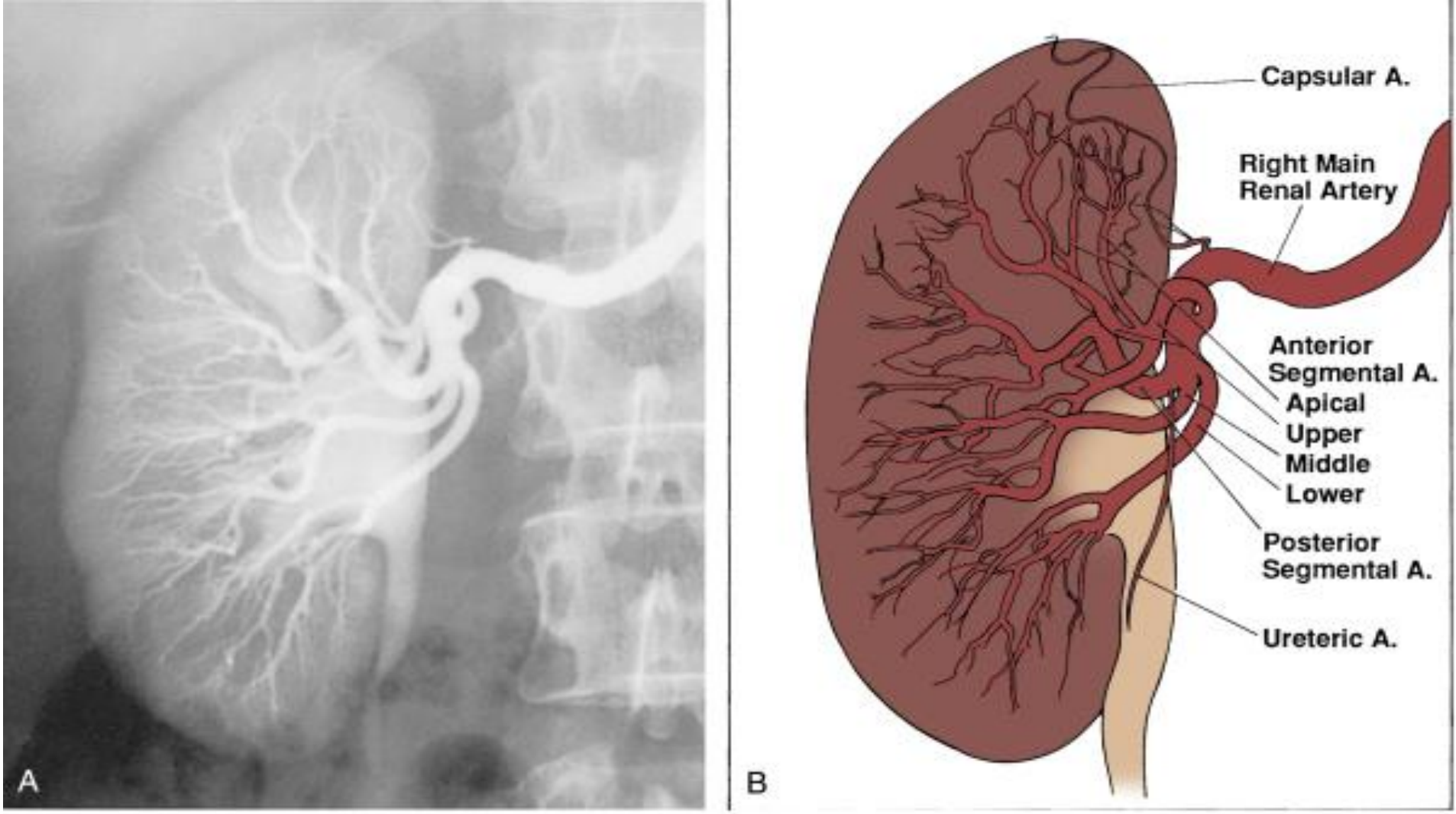


Figure 1-29 **A** and **B,** Segmental branches of the right renal artery demonstrated by renal angiogram.





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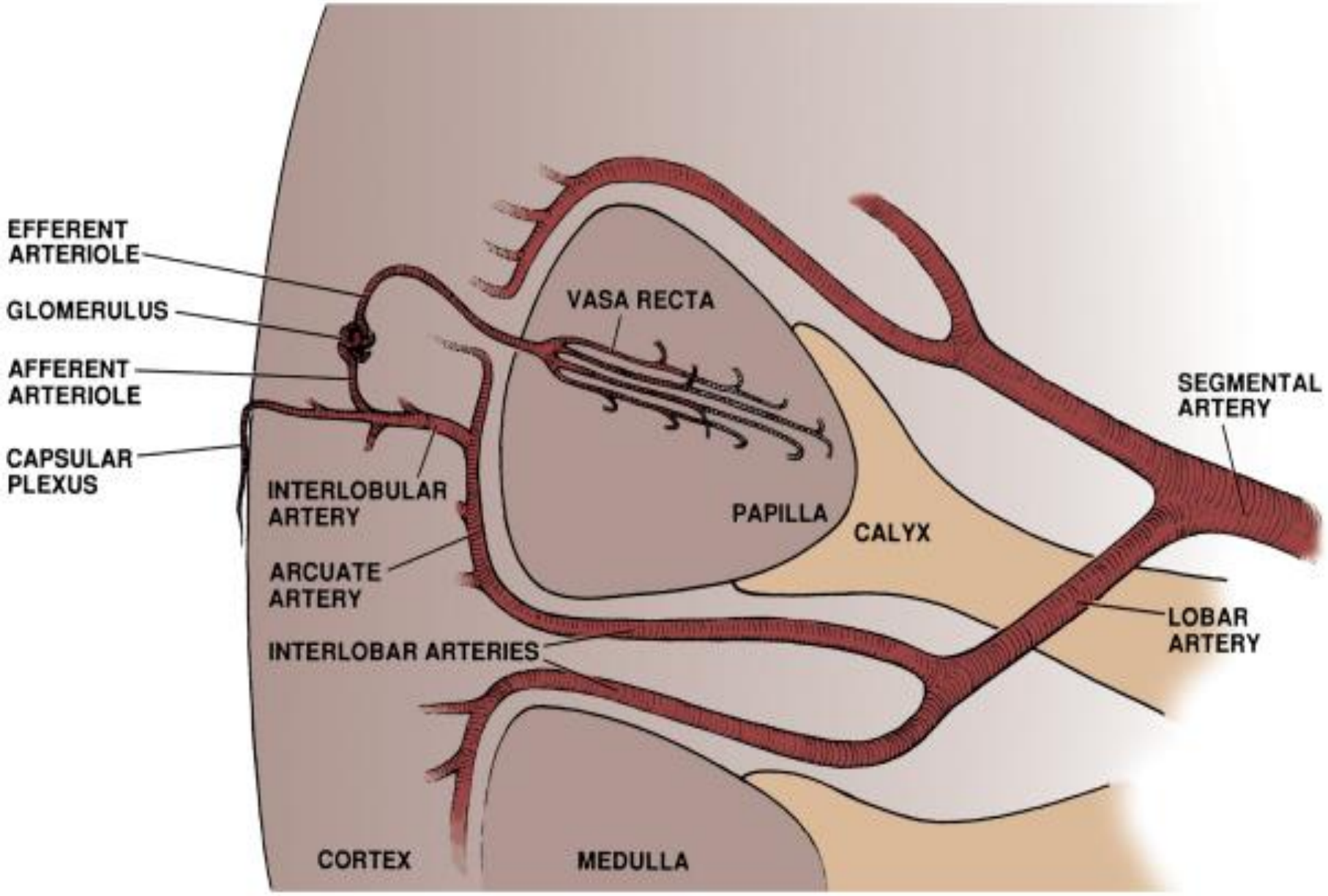
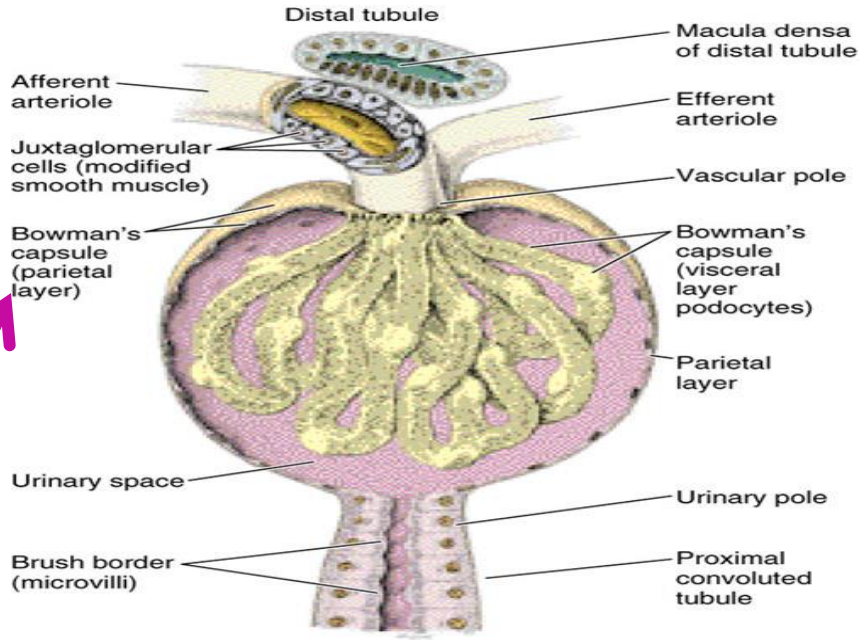


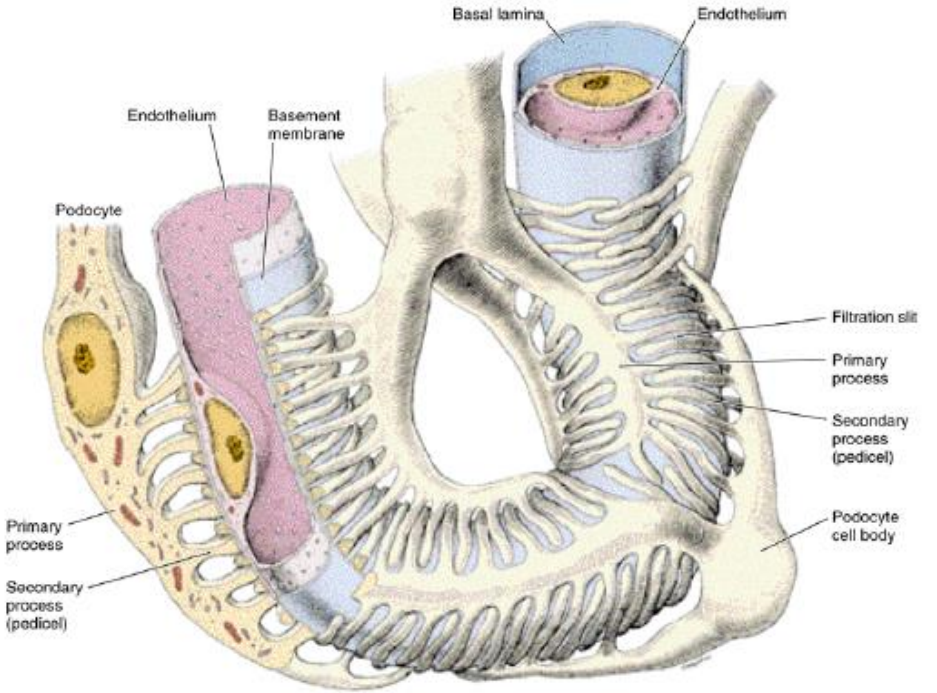
Figure 1-31 Intrarenal arterial anatomy.

2 million glomeruli

Each is fed by an afferent arteriole

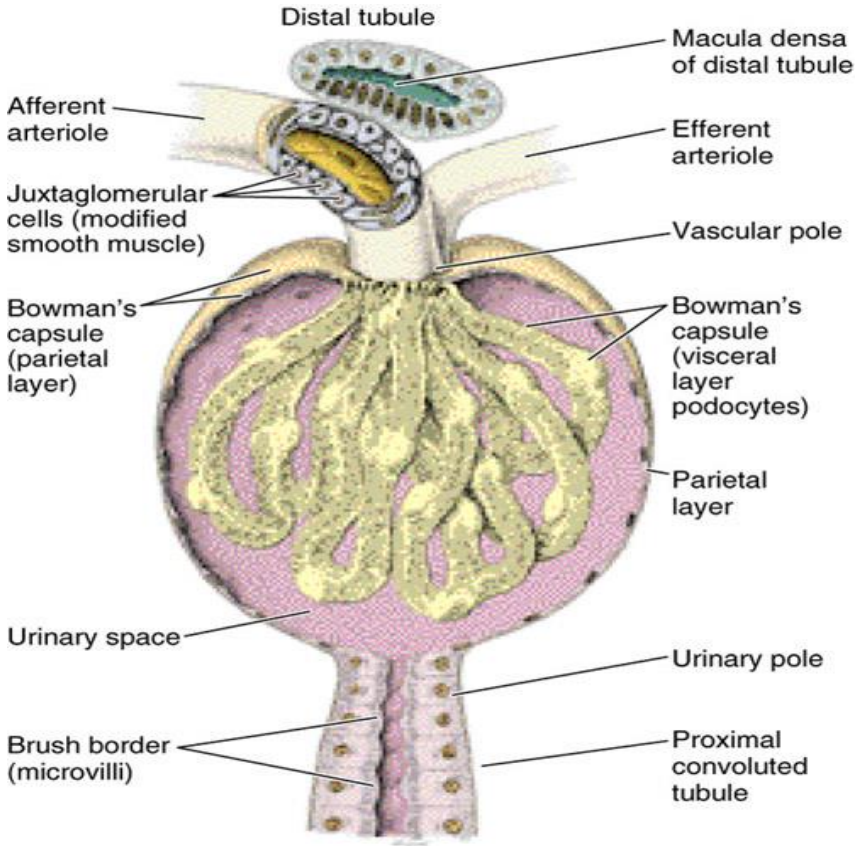
The urine filtrates leaves arterial system & collected in glumeriolar (bowman's) capsule





Glomerulus

- Double wall capsule parietal layer of simple Sequamus cells epithelium
- Visceral podocytes covering capillary network to form glomerulus's
- Between two layer capsular space
- Capsule with its glomerulus's form renal corpuscle

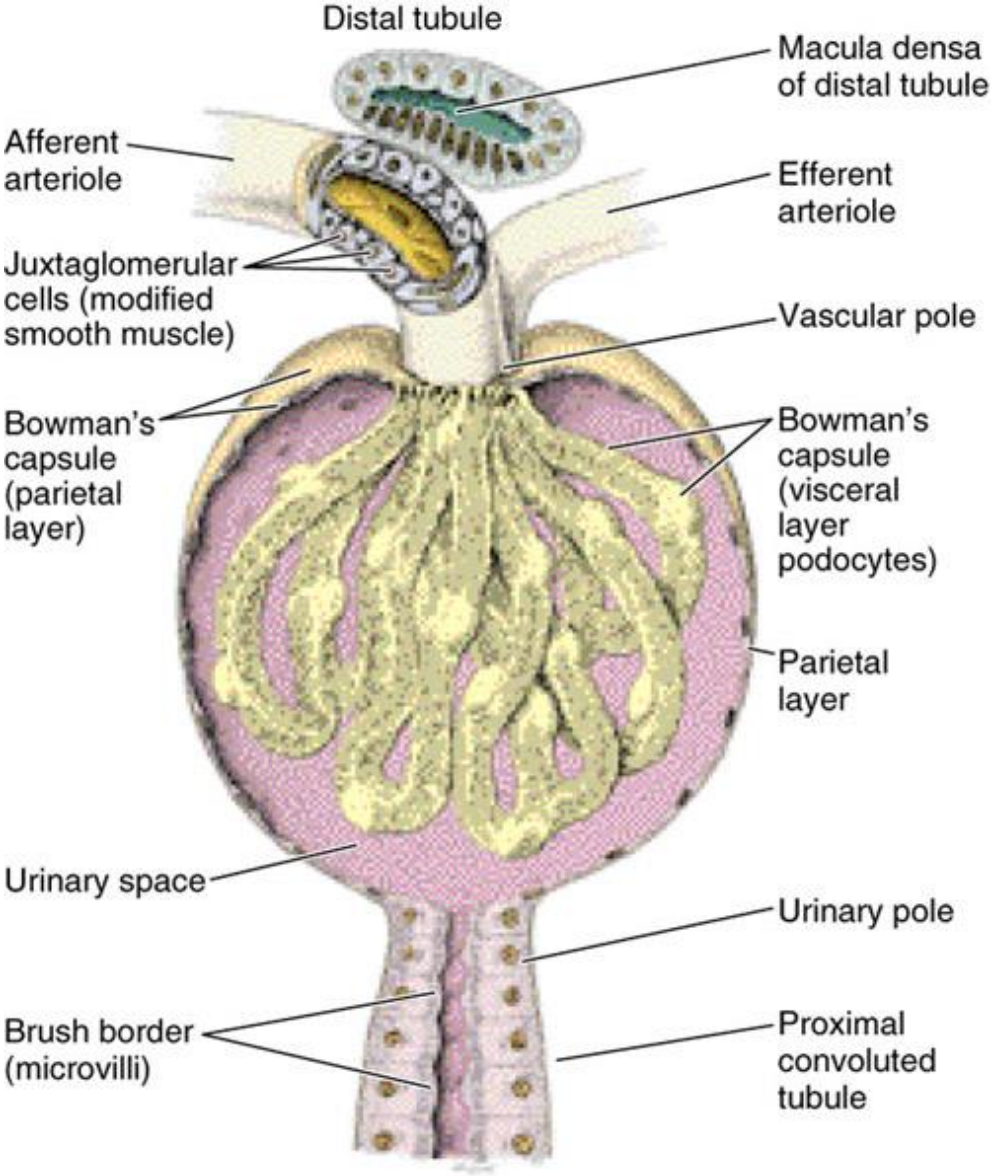


Histology

Blood flow leave glom. capillary via (efferent arteriole)& continues to one of two location:

2ndry capillary network around urinary tubules in cortex, or

Descending into renal medulla as the (vasa recta).

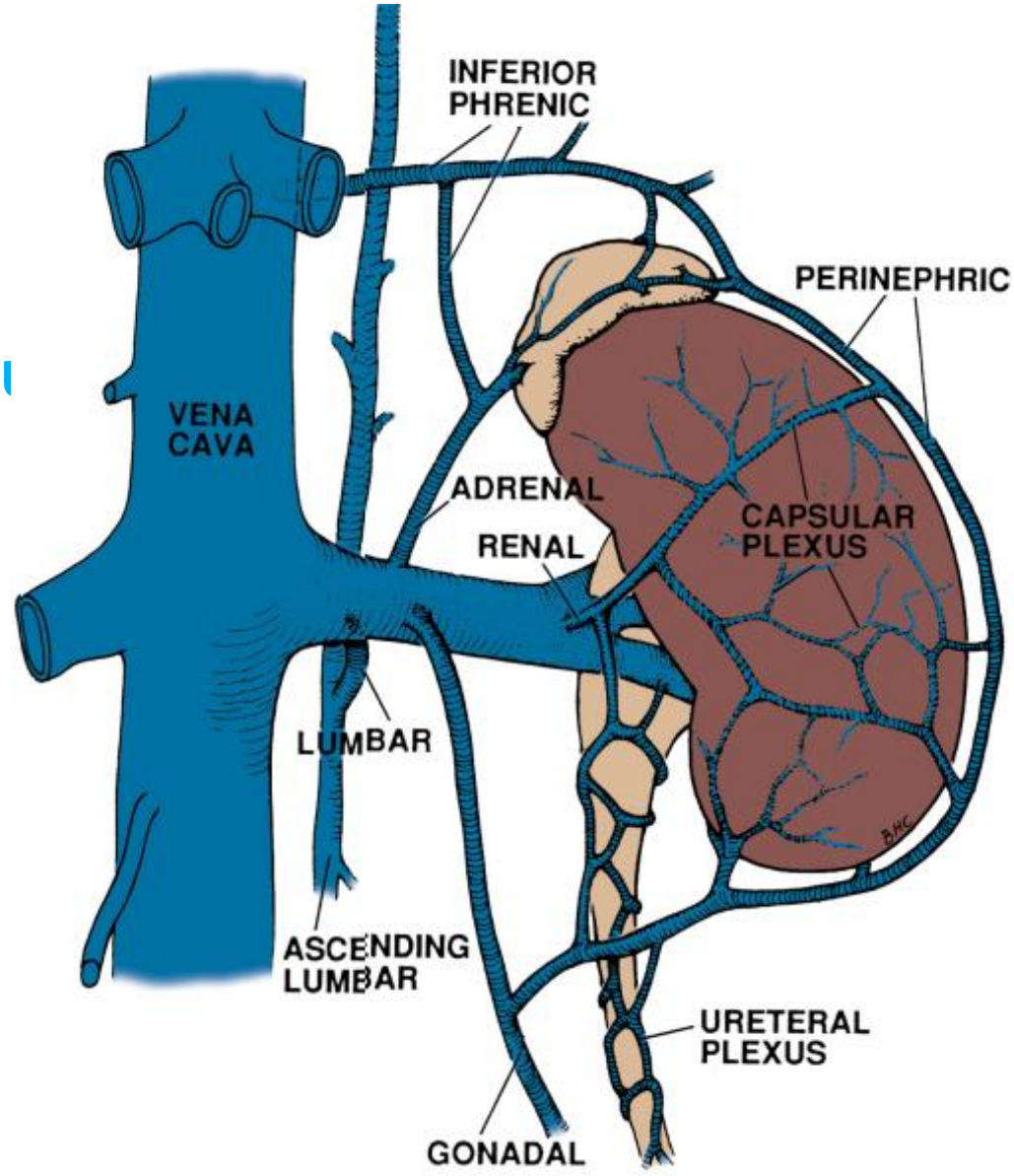


Renal vein

Renal venous drainage correlates closely with arterial supply.

Unlike arterial supply ,venou drainage communicates freely through venous collars around the infundibulum ,providing extensive collateral circulation.

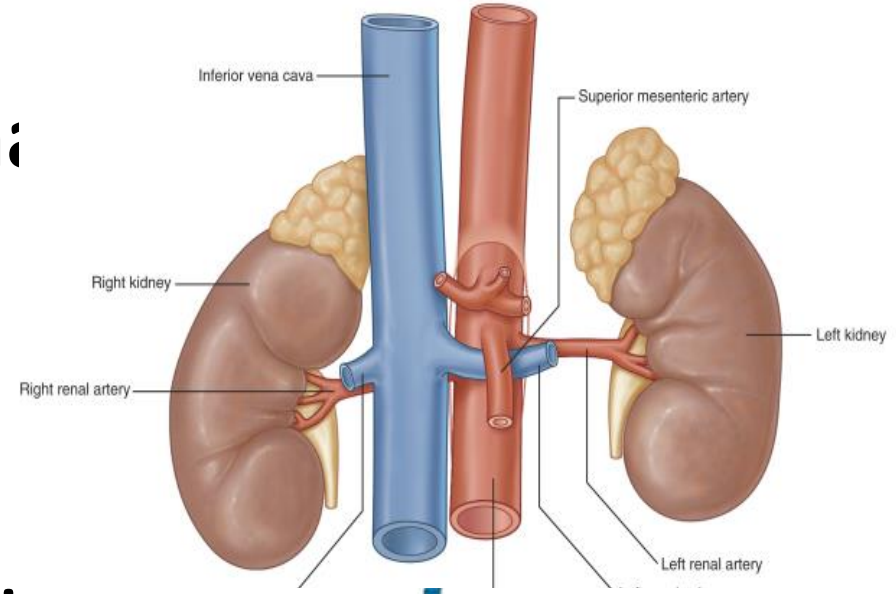
Surgically ,this is important because unlike arterial supply, the segmental venous branch has little effect on venous out flow.

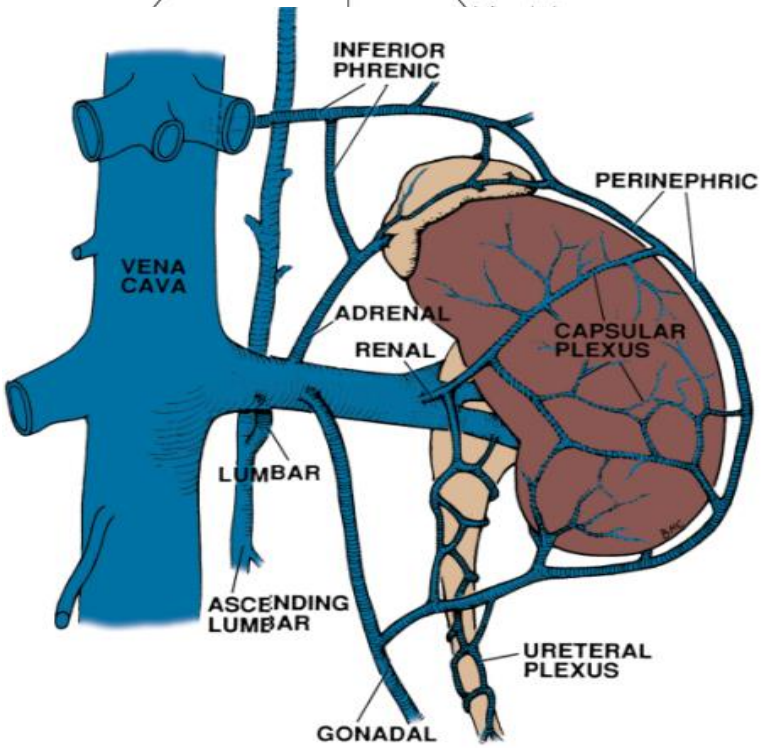


Renal vein is located directly anterior to rena art. ,this position can vary up to 1-2 cm cranially or caudally relative to artery.

Additionally, left renal vei received the ***left adrenal vein superiorly, lumber vein posteriorly & left gonadal vein inferiorly***

R. renal vein typically dose not receive any branches.

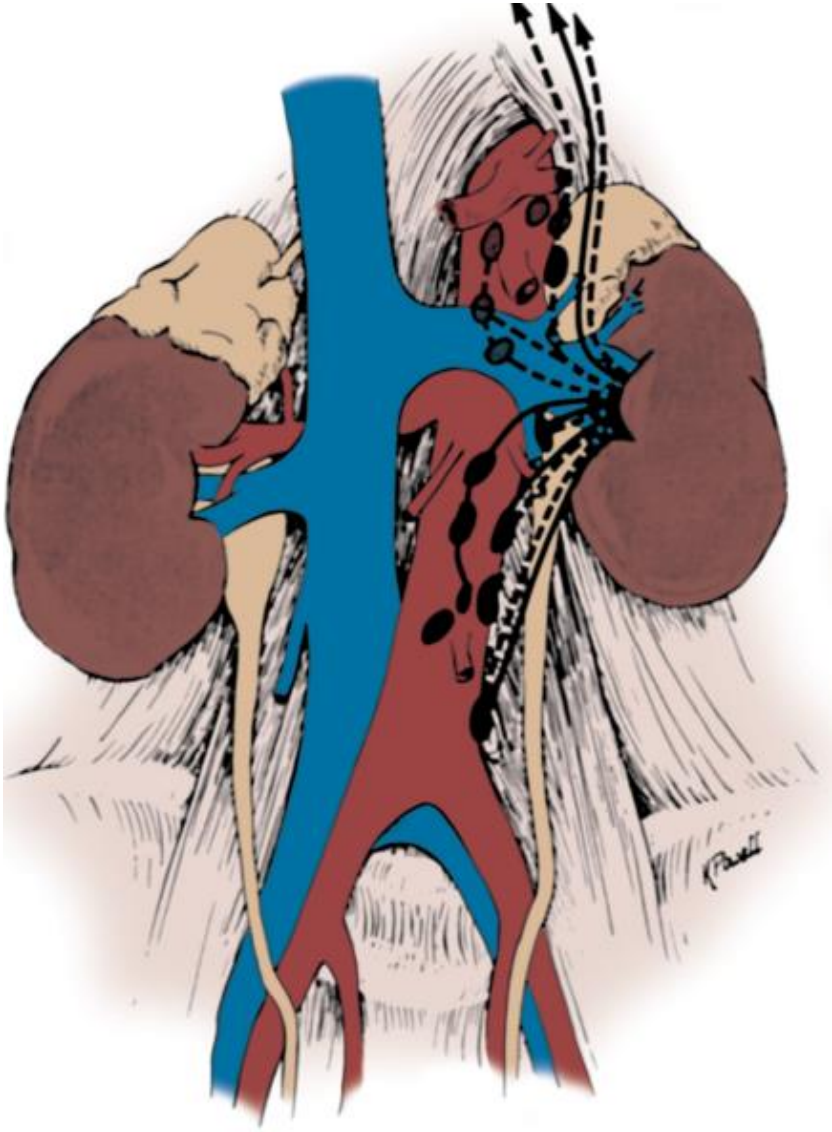




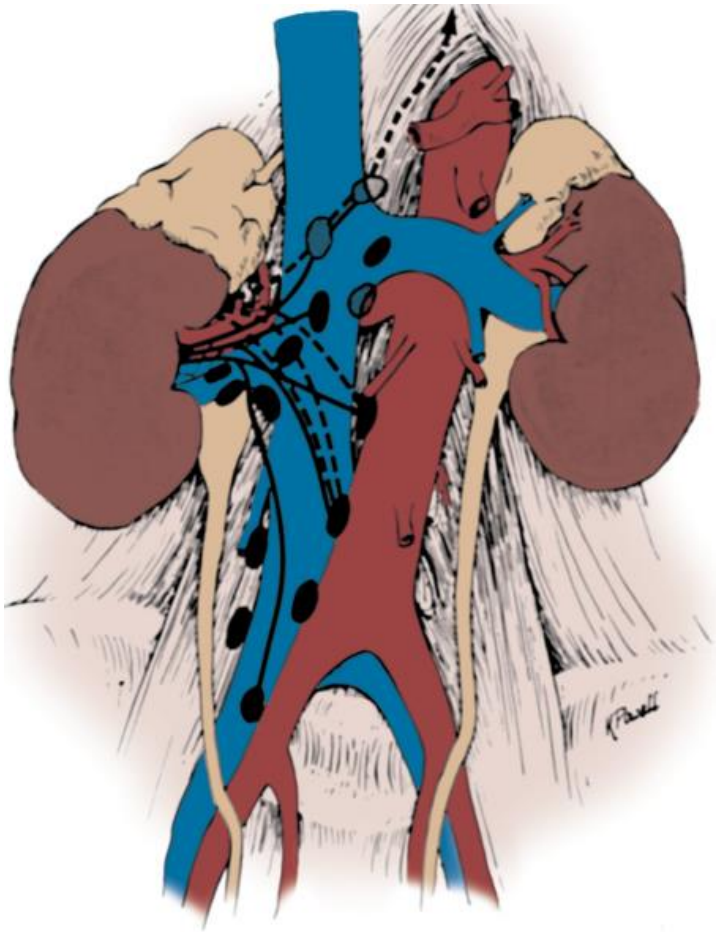
Renal lymphatic's

On the left: primary lymphatic drainage is into L.lateral para-aortic L.N.including node anterior & posterior to the aorta between inferior mesenteric artery & the diaphragm.

- Occasionally ,there will be additional drainage from left kidney in to retrocrural nodes or directly into thoracic duct above diaphragm.

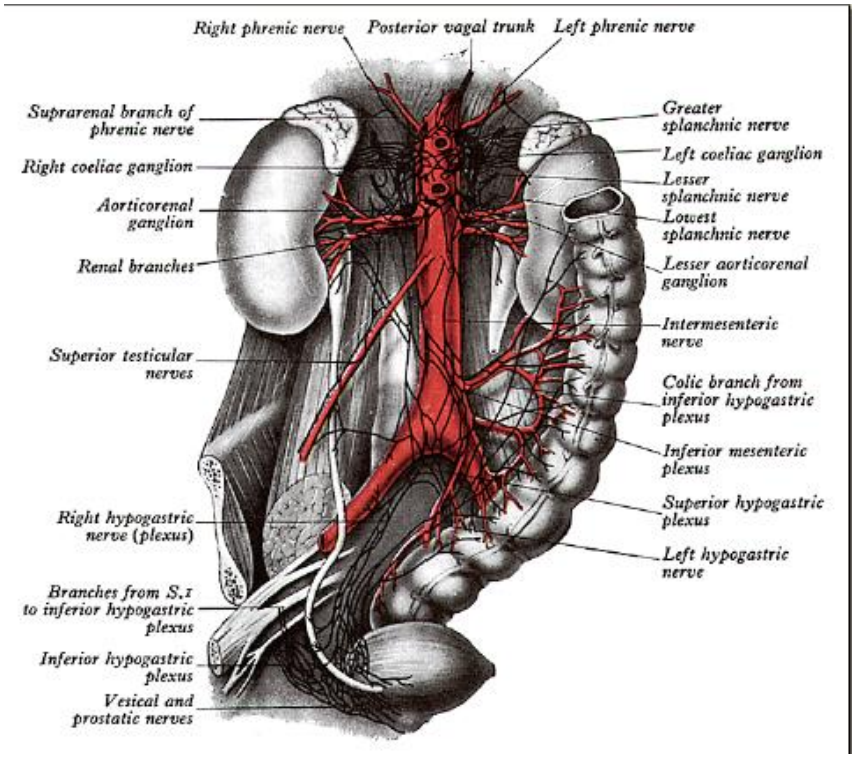


- On right: drainage is into (interaortalcaval) & right (paracaval) L.N.

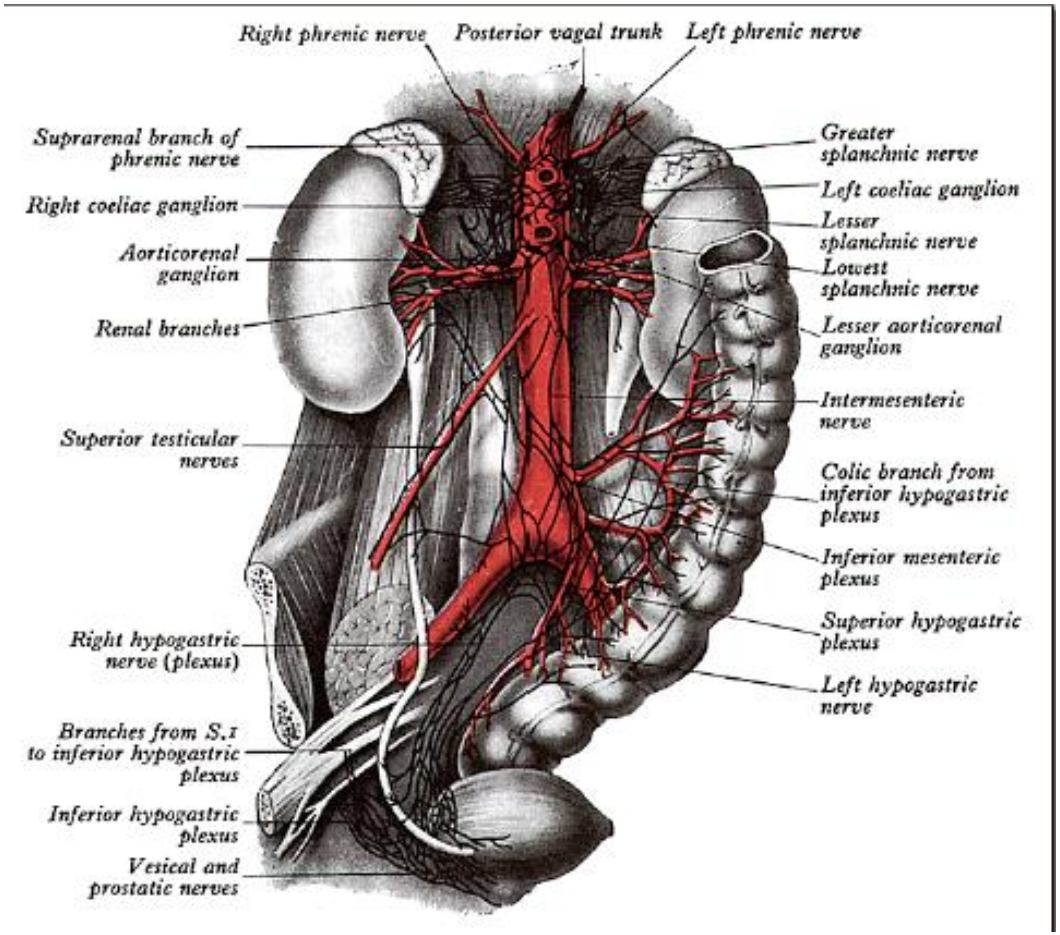


RENAL INNERVATION

- Sympth.pre.gang.nerve originate from 8th thora.through 1st lumber spinal segment & then travel to celiac & aortic gangl.
- Symp.postgang.fiber travel to kidn.via autonomic plexus surrounding renal artery

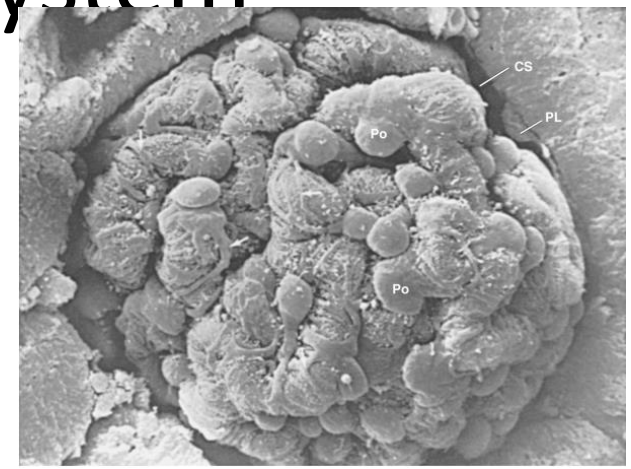


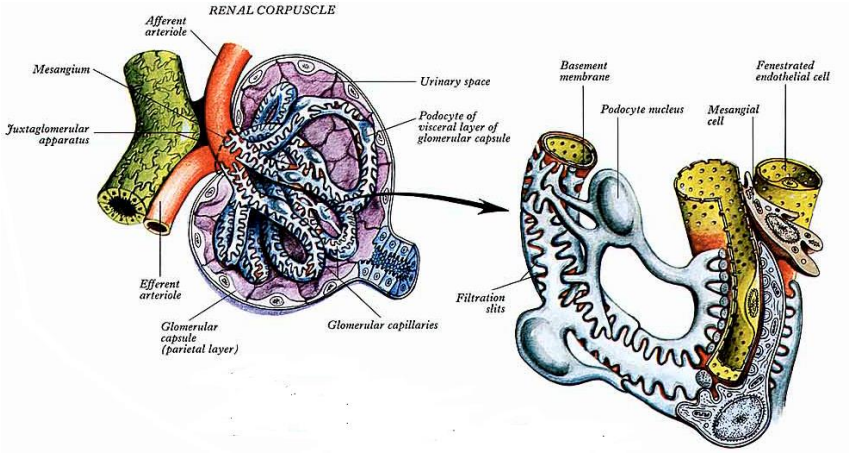
- **Parasympathetic fiber originate from vagus nerve & travel with sympathetic fiber along renal artery.**

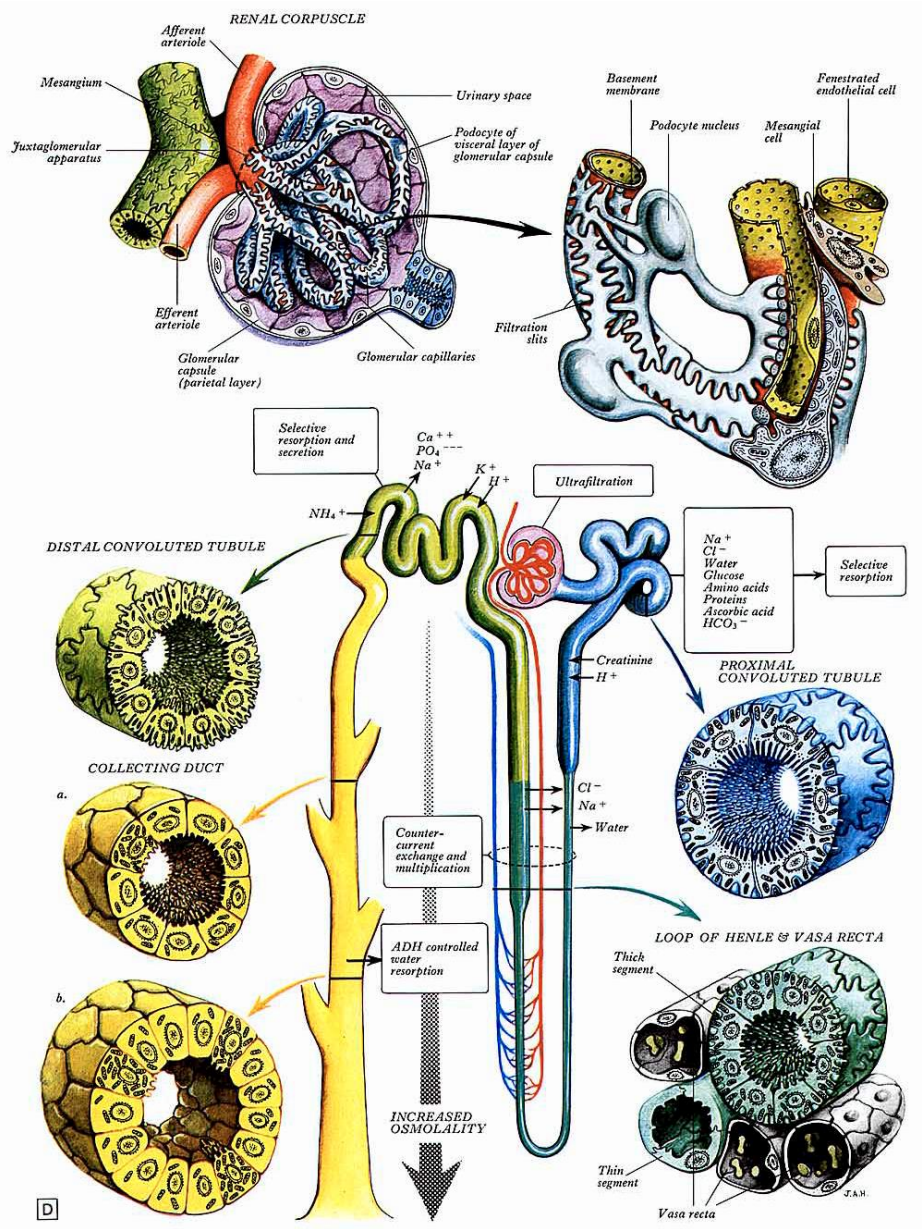


Renal collecting system microscop.anatony from glomerulus to collecting system

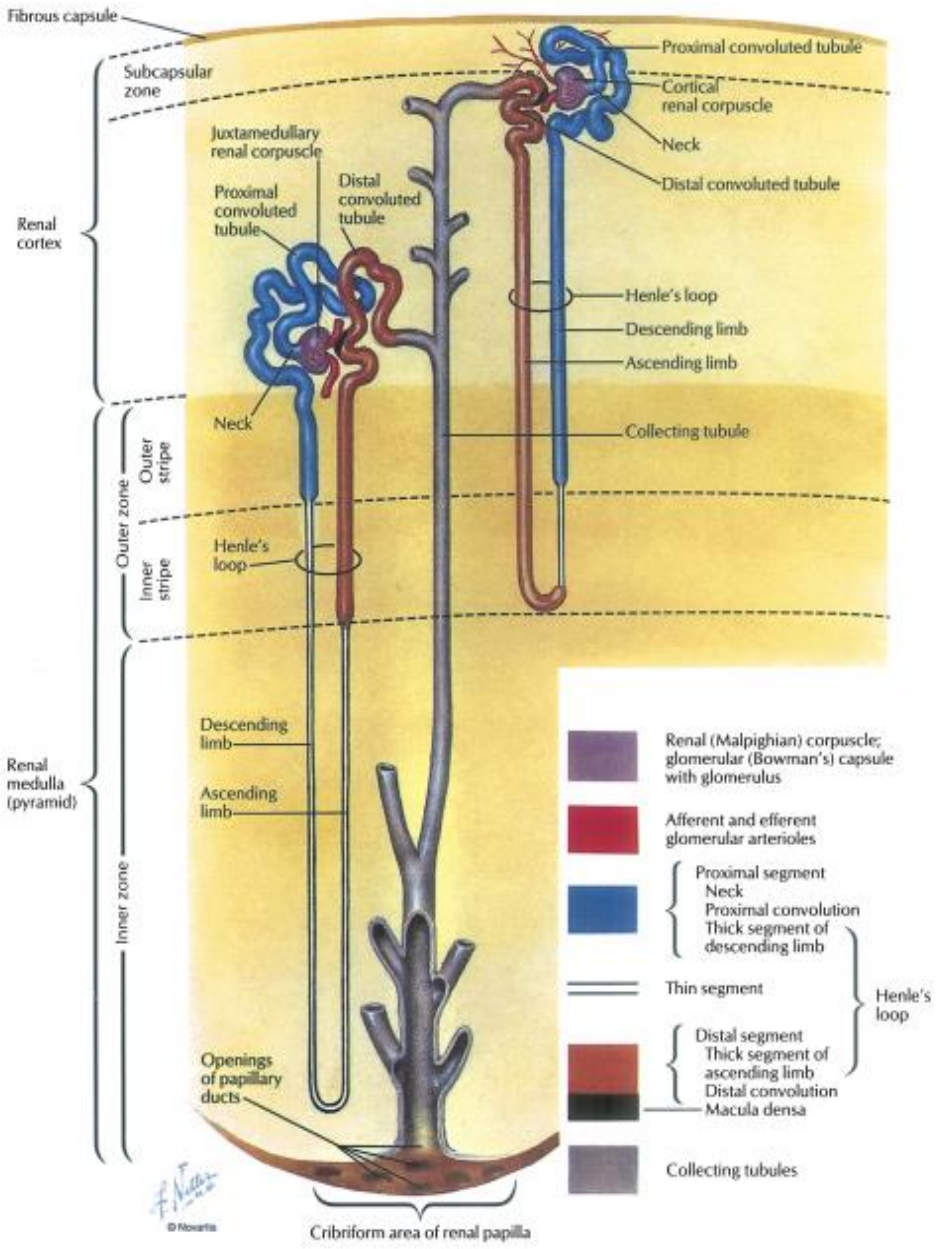
- Microscopically ,originates in renal cortex at (glomerulus) as filtrate enter into (bowman's capsule).
- Bowm.caps. & glomerular capillary network form (renal corpuscle)or called (malpighian corpuscle)
- Glom.cap.netw.is cover by specialized epith.cell called (podocytes),which form barrier across urinary filtrate.



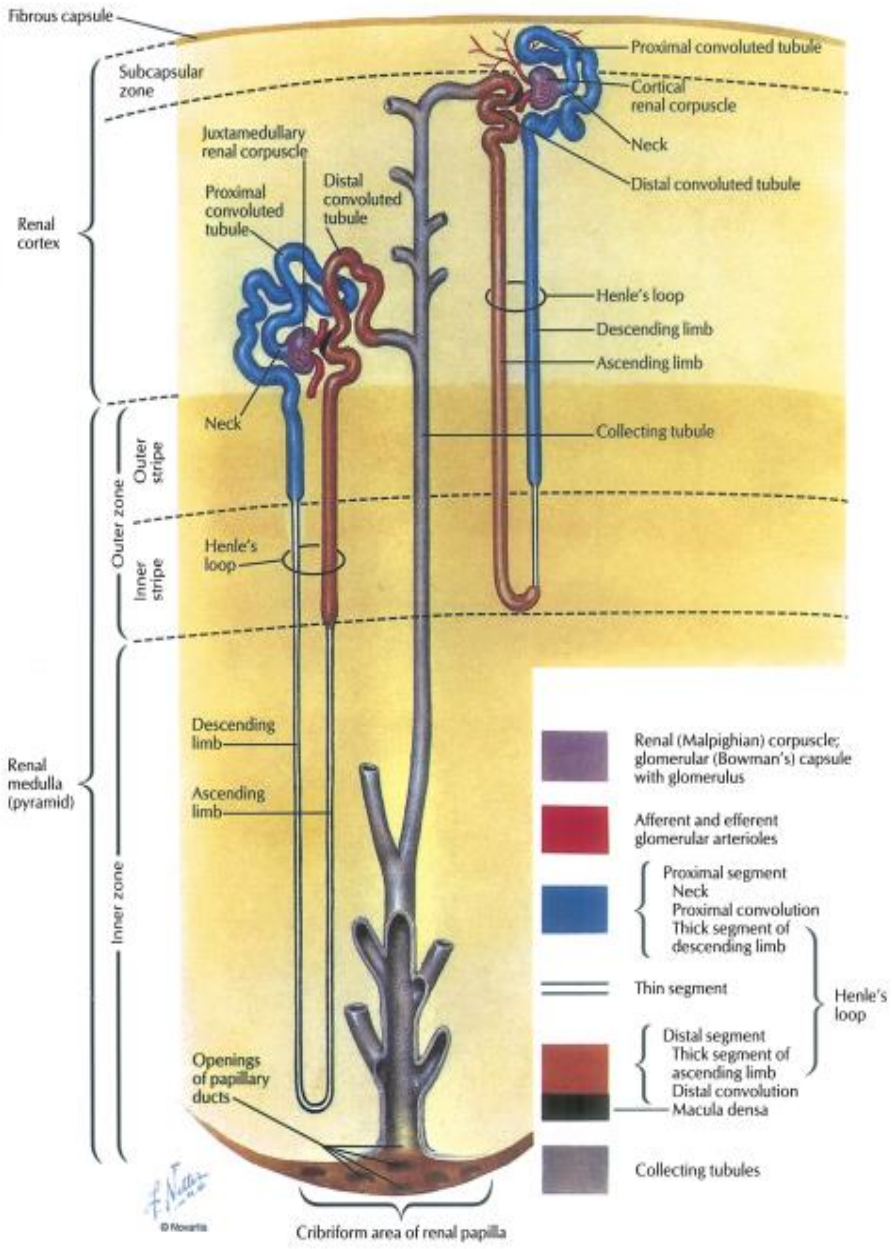



RENAL CORPUSCLE
Afferent arteriole
Mesangium
Juxtaglomerular apparatus
Urinary space
Podocyte of visceral layer of glomerular capsule
Efferent arteriole
Glomerular capsule (parietal layer)
Glomerular capillaries
Basement membrane
Podocyte nucleus
Mesangial cell
Fenestrated endothelial cell
Filtration slits
Selective resorption and secretion
Ca^{++}
PO_4^{---}
Na^+
K^+
H^+
NH_4^+
Ultrafiltration
Na^+
Cl^-
Water
Glucose
Amino acids
Proteins
Ascorbic acid
HCO_3^-
Selective resorption
DISTAL CONVOLUTED TUBULE
PROXIMAL CONVOLUTED TUBULE
Creatinine
H^+
COLLECTING DUCT
a.
b.
Cl^-
Na^+
Water
Counter-current exchange and multiplication
ADH controlled water resorption
LOOP OF HENLE & VASA RECTA
Thick segment
Thin segment
Vasa recta
INCREASED OSMOLALITY
J.A.H.
D

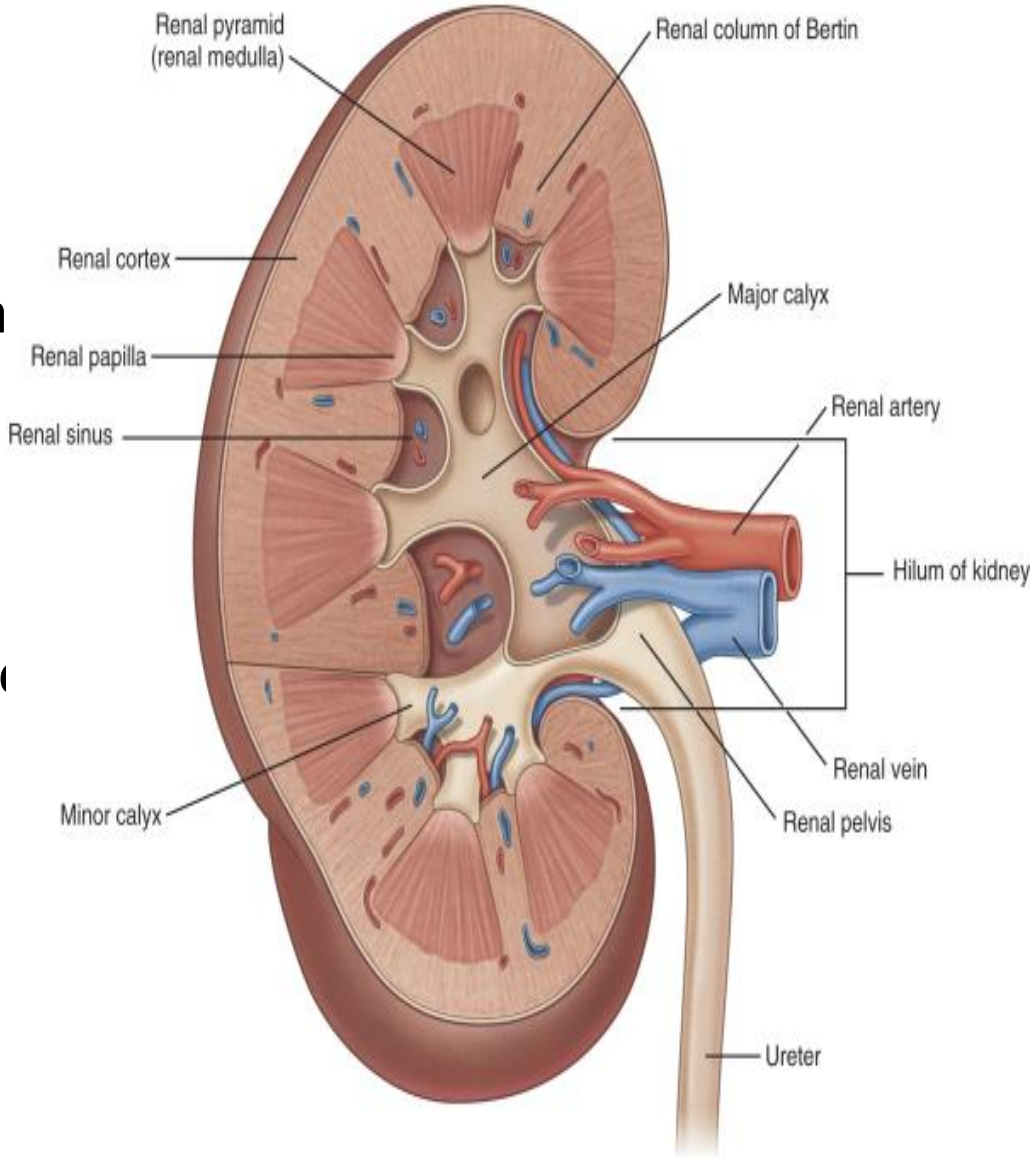
- The filtrates is initially collected in bowman's cap. &then move to (proximal convoluted tubule)
- Pro.con.tub.,composed of thick (cuboidal)epith. Covered by dense microvilli.
- Microvilli,increase surface area of pro.tub., which allowing large portion of urinary filtrate to be reabso.in this section of nephron.



- Pro.tubu.continues deeper into cortical tiss.to become the (loop of henle),which extend variable distance into renal medulla ,which then reveres course & move back toward periphery of kid.,which became thickens &form (distal convoluted tubule).

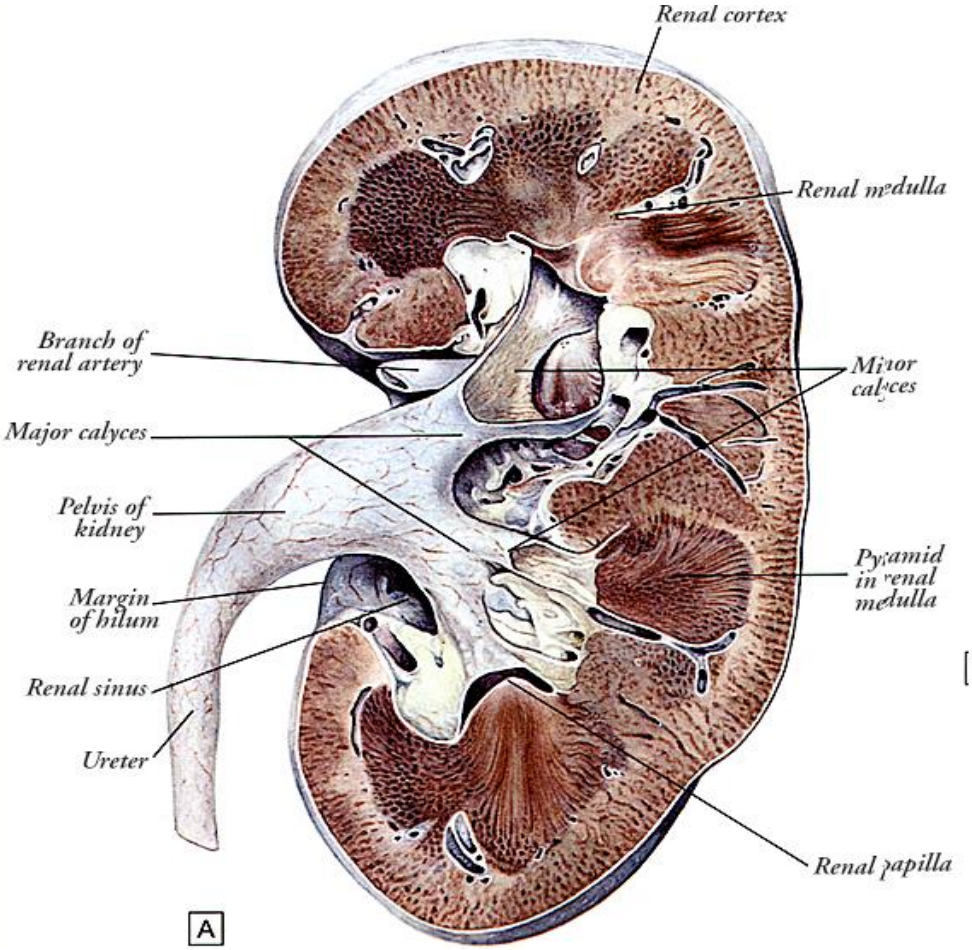


- Distal tubule ,return to position adjacent to origina glmerulus &pro.con.tub., which form(collecting tubule).
- Collecting tubule ,form multiple nephrons ,combin into(collecting duct),which extend in word through renal medulla, which empties into apex of medullary pyramid, the renal papilla.

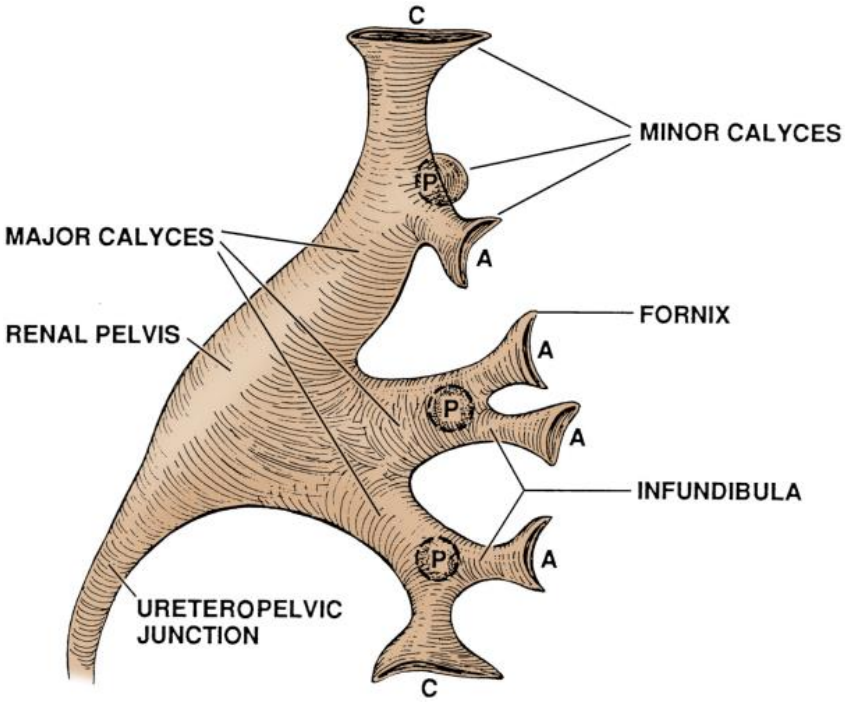


Renal papilla ,calyces, pelvis

- Renal papillae are the tip of medullary pyramid &consist the 1st gross stricture of renal colle.syst.
- Typically there are 7-9 papillae per kidney.
- Each of these papillae cupped by a(minor calyx) each minor calyx narrows to an (infundibulum)
-



- **Infundi.combine to form 2 or 3 (major calyceal) branches which termed (upper, middle, lower pole calyces), which intern combine to form (renal pelvis).**
- **Renal pelvis, itself can vary greatly in size ,ranging from small intrarenal pelvis to large extra renal pelvis.**
- **Pelvis narrows to form (uretropelvic junction), which beginning of (ureter).**



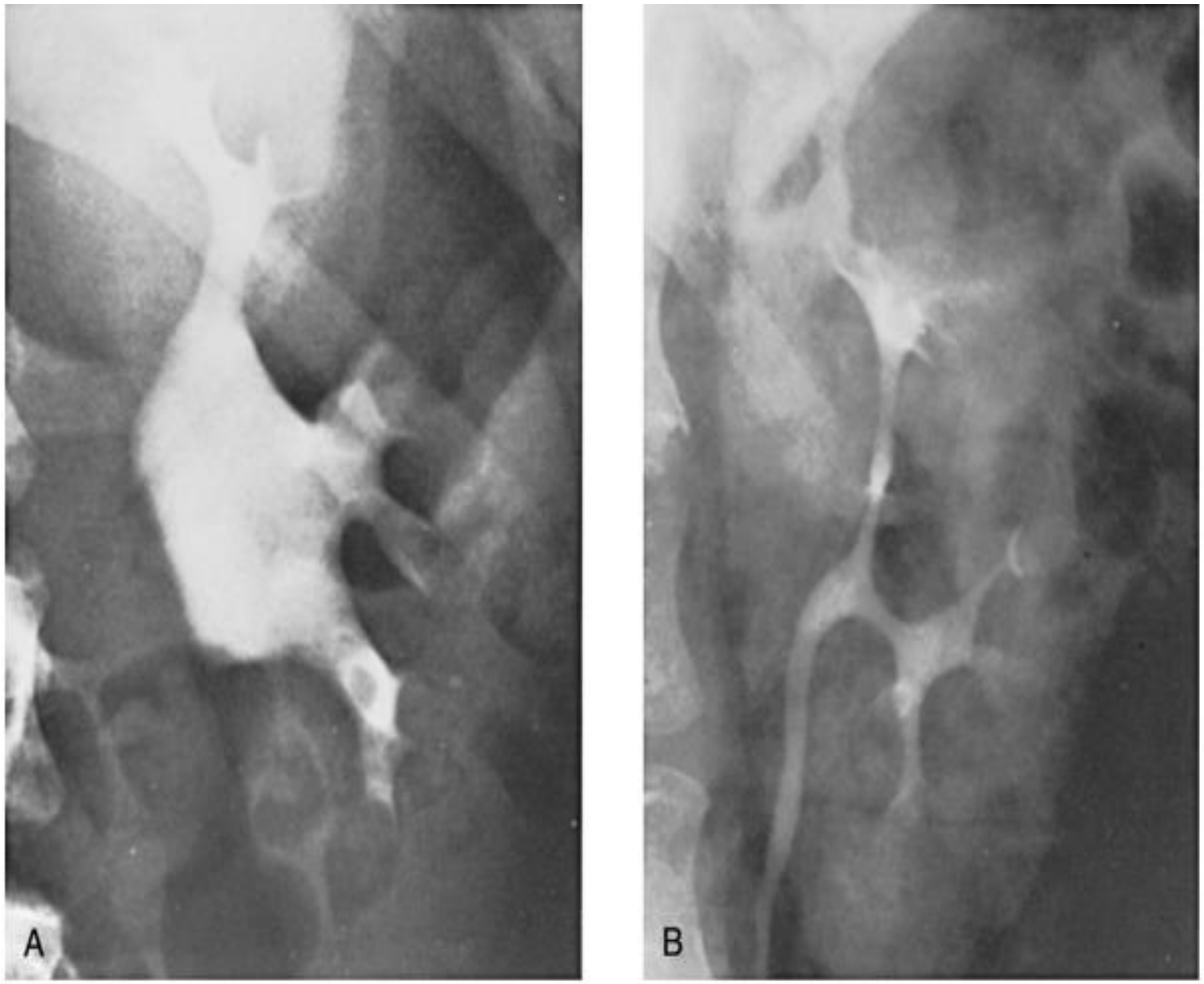


Figure 1-41 Significant variation between two normal renal pelves, demonstrated by excretory urography. **A,** Large, extrarenal pelvis. **B,** Narrow, completely intrarenal pelvis,

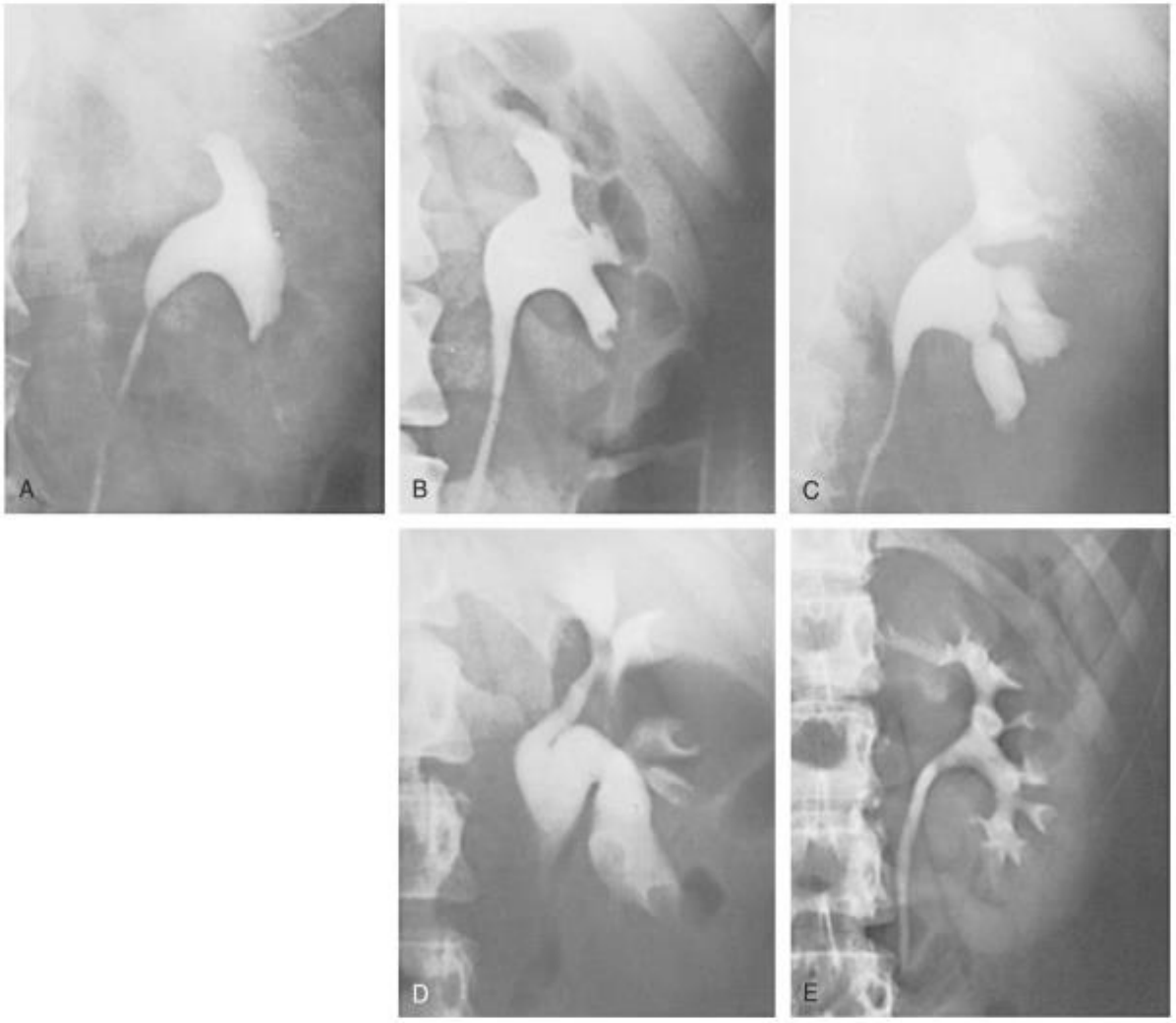


Figure 1-42 Examples of normal variations in the architecture of the renal collecting system, demonstrated by excretory urography. **A,** Absence of calyces. **B,** Minor calyces arising directly from the r
pelvis. **C,** Megacalyces. **D,** "Orchid" calyces. **E,** Multiple minor calyces and nearly absent renal pelvis.