



Renal Block

Physiology Team

1s Lecture

Kidney functions

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Renal Functions and Glomerular Filtration

Physiologic Anatomy of the Kidneys (Introduction):

The kidneys are essentially regulatory organs which maintain the volume and composition of body fluid by filtration of the blood and selective re-absorption or secretion of filtered solutes.

The kidneys are retroperitoneal organs (located behind the peritoneum) situated on the posterior wall of the abdomen.

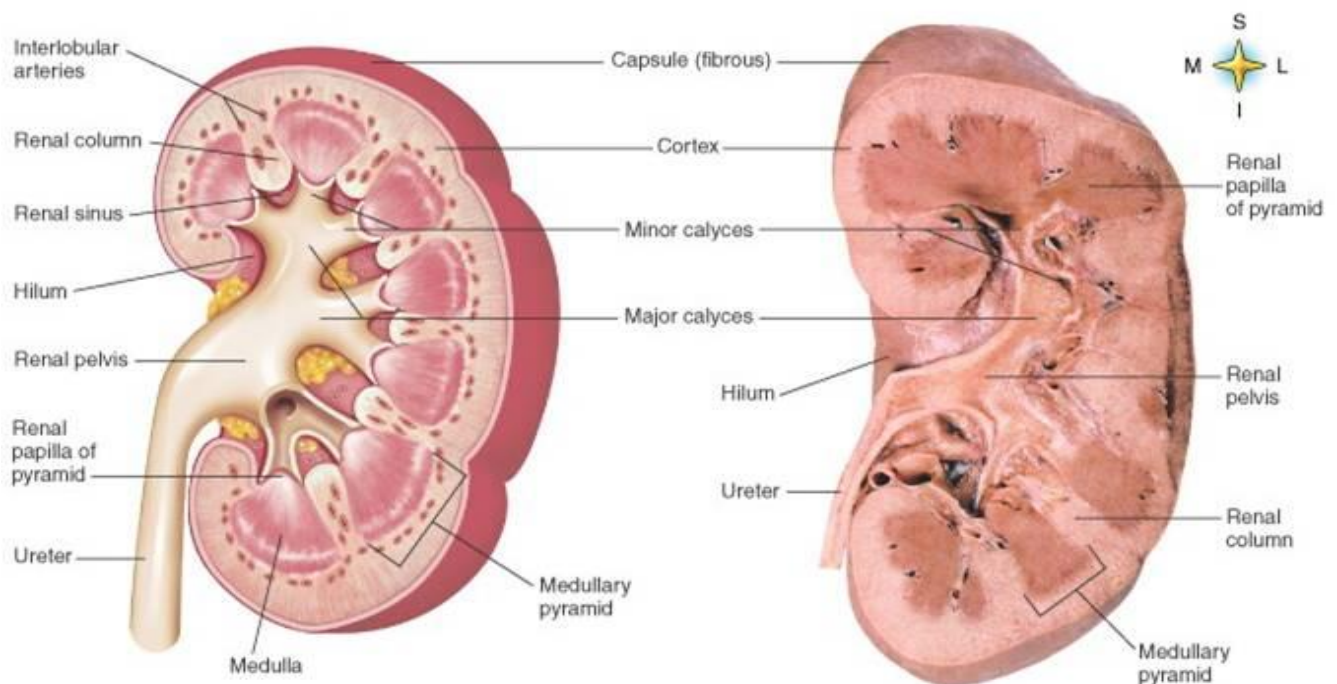
Blood supply directly from:

The aorta via the renal arteries; blood returns to the inferior vena cava via the renal veins.

Urine (the filtered product containing waste materials and water) is excreted from the kidneys and passes down the fibro-muscular ureters and is collected in the bladder.

The bladder muscle (the **detrusor muscle**) is capable of distending to accept urine without increasing the pressure inside; this means that large volumes can be collected (700-1000ml) without high-pressure damage to the renal system occurring.

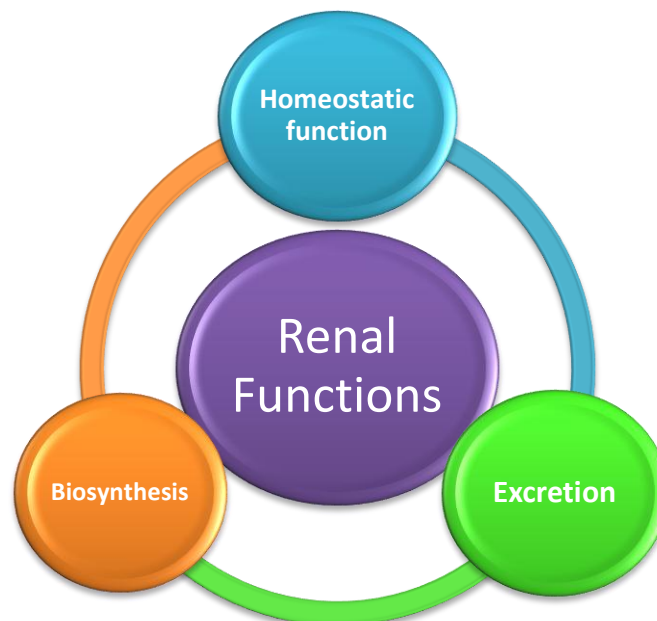
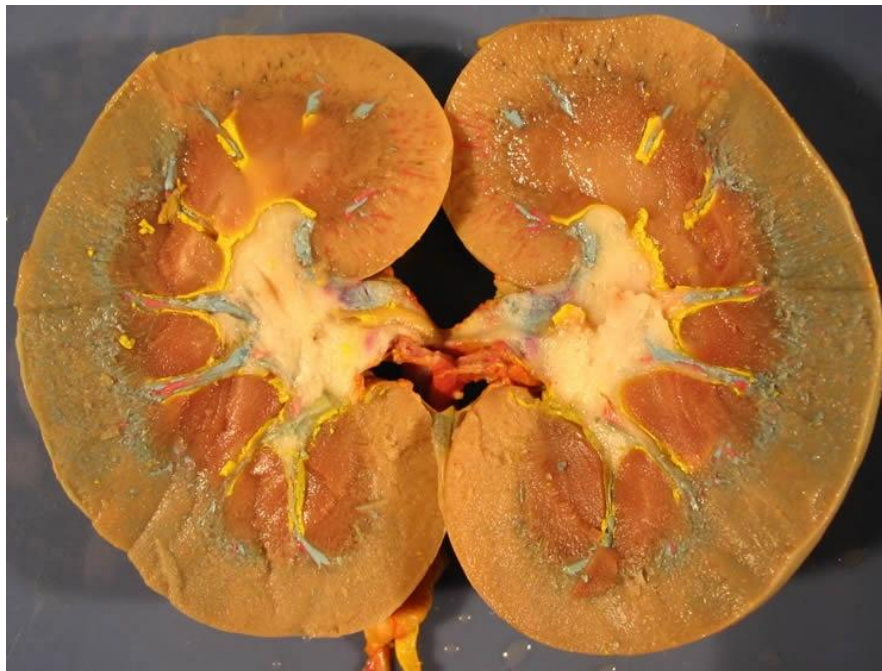
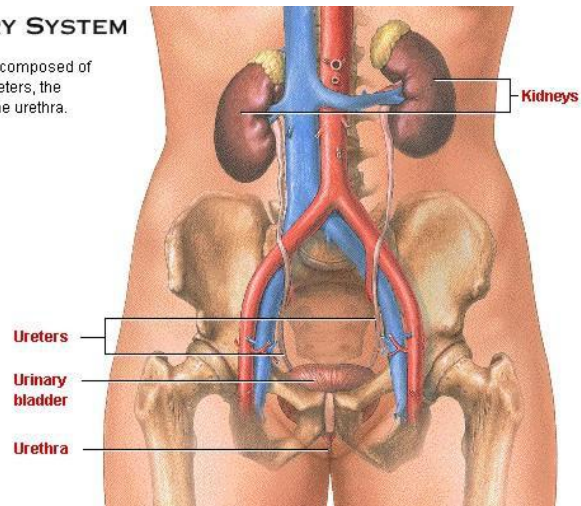
When urine is passed, the urethral sphincter at the base of the bladder relaxes, the detrusor contracts, and urine is voided via the urethra.



Kidney functions

THE URINARY SYSTEM

The urinary system is composed of paired kidneys and ureters, the urinary bladder, and the urethra.



- Kidney functions :

1. **Homeostatic function** : maintain the internal environment constant
the internal environment is the extracellular fluid and PH also the temperature and the electrolytes....

■ **Regulates:**

- **Osmolality of ECF** (is equal 300 miliosmol)
- **Plasma ions concentration**(Na ,K , Cl)
- **ECF volume**
- **Arterial blood pressure** (long term)
- **Acid-base balance**

Note: The K concentration is **3.5 to 5mEq/L ,average =4mEq/L**, if it becomes more than **5** ---"hyperkalemia" affecting cardiac function
#The Na concentration is **140mEq/l**

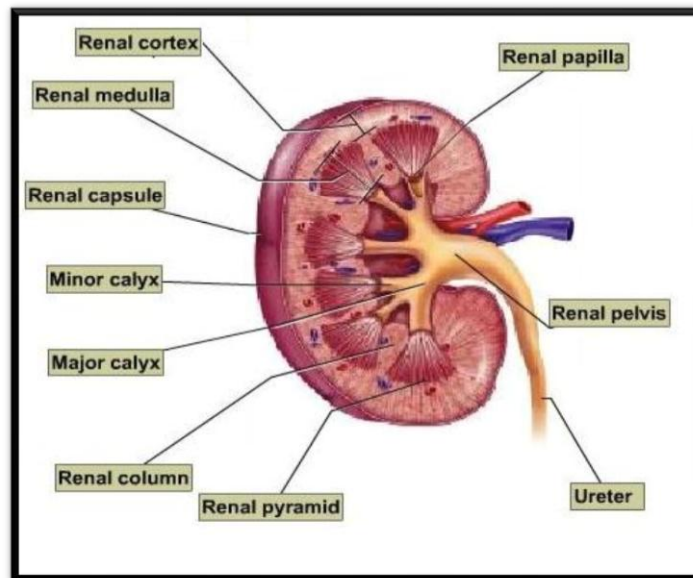
2.Excretion :

- **Metabolic end products** :
Urea, Creatinine, Uric Acid, Bilrubin
- **Foreign substances:**
drugs, toxins

So if the patient takes antibiotics. it will be excreted by the renal system so the smell of the antibiotic will be in the urine

3. Biosynthesis

- **Renin**
- **Erythropoietin** (a hormone released by the kidney carried in the blood to the bone marrow where it stimulates the production of RBCs)
- **Calciferol (1,25 dihydroxy Vit. D)** (**Vitamin D is converted by the kidneys to its biological active form calciferol**)
- **Glucose (gluconeogenesis) angiotensinogen, ammonia**
- **Prostaglandins, adenosine, endothelin, nitric oxide, bradykinin**

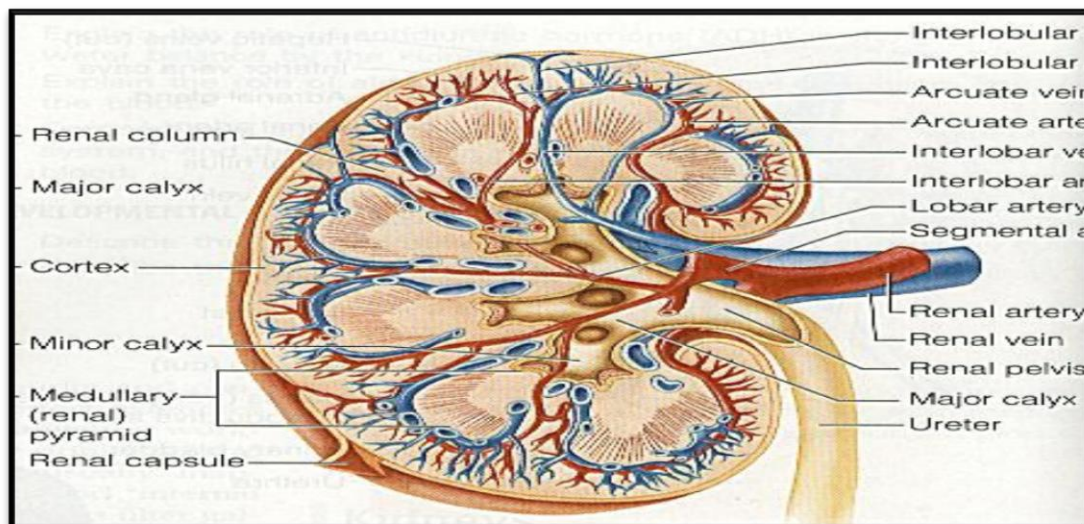


■ Macroscopic structure of the kidney :

- **Renal capsule** (it will keep the kidney in its normal shape and prevent it from swelling and moving)
 - **Cortex**
 - **Medulla – pyramid – papilla**
 - **Pelvis – major & minor calyxes**
 - **Afferent arteriole**
 - **Ureter**
 - **Bladder**
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■ Renal circulation :

- **Renal artery**
- **Segmental branch**
- **Interlobar**
- **Arcuate**
- **Interlobular** (will give the afferent arterioles)
- **Afferent arteriole(imp)**
- **Glomerular capillary(imp)**
- **Efferent arteriole(imp)**
- **Peritubular capillary**



■ RBF (Renal Blood Flow) = 1.2 l/min

(25% of C.O.) that mean 1/4 of the C.O is for filtration not for oxygenation

■ Cortical blood flow > Medullar flow

■ Cortical blood flow meant for filtration

Note: the afferent is arterioles >>> Capillaries >>> the efferent is also arterioles

And It is for filtration

■ Microscopic structure

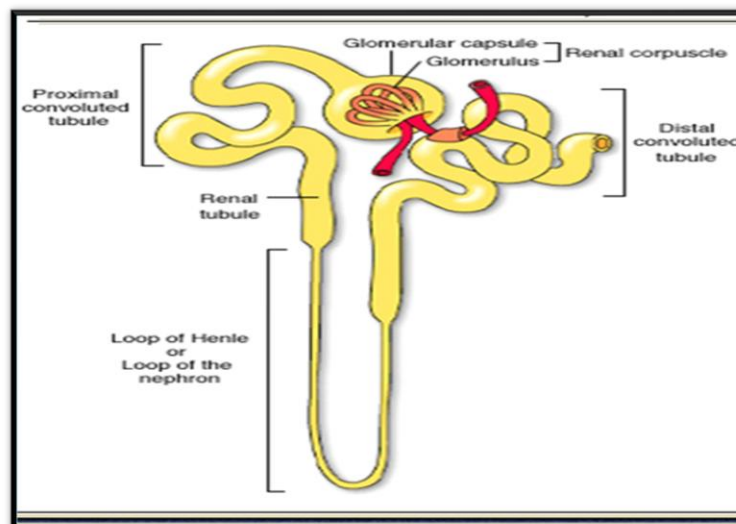
- Nephron is the basic unit of the kidney
- Each kidney consist of 10^6 nephrons
- All kidney functions are performed by nephron
- Nephron is a blind tube consist of 5 different regions

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Nephron :

1. **Glomerulus :**
 - Bowman capsule (like pole)
 - Tuft of capillary
2. **Proximal convoluted tube (PCT)**
3. **Loop of Henle (strait) :**
 - Descending : thin
 - Ascending :
 - 1/3 thin
 - 2/3 thick
4. **Distal convoluted tubule (DCT)**
5. **Collecting duct**

"8 or 9 nephrons have one collecting duct so they sometimes include it as part of the Nephron"

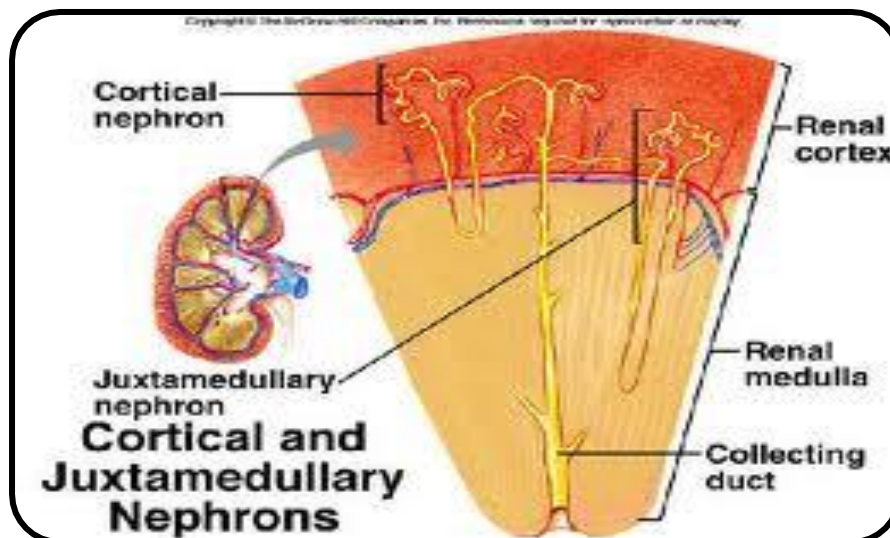


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Kidney functions

Types of nephron : IMP

- 1- **Cortical nephrons** (majority)
- 2- **Juxtamedullary nephrons**
(all of them percent in the cortex)

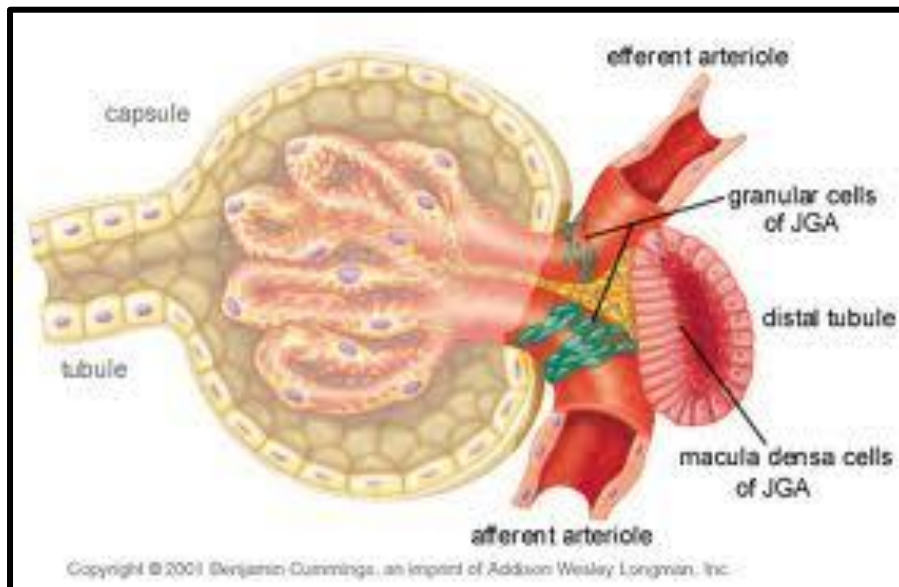


Cortical vs. Juxtamedullary nephron

Cortical	Juxtamedullary
85%	15%
Outer cortex	Deep in the cortex
Larger Glomerulus Because they are responsible for filtration more than the juxtamedullary	Small Glomerulus
Short loop : (look at the picture)	Long loop
Peritubular capillary blood supply It is the branch of Efferent To supply O ₂	Vasa recta : Also it is branch of Peritubular because it has long loop

Juxtaglomerular apparatus(JGA):

- **Junction between thick limb(DCT) & afferent of its Glomerulus**
- **Tall columnar cells in tubule (macula densa)** will regulate the rennin secretion (it will be stimulated when the Na is decreased – release rennin"
- **Granular cells on afferent (Renin)**
(when the blood pressure & Na are low)



Renal innervations

- **Renal plexus sympathetic (imp)** : (mainly)
Vasomotor regulate renal blood flow
(for vasodilator and vasoconstriction)
- **Parasympathetic** "has no effective role "