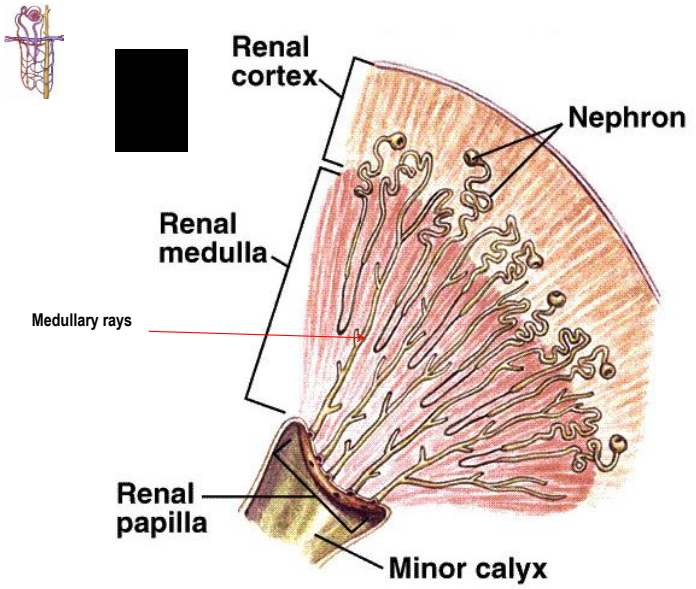


THE URINARY SYSTEM

THE KIDNEY

The urinary system is the principle organ system responsible for water and electrolyte balancing. The urinary system is also responsible for excretion of many toxic substances like urea and nitrogen.

It is consisting of two kidneys, two ureters, one urinary bladder and one urethra. The kidney also has an endocrine function, where it is producing rennin and erythropoietin.

Functions of urinary system:

1-Form urine (exocrine function). 2-Remove waste products .

3-Regulate fluid & electrolytes balance of body .

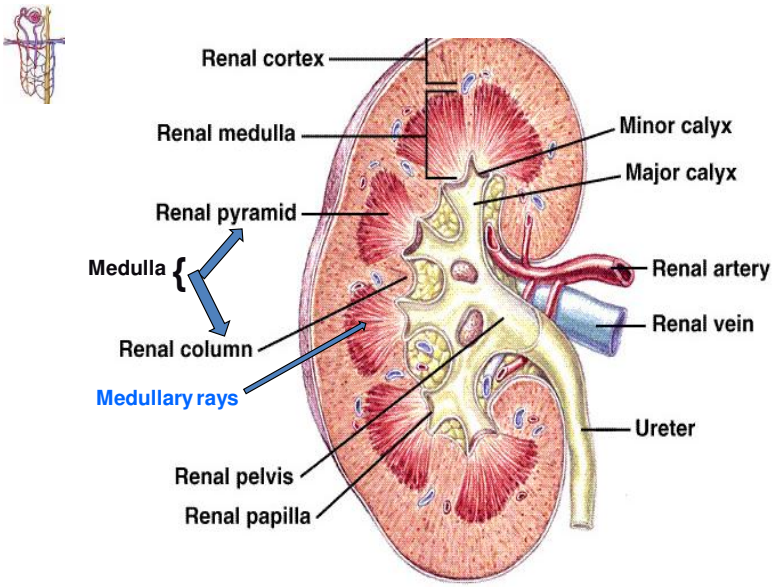
4-Produce hormone (endocrine function).

a- Renin: regulate blood pressure.

b-Erythropoietin: stimulate production of erythrocytes

5. Vitamin D, which regulates calcium balance, is converted to an active form in the kidney.

General structural of the kidney :



General structural of the kidney :

- **A.Nephron** : Represents the secretory functional unit of the kidney .

There are about 1-4 million nephrons in each human kidney.

Each nephron is made up of renal corpuscle and renal tubules :

1. **Renal corpuscles.** Each renal corpuscle is consisting of:

A. Bowman's capsule : Consists of two layers

a. Parietal layer of squamous epithelium

b. Visceral layer (podocytes).

Between the two layers there is a space called the **urinary space**(or capsular space) in which the initial filtration accumulated and moves from there to the first part of renal tubules , the proximal convoluted tubules.

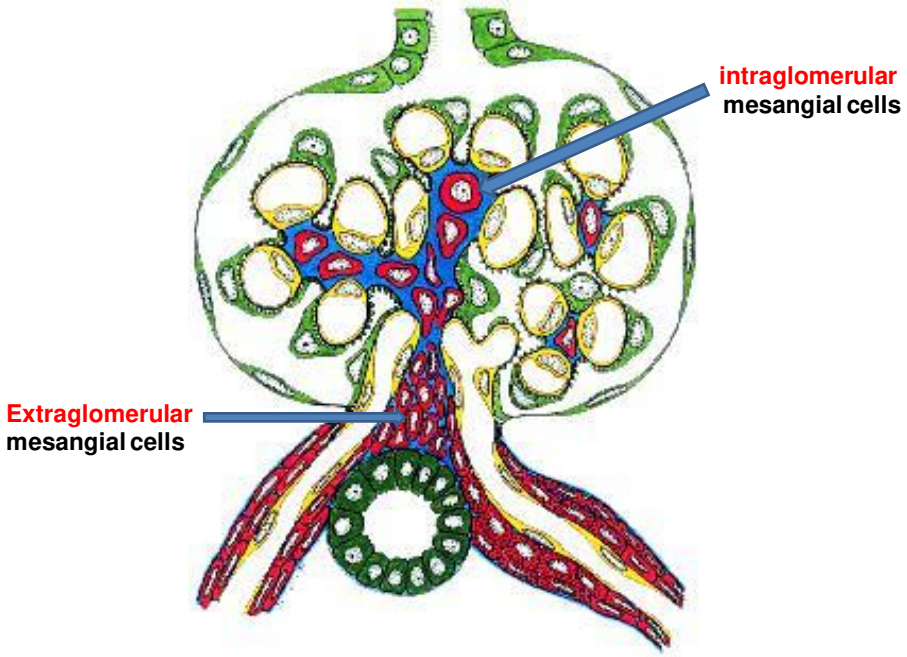
B. Glomerular capillaries: They are groups of capillaries present inside the renal corpuscles. They are originating from afferent arterioles which bring the blood to the renal corpuscles.

2. Proximal convoluted tubules

3. Distal convoluted tubules

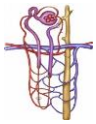
4. Loop of Henle (descending and ascending limbs)

These tubules are channels which carry the filtrate from the renal corpuscles.

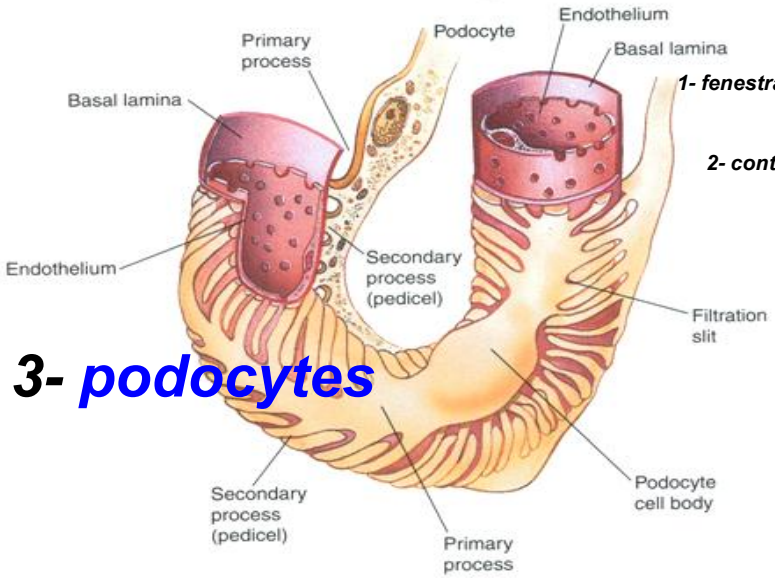


The podocyte

- Represent the visceral layer of Bowman's capsule.
- The podocyte has a basement membrane which joined with the basal lamina of the endothelial cells to form part of the **blood renal barrier.**



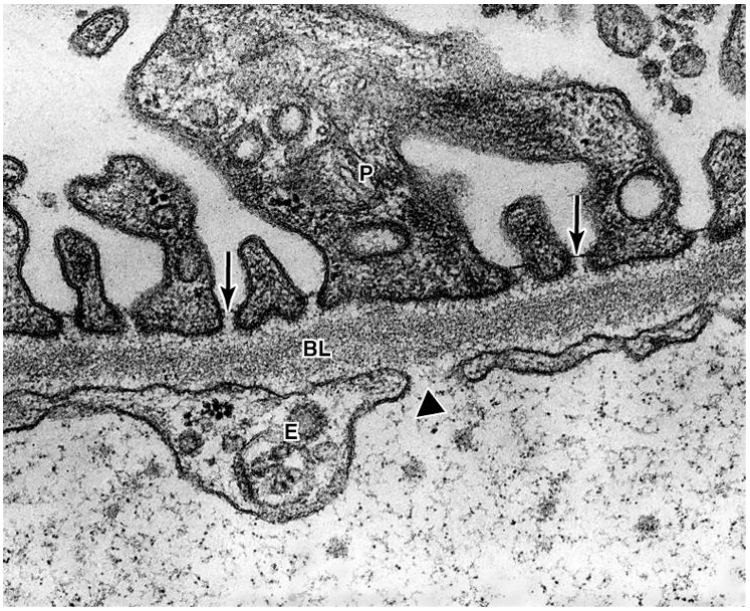
GLOMERULUS (FILTRATION MEMBRANE):



1- fenestrated capillaries

2- continuous basal lamina

3- podocytes



Filtration barrier(*Blood-renal barrier*) :

- 1.Fenestrated endothelium of the glomerular capillaries.
- 2.Basal lamina: Combined basal lamina of both the endothelium and the podocyte.
- Podocyte layer .

Features of the filtration barrier :

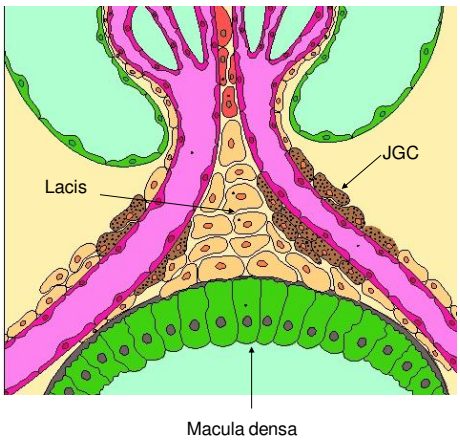
- **1- Hold back RBCs, WBCs & platelets.**
- **2- High molecular weight protein (> 68,000) can not pass.**
- **Small molecular weight sugar, amino acids & protein can pass.**

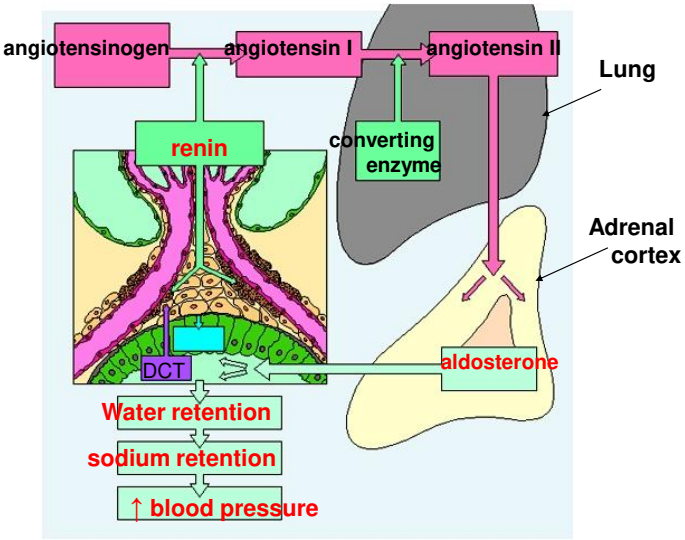
  - 85% of all reabsorption and secretion that occur in the tubular system occur here.

- **Juxtaglomerular apparatus**

The juxtaglomerular apparatus consists of three cells:

1. **the macula densa, a part of the distal convoluted tubule of the same nephron**
2. **juxtaglomerular cells, which secrete renin**
3. **extraglomerular mesangial cells**





This figure demonstrate the Renin angiotensin –aldestrone mechanism

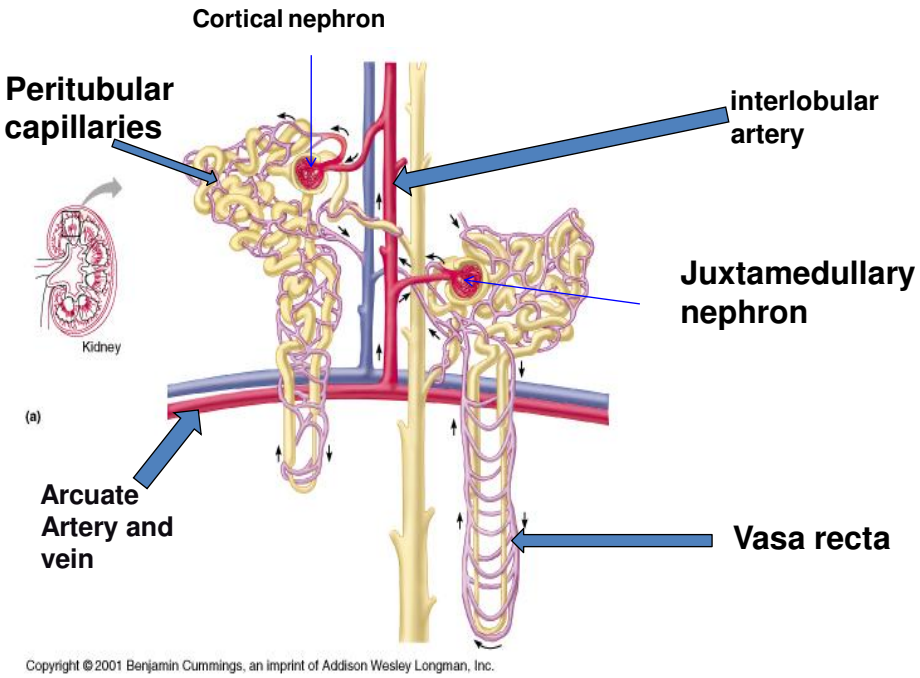
Function of JG apparatus:

1-**Secrete renin** →

- Renin converts plasma angiotensinogen into angiotensin I →
- by converting enzyme in lung → angiotensin II →
- acts directly on DCT →
- water & sodium retention →
- increase blood pressure.

Angiotensin Converting Enzyme: or "ACE" is a central component of the renin-angiotensin system (RAS)), which controls blood pressure by regulating the volume of fluids in the body. Many drugs used to lower blood pressure are called ACE inhibitors.

2-**Secrete erythropoietin** → formation of erythrocytes in bone marrow.

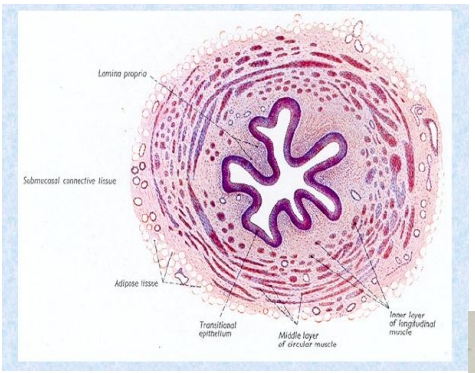


The blood supply of the kidney is paramount in its function.

The two kidneys receive between 15 and 20% of the body's systemic blood flow at rest.

-
- **Ureter**
  - Long tube draining into bladder with a rather symmetrical stellate lumen.
- Tunica Mucosa
  - Transitional epithelium
    - stratified type of epithelium found only in urinary system.
  - Lamina Propria
    - consists of mainly fine collagenous fibers and related cells.
    - lymphoid tissue is frequently present
    - glands are absent

- (no distinct Submucosa)
- Tunica Muscularis
  - Smooth muscle occurs in bundles, separated by C.T.
- Tunica Adventitia
  - Loosely arranged C.T.
  - Many large blood vessels
  - Blends in with pelvic C.T. (fascia)



Ureter



URINARY BLADDER

- The wall of the bladder is similar to that of the lower part of the ureter .

Urethra

Male urethra

- **20 cm tube**
- **Conducts urine from urinary bladder & seminal fluid from male genitalia to outside body.**

`