PHYSIOLOGY TEAM 432

LECTURE : 1

Renal functions and glomerular filtration

Done By: Shaimaa Al-Refaie
Reviewed By: Fahad AL-Rashed

OBJECTIVES

At the end of this lecture student should be able to describe:

- Physiologic anatomy of Urinary system
- Functions of the kidney
- Structure, Parts and Types of Nephrons
- Juxtaglomerular Apparatus
- Blood Supply and innervation

.....

■ Slides

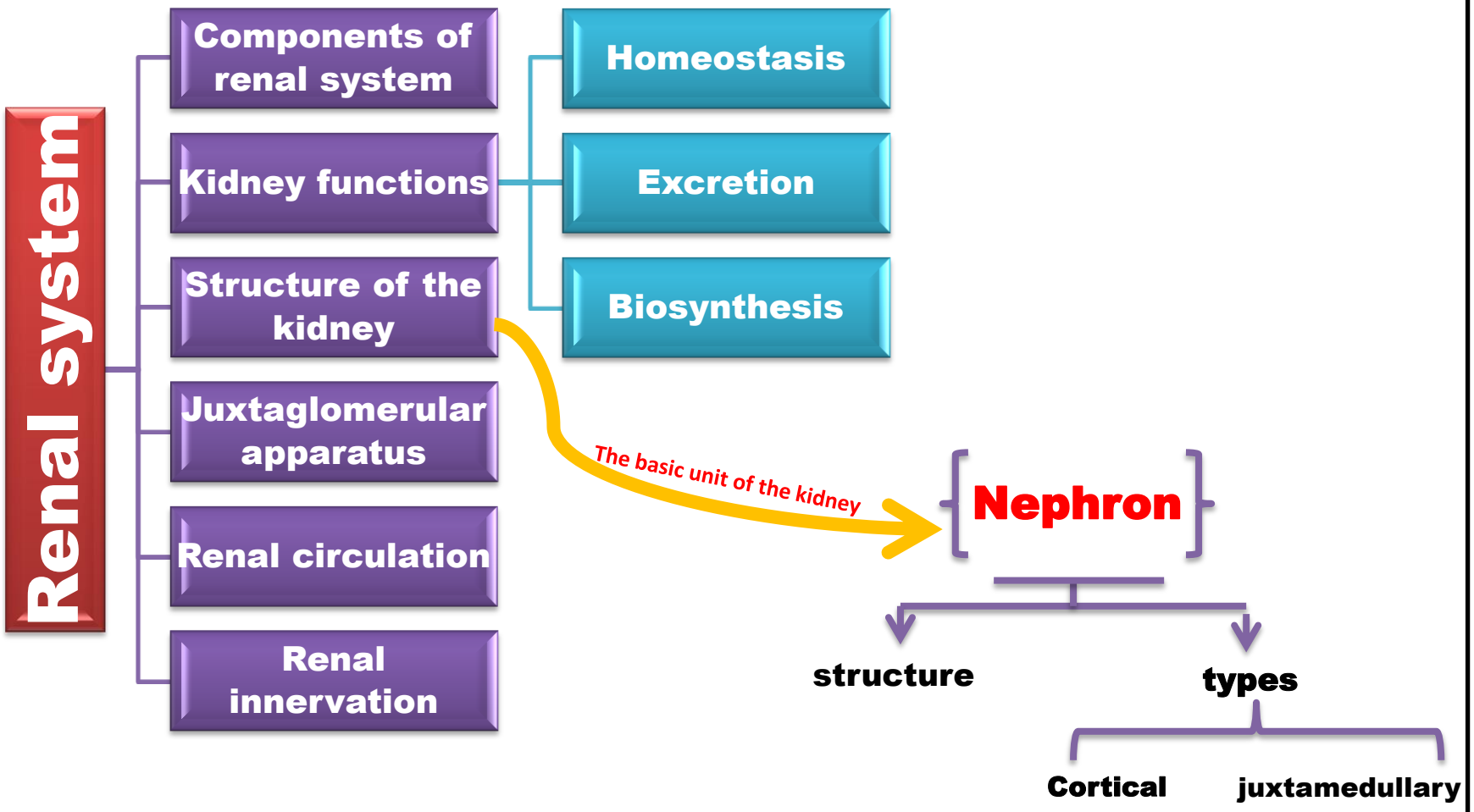
■ Important

■ What doctor said

■ Explanation

■ Notes from boy's slides

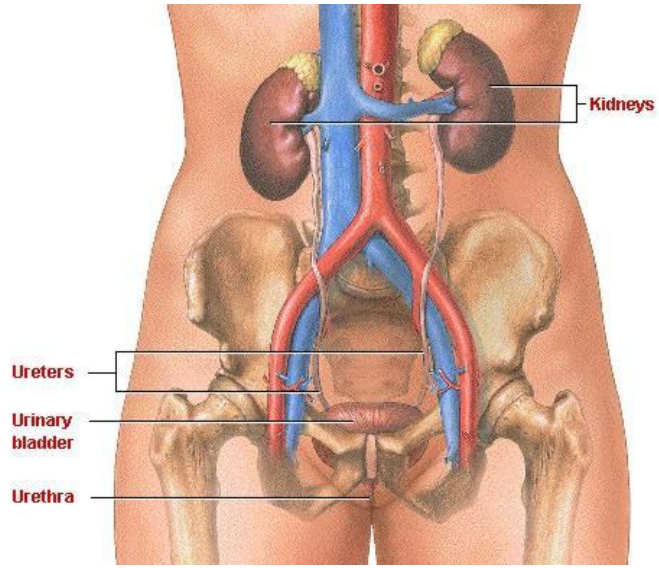
MIND MAP

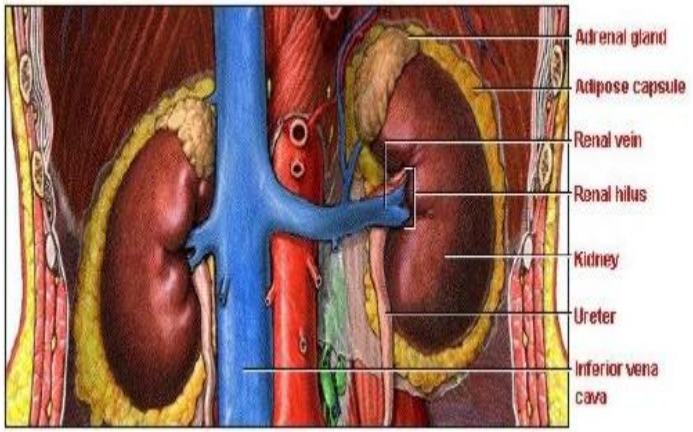

Renal system
Components of renal system
Kidney functions
Homeostasis
Excretion
Structure of the kidney
Biosynthesis
Juxtaglomerular apparatus
Renal circulation
Renal innervation
The basic unit of the kidney
Nephron
structure
types
Cortical
juxtamedullary

Components of urinary system:

-paired kidneys
-paired ureters
-the urinary bladder
-the urethra

-Urine is formed in the kidney.
-The rest components are for transformation.





External structure of the kidneys:

The bean-shaped kidneys are **retroperitoneal**, lying against the dorsal body wall in the upper abdomen.

- The 2 kidneys are placed in the abdomen on the lateral side of aorta, fixed to its place by: fatty tissues.
- There are 2 ureters which travel from the 2 kidneys into the urinary bladder.
- In the medial side of the kidney there is a slit from which the renal artery & vein enters the kidney (hilum).
- There is 2 suprarenal gland on the top of each kidney.

We should know them at the tip of our fingers .. XD

Kidney Functions

Homeostasis	Excretion	Biosynthesis
➢ **Regulates:** - osmolality of ECF. (Normal 300 mOsm/L) - plasma ions concentration. E.X: Na, K …etc. (which we call it Electrolytes balance) - ECF volume - Arterial Blood Pressure - Acid-Base balance.	➢ **Metabolic end products:** urea, creatinine, uric acid, bilrubin ➢ **Foreign substances:** drugs, toxins	➢ **Renin** ➢ **Erythropoietin** ➢ **Calciferol** (1,25 dihydroxy Vit. D)*. ➢ **Glucose (gluconeogenesis)** ➢ **Angiotensinogen, ammonia** ➢ **Prostaglandins, adenosine, endothelin, NO, bradykinin**
- The most important function. - Homeostasis means to keep the internal environment constant = fluid surrounding the cell in constant composition. - We want it constant so the cells can functions properly. - There are other organs play role in regulation, but the kidney is the most important.	So, if there is a problem with the kidney function, all these normal will be change, E.X: increase in blood , urea …etc.	- These are certain substances which are synthesized in the kidney - Renin is synthesized, stored and secreted by juxtaglomerular cells. - Erythropoietin function is stimulate the bone marrow to synthesis more Red Blood Cells. - Active form of vit.D so the kidney is responsible for activation of Vit.D

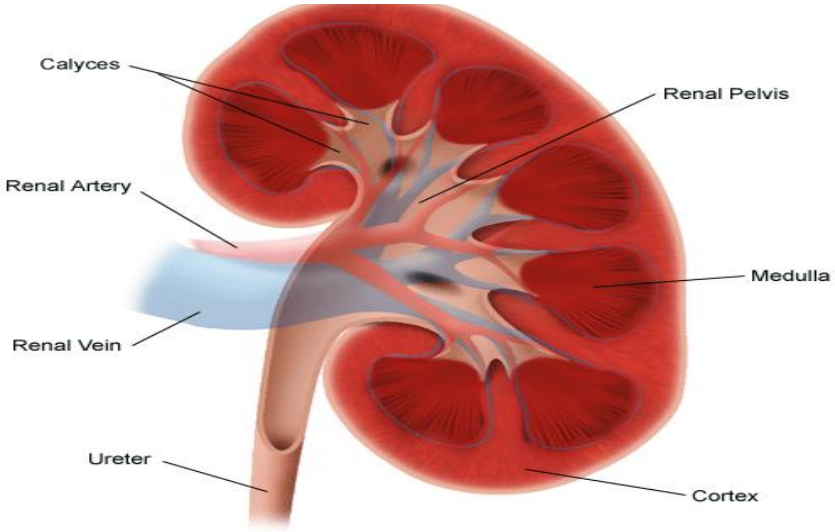
Structure of the kidney

*Macroscopic	Microscopic
➢ Renal capsule ➢ Cortex ➢ Medulla -pyramid- papilla ➢ Pelvis- formed by major & minor calyxes ➢ Ureter ➢ Bladder	➢ **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

* *(what we see with our eyes)*

** that's mean in each kidney we have about 1.2 million nephron.

*** In one side there is an opening & the other side there isn't.



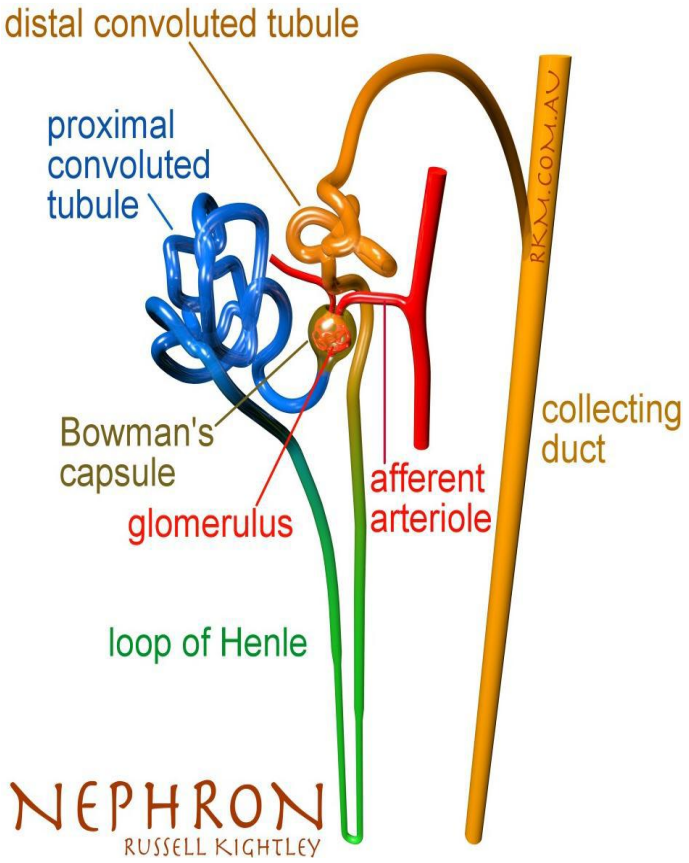
Nephron

Consists of:

- **Glomerulus:**
  - Bowman capsule.
  - tuft of capillaries.

- **Proximal Convoluted Tube (PCT)**
- **Loop of henle:**
  - descending –thin.
  - ascending:
    - 1/3 thin
    - 2/3 thick
- **Distal Convoluted tubule (DCT)**
- **Collecting duct**

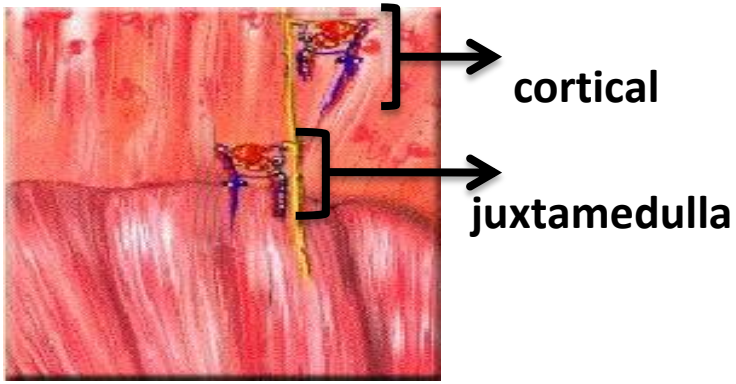
- Not each nephron has its own collecting duct .. each (5-8) open in one duct



Nephron..cont.

difference / Types	cortical nephrons	*Juxtamedullary nephrons
Percentage %	• 85%	• 15%
Location	• Outer cortex	• Deep in the cortex
Glomerulus size	• Larger glomerulus	• Small glomerulus
Loop length	• Short loop	• Long loop
Blood supply	• Peritubular capillary blood supply	• Vasa recta

- There is no glomerulus in the medulla at all.
- All glomerulus are found in the cortex.

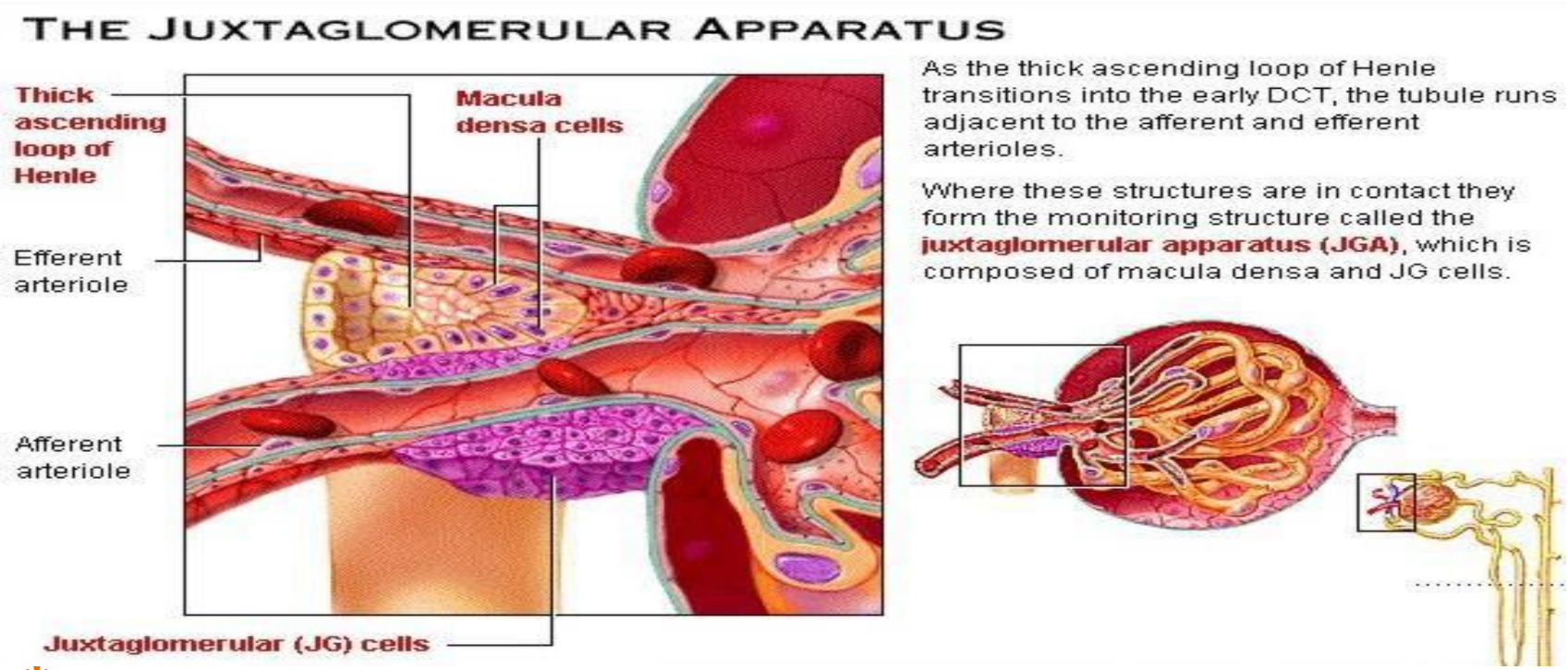


* near to medulla, But still exist deep in the cortex

Juxtaglomerular apparatus

- Junction between * thick limb & afferent of its glomerulus.
- Tall columnar cells in tubule (macula densa - **sense the level of Na** -).
- Granular cells on afferent (The juxta glomerular cells) which secret renin.

Note : in close contact with macula densa we have Lacis cells : a supportive cells that sense the change in Na conc. and send information to the granular cells.



* (end of thick ascending loop of Henle and the beginning of DCT)

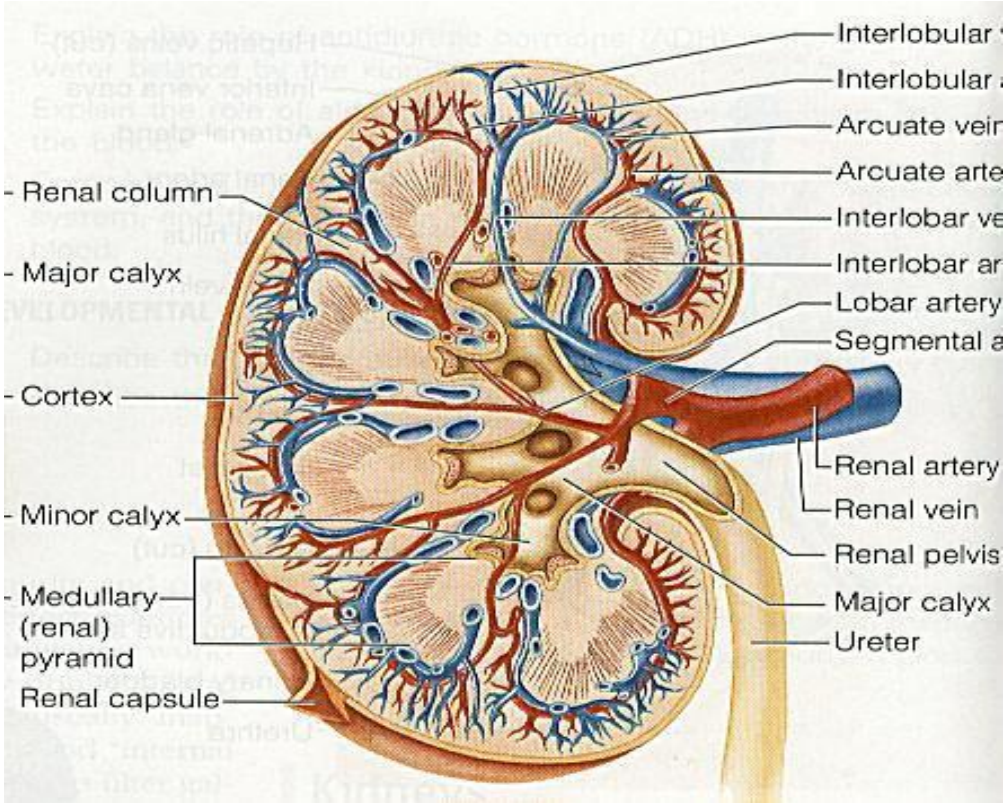
Renal circulation

Renal artery

From abdominal aorta

- Segmental branch
- Interlobar
- Arcuate
- Interlobular
- Afferent arteriole
- Glomerular capillary
- Efferent arteriole
- Peritubular capillaryDr

*



*

-Usually in our body if we have capillary, we found both artery & vein at the ends of capillary (artery – capillary – vein).

-But here in the kidney we have (artery – capillary – artery) which enter bowman capsule.

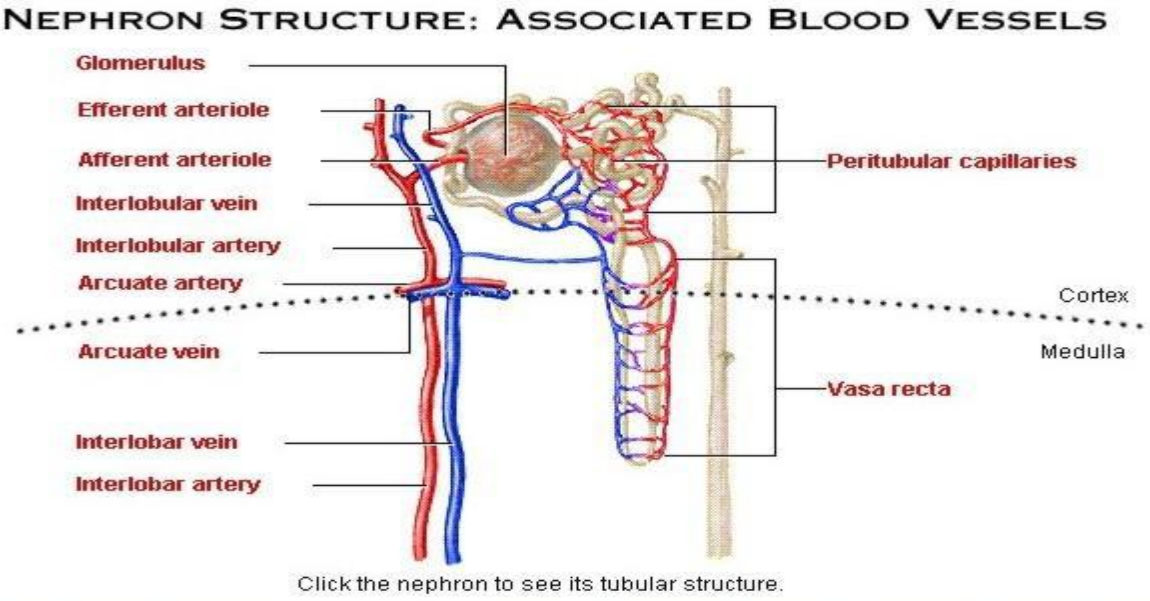
That's what we call it (portal system) which we can only found in the kidney and the liver.

Renal circulation.. cont.

Renal Blood Flow (RBF):

- 1.21/min (25% of C.O.)
- Cortical blood flow > medullary flow

  because all the glomerulus which responsible of filtration found In the cortex
- Cortical blood flow meant for filtration



Renal innervation.

- **Renal plexus sympathetic (mainly)**
  - Vasomotor regulate renal blood flow

- **Parasympathetic**

SUMMARY

- urinary system composed of: paired kidneys & ureters, the urinary bladder &the urethra.
- The kidney is retroperitoneal organ.
- Kidney not only for excretion, it has other functions such as: homeostasis & biosynthesis.
- The kidney have a Macroscopic & microscopic structures.
- Nephron structure: (glomerulus, PCT, Loop of Henle, DCT & collecting duct).
- There is 2 types of nephron: cortical & juxtamedullary nephron.
- Kidneys have very high blood supply because of filtration, not because kidneys need O2.
- Cortical blood flow > medullary flow – more filtration in the cortex.
- Kidney rich in sympathetic innervation.

Some Questions

Q1: The renal pyramids are located within the :

a) Cortex
b) Medulla
c) Pelvis
d) Column

Q2 :What is the basic functional unit of the kidney?

a) Alveolus
b) renal pyramids
c) Nephron
d) renal pelvis

Q3 :What is the function of the renal system?

a) Maintain blood PH
b) regulate blood pressure
c) Control blood concentration
d) all of them

Q4: The kidney secretes _____ for the purpose of stimulating bone marrow activity.

a) Renin
b) Aldosterone
c) Erythropoietin
d) Somatomedin

Some Questions

Q5: The kidney secretes _____ which is an enzyme-hormone which raises blood pressure.

a) Aldosterone
b) Renin
c) Angiotensinogen
d) Angiotensin II

Q6 :How much of the cardiac output passes through the kidneys?

a) 10%
b) 25%
c) 50%
d) 65%

Q7 :Which cells actually secretes renin into the blood?

a) Macula densa
b) Juxtaglomerular apparatus
c) Juxtaglomerular(JG) cells
d) Cortical nephron

Q8: The 2 kidneys are placed in the abdomen on the ..... side of aorta ?

a) **lateral**
b) Medial
c) Anterior
d) Posterior

Some Questions

Q9: which of the following is not a function of the kidney ?

a) Activation of vit.D
b) Activation of angiotensin II
c) Regulation of BP
d) Execration

Q10: In each kidney we have about ..... nephron ?

a) 1 million
b) 2 million
c) 500, 000
d) 1 thousand

1	2	3	4	5	6	7	8	9	10
B	C	D	C	B	B	C	A	B	A

THE END

If there are any problems or suggestions
Feel free to contact:

Physiology Team Leaders
Mohammed Jameel & Khulood Al-Raddadi

432100187@student.ksu.edu.sa
432200235@student.ksu.edu.sa

THANK YOU

Actions speak louder than Words