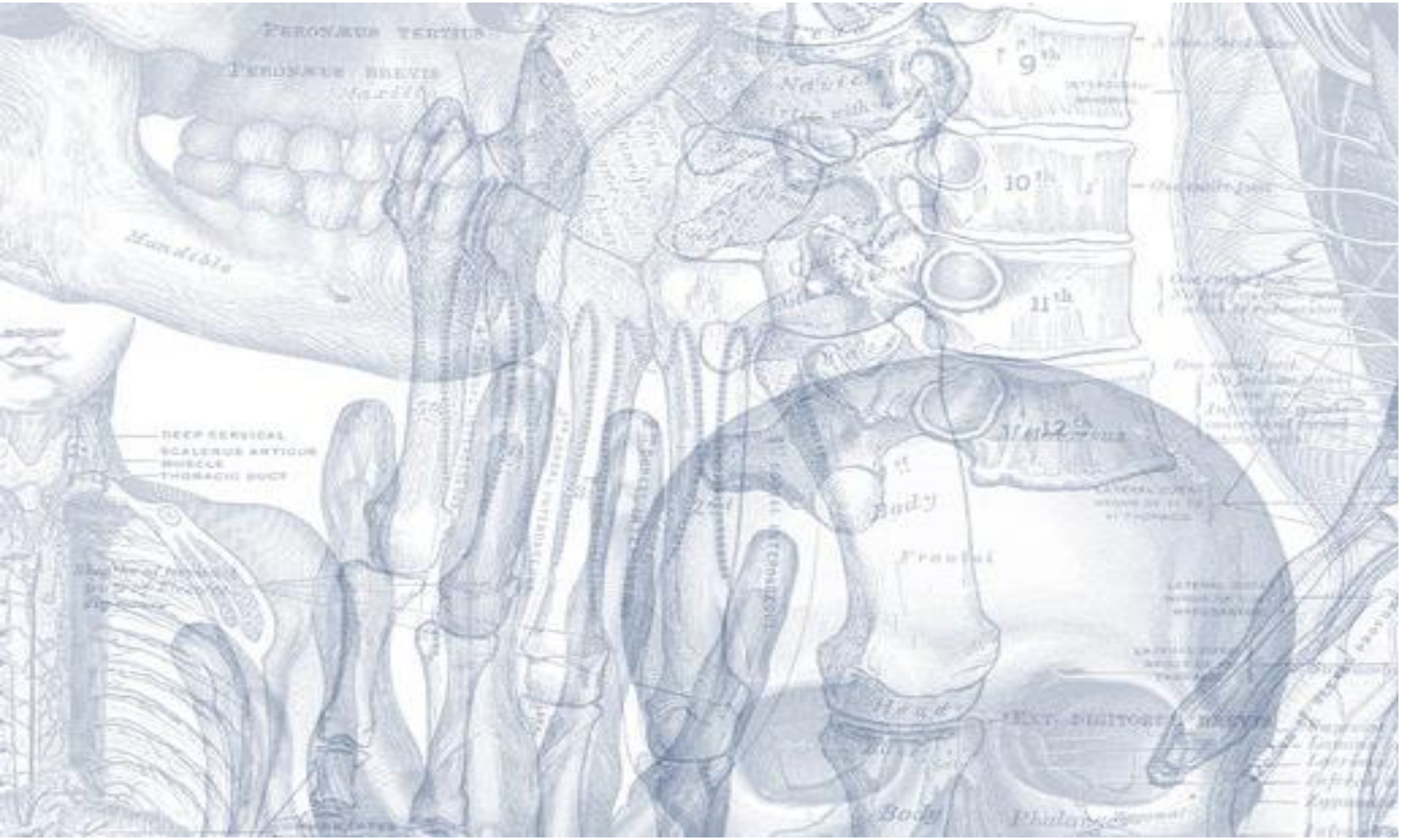
بِسْمِ اللَّهِ الرَّحْمَٰنِ الرَّحِيمِ



ANATOMY
TEAM 436

436
MEDICINE
KING SAUD UNIVERSITY

Revised by
شوق الأحمري & طراد الوكيل

Anatomy of the Kidney

Please view our Editing File before studying this lecture to check for any changes.

Color Code

- **Important**
- **Doctors Notes**
- **Notes/Extra explanation**

Objectives

By the end of this lecture you should be able to discuss the KIDNEY:

- ✓ Shape & Position.
- ✓ Surface Anatomy.
- ✓ External Features.
- ✓ Hilum And Its Contents.
- ✓ Relations.
- ✓ Internal Structure.
- ✓ Blood Supply
- ✓ Lymph Drainage.
- ✓ Nerve Supply.

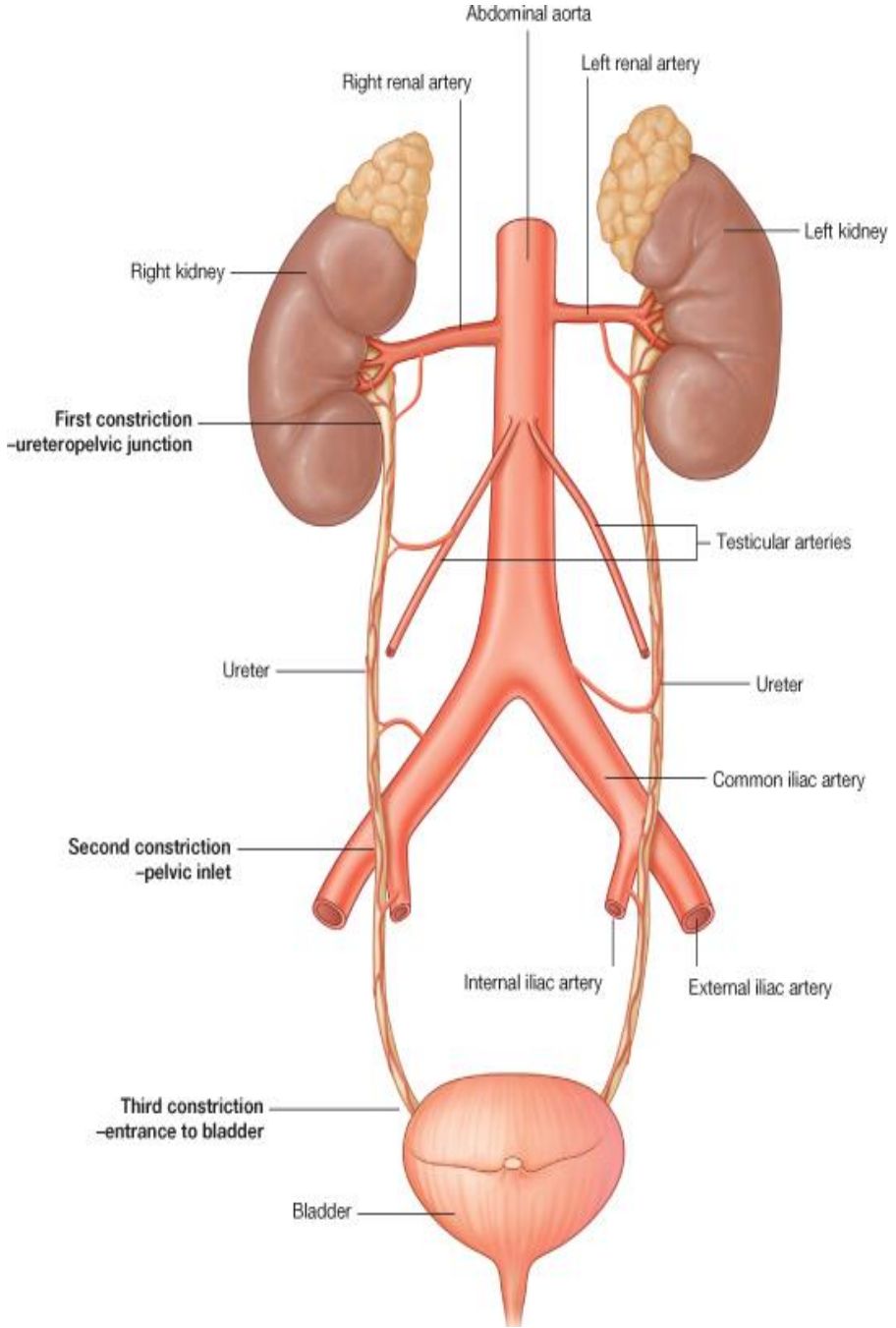
Introduction

- Every day, each **kidney** filters liters of fluid from the bloodstream.
- Although the **lungs** and the **skin** also play roles in excretion, the kidneys bear the major responsibility for eliminating nitrogenous (nitrogen-containing) wastes, toxins, and drugs from the body.

Functions of the kidney

1. **Excretes** most of the waste products of metabolism.
2. **Controls** water & electrolyte balance of the body.
3. **Maintain** acid-base balance of the blood.
4. **Stimulate** bone marrow for RBCs formation by

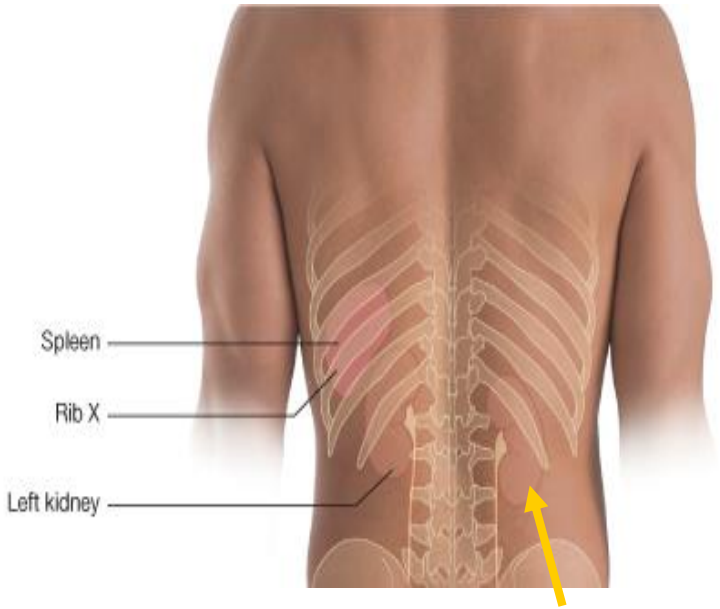
   Erythropoietin hormone.
5. **Regulates** blood pressure by **Rennin** enzyme.
6. **Converts** vitamin D to its active form.



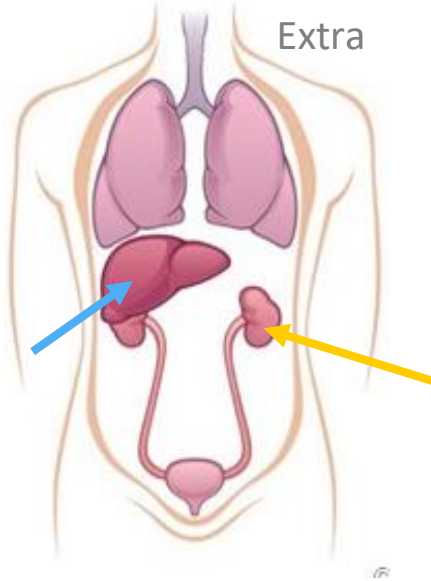
Kidney

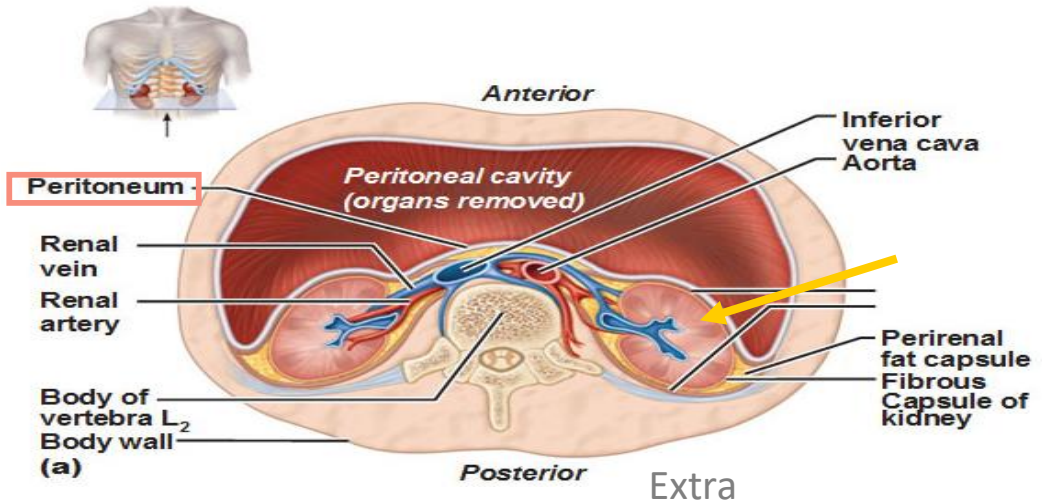
- Kidneys are **reddish brown** in color.
- Lie **behind** the peritoneum (retroperitoneal*), on either side of the **vertebral column** on the posterior abdominal wall.
- They are largely under cover of the costal margin.
- The right kidney lies slightly lower than the left due to the large size of the **right lobe of the liver.**
- The upper border of the right kidney is at the level of **11th intercostal space.**
- The upper border of the left kidney is a the level of the **11th rib.**

*retroperitoneal: only the front of the kidney is covered by peritoneum.



Extra

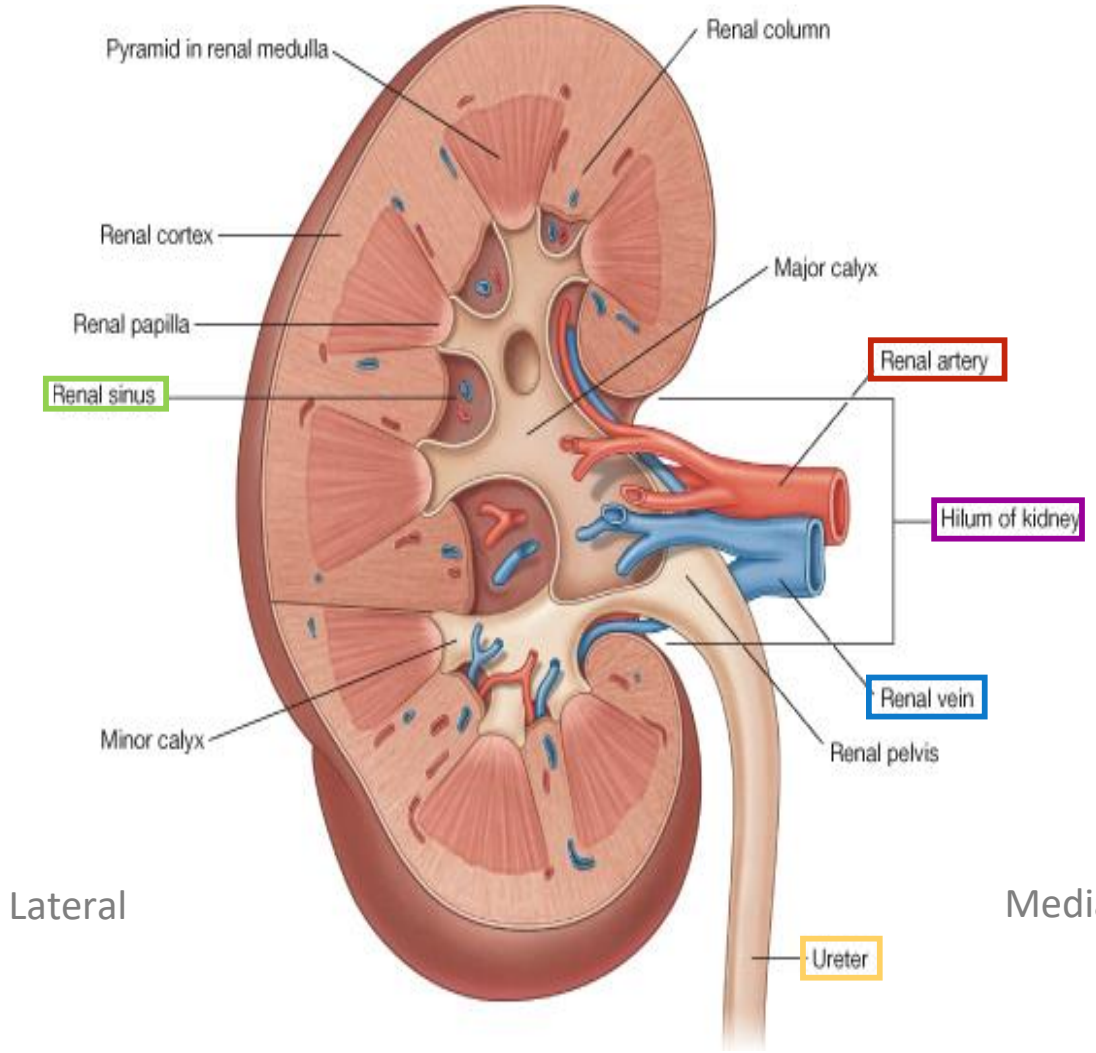




Extra

Kidney

- With contraction of the diaphragm (**inspiration**) the kidney moves downward as much as 2.5 cm.
- The lateral border is convex, while the medial border is convex at both ends but its middle part shows a vertical slit called the **hilum**.
- The hilum extends into a large cavity called the **renal sinus**.
- The hilum transmits (from anterior to posterior) the renal **vein**, two branches of renal **artery**, ureter, and the third branch of renal **artery** from the front backward **(V.A.U.A.)**



Kidney

Covering

From inward to outward:

1- Fibrous capsule: It is adherent to (surrounds) the kidney.

2- Perirenal fat : It covers the fibrous capsule.

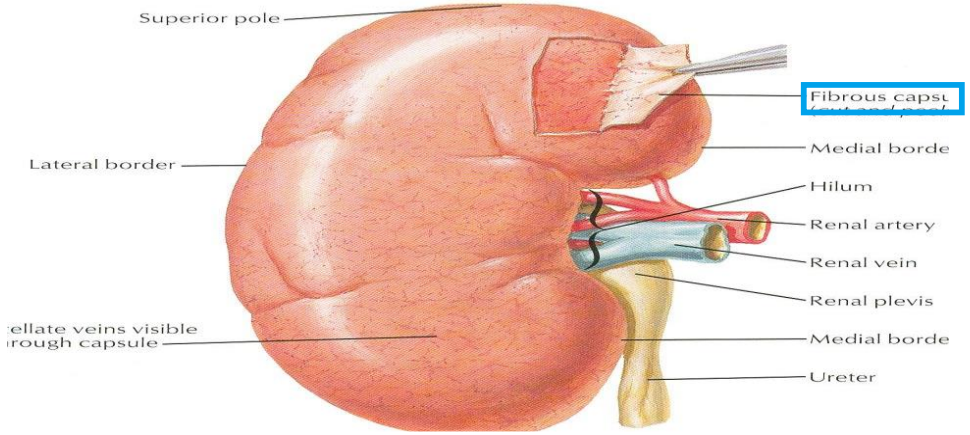
Perirenal fat → Inside

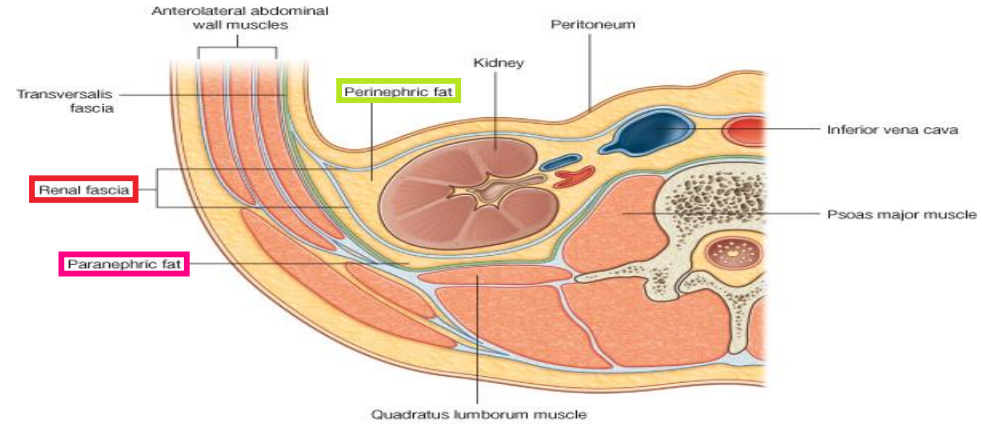
3- Renal fascia: it encloses the kidneys and suprarenal glands (but in different compartments).

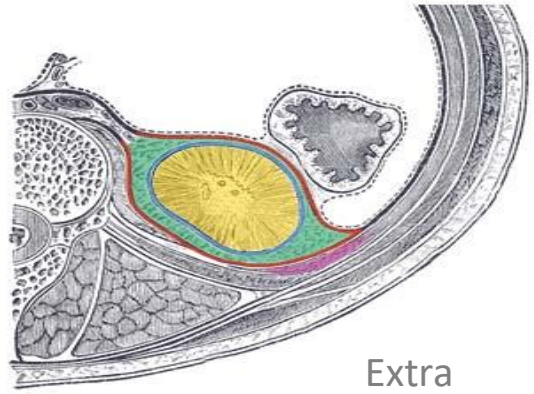
4- Pararenal fat : it lies external to the renal fascia, and forms part of the retroperitoneal fat.

N.B. The last 3 structures support the kidney in position.

**في حالة الأشخاص اللي يسوون رجيم قاسي راح يتأثر عندهم الـ pararenal fat و بيصير بسببها الـ floating kidneys فلذلك راح يكون عندهم الم في أسفل الظهر بعد الهرولة أو الركض بسبب عدم ثبات الكليتين في مكانهم الطبيعي







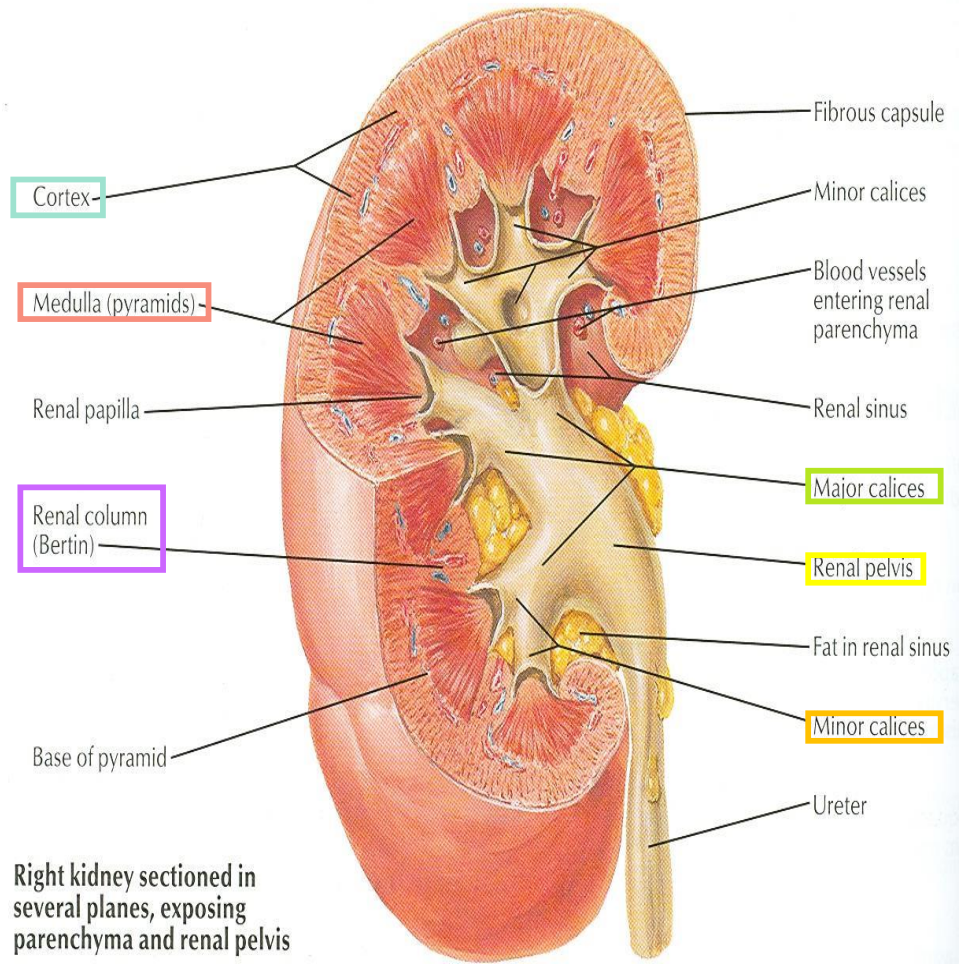
Kidney
Renal capsule
Perirenal fat
Renal fascia
Pararenal fat

Extra

Kidney

Structure

- Each kidney has an outer **cortex** and an inner **medulla.**
- Medulla is composed of about **12 renal pyramids.**
- The base of each pyramid is directed toward the **cortex** & its apex (the renal papilla) is projecting medially.
- The cortex extends into the medulla between adjacent pyramids as the **renal column.**
- Extending from the bases of the renal pyramids into the cortex are striations known as medullary rays.
- The renal sinus within the hilum, contains the upper expanded end of the ureter: the **renal pelvis**.
- Renal pelvis divides into two or three **major calyces**, which divides into two or three **minor calyces**.



Right kidney sectioned in several planes, exposing parenchyma and renal pelvis

Kidney

Posterior Relations

Structures :

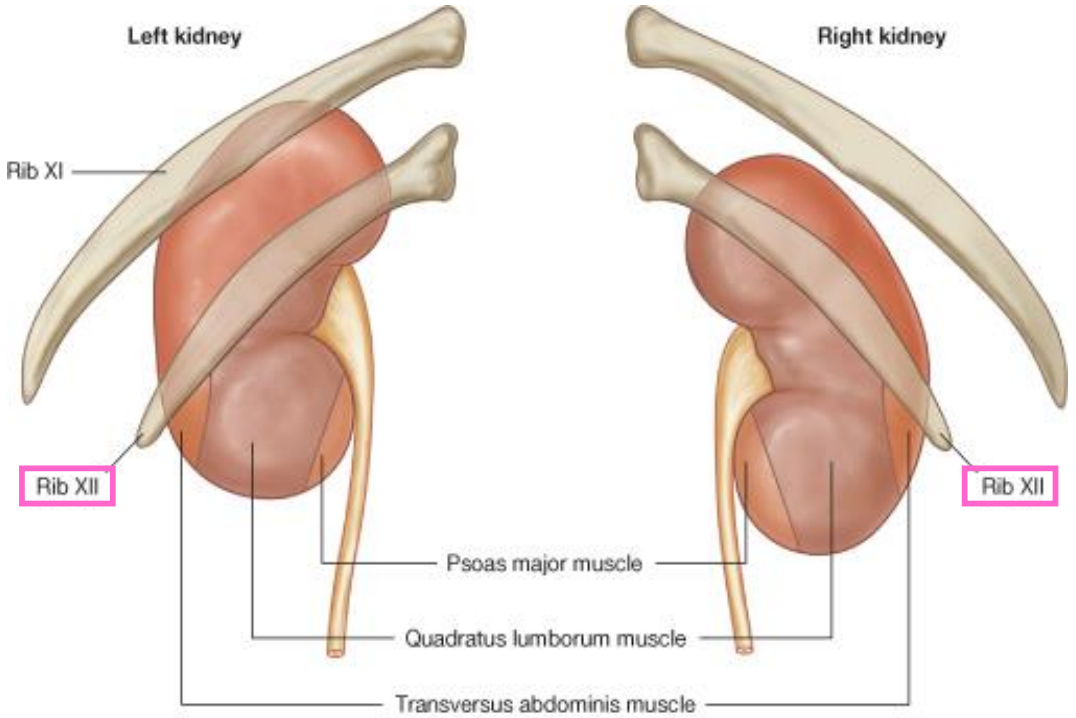
- Last intercostal space (11th)
- Costodiaphragmatic pleural recess
- Twelfth rib (The left kidney reaches up to the 11th rib)

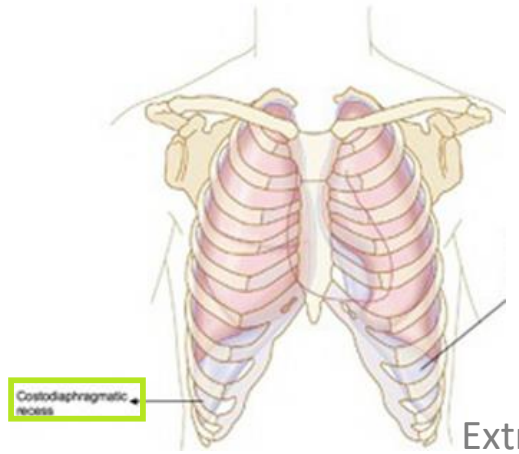
4 Muscles *median to lateral* :

1. Diaphragm
2. Psoas major muscle
3. Quadratus lamborum
4. Transversus abdominis

3 Nerves :

1. Subcostal nerve (T12)
2. Iliohypogastric (L1)
3. Ilioinguinal (L1)

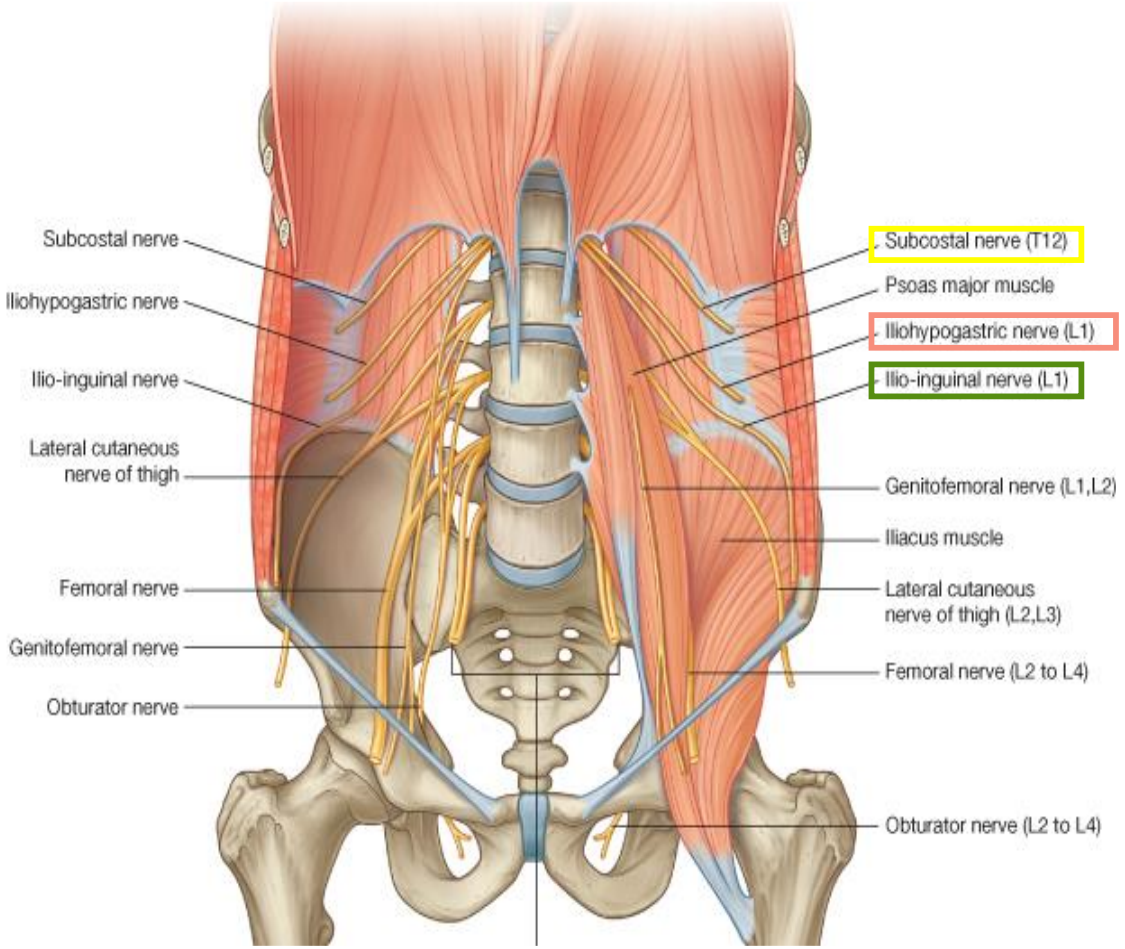


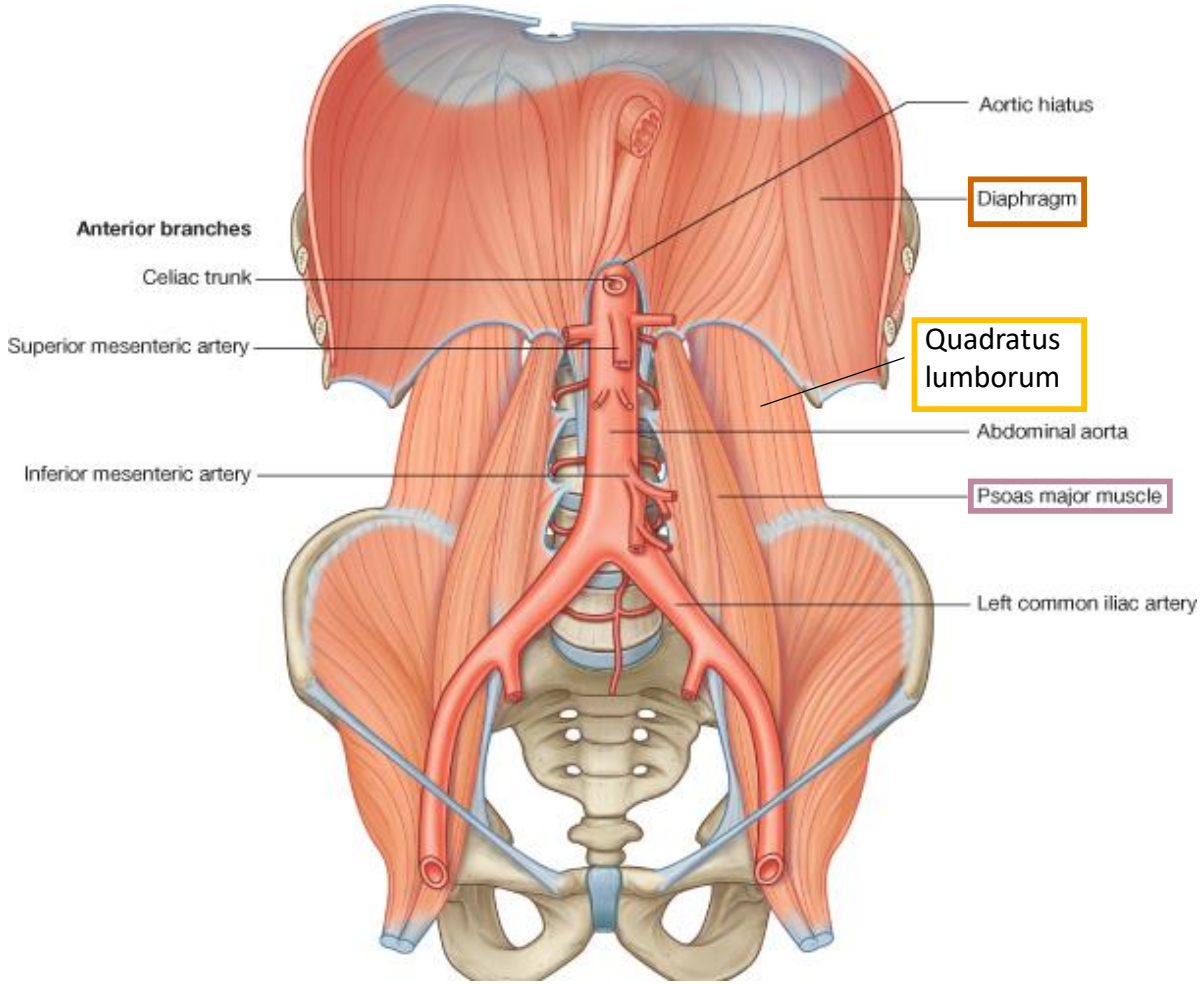


Extra

Kidney

Posterior Relations





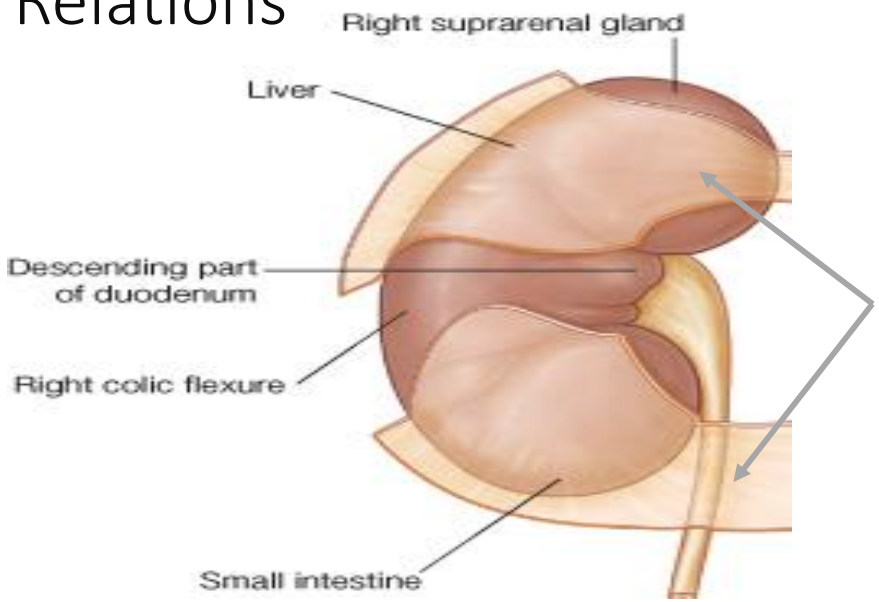
**You should know the location of each nerve and muscle

**It's also important to know the normal location of the kidneys and the vessels, structures that surround it

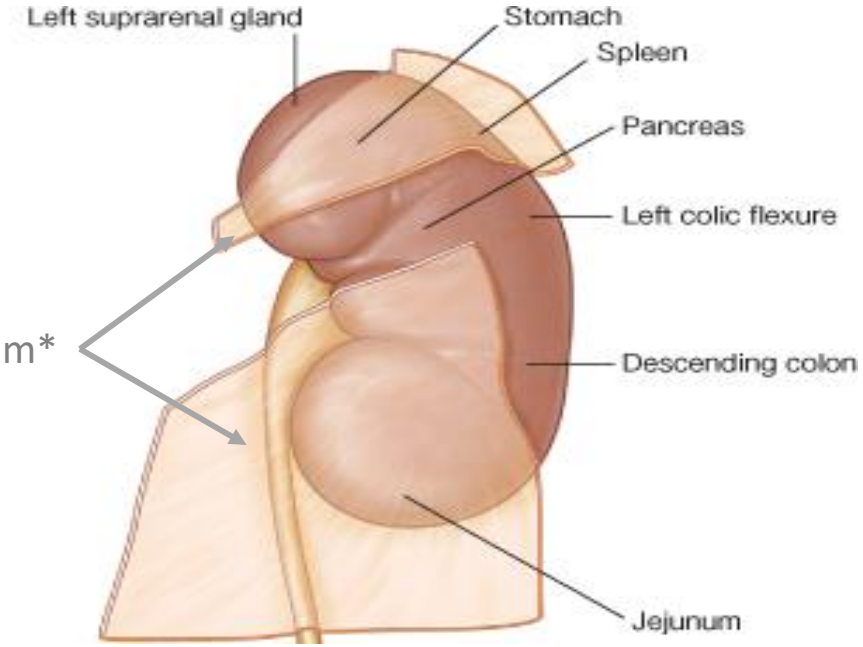
Kidney

Anterior Relations

IMPORTANT!



Peritoneum*



Right kidney:

1- Right suprarenal gland
2- Liver
3- Descending (second) part of duodenum
4- Right colic flexure
5- Coils of small intestine

Left kidney:

1- Left suprarenal gland
2- Stomach
3- Spleen
4- Pancreas
5- Left colic flexure
6-Descending colon
7-colis of jejunum

* The peritoneum is a continuous transparent membrane which lines the abdominal cavity and covers the abdominal organs. The anterior relations of the kidney are either directly on the kidney or lie on the peritoneum. The ones in **bold** are separated from the kidney by the peritoneum.

Extra Explanation

The course of the digestive tract:

Oral cavity → Pharynx → Esophagus → Stomach → Small intestines → Large intestines → Anus

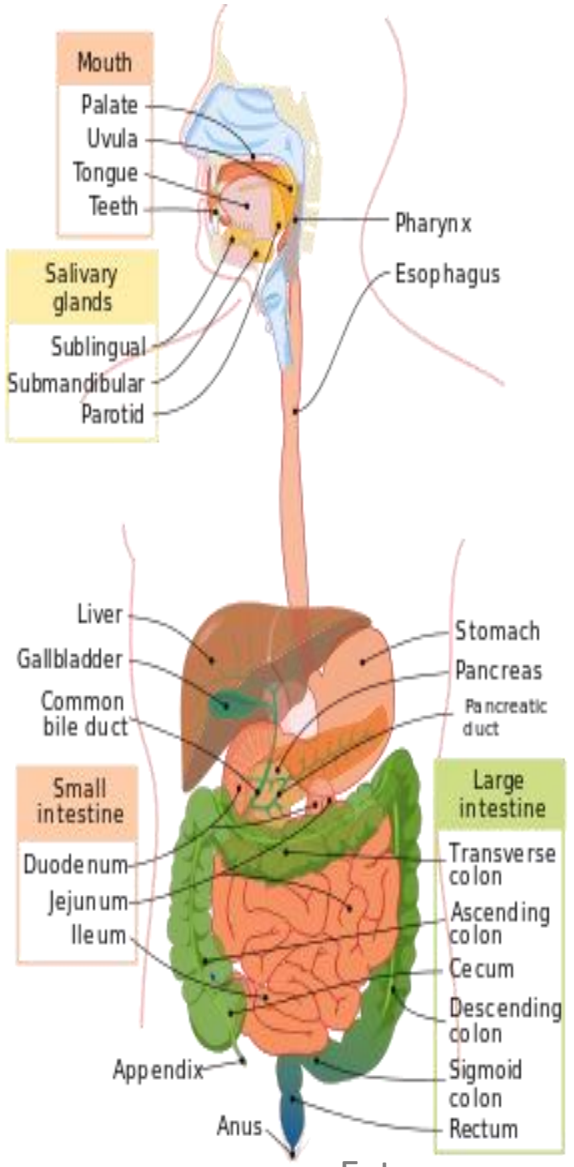
The small intestines is divided into 3 parts:

1. Duodenum (the C-shaped part),
2. Jejunum (the coiled midsection),
3. Ileum (the last section)

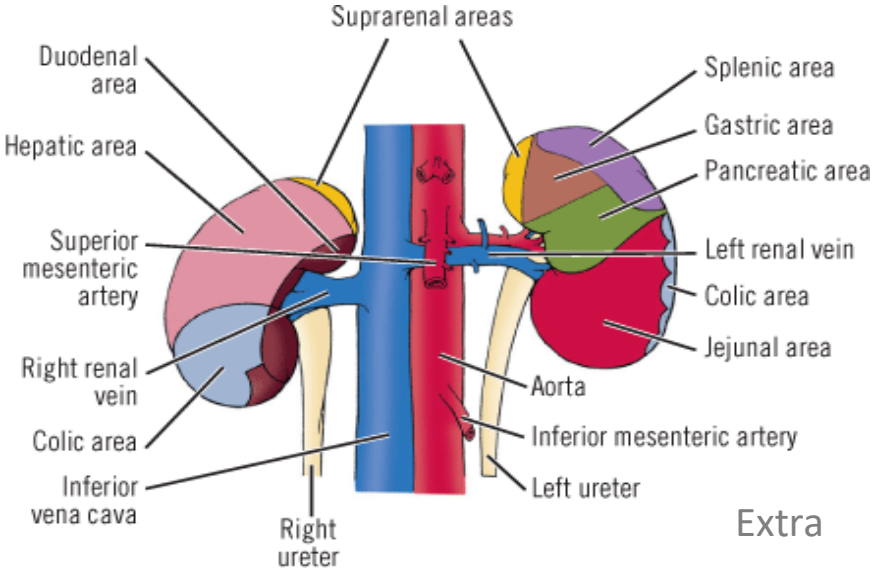
The large intestines is also divided into 3 parts:

1. Cecum
2. Colon (ascending, transverse, descending)
3. Rectum.

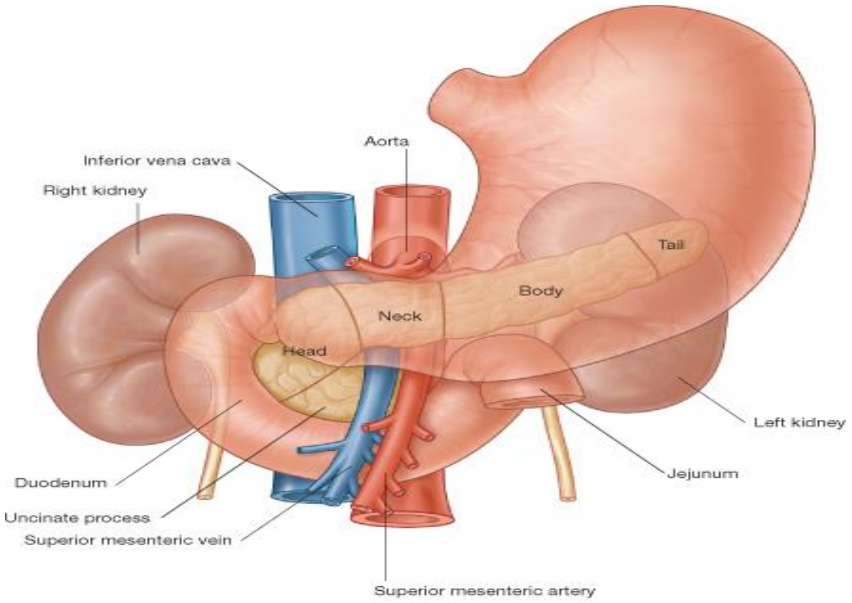
The part where the ascending colon curves to form the transvers colon is called the right colic flexure, and the part where the transverse colon curves to form the descending colon is called the left colic flexure.



Extra



Extra

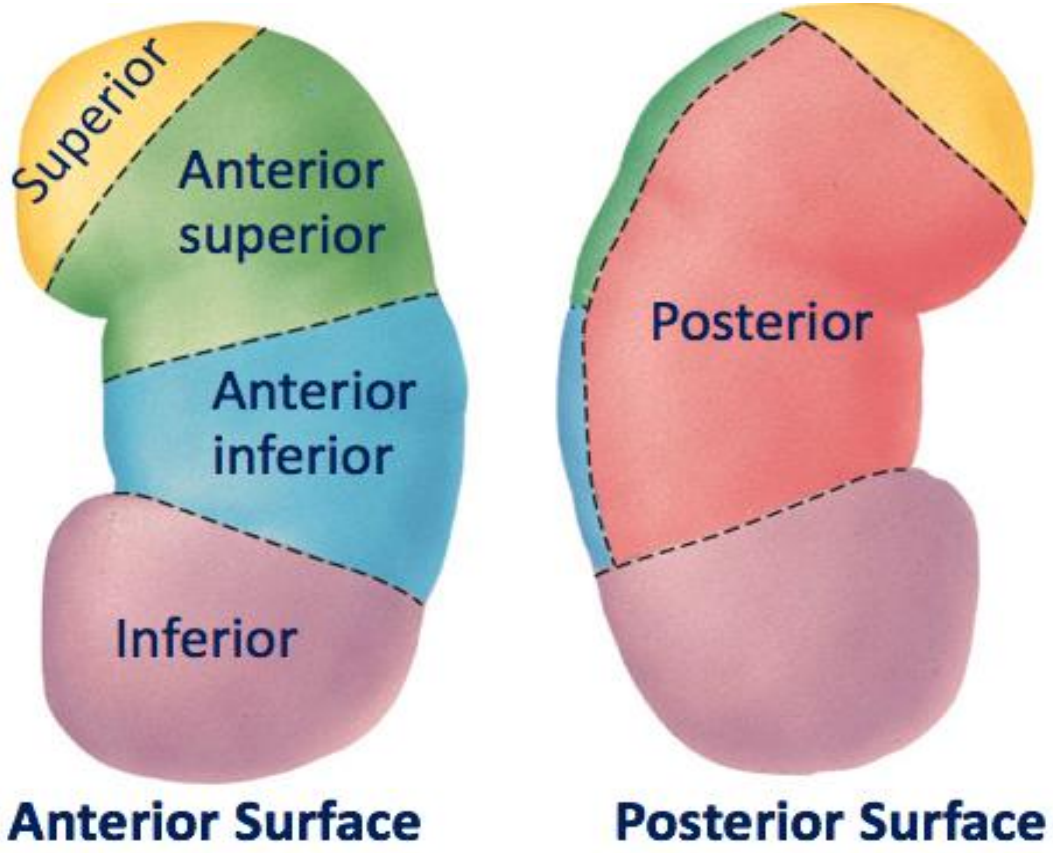


Only on the boys' slides

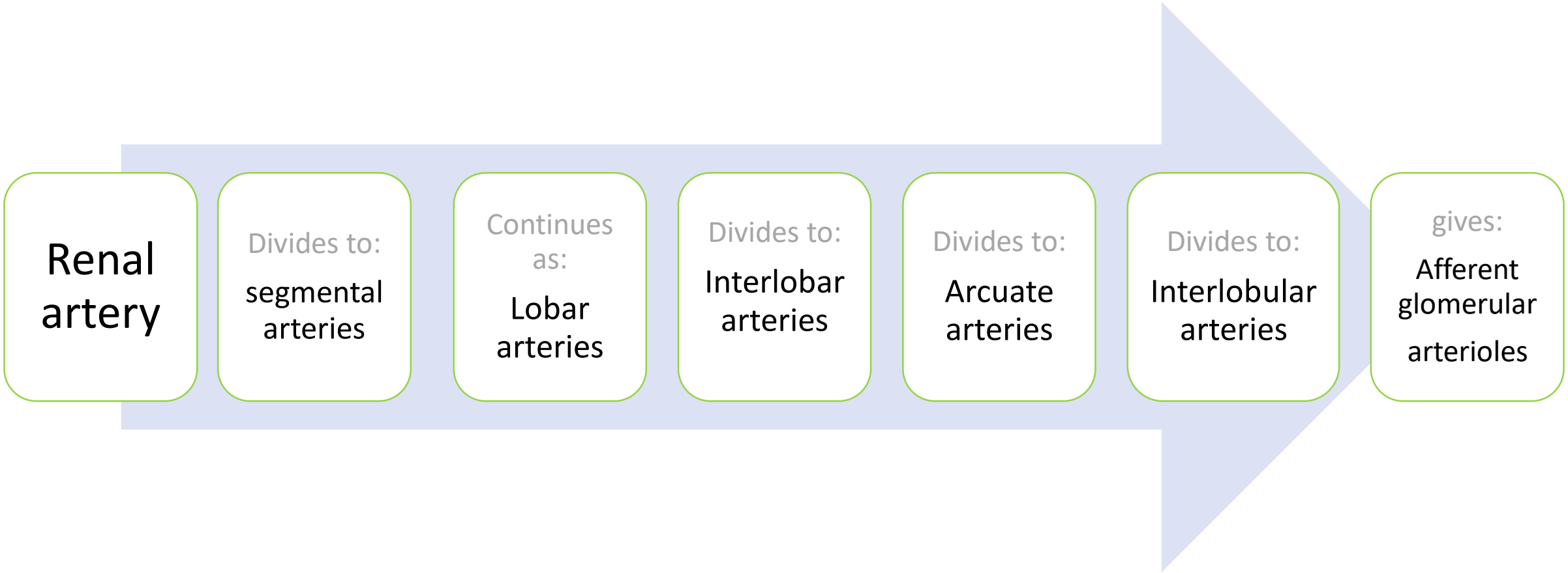
Kidney
Segments

Each kidney consists of 5 segments each having its own blood supply (4 anterior and 1 posterior):

1. Superior or Apical.
2. Anterior Superior.
3. Anterior Inferior.
4. Inferior or Basal.
5. Posterior or Caudal



Kidney
Blood Supply



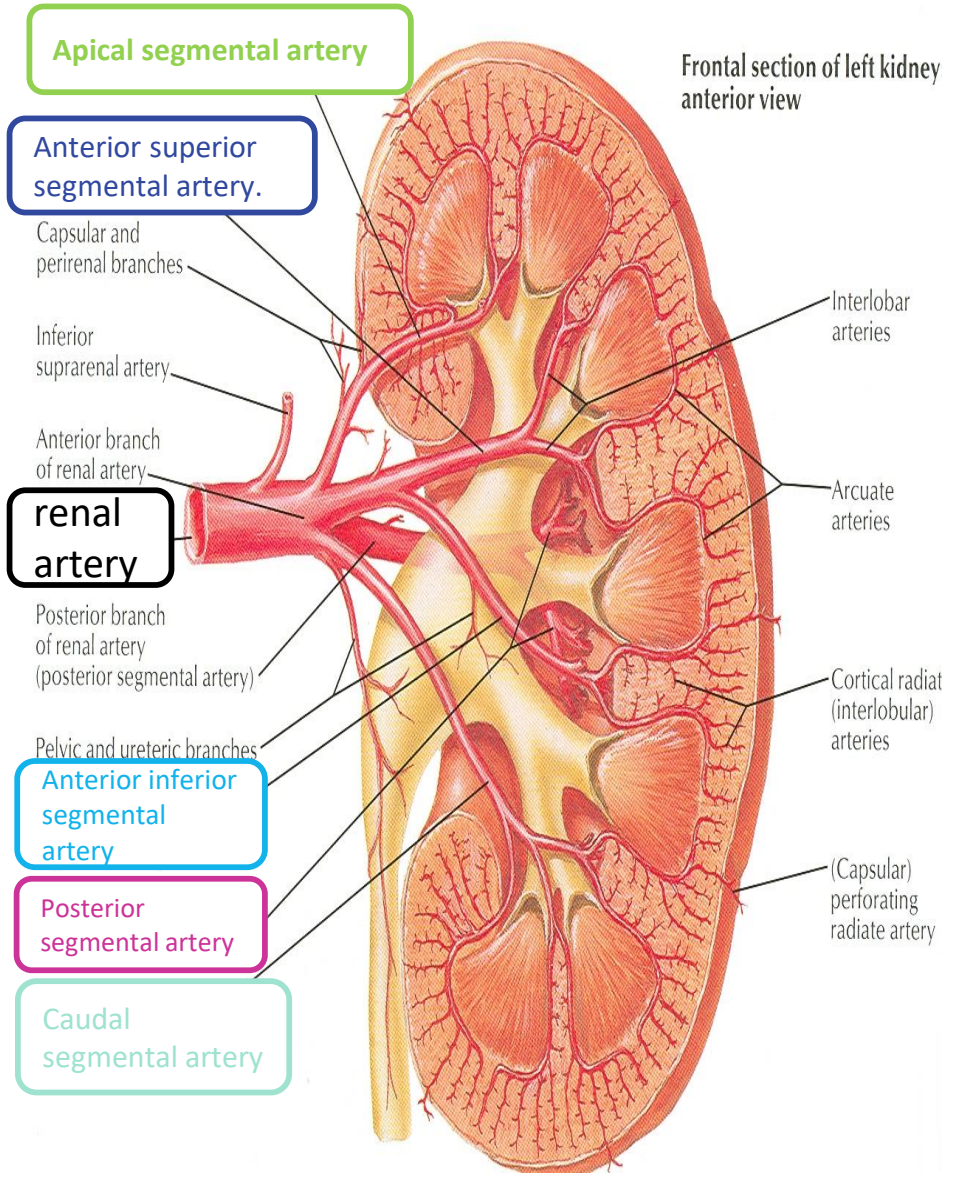
Kidney
Blood Supply

Renal artery

- The renal artery arises from the Aorta (abdominal Aorta) at the level of the **second lumbar vertebra**.

Segmental arteries

- Each renal artery divides into **five segmental arteries** that enter the hilum of the kidney, four in front and one behind the renal pelvis.
- They are distributed to different segments of the kidney, branches :
- 1-Apical segmental artery.
- 2-Anterior superior segmental artery.
- 3- Anterior inferior segmental artery.
- 4-Caudal segmental artery.
- 5-Posterior segmental artery.



Kidney
Blood Supply

Lobar artery

- **Lobar** artery arise from each segmental artery, one for each renal pyramid.
- Each lobar artery gives off 2 or **3 interlobar arteries.**

Inerlobar artery

- The **interlobar** arteries run toward the cortex on each side of the renal pyramid.
- Interlobar arteries give off the **arcuate** arteries at the junction of the cortex and medulla.

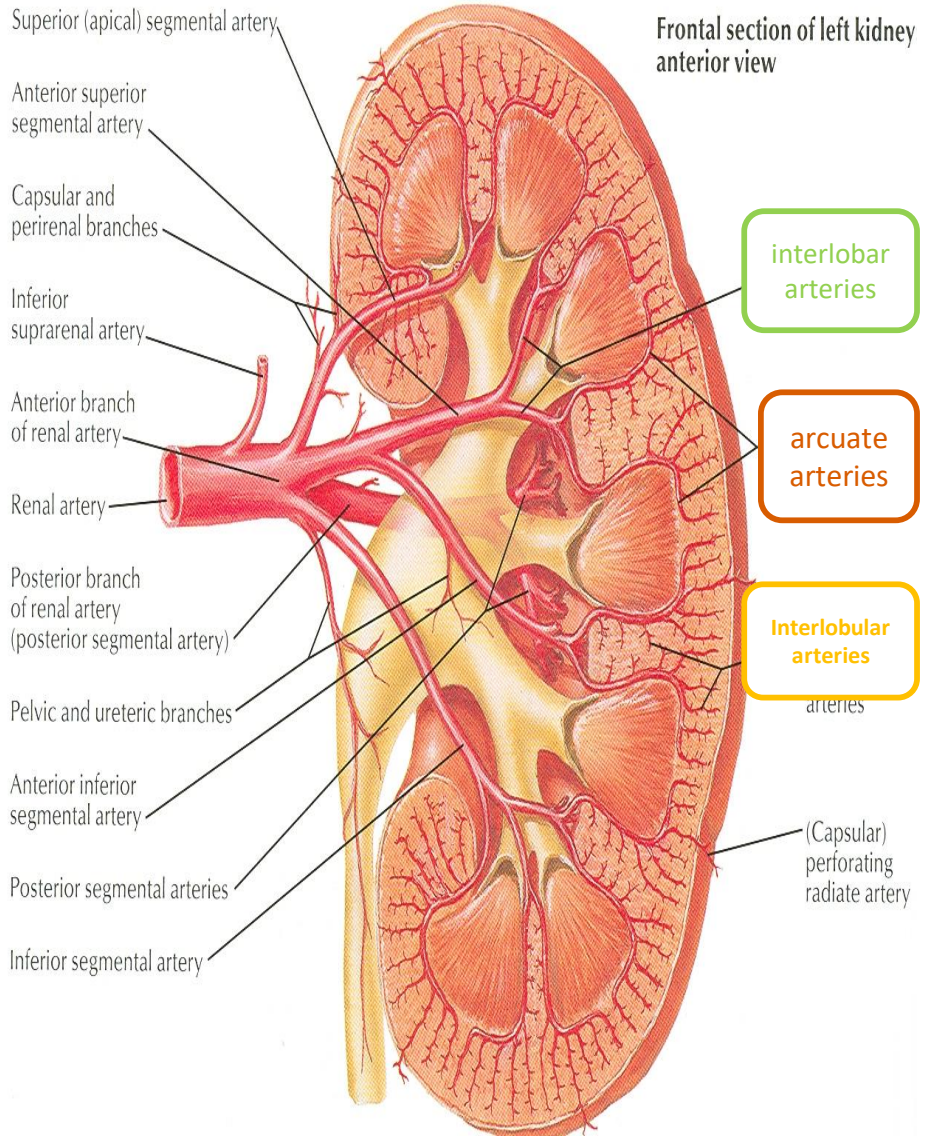
Arcuate arteries

- The **arcuate** arteries give off several **interlobular** arteries.

Interlobular arteries

- **Interlobular** arteries give **afferent** glomerular arterioles.

Note: There is interLOBAR and interLOBULAR



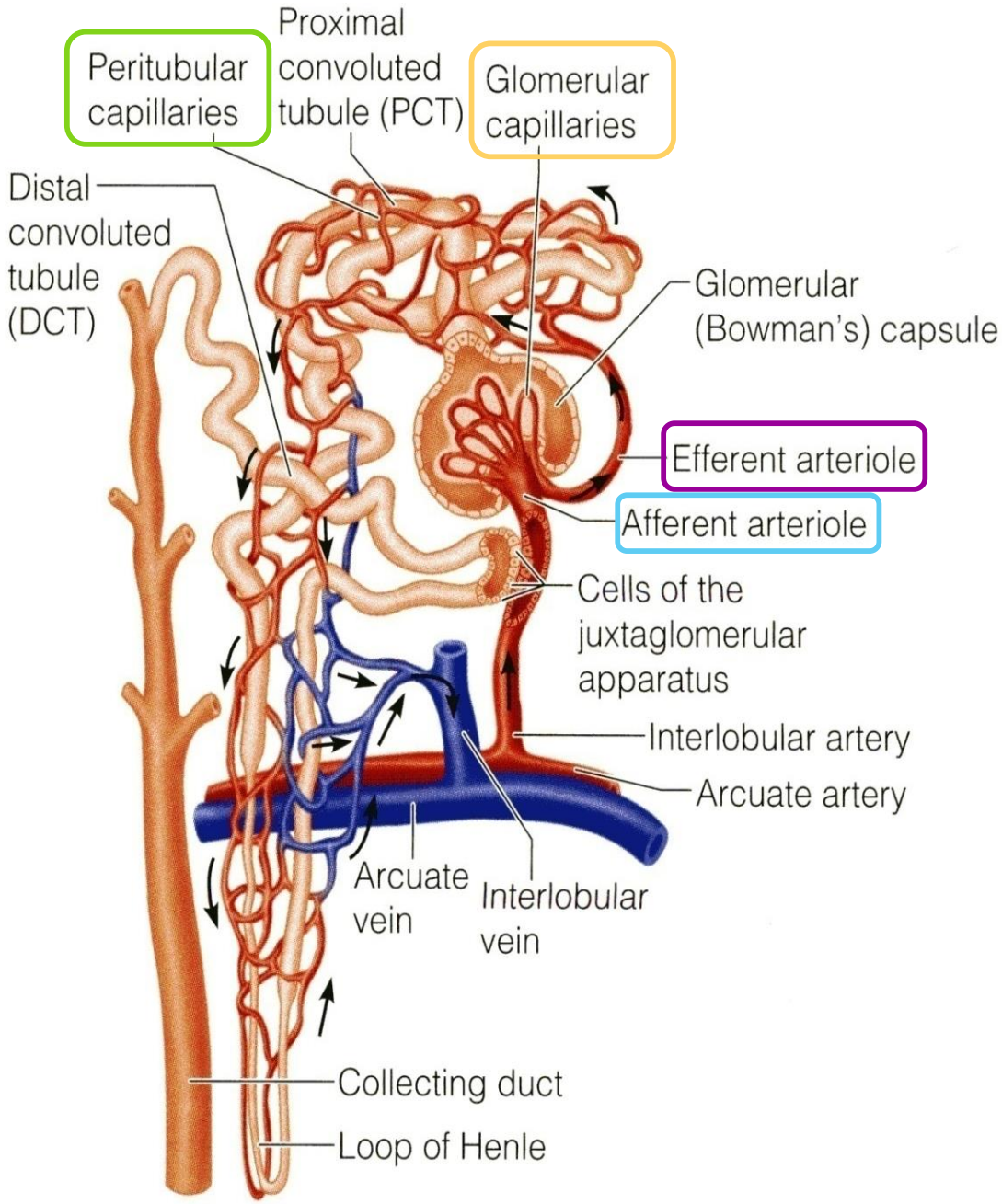
Kidney
Blood Supply

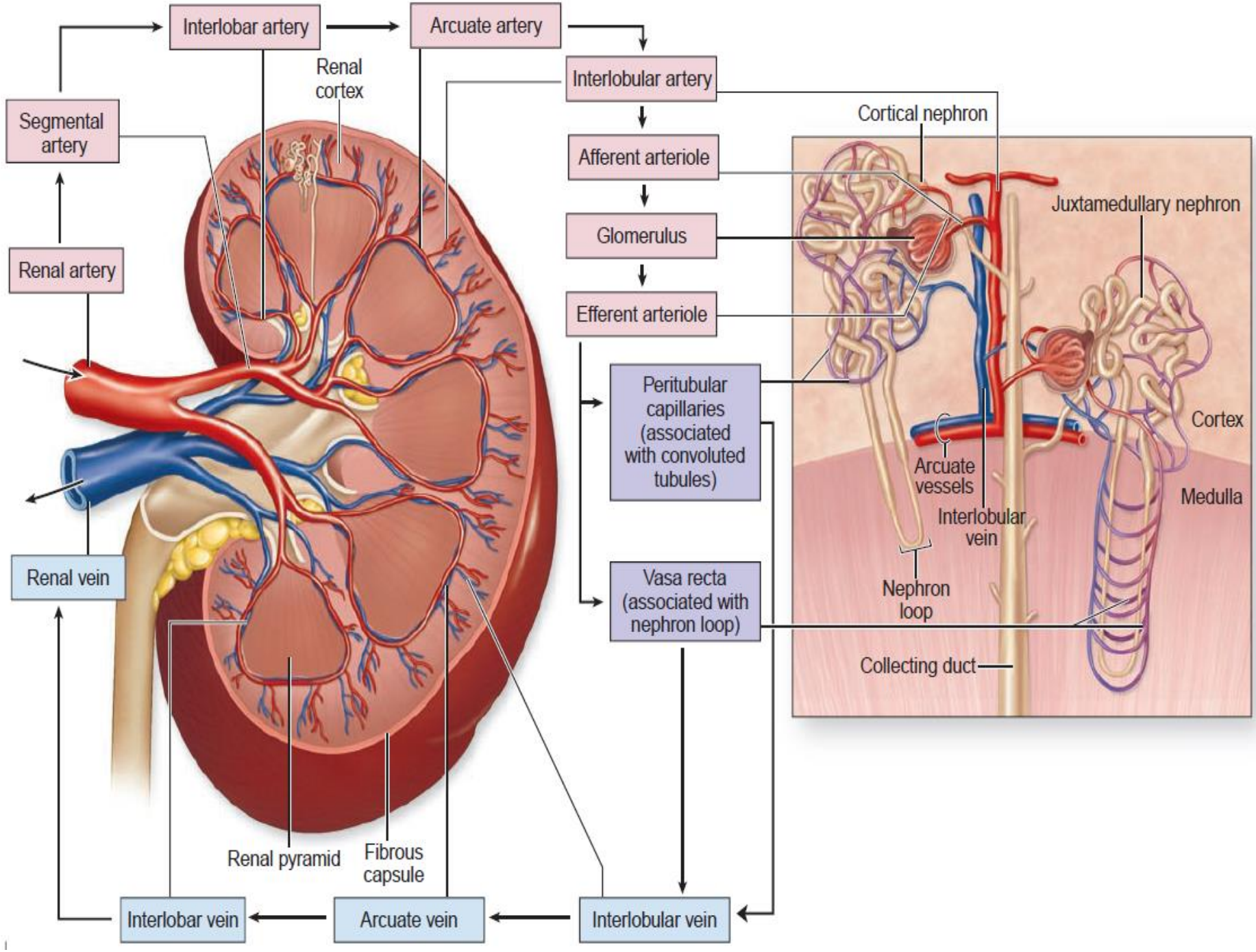
- Each Nephron is associated with **two** capillary beds:
  1. The **glomerulus**
  2. The **peritubular capillary bed**

- The glomerulus is both fed and drained by **arterioles**.

  - The **afferent arteriole**, which arises from an interlobular artery, is the "feeder vessel“.

  - The **efferent arteriole** receives blood that has passed through the glomerulus.

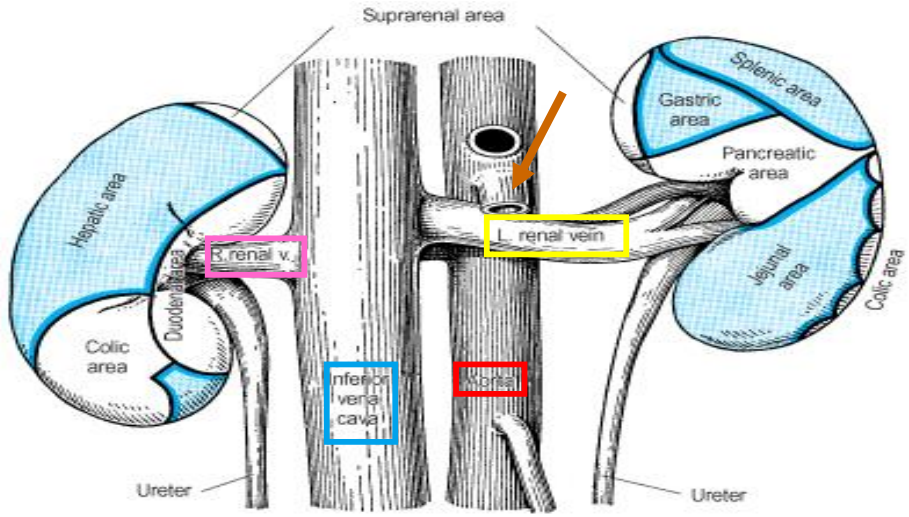


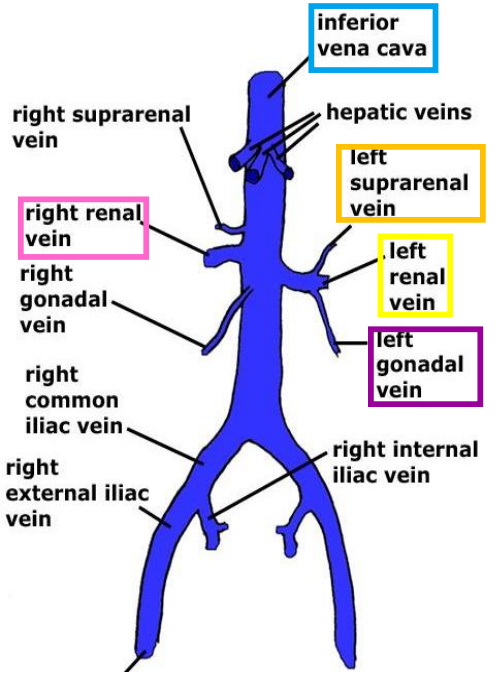

Interlobar artery
Arcuate artery
Interlobular artery
Renal cortex
Segmental artery
Afferent arteriole
Glomerulus
Efferent arteriole
Renal artery
Peritubular capillaries (associated with convoluted tubules)
Vasa recta (associated with nephron loop)
Renal vein
Renal pyramid
Fibrous capsule
Interlobar vein
Arcuate vein
Interlobular vein
Cortical nephron
Juxtamedullary nephron
Cortex
Medulla
Arcuate vessels
Interlobular vein
Nephron loop
Collecting duct

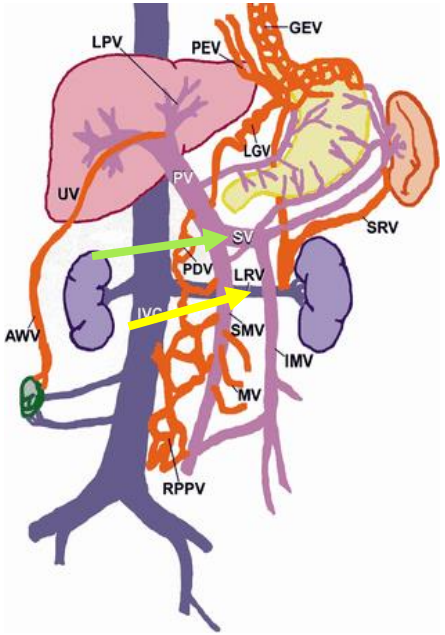
Kidney

Venous Drainage

- Both renal veins drain to the **inferior vena cava** in front of renal artery.
- The left is three times longer than the right (7.5 cm and 2.5 cm). So, for this reason the left kidney is the preferred side for live donor nephrectomy (when a living person donates a kidney).
- It runs from its origin in the renal hilum, posterior to the **splenic vein** and the body of pancreas, and then across the anterior aspect of the **aorta**, just below the origin of the superior mesenteric artery.
- The **left gonadal vein** enters the left renal vein from below, while the **left suprarenal vein** enters it from above but nearer to the midline. (the right gonadal and suprarenal veins drain directly into the IVC)
- The **left renal vein** enters the inferior vena cava a *little above* the **right renal vein**.
- The **right** renal vein is behind the 2nd part of the duodenum and sometimes the lateral part of the head of the pancreas.





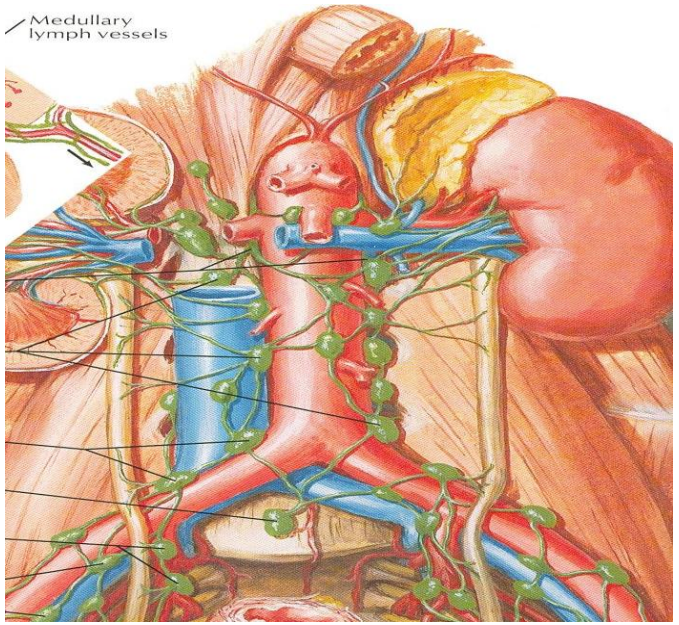


Kidney
Supply

Lymph Drainage:

Lateral aortic lymph nodes around the origin of the renal artery.

(Also called: para-aortic or lumbar lymph nodes)

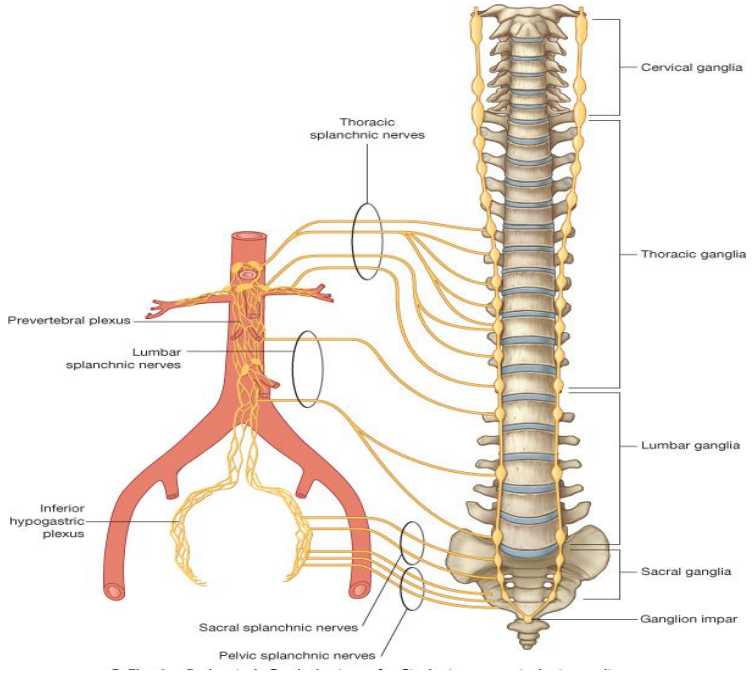


Nerve Supply:

Renal sympathetic plexus. (no parasympathetic)

The afferent fibers that travel through the renal plexus enter the spinal cord in the:

10th, 11th, and 12th Thoracic nerves.



MCQs

1- Which one of the following coverings does not play a role in supporting the kidney in position ?

A. fibrous capsule
B. renal facia
C. pararenal fat
D. perirenal fat

Answer: A

2- The …… contains the upper expanded end of the ureter, the renal pelvis.

A. Cortex.
B. Medulla.
C. Renal column.
D. Renal sinus.

Answer : D

3- At which level does the renal artery arise ?

A. 1st Thoracic vertebra
B. 2nd lumbar vertebra
C. 1st lumbar vertebra
D. 3rd lumbar vertebra

Answer : B

4- Which one of the following gives afferent glomerular arteries ?

A. Interlobar arteries
B. Interlobular arteries
C. Arcuate arteries
D. segmental arteries

Answer : B

5- Left renal vein runs behind which of the following veins?

A. Gonadal vein
B. Suprarenal vein
C. Splenic vein
D. Inferior vena cava

Answer : C

6. Which of the following is related to the left kidney anteriorly with peritoneum?

A. Left suprarenal gland
B. Spleen
C. Pancreas
D. Descending colon

Answer: B

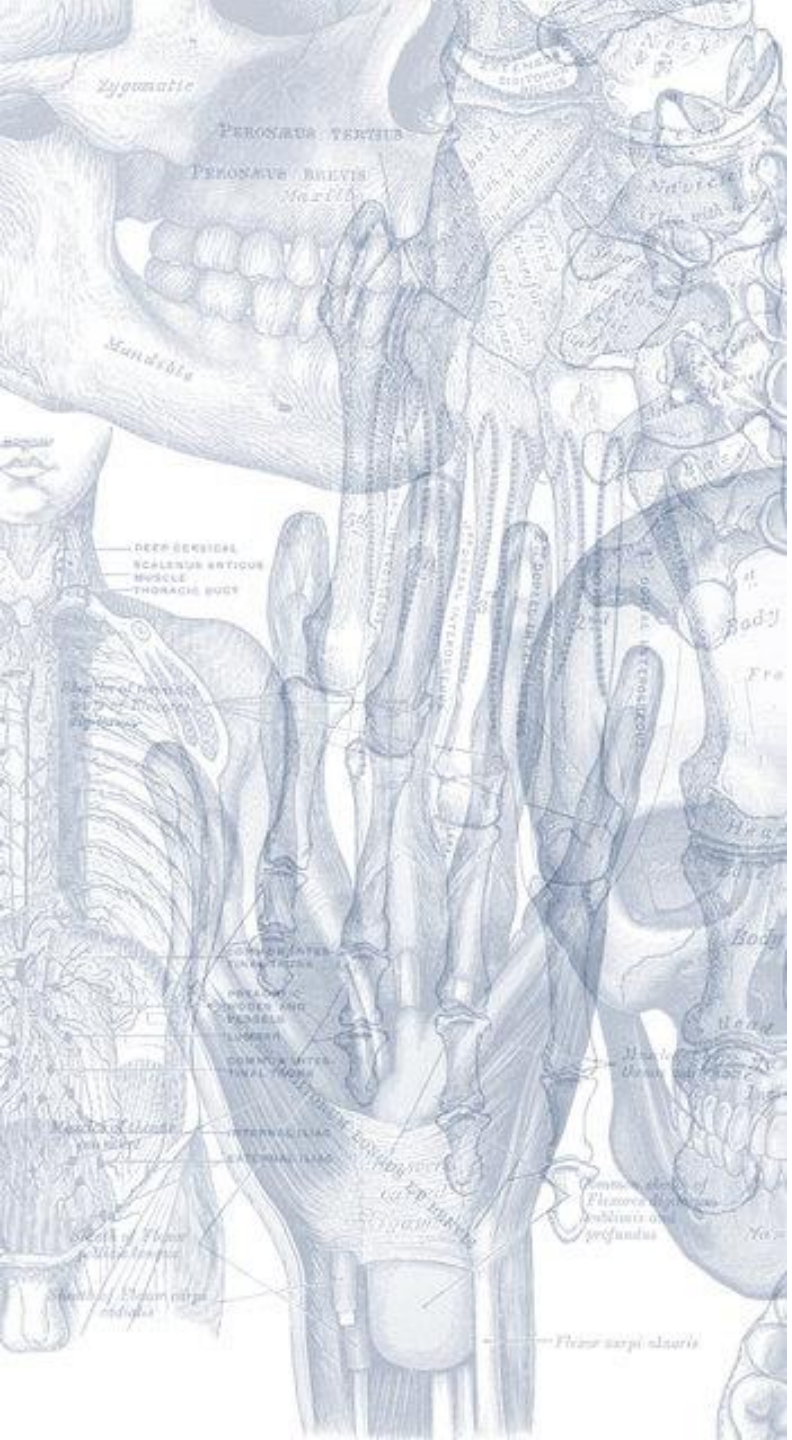
SAQs

An obese person is undergoing a vigorous diet which one of his kidney coverings will be affected most and which condition will be apparent ?

Answer : Pararenal fat will be affected most , (floating kidney)

What are the capillary beds associated with Nephrons?

Answer: Glomerulus and Peritubular capillary bed



Leaders:

Nawaf AlKhudairy

Jawaher Abanumy

Members:

Yazeed Alsuhaibani

Hamad alkhudairy

Talal alhuqail

Abdulmohsen alghannam

Mohammed habib

Khaled aldakheel

Abdulaziz alsalman

Essam alshahrania

anatomyteam436@gmail.com

@anatomy436