ANATOMY OF KIDNEYS

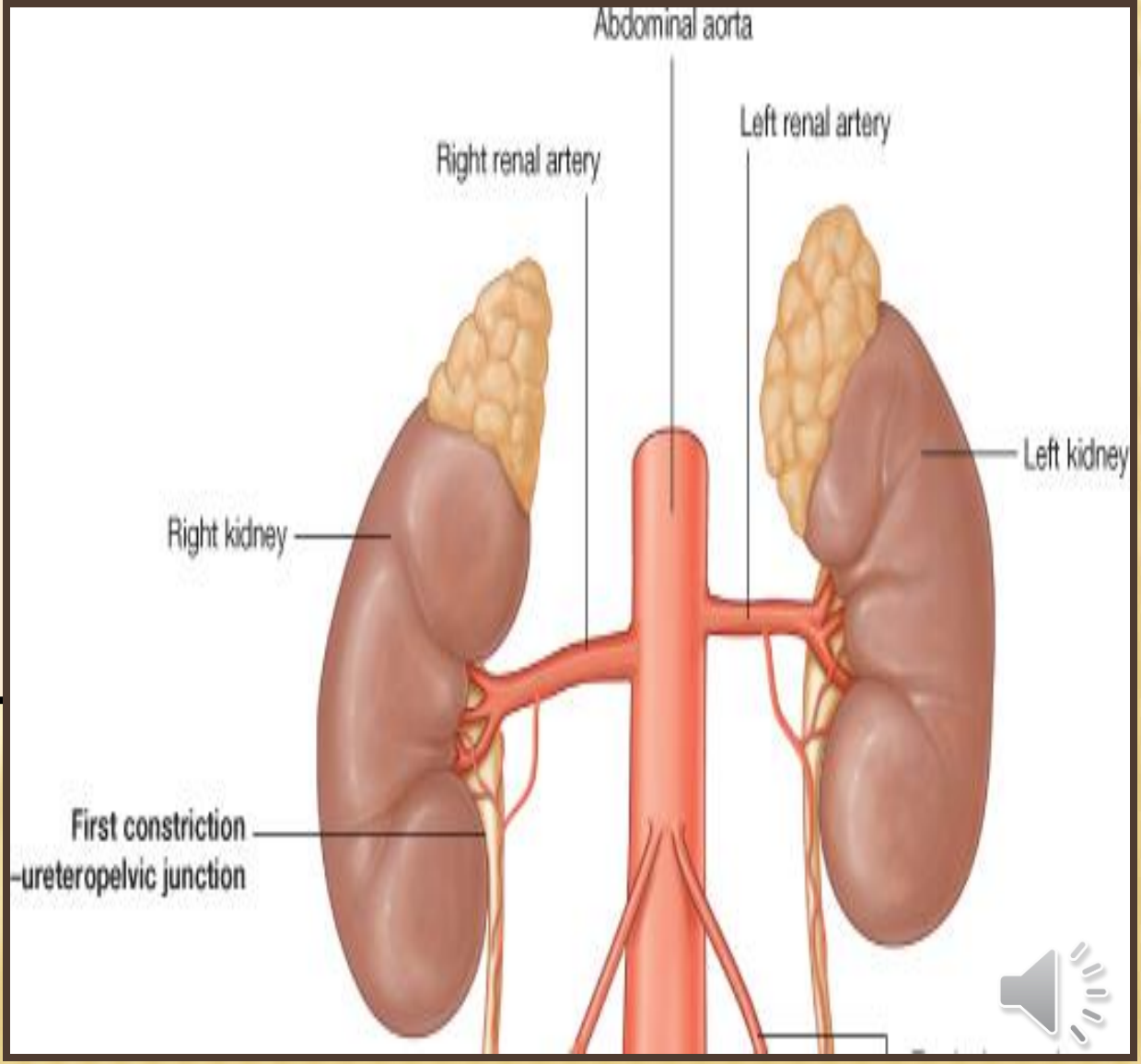
PROF. SAEED ABUEL MAKAREM

Objectives

By the end of the lecture you should be able to *discuss*

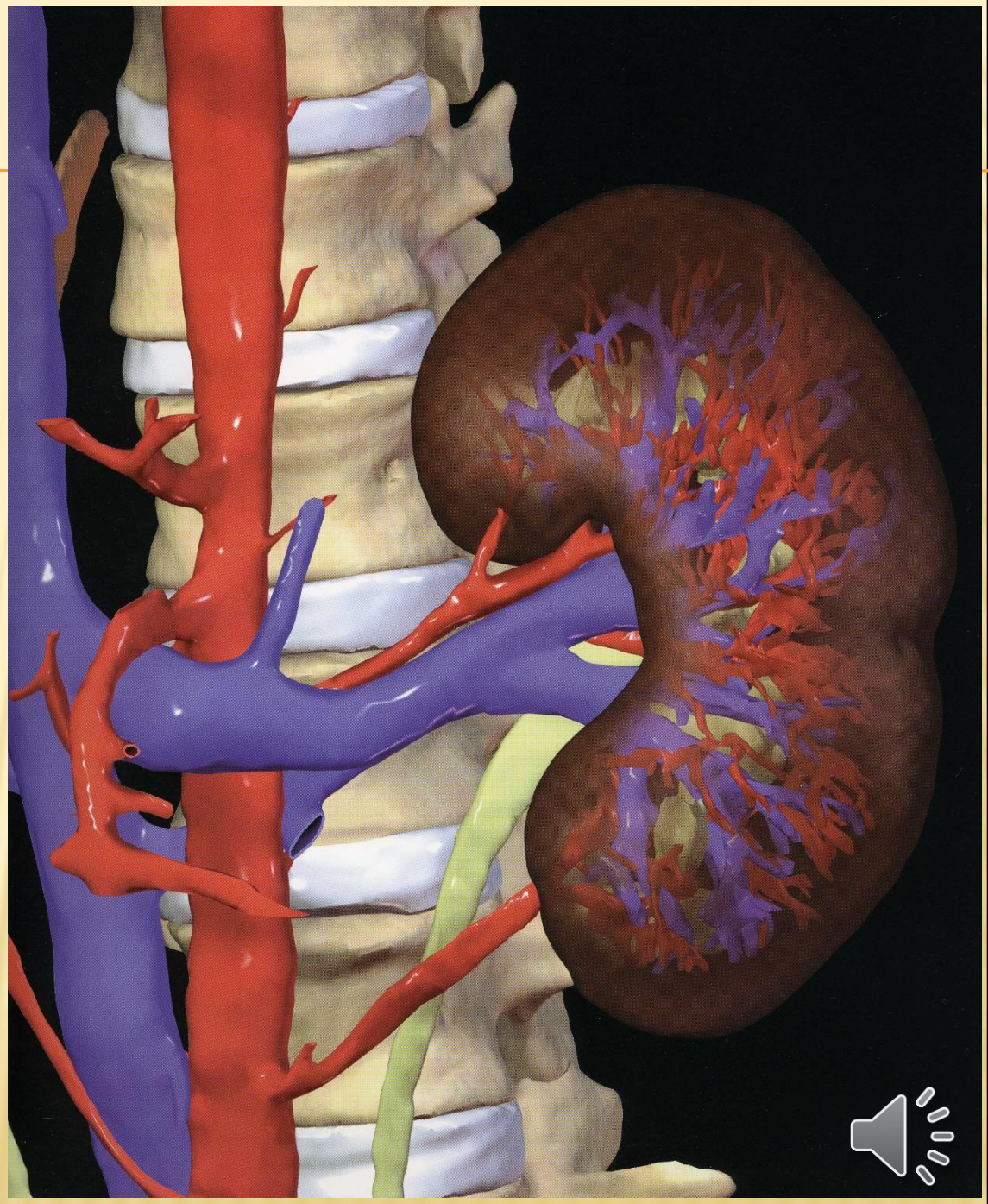
Anatomy of the KIDNEY

- Shape & position.
- External features.
- Hilum and its contents.
- Relations.
- Internal structure.
- BLOOD SUPPLY
- Lymph drainage..
- Nerve supply.



INTRODUCTION

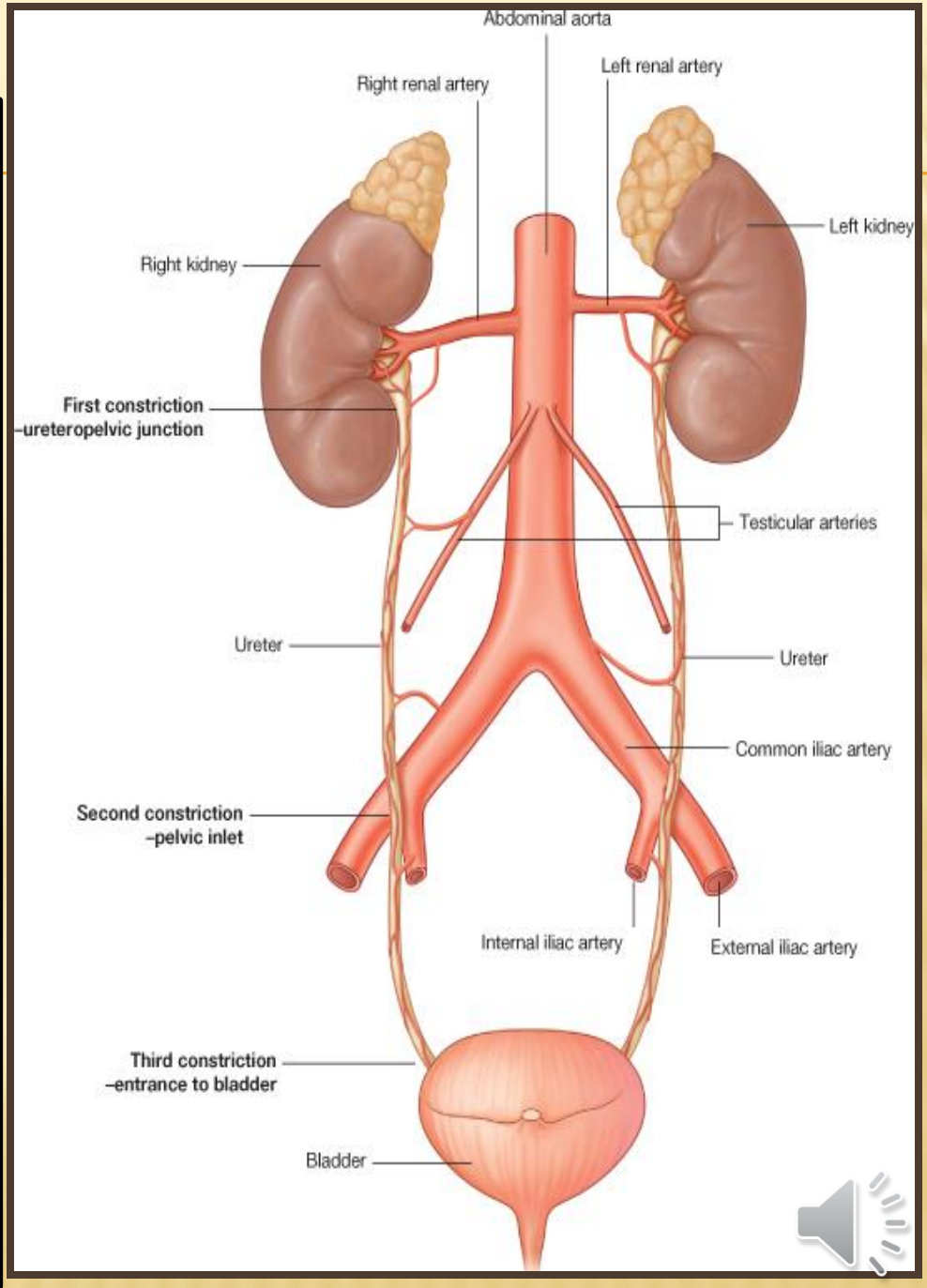
- Every day, each kidney filters liters of fluid from bloodstream.
- Although the lungs and the skin also play roles in excretion.
- The kidneys bear the major responsibility for eliminating nitrogenous wastes, (nitrogen-containing toxins), and drugs from the body.



KIDNEY

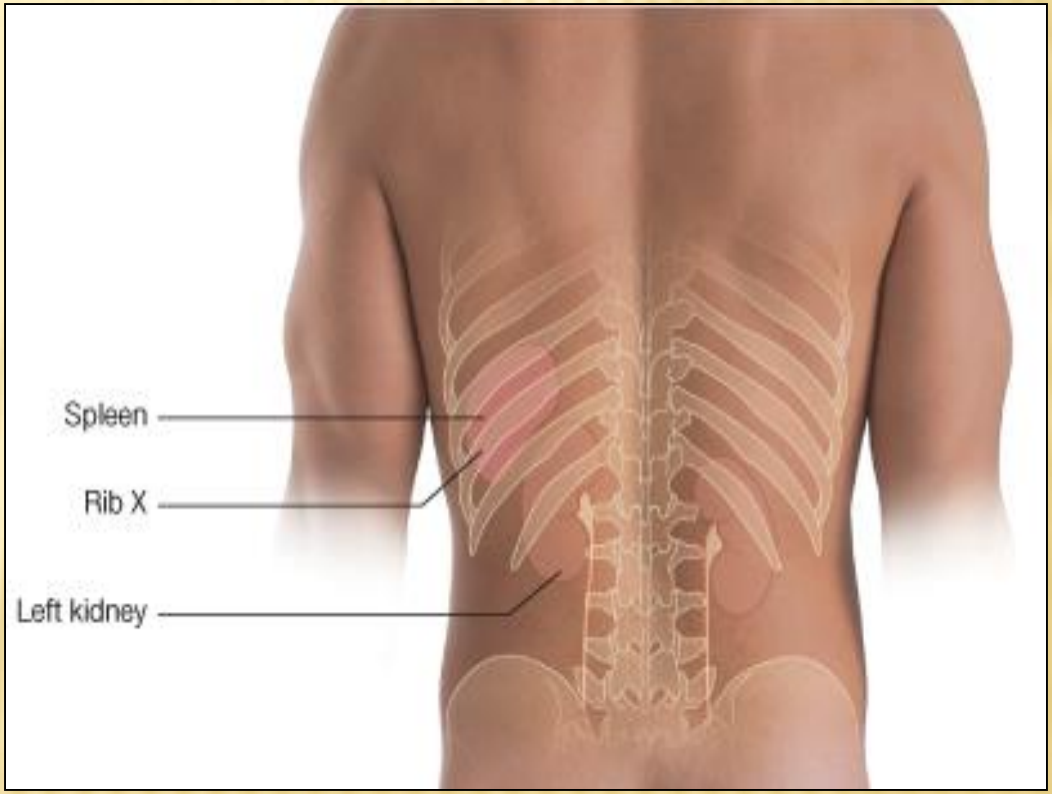
- **Functions:**

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

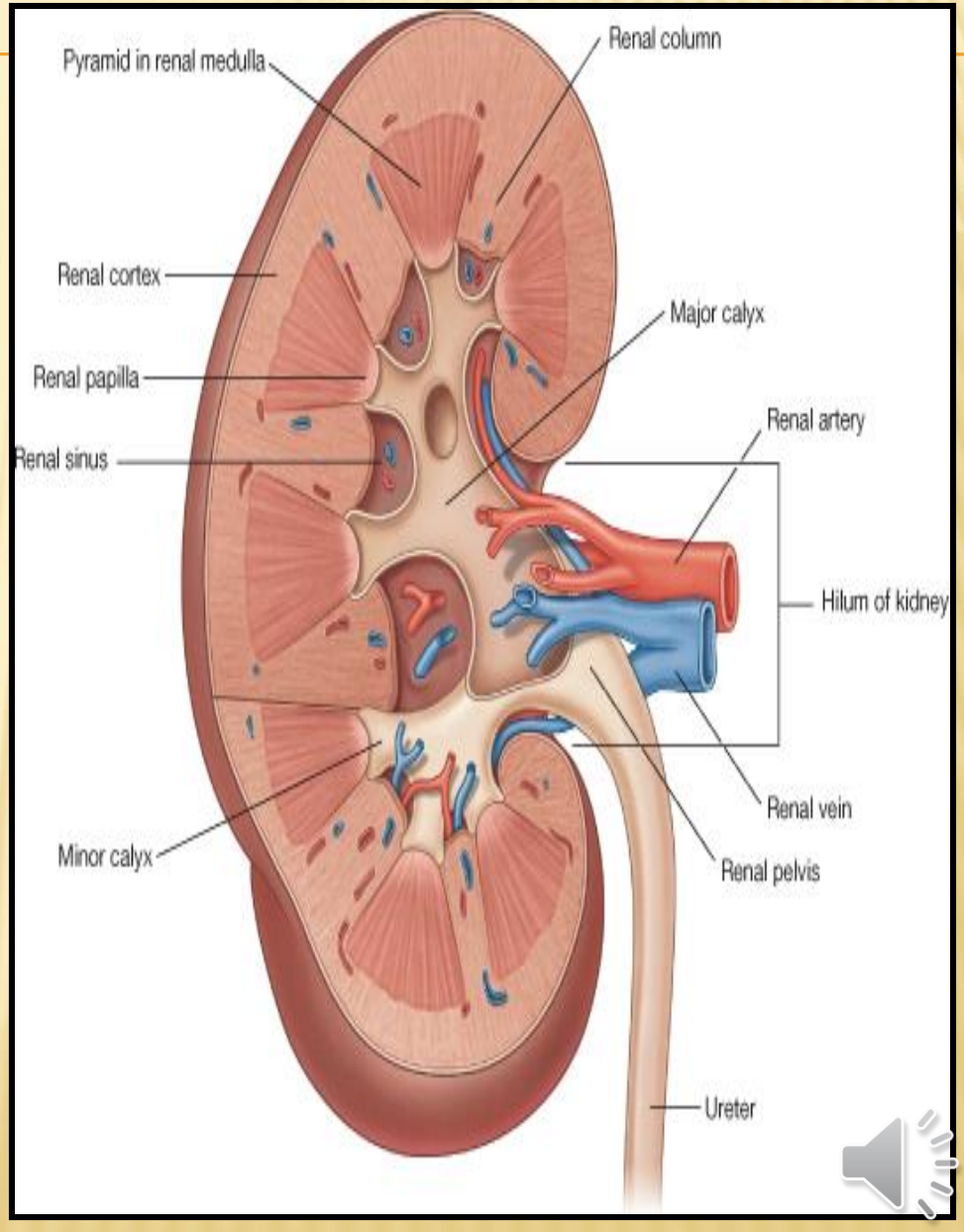
- They are reddish brown in color.
- They lie retroperitoneal structure (behind the peritoneum sac), on the posterior abdominal wall on each side of vertebral column.
- They are largely protected by the costal margin.
- The right kidney lies at slightly lower level than the left due to large size of the right lobe of liver.



KIDNEYS

- With diaphragmatic contraction the kidney moves downward about 2.5 cm.
- Its lateral border is convex, all over while the medial border is convex at both ends but it is concave at its middle where it shows a vertical slit called the hilum.
- The hilum extends into a large cavity called the renal sinus.
- **The hilum transmits from front backward (V.A.U.A.):**

1. Renal vein,
2. 2 branches of renal artery,
3. Ureter, and
4. Third branch of renal artery.



COVERINGS

From inward to outward:

1- **Fibrous capsule:** Which is adherent to the kidney.

2- **Perirenal fat:**

It covers the fibrous capsule.

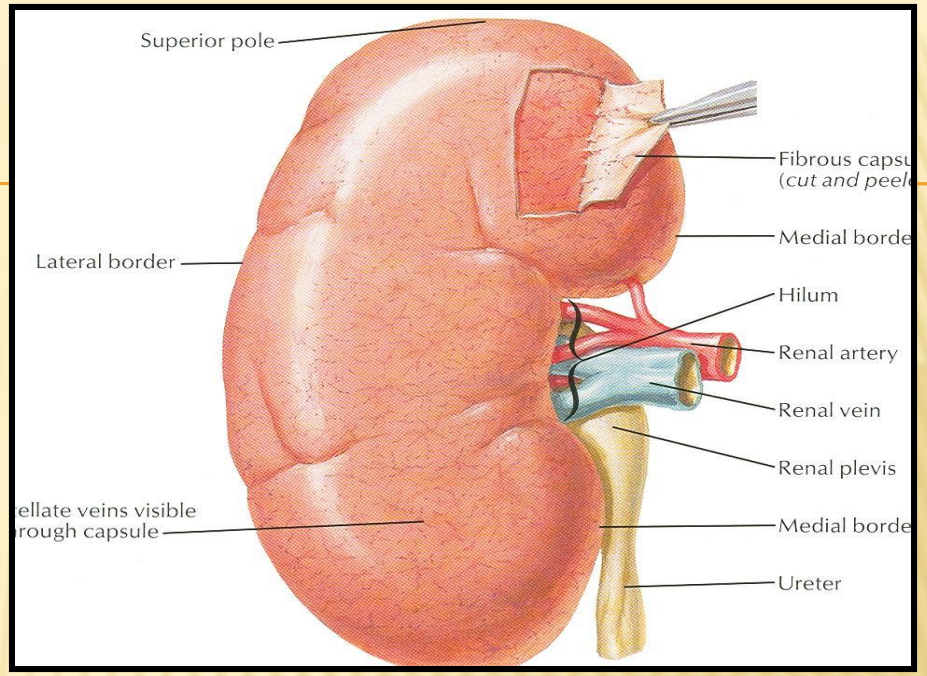
3- **Renal fascia:**

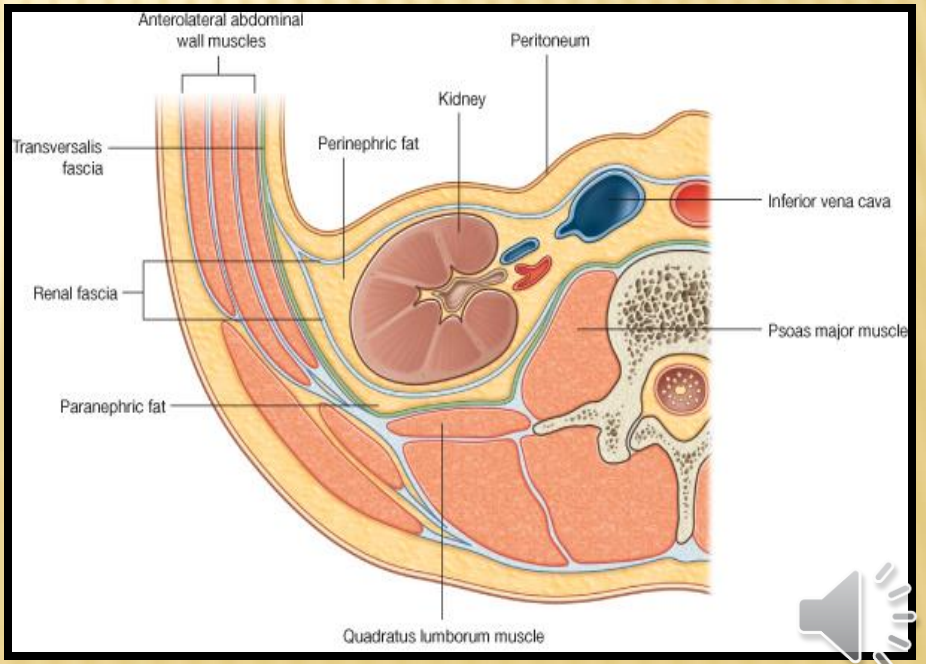
It encloses the kidneys and suprarenal glands.

4- **Pararenal fat:**

It lies external to the renal fascia, and forms part of the retroperitoneal fat.

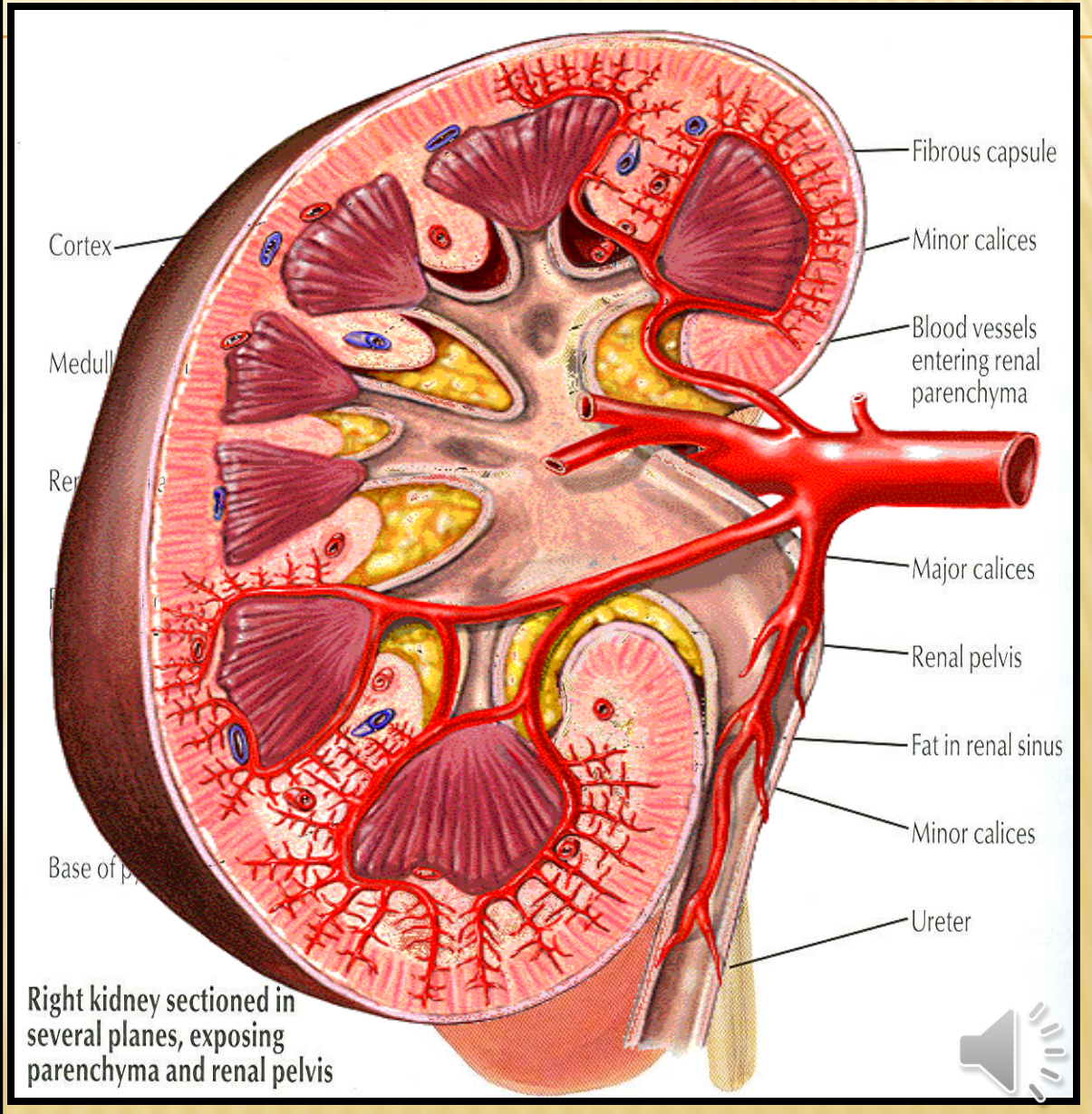
N.B. The last 3 structures support the kidney in position.





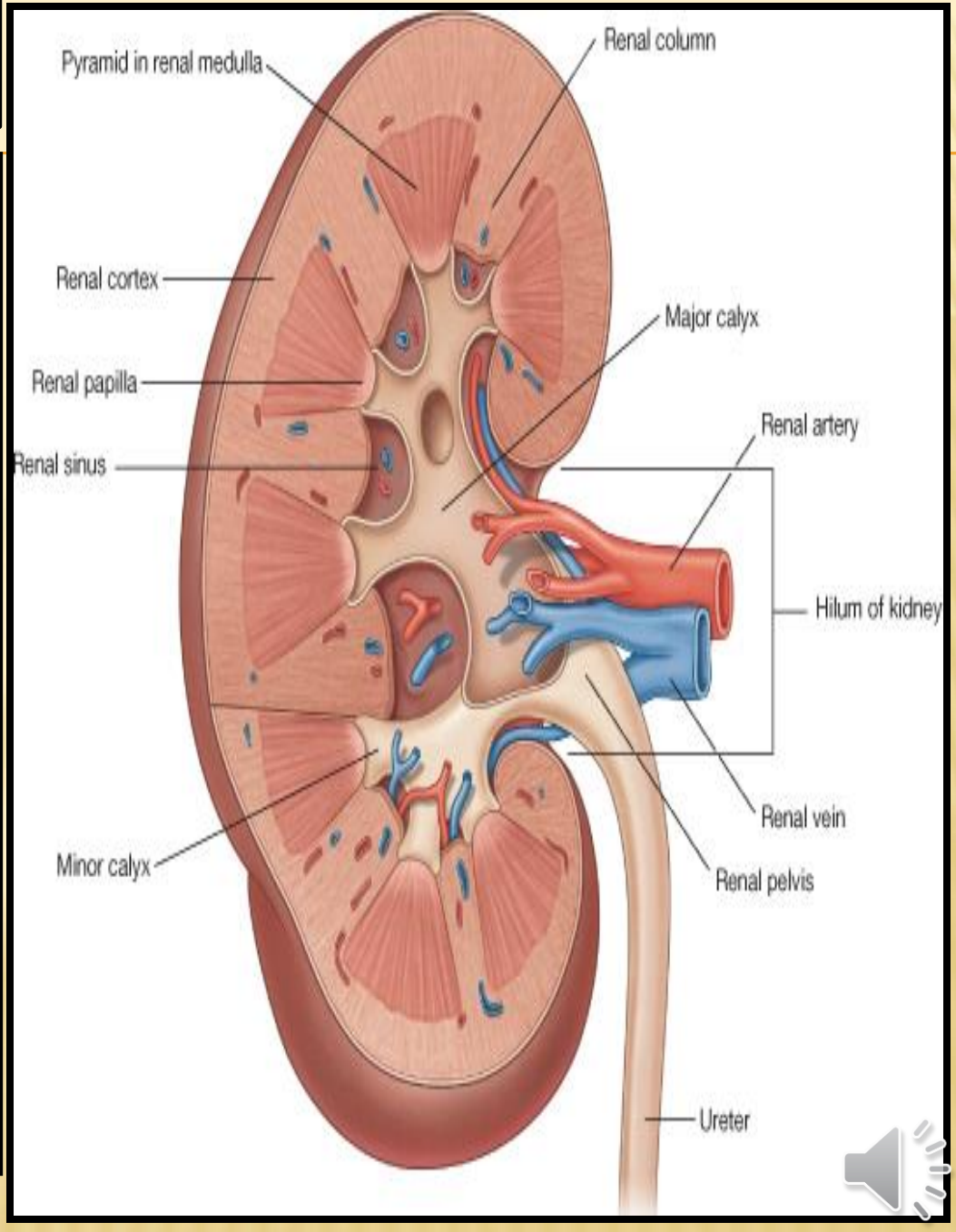
INTERNAL STRUCTURE

- Each kidney has an outer cortex and an inner medulla.
- The medulla is formed of about 12 renal pyramids.
- The base of each pyramid is directed laterally toward the cortex while its apex (**renal papilla**) is projecting medially.
- The cortex extends into the medulla in between adjacent pyramids as the **renal column.**



RENAL STRUCTURE

- 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, which is called the renal pelvis.
- Renal pelvis divides into 2 or 3 major calyces, which redivides into 2 or 3 minor calyces.



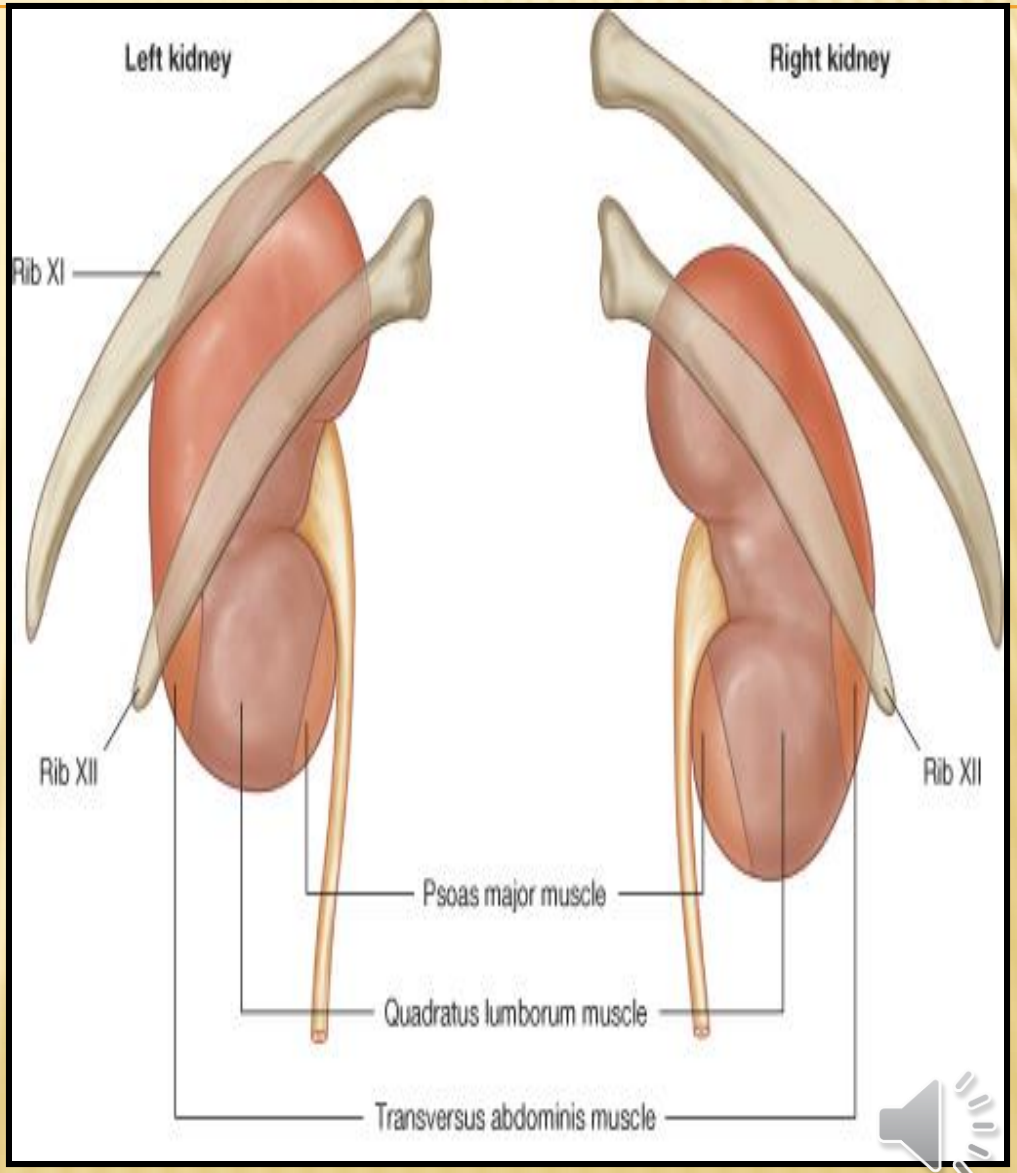
POSTERIOR RELATIONS

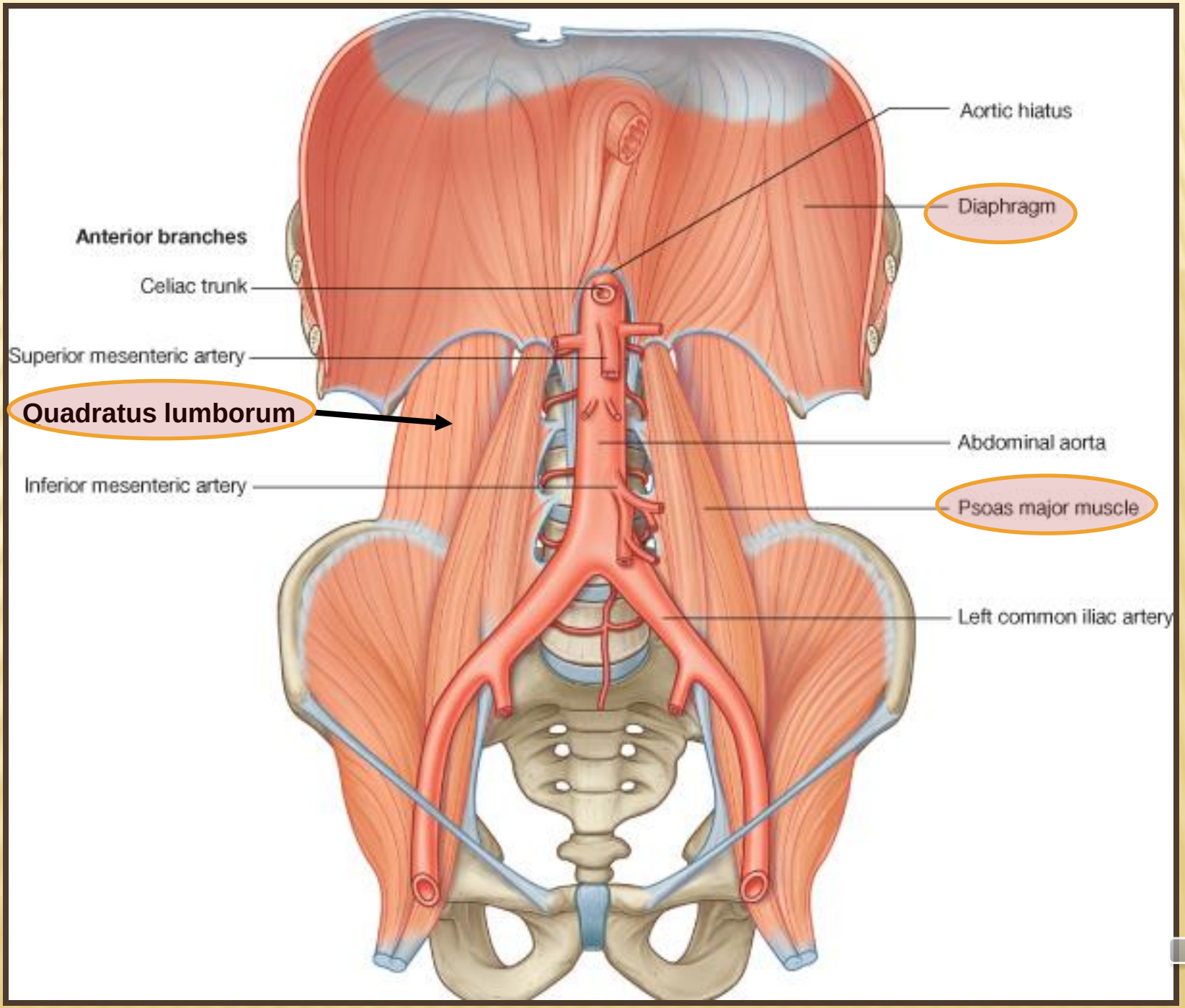
- (Last rib + 4muscles + 3 nerves)
- 12th rib,
- Costodiaphragmatic pleural recess.

1. Diaphragm,(last intercostal space).
2. Psoas major muscle,
3. Quadratus lamborum m.,
4. Transversus abdominis m.,

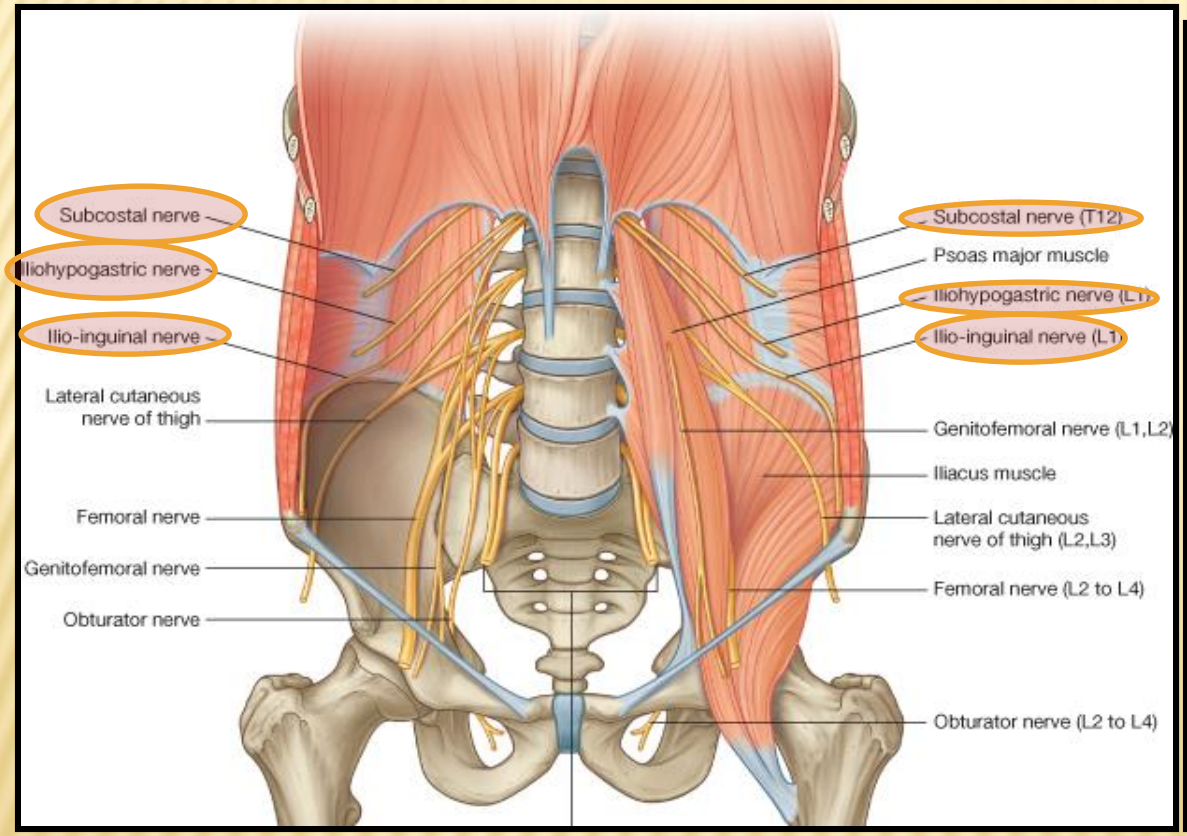
1. Subcostal nerve (T12),
2. Iliohypogastric (L1) nerve.
3. Ilioinguinal (L1) nerve.

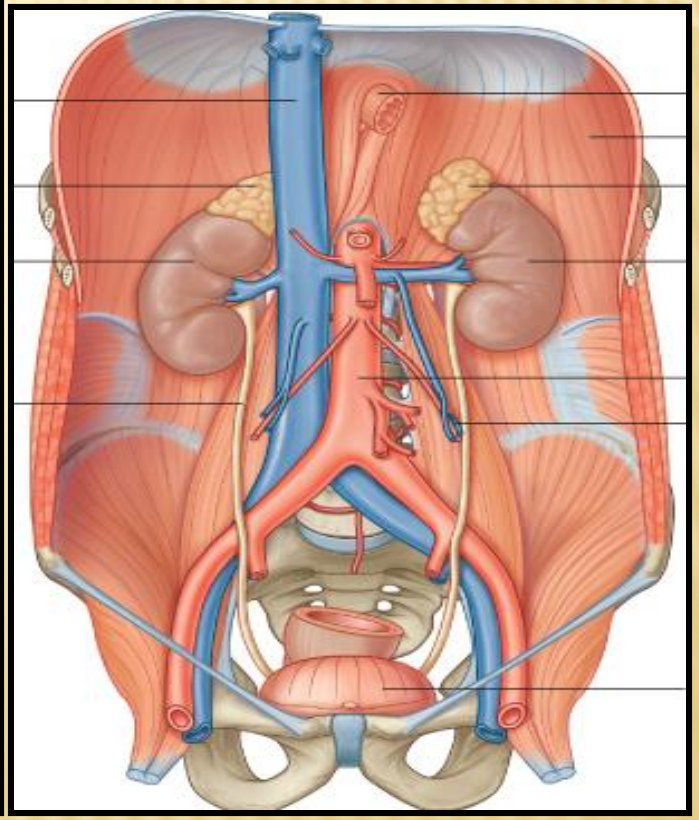
- **NB.** The left kidney reaches up to the **11th** rib.

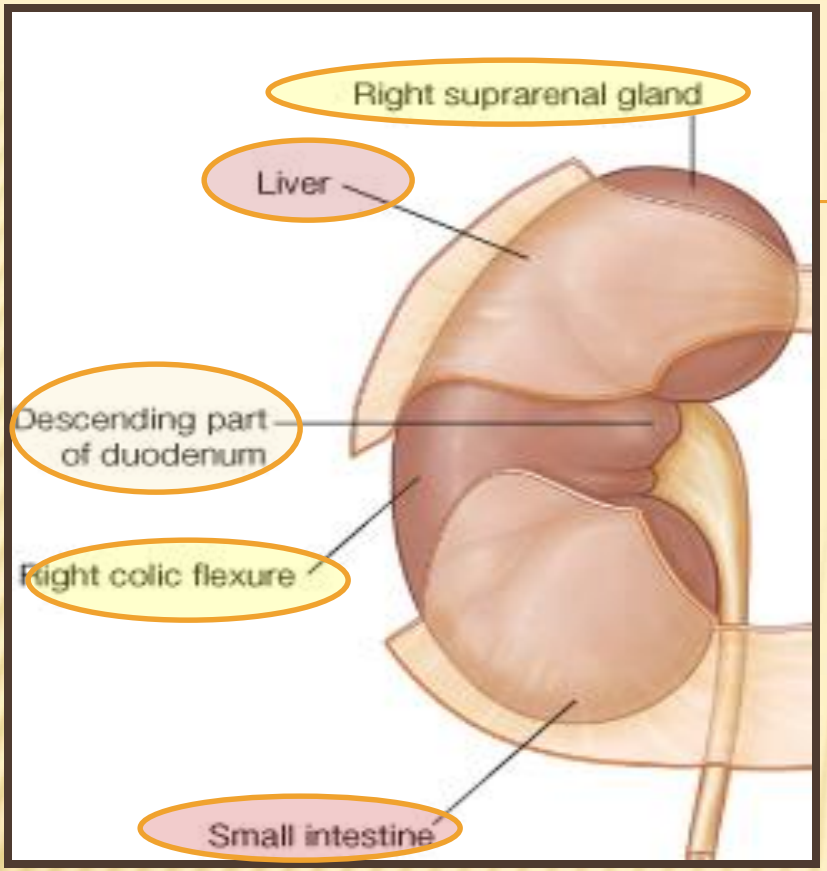



Aortic hiatus
Diaphragm
Anterior branches
Celiac trunk
Superior mesenteric artery
Quadratus lumborum
Abdominal aorta
Inferior mesenteric artery
Psoas major muscle
Left common iliac artery

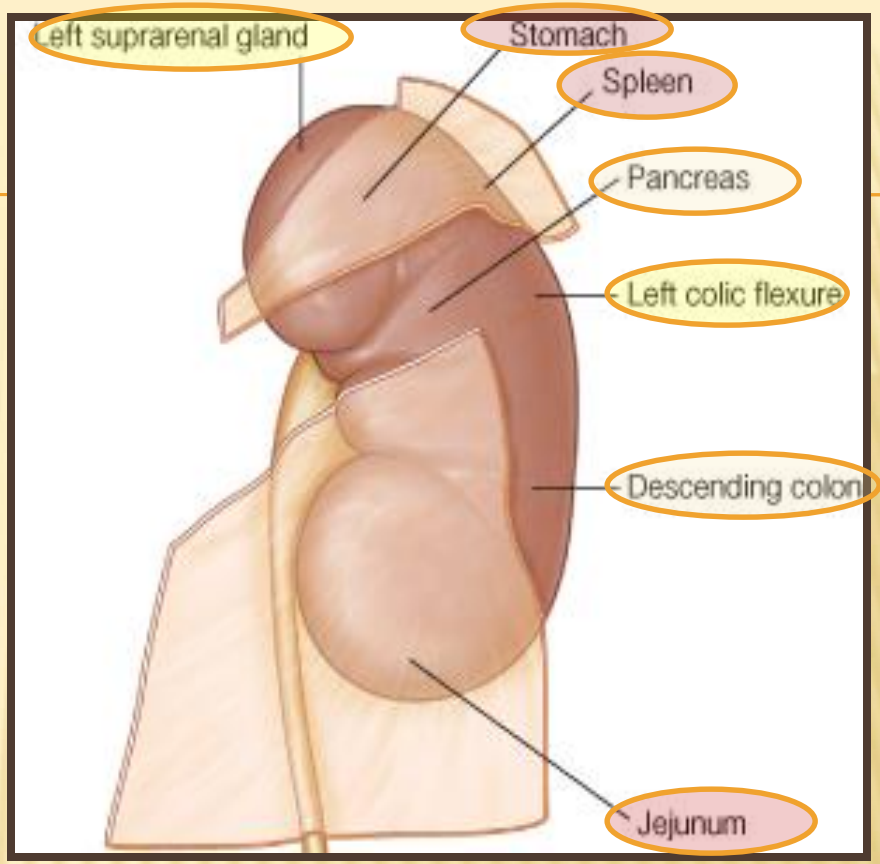
Posterior Relation







ANTERIOR RELATION

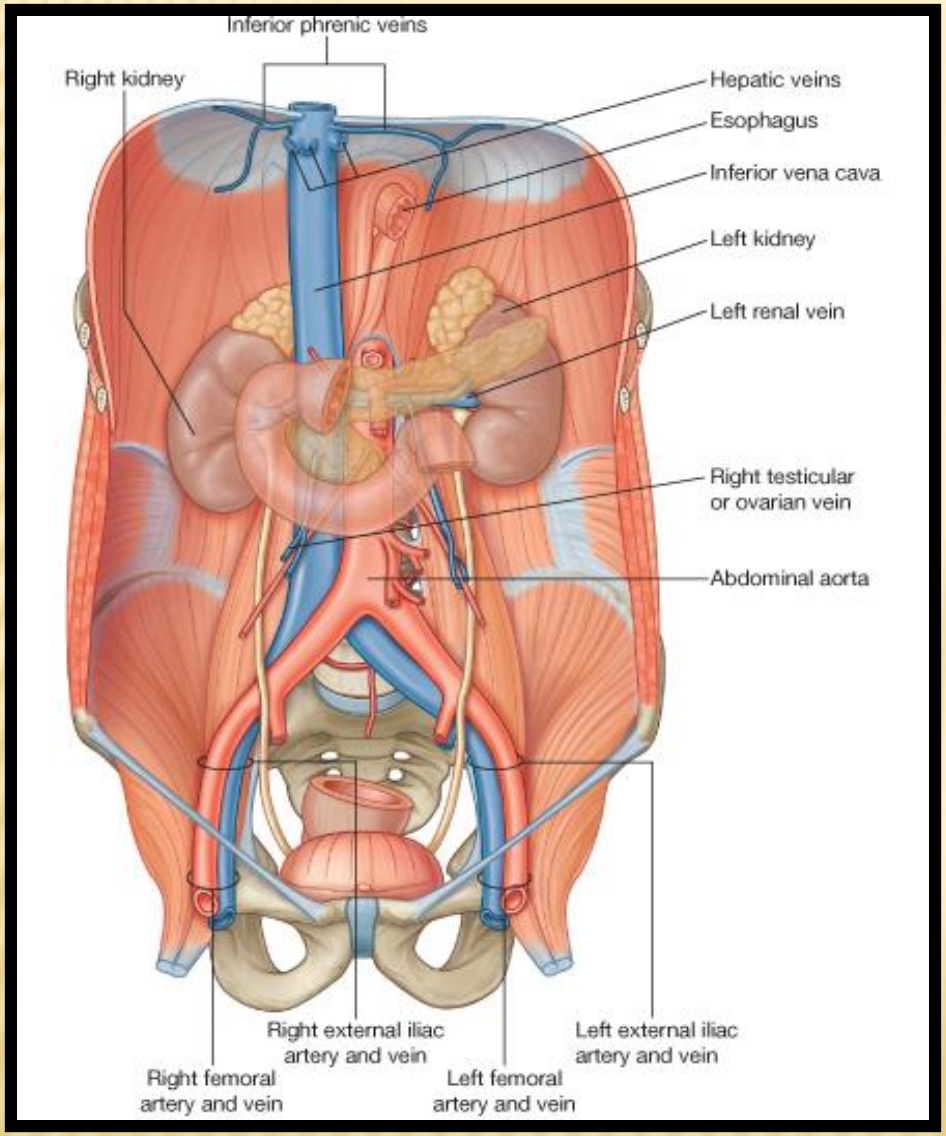


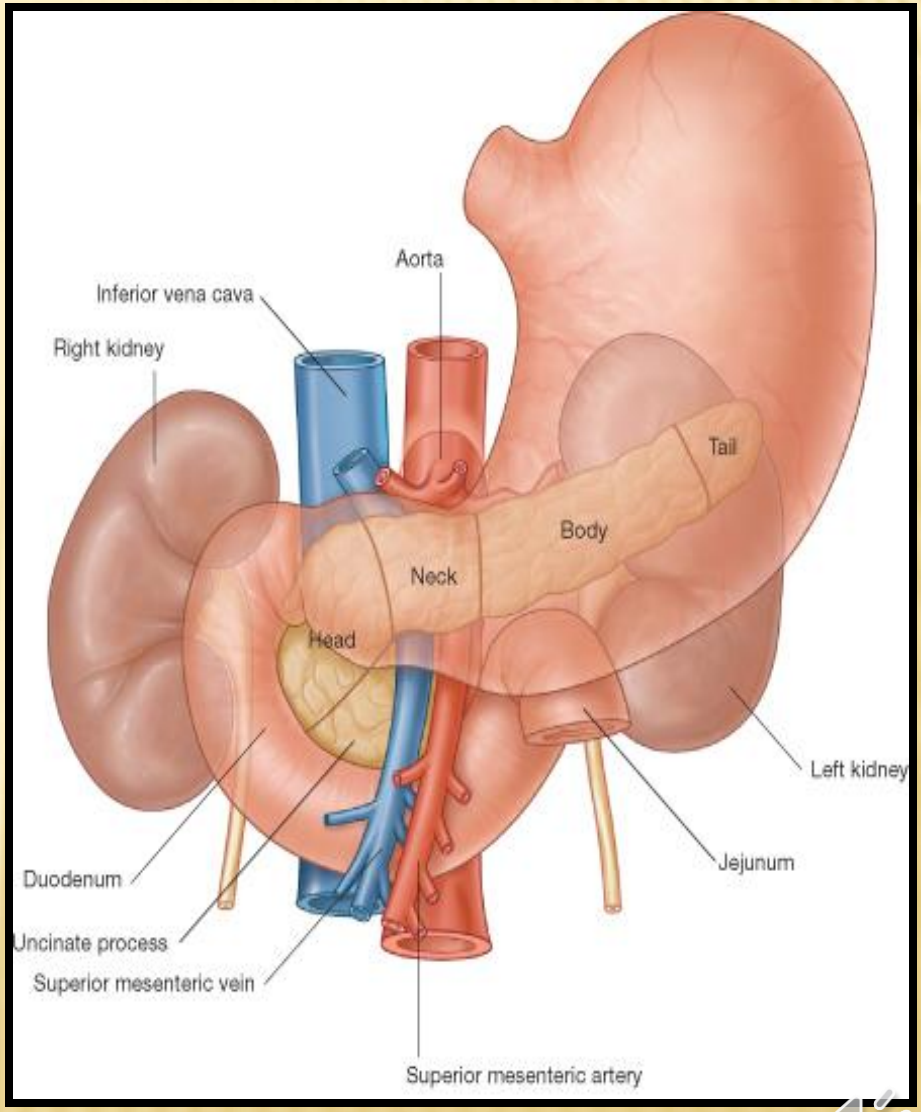
Right Kidney:

- 1- Right suprarenal gland.
- 2- Liver, (right lobe).
- 3- Second part of duodenum.
- 4- Right colic flexure.
- 5- Coils of small intestine.

Left Kidney:

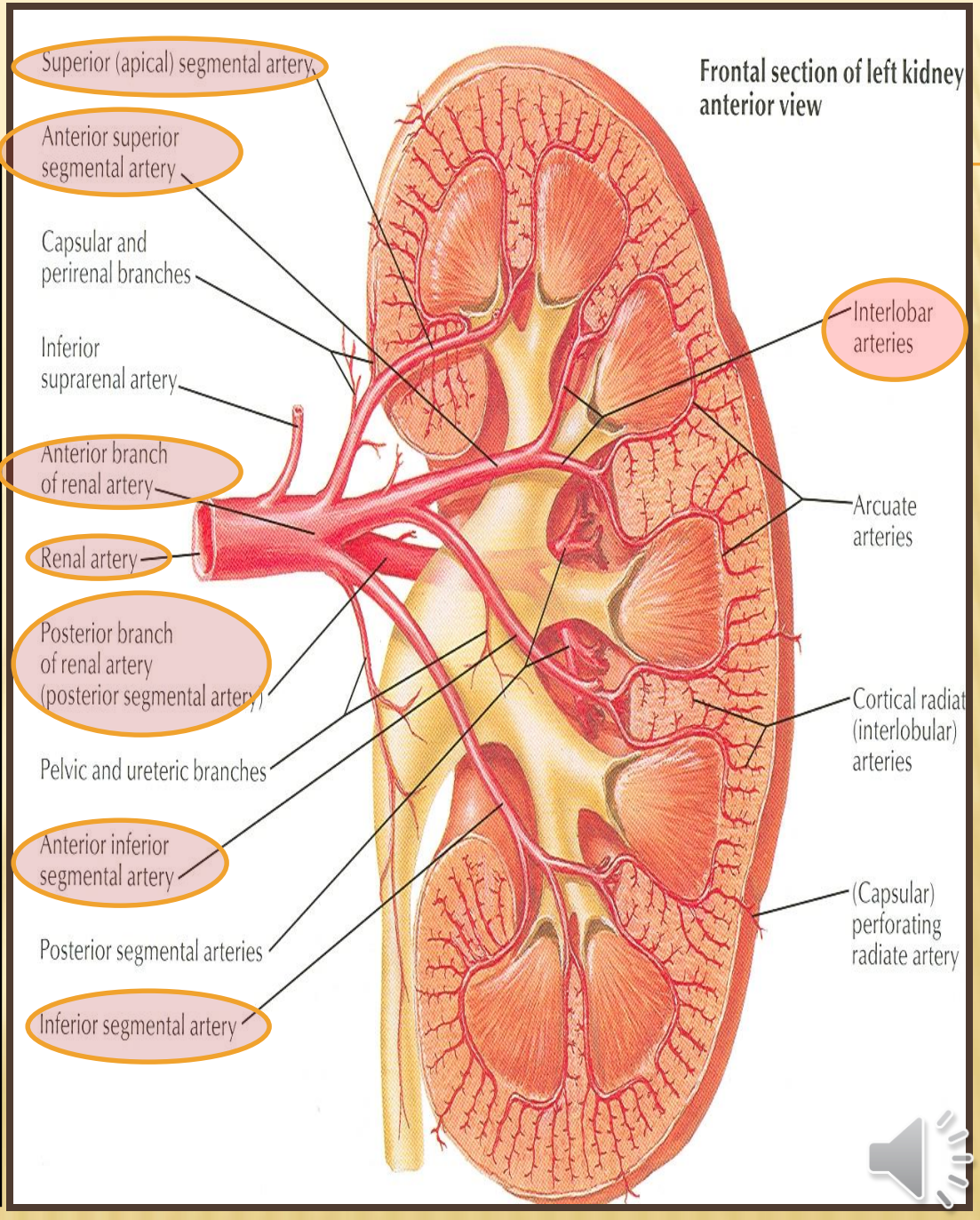
1- Left suprarenal gland.
2- **Stomach.**
3- **Spleen**.
4- Pancreas.
5- Left colic flexure.
6- Descending colon.
7- **Coils of jejunum.**


Inferior phrenic veins
Right kidney
Hepatic veins
Esophagus
Inferior vena cava
Left kidney
Left renal vein
Right testicular or ovarian vein
Abdominal aorta
Right external iliac artery and vein
Left external iliac artery and vein
Right femoral artery and vein
Left femoral artery and vein


Aorta
Inferior vena cava
Right kidney
Tail
Body
Neck
Head
Left kidney
Jejunum
Duodenum
Uncinate process
Superior mesenteric vein
Superior mesenteric artery

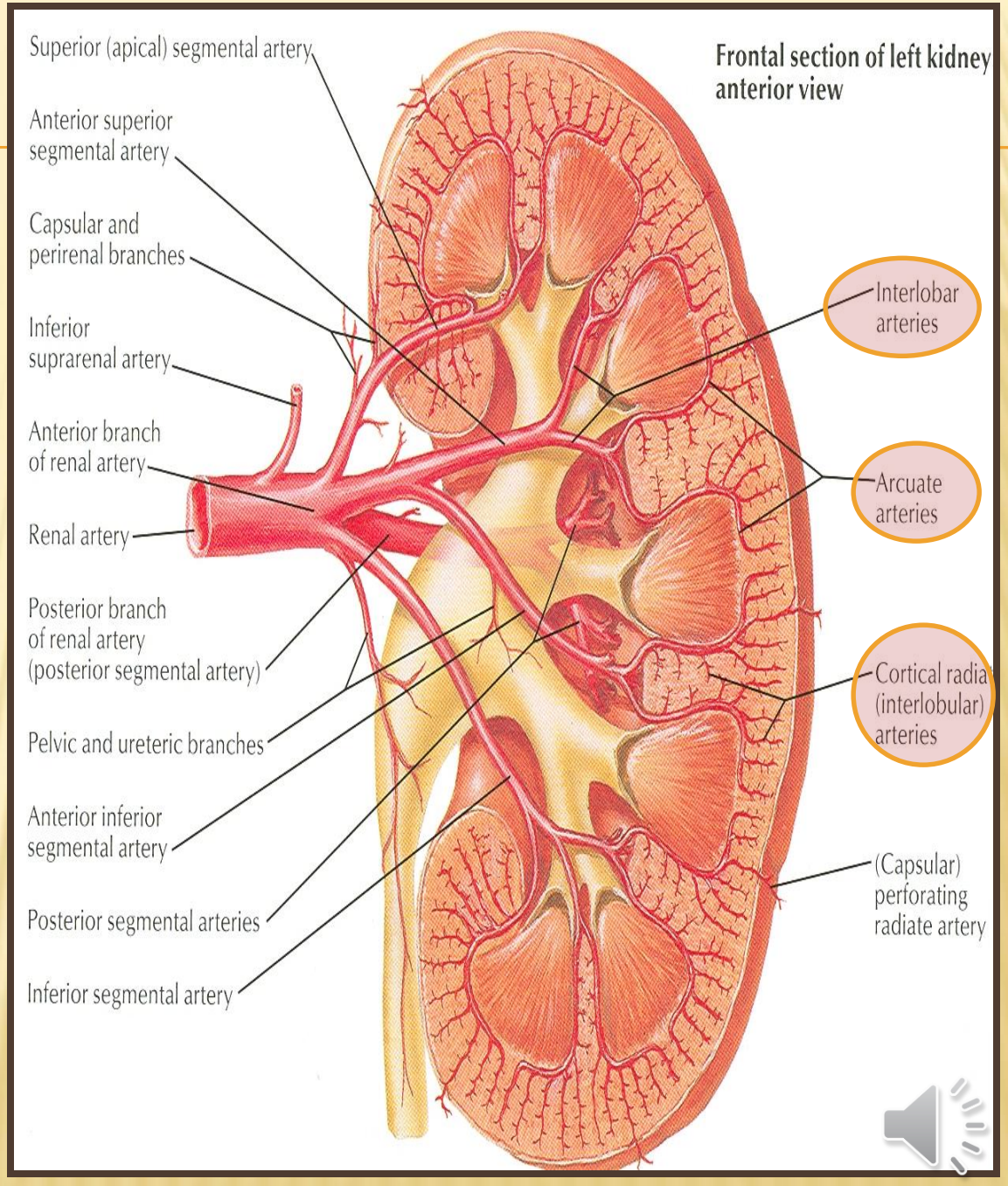
BLOOD SUPPLY

- The renal artery arises from the aorta at the level of **L2.**
- Each renal artery divides into ***five*** **segmental** arteries that enter the hilum of the kidney.
- **Four** in front & **One** behind the renal pelvis.
- They are distributed to different segments of the kidney.
- Each segmental artery gives a **lobar artery.**
- **One** for each renal pyramid.



BLOOD SUPPLY

- Each lobar artery gives off 2 or 3 **interlobar arteries.**
- 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.
- The arcuate arteries give off several interlobular arteries.
- **Interlobular arteries** give afferent ***glomerular arterioles.***



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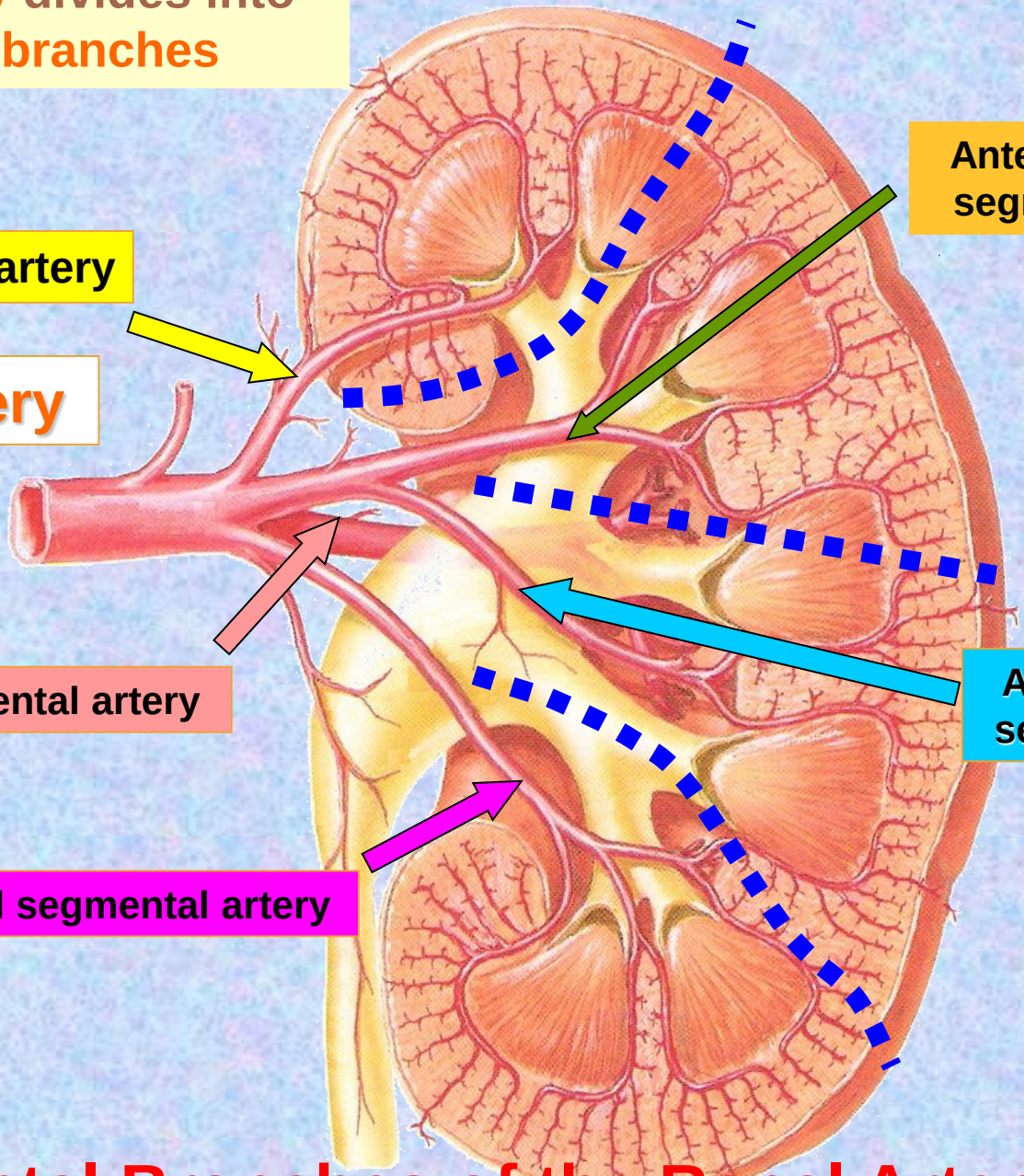
The renal artery divides into
5 segmental branches



Anterior superior segmental artery

Apical segmental artery

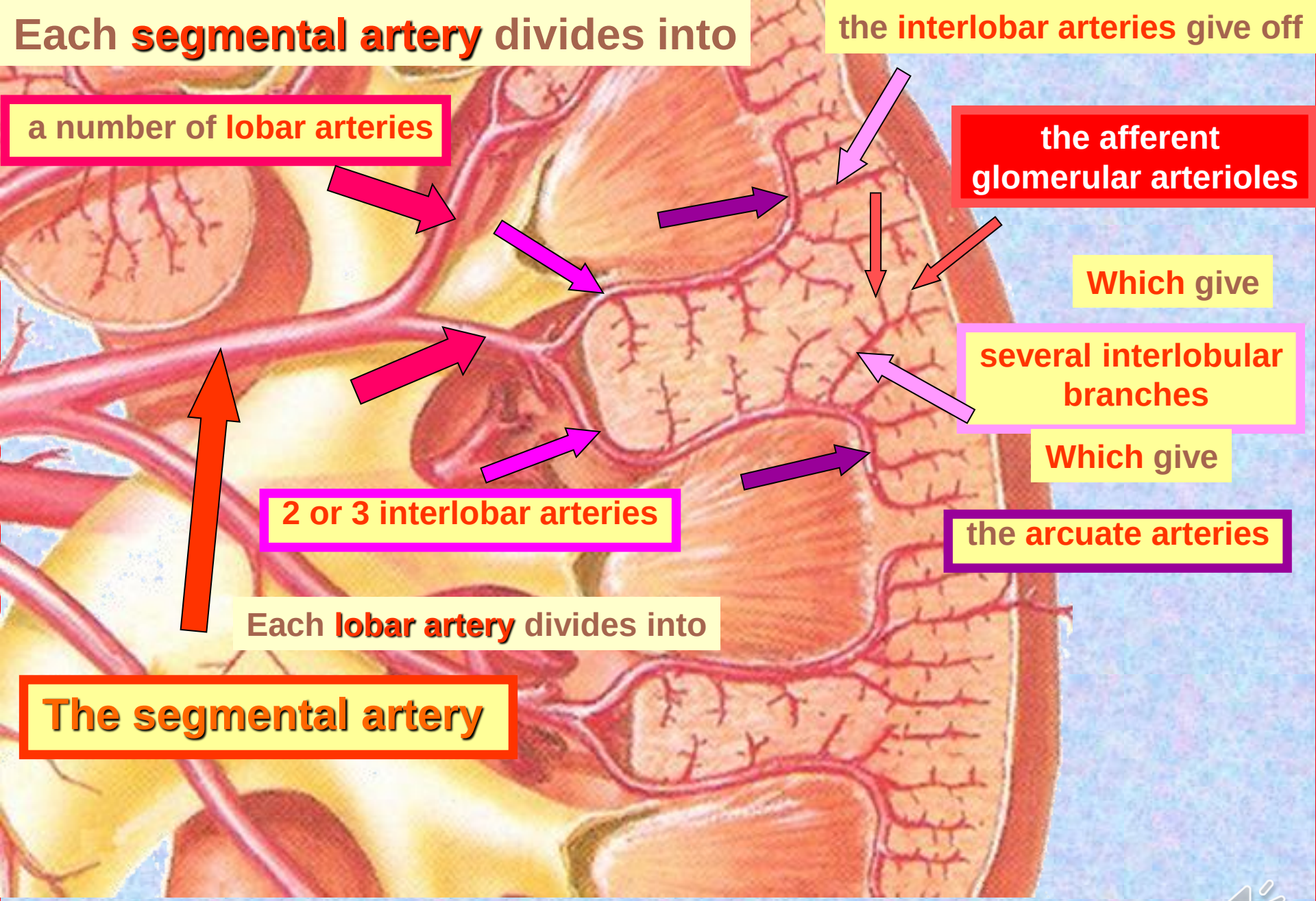
The renal artery

Posterior segmental artery

Anterior inferior segmental artery

Caudal segmental artery

Segmental Branches of the Renal Artery



Branches of the Segmental artery

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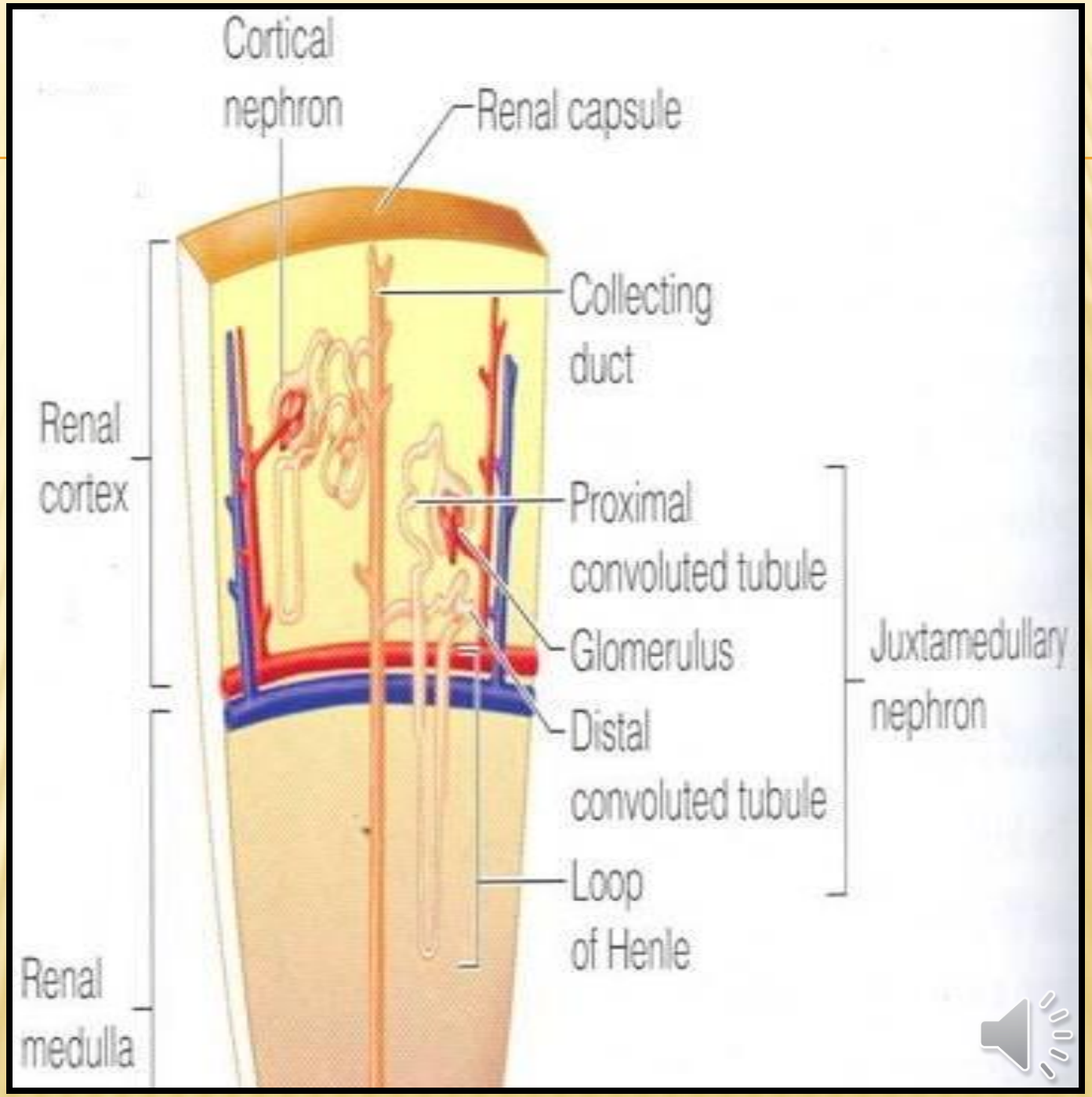
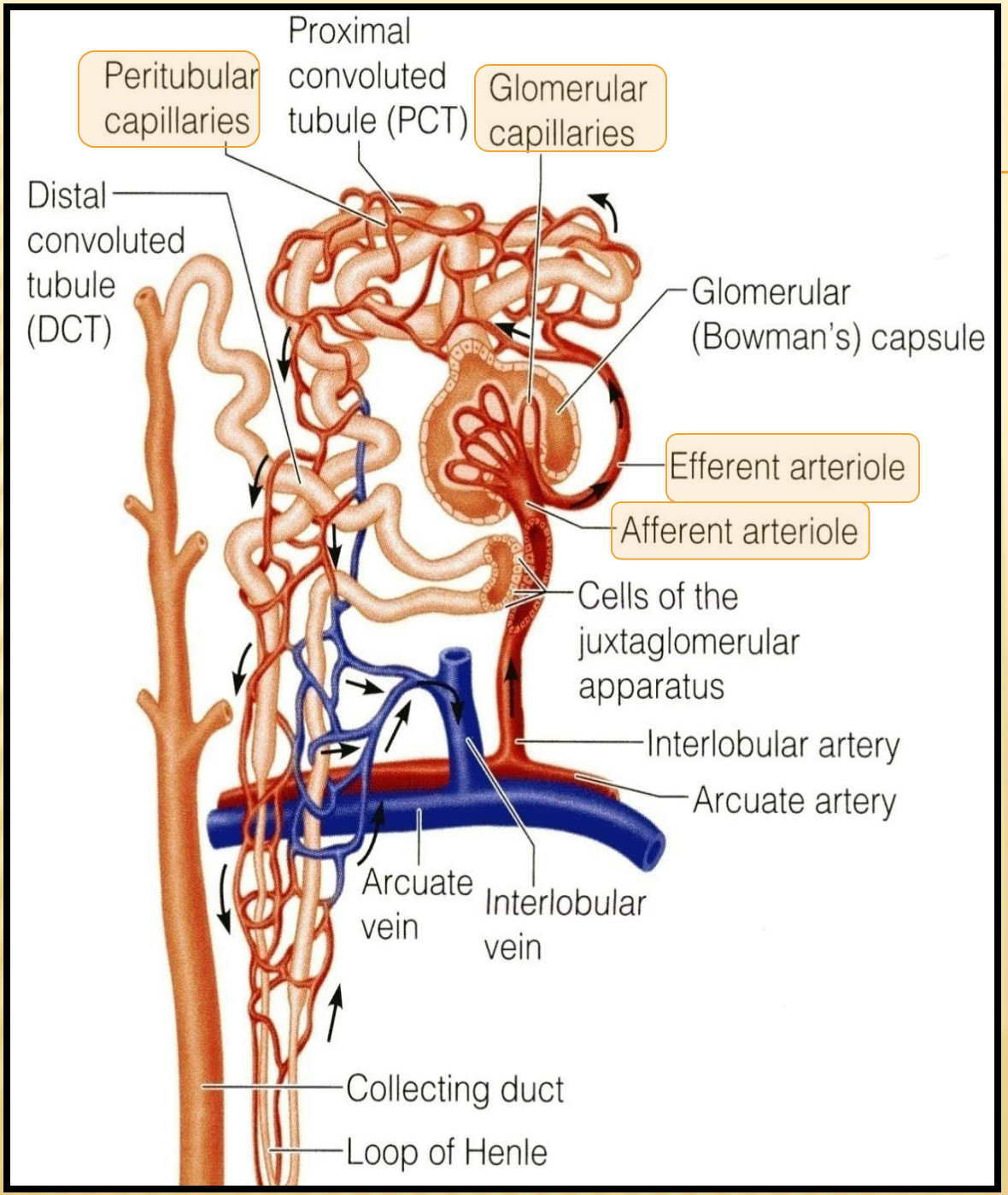
- Interlobular artery gives off afferent glomerular arterioles .





- Each **Nephron** is associated with **two** capillary beds:
  1. The **Glomerulus** and
  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," and
  - the **efferent arteriole** receives blood that has passed through the glomerulus.

VENOUS DRAINAGE

Both renal veins drain to the **inferior vena cava.**

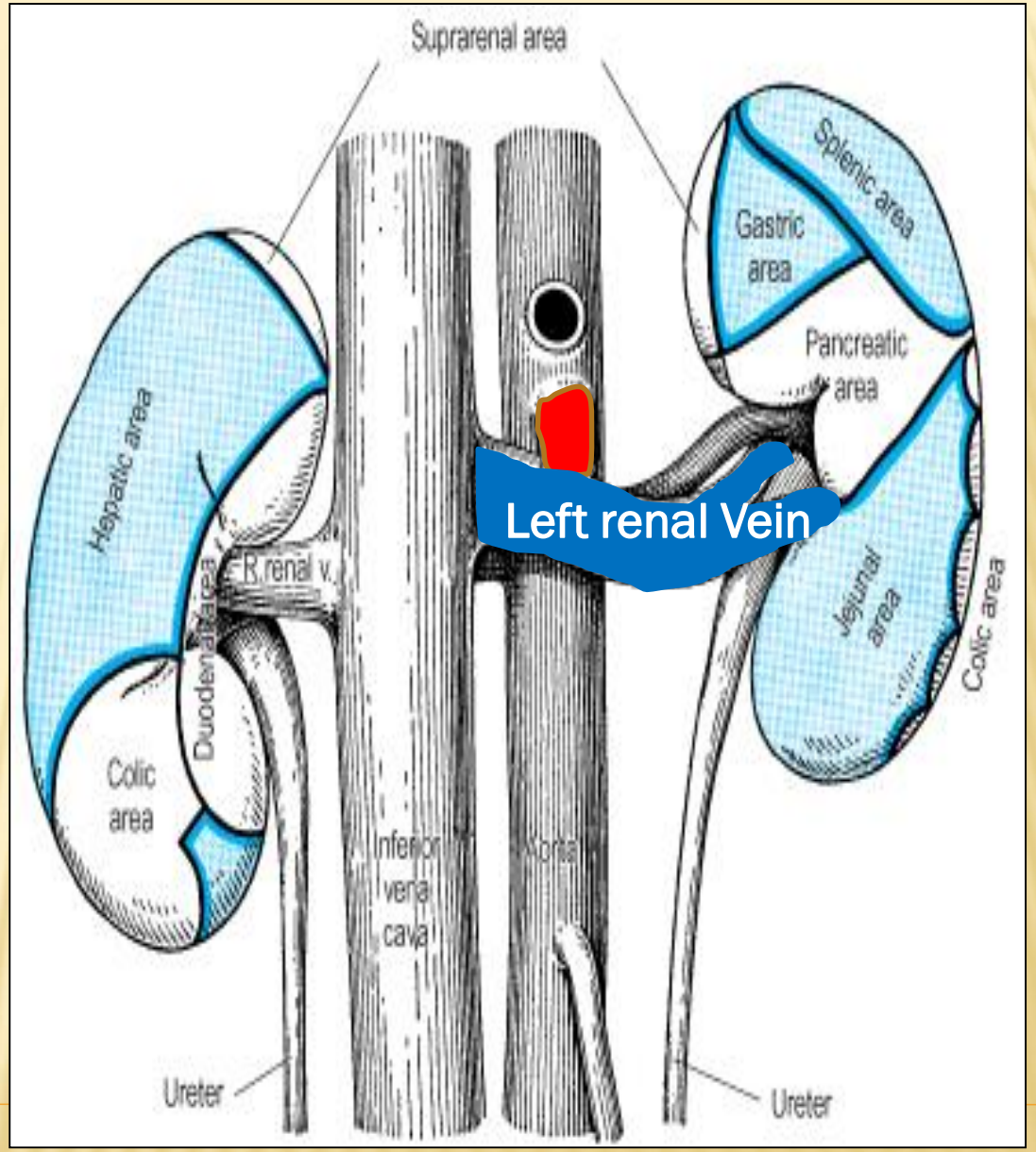
The **left** is (7.5cm) three times **longer** than the right (2.5 cm).

So, for this reason the left kidney is the preferred side for live donor **nephrectomy.**

It runs from its origin in the renal hilum, from left to right **behind:**

1. **Splenic vein** and
2. Body of pancreas.

Then it across anterior to the abdominal **aorta**, just below the origin of the superior mesenteric artery.



VENOUS DRAINAGE

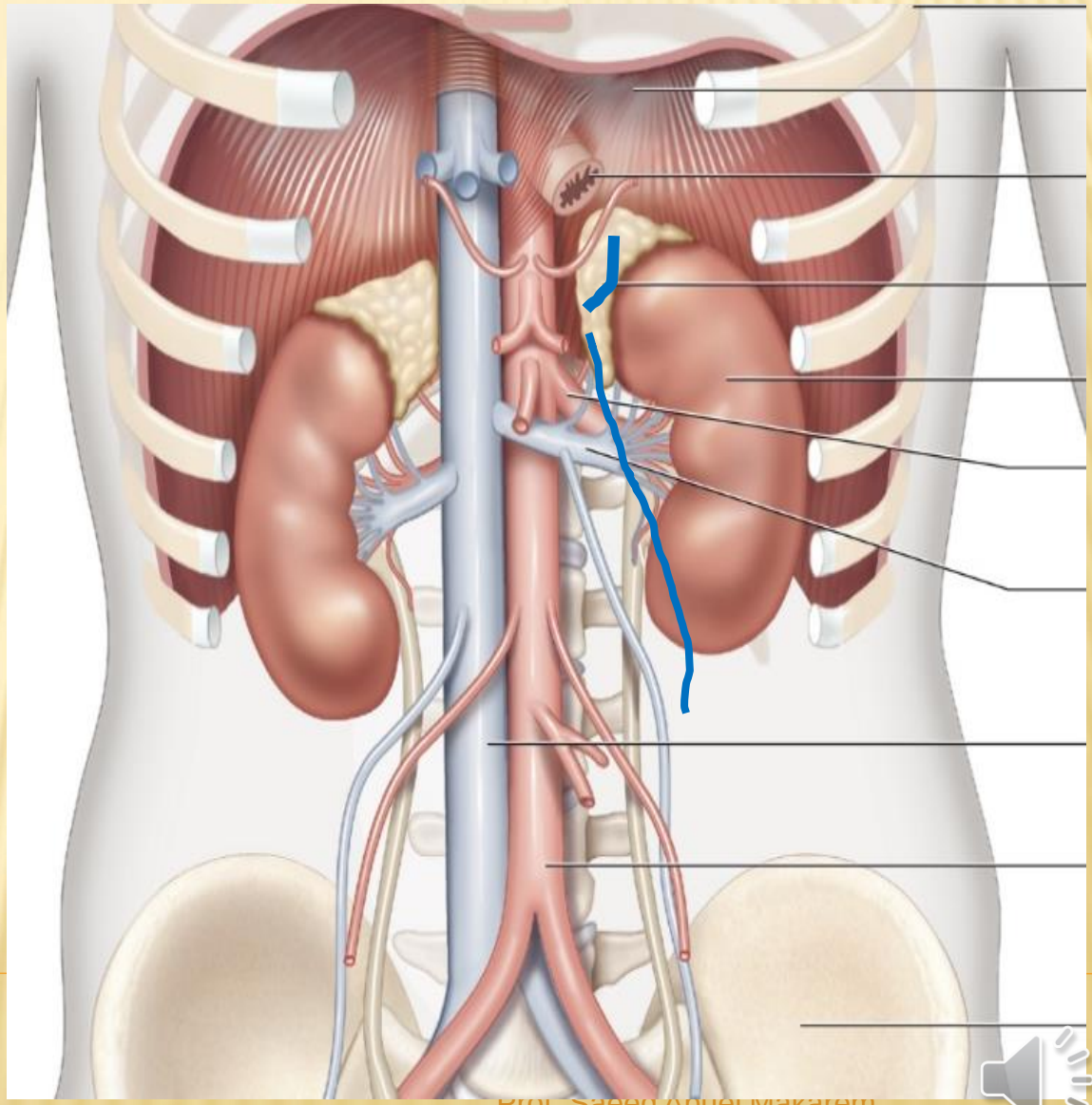
The left gonadal vein enters the left renal vein from below.

While the left suprarenal vein, enters the left renal vein from above.

The left renal vein enters the inferior vena cava a *little above* the right vein.

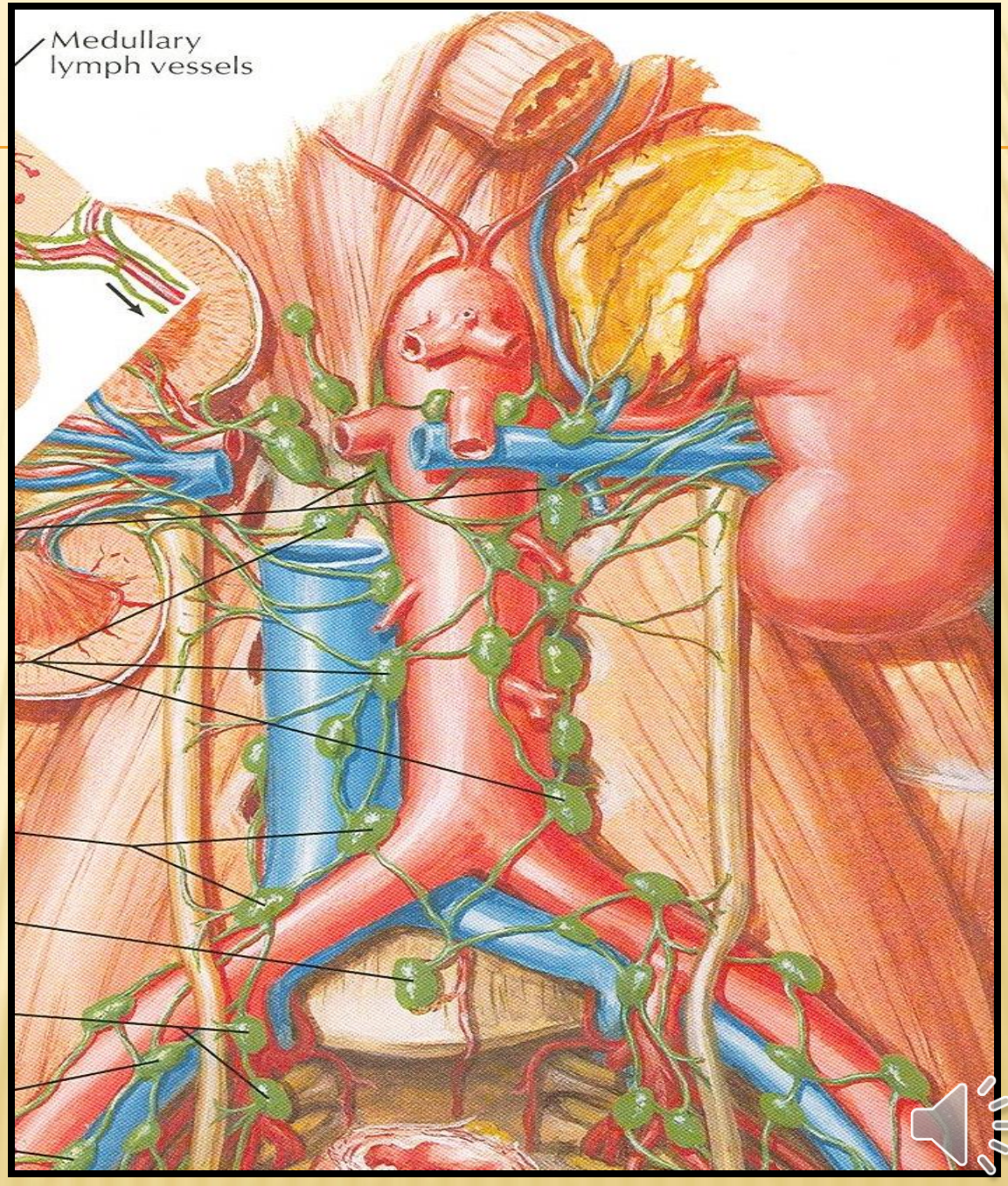
The right renal vein lies behind the **2nd part** of the duodenum.

Sometimes it lies behind the lateral part of the head of the pancreas.



LYMPH

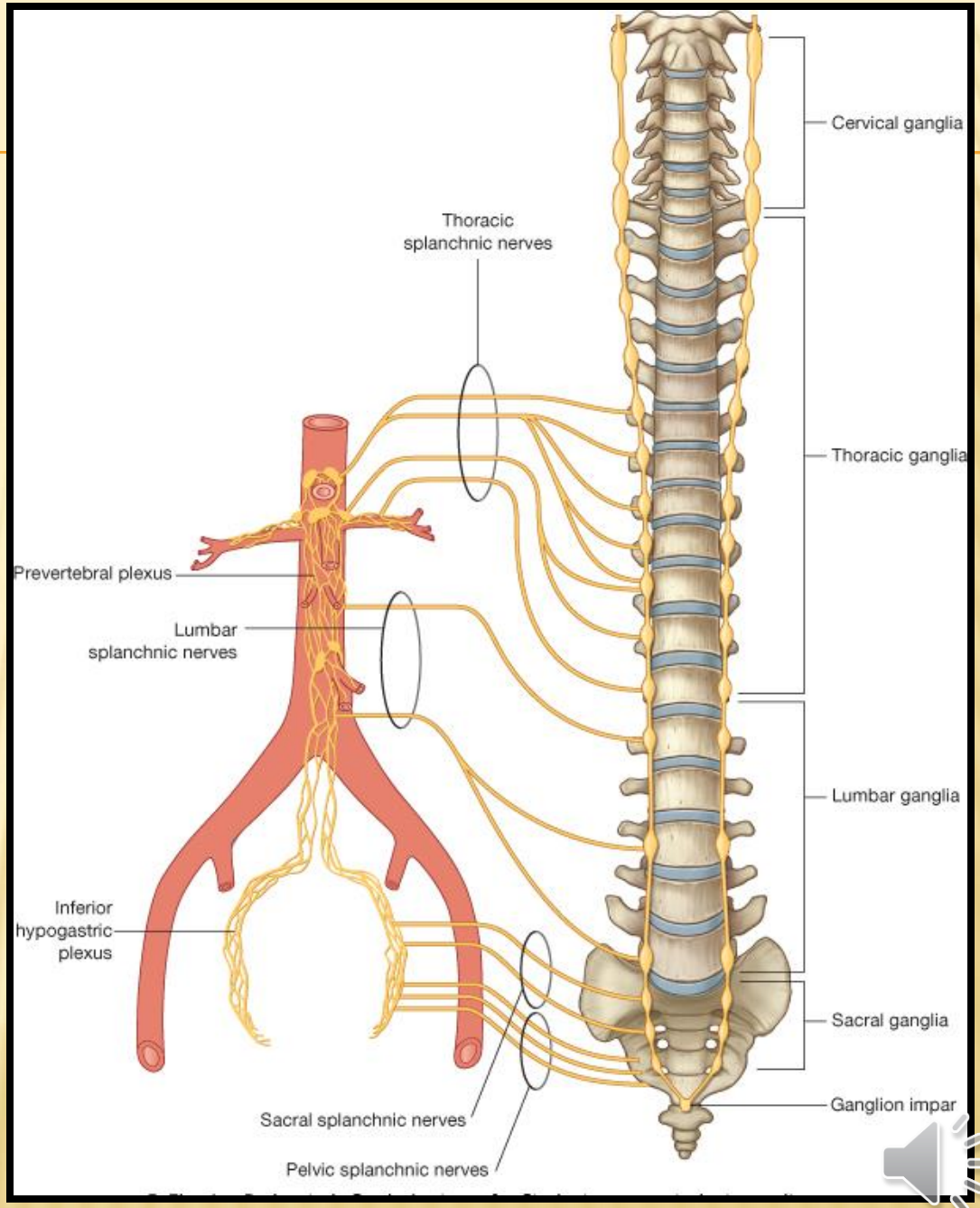
- **Lymph Drainage:**
- Lateral aortic lymph nodes around the origin of the renal artery.



NERVE SUPPLY

Nerve Supply

- Renal sympathetic plexus.
- The afferent fibers that travel through the renal plexus enter the spinal cord in the:
- **10^{th}, 11^{th}, and 12^{th} Thoracic nerves.**



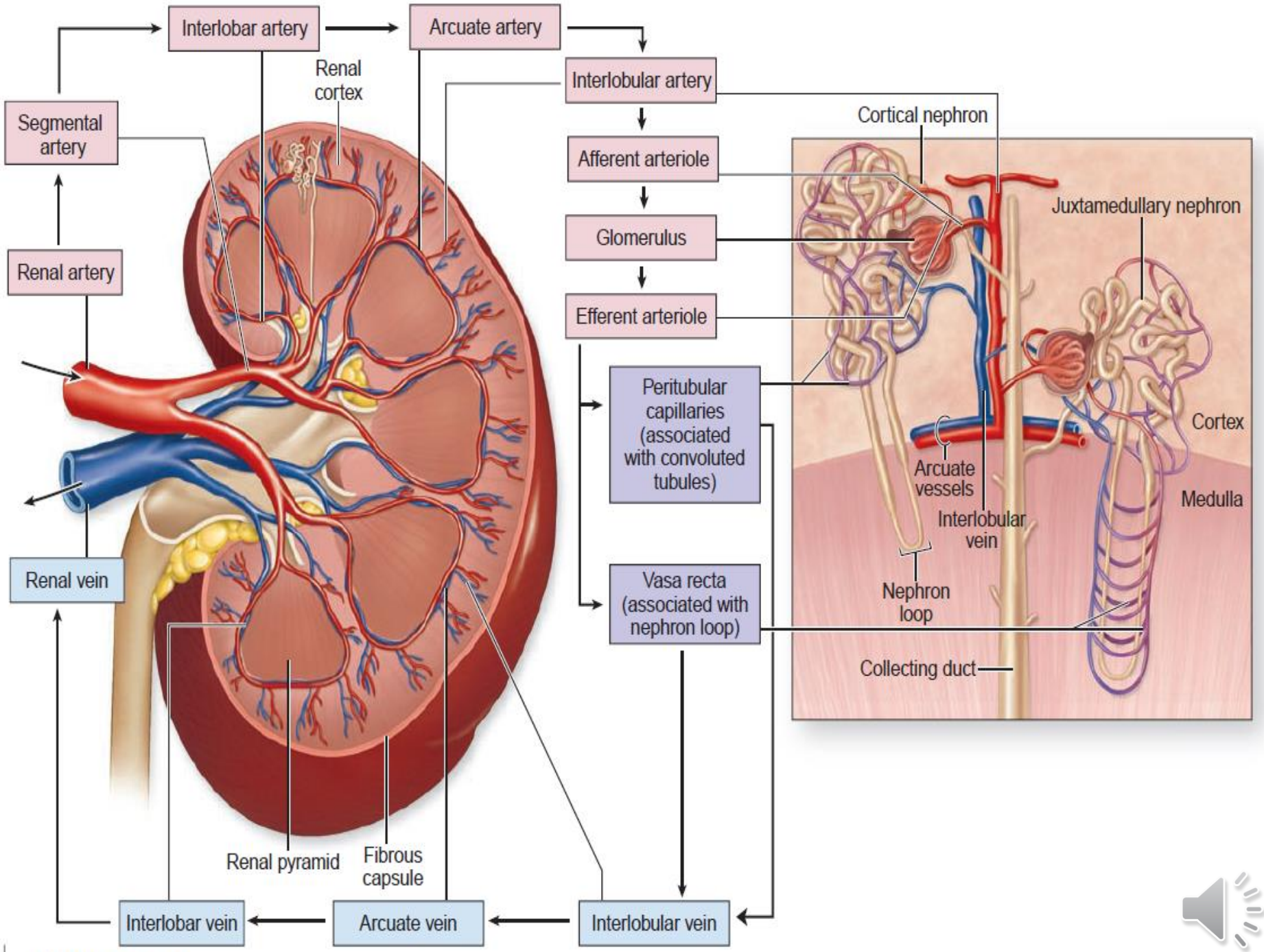

Interlobar artery
Arcuate artery
Renal cortex
Interlobular artery
Segmental artery
Cortical nephron
Afferent arteriole
Juxtamedullary nephron
Renal artery
Glomerulus
Efferent arteriole
Peritubular capillaries (associated with convoluted tubules)
Cortex
Arcuate vessels
Medulla
Interlobular vein
Renal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

Figure 27.4

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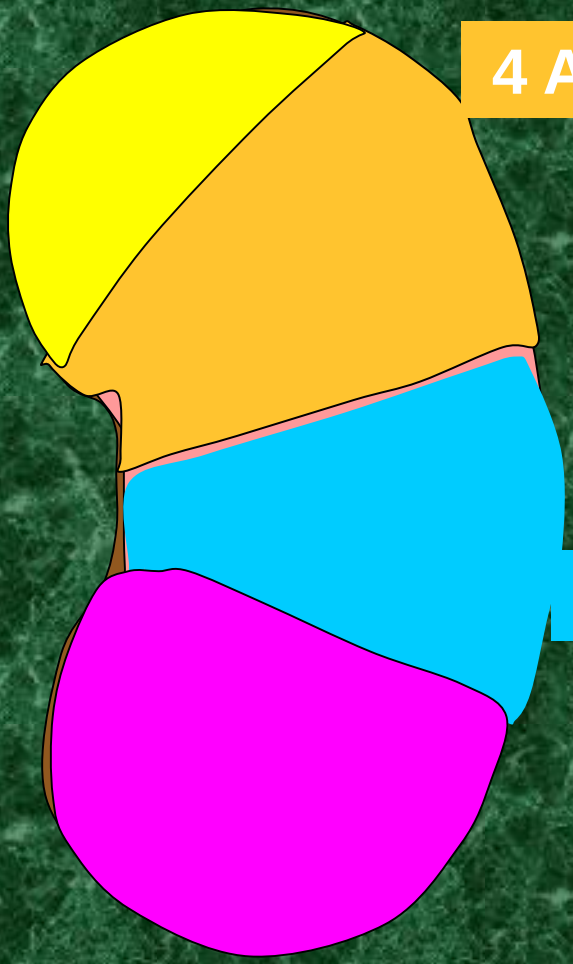
Each kidney consists of 5 segments

1- Apical segment



4 Anterior superior segment

3-Posterior segment

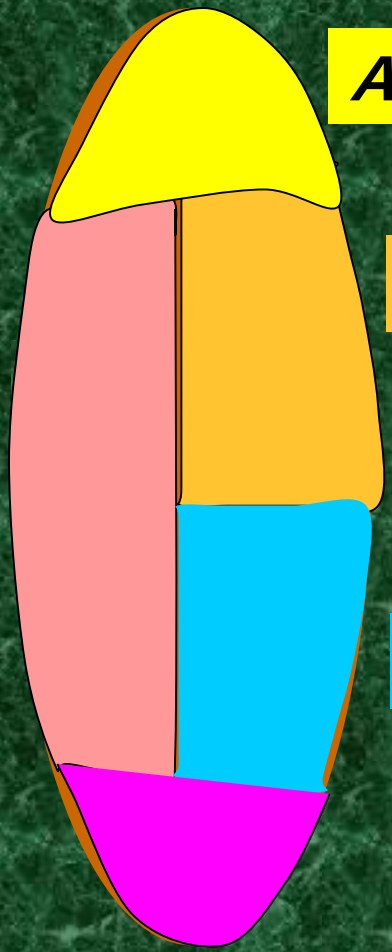
5- Anterior inferior segment

2- Caudal segment

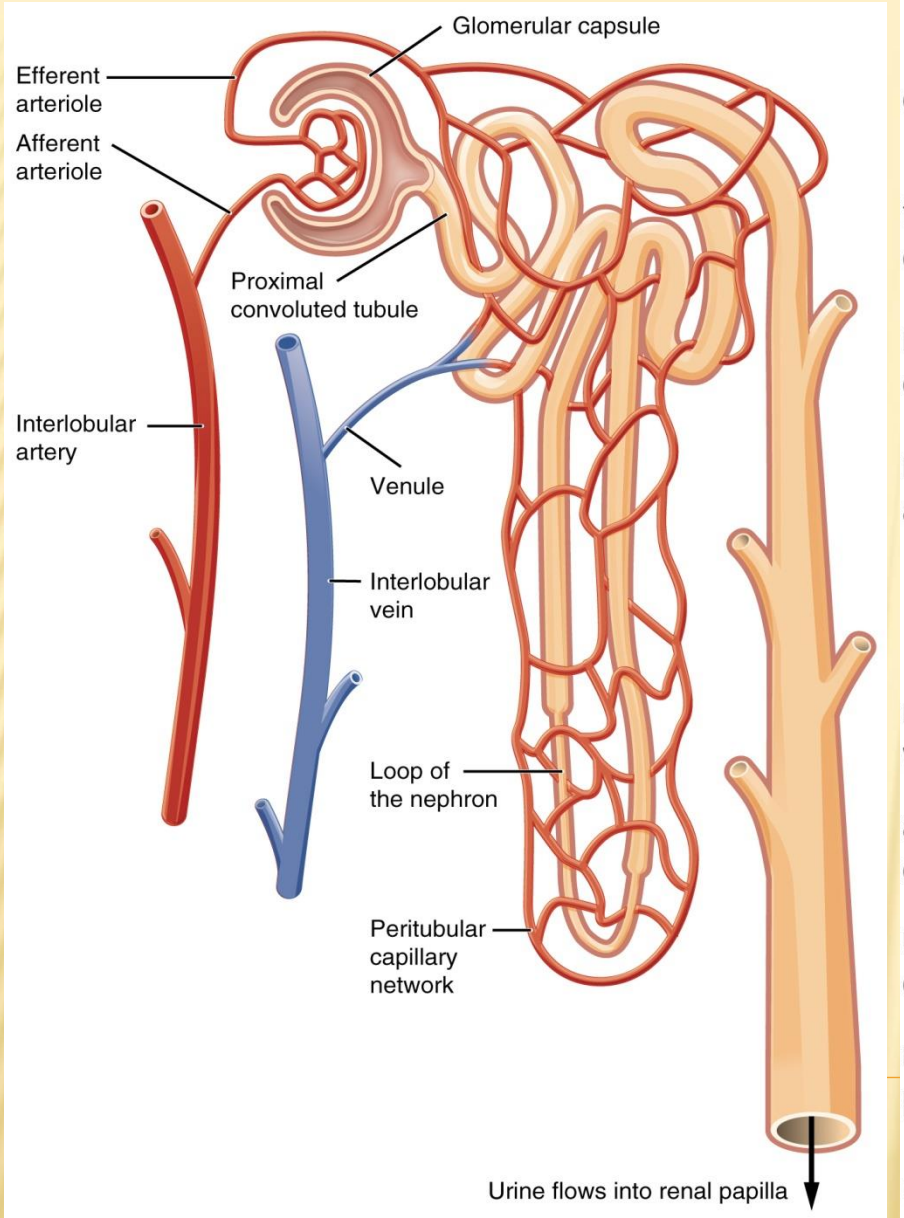
Segments of the kidneys

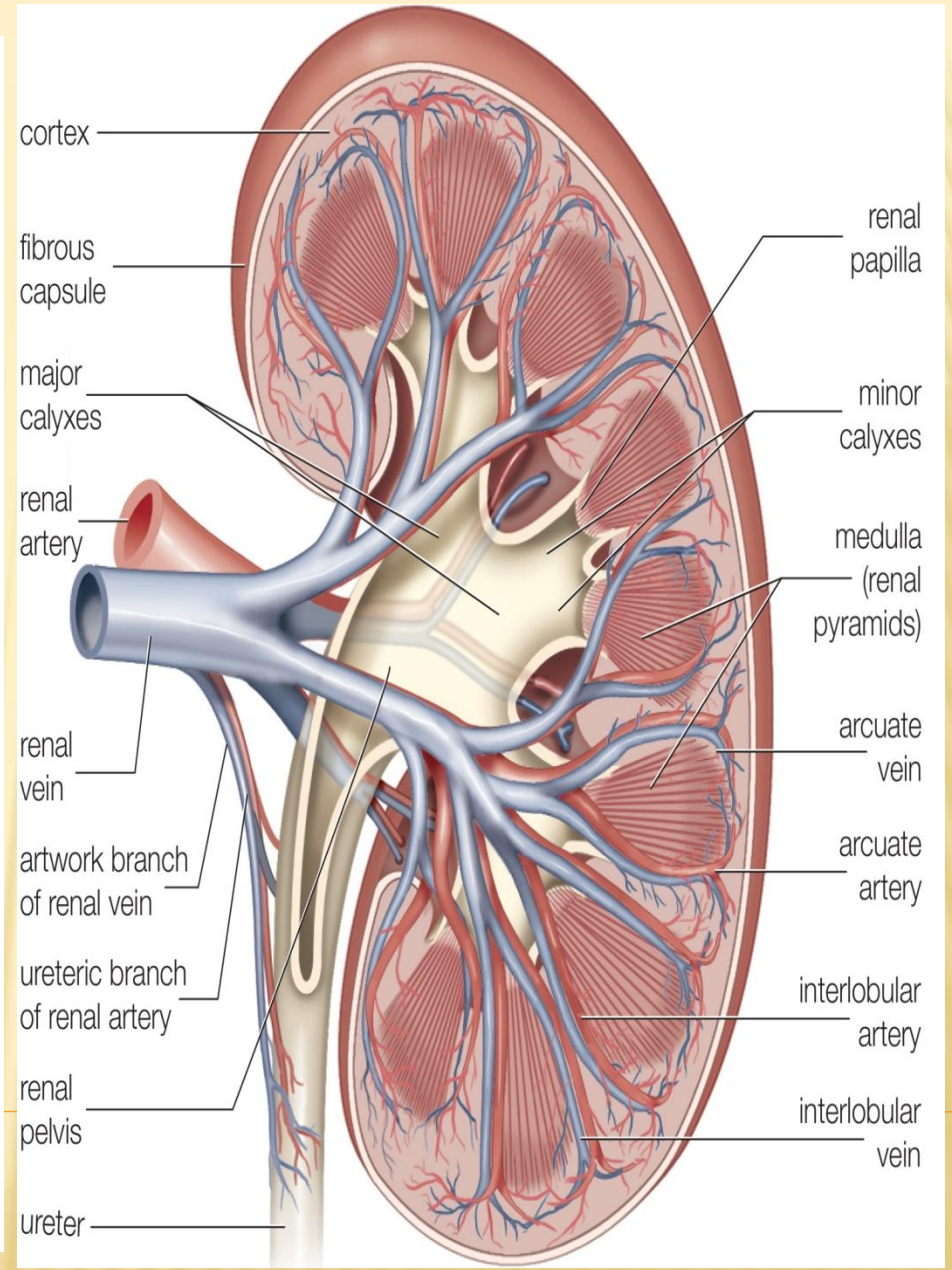
Each kidney consists of 5 segments each has its own blood supply

Lateral view



Segments of the kidneys (Rt.)





THANK YOU AND GOOD LUCK