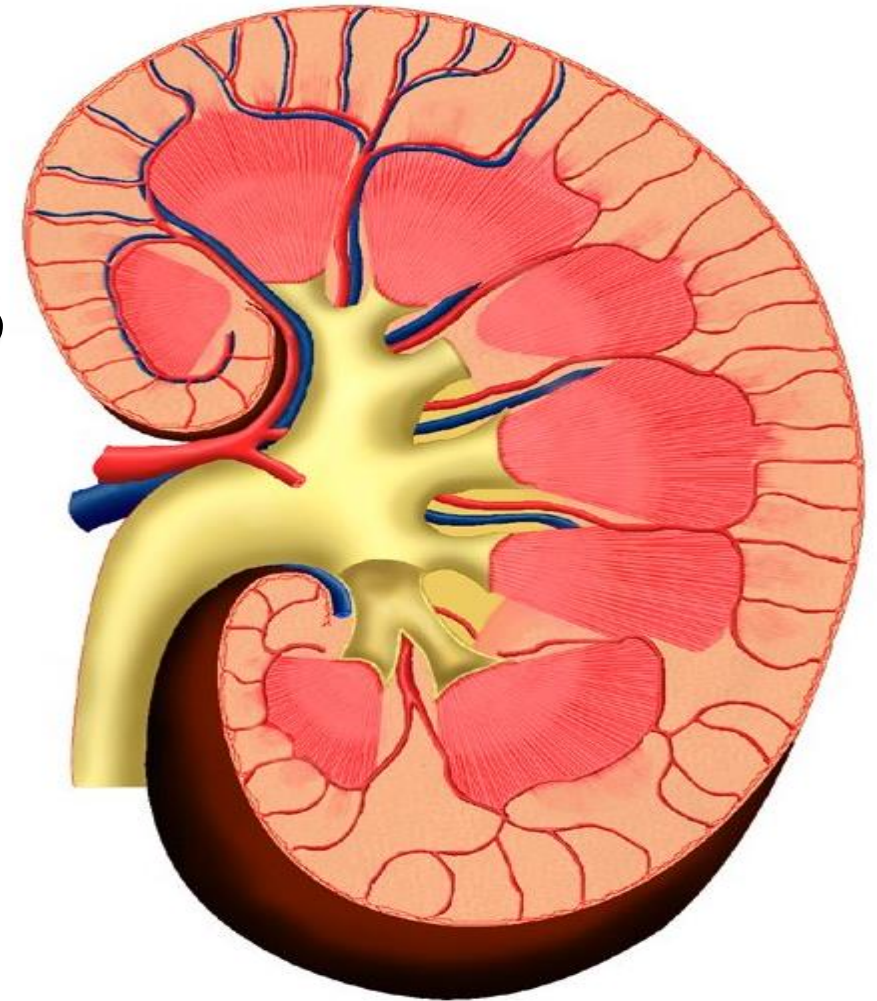




Anatomy of Kidneys

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Objectives

- **By the end of this course you should be able to discuss:**

Components of the urinary system (kidney, ureter, urinary bladder, urethra)

- The Kidney's shape & position.
- Surface anatomy of the kidney.
- External features of the kidney.
- Hilum and its contents.
- Relations of the kidney.
- Internal structure of the kidney.
- Blood supply of the kidney.
- Lymph drainage.
- Nerve supply.

Subjects of the lecture:



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

Excretes most of the waste products of metabolism.

Controls water & electrolyte balance of the body.

Maintain acid-base balance of the blood.

Stimulate bone marrow for RBCs formation by **Erythropoietin** hormone.

Regulates blood pressure by **Rennin** enzyme.

Converts vitamin D to its active form.

Kidneys are reddish brown in color

Lie **behind** the peritoneum (retroperitoneal), on either side of the **vertebral column** on the posterior abdominal wall.

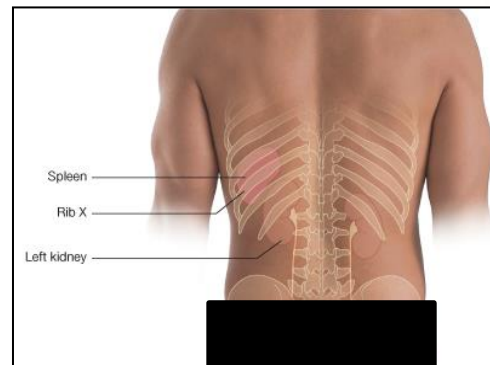
They are largely under cover of the costal margin.

The right kidney lies slightly lower than the left **due to the large size of the right lobe of the liver**.

With contraction of the diaphragm 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 the renal **vein**, two branches of renal **artery**, ureter, and the third branch of renal **artery** from the front backward (**V.A.U.A.**)

Covering of the kidney:

From inward to outward

1- Fibrous capsule:

It is adherent to the kidney.

2- Perirenal fat :

It covers the fibrous capsule

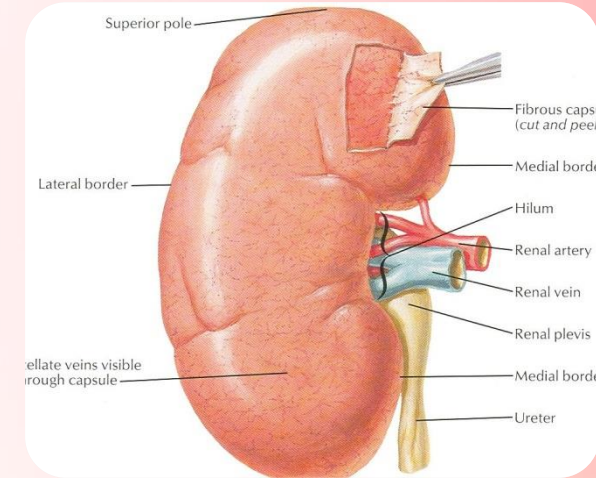
3- Renal fascia:

it encloses the kidneys and suprarenal glands.

4- Pararenal fat :

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

Perirenal fat, Renal fascia and Pararenal fat supports the kidney's position.



Structure of the kidney:

Each kidney has an **outer cortex** and an **inner medulla**

Medulla is composed of about **12 renal pyramids**.

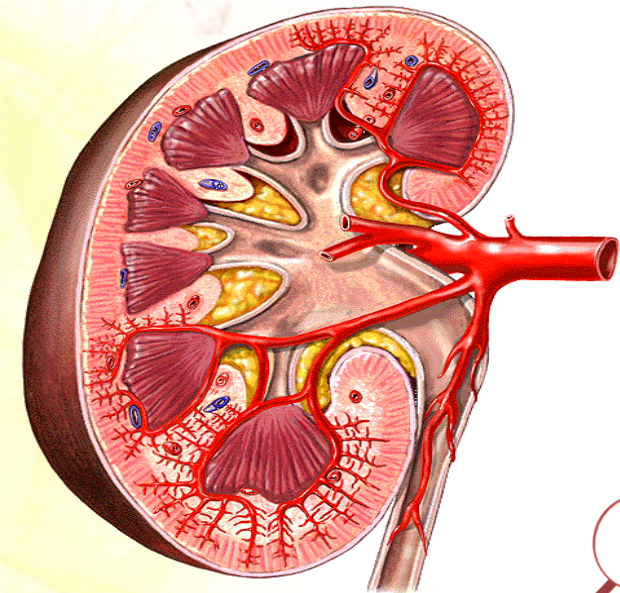
The base of each pyramid is directed laterally toward the cortex & its **apex** (the **renal papilla**) is projecting medially.

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.



Posterior relation

Last rib + four muscles + three nerves

Muscles

Diaphragm

Psoas major

Transversus abdominis

Quadratus lumborum

Nerves

Subcostal (T12)

Illiohypogastric (L1)

Illioinguinal (L1)

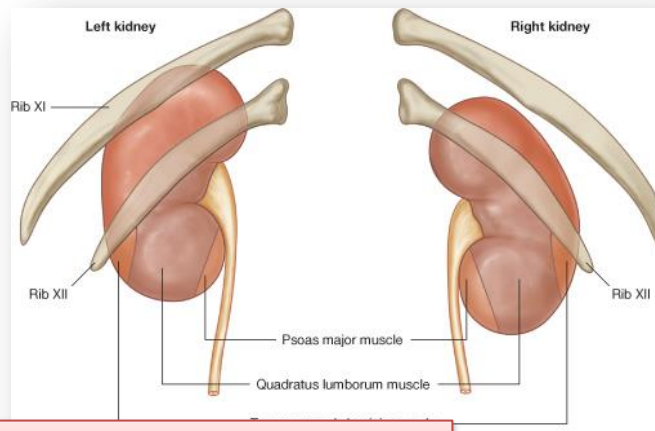
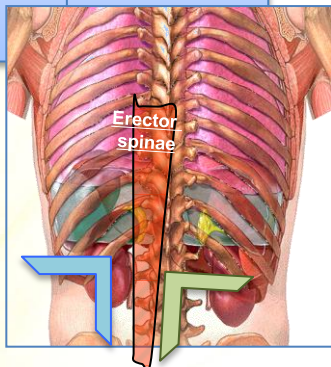
Costodiaphragmatic pleural recess & 12th rib

Vertebrocostal angel

Renal Angel

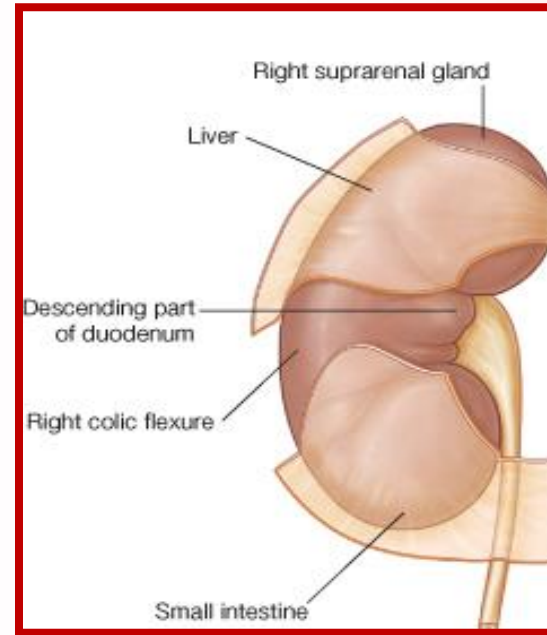
occupied by lower part of the pleural sac

occupied by kidney



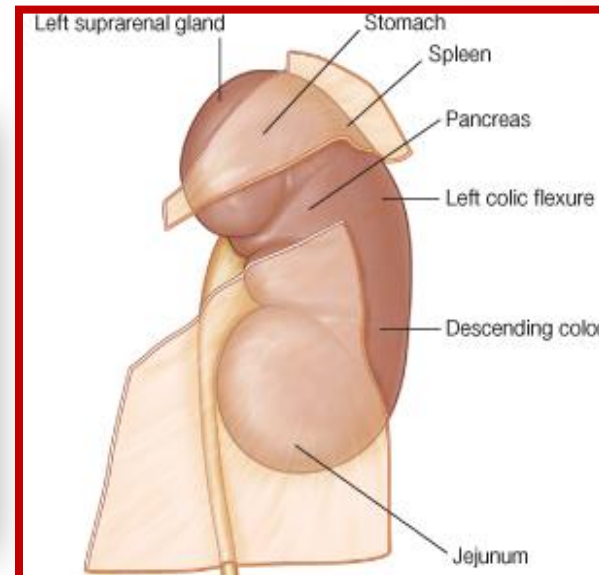
*The left kidney reaches up to the 11th rib

Anterior relation



Right Kidney :

- 1- Right suprarenal gland.
- 2- Liver.
- 3- Second part of the duodenum.
- 4- Right colic flexure.
- 5- Coils of small intestine.



Left Kidney :

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

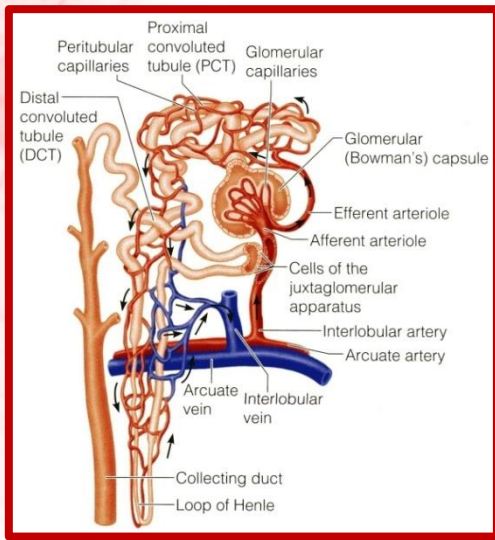
Blood supply:

1. The renal artery arises from **the aorta** at the level of the **second lumbar vertebra “ L2 “**.
2. 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.
3. **Lobar artery** arise from each segmental artery, one for each renal pyramid.
4. Each lobar artery gives off 2 or 3 **Interlobar arteries**.
5. The interlobar arteries run toward the cortex on each side of the renal pyramid.
6. Interlobar arteries give off the **arcuate arteries** at the junction of the cortex and medulla.
7. The arcuate arteries give off several **Interlobular arteries**.
8. Interlobular arteries **give afferent glomerular arterioles**.

Renal > Segmental > Lobar
> Interlobar > Arcuate
> Interlobular > Afferent
^ ^
_

The five Segmental arteries are:





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**

Afferent

- arises from an **interlobular artery**
- "**feeder vessel**"

Efferent

- receives blood that has passed through the glomerulus.

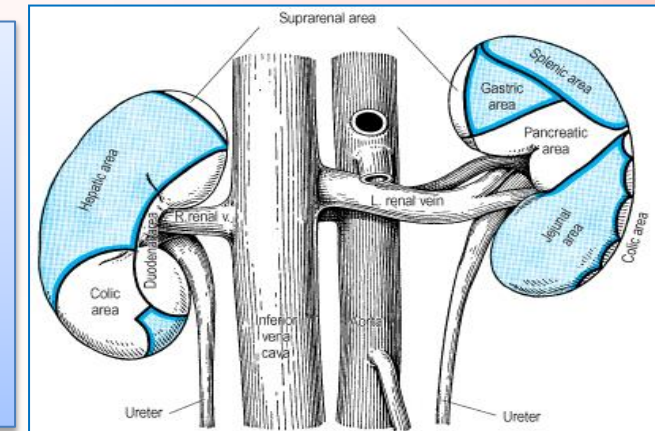
Venous Drainage:

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

The **left** is three times **longer** (7.5 cm) 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, 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**.



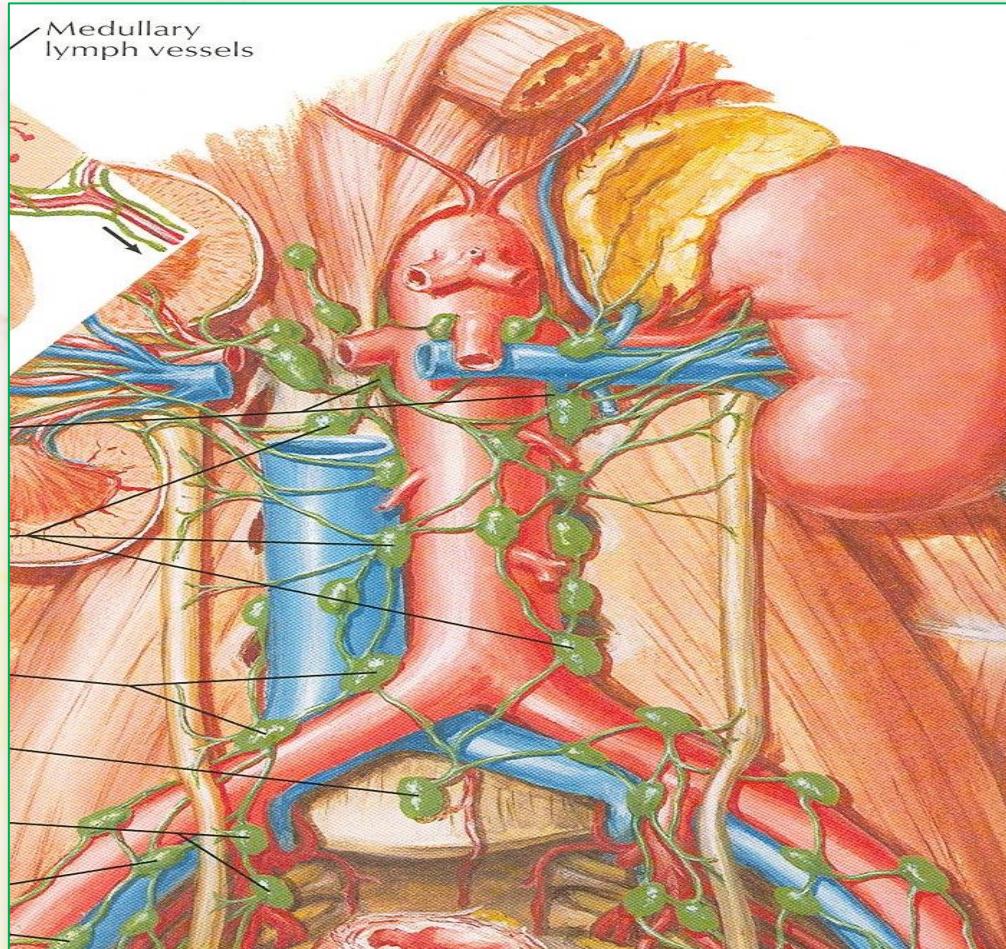
- The left gonadal vein enters **the left renal vein** from **below** while the left suprarenal vein, enters it from **above** but nearer to the midline.

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

- **The right renal vein** is behind the 2nd part of the duodenum and sometimes the lateral part of the head of the pancreas.

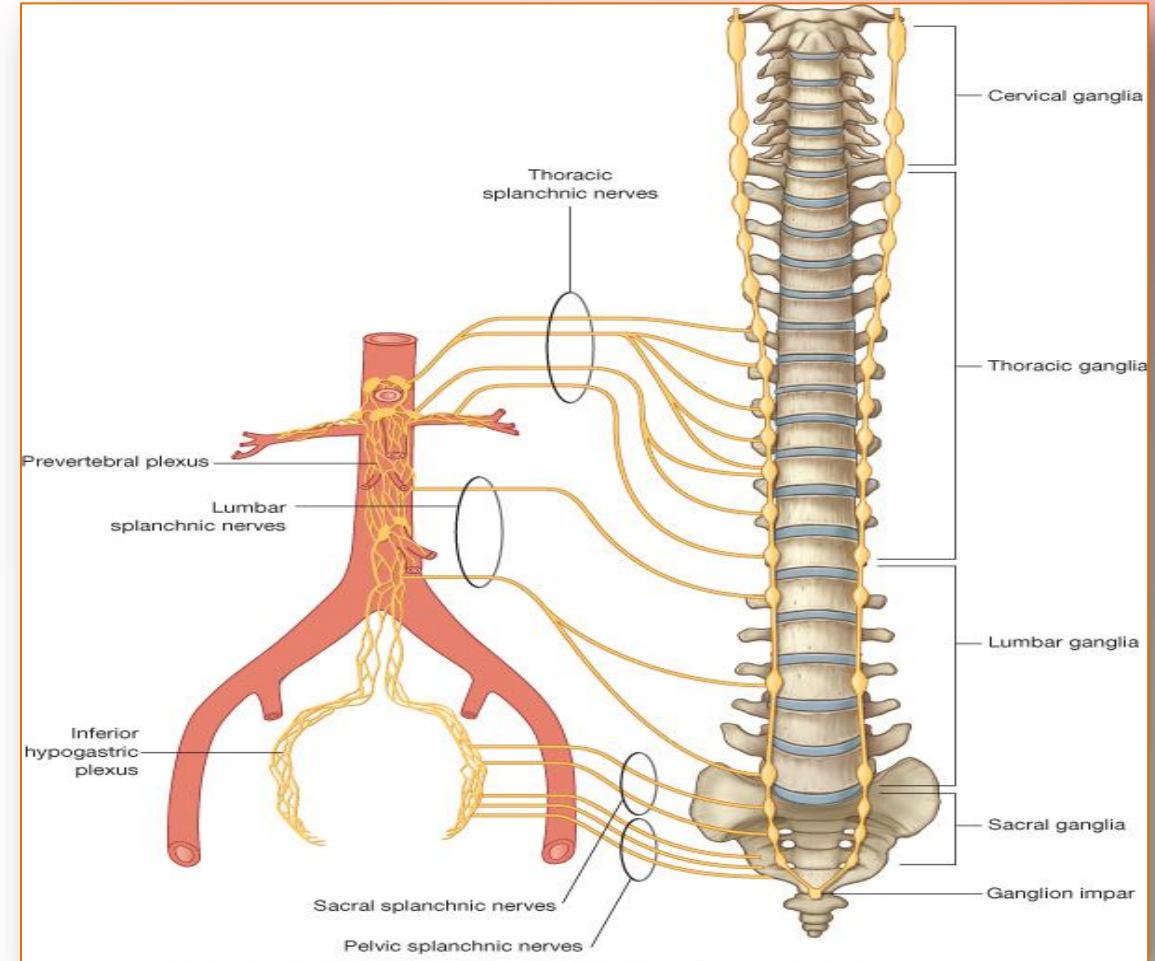
Lymph Drainage:

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



Nerve supply:

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



Summary

- Each kidney has an **outer cortex** and an **inner medulla**, medulla is composed of about **12 renal pyramids**, the right kidney lies slightly lower than the left **due to the large size of the right lobe of the liver**, with contraction of the diaphragm the kidney **moves downward as much as 2.5 cm**, preirenal fat, renal fascia and pararenal fat **supports the kidney's position**.
- **The base** of each pyramid is directed laterally toward the cortex & its apex (the **RENAL PAPILLA**) is projecting medially.
- The renal artery arises from **the aorta** at the level of “ **L2** ”
- The renal artery divides into 5 segmental branches : Apical , Caudal , Anterior superior , Anterior inferior and posterior
- The left kidney is the preferred side for live donor **nephrectomy**
- Nerve supply to the Kidney : **10th, 11th, and 12th Thoracic nerves.**

MCQs

1 - Which one of the following drain into renal vein:

A- Arcuate veins. B- Interlobar veins. C- Interlobular veins.

2- Kidney nerve supply by:

A- Vagus nerve. B- Renal sympathetic plexus (T10, 11, 12).

C- Renal sympathetic plexus (T9, 10, 11)

3- The left renal vein in relation to the splenic vein and Pancreas is:

A. Anterior B. Posterior C. Media

4- Which one of the following related to left kidney from posterior surface:

A- Small intestine. B- Jejunum C- Psoas major.

**For any comments
Please don't hesitate to
contact us by
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