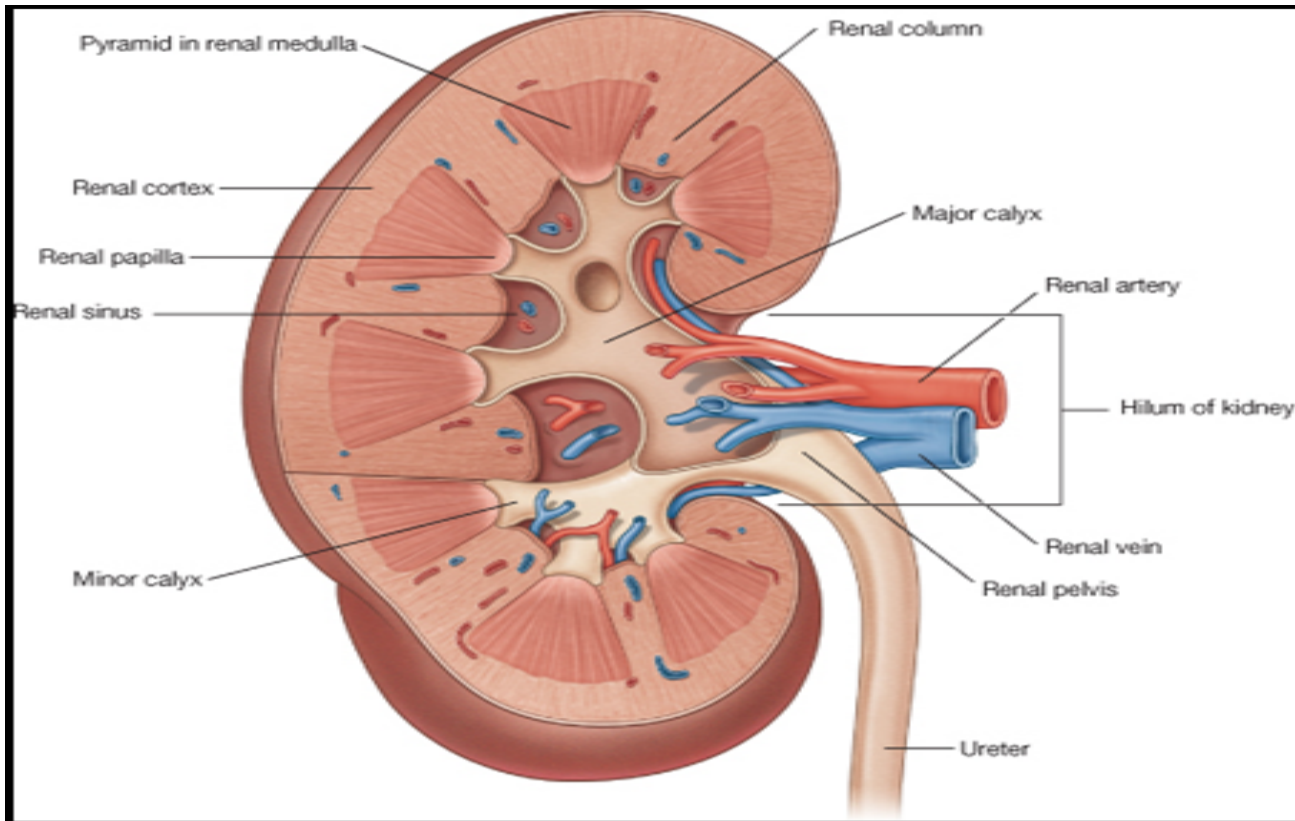


Anatomy of the Kidney



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

KIDNEY

- q **SHAPE & POSITION.**
- q **SURFACE ANATOMY.**
- q **EXTERNAL FEATURES.**
- q **HILUM and its CONTENTS.**
- q **RELATIONS.**
- q **INTERNAL STRUCTURE.**
- q **BLOOD SUPPLY**
- q **LYMPH DRAINAGE..**
- q **NERVE SUPPLY.**

New Terms :

retroperitoneal: Lie behind the peritoneum

Papilla: any small, nipplelike process or projection. (e.g. the papillary muscles that we studied in CVS)

Medulla: Middle of something.

Cortex: the outer layer of an organ or body part (e.g. kidney, cerebrum and cerebellum)

Medullary rays: is the middle part of the cortical lobule or renal lobule or renal pyramid, consisting of a group of straight tubes to the collecting ducts.

Calyces: chambers of the kidney through which urine passes.

Nephron: functional unit of the kidney, the structure that actually produces urine in the process of removing waste and excess substances from the blood.

Glomerulus: globular structures of entwined vessels or fibers.

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:

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.

- ✘ 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.**)

COVERINGS

From inward to outward

1- Fibrous capsule:

It is adherent to the kidney.

2- Perirenal fat:

It covers the fibrous capsule

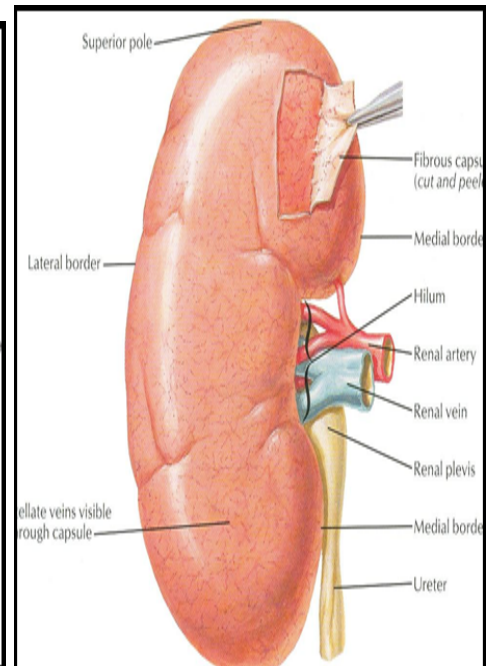
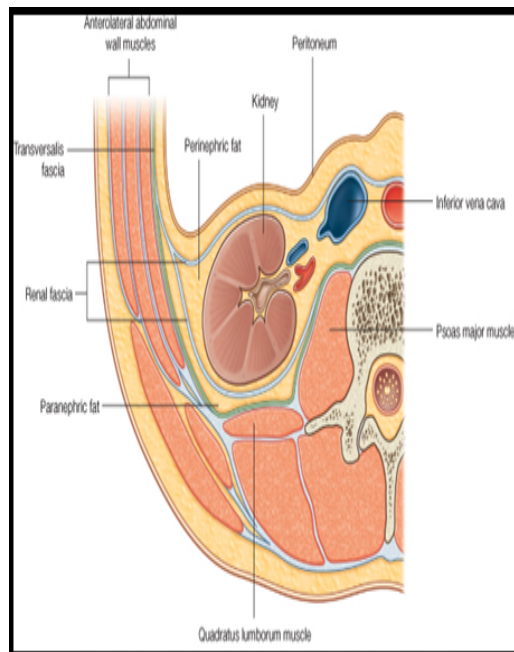
3- Renal fascia:

it encloses the kidneys and suprarenal glands.

4- Pararenal fat:

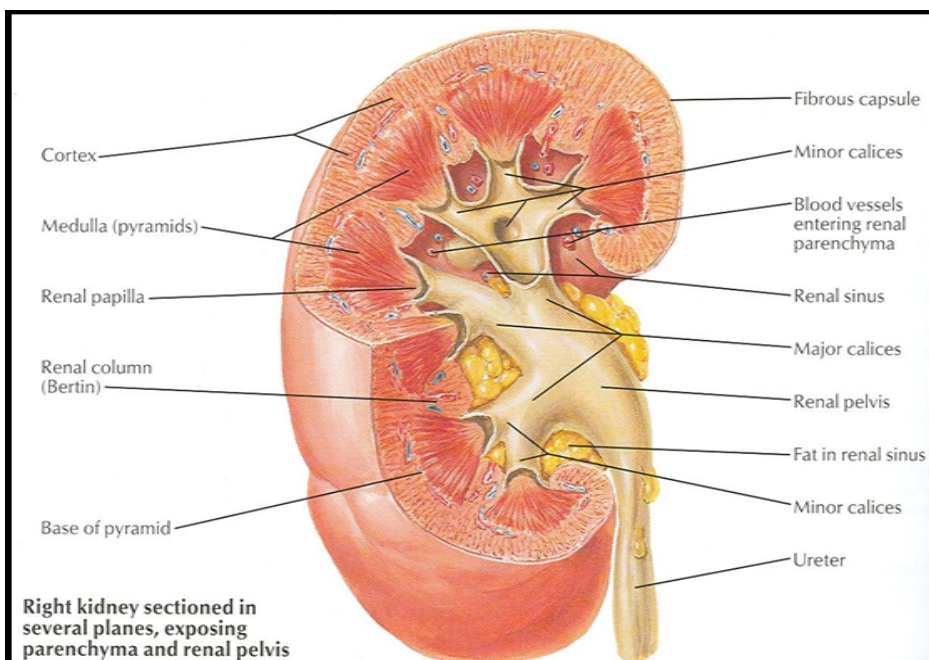
it lies external to the renal fascia, and forms part of the retroperitoneal fat.

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



RENAL 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 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.

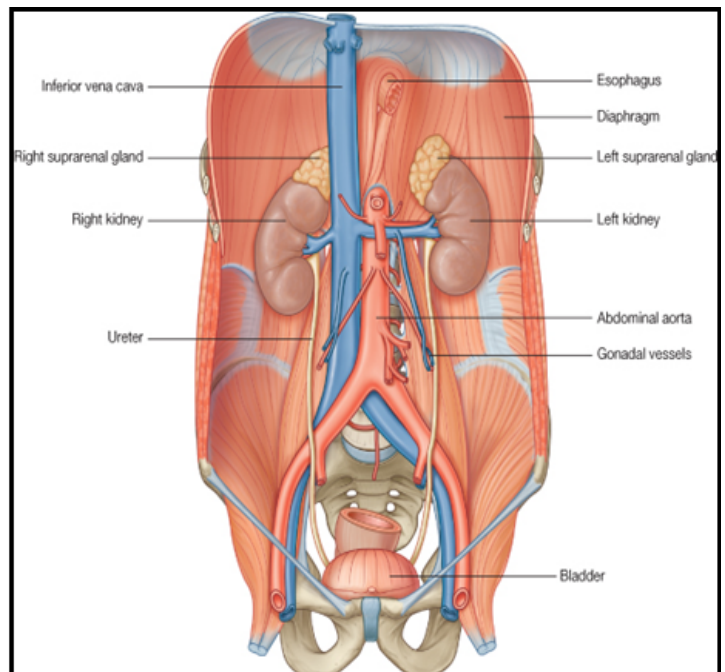
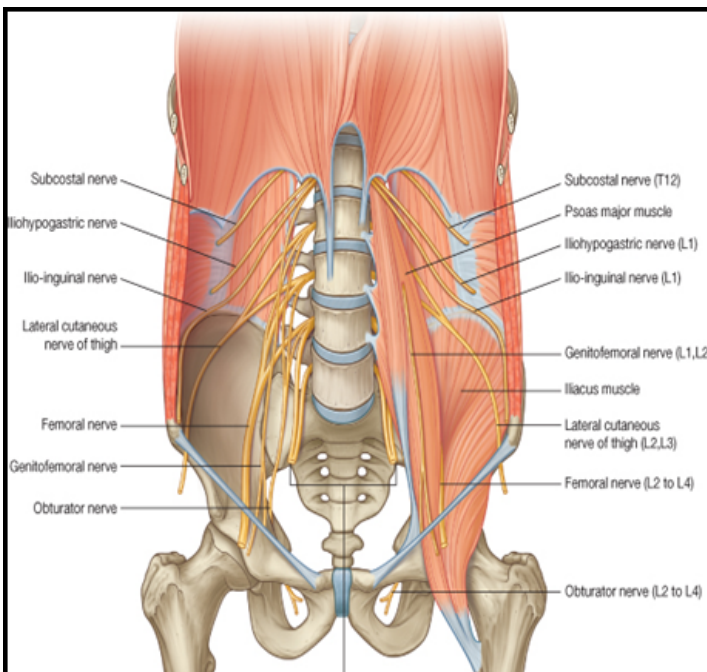
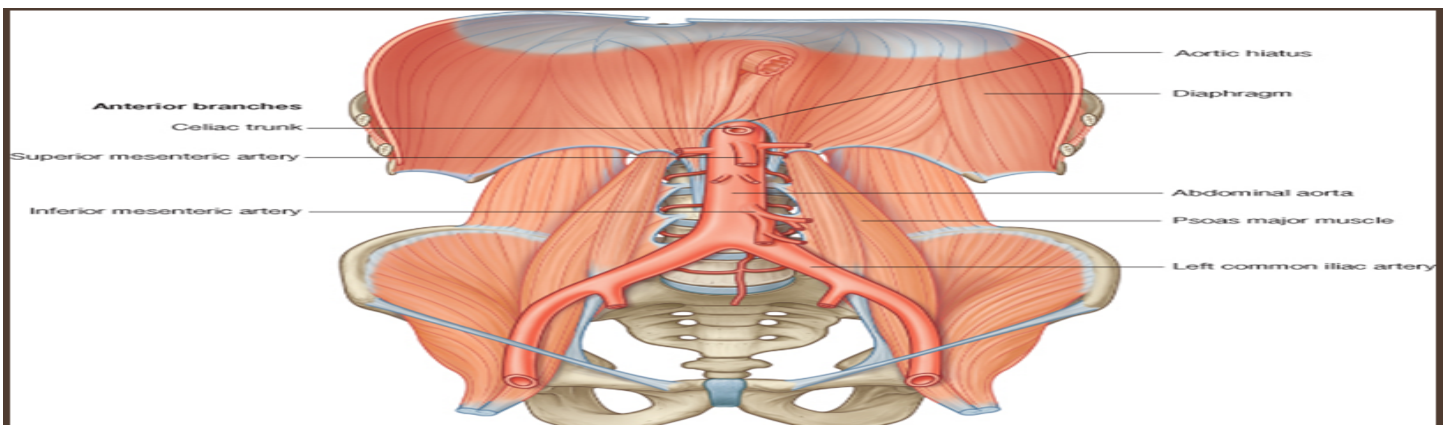
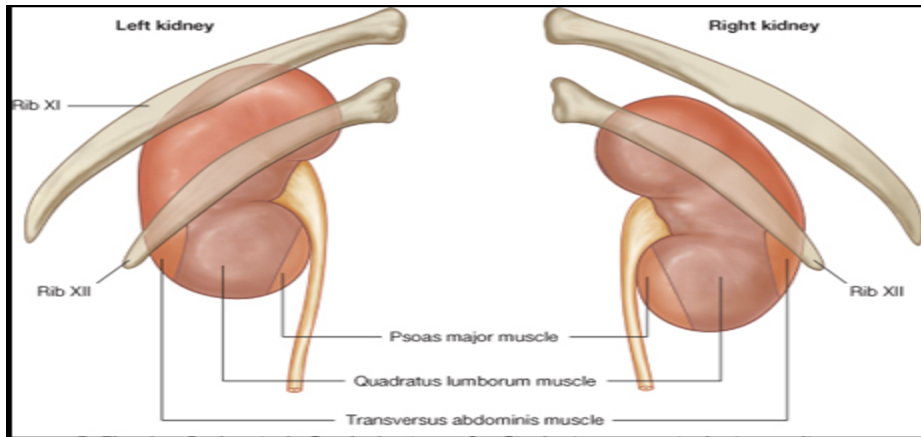


RENAL STRUCTURE

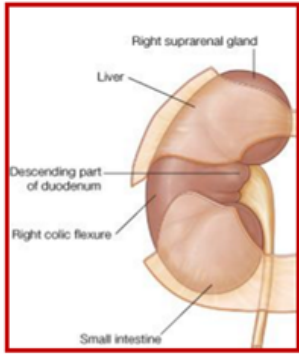
- ✘ Extending from the bases of the renal pyramids into the cortex are striations known as **medullary rays**.
- ✘ The renal sinus within the hilum, contains the upper expanded end of the ureter, the renal pelvis.
- ✘ Renal pelvis divides into two or three **major calyces**.
- ✘ Each **major calyces** divides into two or three minor calyces.

POSTERIOR RELATIONS

- ✦ (Last rib + 4 muscles + 3 nerves)
- ✦ Diaphragm, (last intercostal space)
- ✦ Costodiaphragmatic pleural recess.
- ✦ Twelfth rib,
- ✦ Psoas major muscle,
- ✦ Quadratus lumborum m.,
- ✦ 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.

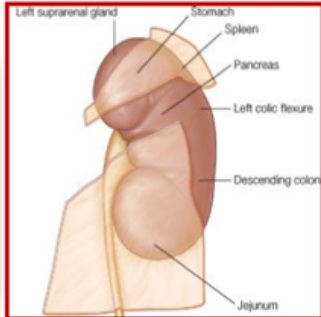


Anterior relation



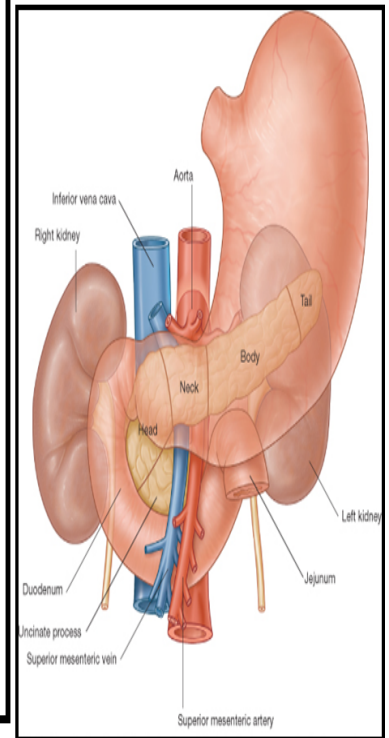
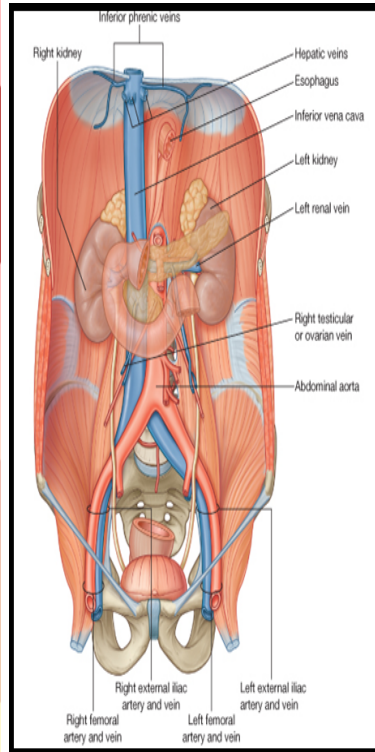
Right Kidney :

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



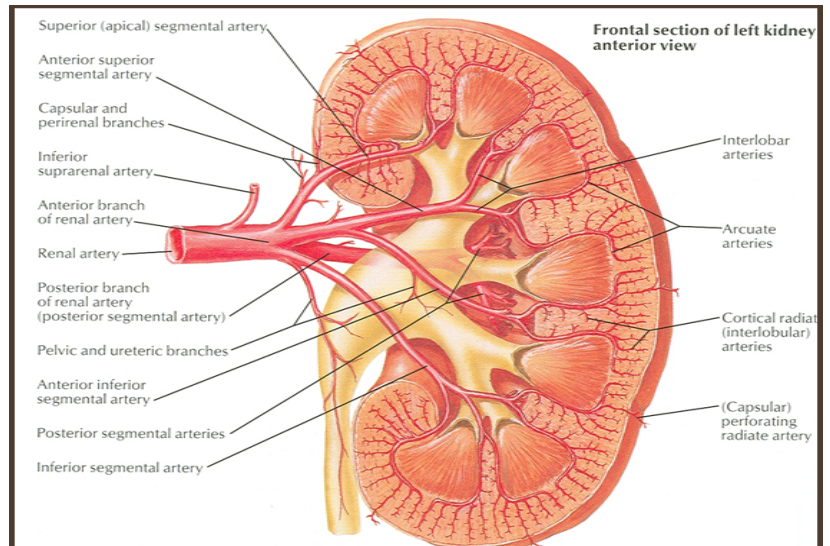
Left Kidney :

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



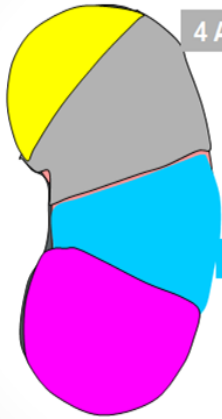
BLOOD SUPPLY

- ✘ 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.**



Each kidney consists of 5 segments

1- Apical segment



4 Anterior superior segment

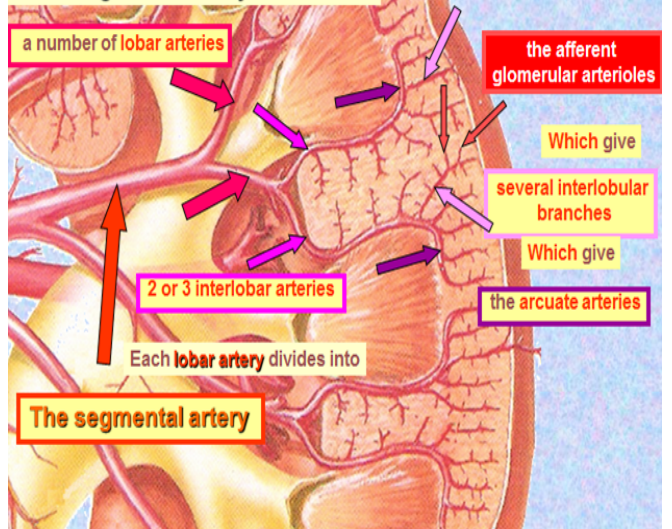
3-Posterior segment

5- Anterior inferior segment

2- Caudal segment

Segments of the kidneys

Each **segmental artery** divides into the **interlobar arteries** give off



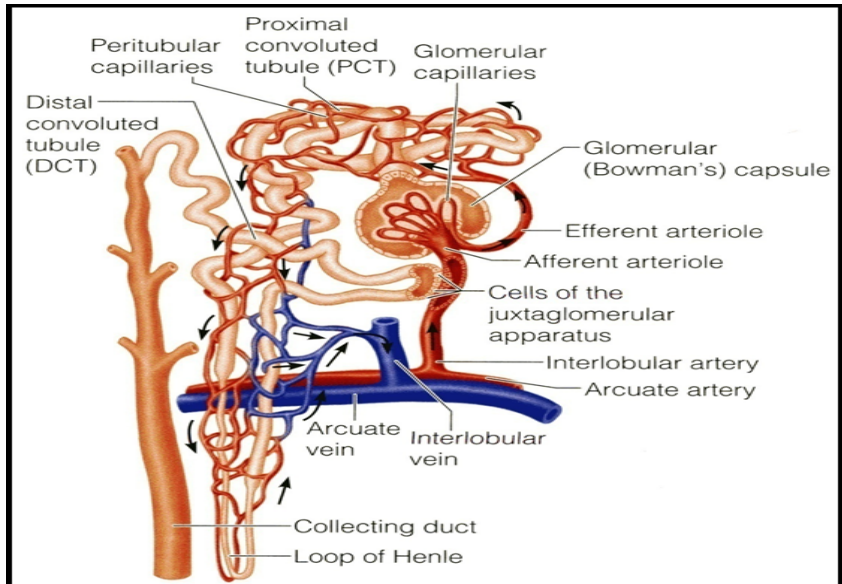
Branches of the Segmental artery

Each **Nephron** is associated with **two** capillary beds:

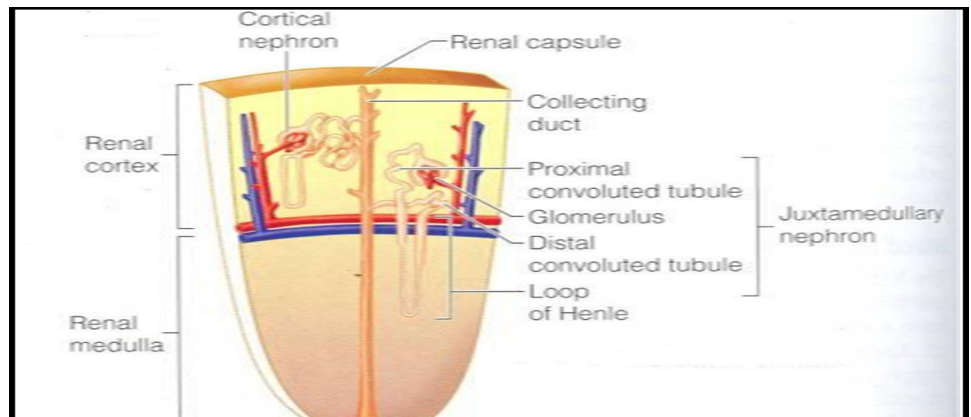
- 1. The **glomerulus** and
- 2. The **peritubular capillary bed**.

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.



Interlobular artery gives off afferent glomerular arterioles .



Venous Drainage

Both renal veins drain to the inferior vena cava.

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

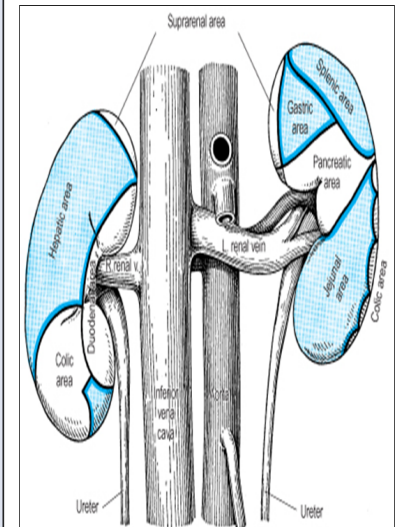
So, for this reason the left kidney is the preferred side for live donor **nephrectomy**.

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.

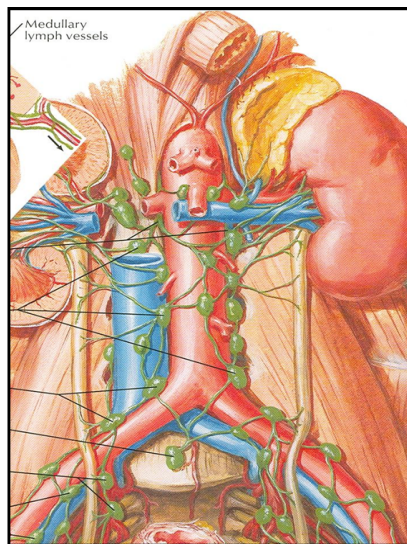
The right renal vein is behind the **2nd** part of the duodenum and sometimes the lateral part of the head of the pancreas



LYMPH

Lymph Drainage:

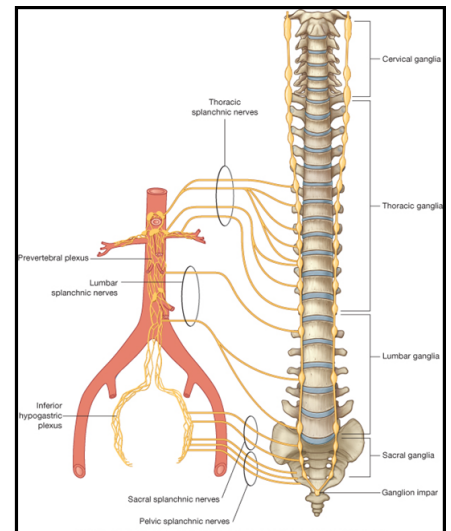
Lateral aortic lymph nodes around the origin of the renal artery.



Nerve Supply

Nerve Supply

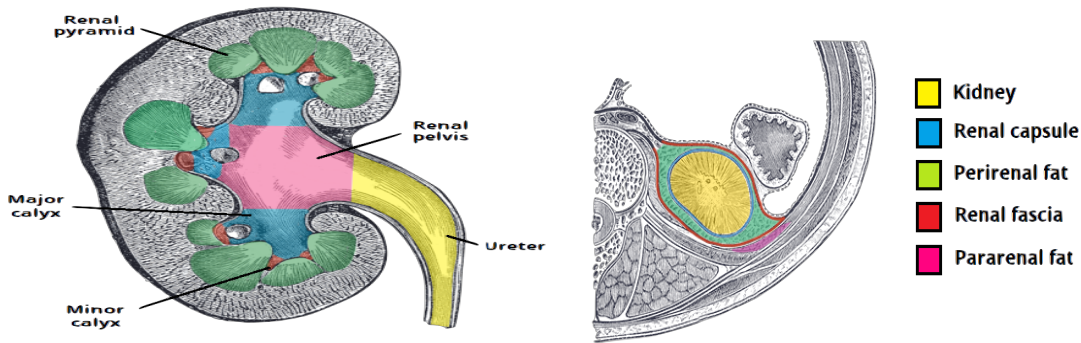
- Renal sympathetic plexus.
- The afferent fibers that travel through the renal plexus enter the spinal cord in the: **10th, 11th, and 12th Thoracic nerves**.



summary:

- Anatomical relation of the kidney

Left Kidney		Right Kidney	
Anterior	Posterior	Anterior	Posterior
<ul style="list-style-type: none"> Suprarenal gland Spleen Stomach Pancreas Left colic flexure Jejunum 	<ul style="list-style-type: none"> Diaphragm 11th and 12th ribs Psoas major, quadratus lumborum and transverse abdominis muscles Subcostal, iliohypogastric and ilioinguinal nerves 	<ul style="list-style-type: none"> Suprarenal gland Liver Duodenum Right colic flexure 	<ul style="list-style-type: none"> Diaphragm 12th rib Psoas major, quadratus lumborum and transverse abdominis muscles Subcostal, iliohypogastric and ilioinguinal nerves



MCQS:

1- The renal sinus contains the upper expanded part of the ureter called:

- A- Renal papilla.
- B- Renal pelvis. *
- C- Renal Ureter.

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

- A- 12th rib.
- B- 11th & 12th ribs; last intercostals space. *
- C- Right colic flexure.

3- Which one of the following drain into left renal vein:

- A- Left gonadal vein. *
- B- Inferior mesenteric.
- C- Superior mesenteric.

4- Kidney supply by:

- A- Renal sympathetic plexus (T11, T12, L1).
- B- Renal sympathetic plexus (T10, T11, T12). *
- C- Renal sympathetic plexus (T9, T10, T11).

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

- A. Anterior
- B. Posterior *
- C. Media

~ Done by :

يوسف اللهميميد, عبدالعزيز النوييت, طارق الحسن, عبدالله العمير, معاذ البطاح