OBJECTIVES

-Anatomical features of the kidneys:
position, extent, relations, hilum, peritoneal coverings.

-Internal structure of the kidneys:
Cortex, medulla and renal sinus.

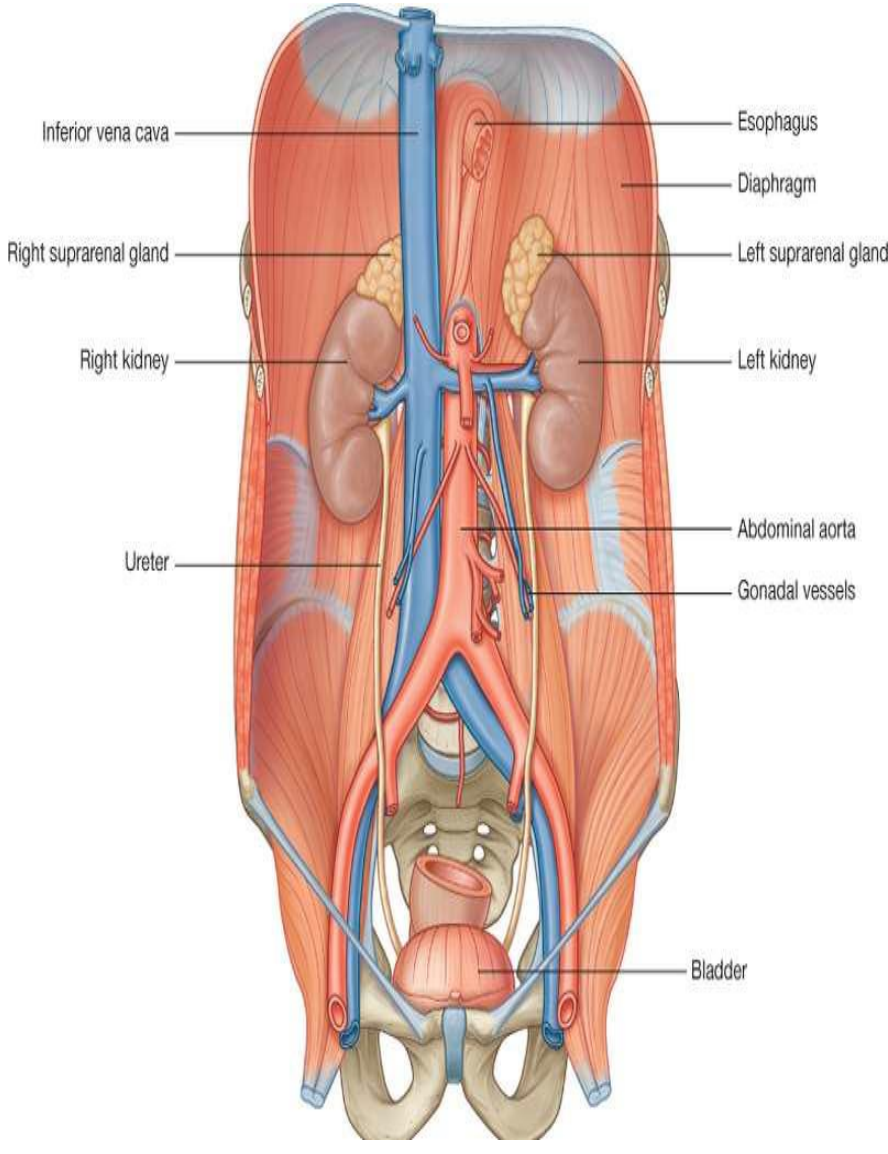
-The vascular segments of the kidneys.

-The blood supply and lymphatics of the kidneys.

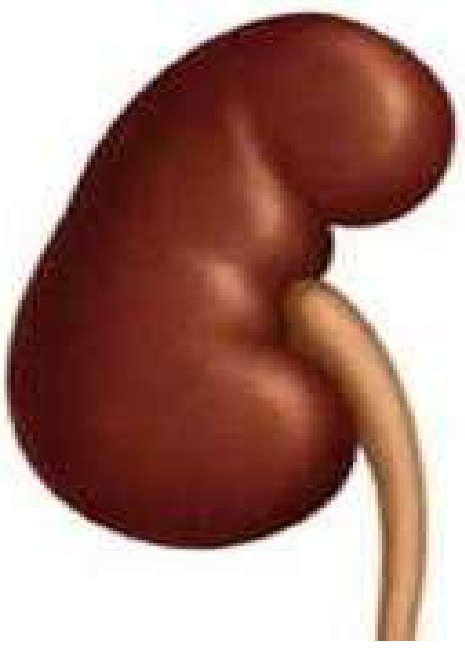
POSITION OF KIDNEY

Kidneys are retroperitoneal paired organs.

- Each kidney lies , on the posterior abdominal wall, lateral to the vertebral column
- In the supine position, the kidneys extend from approximately T12 toL3.
- *The right kidney is slightly lower than the left kidney b*ecause of the large size of the right lobe of the liver.
- With contraction of the diaphragm during respiration, both kidneys move downward in a vertical direction (high of one vertebra, 1 inch,2.5 cm).

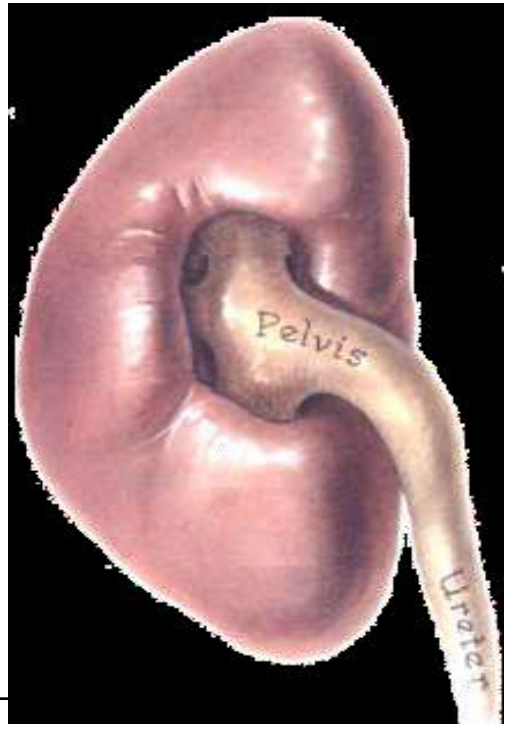


COLOUR, SHAPE & DIMENSIONS



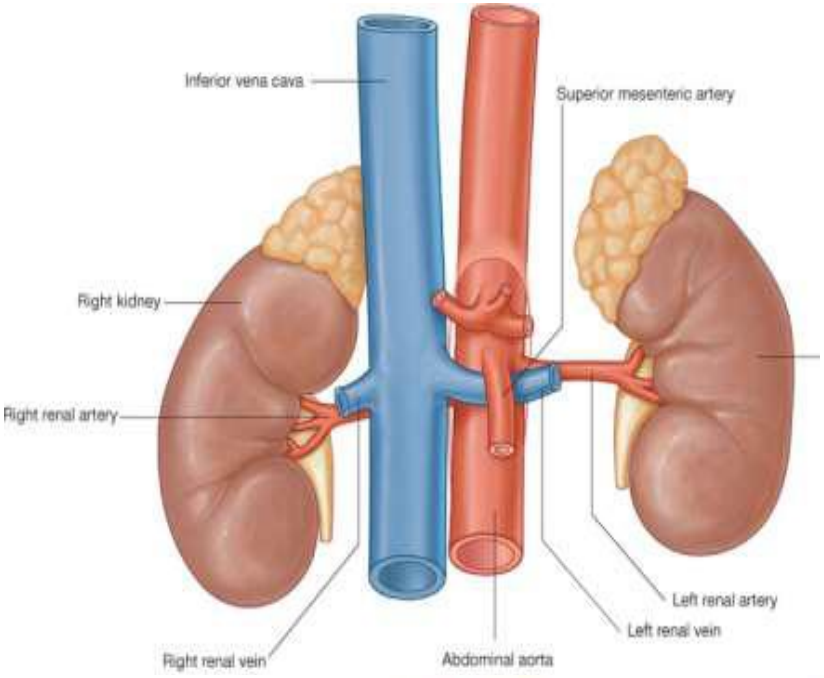
- The kidney is a **reddish brown, bean-shaped organ with the dimensions 12 x 6 x 3cm.**
- Although they are similar in size and shape, the **left kidney is slightly longer and more slender than the right kidney,** and nearer to the midline.
- **Each kidneys has:**Convex upper & lower ends.

Convex lateral border &Convex medial border at both ends, but its middle shows a vertical slit called the **hilum.**Internally the hilum extends into a large cavity called the **renal sinus.**



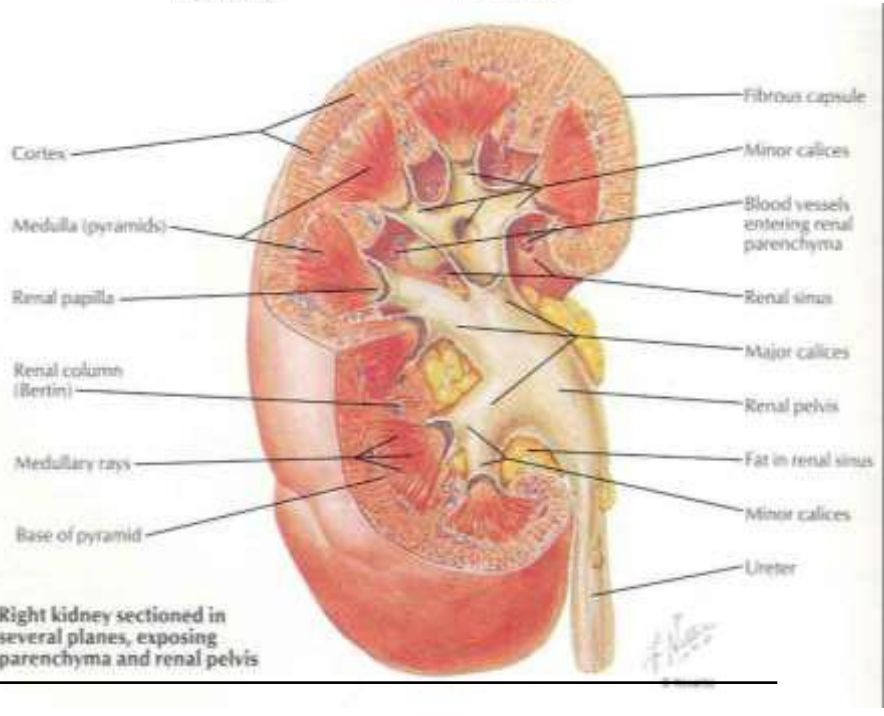
HILUM & RENAL SINUS

• The hilum transmits, from ant erior to posterior, the **renal vei n, renal artery & the ureter (VAU).**



• **Lymph vessels & sympathetic fibers also pass through the hil**um.

• The **renal sinus contains the u**pper expanded part of the ureter called the **renal pelvis.**



• Perinephric fat is continues into the hilum and the sinus and surrounds all these structures.

COVERINGS

1. Fibrous capsule:

Is closely adherent to its surface

2. Perirenal fat:

covers the fibrous capsule.

3. Renal fascia:

Condensation of areolar connecti

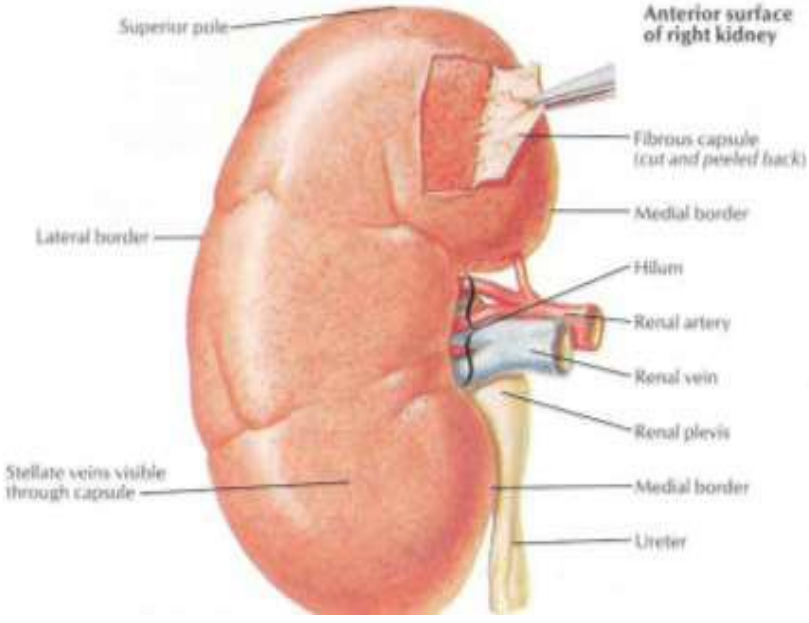
ve tissue that lies outside the

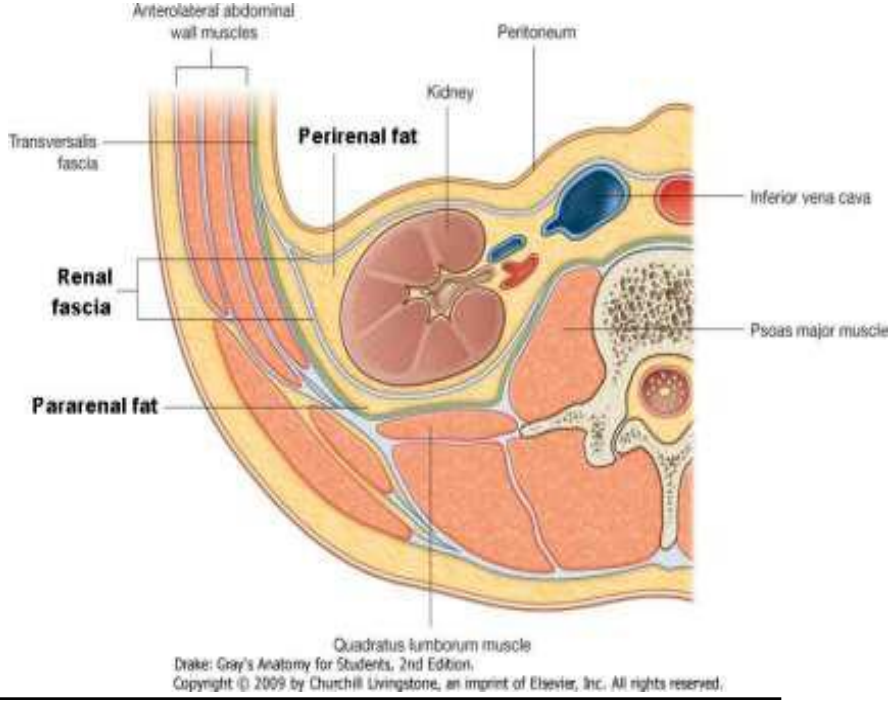
Perirenal fat and encloses the kidney and the suprarenal gland.

4. Pararenal fat:

Lies external to the renal fasci

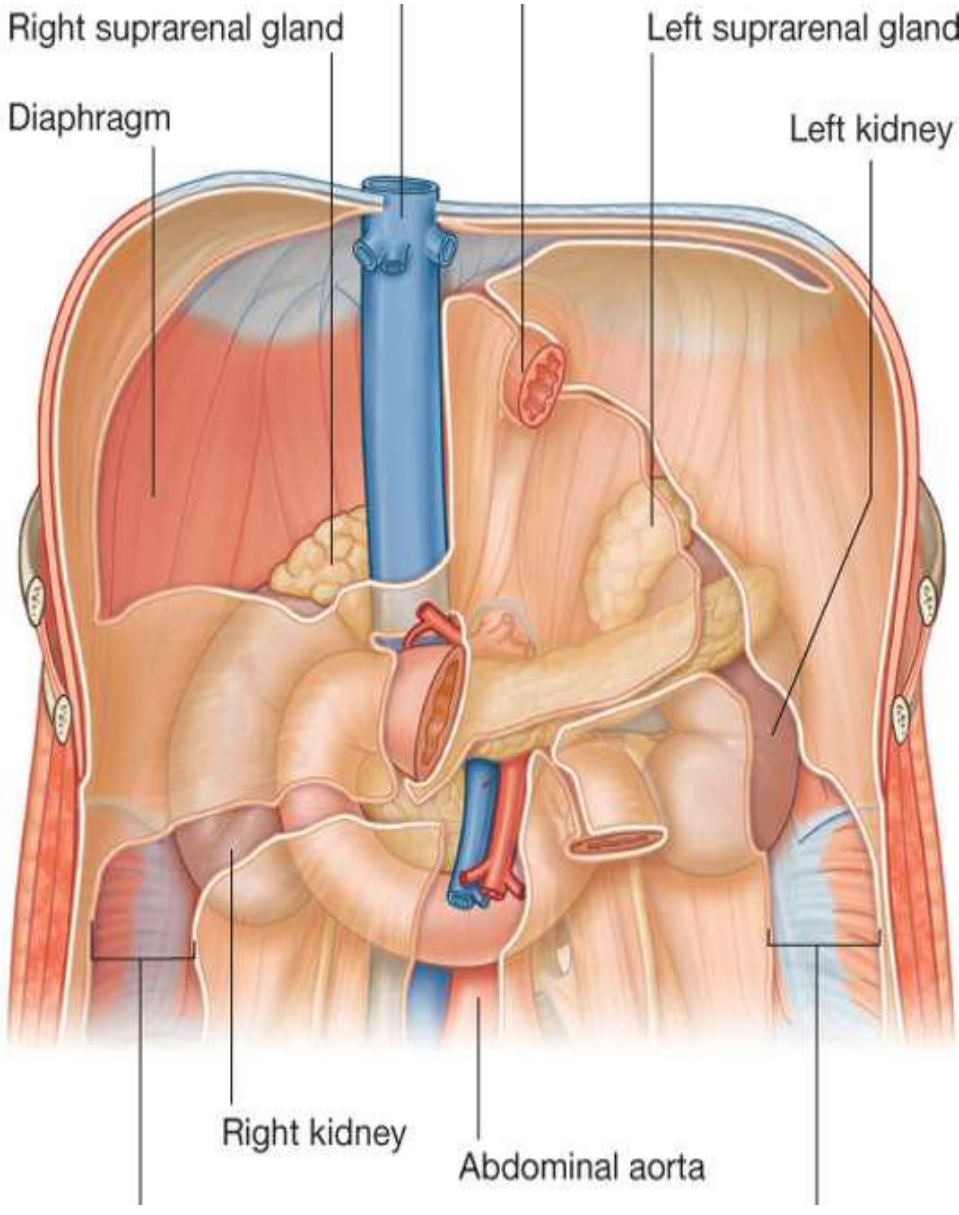
a, is part of the retroperitoneal fat.



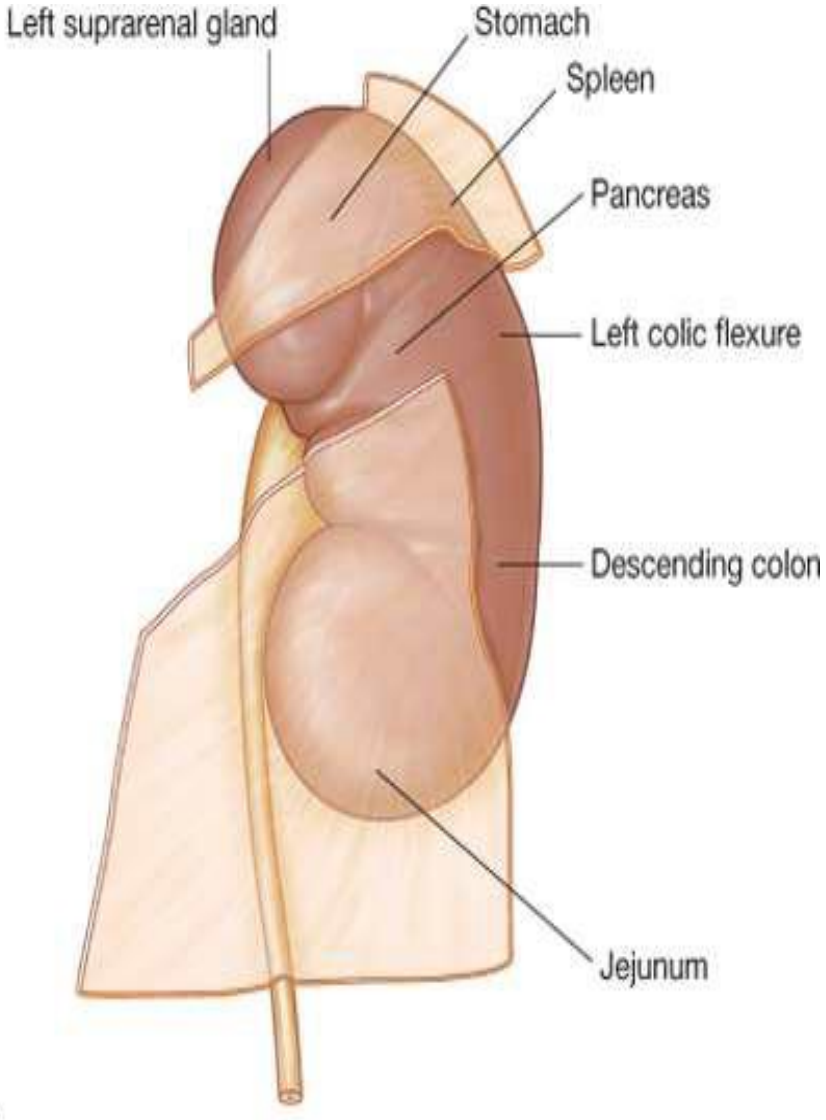


ANTERIOR RELATIONS

The anterior surface of both kidneys are related to numerous structures, some with an intervening layer of peritoneum and others lie directly against the kidney without peritoneum.



LEFT KIDNEY



- A small part of the **superior pole,**along the medial border , is covered by **left suprarenal gland.**

- The rest of the superior pole is covered by the **intraperitoneal stomach and spleen**

.

- The **retroperitoneal pancreas co**vers the middle part of the kidney.

- Its lower lateral part is directly related to the **left colic flexure and** beginning of descending colon.

- Its lower medial part is covered by the **intraperitoneal jejunum.**

RIGHT KIDNEY

- A small part of the **upper pole**

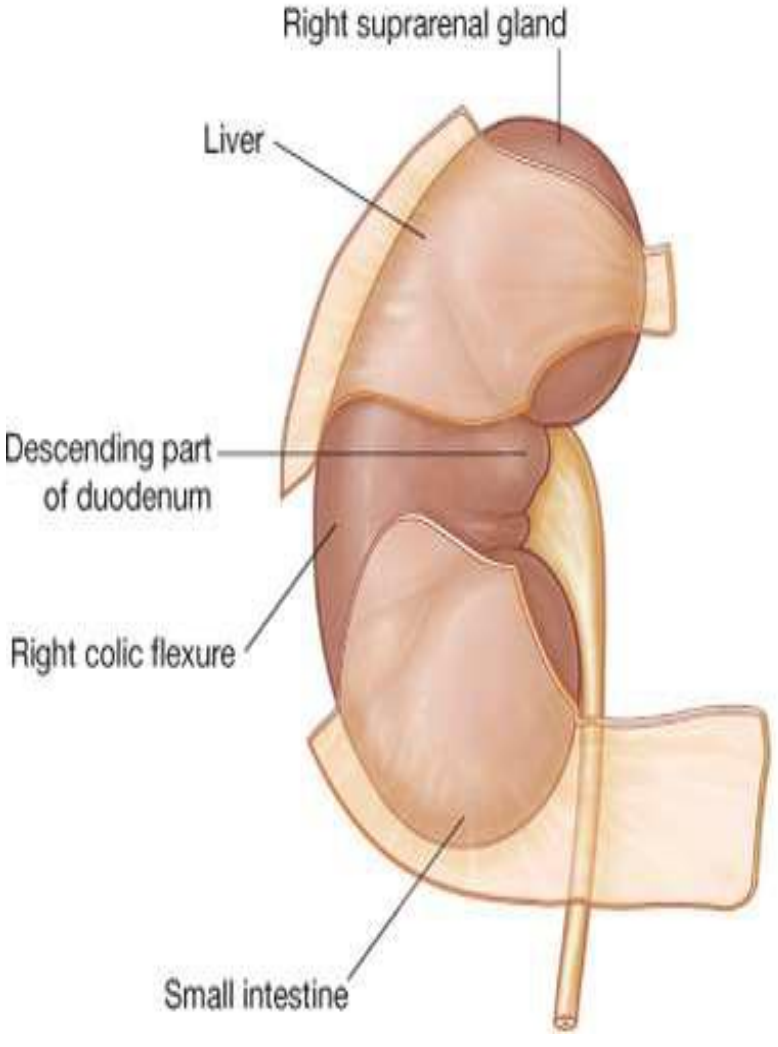
is covered by **right suprarenal gland.**

- The rest of the upper part of **anterior surface is related to the liver and is separated by a layer** of peritoneum.

- The **2nd part of duodenum lies** directly in front of the kidney

close to its hilum.

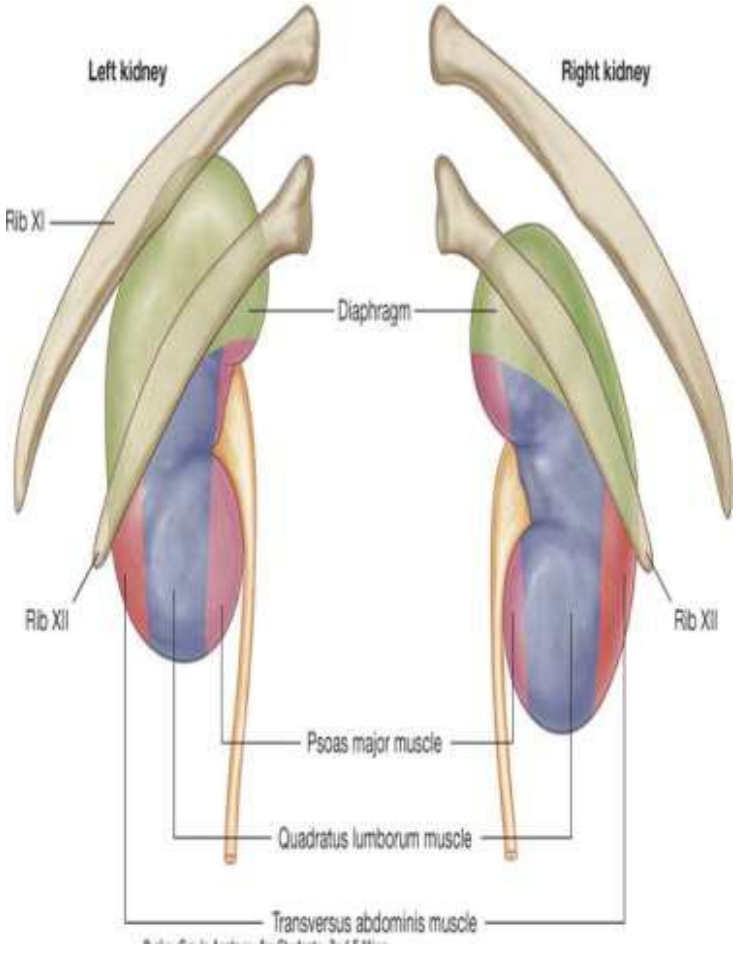
- The **lower lateral part is directly** related to the **right colic flexure and, on its lower medial side**, is related to the **intraperitoneal small intestine**



POSTERIOR RELATIONS

Posteriorly, the right and left kidneys are almost related to similar structures.

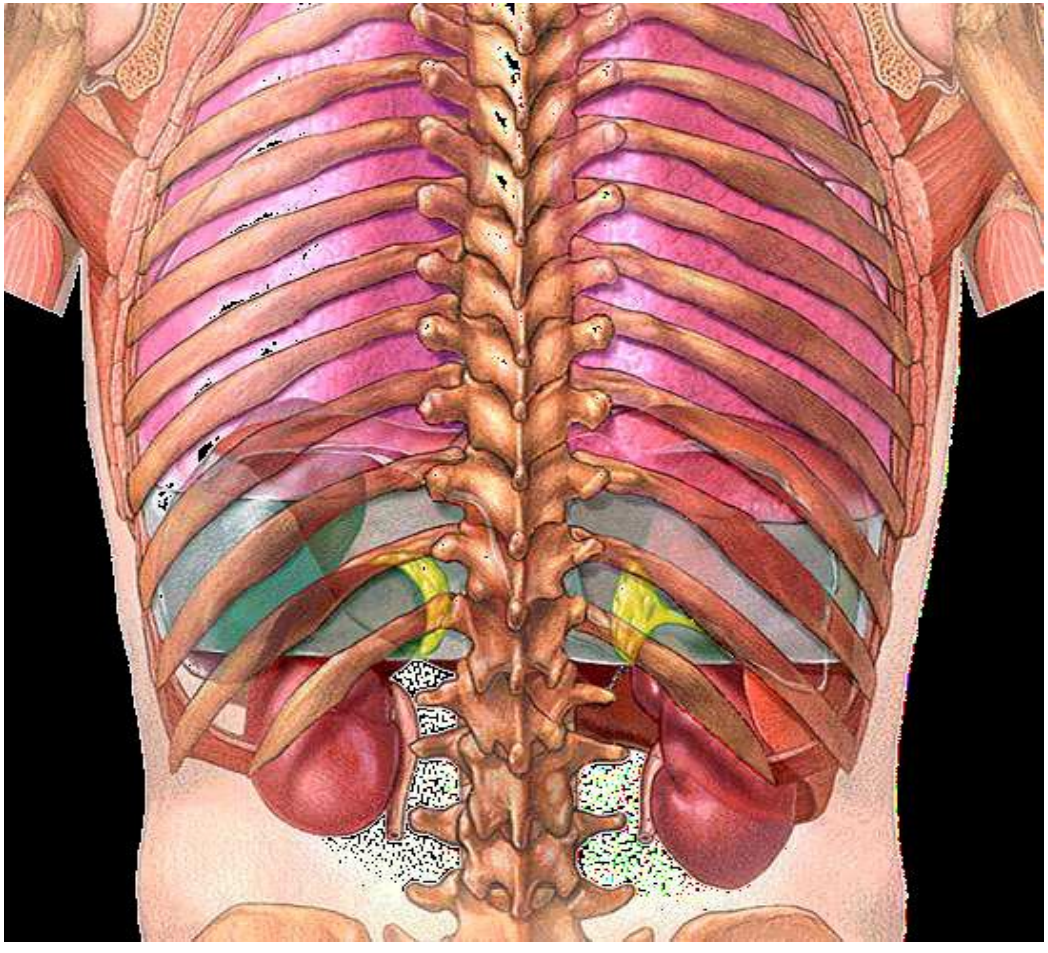
Left kidney:
Diaphragm
Costodiaphragmatic rec ess of the pleura
11th & 12th ribs; last int ercostal space
Psoas major
Quadratus lumborum tr ansversus abdomini s.
Subcostal (T12), iliohypogastric & ilioin guinal nerves.



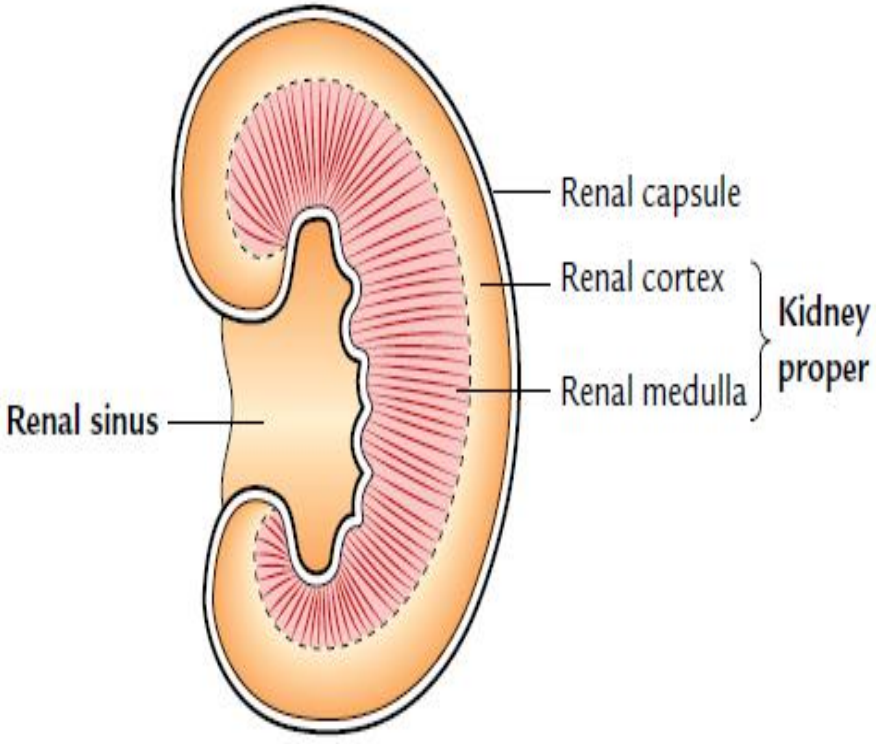
Right kidney:
- Diaphragm
- Costodiaphragmatic recess, of the pleur a
- 12th rib, last interco stal space
- Psoas major
- Quadratus lumboru m, transversus abd ominis.
- Subcostal (T12), ili ohypogastric & ilioi nguinal nerves.

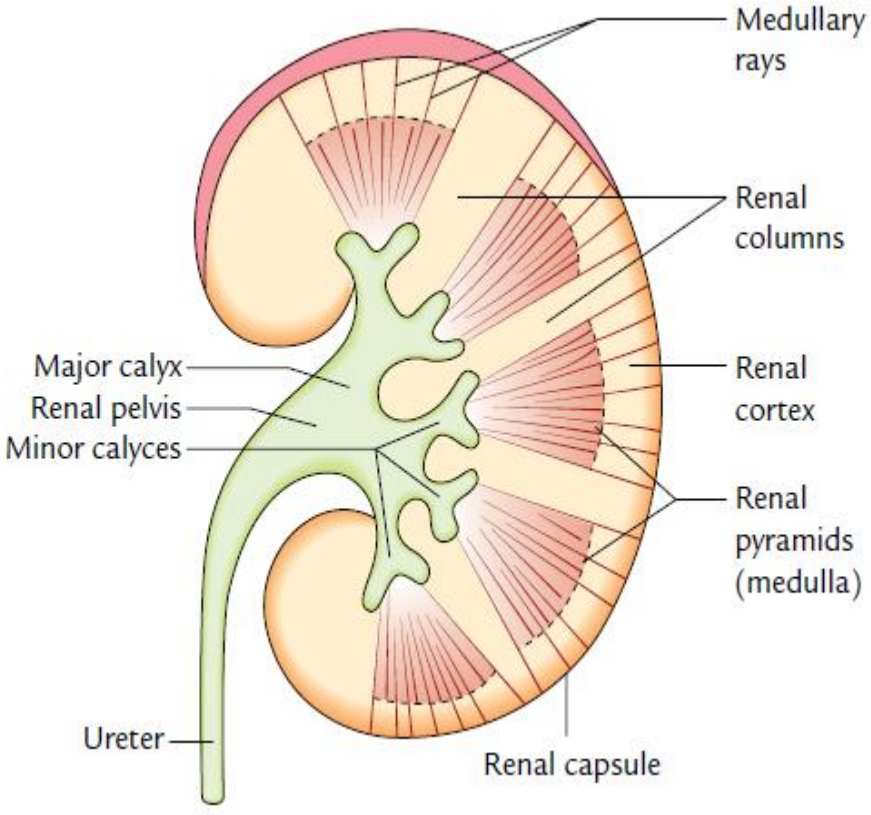
Vertebrocostal & Renal Angles

- The angle between the **last rib and the lateral** border of **erector spinae muscle is occupied by** kidney and is called the **'Renal angle'**
- The **Vertebrocostal angle is occupied by the** lower part of the pleural sac.



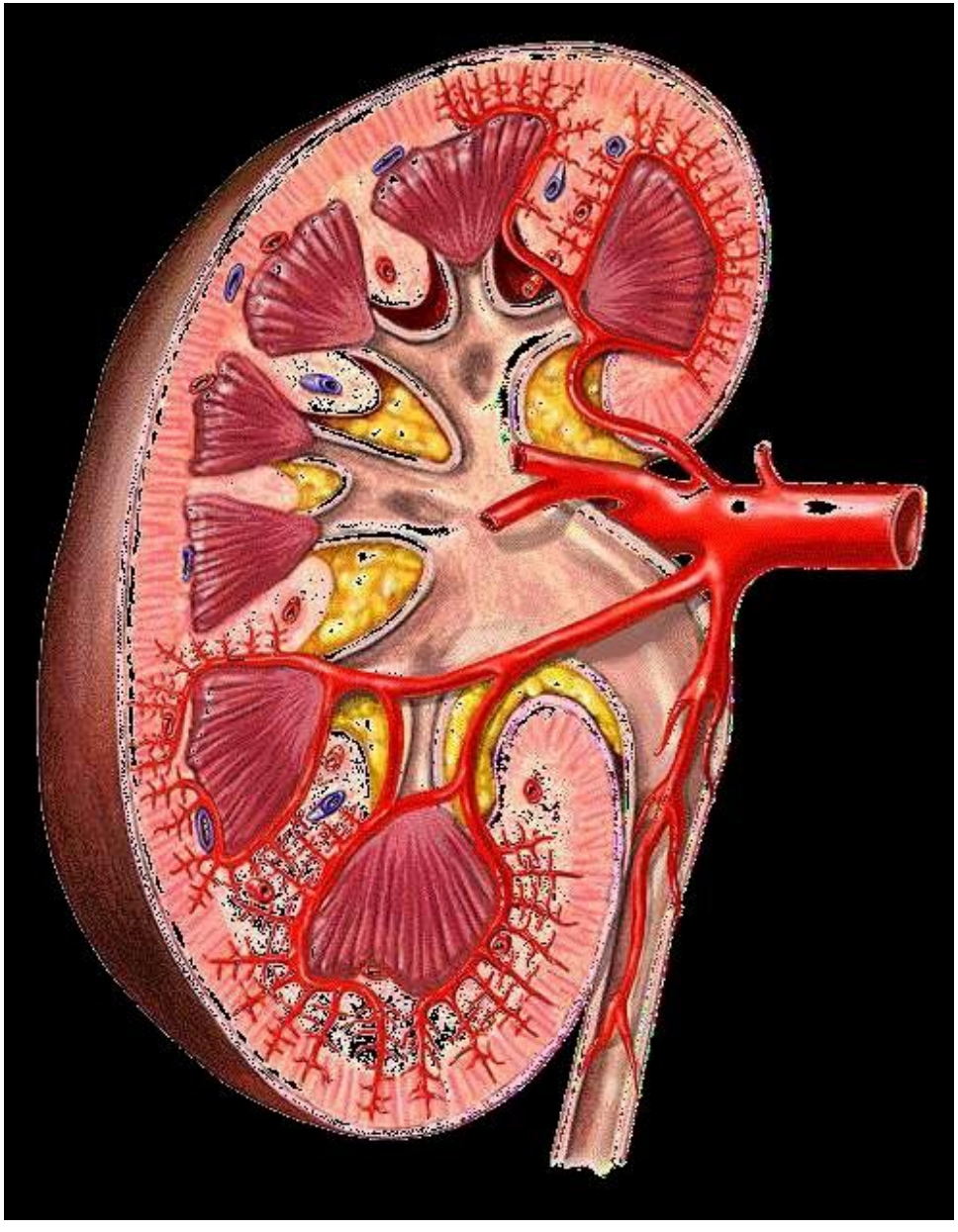
INTERNAL STRUCTURE



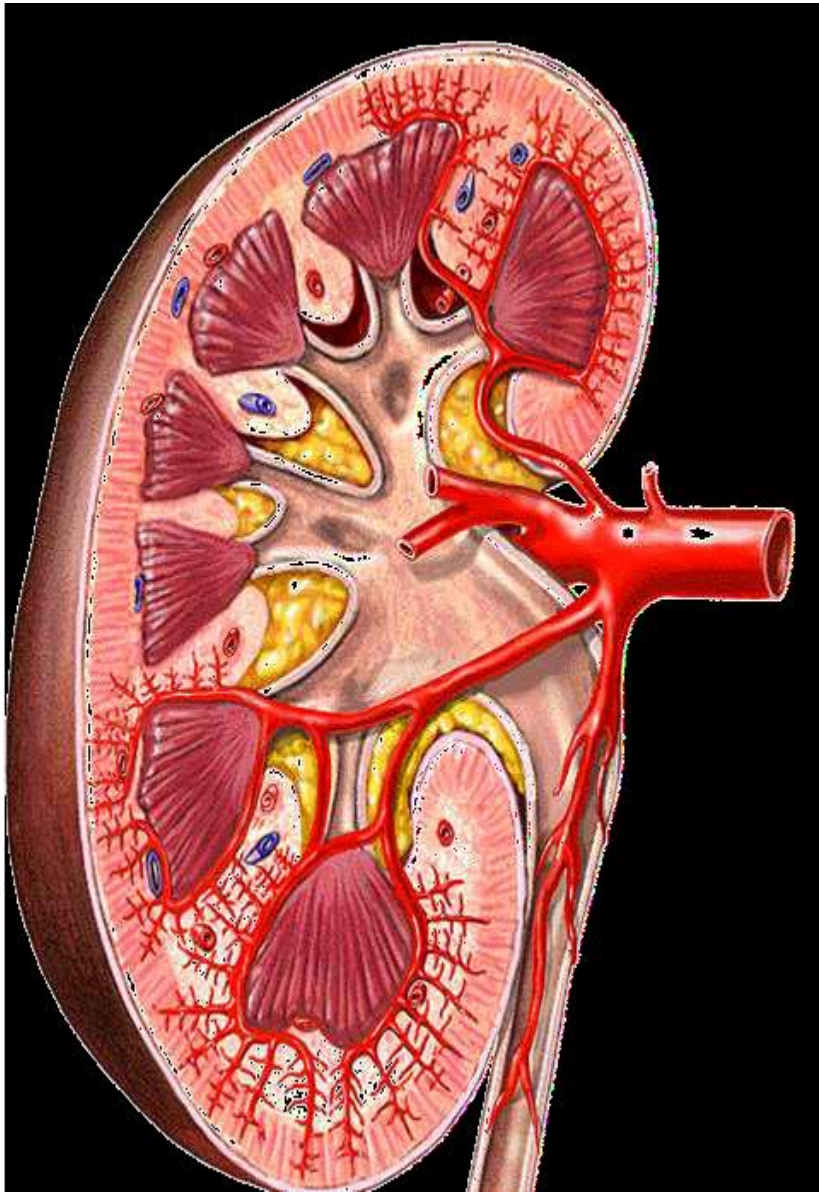


INTERNAL STRUCTURE

- Each kidney consists of an outer **renal cortex and an inner renal medulla.**
- The renal cortex is a continuous band of pale tissue that completely surrounds the renal medulla.
- Extensions of the renal cortex,the **renal columns project into** the inner aspect of the kidney,dividing the renal medulla into discontinuous aggregations of triangular-shaped tissue, the **renal pyramids.**



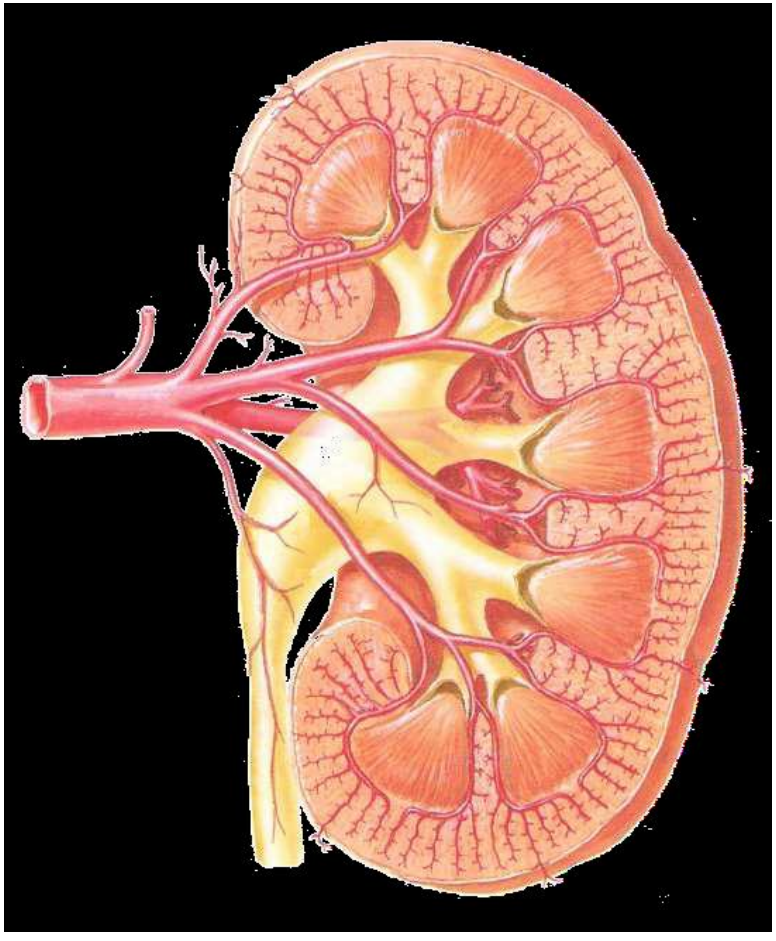
The **bases of the renal** pyramids are directed outward, toward the cortex, while the **apex of each** renal pyramid projects inward, toward the **renal sinus.**



- The apical projection (**renal papilla) is surrounded by a minor calyx**

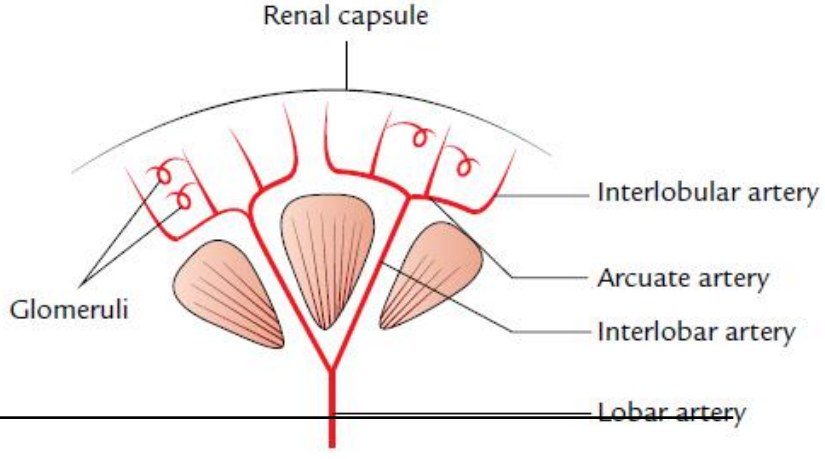
- In the renal sinus, several minor calices unite to form a **major calyx, and two or** three major calices unite to form the **renal pelvis, which** is the funnel-shaped superior end of the ureters

ARTERIAL SUPPLY

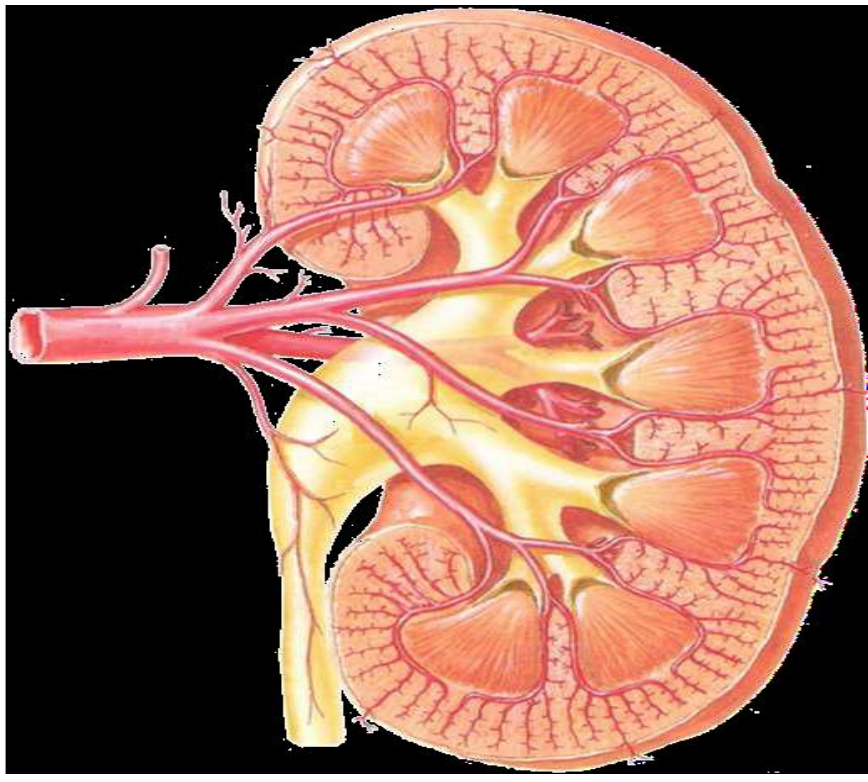


The renal **artery arises from the aorta at the level of the second lumbar vertebra.**

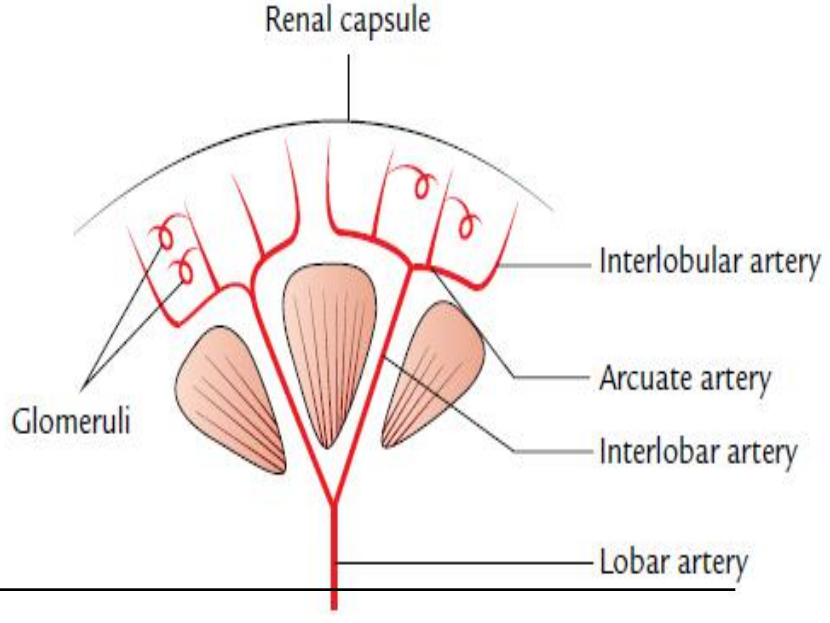
- Each renal artery divides into **5 segmental arteries that enter the hil**um of the kidney, 4 in front of the renal pelvis and one behind it.
- They are distributed to the different **segments of the kidney.**
- Each segmental artery gives rise to number of **lobar arteries, each su**pplies a renal pyramid.
- Before entering the renal substance, each lobar artery gives off two or three **interlobar arteries.**



- The **interlobar arteries** run toward the cortex on each side of the renal pyramid.
- At the junction of the cortex and the medulla, the Interlobar arteries give off the **arcuate arteries, which arch over the b**ases of the pyramids.

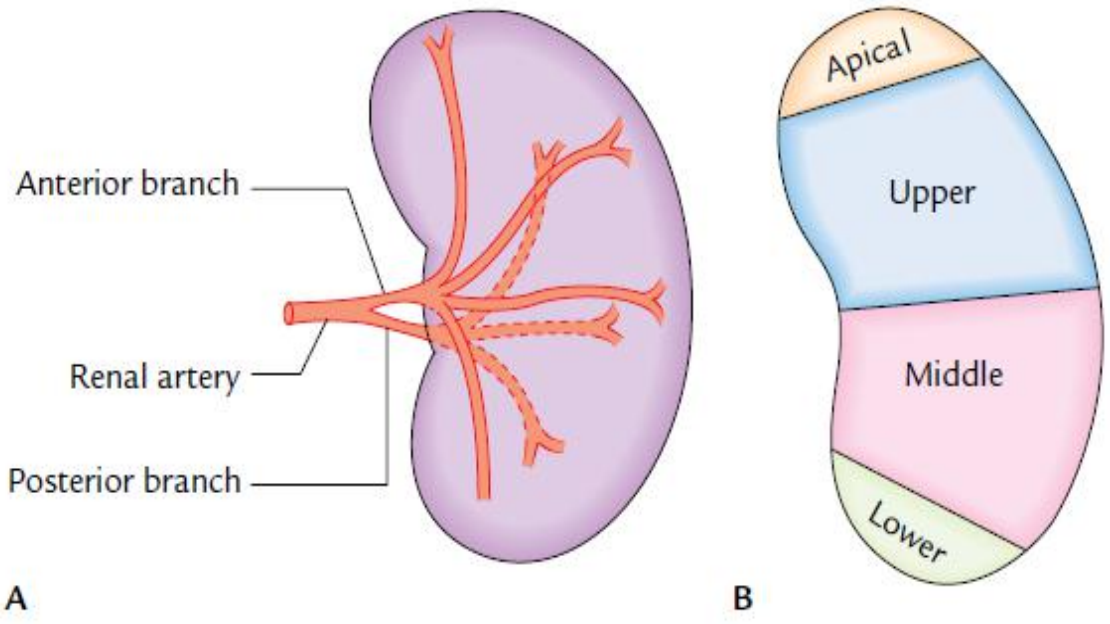


- The arcuate arteries give off several **interlobular arteries that ascend in**the cortex and give off the afferent glomerular arterioles



Segmental branches & vascular segments of kidneys(e.g. Left)

Each kidney has 5 segmental branches and is divided into 5 vascular segments:



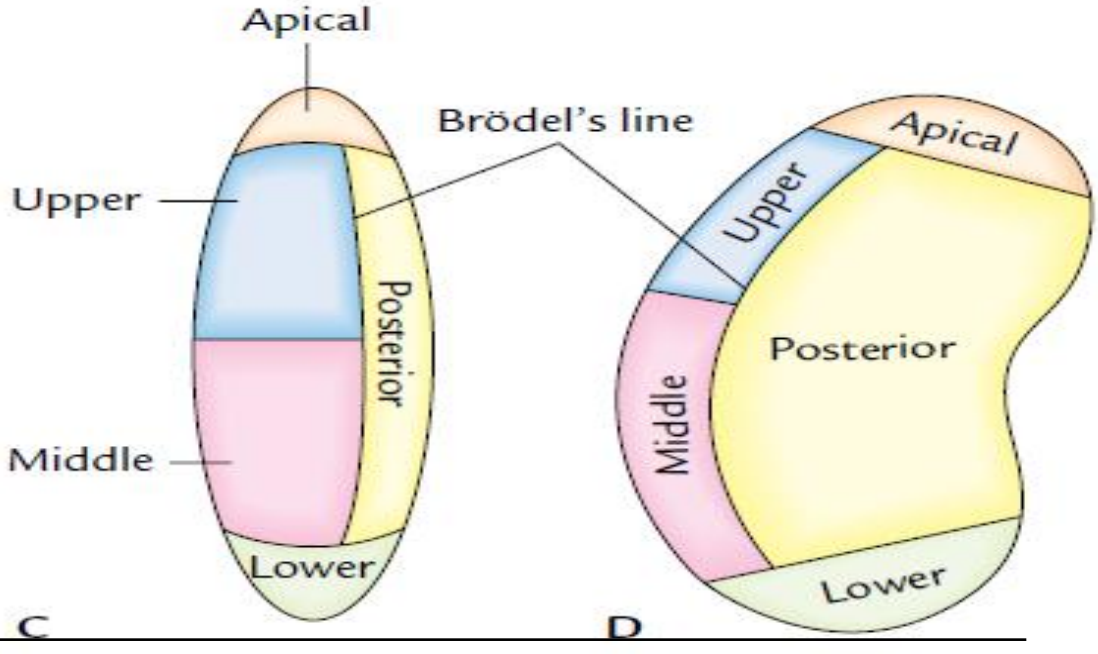
1. Apical.

2. Caudal/Lower

3. Anterior Superior/Upper

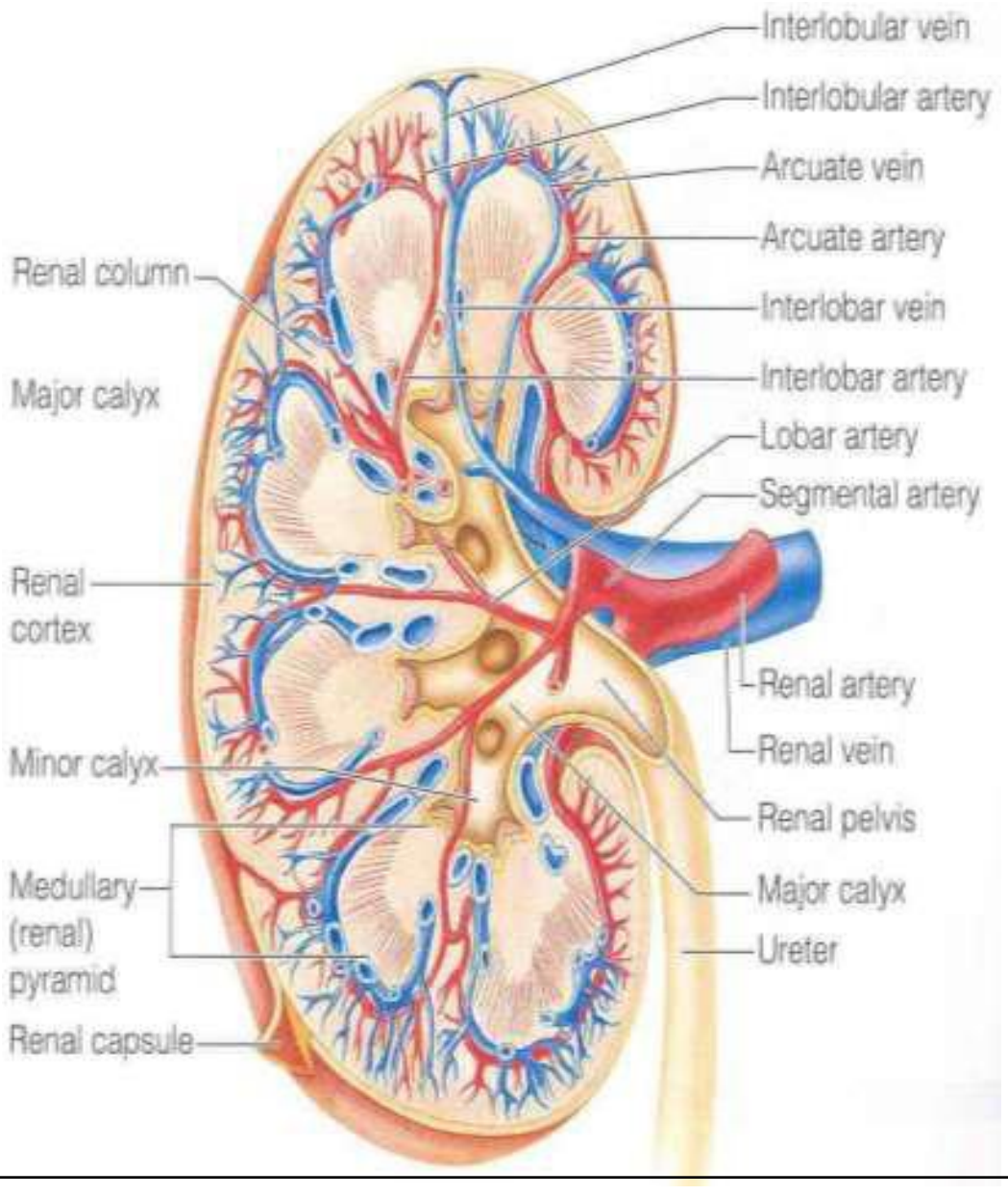
4. Anterior Inferior/Middle

5. Posterior.



BLOOD SUPPLY

Abdominal aorta
- Renal artery
- Segmental arteries
- lobar arteries
- Interlobar arteries
- Arcuate arteries
- Interlobular arteries
- Afferent glomerular arterioles

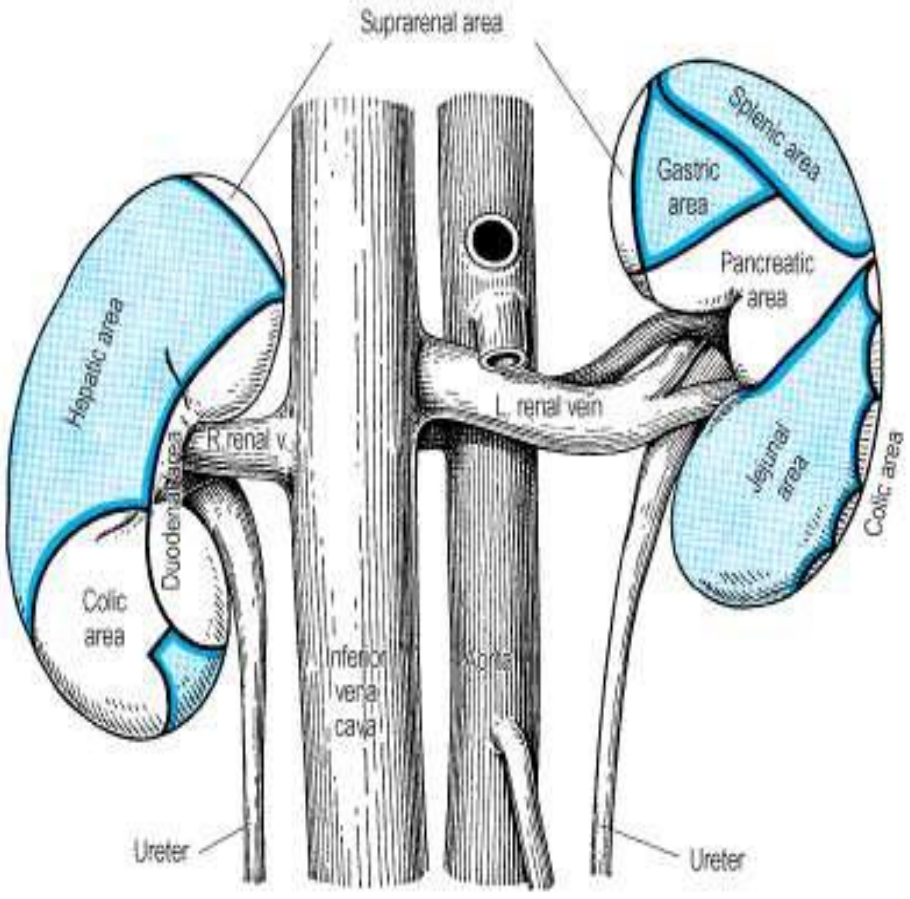


- Inferior vena cava
- Renal vein
- Interlobar veins
- Arcuate veins
- Interlobular veins

Venous Drainage

Both renal veins drain to the inferi or vena cava.

- **The right renal vein is behind the 2nd p art of the duodenum and sometimes** behind the lateral part of the **head of t he pancreas**
- **The left renal vein is three times longer t** han the right (7.5 cm and 2.5 cm).
- ***So, for this reason the left kidney is the pr*** *eferred side for live donor* ***nephrectomy.***
- **It runs from its origin in the renal hilum, posterior to the splenic vein and the bod y of pancreas, and then across the anteri or aspect of the aorta, just below the ori gin of the superior mesenteric artery.**
- The **left gonadal vein enters it from belo** w and the **left suprarenal vein, usually re** ceiving one of the left inferior phrenic vei ns, enters it above but nearer the midline
- The **left renal vein enters the inferior vena** cava a little **above the right vein.**



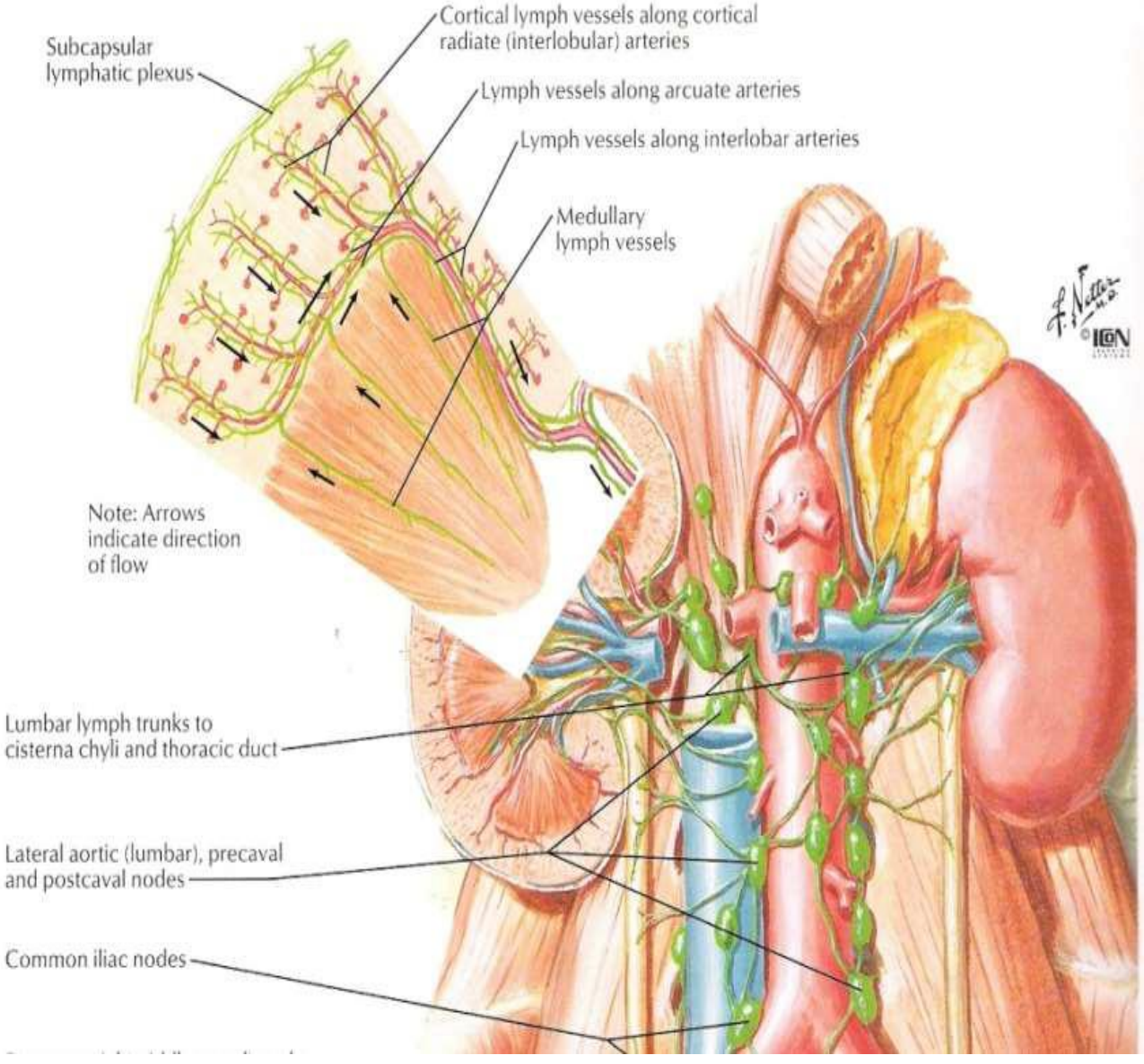
- **The right renal vein is behind the 2nd p art of the duodenum and sometimes** behind the lateral part of the **head of the pancreas.**

Lymphatic Drainage:

- The lymph vessels follow the arteries.
- Lymph drains to the **lateral aortic lymph nodes** around the origin of the renal artery.

Nerve Supply:

The nerve supply is the **renal sympathetic plexus.** **The afferent fib**ers that travel through the renal plexus enter the spinal cord in the 10th, 11th, and 12th thoracic nerves.



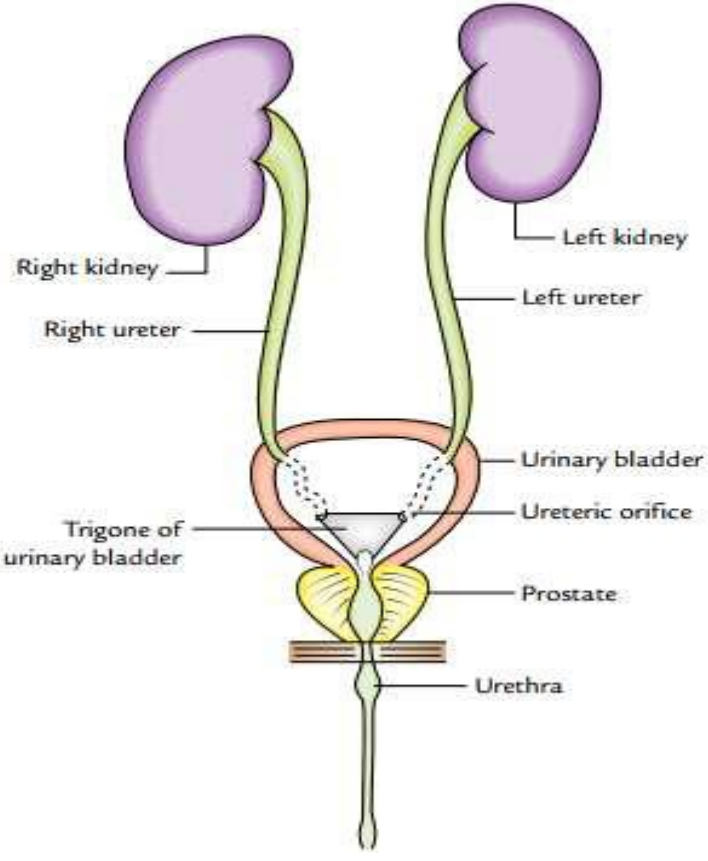
URETER

INTRODUCTION

- The ureter is a narrow, thick walled, expansile muscular tube.

- Conveys urine from the kidney to the urinary bladder.

- The urine is propelled from the kidney to the urinary bladder by the peristaltic contractions of the smooth muscle of the wall of the ureter.

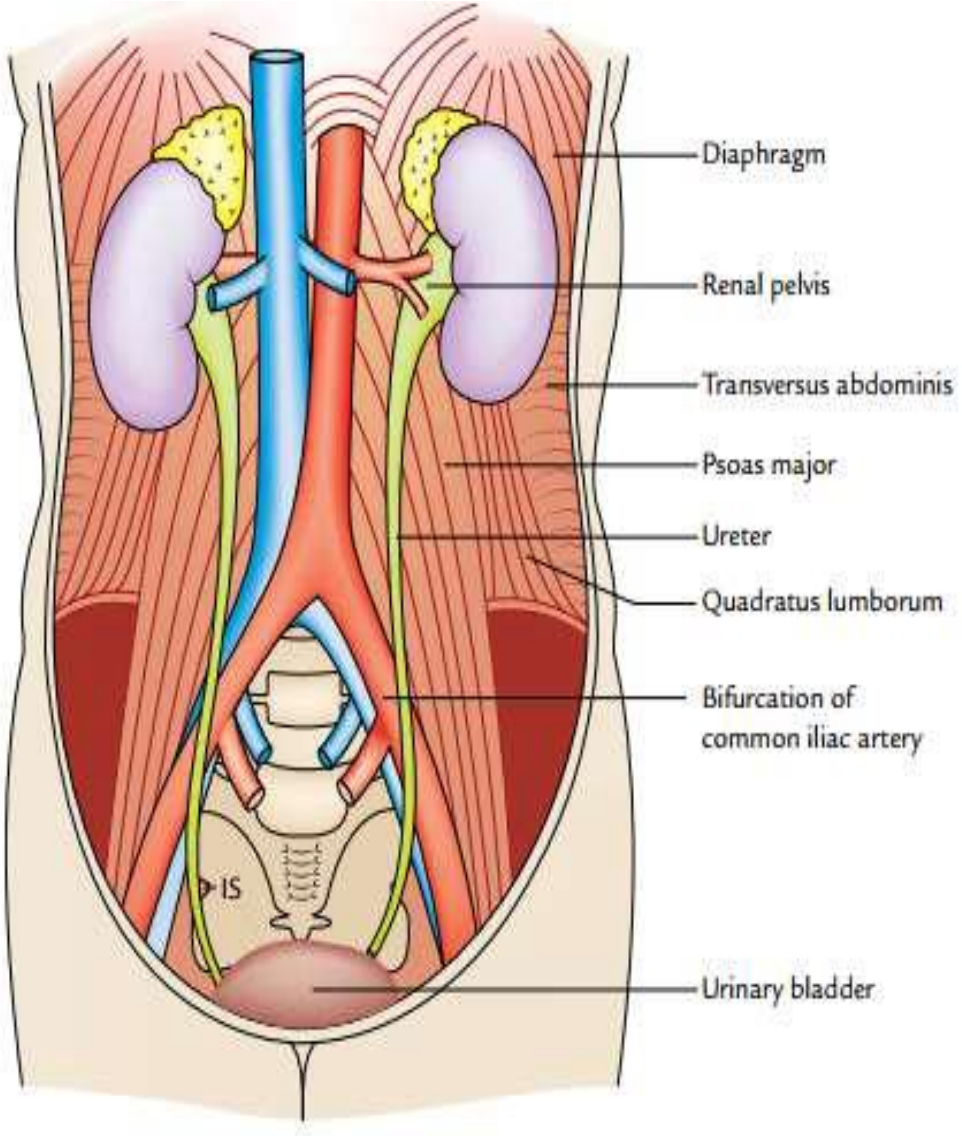


Measurements

- Length: 25 cm (10 inches).
- Diameter: 3 mm.

COURSE IN ABDOMINAL PART

- The ureter begins as a downward continuation of a funnel shaped renal pelvis at the medial margin of the lower end of the kidney.
- The ureter passes downward and slight medially on the psoas major, which separates it from the transverse processes of the lumbar vertebrae.
- Enters the pelvic cavity by crossing in front of the bifurcation of the common iliac artery at the pelvic brim in front of the sacroiliac joint.



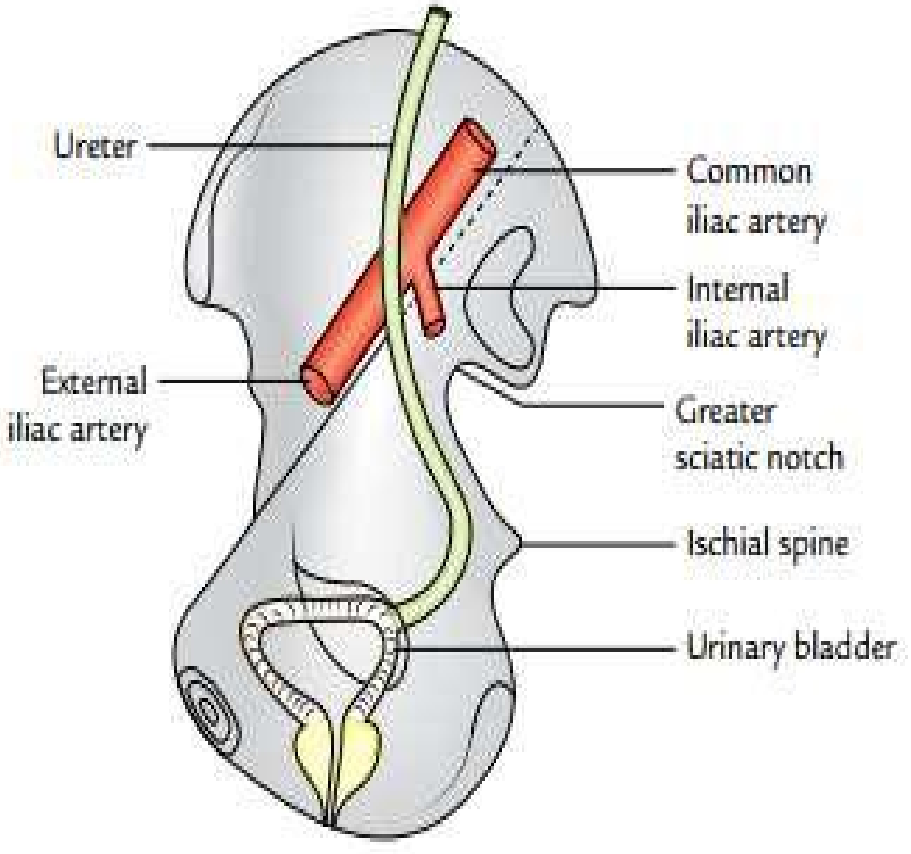
COURSE IN PELVIS

• In the pelvis, the ureter first runs downward, backward, and laterally along the anterior margin of the greater sciatic notch.

• Opposite to the ischial spine, it turns forward and medially to reach the base of the urinary bladder.

• Where it enters the bladder wall obliquely.

• Within the bladder wall, it narrows down,takes a sinuous course, and opens into the cavity of the bladder at the lateral angle of its trigone as ureteric orifice.



PARTS AND RELATIONS

- The ureter is generally divided into two parts: abdominal and pelvic.

- Each part is about the same length, i.e., 12.5 cm (5 inches).

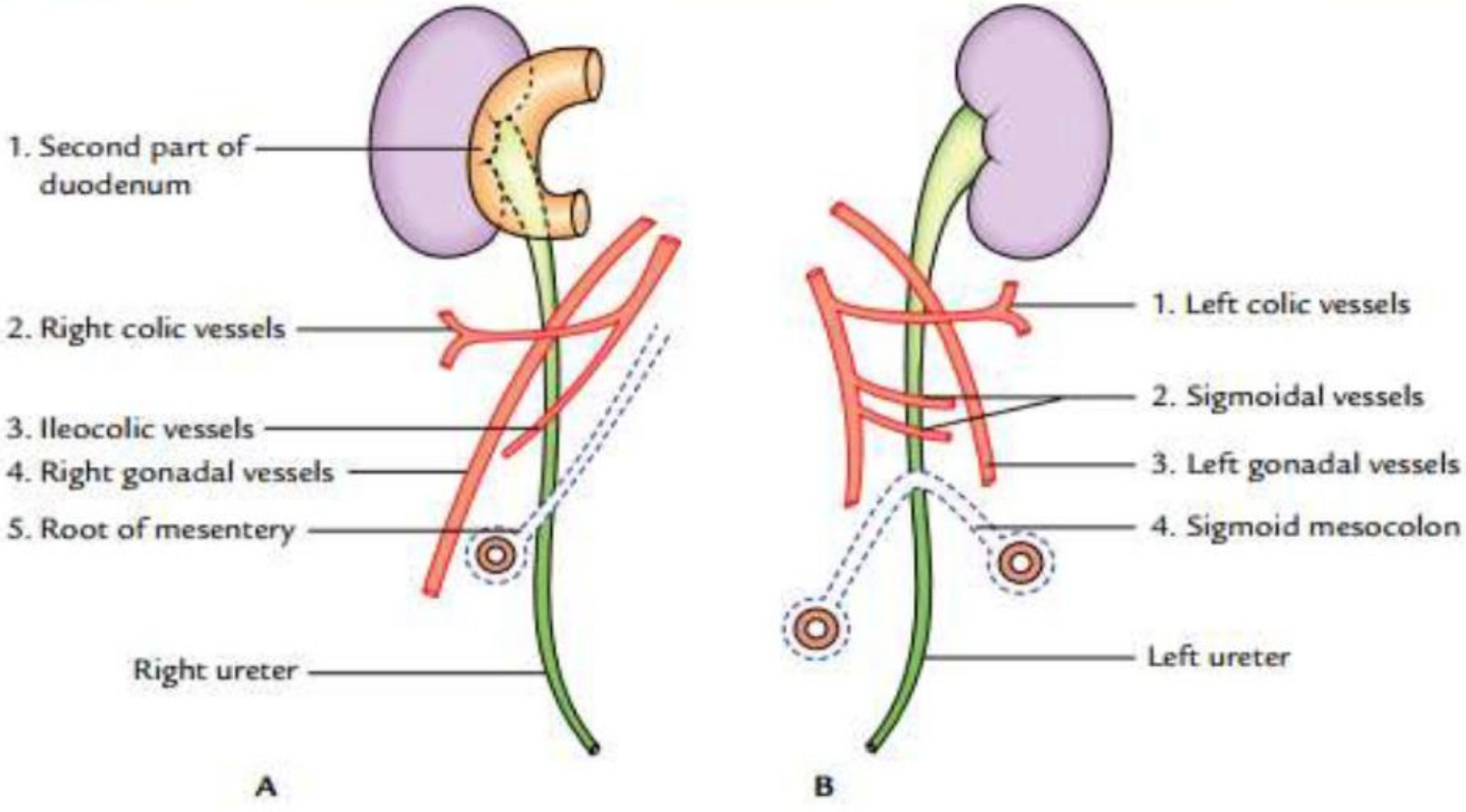
- The abdominal part of ureter extends from the renal pelvis to the bifurcation of the common iliac artery.

- The pelvic part of the ureter extends from the pelvic brim (at the level of bifurcation of the common iliac artery) to the base of the urinary bladder.

RELATIONS OF ABDOMINAL PART

	Anterior relations (Fig. 11.22)	Posterior relations
Right ureter	• Second part of the duodenum • Right colic vessels • Ileocolic vessels • Right testicular or ovarian vessels • Root of mesentery	• Right psoas major • Bifurcation of right common iliac artery
Left ureter	• Left colic vessels • Sigmoidal vessels • Left testicular or ovarian vessels • Sigmoid mesocolon	• Left psoas major • Bifurcation of left common iliac artery

Medially the right ureter is related to inferior vena cava and left ureter is related to left gonadal vein and inferior mesenteric vein.



Anterior relations of the abdominal parts of the ureters: A, right ureter; B, left ureter.

RELATIONS OF PELVIC PART

- The pelvic part of the ureter crosses in front of all the nerves and vessels on the lateral pelvic wall except vas deferens, which crosses in front of it.

- Near the uterine cervix, the uterine artery lies above and in front of it, a highly important surgical relationship.

SITES OF ANATOMICAL NARROWINGS/CONSTRICTIONS

The lumen of the ureter is not uniform throughout and presents three constrictions at the following sites.

1. At the pelviureteric junction where the renal pelvis joins the upper end of ureter. It is the upper most constriction, found approximately 5 cm away from the hilum of kidney.

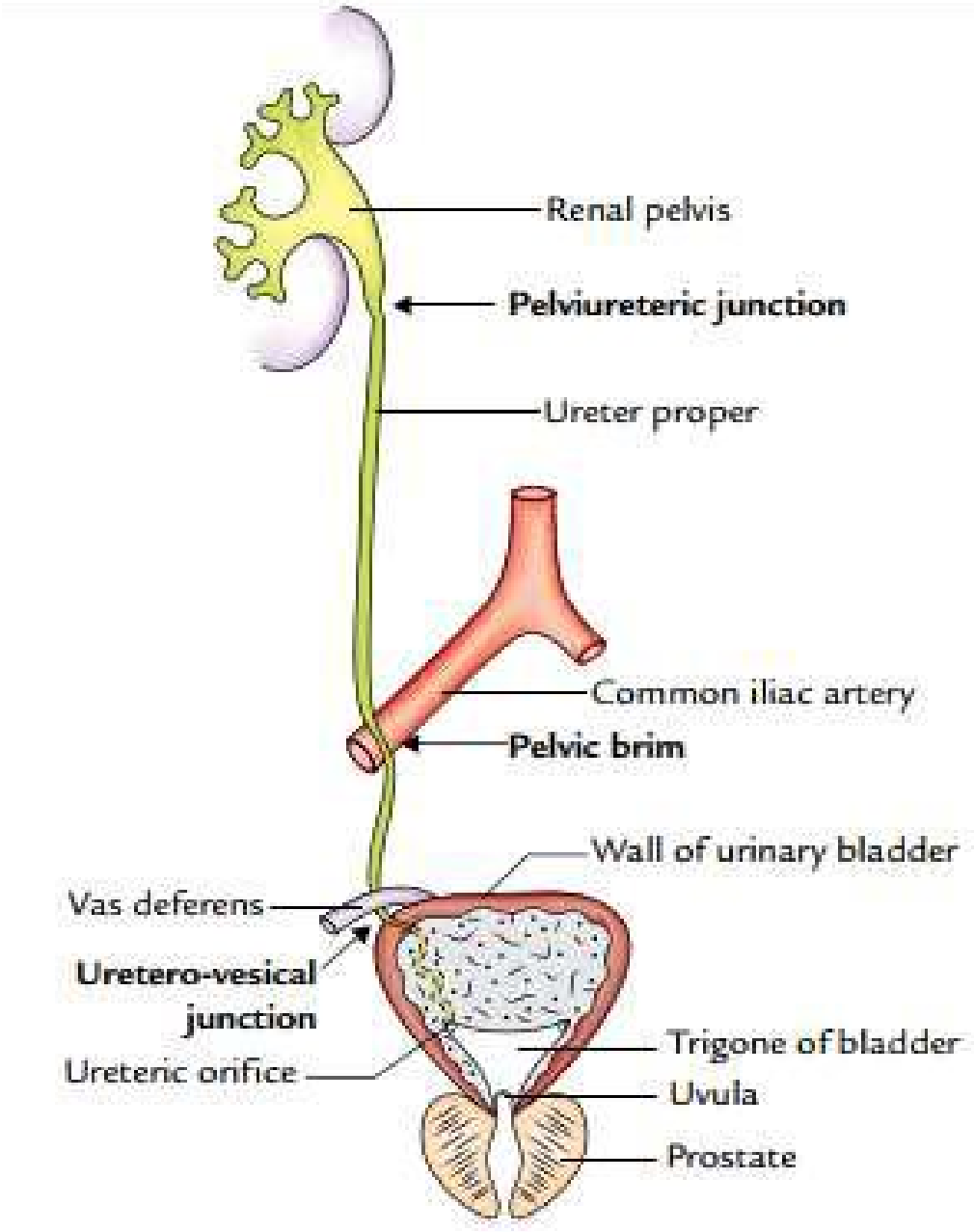
2. At the pelvic brim where it crosses the common iliac artery.

3. At the uretero-vesical junction (i.e., where ureter enters into thebladder).

• In addition to above three sites of constrictions, two more sites of constrictions are described by the surgeons.

1. At juxtaposition of the vas deferens/broad ligament.

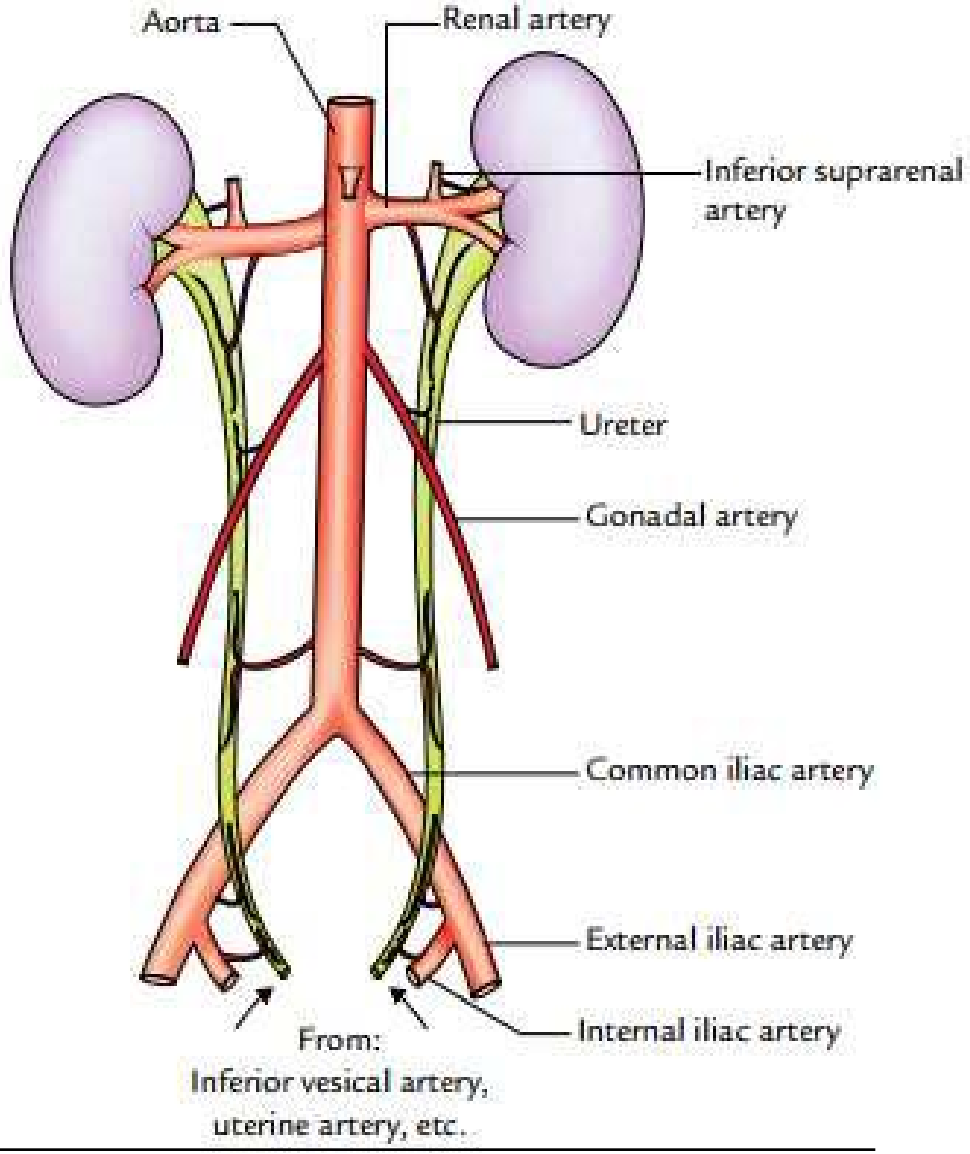
2. At the ureteric orifice.



ARTERIAL SUPPLY

• The ureter derives its arterial supply from the branches of all the arteries related to it. The important arteries supplying ureter from above downward are:

1. Renal.
2. Testicular or ovarian.
3. Direct branches from aorta.
4. Internal iliac.
5. Vesical (superior and inferior).
6. Middle rectal.
7. Uterine.



- **VENOUS DRAINAGE**

The venous blood from the ureter is drained into the veins corresponding to the arteries.

- **LYMPHATIC DRAINAGE**

The lymph from the ureter is drained into lateral aortic and iliac nodes.

- **NERVE SUPPLY**

1. The sympathetic supply of the ureter is derived from T12–L1 spinal segments through renal, aortic, and hypogastric plexuses.

2. The parasympathetic supply of ureter is derived from S2–S4 spinalsegments through pelvic splanchnic nerves.

Clinical correlation

- **Mobilization of ureter**: Branches of the arteries supplying the ureter form an anastomosis in the fat and fascia around the ureter. Therefore, surgeons should bear in their mind that stripping off this fascia, while mobilizing the ureter for transplantation, will hamper the blood supply of the ureter and may cause its necrosis.

- **Identification of ureter**: Ureter is a muscular structure, and in life waves of muscular contractions produce a worm-like rhythmic movement (peristalsis) thus milking urine toward the bladder. The ureter is readily identified in life by its thick muscular wall which is seen to undergo worm-like writhing movements, especially when it is gently stroked or Squeezed.

Clinical correlation

- **Ureteric calculus** is likely to lodge at one of the sites of anatomical narrowings of the ureter particularly:

(a) At the pelvic ureteric junction.
(b) Where it crosses the pelvic brim.
(c) In the intramural part—the narrowest part.

- **Injury to ureters**: According to Kenson and Hinman, the ureter may be injured at one of the following four dangerous sites:

(a) Point where the ureter crosses the iliac vessels.
(b) In the ovarian fossa.
(c) Where the ureter is crossed by the uterine artery (most dangerous site) as damage is likely at this site during hysterectomy.
(d) At the base of the bladder.

THE ADRENAL GLAND(SUPRARENAL GLAND)

Position and location

- The adrenal glands located on the upper poles of each kidney on the right and left sides.

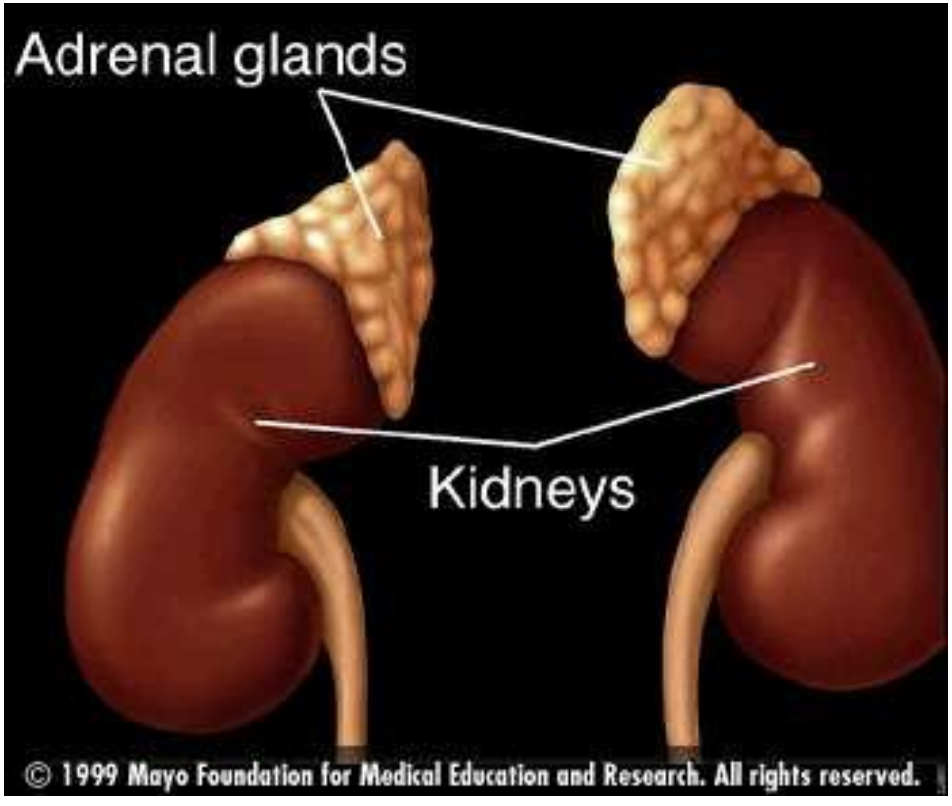
-They are covered by peritoneum on the posterior abdominal wall they are embeddedinto pre renal fat.

- The left one is larger and higher than the right

Location:

Rest superiorly to kidneys

Hormones Produced:
~30 steroid hormones!



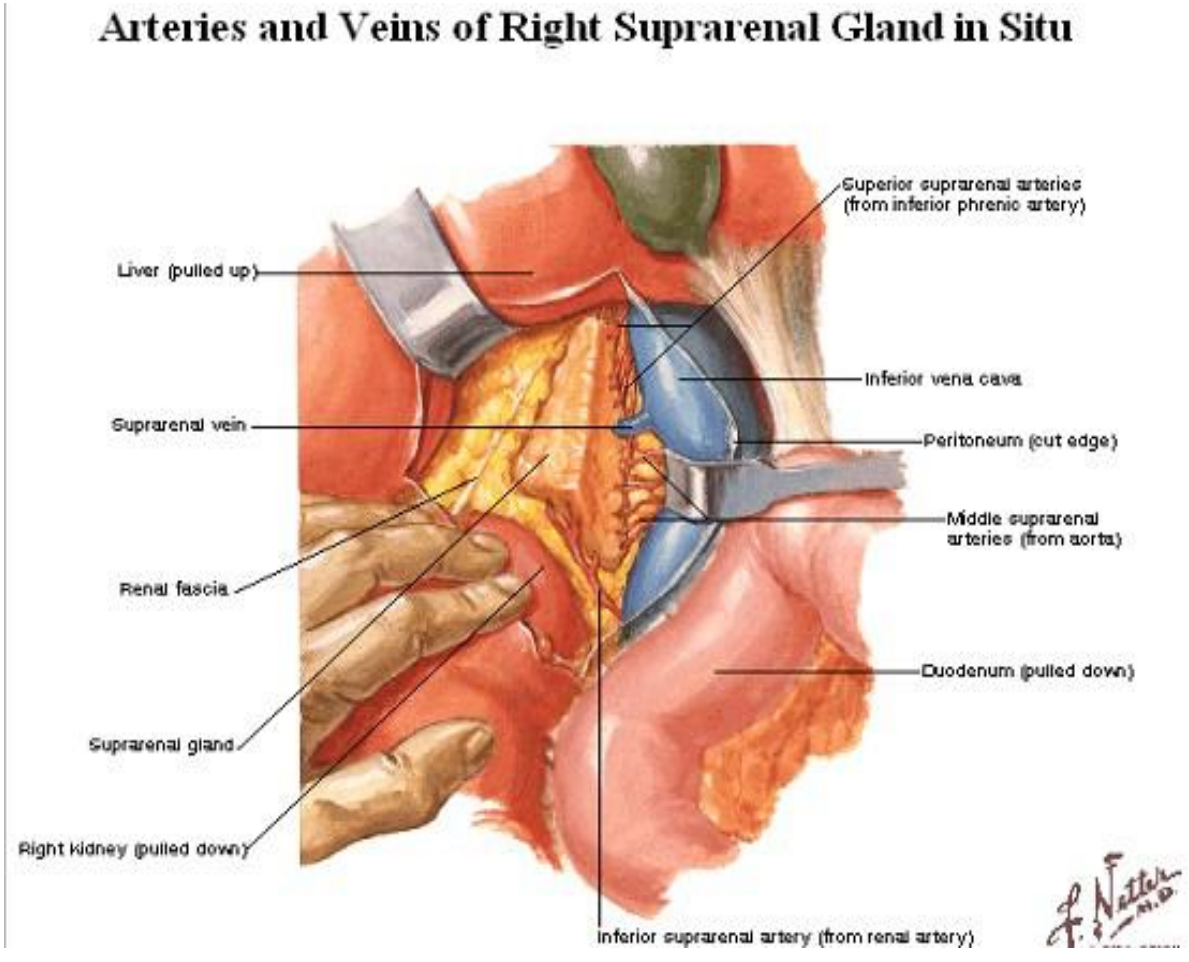
The right adrenal gland

-It is triangular in shape located on the upper pole of the right kidney behind the inferior vena cava.

-It is related anterior to the inferior vena cava and the right lobe of the liver.

-Posterior it is related to the right crus of diaphragm

The right adrenal gland



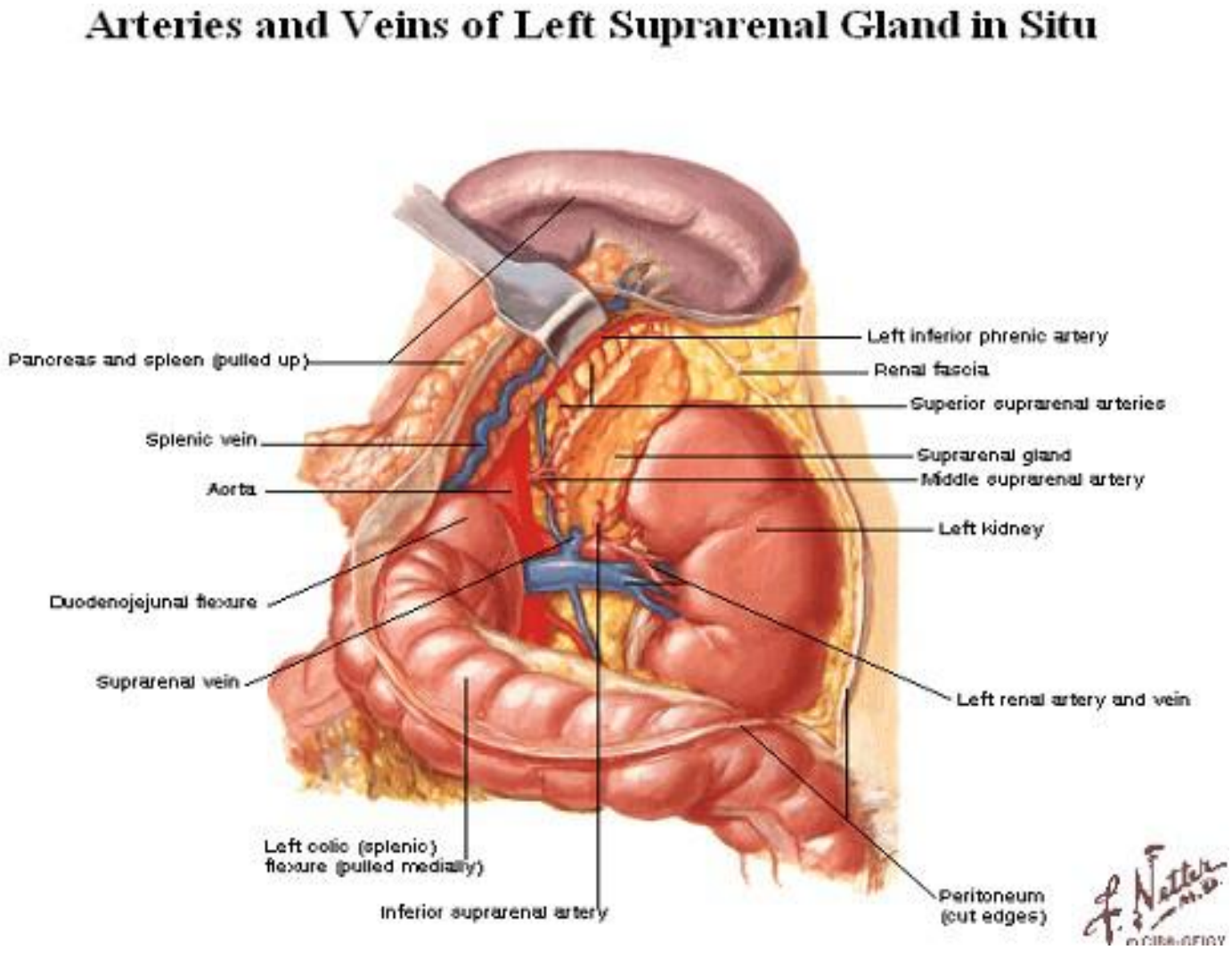
The left adrenal gland

-It is crescent in shape located on the upper pole of the left kidney behind the stomach

-Anterior it is related to the stomach, the tail of pancreas and the lesser sac

- Posterior it is related to the left crus of diaphragm

Relation of the left gland



The blood supply

Each adrenal gland supply by three arteries superior ,middle and inferior supra renal arteries.

The **superior supra renal artery** branch from **inferior phrenic artery** which is branch from the aorta, the middle supra renal artery branch from the aorta and the inferior supra renal artery branch from the renal artery

The **venous drainage** by the supra renal vein on the **right** side at the inferior vena cava and on the **left** side at **the left renal vein**

Structure of adrenal gland

--The adrenal gland formed of outer cortex which is yellow forming the main mass of the gland
and inner medulla completely enclosed by the cortex except at the hilum the gland enclosed by capsule of connective tissue.

-The cortex has mesoderm development while the medulla developed from the neural crest

The cortex and capsule