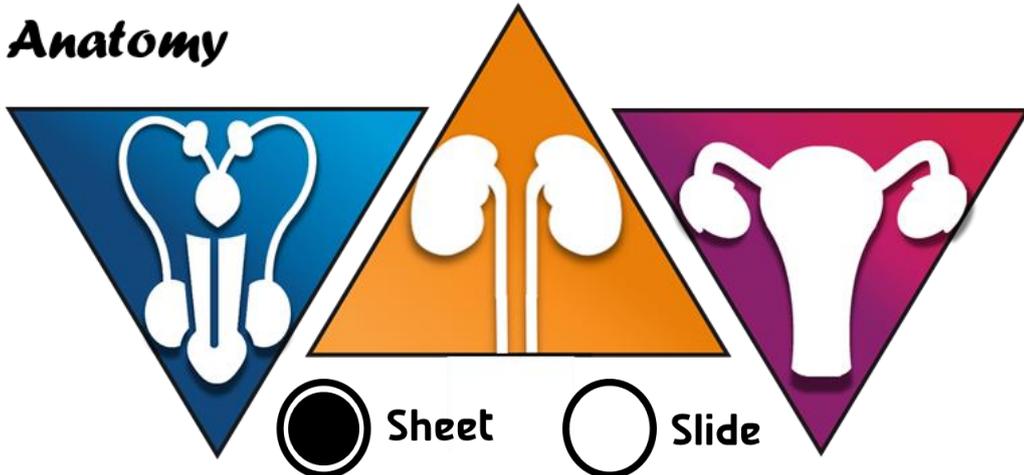




# Urogenital system

## Anatomy



**Number:**

- 3

**Done by:**

- Shahd Alqudah

**Corrected by:**

- Sohayyla Y.Dababseh

**Doctor:**

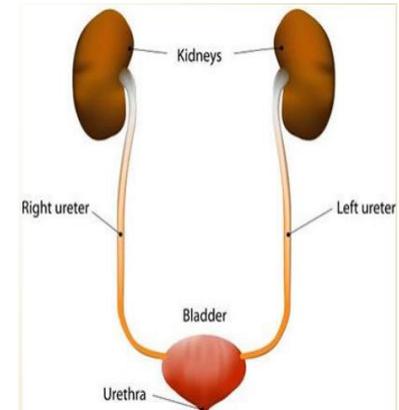
- Ahmad Salman

## Urinary System

The urinary system is composed of two kidneys, two ureters, urinary bladder and urethra.

The main functions are:

- ✓ Excrete most of the waste products of metabolism.
- ✓ Control the water and electrolyte balance within the body.
- ✓ Maintain the acid–base balance of the blood.

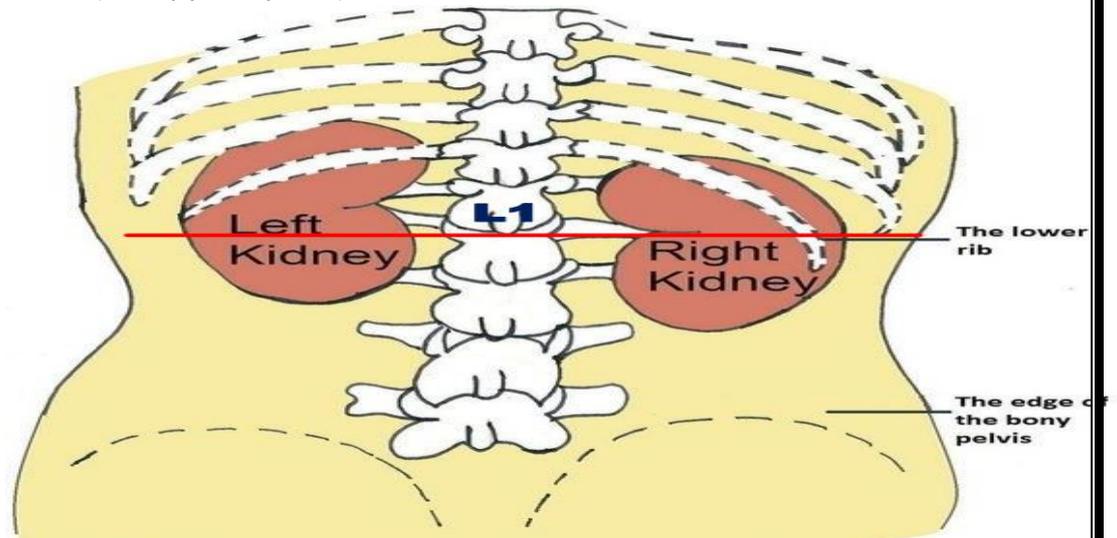


### Kidneys

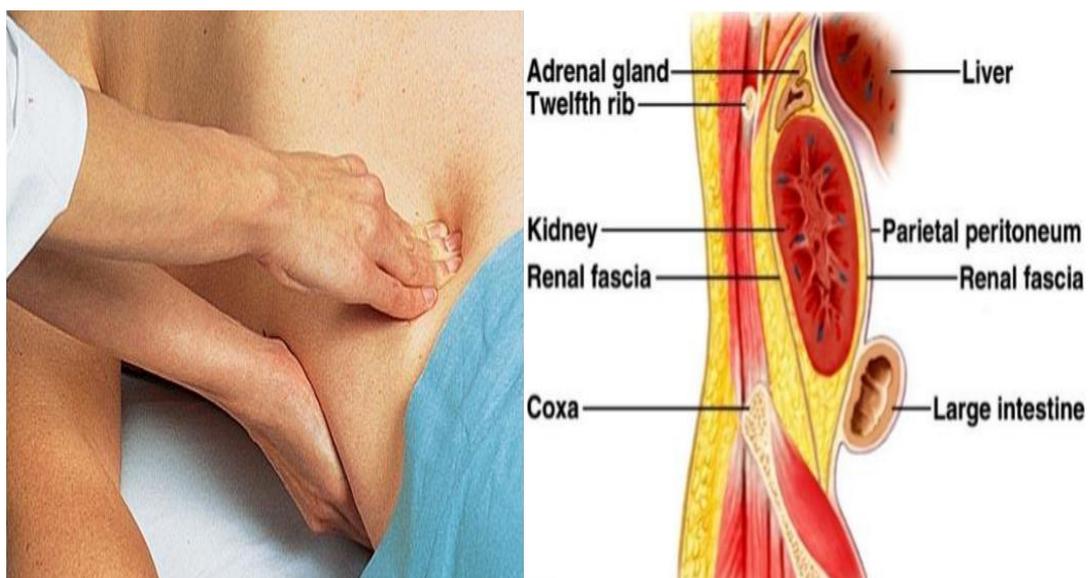
Location:

- ✓ The kidneys are retroperitoneal organs, located on the posterior abdominal wall.
- ✓ They are located at paravertebral gutters opposite to T12, L1, L2, L3 vertebrae.
- ✓ The right kidney is about 1.25 cm lower than the left because of the large size of the right lobe of the liver which pushes the right kidney down a bit. And based on that:
  - The upper pole of the right kidney reaches the **12th rib** and that of left kidney reaches **11th rib**.
  - The hilum of right kidney is just below transpyloric plane (L1), and that of the left kidney is just above it. [the prof mentioned that the hilum of the right kidney is at the level of L1 not

below (transpyloric plane)]



- ✓ Kidneys can be palpated in thin people, by pressing between **12<sup>th</sup> rib (the last rib) and iliac crest (posteriorly)** and below **costal margin (anteriorly)**



General Features of the Kidneys: The kidney has:

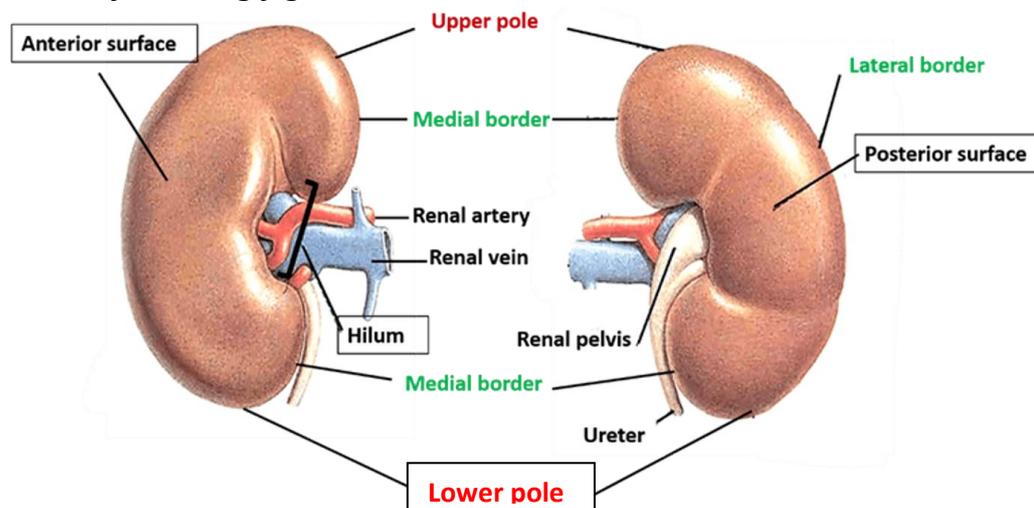
- ✓ **Two poles (upper and lower)** the upper pole is nearer to the midline than the lower pole. The inferior pole of right kidney is about one finger breadth above iliac crest
- ✓ **Two borders (lateral and medial)**. The lateral border is smooth and convex the medial is concave and presents a **hilum** at its middle.

-The hilum leads to a space within the kidney, called the sinus of the kidney. The structures that pass through the hilum are renal vein, renal artery, and renal pelvis. **The renal vein is most anterior and renal pelvis is most posterior.** (In the class, the doctor said ureter instead of renal pelvis, but it's not a big deal since the renal pelvis joins the ureter at the level of L2)

- Note: The arrangement of the structures in the hilum is essential to put the kidney in its anatomical position and to determine if it's the right or the left one.

✓ **Two surfaces (anterior and posterior).**

- *The following figure illustrates it all.*



\***Coverings of the kidney:** From the cortex outwards

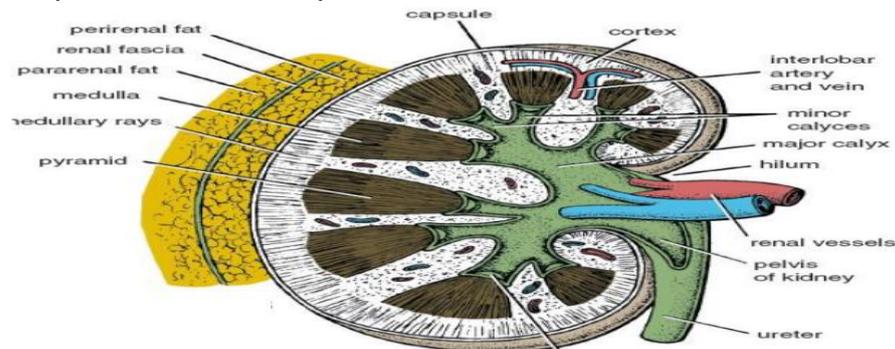
- 1- Fibrous capsule: (like any other organ); it surrounds the kidney all around.
- 2- The perirenal fat: This covers the fibrous capsule and surrounds the kidney all around.
- 3- Renal fascia: it is formed of 2 layers which cover the front and back of the kidneys.

→The renal fascia is continuous with:

- Fascia transversalis, laterally.
- The fascia around the renal vessels, aorta and IVC, medially.
- The diaphragmatic fascia -after forming a separate compartment for the suprarenal gland- superiorly
- And inferiorly it remains separate in front and back of the ureter (the two layers of renal fascia don't fuse inferiorly, thus

a contact with the pelvis exists through the inferior side, therefore pus and hematoma will find their way to the pelvic cavity from this opening).

- 4- The Pararenal fat: outside the renal fascia, most condensed posterior to the kidney. So, the renal fascia is sandwiched between the perirenal fat and pararenal fat.



→ Supporting factors of the kidney: The kidney is kept in situ by

- i. Adjacent organs
- ii. Renal Blood vessels and ureters. (they work as cords that sew the kidney in its place)
- iii. Abdominal pressure
- iv. Perirenal fat
- v. Renal Fascia
- vi. Pararenal fat

\*\* The professor started the lecture with a question about rapid weight loss and whether the kidneys will be affected or not!

And the answer is yes, as you can see the kidney is covered and supported by layers of fat, so in case of rapid weight loss, these layers might be absorbed resulting in what's called **Nephroptosis**. In nephroptosis; the kidney drops down into the pelvis when the patient stands up causing intermittent pain in the renal region (flank pain), relieved by lying down. This pain is a result of traction of the renal vessels.

**Clinical notes:**

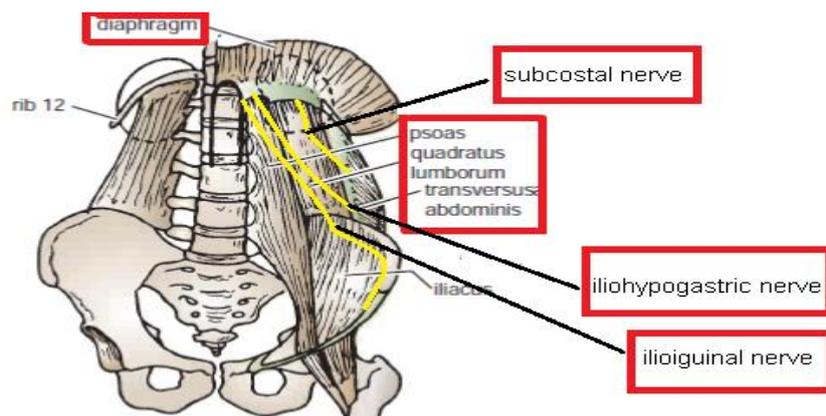
1. Kidneys Transplantation: the iliac fossa of the greater pelvis is the usual location chosen for transplantation of the kidney, due to lack of inferior support for the kidneys in the lumbar region (the normal location of the kidney).
2. Perinephric Abscess (pus around the kidney):

- Pus from an abscess (or blood from an injured kidney) may spread into the pelvis between the loosely attached anterior and posterior layers of the renal fascia. (As mentioned earlier, the renal fascia is open inferiorly).
- The attachments of the renal fascia to the renal vessels and ureter, usually preventing the spread of pus to the contralateral side.

**Relation of the Kidneys**

**Posterior relations;** are nearly similar for both kidneys

- 1- Four muscles; diaphragm (superiorly), psoas major, quadratus lumborum and transversus abdominis (ordered from medial to lateral).
- 2- Four neurovascular structures; subcostal vessels, and subcostal, iliohypogastric, and ilioinguinal nerves.
- 3- Pleura and ribs, the diaphragm separates the upper part of each kidney from the *costodiaphragmatic recess* of the pleura and 12th rib on right side and 11th and 12th ribs on left side.

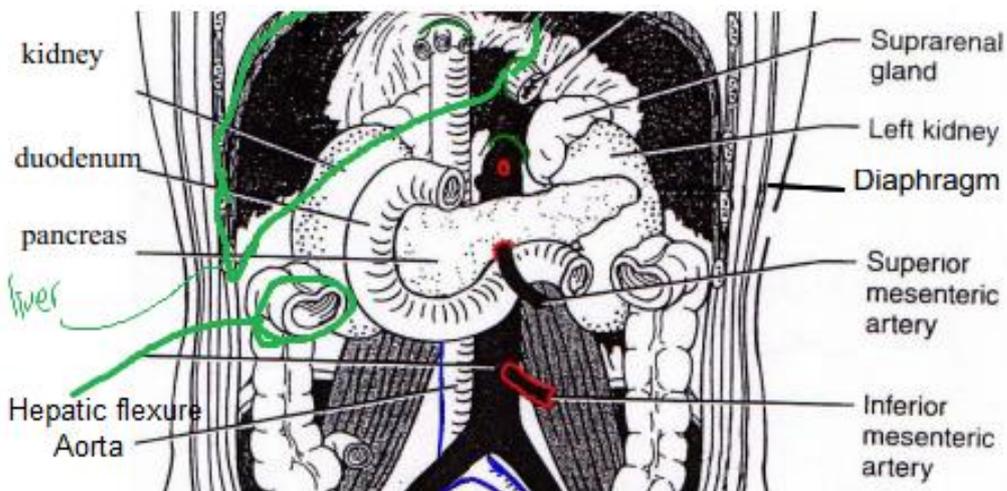
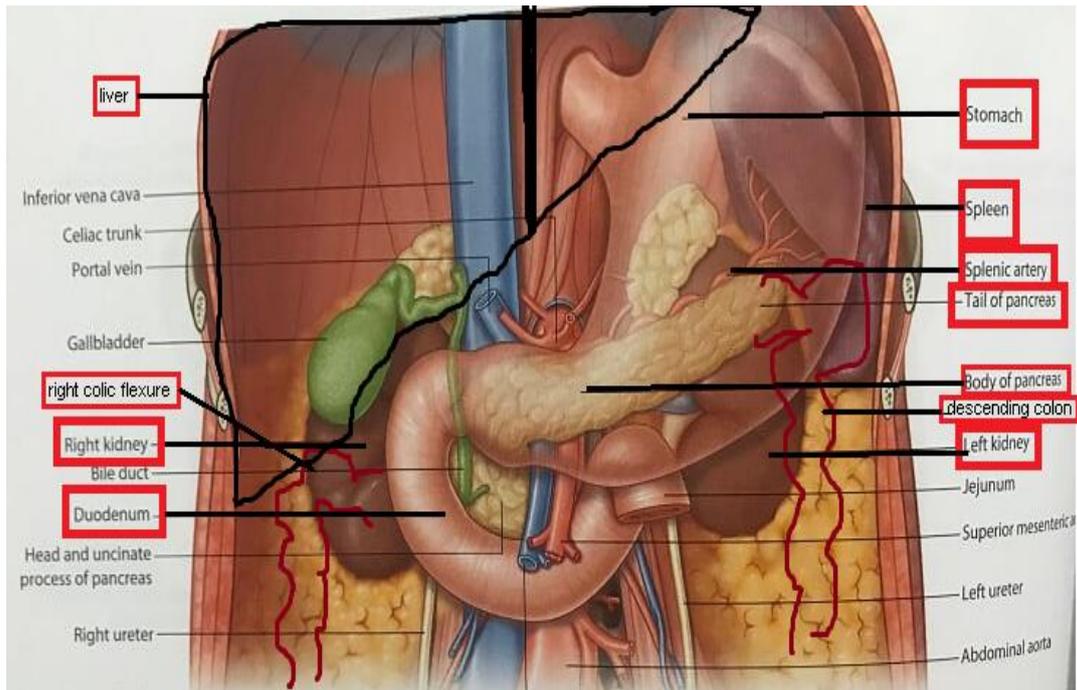


Pleura Injury: During Renal surgical operations due to the close relation between costodiaphragmatic recess of the pleura and upper pole of the kidney; any incidental incision in the pleura will cause pneumothorax.

**Anterior relations**

<b>Right Kidney</b>	<b>Left Kidney</b>
Right suprarenal gland	Left suprarenal gland.
Second part of duodenum.	Spleen with lienorenal ligament, Body of pancreas with splenic vessels.

Right lobe of liver (with <b>hepatorenal pouch</b> in-between).	Posterior surface of stomach ( <b>with lesser sac</b> in-between)
Right colic flexure (hepatic flexure).	Descending colon.
Coils of the small intestine.	Coils of the small intestine.
Ascending branch of right colic artery.	Ascending branch of left colic artery.



Notes:

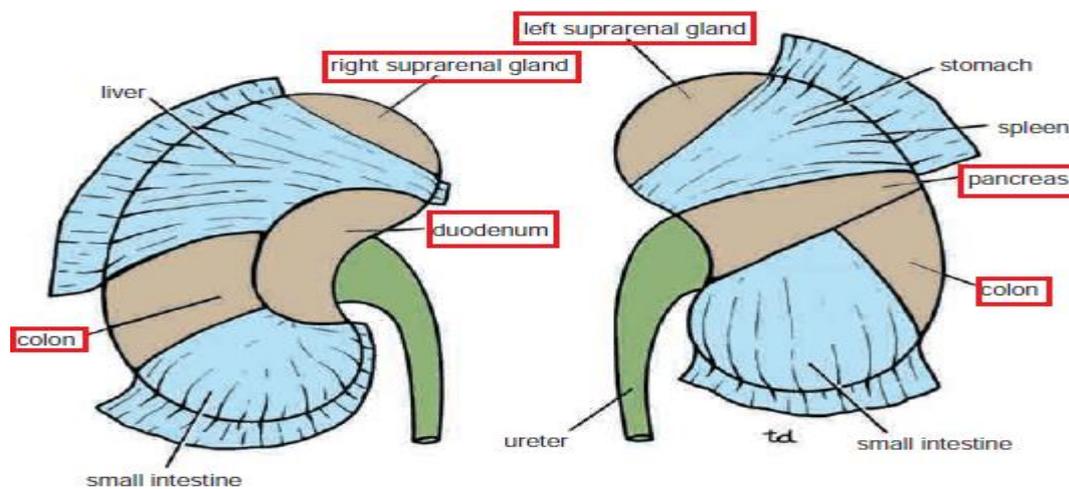
- Left kidney and stomach as well as right kidney and liver are not in a direct contact. There are two pouches separating them; the lesser sac and hepatorenal pouch, respectively.

- Branches of right and left colic arteries are in relation with kidneys not the colic arteries themselves.
- Coils of small intestine aren't shown in the figures above.

Peritoneal covering of the kidney:

-Kidneys are retroperitoneal organs, i.e. only their anterior surfaces are covered by peritoneum. However, on the anterior surface of each kidney; there are 3 small areas that are not covered by peritoneum, they're in direct contact with the posterior surfaces of other retroperitoneal structures (their post. surfaces are not covered by peritoneum) –These areas are called **bare areas**.

Bare areas on right kidney	Bare areas on left kidney
Suprarenal area	Suprarenal area
Duodenal area	Pancreatic area
Colic area (hepatic flexure)	Colic area (descending colon)



**A clinical case:** The E-learning question

Bushra, 25 years old married female, complaining of severe renal colic. X-ray and ultrasonography revealed stag horn renal stone.

- 1- What are the structures that may be cut off during surgical removal of this stone?

2- After the operation her husband asked the doctor when she can drink and eat.

In order to answer the first question you need to know that the operation will be performed through the posterior abdominal wall. So, some of the structures that are posteriorly related to the kidneys will be cut off such as psoas major and quadratus lumborum muscles. The transversus abdominis muscle is far lateral so it's unlikely to be cut.

And In order to answer the second question you need to know that the operation will be performed within the retroperitoneal space (away from the peritoneum) so paralytic ileus is unlikely to happen. So, once she recovers from the anaesthesia (to avoid vomiting and aspiration of food particles) she can eat and drink (after 2-6 hrs).

-Paralytic ileus: A temporary paralysis of a portion of the intestines occurs typically after abdominal surgery due to the incision of peritoneum. Since the intestinal content of this portion is unable to move forward, food or drink should be avoided until peristaltic sound is heard by auscultation (use of a stethoscope) of the area where this portion lies or when defecation occurs.

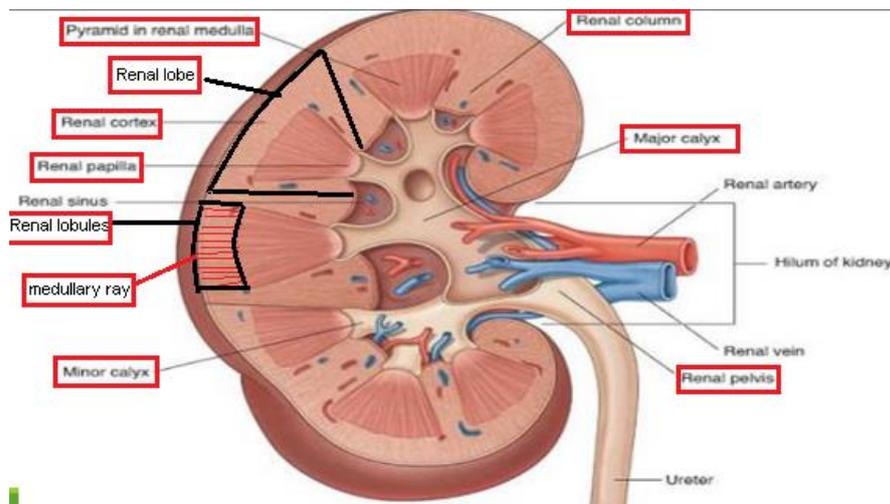
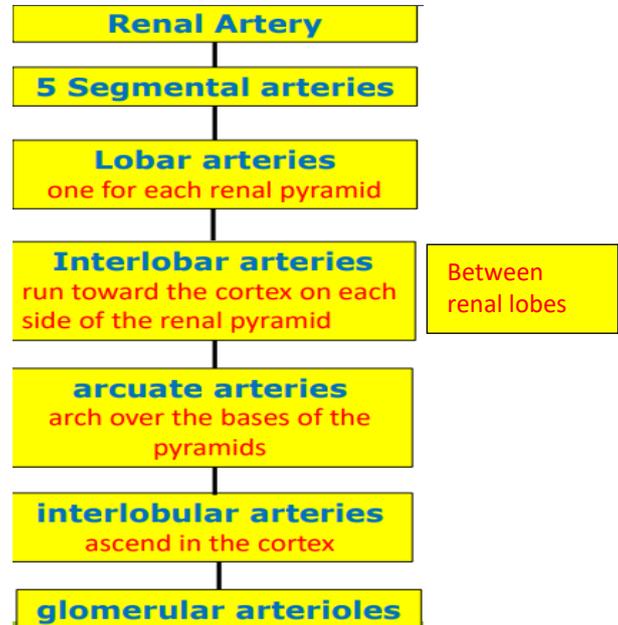


### Structure of the kidney:

The Kidneys has two zones (outer cortex and inner medulla) surrounding sinus of the kidney.

- 1- Cortex; pale and adjacent to the capsule. It is divided into; Cortical arches -which form caps over the bases of the medullary pyramids- and renal columns.
- 2- Medulla; is darker and deep to the cortex.
  - ✓ It is formed of 7-14 pyramids.
  - ✓ Each pyramid has a base directed towards the cortex and an apex called renal papilla.
  - ✓ The part of cortex **between** the medullary pyramids is called renal columns.

- ✓ Each pyramid with its cap of cortex form a lobe of the kidney ( in each kidney there are 7-14 lobes)
- ✓ The medullary ray is the middle part of the cortical lobule or renal lobule, consisting of a group of straight tubes connected to the collecting ducts. Their name is potentially misleading — the "medullary" refers to their destination, not their location.
- ✓ A cortical **lobule** (or **renal lobule**) is a part of a **renal lobe** over the base of the pyramid. It consists of the nephrons grouped around a single medullary ray, and draining into a single collecting duct.

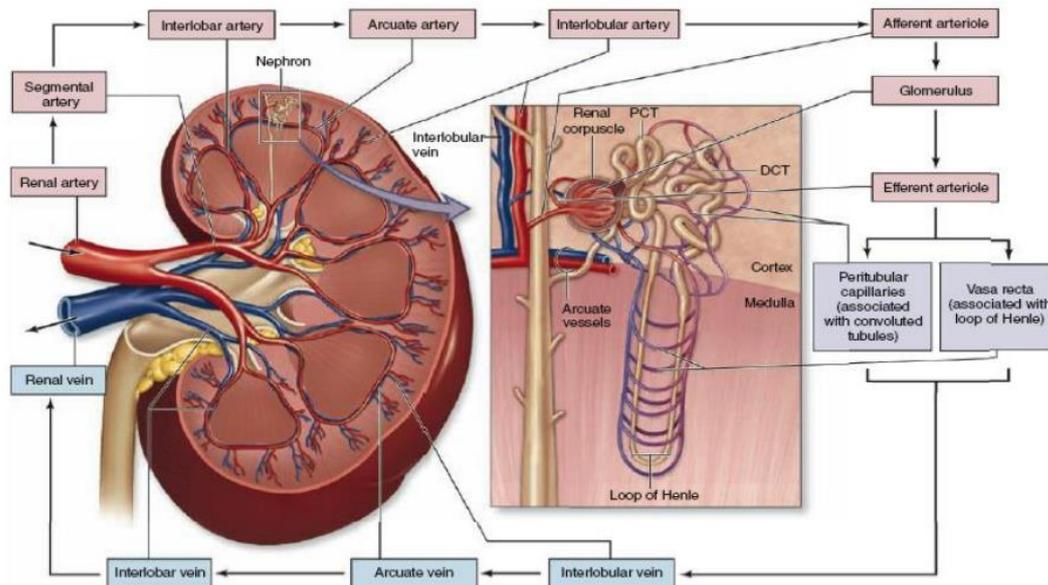


- The minor calyces are about 5-12 per kidney. Each is a short funnel like tube which receives renal papillae.
- The minor calyces unite to form 2-3 major calyces (in each kidney) and these in turn, unite to form the renal pelvis.

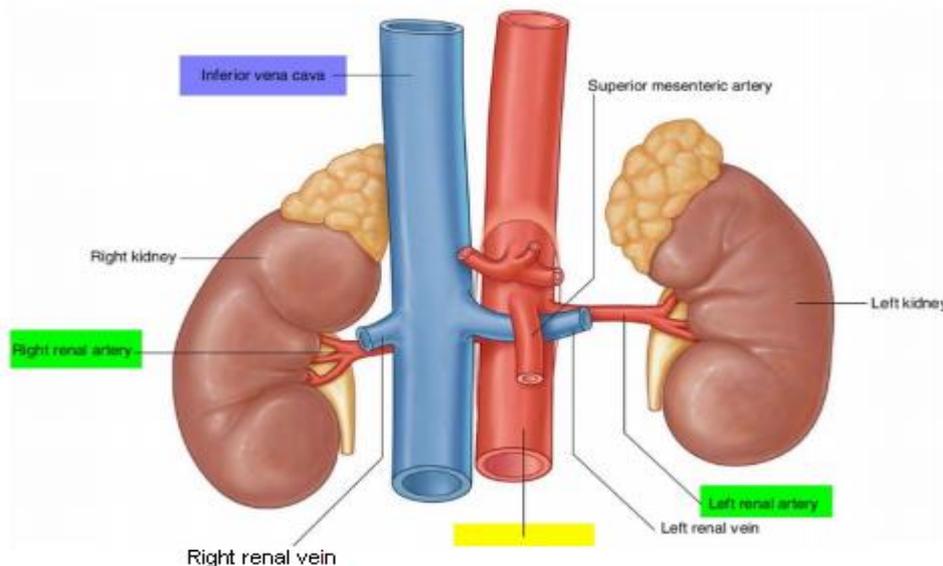
### Arterial blood supply

- The renal arteries arise from the side of abdominal aorta, opposite the upper border of **L2** vertebra.

- The right renal artery is **longer** than the left is since the abdominal aorta is shifted to the left, and passes **posterior to IVC**.
- The renal artery gives inferior suprarenal artery.
- It divides into 5 segmental arteries which are end arteries.
- Collectively, the cortex receives over 10 times more blood than the medulla.
- Branches of segmental arteries are illustrated in the yellow scheme above.



### Renal arteries and veins



- Both right and left renal arteries open directly into IVC. But the left renal vein is longer than the right since the IVC is shifted to the right. It also receives the left suprarenal and gonadal veins.

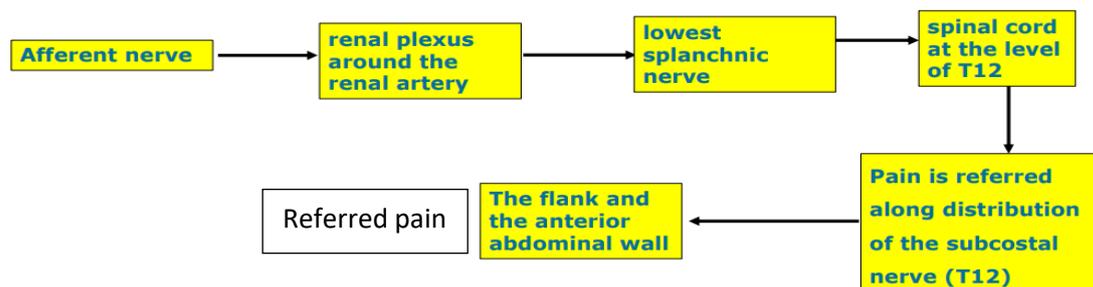
- Renal veins are anterior to the arteries in order not to be compressed by the thick and pulsating arteries.
- Left renal vein lies between the superior mesenteric A. (SMA) anteriorly and the abdominal aorta posteriorly.
- If it is compressed, the patient will suffer from haematuria due to renal venous hypertension, rupture of thin-walled veins into the collecting system. This is known as **Renal Vein Entrapment Syndrome (Nutcracker syndrome)**.
- ✓ **Lymph drainage;** the kidneys drain to lateral aortic lymph nodes.
- ✓ **Nerve supply;** by renal plexus derived from the celiac plexus and supplemented by the lowest splanchnic nerve. It is mainly vasomotor in function.

### Renal Pain

Renal pain varies from a dull ache to a severe pain in the flank.

Renal pain can result from stretching of the kidney capsule or spasm of the smooth muscle in the renal pelvis.

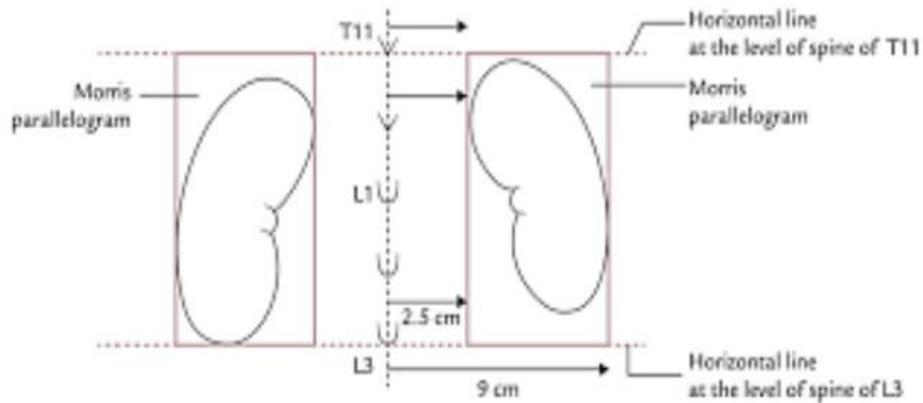
-The mechanism of developing flank pain is illustrated in this scheme:



### Surface anatomy of the Kidneys

To indicate the position of the kidney from the back, the Morris rectangle is used; two vertical lines are drawn, the first 1 inch (2.5 cm.), the second 3 inches (9.5 cm.) from the middle line; the rectangle is completed by two horizontal lines drawn respectively at the levels of the tips of the spinous process of the T11 and L3 vertebra. The hilum is 5 cm. from the middle line at the level of the spinous process of the first lumbar vertebra. According to this:

- The upper end lies **1 inch** from midline opposite upper end of T12 vertebra.
- The hilum is **2 inches** from midline at the transpyloric plane (L1).
- The lower end is **3 inches** from the midline opposite L3 vertebra.



### **Kidney Trauma**

- ❖ The kidneys are well protected by the lower ribs, the lumbar muscles, and the vertebral column.
- ❖ A severe blunt trauma to the abdomen may crush the kidney against the last rib and the vertebral column.
- ❖ Depending on the severity of the blow, the injury varies from a mild bruising to a complete laceration
- ❖ Because 25% of the cardiac outflow passes through the kidneys, renal injury can result in rapid blood loss

The End