

Jordan University
Faculty Of Medicine



Urinary System

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Dr Ahmet Solman

Before

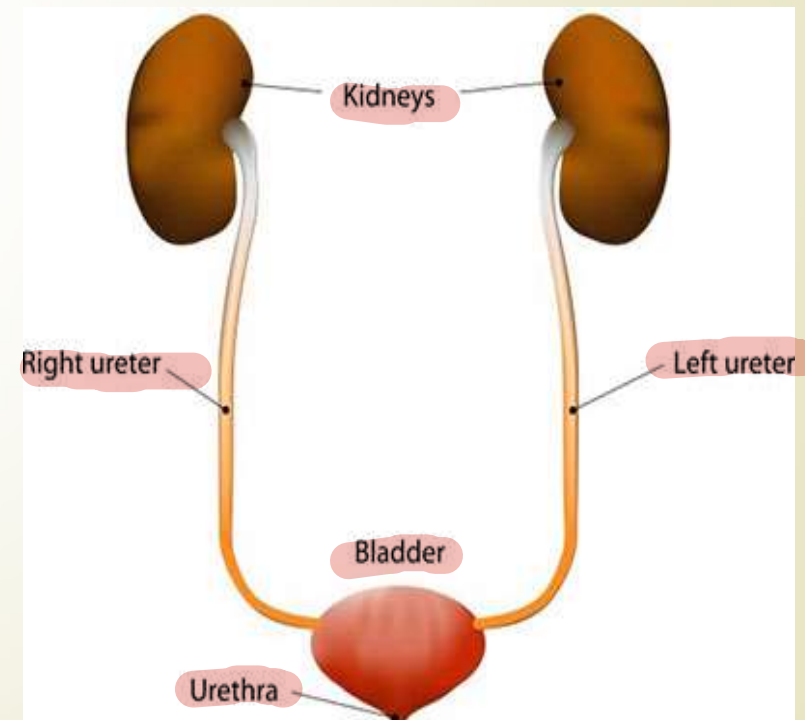


After

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

The main function is

- 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.



have peritoneum on their anterior side only.

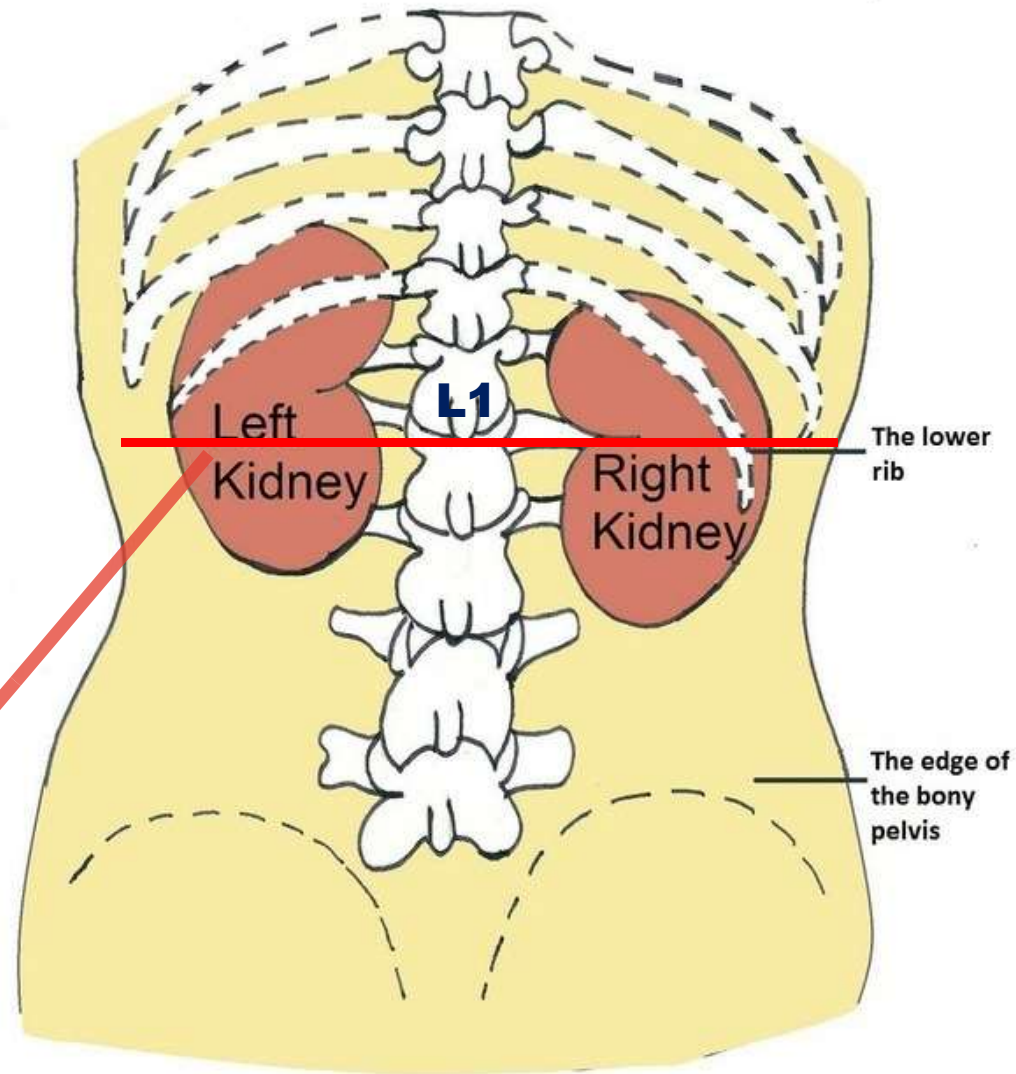
Kidneys



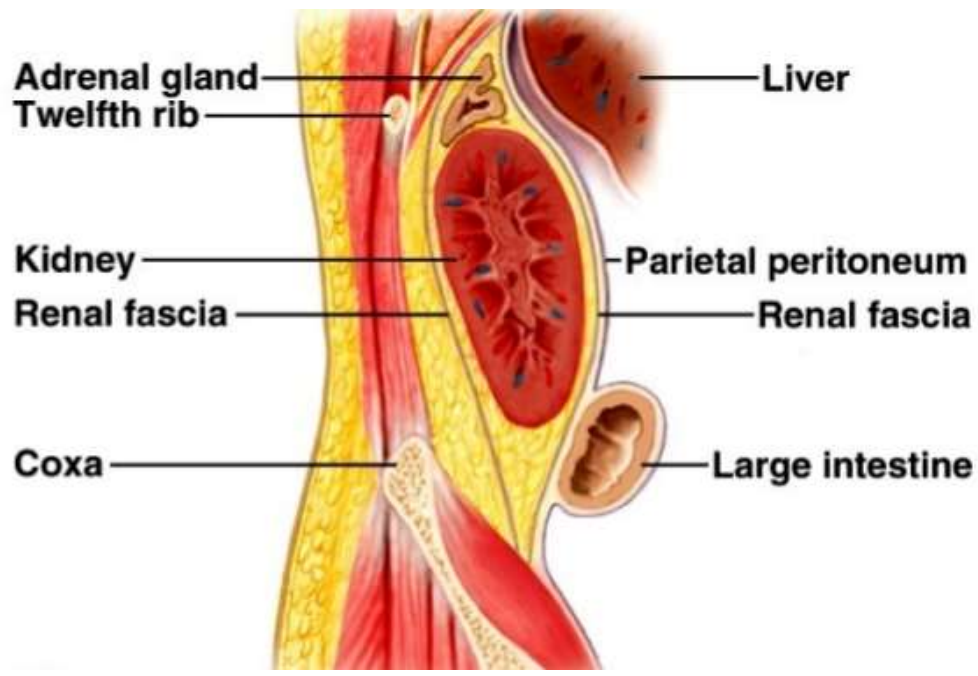
Location:

- The kidneys are retroperitoneal organs, on the posterior abdominal wall .
- They are located at paravertebral gutters opposite T12, L1, L2, L3 vertebrae.
- The right kidney is about 1.25 cm lower than the left.
- 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.

transpyloric plane



➤ Kidneys Can be palpated in thin people ,By press between 11th and 12th ribs and iliac crest (posteriorly) and below costal margin (anteriorly)



General Features of the Kidneys:

The kidneys has :-

➤ **Two poles** (upper and lower)

1 The upper pole is nearer to the midline than the lower pole.

2 The inferior pole of right kidney is about one finger breadth above iliac crest

➤ **Two borders** (lateral and medial).

3 The lateral border is smooth and **convex**

4 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.

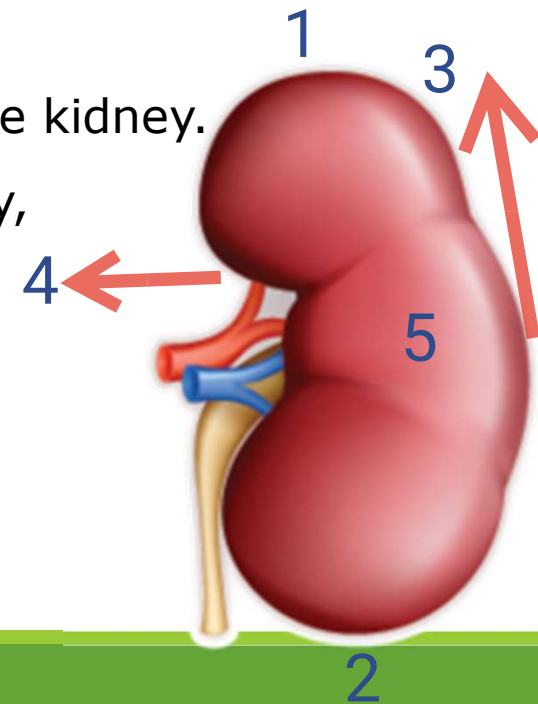
The structures passes through the hilum are renal vein, renal artery, renal pelvis.

The renal vein is **most anterior** and renal pelvis is **most posterior**.

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

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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

Coverings of the kidney :-

From the cortex outwards

- 1- Fibrous capsule:** surrounds the kidney all around
- 2- The perirenal fat:** 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

Laterally with fascia transversalis,

Medially with the fascia around the renal vessels, aorta and IVC. **

Superiorly with the diaphragmatic fascia after forming a separate compartment for the suprarenal gland.

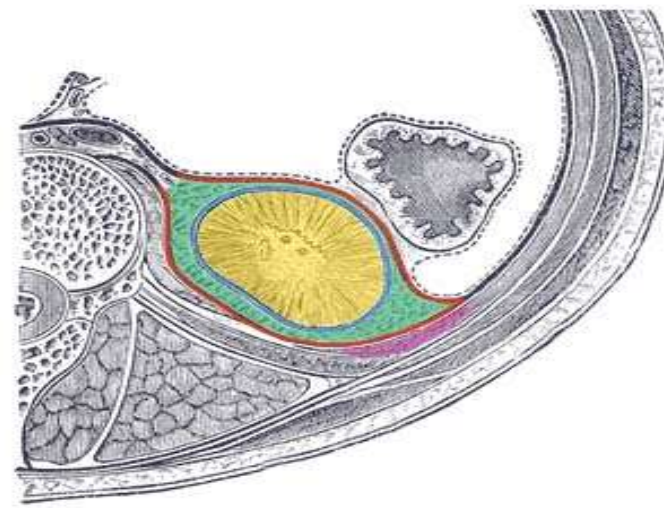
Inferiorly it remains separate in front and back of the ureter.

- 4- Pararenal fat :** outside the renal fascia, most condensed **posterior** to the kidney

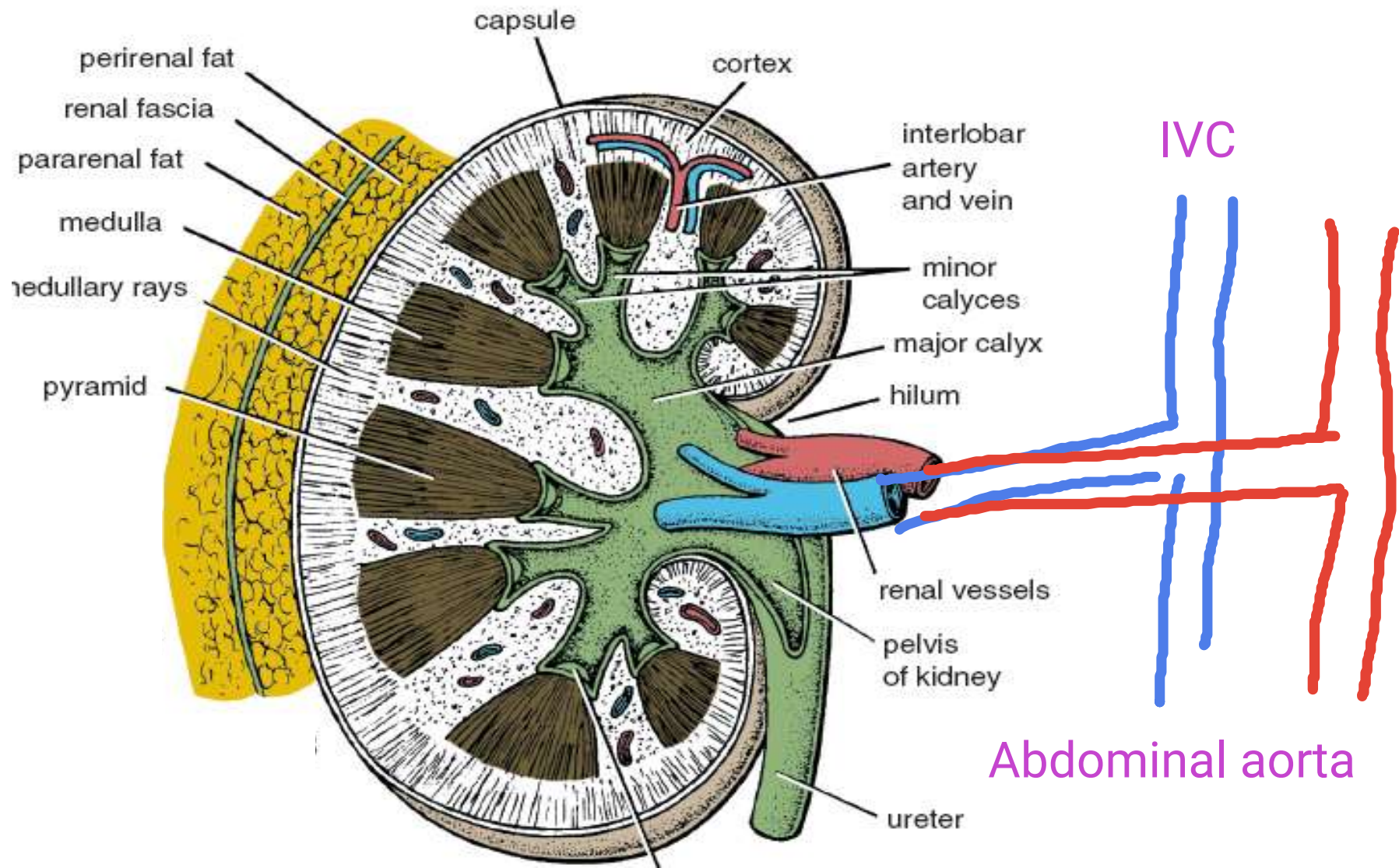
* Renal veins drain into inferior vena cava

* Renal arteries originate from the abdominal aorta

^^ see the next slide



- Kidney**
- Renal capsule**
- Perirenal fat**
- Renal fascia**
- Pararenal fat**



The attachments of the renal fascia:

Superiorly with the diaphragmatic fascia

Medially with renal vessels

Laterally with fascia transversalis

Inferiorly the renal fascia

surrounds the ureter from its anterior and posterior.

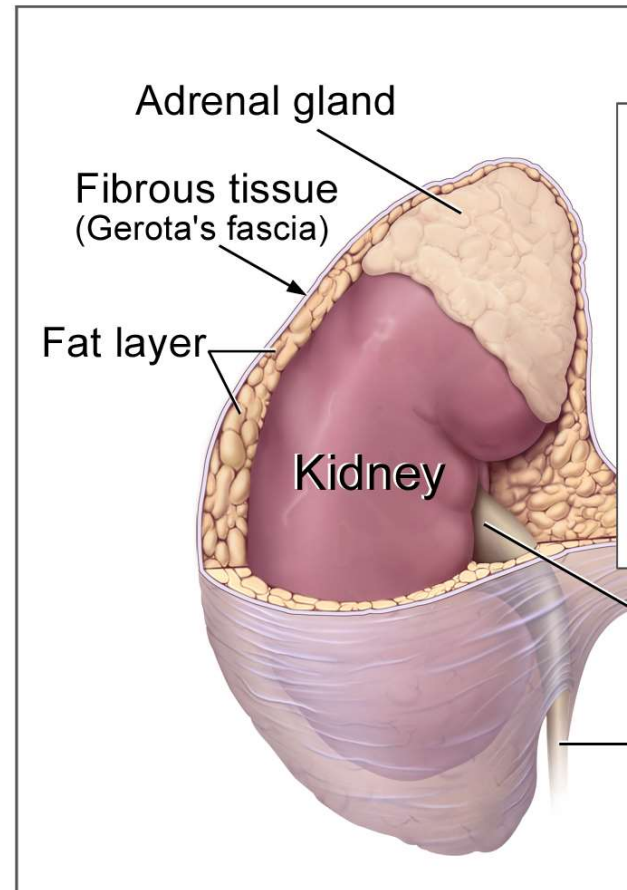
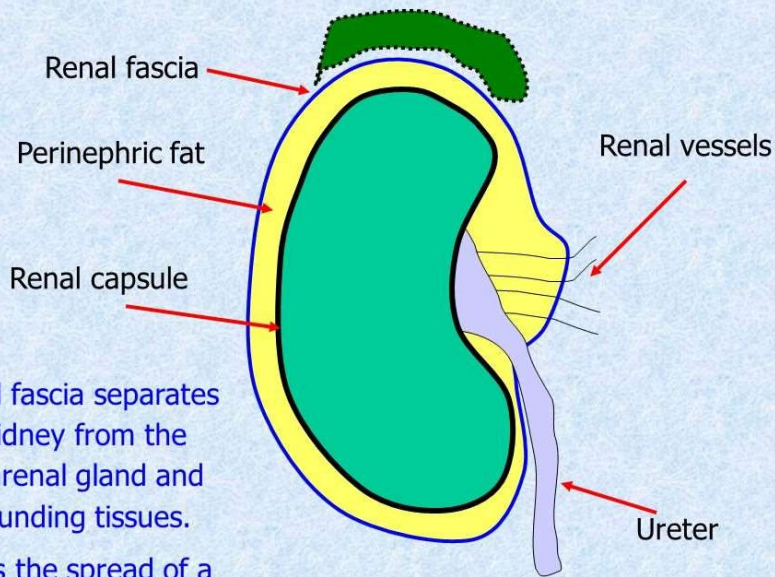
So, if we have pus or bleeding in the kidney the only way to spread is downward

Supporting factors of the kidney :-

The kidney is kept in situ by

- Adjacent organs
- Abdominal pressure
- Perirenal fat
- Renal Fascia
- Pararenal fat
- Renal Blood vessels and ureters

If the fat absorbed, as in rapid weight loss, descent of the kidney occurs (**Nephroptosis**).



Clinical notes :

Nephroptosis cause intermittent pain in the renal region, relieved by lying down.

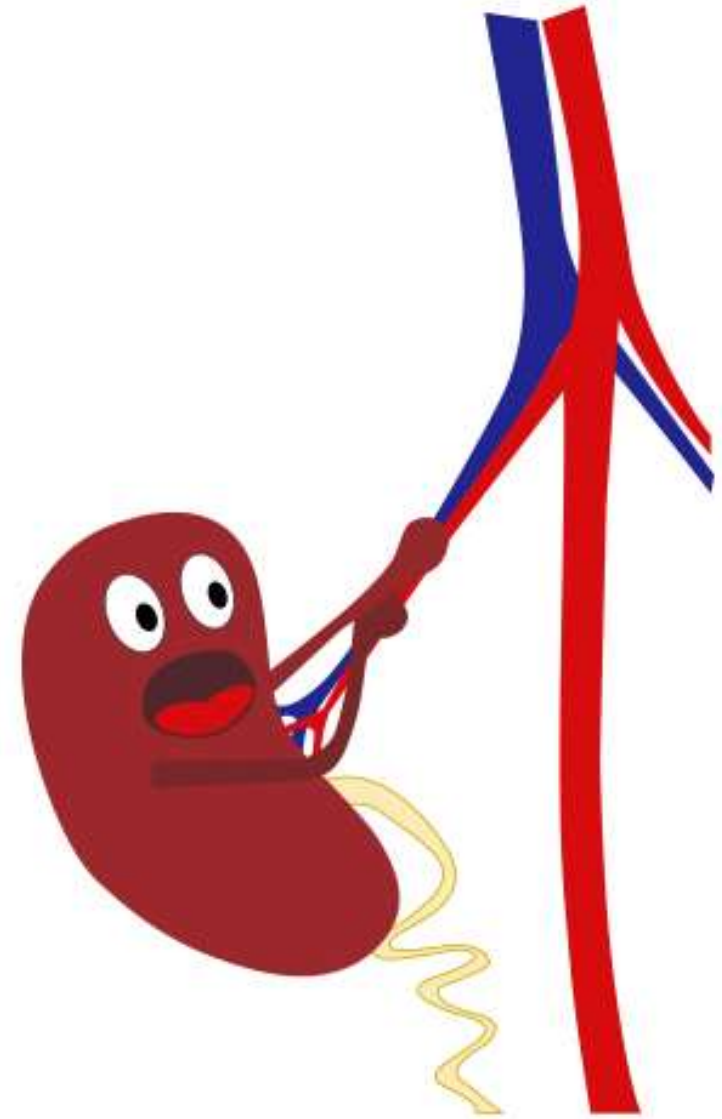
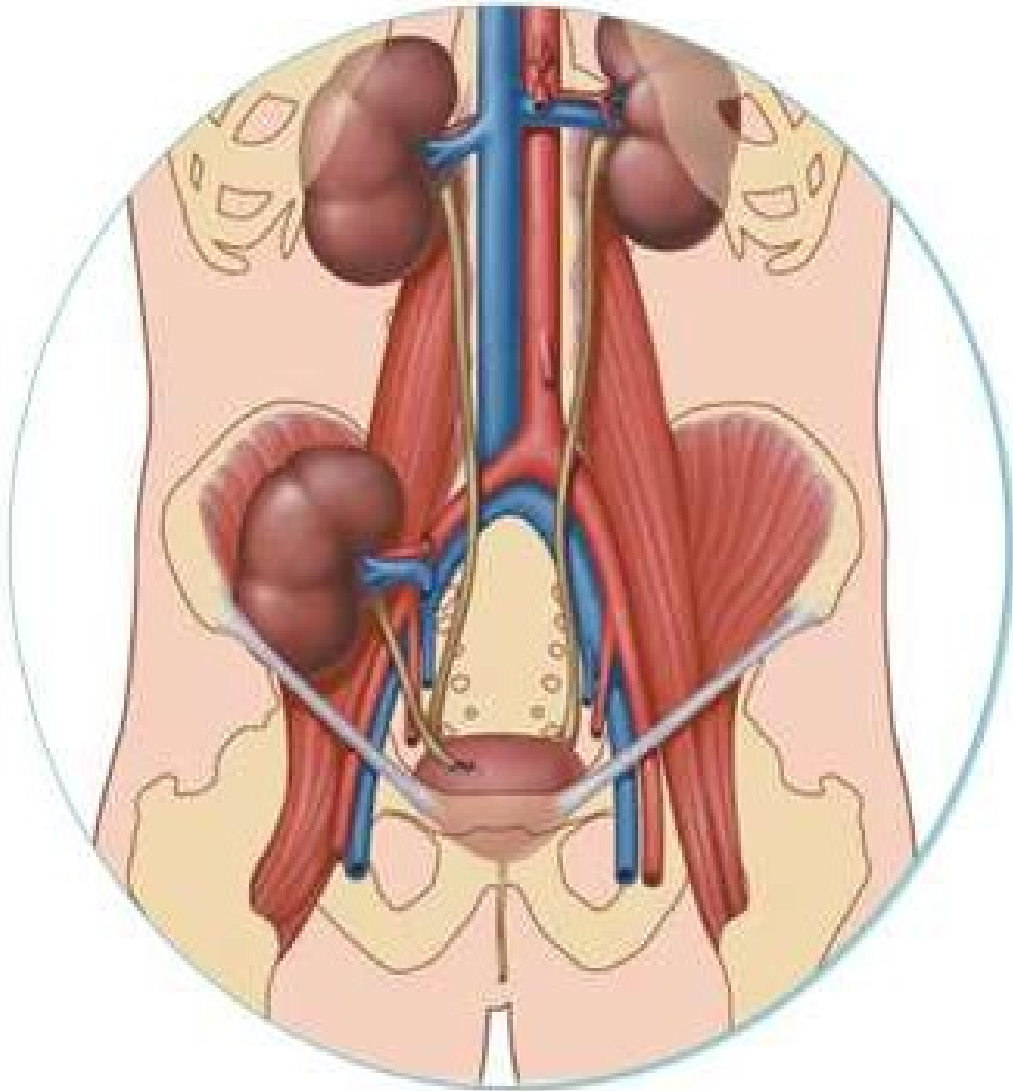
This pain as result of traction on the renal vessels.

Kidneys Transplantation

The site of renal transplantation is the iliac fossa of the greater pelvis ,due to lack of inferior support for the kidneys in the lumbar region

Perinephric Abscess (pus around the kidney)

- The attachments of the renal fascia to the renal vessels and ureter, usually preventing the spread of pus to the contralateral side.
- 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.

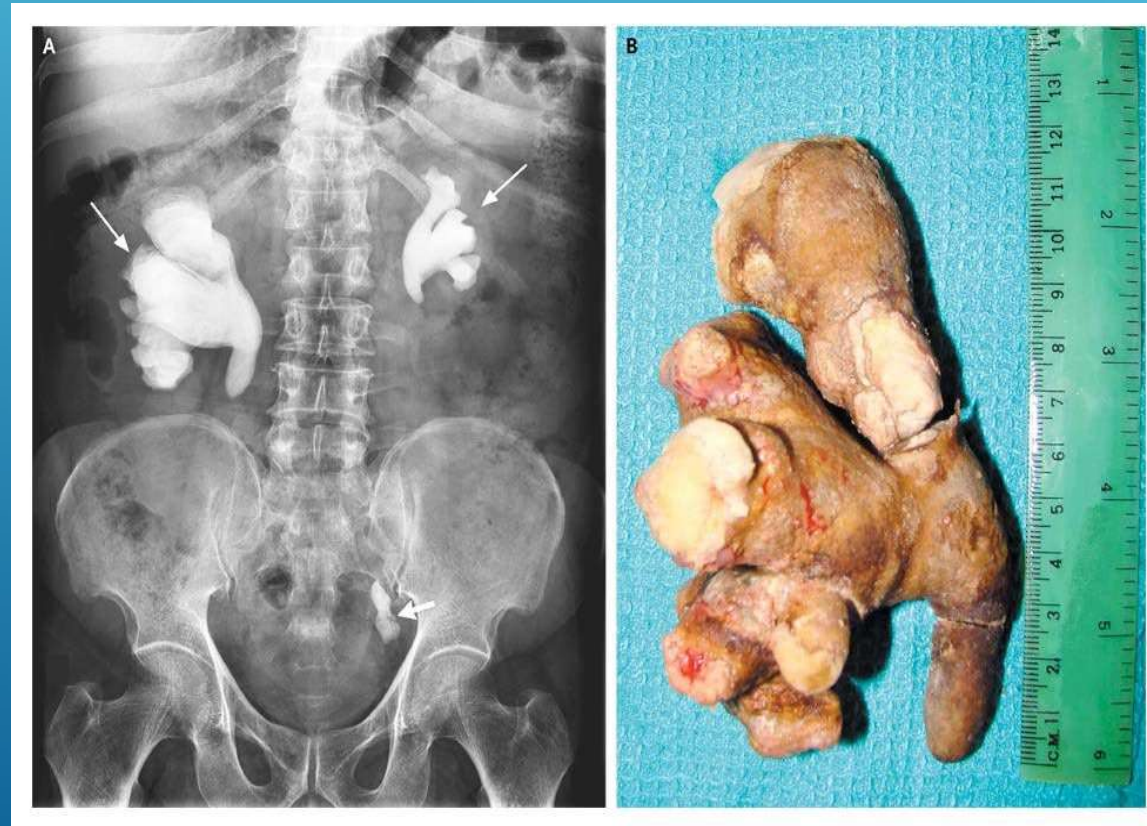


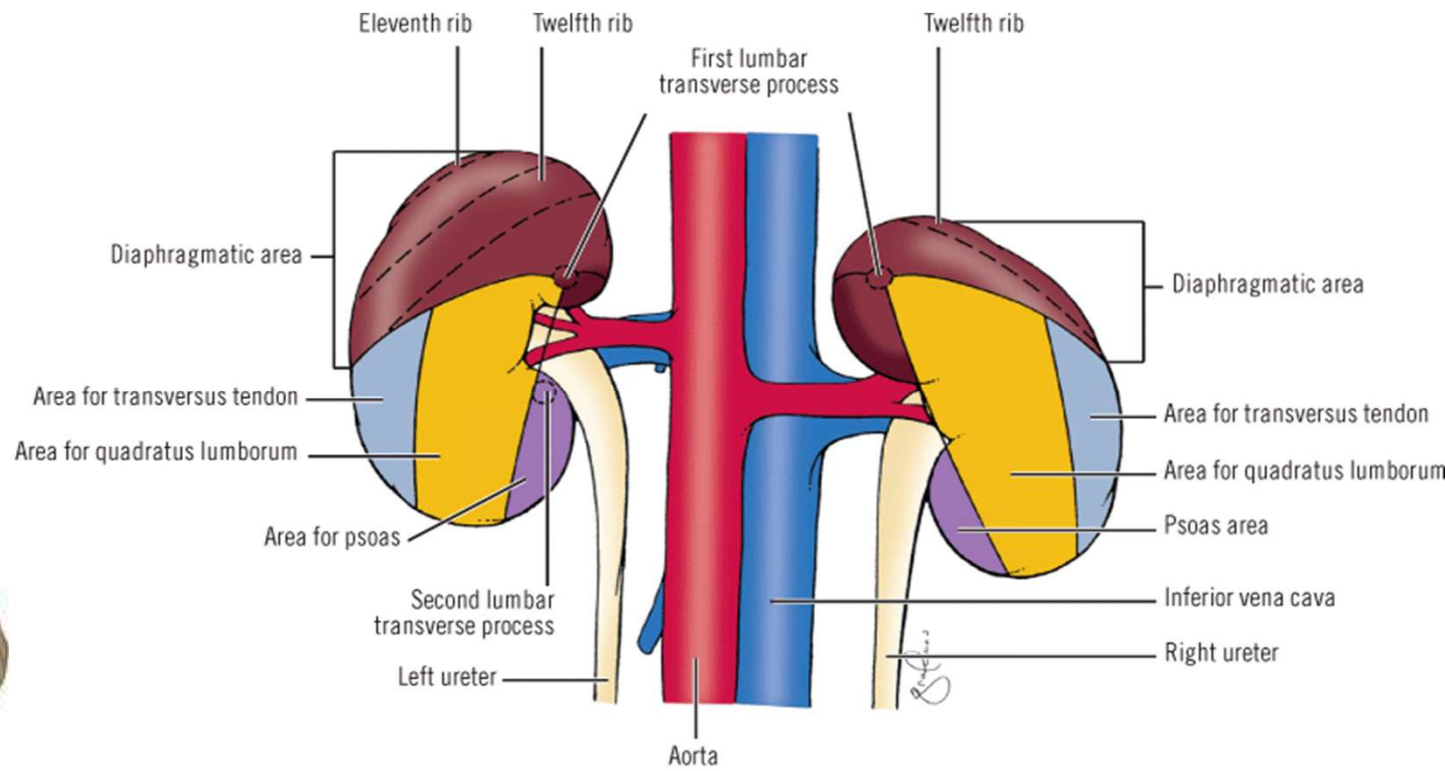
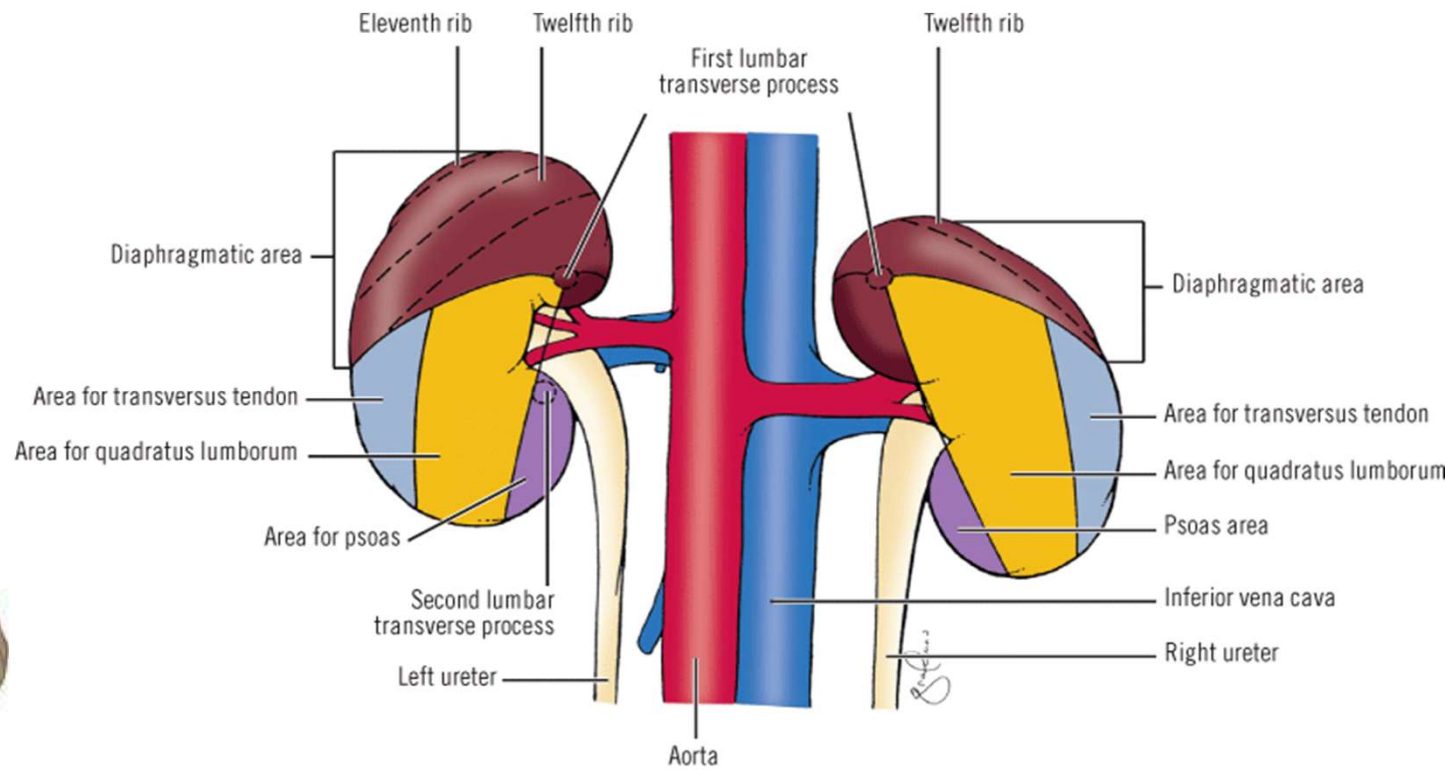
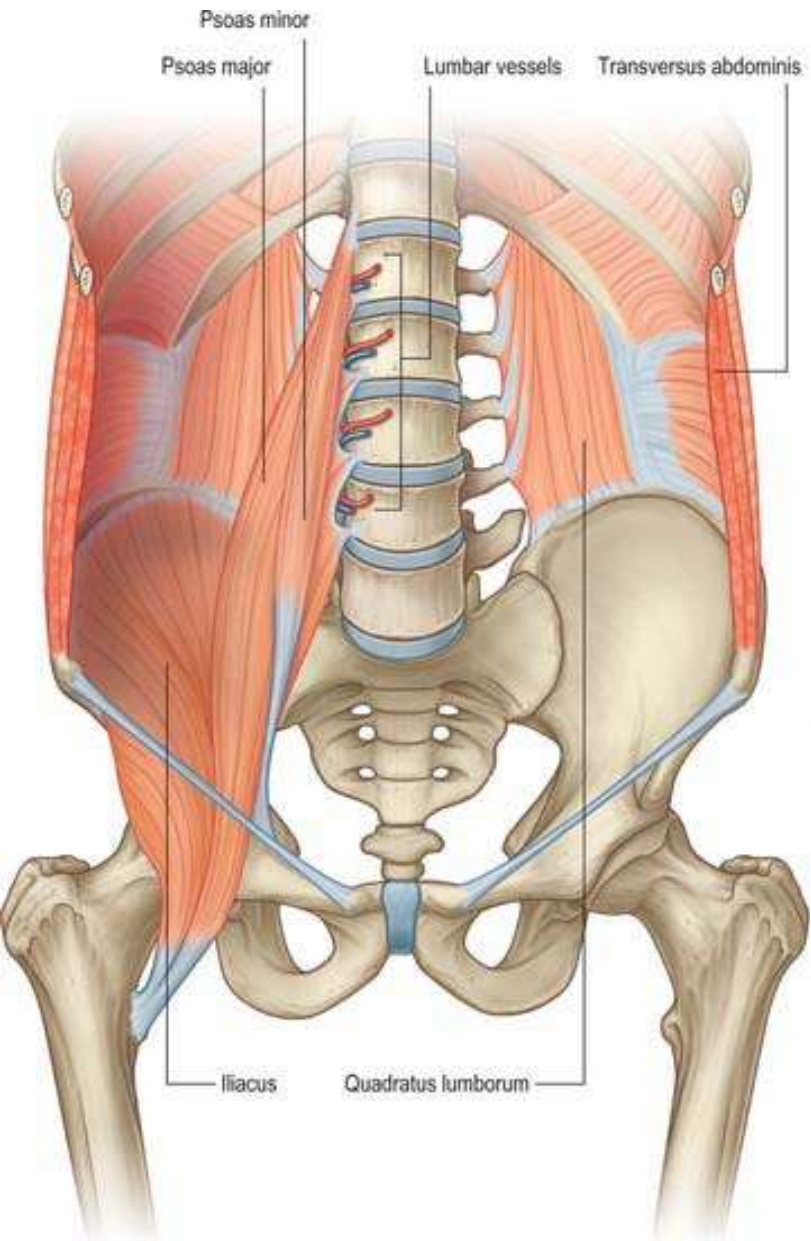
Transplanted kidney in the iliac fossa

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

1- What the structures 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 ?





Relation of the Kidneys

Posterior relations; are nearly similar for both kidneys

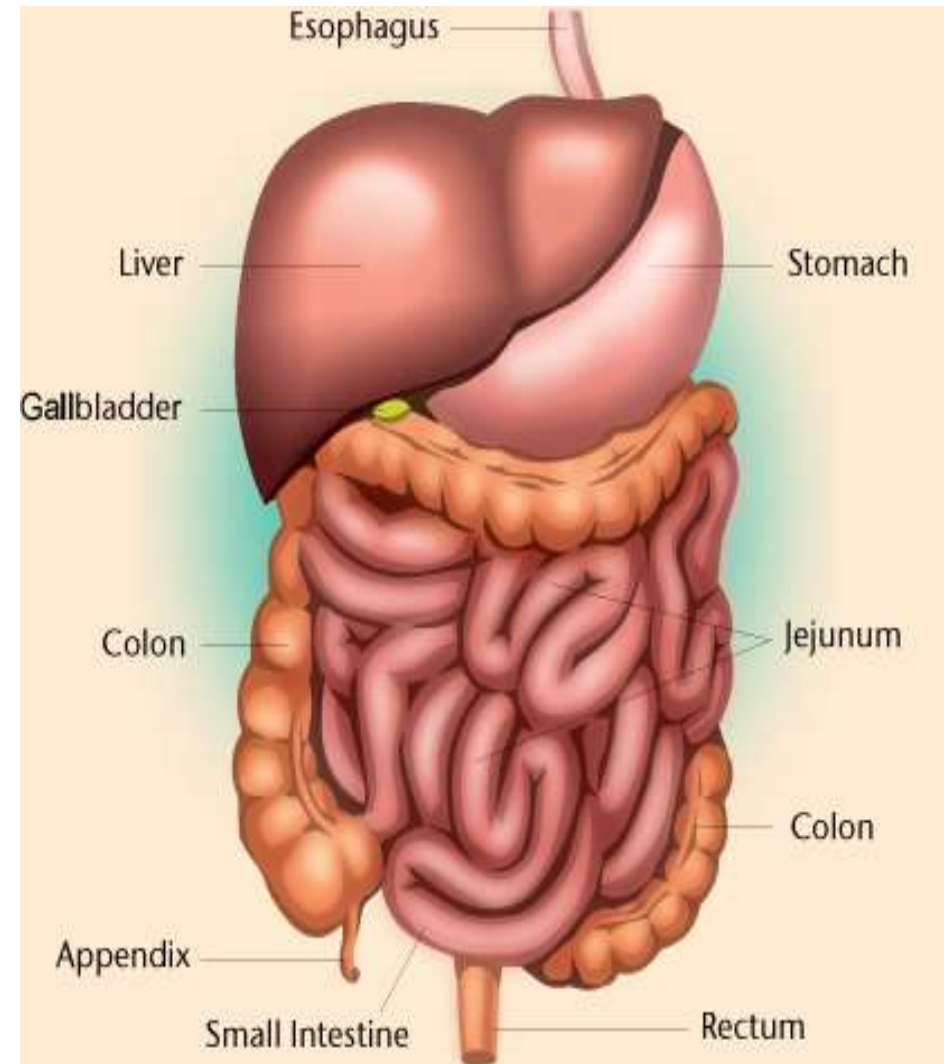
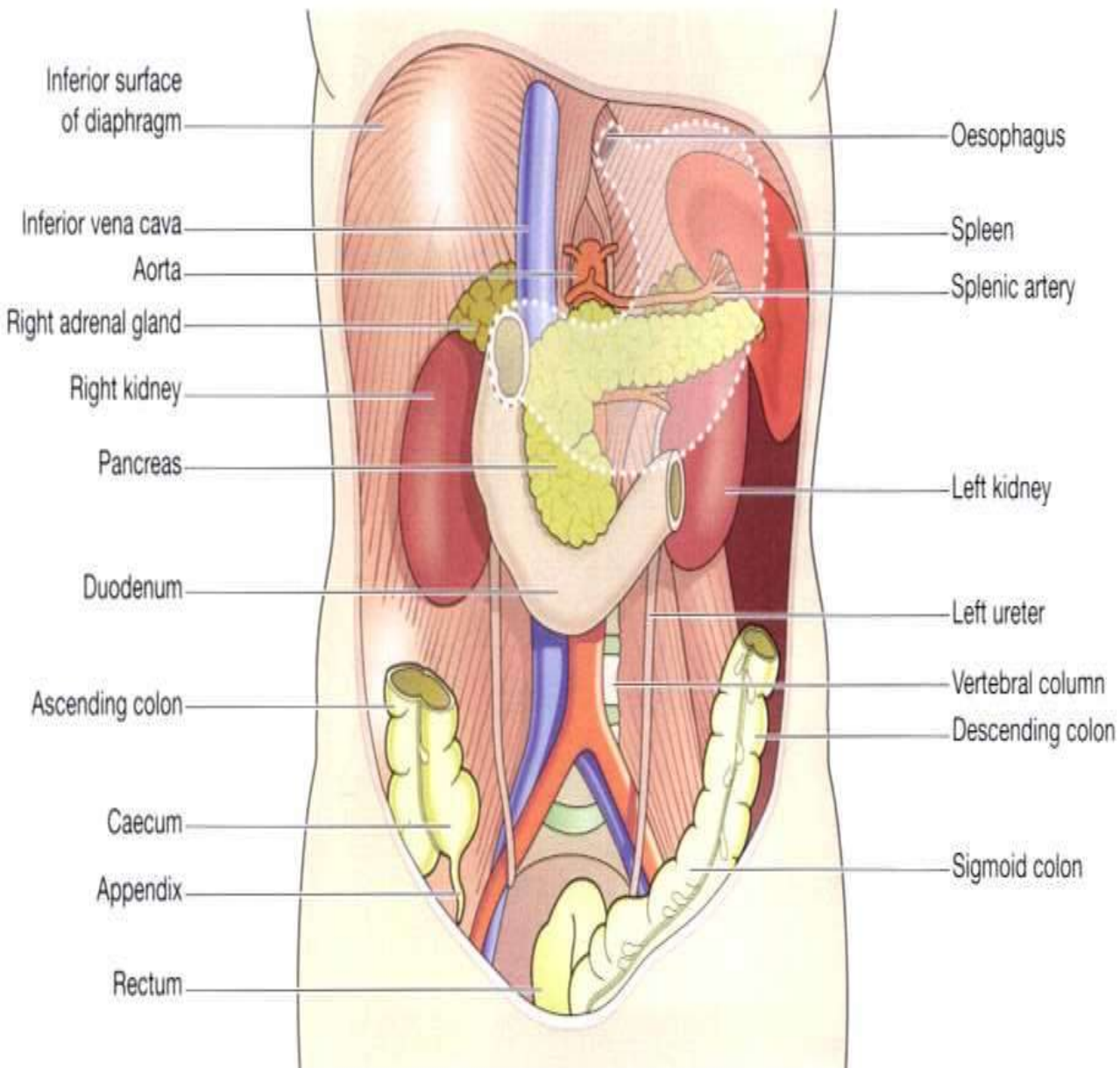
1- Four muscles, diaphragm (superiorly), psoas major, quadratus lumborum and transversus abdominis.

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 costo-diaphragmatic 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 close relation between costo-diaphragmatic recess of the pleura and kidney



Anterior relations

Right Kidney

Right suprarenal gland

Second part of duodenum

Right lobe of liver (with **hepatorenal pouch** in between)

Right colic flexure (hepatic flexure)

Coils of the small intestine

Ascending branch of right colic artery

Left Kidney

Left suprarenal gland

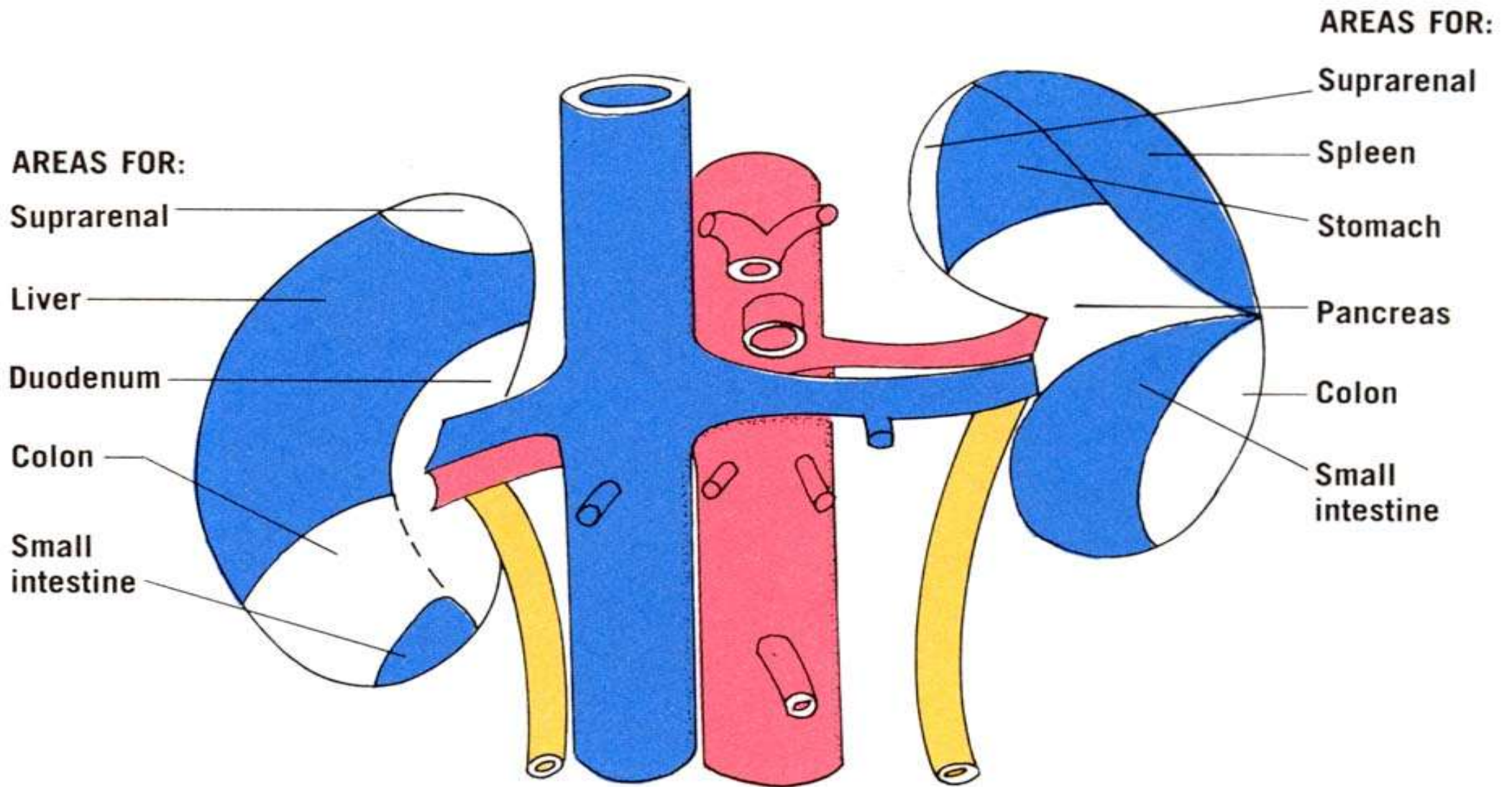
Spleen with lienorenal ligament, Body of pancreas with splenic vessels

Posterior surface of stomach (**with lesser sac** in between)

Descending colon

Coils of the small intestine

ascending branch of left colic artery



Peritoneal covering of the kidney :-

Although, the kidneys are **retroperitoneal**, the anterior surface of each kidney has **3 bare areas** not covered by peritoneum.

The other retroperitoneal structures are interposed between front of kidneys and the parietal peritoneum of posterior abdominal wall.

Bare areas on right kidney

Suprarenal area

Duodenal area

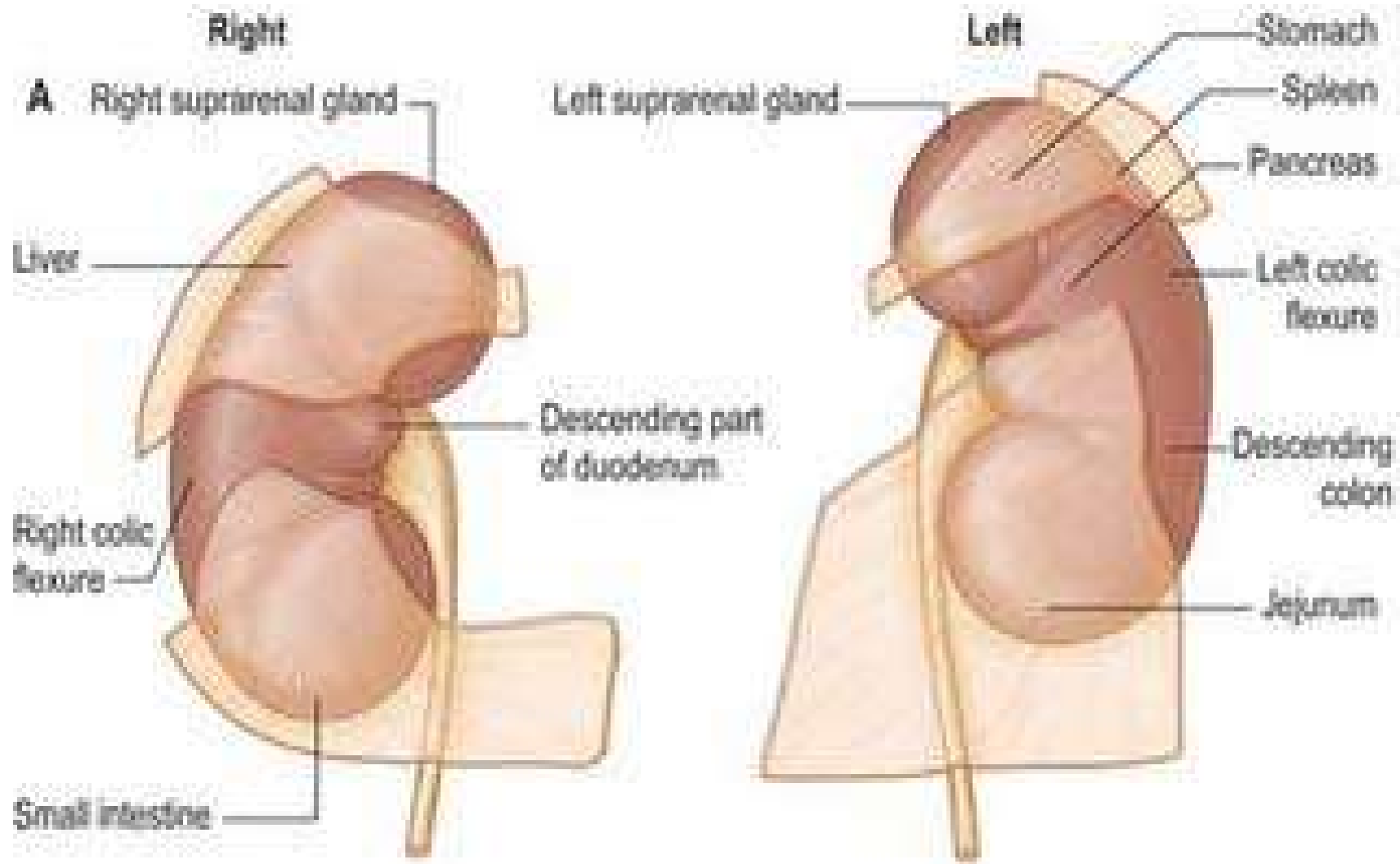
Colic area (hepatic flexure)

Bare areas on left kidney

Suprarenal area

Pancreatic area

Colic area (descending colon)



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.

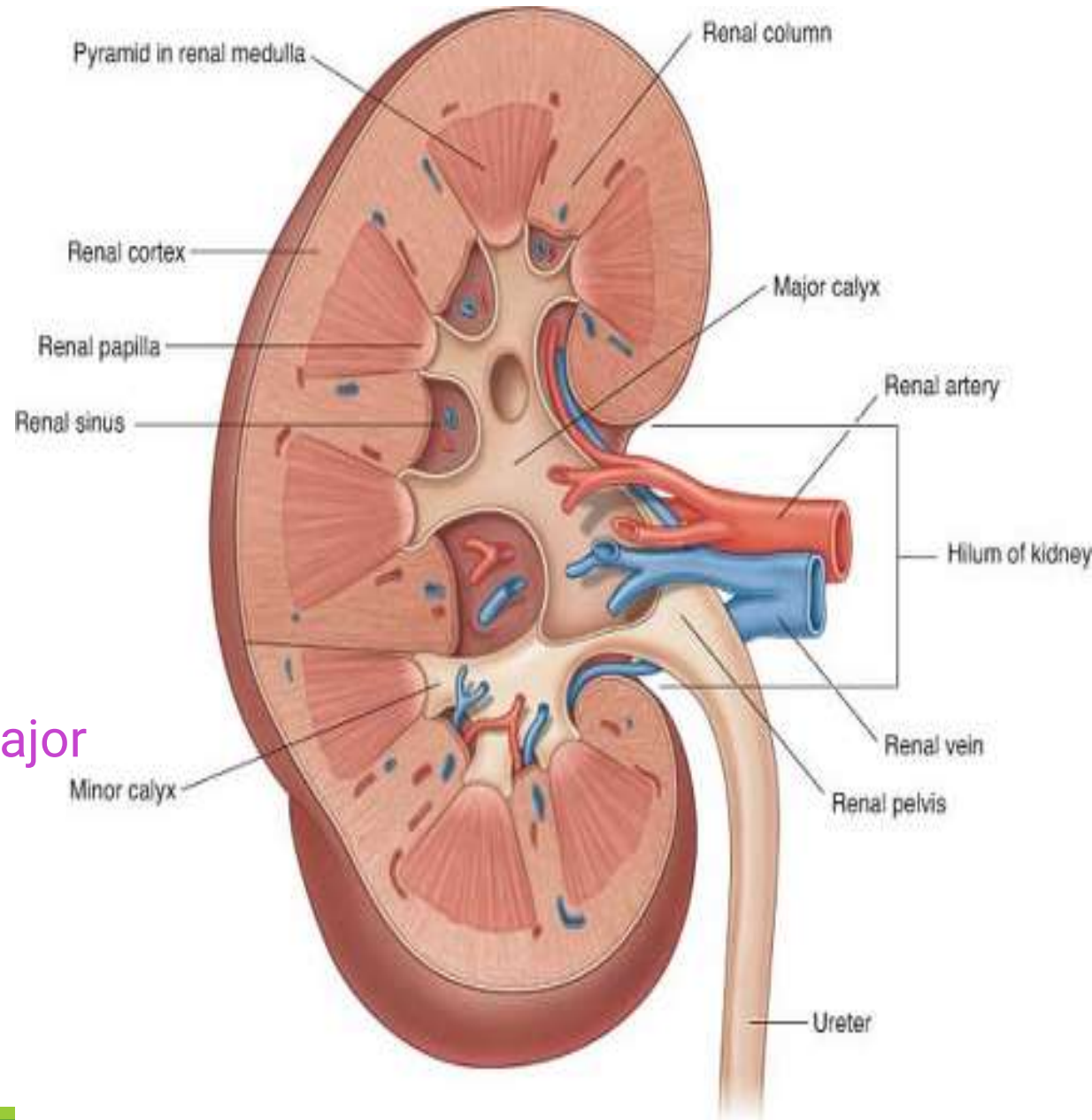
2- Medulla; is darker, deep to the cortex.

- 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 (7-14 lobes)

The space between the cortex and the base of pyramid is called renal lobule.

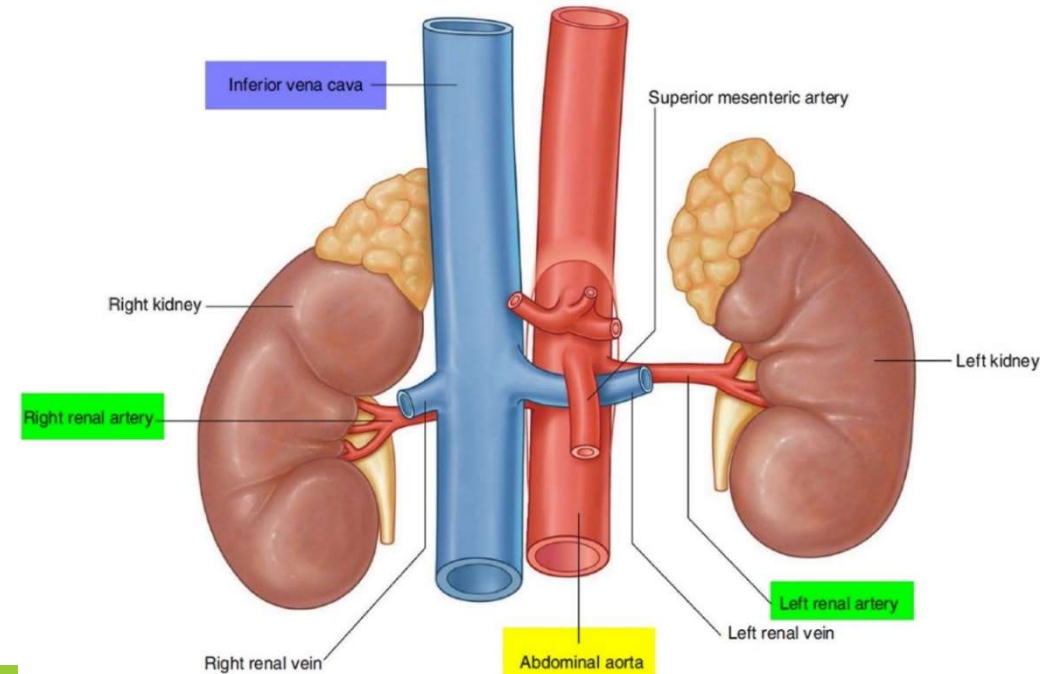
- The minor calyces are about 5-12 per kidney. Each is a short funnel like tube which receives renal papillae
- The minor calyces unite to form 2-3 major calyces (in each kidney) and these in turn, unite to form the renal pelvis.

renal papillae ---> minor calyces ---> major calyces ---> renal pelvis ---> ureter



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 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



^^ for clearer photo, see the next slide

Renal Artery

5 Segmental arteries

Lobar arteries

one for each renal pyramid

Interlobar arteries

run toward the cortex on each side of the renal pyramid

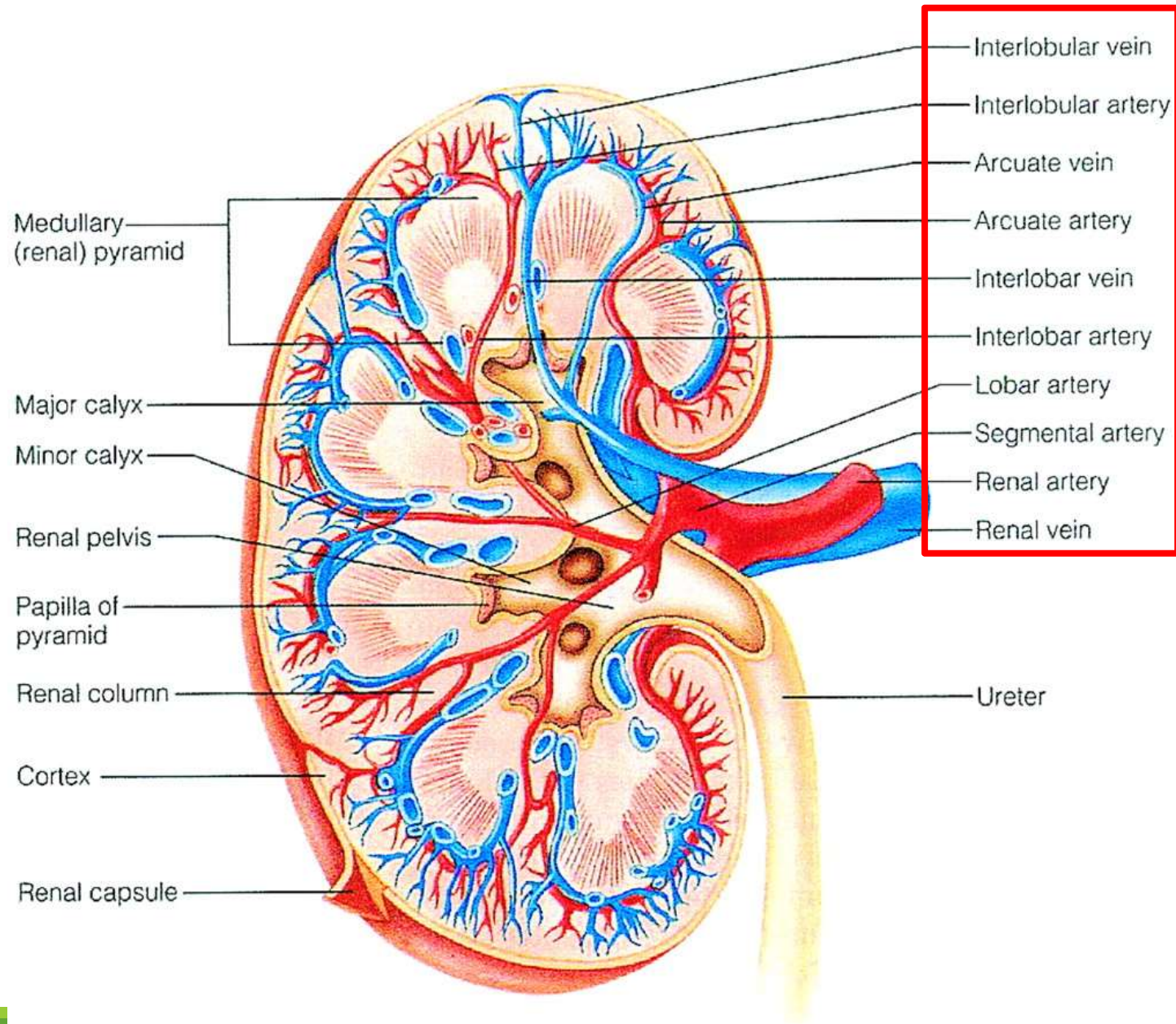
arcuate arteries

arch over the bases of the pyramids

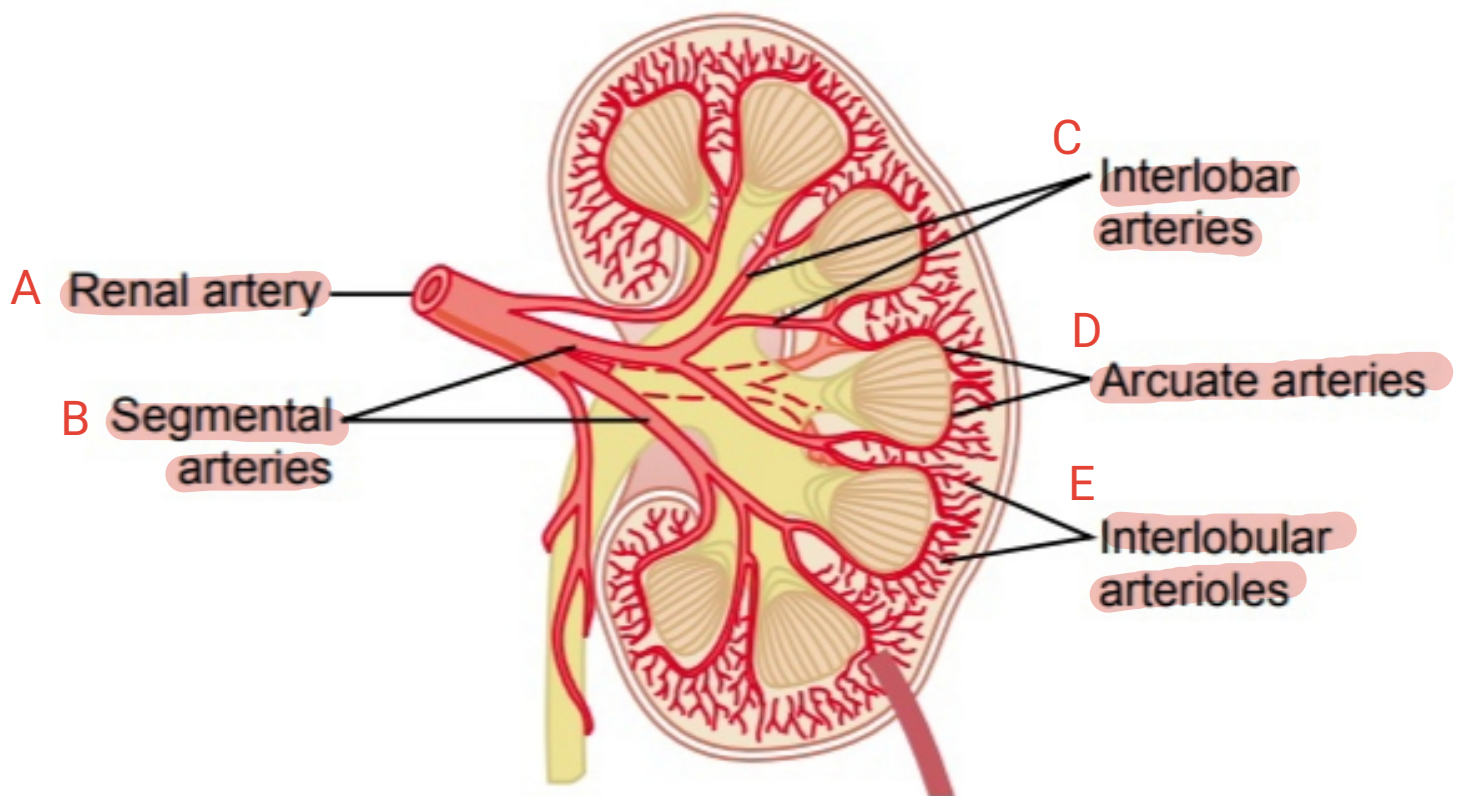
interlobular arteries

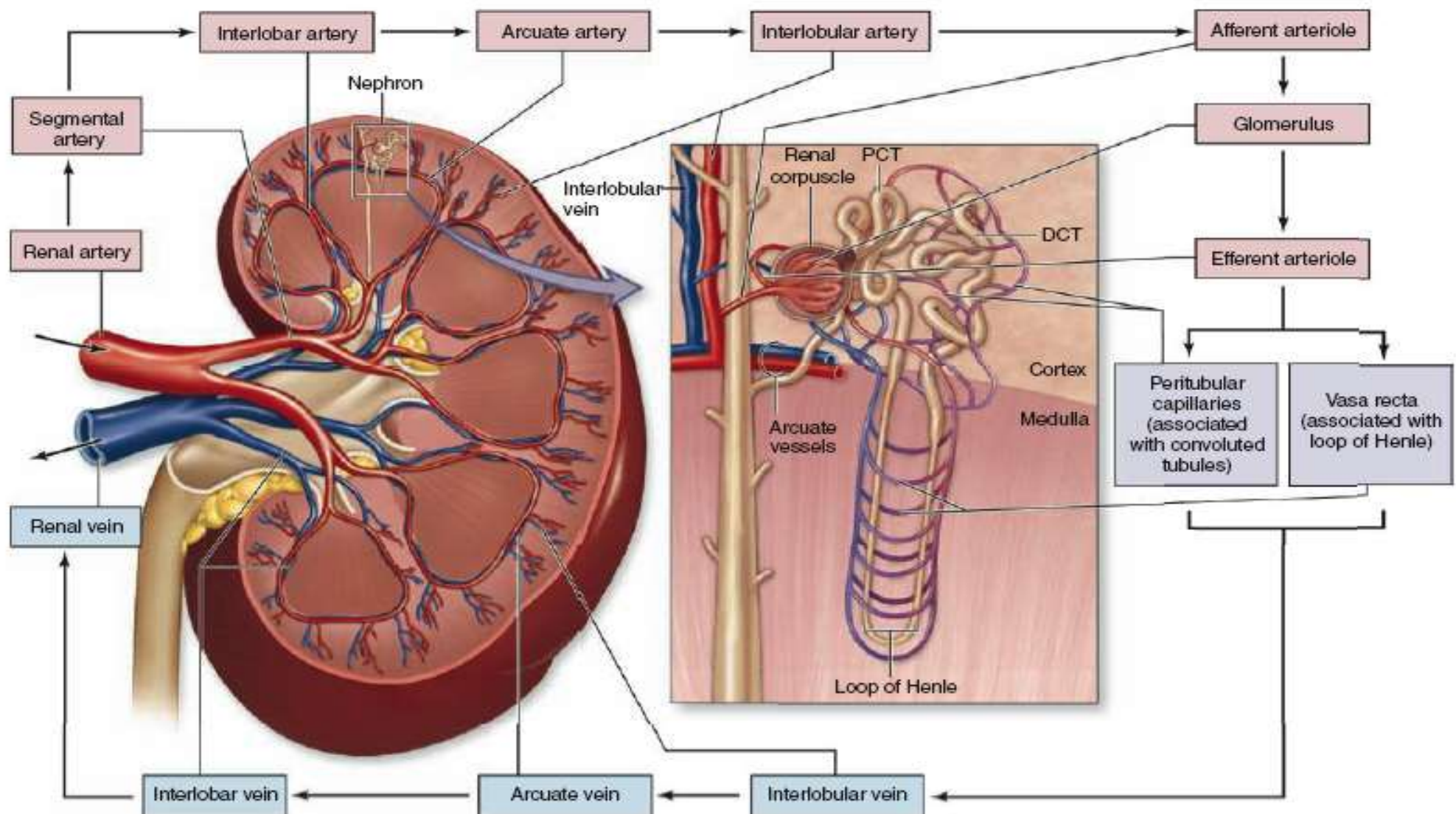
ascend in the cortex

glomerular arterioles



Renal Blood Supply





Venous drainage

* **Both right and left renal veins open directly into IVC**

- **Left renal vein is** longer than the right and passes anterior to the aorta below origin of the **superior mesenteric artery**. (next slide)
- **The-left vein receives** the left suprarenal and left gonadal vein.

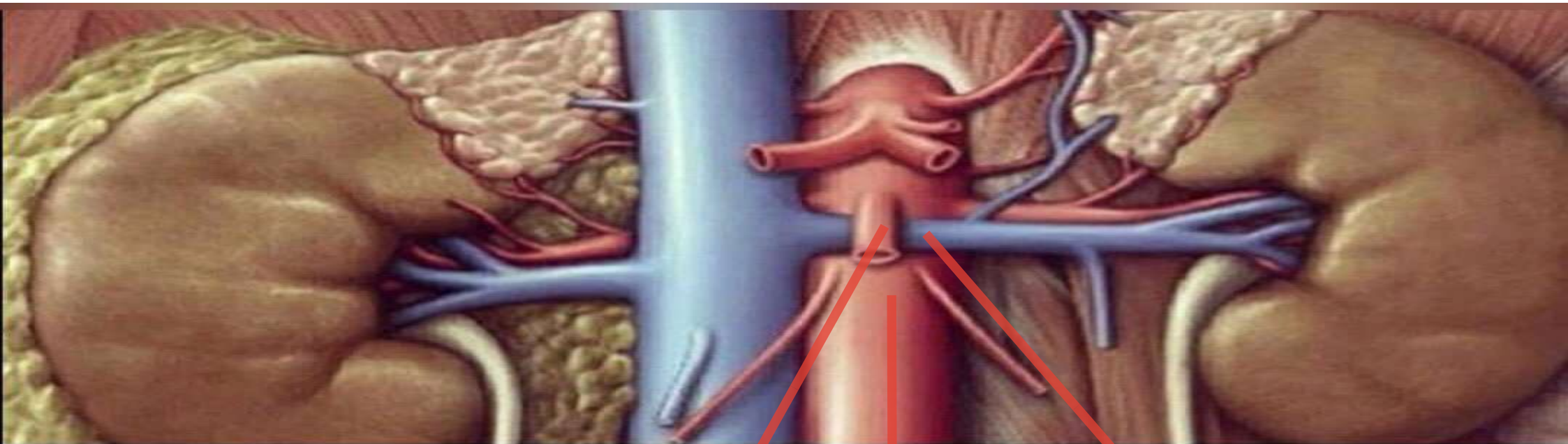
Lymph drainage

To lateral aortic lymph nodes.

Nerve supply :-

By renal plexus derived from the coeliac plexus and supplemented by the **lowest splanchnic nerve**. It is mainly vasomotor in function.

- superior to the pelvic line + covered by peritoneum ---> supplied by sympathetic nerve which is here the lowest splanchnic nerve (T12)
- T12 also gives origin to the subcostal nerves which supply the anterior abdominal wall and flanks



Origin of the superior mesenteric artery.

Left renal vein

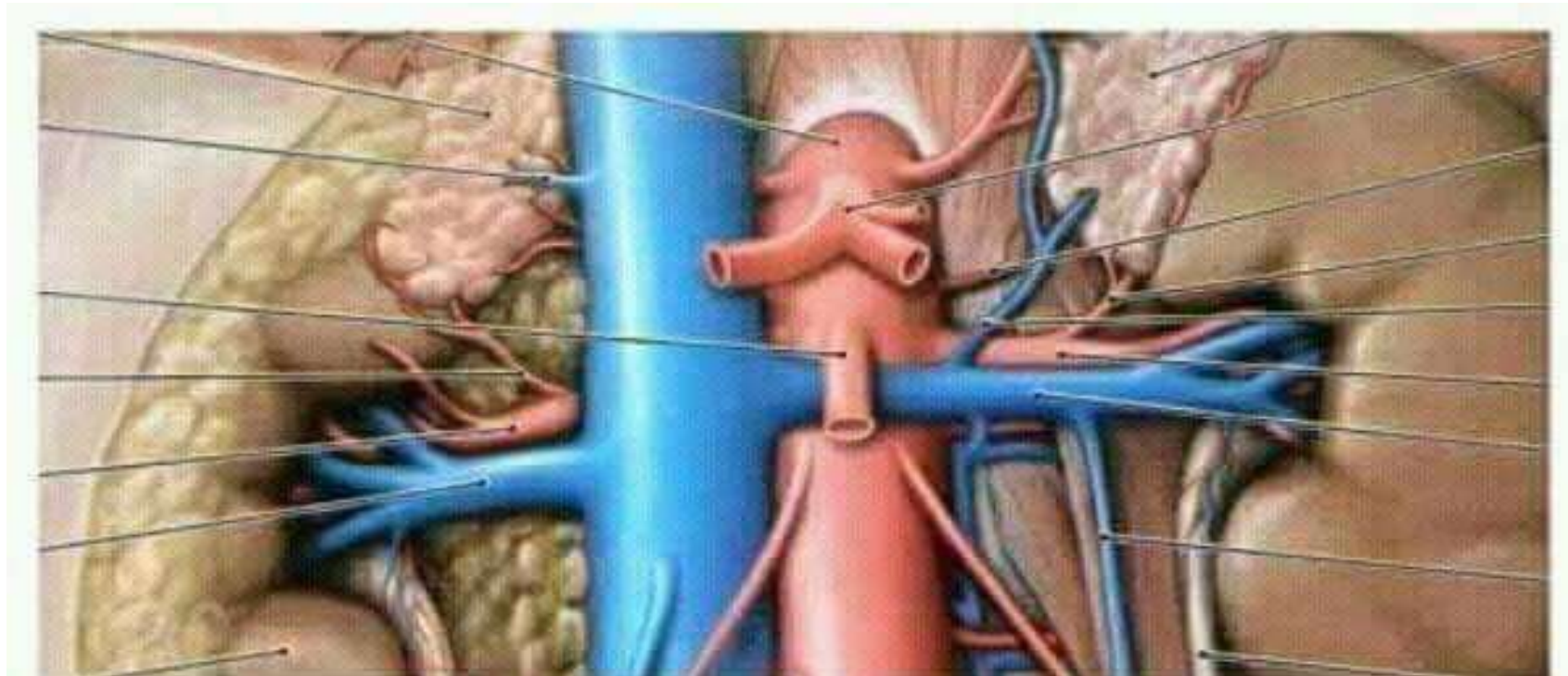
Abdominal Aorta

Renal Vein Entrapment Syndrome (Nutcracker syndrome)

Compression of left renal vein between the SMA anteriorly and the abdominal aorta posteriorly .

Clinical presentation

Haematuria due to renal venous hypertension, rupture of thin-walled veins into the collecting system



RENAL CALCULI

- * ↑ Incidence in male over age 40.
- * Nausea and vomiting

* Pain radiates in a flank area

* Hematuria

* Sharp, sudden, severe pain: may be intermittent depending on stone movement)

* Risk factors-etiology

Infection
unirary stasis
immobility
hyper calcemia
↑ Uric Acid
↑ Urinary oxalate level

Diagnosis:

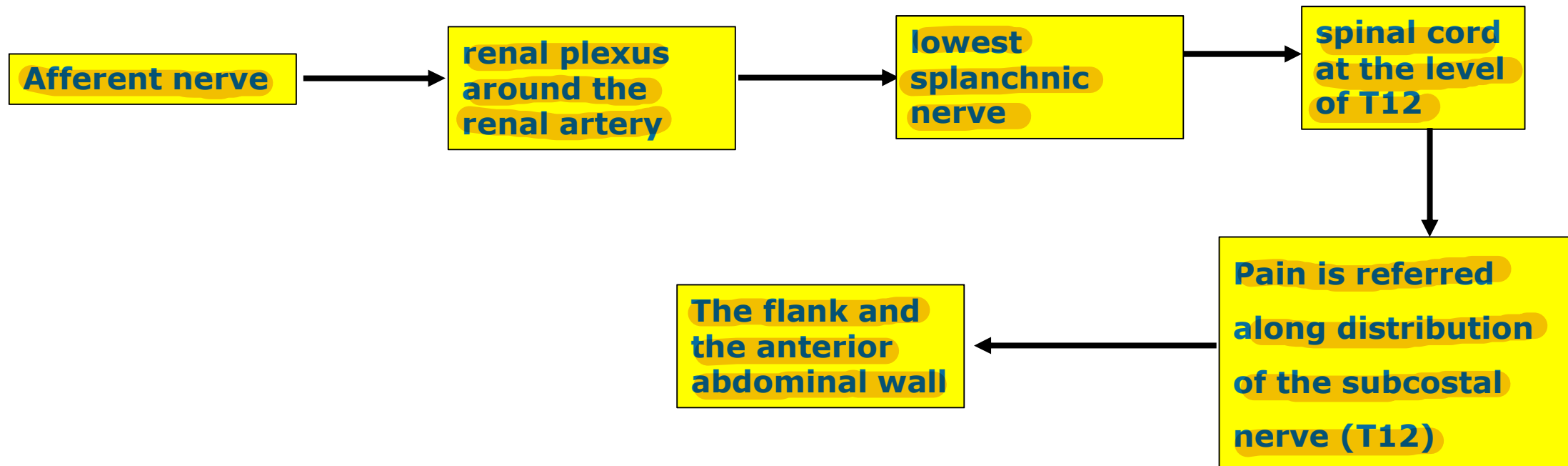
UA
Cystoscopy
IVP
Renal
Stone Analysis
KUB (X-ray)
Serum: Calcium
Oxalate
Uric acid



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.



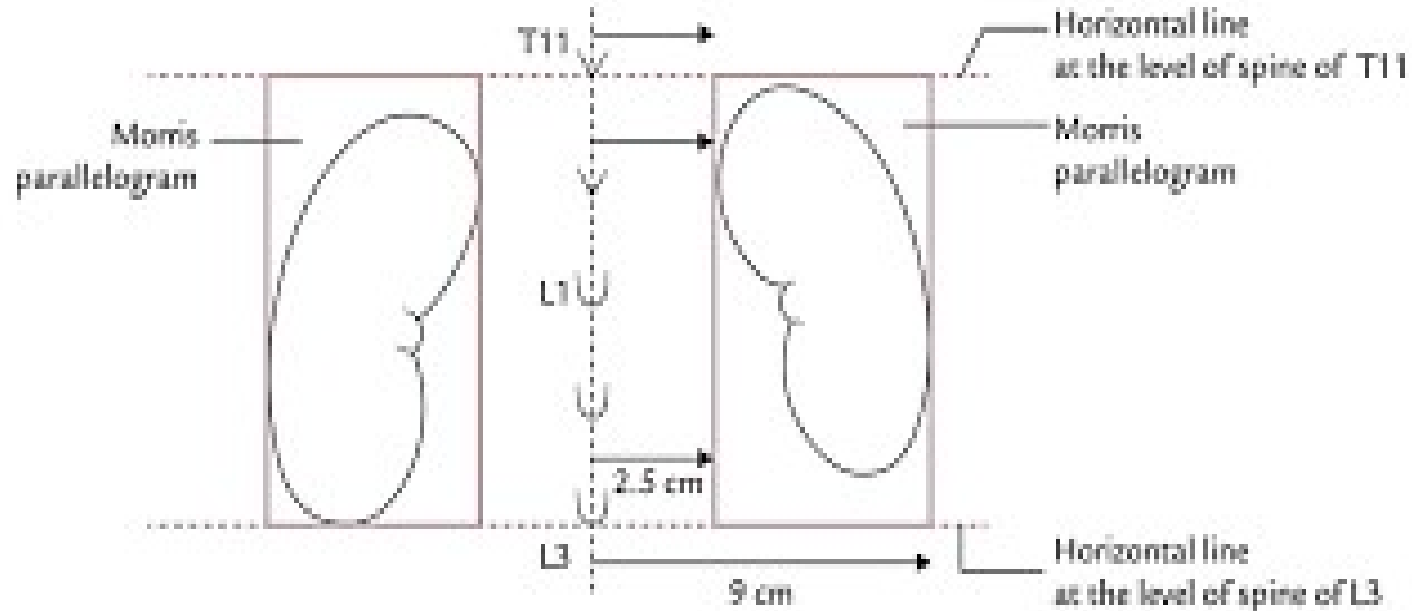
Surface anatomy of the Kidneys

Morris rectangle :

Two vertical lines are drawn; one and three inches from the middle line.

Two horizontal planes are drawn opposite the spines of T11 and L3 .

- 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

