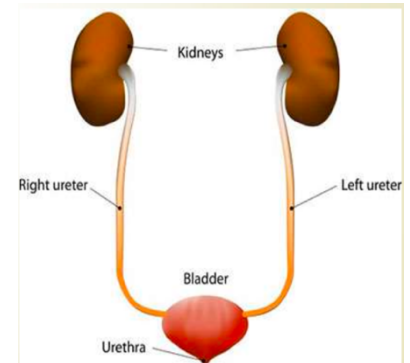


The Urinary System

- 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.



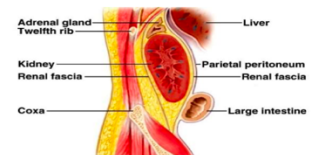
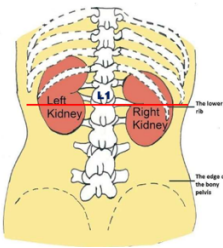
Kidneys

○ 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.
- 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:

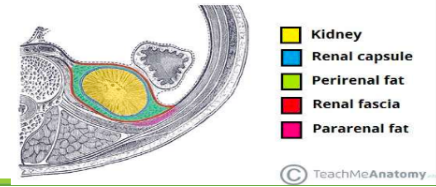
- The kidneys has :-
 - **Two poles** (upper and lower)
 - The upper pole is nearer to the midline than the lower pole.
 - The inferior pole of right kidney is about one finger breadth above iliac crest
 - **Two borders** (lateral and medial).
 - The lateral border is smooth and **convex**
 - the medial 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 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).



○ **Coverings of the kidney :-**

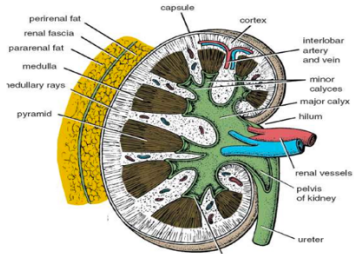
○ From the cortex outwards

- 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.

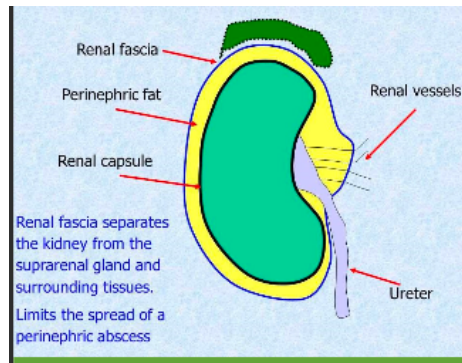


- 4- **Pararenal fat** : outside the renal fascia, most condensed **posterior** to the kidney

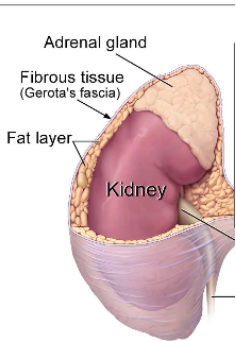
○ **Supporting factors of the kidney :-**

○ The kidney is kept in situ by

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

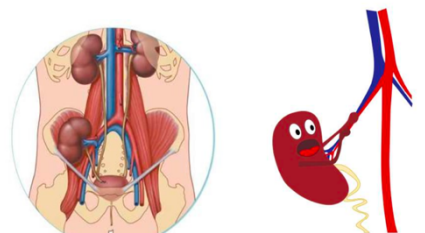
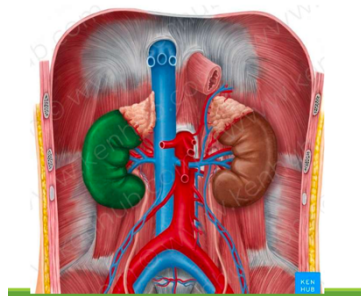
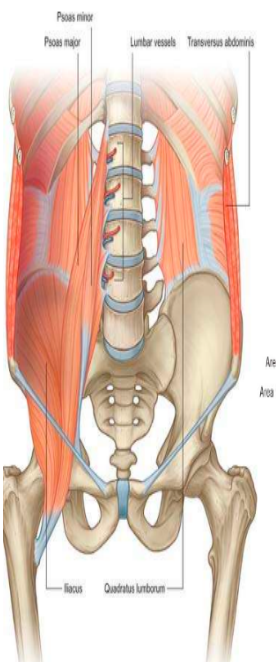


- If the fat absorbed, as in rapid weight loss, descent of the kidney occurs (**Nephroptosis**).



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.



○ **Relation of the Kidneys**

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

▪ **1- Four muscles:**

- diaphragm (superiorly)
- psoas major
- quadratus lumborum
- transversus abdominis.

▪ **2-Four neurovascular structures:**

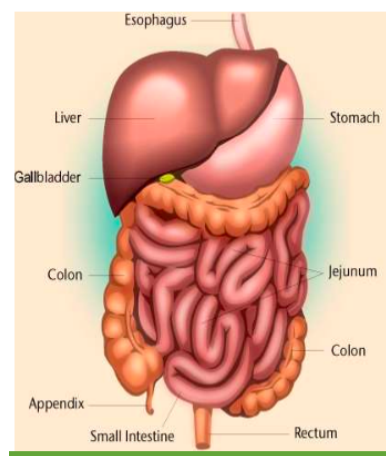
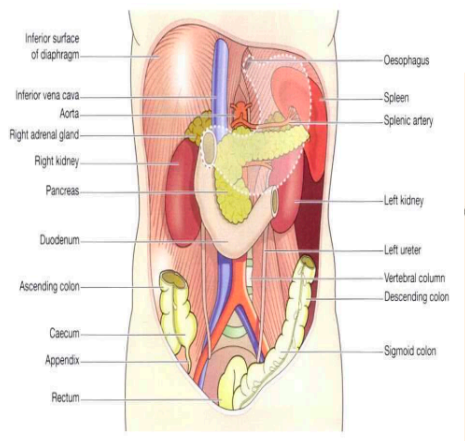
- subcostal vessels
- subcostal
- iliohypogastric
- ilioinguinal nerves.

▪ **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.

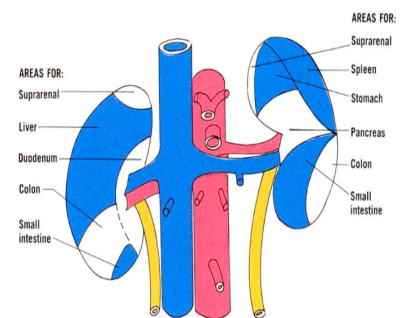
Pleura Injury

During Renal surgical operations Due to close relation between costo-diaphragmatic recess of the pleura and kidney



Anterior relations

Right Kidney	Left Kidney
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 hepatorenal pouch in between)	Posterior surface of stomach (with lesser sac 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

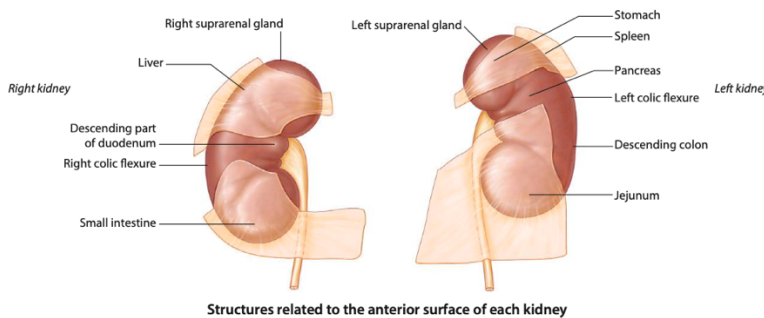


○ **Peritoneal covering of the kidney :-**

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

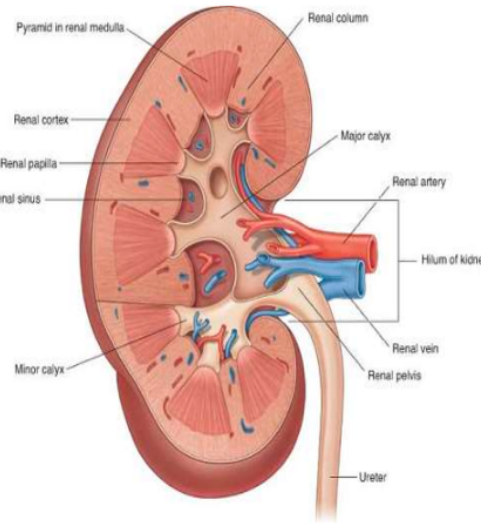
DR AHMED SALMAN



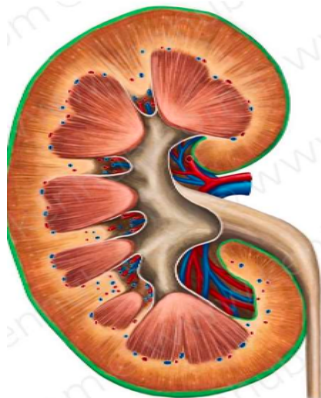
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○ **Structure of the kidney :-**

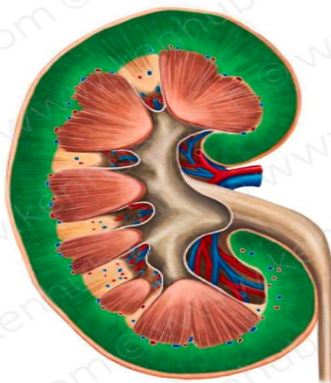
- The Kidneys has two **zones** (**outer** cortex and **inner** medulla) surrounding **sinus** of the kidney.
 - **1- Cortex**; pale and adjacent to the capsule. It is divided into;
 - Cortical arches which form caps over the bases of the medullary pyramids.
 - **2- Medulla**; is darker, deep to the 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



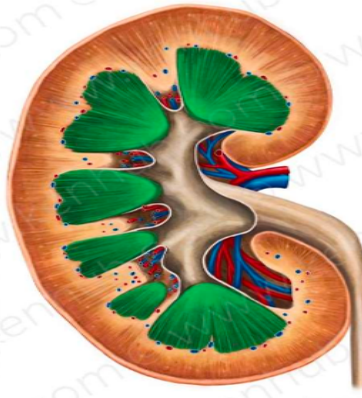
- Each pyramid with its cap of cortex form a **lobule** of the kidney (7-14 lobes)
- The minor calyces are about 5-12 per kidney. Each is a short funnel like tube which receives renal papillae
- The minor calyces unite to form 2-3 major calyces (in each kidney) and these in turn, unite to form the renal pelvis.



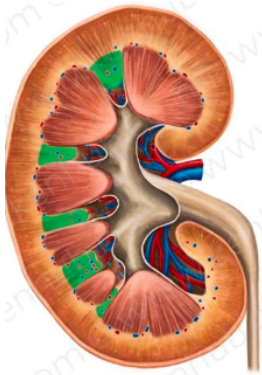
Renal Capsule



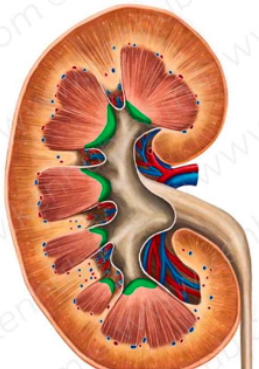
Renal Cortex



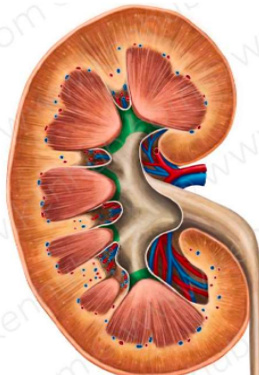
Renal Medulla



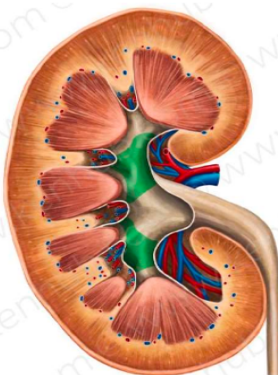
Renal columns



Renal papilla



Minor calyces



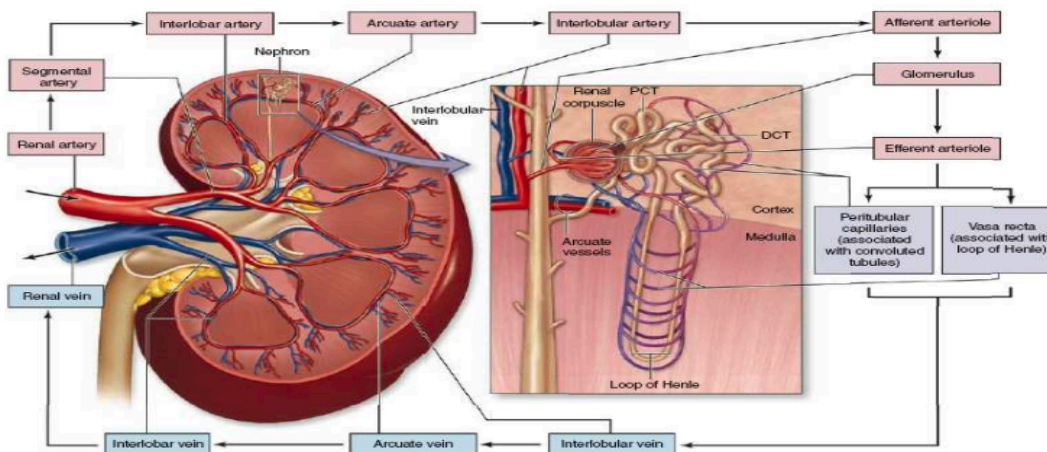
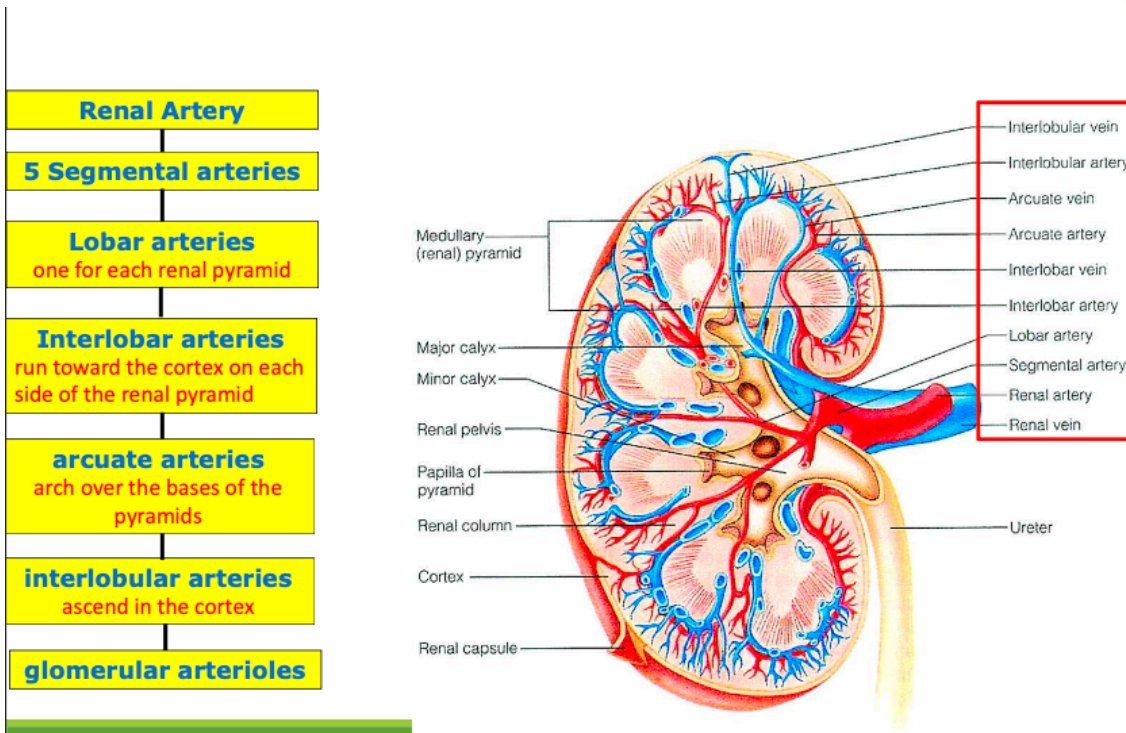
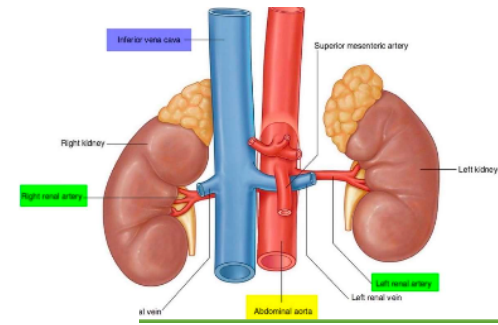
Major calyces



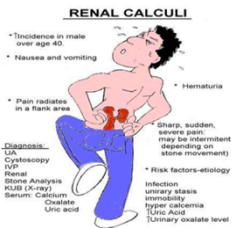
Renal pelvis

○ **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 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

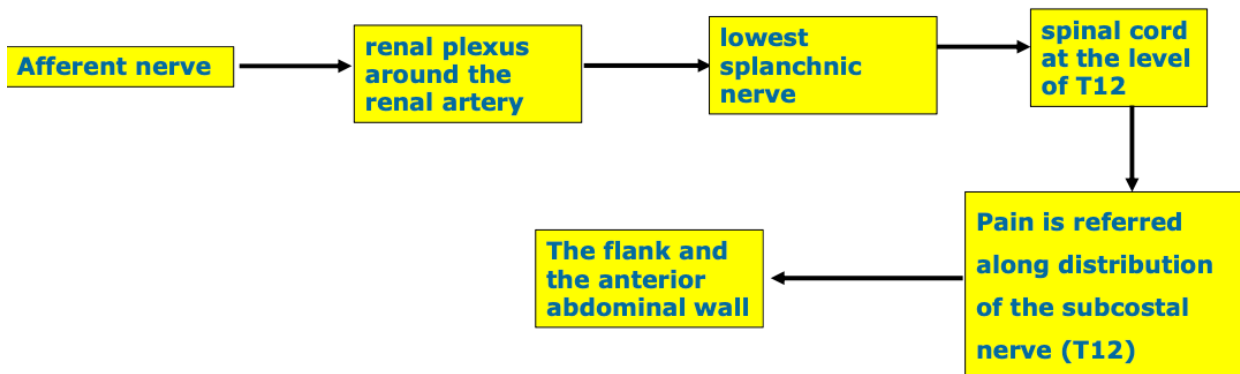


- **Venous drainage**
 - Both **right** and **left renal veins open directly into IVC**
 - **Left renal vein is** longer than the right and passes anterior to the aorta below origin of the **superior mesenteric artery.**
 - **The-left vein receives** the left suprarenal and left gonadal vein.
- **Lymph 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.
- **Renal Vein Entrapment Syndrome (Nutcracker syndrome)**
 - Compression of left renal vein between the SMA anteriorly and the abdominal aorta posteriorly .



Clinical presentation

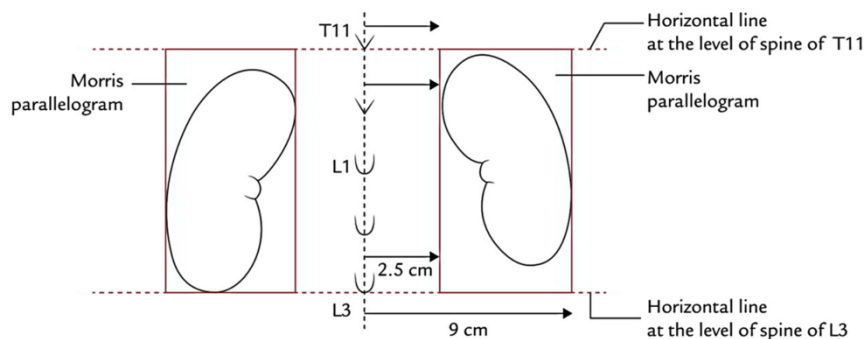
- Haematuria due to renal venous hypertension, rupture of thin-walled veins into the collecting system
- **Renal Pain**
 - Renal pain varies from a dull ache to a severe pain in the flank
 - Renal pain can result from stretching of the kidney capsule or spasm of the smooth muscle in the renal pelvis.



○ **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

