



MED437
KING SAUD UNIVERSITY



Kidney

Lecture 1

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هذا العمل لا يغني عن المصدر الأساسي للمذاكرة

{وَمَنْ يَتَوَكَّلْ عَلَى اللَّهِ فَهُوَ حَسْبُهُ}

Objectives

- Components of the Urinary system
- Kidney:
 - Shape & position
 - Surface anatomy
 - External features
 - Hilum and its contents
 - Relations
 - Internal structure
 - Blood supply
 - Lymph drainage
 - Nerve supply

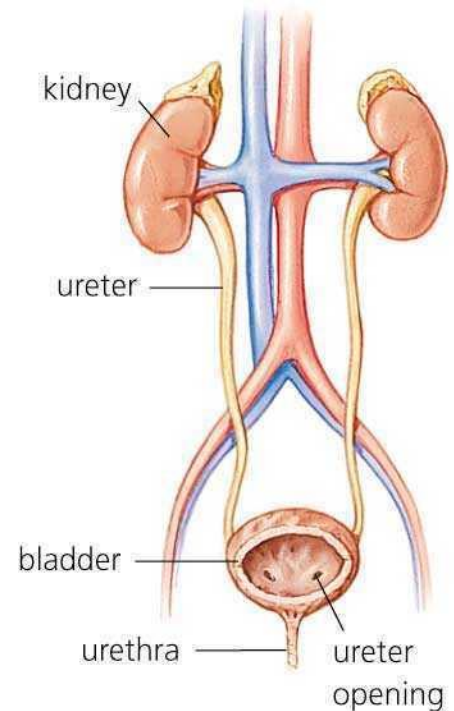
- Text in BLUE was found only in the boys' slides
- Text in PINK was found only in the girls' slides
- Text in RED is considered important
- Text in GREY is considered extra notes

Introduction

- The urinary system consists of the **kidneys**, **ureters**, **urinary bladder**, and **urethra**.
- 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.

Kidney (Renal) function

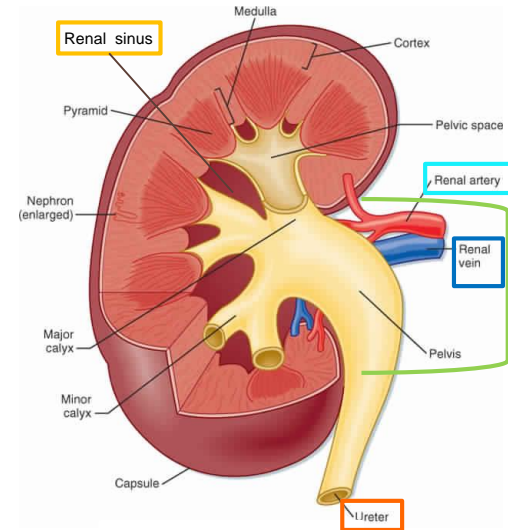
1. **Excretes** most of the waste products of metabolism.
2. **Controls** water & electrolyte balance of the body.
3. **Maintain** acid-base balance of the blood.
4. **Erythropoietin** hormone stimulates bone marrow for RBCs formation.
5. **Renin** enzyme regulates the blood pressure.
6. **Converts** vitamin D to its active form.



Kidney (Renal)

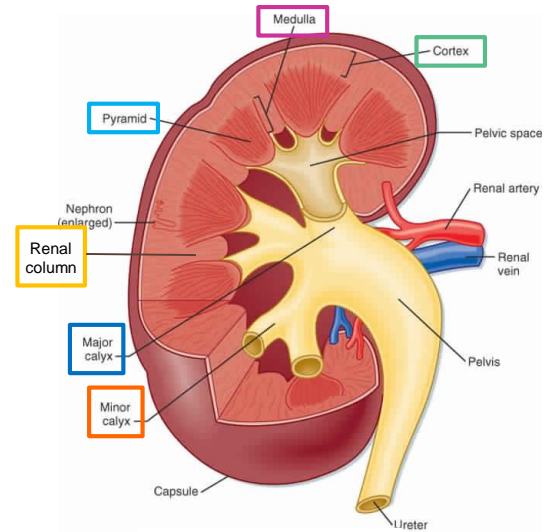
- Kidneys are **reddish brown** in color.
- Lie **behind** the peritoneum on the posterior abdominal wall on either side of the vertebral column. (T12-L3)
- They are largely under cover of the costal margin.
- The **right kidney** lies slightly **lower than** the left due to the large size of the right lobe of the liver.
- **The upper border of the right kidney is at the level of 11th intercostal space.**
- **The upper border of the left kidney is at the level of 11th rib.**
- With contraction (inspiration) 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.)**

You should know how to differentiate between right and left kidney



Kidney (Renal) Structure

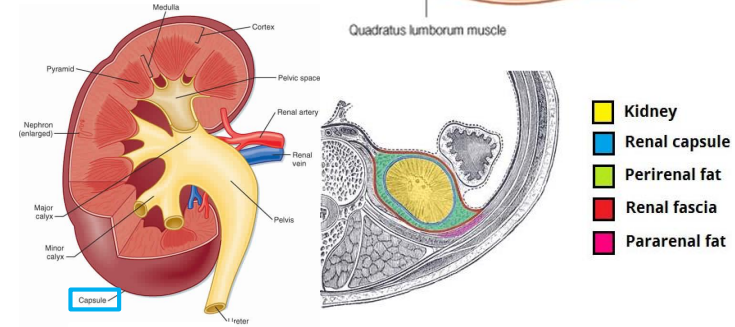
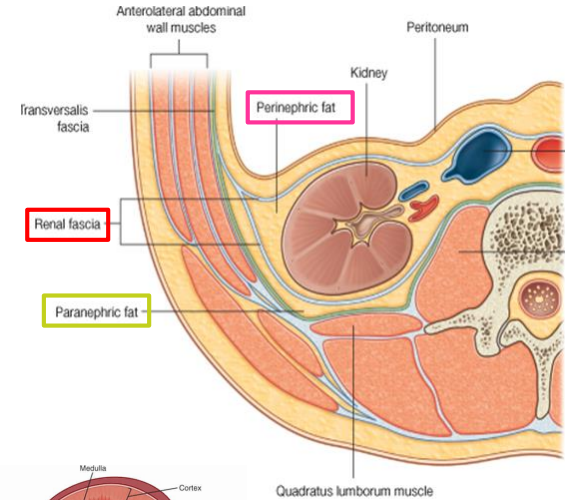
- Each kidney has an outer cortex and an inner medulla.
- Medulla is composed of about 12 renal pyramids.
- The **base** of each pyramid is directed toward the cortex & its apex (the renal papilla) is projecting medially.
- The cortex extends into the medulla between adjacent pyramids as the renal column.
- 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, which divides into **two** or **three** minor calyces.



Kidney (Renal) Coverings

- 1) **Fibrous capsule:**
It surrounds the kidney.
- 2) **Perirenal (perinephric) fat:** “i=inside”
It covers the fibrous capsule.
- 3) **Renal fascia:**
It encloses the kidneys and suprarenal glands.
- 4) **Pararenal (paranephric) fat:**
It lies external to the renal fascia, and forms part of the retroperitoneal fat. On extreme diets this layer will shrink leading to “floating kidneys” causing severe pain during trotting (هرولة).

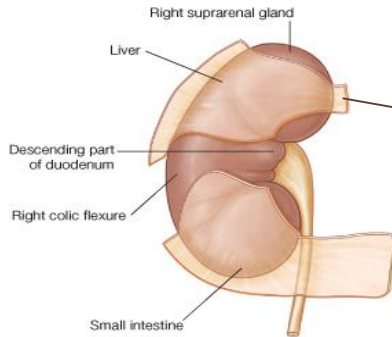
N.B. The last 3 structures support the kidney in position.



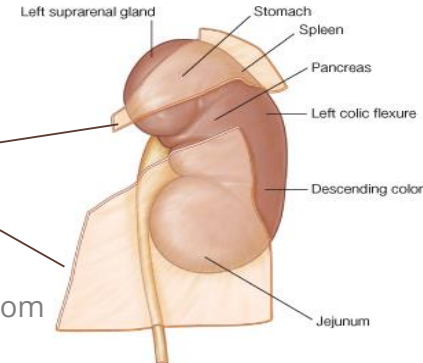
Kidney (Renal) Relations

Anterior Relation

Right Kidney



Left Kidney



peritoneum

*The ones in **bold** are separated from the kidney by the **peritoneum**.

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

*Flexure: Junction between the descending column & Transverse column

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

Kidney (Renal) Relations

Posterior Relation

Right Kidney

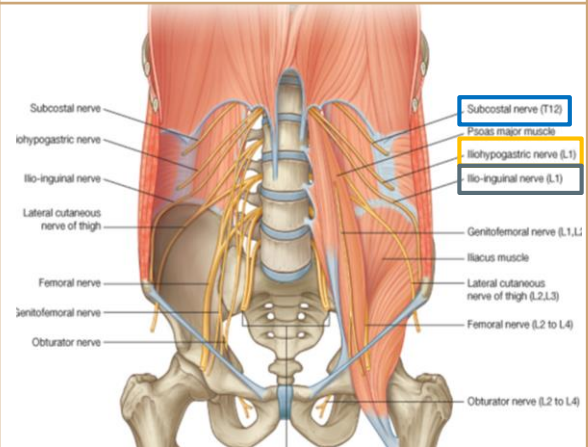
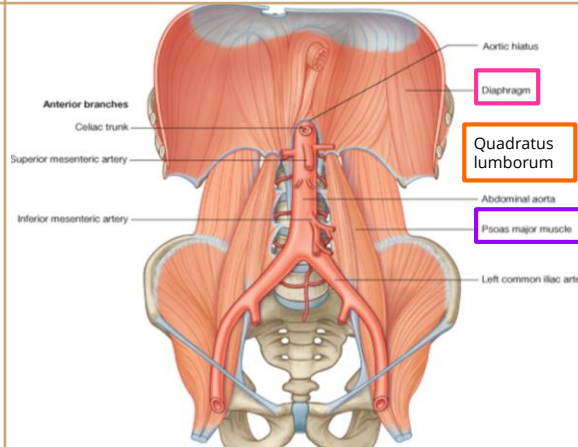
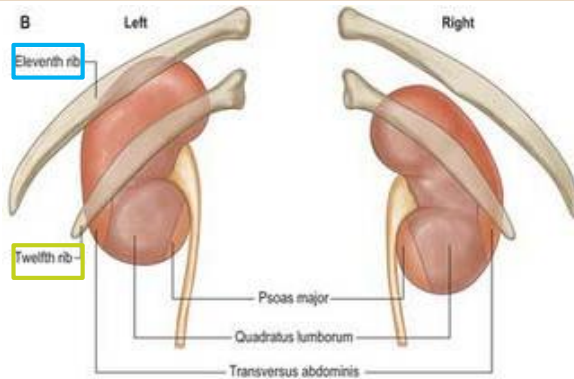
- Last intercostal space “between 11th and 12th ribs”
- Twelfth rib “the left kidney reaches up to the 11th rib”
- Costodiaphragmatic pleural recess

Muscles

- Diaphragm
- Psoas major “most medial”
- Quadratus lumborum “in between”
- Transversus abdominis “most lateral”

Nerves

- Subcostal nerve (T12)
- Iliohypogastric (L1) nerve
- Ilioinguinal (L1) nerve



Kidney (Renal) Blood supply

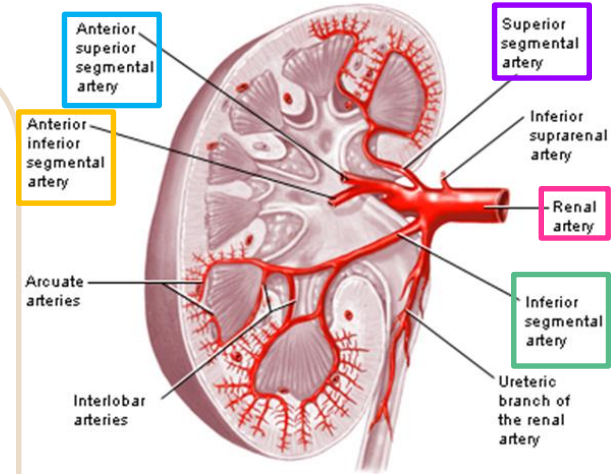
Renal artery

- arises from the aorta at the level of the **second lumbar vertebra**.

Segmental arteries

- Each renal artery divides into **five segmental** arteries that enter the hilum of the kidney, **four in front and one behind** the renal pelvis.
- They are distributed to different segments of the kidney.
 1. Apical (superior) segmental artery.
 2. Caudal (Inferior) segmental artery.
 3. Anterior superior segmental artery.
 4. Anterior inferior segmental artery.
 5. Posterior segmental artery.

ONLY in boy's slides



Kidney (Renal) Blood supply

Lobar artery

- arises from each segmental artery, one for each renal pyramid.
- Each lobar artery gives off **2 or 3 interlobar arteries**.

Interlobar arteries

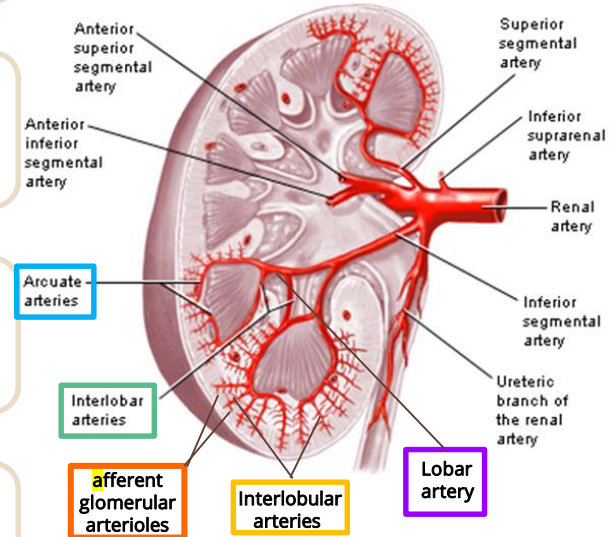
- run toward the cortex on each side of the renal pyramid.
- **Interlobar arteries** give off the arcuate arteries **at the junction of the cortex & medulla**.

Arcuate arteries

- give off several interlobular arteries.

Interlobular arteries

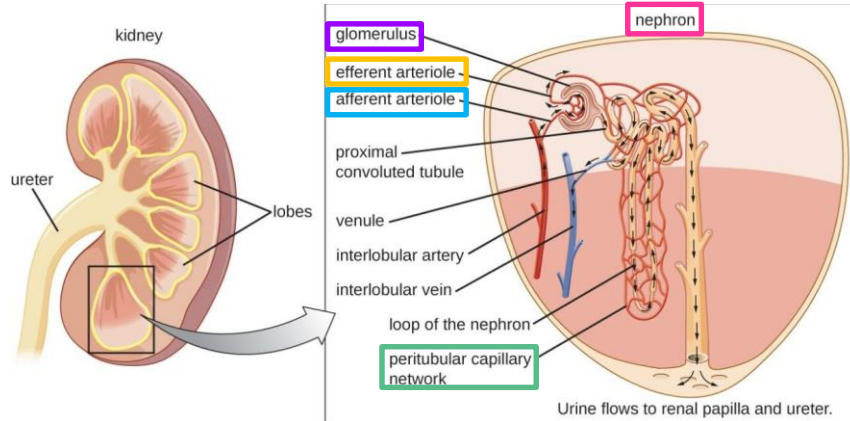
- gives off **afferent glomerular arterioles**.



Kidney (Renal) Blood supply

Nephron

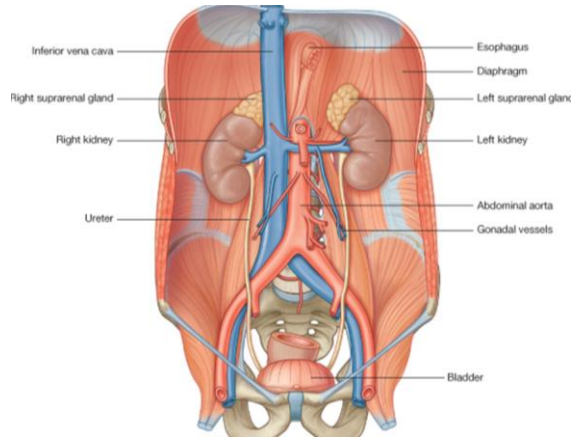
- **Nephron**, functional unit of the kidney. each nephron of the kidney contains blood vessels and a special tubule.
- Each **nephron** is associated with **two** capillary beds:
The **glomerulus**
The **peritubular capillary bed (network)**.
- The glomerulus is both fed and drained by **arterioles**:
The **afferent arteriole** which **arises** from an **interlobular artery**, is the "feeder vessel"
The **efferent arteriole** **receives** blood that has passed through the **glomerulus**.



In next slide "explanation
by prof. Abuel Makarem"

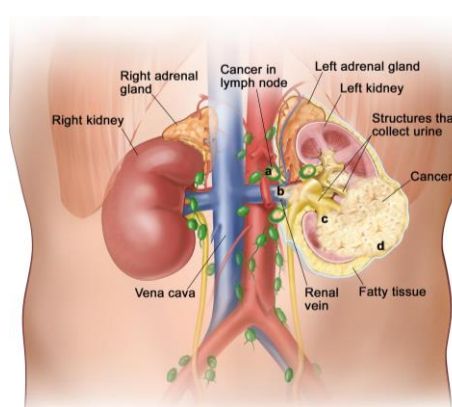
Venous Drainage

- Renal vein emerges from the hilum in front of the renal artery and **drains into the IVC.**
- The **left renal vein** is **longer** than the **right renal vein.**
- The **left renal vein** receives the **left gonadal & the left suprarenal veins.**



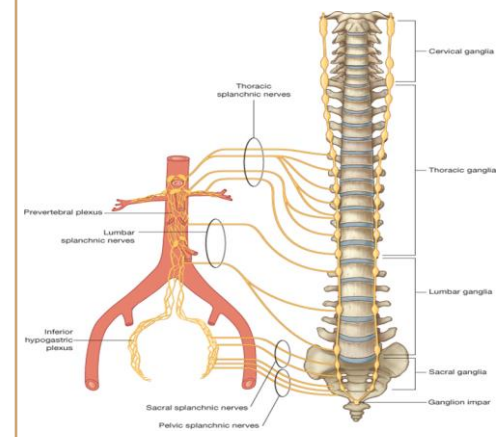
Lymph Drainage

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



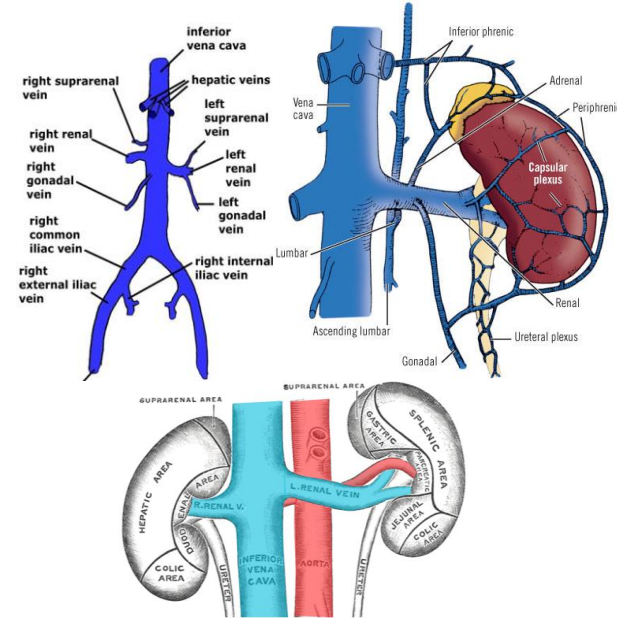
Nerves Supply

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



Venous drainage

- 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**
- **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**.

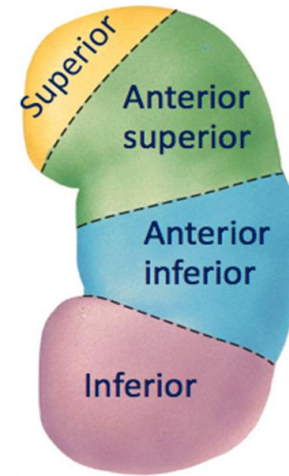


Kidney (Renal) Segments

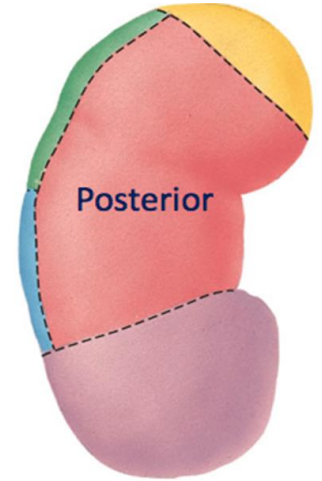
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Each kidney consists of 5 segments each has its own blood supply

1. Apical (superior) segment.
2. Anterior superior segment.
3. Anterior inferior segment.
4. Posterior segment
5. Caudal (Inferior) segment.



Anterior Surface



Posterior Surface

Summary

Easily forgotten:

- Kidneys lie **behind** the peritoneum on the posterior abdominal wall on either side of the vertebral column. (T12-L3)
- The **upper border** of the **right kidney** is at the level of **11th intercostal space**.
- The **upper border** of the **left kidney** is at the level of **11th rib**.
- The hilum transmits the renal **vein**, two branches of renal **Artery**, **Ureter**, and the third branch of renal **Artery (from anterior to posterior)**
- The cortex extends into the medulla between adjacent pyramids as the **renal column**.
- The renal sinus within the hilum, contains the upper expanded end of the ureter, the renal pelvis.

Kidney Relations (Anterior):

1- Right kidney:

- Right suprarenal gland
- **Liver**
- Second part of the duodenum (Descending part)
- Right colic flexure
- **Coils of small intestine**

2- left kidney:

- Left suprarenal gland
- **Stomach**
- **Spleen**
- Pancreas
- Left colic flexure
- Descending colon
- **Coils of jejunum**

Kidney Relations (Posterior):

1- Nerves:

- Subcostal nerve (T12)
- Iliohypogastric (L1) nerve
- Ilioinguinal (L1) nerve

2-Muscles:

- Diaphragm
- Psoas major (most medial)
- Quadratus lumborum (in between)
- Transversus abdominis (most lateral)

3- Others:

- Last intercostal space (between 11th and 12th ribs)
- Twelfth rib “the left kidney reaches up to the 11th rib”
- Costodiaphragmatic pleural recess

Renal functions:

- Excretes wastes
- water & electrolyte balance
- Acid-base balance
- Erythropoietin
- Renin regulates BP
- Converts Vitamin D to its active form

Renal covering:

- Fibrous capsule
- Perirenal (perinephric) fat “i=inside”
- Renal fascia
- Pararenal (paranephric) fat

MCQs

(1) What is the major responsibility of kidneys?

- A) Eliminating wastes
- B) Maintain of acid base
- C) Control of electrolytes
- D) Regulate blood pressure

(2) The right kidney lies slightly lower than the left due to the?

- A) Large left lobe of liver
- B) Large right lobe of liver
- C) Smaller right kidney
- D) Descent of the diaphragm

(3) Which of the following structure arrangements are the cover of kidney from superficial to deep?

- A) Fibrous capsule, renal fascia, perirenal fat, pararenal fat
- B) perirenal fat, pararenal fat, renal fascia ,fibrous capsule
- C) Pararenal fat, renal fascia, perirenal fat ,fibrous capsule
- D) Fibrous capsule, perirenal fat ,renal fascia ,pararenal fat

(4) which of the following is not considered an anterior relation with right kidney?

- A) Right suprarenal gland
- B) Second part of the duodenum
- C) Liver
- D) Pancreas

(5) The renal artery arises from abdominal aorta at the level of?

- A) L3
- B) L2
- C) L1
- D) T12

MCQs

(6) Which one of the following is a capillary bed?

- A) Peritubular
- B) Interlobar
- C) Juxtaglomerular apparatus
- D) Arcuate

(7) The right renal vein is behind the 2nd part of the duodenum and sometimes the?

- A) Head of the pancreas
- B) Ascending colon
- C) Mobilized Jejunum
- D) Right lobe of liver

(8) the lymphatic drainage of the kidneys is?

- A) Intermediate aortic lymph nodes near right lobe of liver
- B) Right colic lymph nodes
- C) Renal lymph vessels
- D) Lateral aortic lymph nodes around the origin of the renal

(9) Which of the following are segments of the kidney?

- A) Lateral segment
- B) Caudal segment
- C) Cortical segment
- D) Oblique segment

(10) Kidneys are _____ in color?

- A) Brown
- B) Reddish brown
- C) Red
- D) Black

MCQs

(11) Every day, each kidney filters liters of fluid from?

- A) Bloodstream
- B) Lung
- C) Skin
- D) All of them

(12) The right kidney lies _____ the left kidney?

- A) Upper than
- B) Lower than
- C) Upper border of
- D) As the level of

(13) The function of kidney?

- A) Excretes most of the waste products
- B) Controls water & electrolyte balance
- C) Maintain acid-base balance
- D) All of them

(14) With contraction of the diaphragm the kidney moves _____?

- A) Downward as much as 2 cm
- B) Upward as much as 2 cm
- C) Downward as much as 2.5 cm
- D) Upward as much as 2.5 cm

(15) _____ encloses the kidneys and suprarenal glands?

- A) Fibrous capsule
- B) Perirenal fat
- C) Renal fascia
- D) Pararenal fat

MCQs

(16) Medulla is composed of about?

- A) 9 renal pyramids
- B) 10 renal pyramids
- C) 11 renal pyramids
- D) 12 renal pyramids

(17) Renal pelvis divides into?

- A) 2 or 3 major calyces
- B) Renal sinus
- C) 2 or 3 minor calyces
- D) Pyramids

(18) Describe the position of spleen in Anterior relation of ?

- A) Right kidney with peritoneum
- B) Right kidney without peritoneum
- C) Left kidney with peritoneum
- D) Left kidney without peritoneum

(19) Interlobular arteries gives off _____?

- A) Afferent glomerular arterioles
- B) Efferent glomerular arterioles
- C) Loop of Henle
- D) Arcuate arteries

(20) The afferent fibers that travel through the renal plexus enter the spinal cord in the?

- A) 9th, 10th, and 11th thoracic nerves
- B) 10th, 11th, and 12th thoracic nerves
- C) 11th, and 12th thoracic nerves
- D) 12th thoracic nerve & 1st lumbar nerve

Answers

(1) A

(6) A

(2) B

(7) A

(3) C

(8) D

(4) D

(9) B

(5) B

(10) B

Answers

(11) A

(16) D

(12) B

(17) A

(13) D

(18) C

(14) C

(19) A

(15) C

(20) B



GOOD LUCK 

Rawan Alharbi
Faisal Alsaif
Abdulelah Aldossari
Abdulrahman Alduhayyim
Abdulaziz Aldrgam

