

# KABD II ANATOMY



**Urinary system**

**Lecture: 14**

**Pages: 6**

# Lecture 13: Urinary system

- **Nephrology**: the medical specialty that deals with the anatomy, physiology, and pathology of the kidney
- **Urology**: the branch of medicine that deals with the male and female urinary systems and the male reproductive system

## The Kidney

- Kidneys are the paired, reddish organs in the **posterior abdominal wall**
- dimensions: 12cm in length, 6cm in width, 3cm in thickness
- their medial border is concave, and their lateral border is convex
- they are considered **Retroperitoneal organs**; the parietal layer of peritoneum covers their anterior surface
- both kidneys are partially protected by the **11<sup>th</sup> & 12<sup>th</sup> ribs**
- the right kidney is located **slightly at lower level** than the left kidney; because the liver occupies the RUQ

## Functions of Kidneys

- 1 Regulation of:
  - blood ionic composition, by excreting excess salts and ions of the body
  - blood pH, by excreting excess  $H^+$  ions or reabsorption of  $HCO_3^-$  ions
  - blood volume, by monitoring volume of water
  - blood pressure, by secreting Renin enzyme that activates the RAAS
  - blood glucose, by the process of Gluconeogenesis
- 2 Maintaining blood osmolarity
- 3 Production of hormones, mainly Calcitriol (active vitamin D) and Erythropoietin
- 4 Excretion of wastes and foreign substances

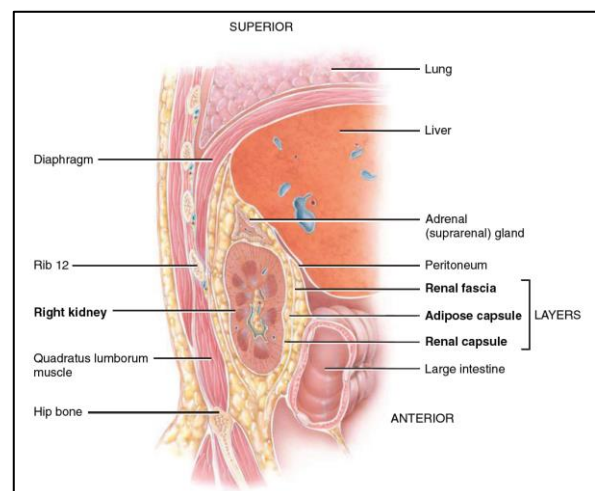
## External anatomy

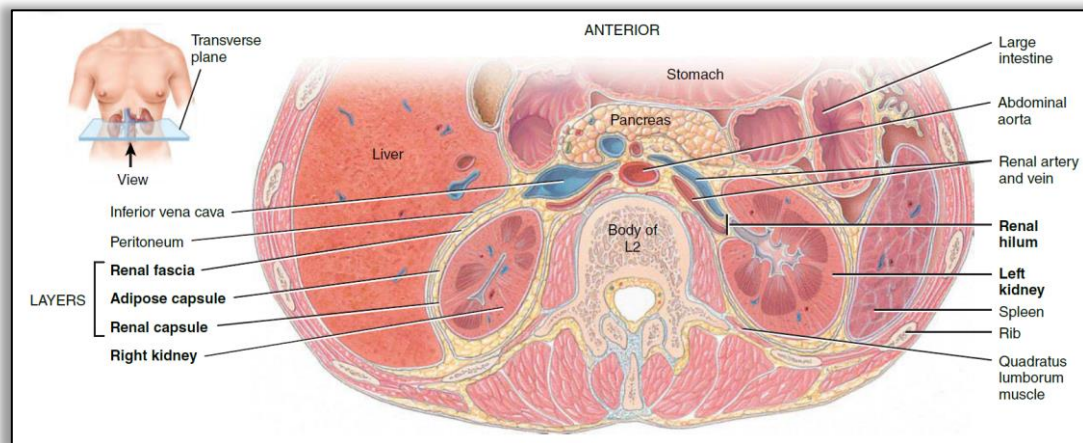
### ➤ Renal hilum

- concave indentation at the medial border of each kidney
- it is where blood vessels, lymphatic vessels, nerves, and ureter enter or exit the kidney
- the renal hilum is the entrance to a cavity in the kidney called (**Renal sinus**)

### ➤ Covering layers

- 1 **Renal capsule (inner)**, covers the cortex, serves as a barrier against trauma, and maintain kidneys shape
- 2 **Adipose capsule (middle)**, a fatty mass that surrounds kidneys and helps hold it in place and protect it from trauma
- 3 **Renal fascia (outer)**, anchors the kidney to the surrounding structures and to the posterior abdominal wall

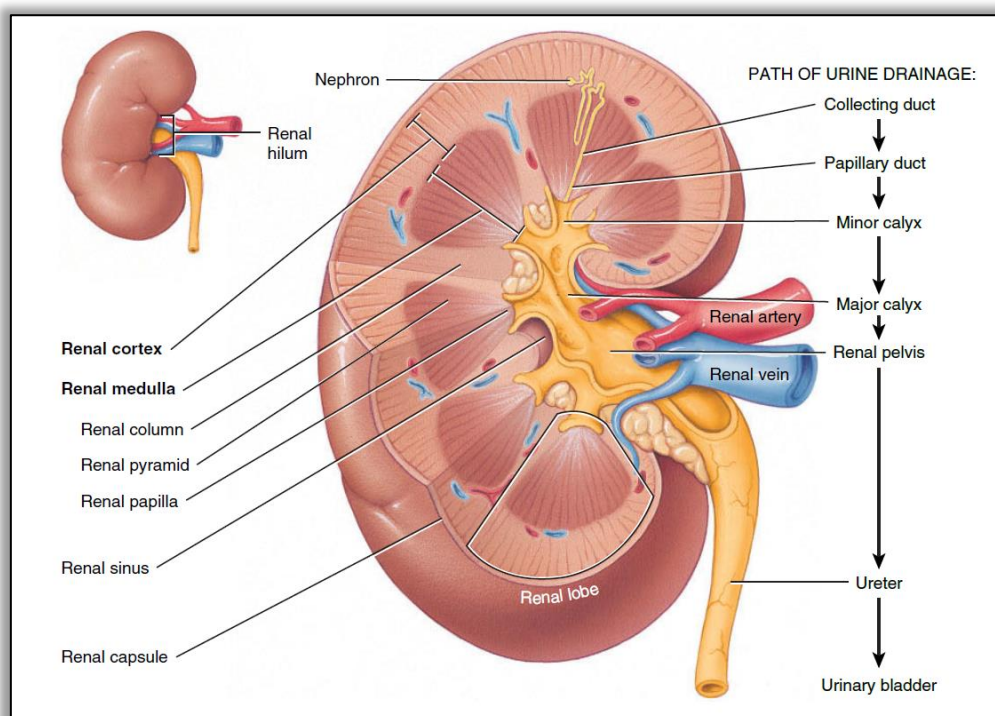




## Internal anatomy

The **functional tissue** of the kidneys is **Parenchyma**, and it contains the **functional unit** of the kidneys which is the **Nephron**. Parenchyma is composed of the following parts:

- 1) **Renal cortex**, the light-red outer layer of parenchyma, divided into:
  - A. **Cortical zone**, the outer portion of the cortex
  - B. **Juxtamedullary zone (Renal columns)**, the portion of the renal cortex that extend between the renal pyramids
- 2) **Renal medulla**, the dark-red inner region of the parenchyma that consists of several (8 - 18) cone-shaped regions called (**Renal pyramids**) whose apexes are called (**Renal papillae**) facing the interior of the kidney towards the hilum
- 3) **Renal lobe**, consists of:
  - ♦ 1 renal pyramid
  - ♦ the 1 overlying area of renal cortex
  - ♦ half of each one of the adjacent renal columns





▪ **Urine drainage pathway:** the pathway in which urine travels from the point where it is produced until it exits to the exterior environment, this pathway is composed of (in the following order):

- ❶ Collecting duct, the last part of the nephron that collects all urine produced
- ❷ Papillary duct, delivers urine to the minor calyx
- ❸ Renal papilla, found on each apex of each one of the renal pyramids, and each renal papilla open to 1 minor calyx
- ❹ Minor calyx, it drains the papillary ducts at that location
- ❺ Major calyx, made by the aggregation of minor calyces, it drains these minor calyces and delivers urine to renal pelvis
- ❻ Renal pelvis, large cavity at renal sinus that collects urine from all major calyces of the kidney to drain it in the ureter

▪ **Calyx:** cup-like cavity or sac

## Microscopic anatomy

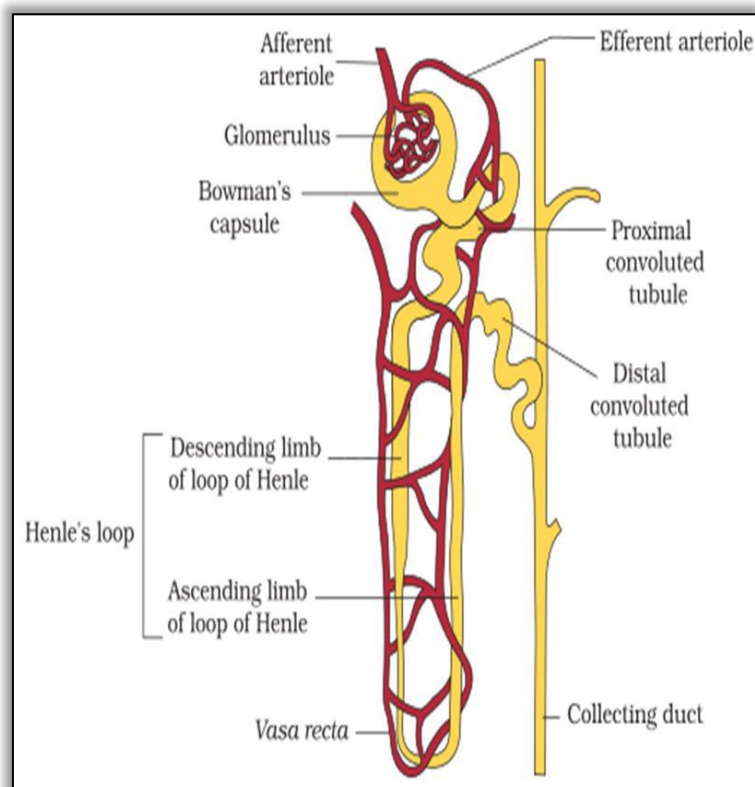
- **Nephron** is the microscopic functional unit of the kidney
- each parenchyma of each kidney contains 1 million nephrons
- the nephron produces urine by filtering blood, reabsorbing useful substances and removing unwanted substances
- each nephron consists of 2 major portions:

1) **Renal corpuscle**, the vesicle where the plasma is filtered, has 2 components:

- A. **Glomerulus**, a network of capillaries that receives blood from afferent arteriole when it enters the renal corpuscle
- B. **Bowman's capsule (Glomerular capsule)**, a double-walled epithelial cup surrounding the glomerulus

2) **The renal tubule**, the tubular tract where the filtered fluid flows into, it consists of 3 segments:

- A. **Proximal convoluted tubule**
- B. **Loop of Henle**, has 2 limbs: ascending limb and descending limb
- C. **Distal convoluted tubule**



## ➤ Types of nephrons:

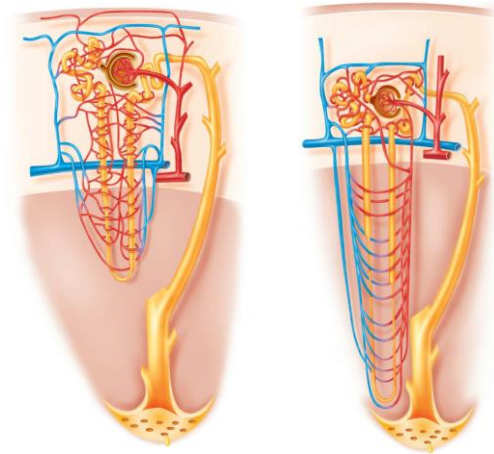
### 1) Cortical nephron (80% - 85% of all nephrons):

- the glomerulus is in the outer part of the cortex
- loop of Henle is short and penetrates only into the outer region of the medulla

### 2) Juxtamedullary nephron (15% - 20% of all nephrons):

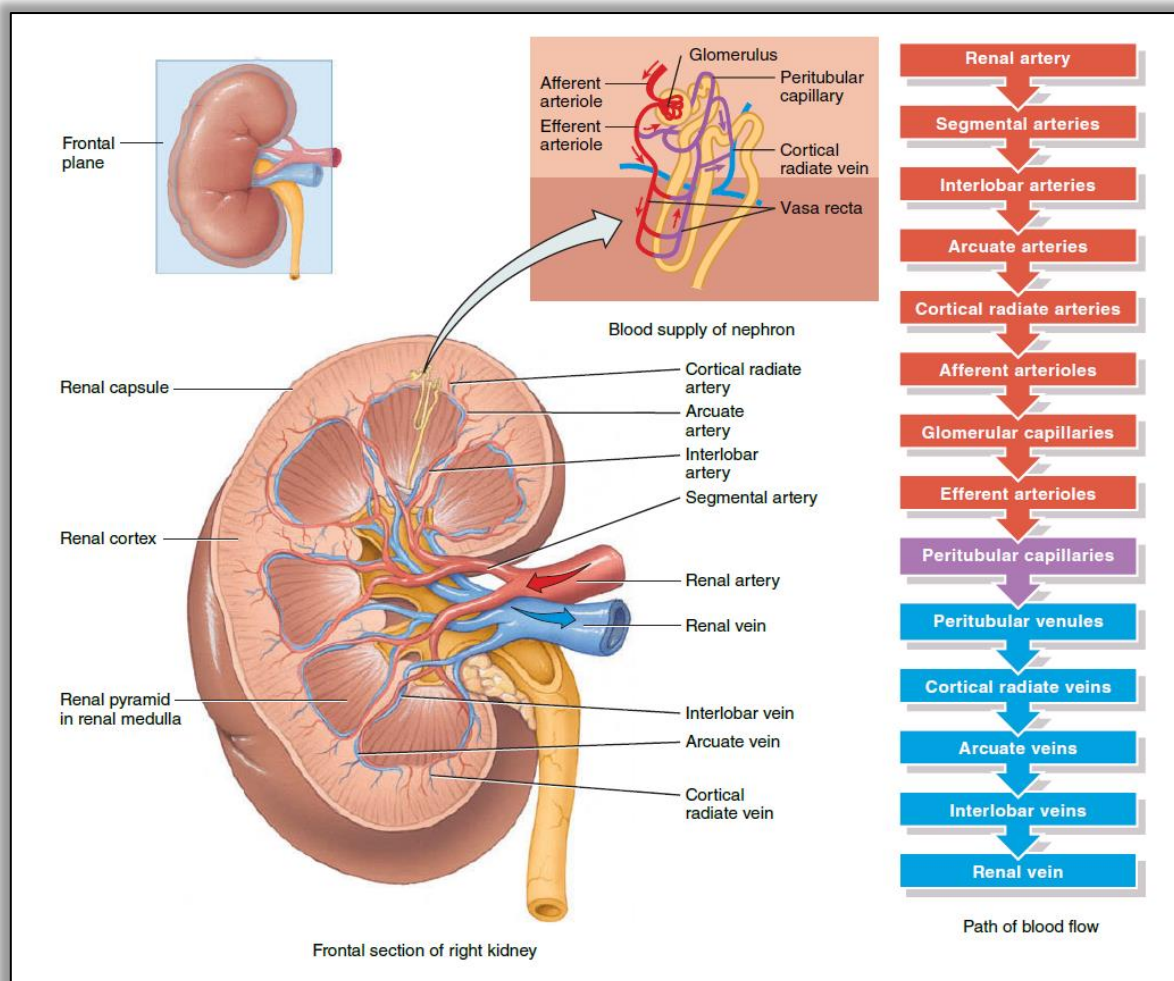
- the glomerulus is usually deep in the cortex and close to the medulla
- loop of Henle is long, penetrates deep into the medulla and its ascending limb has a thin then a thick portion
- these nephrons allow kidneys to excrete very concentrated urine; because loop of Henle is long

Cortical Nephron      Juxtamedullary Nephron



## Blood supply

The blood supply of kidneys come from the Abdominal aorta via the Renal arteries and it branches as the following:

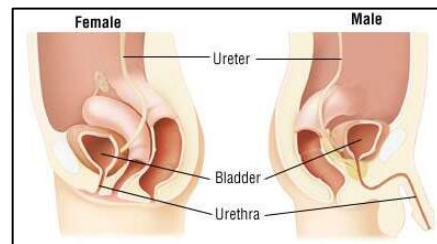


# The Ureters

- Ureters are 2 long (26 cm in length) retroperitoneal tubes
- they exit the renal pelvis at the renal hilum and enter the base of the urinary bladder from the posterior aspect
- the function of ureters is to transport urine into the urinary bladder, transport is accomplished by:
  - ♦ Peristaltic waves
  - ♦ Hydrostatic pressure
  - ♦ Gravity
- there is no **ANATOMICAL** valve of the ureters, but there is a **PHYSIOLOGICAL** valve for each ureter into the urinary bladder, this valve prevents the backflow of urine; **Mechanism?** the filling of the urinary bladder with urine will compress the oblique openings into the ureters, this pressure prevents urine backflow upwards

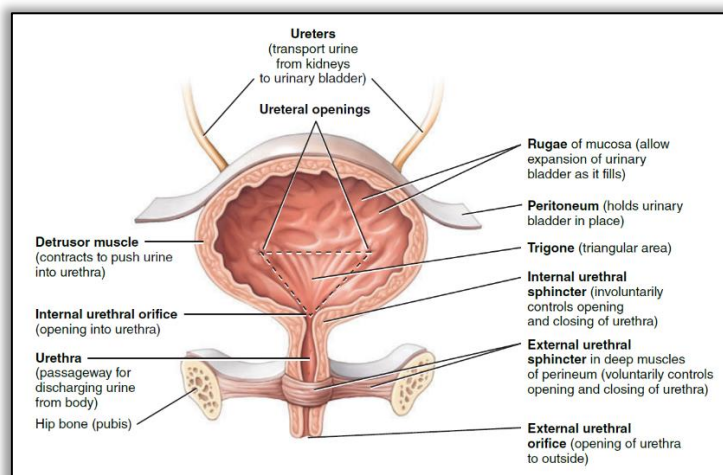
# The Ureters

- Urinary bladder is a hollow (spherical or pear-shaped) distensible muscular organ
- situated in the pelvic cavity posterior to the pubic symphysis, it stores urine until it exits the body by urination
- urinary bladder capacity is about (700 - 800) and may decrease when compressed by tumors or pregnancy
- location of urinary bladder:
  - ♦ In both genders → posterior to the pubic symphysis
  - ♦ In males → anterior to rectum
  - ♦ In females → anterior to vagina & inferior to uterus



## Anatomy of Bladder

- **Ureteral openings**, 2 oblique openings that attach both ureters to the interior of the urinary bladder
- **Internal urethral orifice**, the urethral opening that links urinary bladder to the urethra
- **Rugae**, the folds of the mucosa of the urinary bladder at the internal surface except for the trigone
- **Detrusor muscle**, smooth involuntary muscle that contracts to compress urinary bladder and push urine into urethra
- **Trigone**, smooth flat triangular area in the floor of bladder, bordered by 2 ureteral openings and 1 urethral opening. Trigone has a smooth appearance; because its mucosa is firmly bound to the muscularis of the urinary bladder



# The Ureters

Urethra is a tube that delivers urine from the internal urethral orifice of urinary bladder to the exterior to be eliminated

## Male urethra Vs Female Urethra

Gender	Male	Female
<b>Length</b>	20 cm long	4 cm long
<b>Location</b>	through the prostate, UG diaphragm, and Penis	a short separate tube through the UG diaphragm
<b>Passageway</b>	Internal urethral orifice → Prostatic urethra → Intermediate (Membranous) urethra → Spongy urethra → External urethral orifice	Internal urethral orifice → Urethra → External urethral orifice (between clitoris and vaginal opening)

**\*\*\*Note:** The male urethra is longer and more modified; because it is a passage way for both urine expelling (Urinary system) and semen discharging (Reproductive system)

