

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 **11th & 12th 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

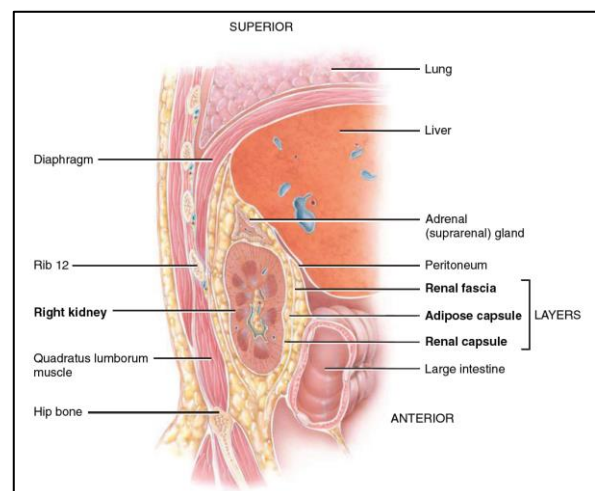
External anatomy

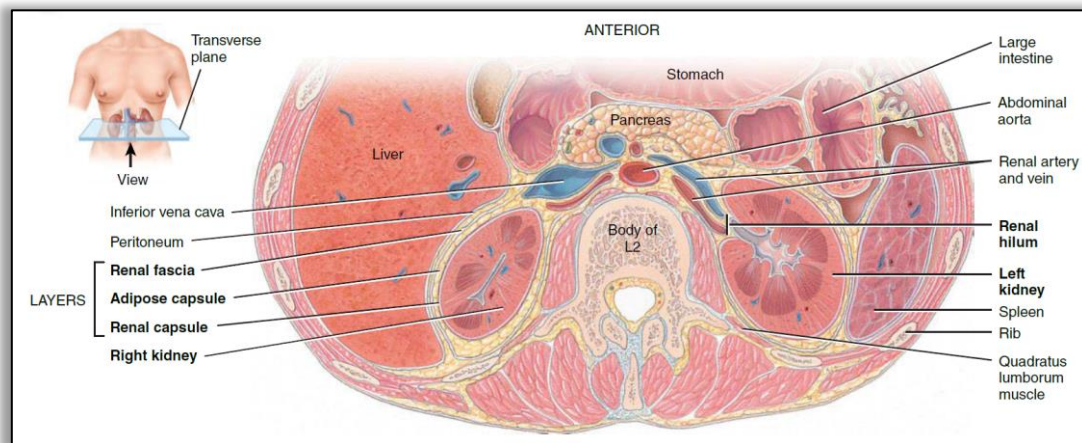
➤ Renal hilum

- 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 holds kidneys in place and protect them from trauma (MAIN PROTECTOR)
- 3 **Renal fascia (outer)**, anchors the kidney to the surrounding structures and to the posterior abdominal wall

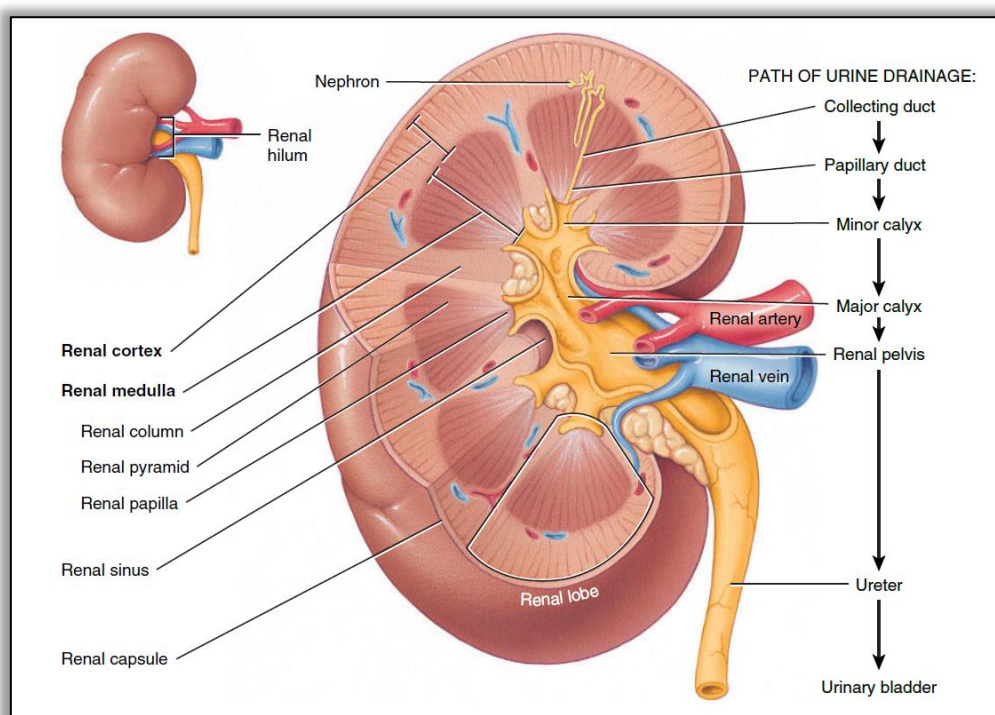




Internal anatomy

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

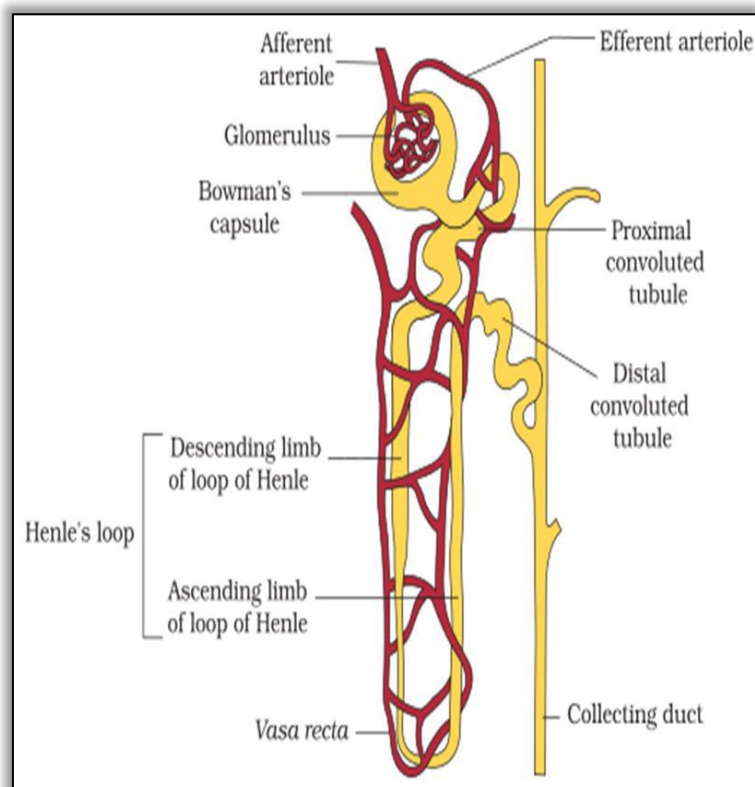
- **Nephron** is the microscopic functional unit of the kidney
- each parenchyma of each kidney contains 1 million nephrons
- the nephron produces urine by filtering blood, reabsorbing useful substances and removing unwanted substances
- each nephron consists of 2 major portions:

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):

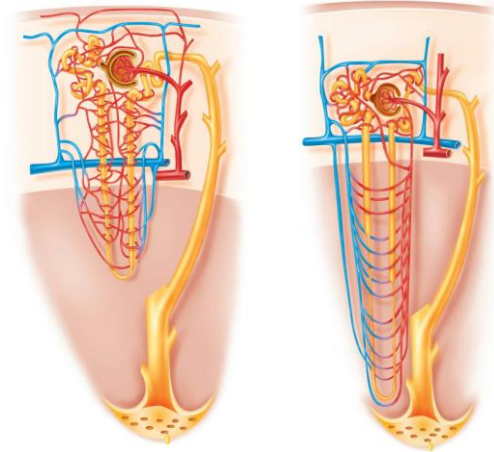
- the glomerulus is in the outer part of the cortex
- loop of Henle is short and penetrates only into the outer region of the medulla

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

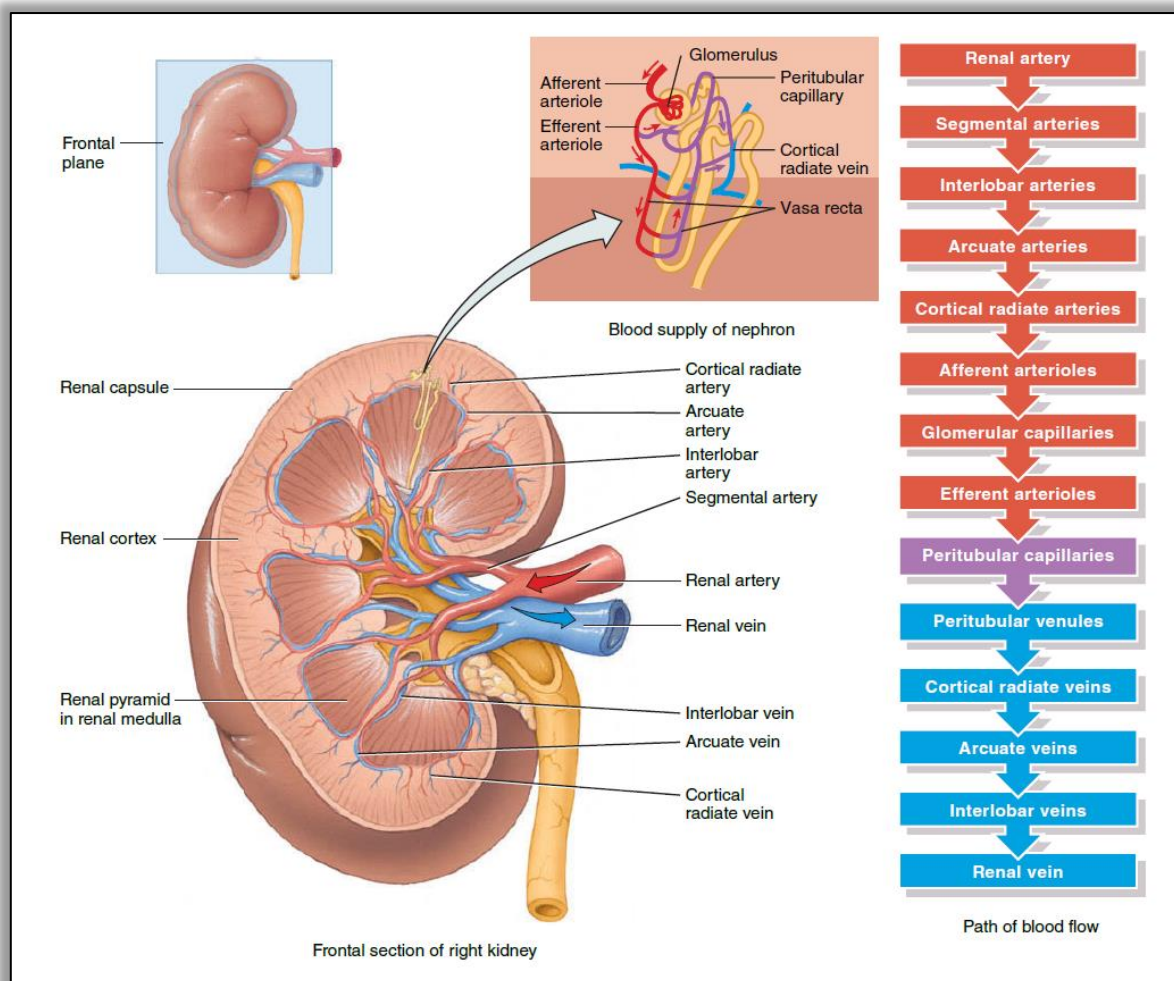
Cortical Nephron

Juxtamedullary Nephron



Blood supply

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



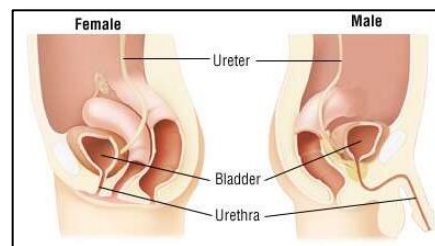
The Ureters

- 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 Urinary bladder

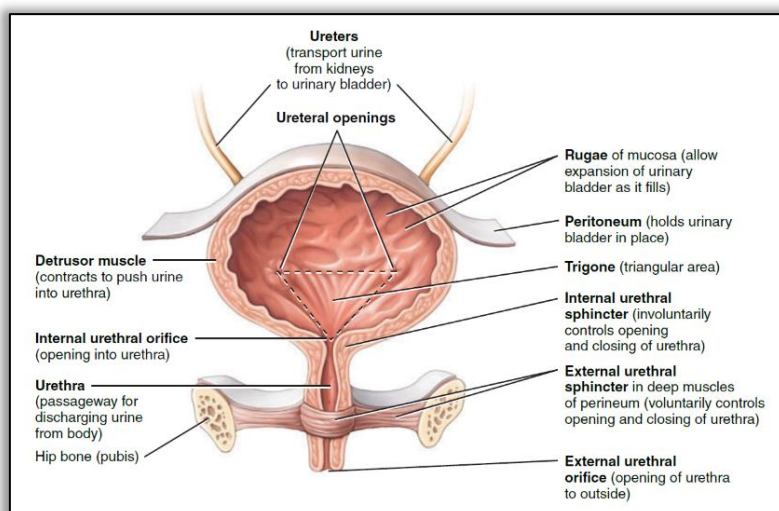
- Urinary bladder is a hollow (spherical or pear-shaped) distensible muscular organ
- situated in the pelvic cavity posterior to the pubic symphysis, it stores urine until it exits the body by urination
- urinary bladder capacity is about (700 - 800) and may decrease when compressed by tumors or pregnancy
- 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
- **External urethral sphincter**, the sphincter that controls the urine flow from urinary bladder to urethra; **voluntary**



The Urethra

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
Length	20 cm long	4 cm long
Location	through the prostate, UG diaphragm, and Penis	a short separate tube through the UG diaphragm
Passageway	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)

