

# HUMAN ANATOMY AND PHYSIOLOGY-II

## URINARY SYSTEM

**(Anatomy and functions nephron and urinary tract)**



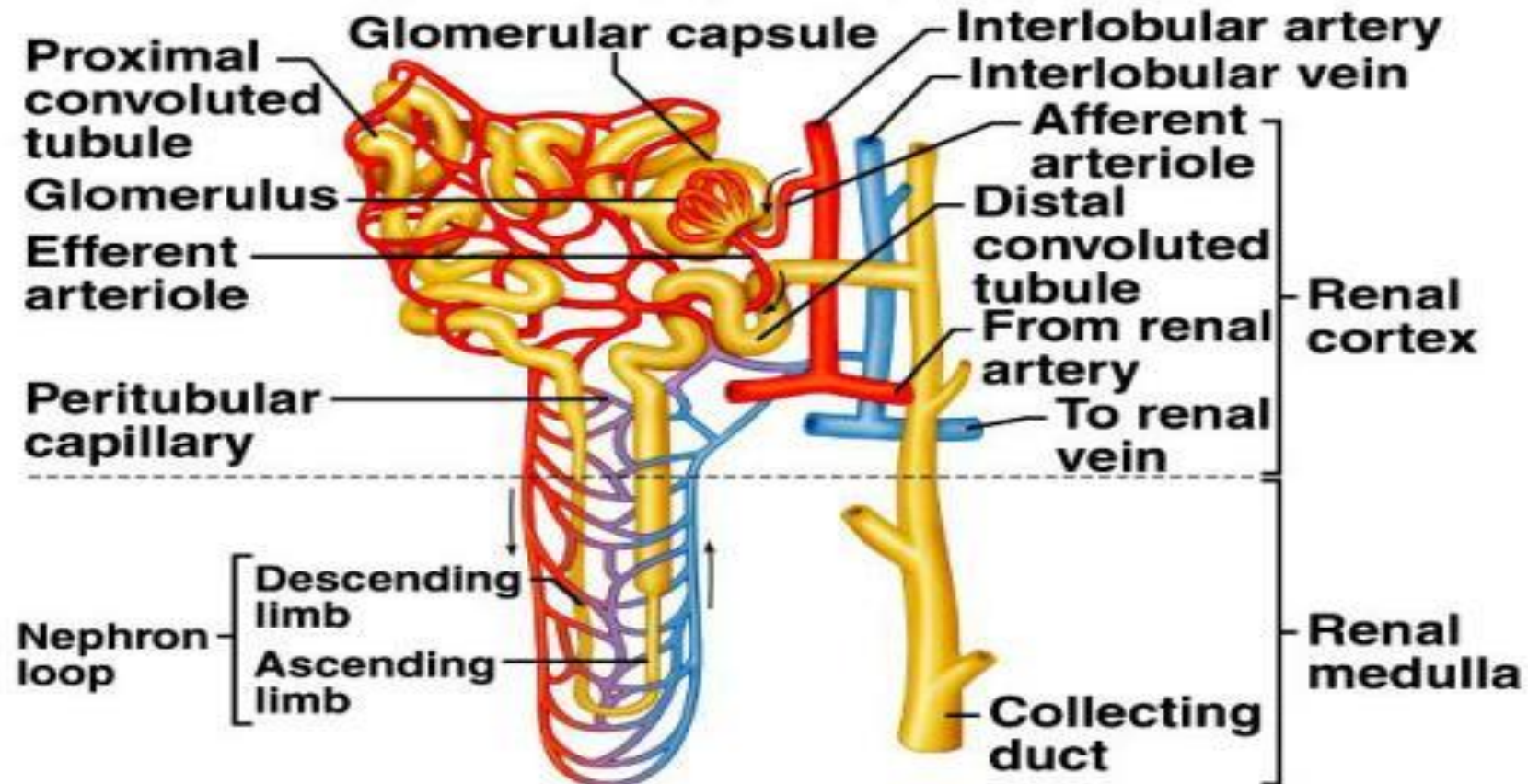
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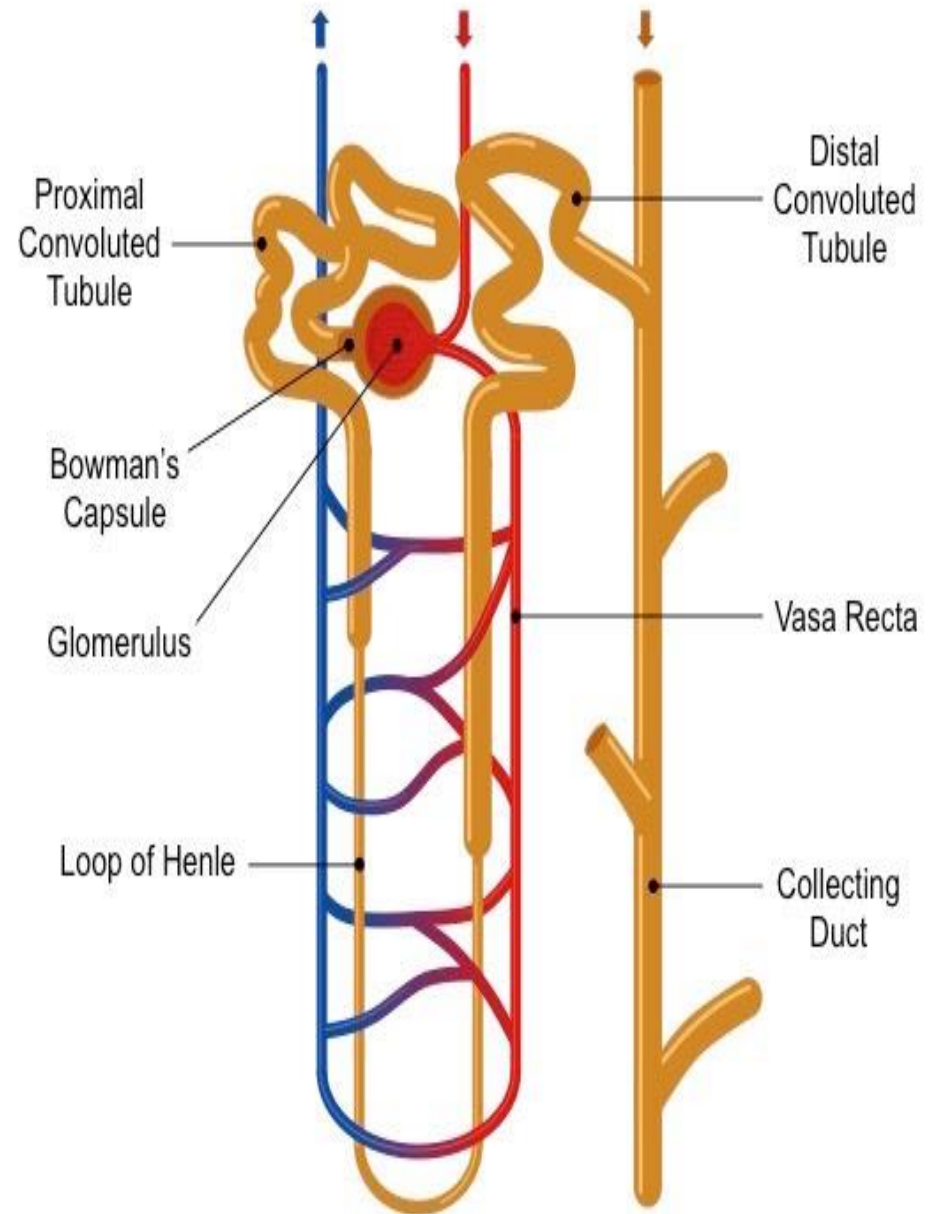
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# Nephron and Associated Blood Vessels

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- The nephron consists of a tubule closed at one end, the other end opening into a collecting tubule.
- The closed or blind end is indented to form the cup-shaped **glomerular capsule (Bowman's capsule)**, which almost completely encloses a network of tiny arterial capillaries, the glomerulus.
- Continuing from the glomerular capsule, the remainder of the nephron is about 3 cm long and is described in three parts
  - i. The proximal convoluted tubule
  - ii. the medullary loop (loop of Henle)
  - iii. the distal convoluted tubule, leading into a collecting duct



- The kidneys receive about 20% of the cardiac output. After entering the kidney at the hilum the renal artery divides into smaller arteries and arterioles.
- In the cortex an arteriole, the afferent arteriole, enters each glomerular capsule and then subdivides into a cluster of tiny arterial capillaries, forming the glomerulus.
- Between these capillary loops are connective tissue phagocytic mesangial cells, which are part of the monocyte–macrophage system
- The blood vessel leading away from the glomerulus is the efferent arteriole.
- The afferent arteriole has a larger diameter than the efferent arteriole, which increases pressure inside the glomerulus and drives filtration across the glomerular capillary walls
- The efferent arteriole divides into a second peritubular (meaning ‘around tubules’) capillary network, which wraps around the remainder of the tubule, allowing exchange between the fluid in the tubule and the bloodstream
- This maintains the supply of oxygen and nutrients to the local tissues and removes waste products.
- Venous blood drained from this capillary bed eventually leaves the kidney in the renal vein, which empties into the inferior vena cava

## **Renal Vein :**

- drain the kidney.
- connect the kidney to the inferior vena cava.
- Because the inferior vena cava is on the right half of the body, the left renal vein is generally the longer of the two.
- Unlike the right renal vein, the left renal vein often receives the left gonadal vein (left testicular vein in males, left ovarian vein in females).

## **Renal Artery:**

- normally arise off the abdominal aorta and supply the kidneys with blood.
- The arterial supply of the kidneys are variable and there may be one or more renal arteries supplying each kidney.
- Due to the position of the aorta, the inferior vena cava and the kidneys in the body, the right renal artery is normally longer than the left renal artery.
- The renal arteries carry a large portion of the total blood flow to the kidneys. Up to a third of the total cardiac output can pass through the renal arteries to be filtered by the kidneys.

## Functions of the Urinary System

### **The function of the kidneys are as follows:**

- **Filter:** Every day, the kidneys filter gallons of fluid from the bloodstream.
- **Waste processing:** The kidneys then process this filtrate, allowing wastes and excess ions to leave the body in urine while returning needed substances to the blood in just the right proportions.
- **Elimination:** Although the lungs and the skin also play roles in excretion, the kidneys bear the major responsibility for eliminating nitrogenous wastes, toxins, and drugs from the body.
- **Regulation:** The kidneys also regulate the blood's volume and chemical makeup so that the proper balance between water and salts and between acids and bases is maintained.
- **Other regulatory functions:** By producing the enzyme renin, they help regulate blood pressure, and their hormone erythropoietin stimulates red blood cell production in the bone marrow.
- **Conversion:** Kidney cells also convert vitamin D to its active form.

- **Ureters**

- The ureters do play an active role in urine transport.
- **Size:** The ureters are two slender tubes each 25 to 30 cm (10 to 12 inches) long and 6 mm (1/4 inch) in diameter.
- **Location:** Each ureter runs behind the peritoneum from the renal hilum to the posterior aspect of the bladder, which it enters at a slight angle.
- **Function :** Essentially, the ureters are passageways that carry urine from the kidneys to the bladder through contraction of the smooth muscle layers in their walls that propel urine into the bladder by peristalsis and is prevented from flowing back by small valve-like folds of bladder mucosa that flap over the ureter openings.

## • **Urinary Bladder**

The urinary bladder is a smooth, collapsible, muscular sac that stores urine temporarily.

- **Location:** It is located retroperitoneally in the pelvis just posterior to the symphysis pubis.
- **Function:** The detrusor muscles and the transitional epithelium both make the bladder uniquely suited for its function of urine storage.
- **Trigone:** The smooth triangular region of the bladder base outlined by these three openings is called the trigone, where infections tend to persist.
- **Detrusor muscles:** The bladder wall contains three layers of smooth muscle, collectively called the detrusor muscle, and its mucosa is a special type of epithelium, transitional epithelium.



- **Urethra**

- The urethra is a thin-walled tube that carries urine by peristalsis from the bladder to the outside of the body.
- **Internal urethral sphincter:** At the bladder-urethral junction, a thickening of the smooth muscle forms the internal urethral sphincter, an involuntary sphincter that keeps the urethra closed when the urine is not being passed.
- **External urethral sphincter:** A second sphincter, the external urethral sphincter, is fashioned by skeletal muscle as the urethra passes through the pelvic floor and is voluntarily controlled.
- **Female urethra:** The female urethra is about 3 to 4 cm (1 1/2 inches) long, and its external orifice, or opening, lies anteriorly to the vaginal opening.
- **Male urethra:** In men, the urethra is approximately 20 cm (8 inches) long and has three named regions: the prostatic, membranous, and spongy (penile) urethrae; it opens at the tip of the penis after traveling down its length.