

The urinary system

The kidneys have multiple functions: The main role of the urinary system is to maintain the body's homeostasis by regulating the composition, volume and pressure of the blood. To do this, it eliminates and returns specific quantities of water and solutes. The urinary system consists of two kidneys, two ureters, a bladder and a urethra.

1. Blood volume and composition.

The kidneys regulate the composition and volume of the blood and remove waste products from the blood in the form of urine. They eliminate a selective amount of various waste products, including excess H^+ , which helps to regulate the pH of the blood.

2. Blood pressure.

They help regulate blood pressure by secreting an enzyme, renin, which activates the renin-angiotensin system.

3. Metabolism.

The kidneys contribute to metabolism by :

- a) carrying out gluconeogenesis (the synthesis of new glucose molecules) during starvation or fasting,
- b) secreting erythropoietin, which stimulates the production of red blood cells, and
- c) participation in the synthesis of calcitriol, the active form of vitamin D.

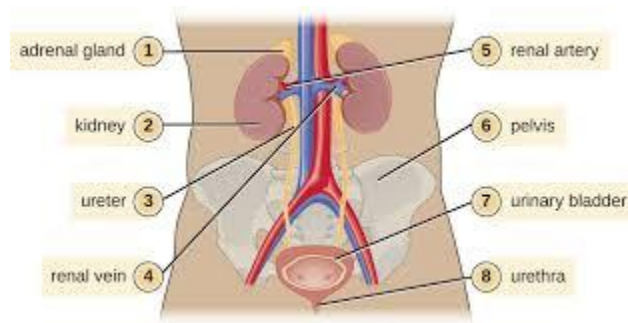
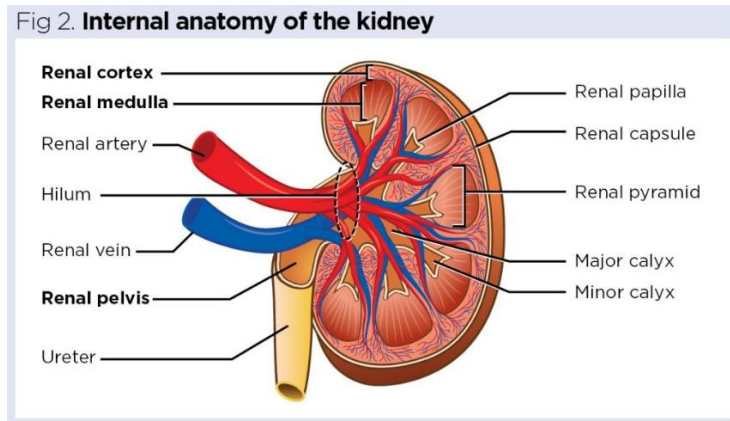


Fig 1: Constituents of the urinary system.



The nephron: is the functional unit of the kidney. A nephron has three main functions: filtration, secretion and reabsorption. During filtration, certain substances can pass from the blood into the nephrons, while others are prevented from doing so. Then, as the filtered liquid (filtrate) moves through the nephrons, it receives other substances (waste and excess substances); this is known as secretion. The process by which other substances (useful substances) are returned to the blood is called reabsorption. Urine is formed as a result of these activities of the nephrons.

PHYSIOLOGY OF URINE FORMATION: Urine formation involves three main processes:

1- Glomerular filtration: forced passage of liquids and dissolved substances through a membrane under the effect of pressure, into the renal corpuscle through the glomerular membranes. Blood pressure forces water and dissolved blood components through the fenestrations. The filtered liquid is called filtrate. In the glomerulus, blood filtration depends on three major pressures.

- **Glomerular hydrostatic pressure:** Glomerular hydrostatic pressure is the blood pressure in the glomerular capillaries.

- **Two other forces oppose this pressure:** capsular hydrostatic pressure and colloidal osmotic pressure in the blood.

2- Tubular reabsorption: Solutes liable to be reabsorbed by active and passive processes include glucose, amino acids, urea and ions such as Na^+ , K^+ , Ca^{2+} , Cl^- , HCO_3^- and HPO_4^{2-} . It occurs mainly in the proximal convoluted tubules, whose epithelial cells have numerous microvilli which increase the reabsorption surface.

3- Tubular secretion:

Tubular secretion removes substances from the blood and adds them to the filtrate (K^+), (H^+) (NH_4^+), creatinine, drugs, .

- RENAL FUNCTION CONTROL:

- Renal autoregulation of the glomerular filtration rate using negative feedback systems involving the juxtaglomerular apparatus.

- Hormonal regulation of the glomerular filtration rate by angiotensin II (renin-angiotensin-aldosterone system and (ADH).) and atrial natriuretic factor (ANF).

- the sympathetic division of the ANS.