

URINARY SYSTEM – Textbook and Lecture Slides

The organs of the **urinary system** are the kidneys, ureters, urinary bladder, and urethra. The kidneys filter waste products from the blood and convert the filtrate into **urine**. The ureters, urinary bladder, and urethra are collectively known as the **urinary tract** because they transport the urine out of the body.

Besides removing waste products from the blood, the urinary system performs many other functions, including the following:

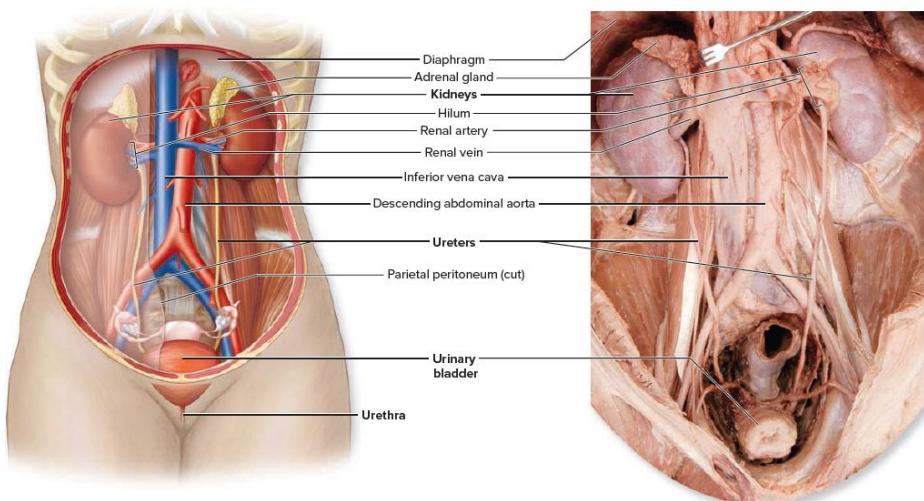
■ **Storage of urine.** Urine is produced continuously, but it would be quite inconvenient if we were constantly excreting urine. The urinary bladder is an expandable, muscular sac that can store as much as 1 liter of urine.

■ **Excretion of urine.** The urethra transports urine from the urinary bladder and expels it outside the body (micturition/urination).

■ **Regulation of blood volume.** The kidneys control the volume of interstitial fluid and blood under the direction of certain hormones. Because changes in blood volume affect blood pressure, the kidneys also indirectly affect blood pressure.

■ **Regulation of erythrocyte production.** As the kidneys filter the blood, they are also indirectly measuring the oxygen level in the blood. If blood oxygen levels are reduced, cells in the kidney secrete a hormone called **erythropoietin**. Erythropoietin acts on stem cells in the bone marrow to increase erythrocyte production. Having more erythrocytes allows the blood to transport more oxygen. **Regulation of ion levels.** The kidneys help control the blood's ion balance, such as sodium ions (Na^+), potassium ions (K^+), calcium ions (Ca^{2+}), and phosphate ions (PO_4^{3-}) by eliminating varying amounts of these ions in the urine, depending upon dietary intake.

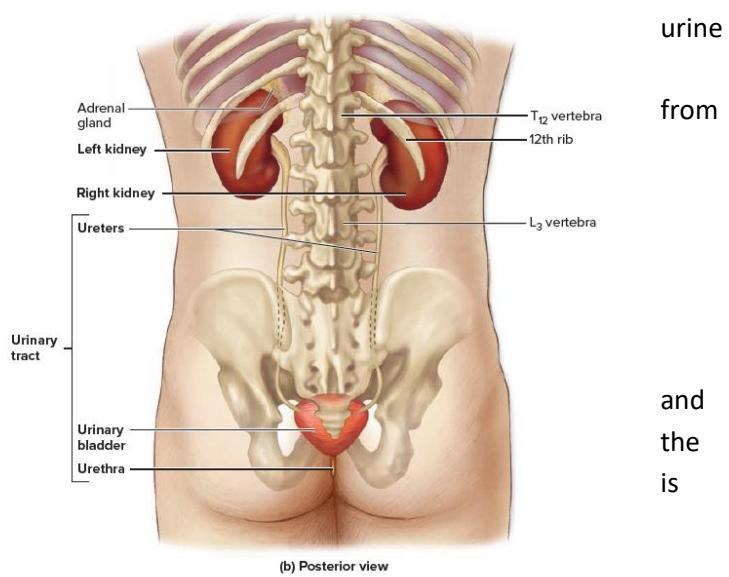
■ **Regulation of acid-base balance.** The kidneys aid in maintaining acid-base balance by altering blood levels of both hydrogen ions (H^+) and bicarbonate ions (HCO_3^-) by also eliminating varying amounts of these ions.



Kidneys filter waste products from the bloodstream convert the filtrate into urine. Ureters transport from the kidney to bladder via peristalsis. Urinary bladder stores urine and urethra transports urine the bladder to outside the body.

KIDNEYS

The left kidney is higher than the right kidney. They regulate blood volume and pressure, regulate erythrocyte production via erythropoietin, regulate blood's inorganic ion balance, sodium, potassium phosphate ions, acid balance through changes in rates of hydrogen ions and ammonium secretion. It **retroperitoneal** (behind parietal peritoneum).



Renal fascia is dense irregular tissue, anchors the kidney to surrounding tissue. **Adipose capsule** fat with adipose tissue cushioning and insulation. **Renal capsule** dense connective tissue, maintains kidney shape and protects from pathogens.

Ureters are always posterior and the renal vein is anterior to the renal artery. The ureter is a vessel for urine not a blood vessel. Hilum is the door and renal sinuses are inside the house. The renal sinus contains minor and major calices, renal pelvis, renal fat and blood vessels and the access to the renal sinus is the renal hilum.

Renal arteries branch laterally off descending abdominal aorta – renal arteries laterally = celiac trunk -medially and supplies unpaired structures and organs above transverse mesocolon. The kidneys blood supply goes from the kidneys to the renal vein to the inferior vena cava and into the right atrium (deoxygenated). It is via the systemic circuit. The branching of the renal arteries is before the hilum.

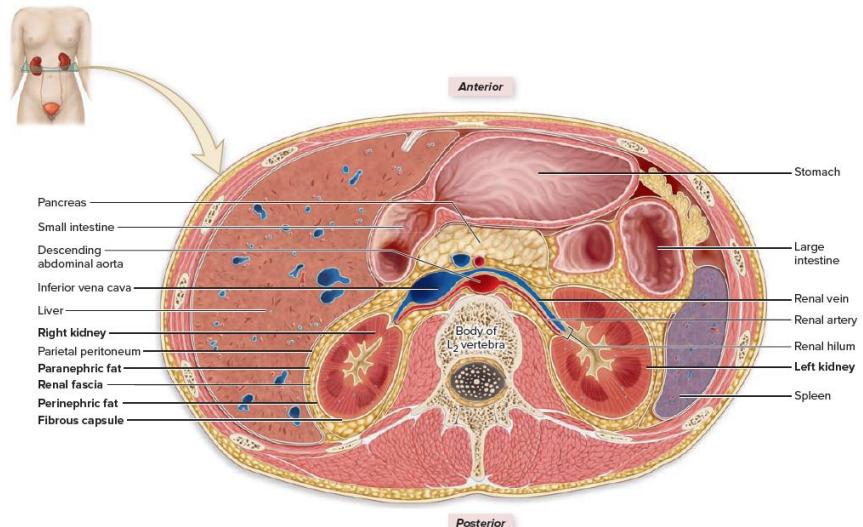
The glomerulus is the heart of the nephron that filtrates blood and leaves via the efferent arteriole. Interlobular veins and arteries, interlobar and segmental veins and arteries. Afferent arterioles IN, efferent arterioles OUT.

The **renal corpuscle**: composed of a capillary network called glomerulus which is surrounded by the glomerular capsule (Bowmans capsule) and produces a filtrate of blood. Waste moves from the glomerulus into the proximal convoluted tubule – tubular fluid – loop of Henle in medulla of kidney. Proximal convoluted tubule reabsorbs ions, nutrients, plasma proteins, vitamins and water and filtrate is called tubular fluid – distal convoluted tubule secretes ions into the tubular fluid and reabsorbs water – collecting duct for urine. The loop of Henle is surrounded by *vasa recta*.

The kidneys are two symmetrical, bean-shaped, reddish-brown organs located along the posterior abdominal wall, lateral to the vertebral column. Each kidney weighs about 100 grams and measures about 12 centimeters (cm) in length, 6.5 cm in width, and 2.5 cm in thickness.

The kidneys are retroperitoneal, because their anterior surface is covered with parietal peritoneum and the posterior aspect lies directly against the posterior abdominal wall. The **superior pole** (also called *superior extremity*) of the left kidney is at about the level of the T12 vertebra, and its **inferior pole** (also called *inferior extremity*) is at about the level of the L3 vertebra. The superior pole of the right kidney is positioned about 2 cm inferior to the superior pole of the left kidney to accommodate the large size of the liver.

An adrenal gland rests on the superior pole of each kidney.



The kidney has a concave medial border called the **hilum**, where vessels, nerves, and the ureter enter and/or exit the kidney. The hilum is continuous with an internal space within each kidney called the **renal sinus**. The renal sinus houses renal arteries, renal veins, lymph vessels, nerves, the renal pelvis, renal calyces, and a variable amount of adipose connective tissue. The kidney's lateral border is convex.