18/mhs07/018

Phs 212 Assignments

June 28, 2020

Explain urine formation and concentration.

**Urine formation**

Average urine production in adult humans is about 1–2 [litres](/wiki/Litres%22%20%5Co%20%22Litres) (L) per day, depending on state of hydration, activity level, environmental factors, weight, and the individual's health. Producing too much or too little urine requires medical attention. [Polyuria](/wiki/Polyuria%22%20%5Co%20%22Polyuria) is a condition of excessive urine production (> 2.5 L/day). [Oliguria](/wiki/Oliguria%22%20%5Co%20%22Oliguria) when < 400 mL (millilitres) are produced, and [anuria](/wiki/Anuria%22%20%5Co%20%22Anuria) one of < 100 mL per day.

The first step in urine formation is the filtration of blood in the kidneys. In a healthy human the kidney receives between 12 and 30% of [cardiac output](/wiki/Cardiac_output%22%20%5Co%20%22Cardiac%20output), but it averages about 20% or about 1.25 L/min.

The basic structural and functional unit of the kidney is the [nephron](/wiki/Nephron%22%20%5Co%20%22Nephron). Its chief function is to regulate the [concentration](/wiki/Concentration%22%20%5Co%20%22Concentration) of [water](/wiki/Water%22%20%5Co%20%22Water) and soluble substances like [sodium](/wiki/Sodium_salt%22%20%5Co%20%22Sodium%20salt) by filtering the [blood](/wiki/Blood%22%20%5Co%20%22Blood), reabsorbing what is needed and excreting the rest as [urine](/wiki/Urine%22%20%5Co%20%22Urine).

In the first part of the nephron, [Bowman's capsule](/wiki/Bowman%27s_capsule%22%20%5Co%20%22Bowman%27s%20capsule) filters blood from the [circulatory system](/wiki/Circulatory_system%22%20%5Co%20%22Circulatory%20system) into the tubules. Hydrostatic and osmotic pressure gradients facilitate filtration across a semipermeable membrane. The filtrate includes water, small molecules, and ions that easily pass through the filtration membrane. However larger molecules such as [proteins](/wiki/Proteins%22%20%5Co%20%22Proteins) and [blood cells](/wiki/Blood_cell%22%20%5Co%20%22Blood%20cell) are prevented from passing through the filtration membrane. The amount of filtrate produced every minute is called the [glomerular filtration rate](/wiki/Glomerular_filtration_rate%22%20%5Co%20%22Glomerular%20filtration%20rate) or GFR and amounts to 180 litres per day. About 99% of this filtrate is reabsorbed as it passes through the nephron and the remaining 1% becomes urine.

The urinary system is regulated by the [endocrine system](/wiki/Endocrine_system%22%20%5Co%20%22Endocrine%20system) by [hormones](/wiki/Hormone%22%20%5Co%20%22Hormone) such as [antidiuretic hormone](/wiki/Antidiuretic_hormone%22%20%5Co%20%22Antidiuretic%20hormone), [aldosterone](/wiki/Aldosterone%22%20%5Co%20%22Aldosterone), and [parathyroid hormone](/wiki/Parathyroid_hormone%22%20%5Co%20%22Parathyroid%20hormone).

**Regulation of concentration and volume**

The urinary system is under influence of the [circulatory system](/wiki/Circulatory_system%22%20%5Co%20%22Circulatory%20system), [nervous system](/wiki/Nervous_system%22%20%5Co%20%22Nervous%20system), and [endocrine system](/wiki/Endocrine_system%22%20%5Co%20%22Endocrine%20system).

[Aldosterone](/wiki/Aldosterone%22%20%5Co%20%22Aldosterone) plays a central role in regulating blood pressure through its effects on the kidney. It acts on the distal tubules and collecting ducts of the nephron and increases reabsorption of sodium from the glomerular filtrate. Reabsorption of sodium results in retention of water, which increases blood pressure and blood volume. Antidiuretic hormone (ADH), is a [neurohypophysial hormone](/wiki/Neurohypophysial_hormone%22%20%5Co%20%22Neurohypophysial%20hormone) found in most [mammals](/wiki/Mammals%22%20%5Co%20%22Mammals). Its two primary functions are to retain water in the body and [vasoconstriction](/wiki/Vasoconstriction%22%20%5Co%20%22Vasoconstriction). Vasopressin regulates the body's [retention of water](/wiki/Water_retention_%28medicine%29%22%20%5Co%20%22Water%20retention%20%28medicine%29) by increasing water reabsorption in the collecting ducts of the kidney nephron. Vasopressin increases water permeability of the kidney's collecting duct and distal convoluted tubule by inducing translocation of aquaporin-CD water channels in the kidney nephron collecting duct plasma membrane.