

The Kidneys

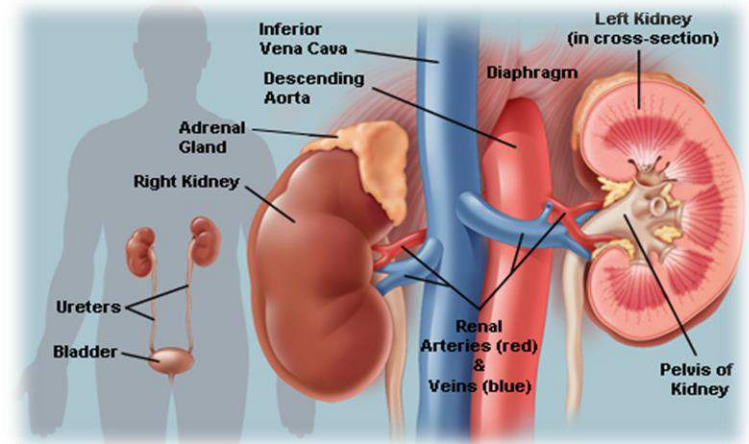
Overview

The kidneys are a pair of organs located in the back of the abdomen. Each kidney is about the size of a fist. The kidneys' function is to filter the blood by removing waste products, and control the fluid balance in the body whilst regulating the balance of electrolytes. The kidneys are also involved in hormone production and blood pressure regulation. All the blood in our body passes through the kidneys several times a day.

Excretion

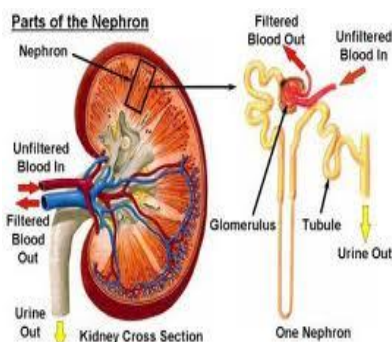
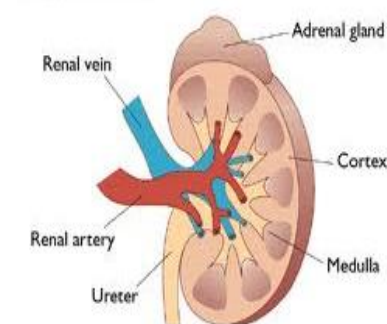
The kidneys, ureters, bladder and urethra make up the urinary system. The anatomy of the kidney enables it to function as a filter, removing waste from the blood to make urine. The urine travels down the ureters to the bladder, where it is stored until it is evacuated through the urethra.

Blood containing waste products enters the kidney through the renal artery. The kidney can be divided into two distinct regions. There is an outer reddish brown capsule called the cortex and an inner lighter coloured part called the medulla. Once the blood has been filtered it leaves the kidney via the renal vein.



The Cortex

The cortex is where the initial process of ultrafiltration takes place. The cortex is made up of special units called nephrons and a system of straight and curvy collecting tubules supplied by many blood vessels. Each kidney contains about a million nephrons which contain filtering units known as glomeruli, through which blood is filtered by high pressure in the first stage of filtration. The substance removed from the blood in the glomeruli is called glomerular filtrate and this is collected in the Bowman's capsule, surrounding the glomeruli, before continuing on its journey through the nephrons.



The Medulla

The medulla is the inner part of the kidney, a continuation of the specialised nephrons in the cortex. The medulla contains structures responsible for maintaining the electrolyte and water balance of the blood. These structures include the proximal and distal convoluted tubules, the loop of Henle, and the collecting duct, which are all involved in further filtration of the glomerular filtrate in the medulla of the kidney, eventually leaving the waste product that is urine. The concentration of the urine depends on how much water and electrolytes the body needs to retain or excrete.

Blood Pressure Regulation

The process of filtration does not only occur to excrete waste. Long term regulation of blood pressure predominantly depends upon the kidneys. As mentioned above, the kidneys are responsible for maintaining electrolyte and fluid levels in the bloodstream. When the kidneys filter the blood of waste products, they also regulate electrolytes in the blood. Electrolytes are minerals such as sodium, calcium and potassium in your body that carry an electric charge. They help control fluid levels, blood acidity, muscle action and nerve conduction.

Although the kidney cannot directly detect changes in blood pressure, changes in the delivery of sodium and chloride to the distal part of the nephron are detected so when blood pressure is increased, the delivery of the electrolytes will be increased which triggers a decrease in the production of the enzyme renin. Renin is secreted by the kidney and plays an important role in vasoconstriction, which is the constriction of blood vessels, so blood vessels will dilate when there is less renin in the blood stream, decreasing blood pressure.

People with chronic high blood pressure or hypertension are sometimes prescribed a class of drugs called diuretics to control their blood pressure. Diuretics reduce sodium reabsorption into the body. Water reabsorption is also reduced. Therefore, sodium and water are lost in the urine, which increases urine flow. The decreased reabsorption of sodium and water from the kidney reduces blood volume, thereby reducing blood pressure.

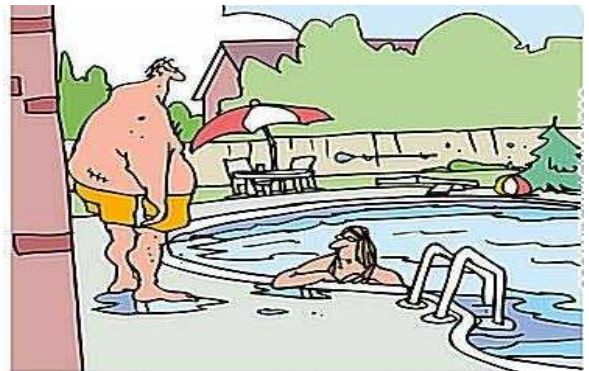
Hormone Production

The kidneys secrete two main hormones, erythropoietin, and calcitriol. Erythropoietin is released in response to low levels of oxygen at tissue level in the renal circulation. This could be in response to bleeding, or a person being at high altitude. Erythropoietin stimulates erythropoiesis, production of red blood cells, in the bone marrow, so there will be increased blood cells to circulate oxygen around the body.

Calcitriol is the activated form of vitamin D, and it promotes intestinal absorption of calcium and the renal reabsorption of phosphate, as well as acting on bone to mobilise calcium into the blood. Insufficient levels of calcium can lead to calcium deficits in the blood and conditions affecting the bones such as osteomalacia, or soft bones.

Kidney Facts

- The kidneys produce between one to two litres of urine a day.
- If all the nephrons in one kidney were connected, they would run for eighty kilometres.
- We have about a million glomeruli at birth, however we lose about 100,000 of these every decade of our lives.



“The kidney shape was a cool idea. Reminds us what you sold to pay for it.”

LexiMed Consultants

• **Dr Malcolm Wright**
Physician

• **Dr Matthew Rickard**
Physician