

Mechanical properties of tissues - Excretory system

Parts of the excretory system

From a functional point of view, the urinary system is divided into the **part that produces urine** (kidney parenchyma) and the part that **drains urine** from the body (renal pelvis, ureter, bladder and urethra). These structures are collectively referred to as the urinary tract.

Functions

The main function of the excretory system is to ensure the homeostasis of the organism through the **production of urine**. Harmful metabolic waste products are excreted from the body through urine. It also produces several different hormones.

Kidneys

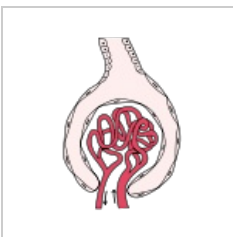
The kidney is a paired organ on the surface covered with a fibrous capsule and entirely surrounded by a fatty capsule. The functional part of the kidney, where urine is filtered in the kidney, is the kidney body (nephron), located in the kidney parenchyma. It consists of a **glomerulus** and **Bowman's capsule**. It contains two leaves. **Internal** (visceral) and **external** (parietal). The parietal sheet is made up of a **single layer of squamous epithelium**. This wall must withstand the pressure that is in the housing space (15 mm Hg). The visceral sheet is made up of a layer of epithelial cells called **podocytes**. **Pedicels** protrude from their bodies. Pedicles surround the capillaries of the glomerulus.

Blood filtration

The **glomerular filter (blood/urine barrier)** consists of three layers:

- **capillary endothelium**
- **basement membrane** (of endothelial cells)
- **podocyte pedicles**

The task of this filter is to pass water dissolved low molecular weight substances and, conversely, to retain plasma proteins and blood cells; eg albumin (molecular weight up to 70,000, diameter greater than 10 nm). This is where blood is filtered. The result of filtration is **primary urine**, which is an ultrafiltrate of blood plasma. However, the vast majority of primary urine is reabsorbed back and only a small fraction of its volume is emptied into the renal pelvis as urine.



Urinary tract

The urinary tract consists of the **renal cups and calyces, the renal pelvis, the ureter, the bladder and the urethra**. In the excretory tracts, the urine that was created in the kidneys is stored and subsequently excreted from the body.

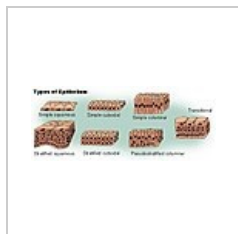
Outlet roads have basically a uniform construction. They consist of:

- **mucous membrane** (formed by multi-layered transitional epithelium = **urothelium**)
- **muscles**
- **adventitia** (serves to fix the draining urinary tracts to the surrounding structures)

Urothel

The urothelium is a type of multi-layered transitional epithelium that lines most of the surface of the urinary tract. This epithelium has the ability to adapt to the degree of dilatation of a given organ. It consists of **basal** cells, several layers of cells above these cells and **covering cells**, which can be up to 0.1 mm in size and protrude into the lumen of the urinary tract (**umbrella cells**). Cover cells are special for several reasons. First, they are located

in an extreme environment. They constantly come into contact with **hypertonic urine**, so their membrane has a special composition and is practically **impermeable**. When the organ dilates, the number of epithelial rows decreases and the surface cells become flattened.



Ureter

The ureter is a tube about 7 mm thick, which contains longitudinal cilia and is therefore star-shaped in cross-section when empty. The muscle is mixed with fiber and arranged in spirals, which is why it appears as two or three layers. The muscle enables the **peristaltic transport** of urine into the bladder.

Bladder

The bladder consists of a **mucous membrane** that has distinct cilia when unfilled. In this state, a multi-row transitional epithelium forms 6 to 8 rows of cells. When filled, the cells smooth out and we can find only 2 to 3 cell rows here. The **muscle** under the epithelium has a complex structure. The bladder wall contains **ganglion cells** and **nerves**. Afferent nerve fibers convey information about **wall tension** (the urge to urinate).

Urethra

The female urethra is about 4 cm long. The initial section is covered by **urothelium**, the remaining part by **non-keratinizing squamous epithelium**. The urethral muscle is related to the bladder and its circular parts act as a sphincter. The male urethra is 15 to 20 cm long. The inner part is surrounded by a clearance-controlled striated **sphincter**. In this place it is covered by urothelium. Towards the distal part, it changes into a **multi-layered cylindrical epithelium**, and at the mouth of the urethra it is replaced by a **layered non-keratinizing squamous epithelium**.

Links

Source

- VAJNER, Luděk. *Lékařská histologie II : mikroskopická anatomie*. 1. edition. Praha : Karolinum, 2012. ISBN 978-80-246-2165-4.
- NAVRÁTIL, Leoš – ROSINA, Jozef, et al. *Medicínská biofyzika*. 1. edition. Praha : Grada Publishing, 2005. 524 pp. ISBN 978-80-247-1152-2.

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