

# 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

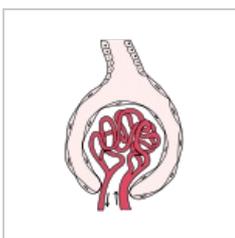
The kidney is a paired organ on the surface covered with a fibrous capsule and entirely surrounded by a fatty capsule. The functional part of the kidney, where urine is filtered in the kidney, is the kidney body (nephron), located in the kidney parenchyma. It consists of a **glomerulus** and **Bowman's 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.

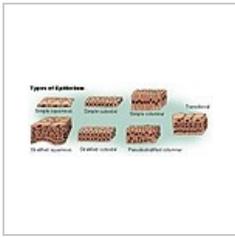
Outlet roads have basically a uniform construction. They consist of:

- **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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