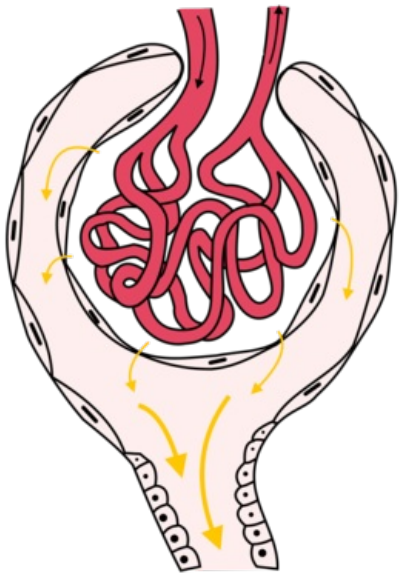
Examination of glomerular filtration

During **glomerular filtration (GF)** ultrafiltration of blood plasma occurs. The glomerular filtrate therefore has similar chemical and physical properties to blood plasma, however: the filtrate practically does not contain proteins.



Glomerulus – filtration occurs here

Glomerular filtration is best determined by substances that are excreted only by glomerular filtration and are not reabsorbed. An example is the fructose polymer *inulin*:

$$GF \cdot P_{in} = U_{in} \cdot V$$

or

$$GF = \frac{U_{in} \cdot V}{P_{in}},$$

where $\mathbf{P_{in}}$ =concentration of substance in plasma,
GF = volume of glomerular ultrafiltrate,
$\mathbf{U_{in}}$ = concentration of substance in urine and
V = volume of urine.

The term $\frac{U_{in} \cdot V}{P_{in}}$ is also referred to as **clearance** and determines the kidney's ability to excrete individual substances.

The size of the GF is affected by:

- by hydrostatic pressure in Bowman's capsule;
- the amount of renal blood flow;
- possible damage to the permeability of the filter membrane;
- plasma proteins and their concentration;
- the size of the filtering surface of the glomerular capillaries - this can be reduced by the contraction of mesangial cells and their projections due to angiotensin II;
- pregnancy – in the first trimester it can increase by 50%.

In one minute, around 1200 ml of blood flows through the kidneys, which represents 660 ml of plasma. 128 ml of plasma per minute and 180 l per 24 hours are transferred to the glomerular filtrate. This amount of ultrafiltrate is converted by the kidneys into 1-1.5 l of final urine - the rest is returned to the circulation.

The volume fraction of plasma that is filtered from the glomerular capillaries into Bowman's capsule is called the filtration fraction . In a healthy individual, **the filtration fraction** makes up about 20% of the renal plasma flow. An increase in the filtration fraction can be an indicator of chronic polycythemia. Although blood flow through the kidneys is reduced in polycythemia, the volume of glomerular ultrafiltrate is not smaller, as the filtration fraction is increased (thanks to the adaptive function of the glomeruli).

High hydrostatic blood pressure is maintained in the capillaries of the glomerulus thanks to the resistance formed by the efferent arteriole (difference to ultrafiltration in tissue microcirculation).

Endogenous creatinine, which is produced by muscle metabolism, is most often used to determine glomerular filtration. However, if the concentration of creatinine in the plasma is increased, the examination becomes less accurate, as tubular secretion is strengthened and glomerular filtration is then overestimated (7 to 10%).

Performing the examination:

The patient collects urine for 24 hours. During this time he should follow a diet without excess protein. At the end of the urine collection, we take a fasting blood sample to determine the plasma creatinine concentration. Possible measurement errors are either on the part of the patient, who did not capture all the urine, or on the part of the nurse, who did not accurately measure the volume of urine. The concentration of creatinine in the plasma and the excretion of creatinine in the urine depend on the size of the muscle mass and thus on the body surface. If the measured creatinine is 50% lower than the expected values, the urine collection can be called erroneous.

Values of glomerular filtration according to age and gender:

Age	sex	GF [ml/s/1.73m^2]
2−20 years	no difference	1.80 ± 0.40
20−40 years	men	2.17 ± 0.39
20−40 years	women	2.09 ± 0.28
40−60 years	men	1.85 ± 0.60
40−60 years	women	1.50 ± 0.50

Values of daily creatinine excretion depending on age and gender (μmol/kg/24 h)'

Age	Men	Women
20−29	196 ± 37	170 ± 30
30−39	192 ± 70	174 ± 38
40−49	174 ± 40	152 ± 32
50−59	166 ± 40	131 ± 24
60−69	139 ± 20	116 ± 26
70−79	131 ± 24	100 ± 24

Glomerular filtration can also be determined thanks to **the radionuclides EDTA and DTPA**. We apply these substances intravenously and then measure the decrease in their plasma activity over time. The advantage is that there is no need to collect urine for a long time, thus reducing the risk of possible errors during the examination.

Links

Related Articles

- Examination of kidney function
- Glomerular filtration

References

- KITTNAR, Otomar, et al. *Medical Physiology.* 1. edition. Prague : Grada, 2011. ISBN 978-80-247-3068-4.
- NEČAS, Emanuel, et al. *Pathological physiology of organ systems: Part II.* 1. edition. Prague : Karolinum, 2003. ISBN 80-246-0674-7.