Sodium in urine

Sodium ions are the major cations of extracellular fluid and contribute the most to osmolality of plasma. The daily intake is roughly between 100 and 260 mmol and is significantly influenced by the salting of the food. Excretion from the body occurs mainly through the kidneys. Approximately 25 mol of Na^+ are filtered daily by glomerular filtration, but the majority is reabsorbed; 60–70% in the proximal tubule, 25–30% in the loop of Henle, and about 5% in the distal tubule. About 1% of the filtered amount remains in the final urine.

Basic information about sodium metabolism can be obtained from serum and urine tests. The concentration of Na^+ in the urine can be used to calculate other parameters:

- **Na^+ losses in 24 hours** (requires urine collection for 24 hours).
- **Fractional excretion** (FE) and **tubular resorption** (TR). Fractional excretion represents the proportion of the total filtered Na^+ that is excreted in the urine. Tubular resorption indicates the proportion of Na^+ that is resorbed from the total amount filtered in the glomeruli. The advantage of these parameters is that it is sufficient to examine the concentration of Na^+ and creatinine in the serum and in a one-time urine sample, eliminating the need for all-day urine collection.

Serum and urine Na^+ values and daily Na^+ balance represent important indicators of water and electrolyte metabolism. Their assessment contributes to the diagnosis of deviations in water, electrolyte and acid-base balance, renal diseases, hypertension, endocrine and other disorders. They provide important information on the basis of which decisions are made about the treatment of certain deviations. The value of $\mathbf{FE_{Na+}}$ is a very valuable parameter for distinguishing between renal (damage to the kidney parenchyma) and extrarenal (restriction of kidney blood flow) causes renal failure. **For renal origin it is higher than 1% and for extrarenal causes, on the contrary, it is between 0.2-1%**.

Physiological values

Concentration of Na^+ in plasma: 137-144 mmol/l.
Urine Na^+ waste in 24 hours: 120-240 mmol/24 hours.
FE_{Na+}: 0.004–0.012 (0.4–1.2%).
TE_{Na+}: 0.996–0.988 (99.6–98.8%).

Determination of Na^+ in biological fluids

At present, it belongs to the common analytical procedures used for the determination of ions by **potentiometry using ion selective electrodes** (ISE). Potentiometric methods are simple, fast, safe and suitable for automation.

🔎 *For more information see Electrochemistry.*

The measurement of Na^+ activity is performed using a cell consisting of a sodium ion-selective electrode and a reference electrode, e.g. calomel. The sodium electrode resembles a pH-metric glass electrode, but is made of a different material: the calcium oxide in the soda-lime glass is replaced by aluminum oxide.

- We can simply consider the thin glass bulb of the sodium ion-selective electrode to be permeable to sodium ions; on the surface of the hydrated glass, Na^+ cations are exchanged with the solution and thus the potential of the electrode changes (cf. a similar principle with pH-metric electrode). At the same time, other cations pass through the membrane much more difficult. The exception is H^+, which must be in a much smaller concentration in the measured solution than Na^+ – the samples are therefore diluted with an alkaline buffer.
- The voltage between the sodium electrode and a suitable reference electrode is measured using a millivoltmeter, in practice it is often a pH meter. It follows from the Nernst equation that this voltage will be directly proportional to the logarithm of the Na^+ concentration.

Sodium ion-selective electrodes are part of automatic analyzers equipped in clinical-biochemistry laboratories and allow the measurement of ion concentration directly in an undiluted blood, serum or plasma sample (direct potentiometry) or in diluted urine samples (indirect potentiometry). The principle of ion-selective electrodes is also used to determine other important ions, such as K^+, Ca^{2+}, Cl^-.

Links

Related articles

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