Countercurrent multiplication system

The countercurrent multiplication system is a system that allows for the formation of a hypertonic medulla with an osmolarity gradient growing from the cortex to the depth of the kidney's medulla. In humans, it exists in the kidneys' medulla, specifically in the part of the nephron called the loop of Henle.

Loop of Henle

The loop of Henle consists of a descending arm and an ascending arm, which are parallel to each other. These parts are separated by an interstitium and **differ in their permeability**.

The descending arm is highly permeable to water, but poorly permeable to solutes. On the contrary, the ascending arm is almost impermeable to water, but there is active transport of Na + and Cl - from the tubular fluid into the interstitium.

🔎 *For more information see Loop of Henle.*

The mechanism

Isoosmotic tubular fluid flows into the descending arm of Loop of Henle. The surrounding interstitium is **hyperosmotic**, so there is a passive transport of water from the tubules to the interstitium. The tubular fluid becomes **more concentrated (higher osmolarity)**.

The highest tubular fluid osmotic concentration is reached at the lowest part of the loop. In the ascending arm, there is active transport of solutes from the tubular fluid to the interstitium, which contributes to the **hypertonicity of the medulla** (there is no water resorption). The tubular fluid's concentration is gradually **decreased** and the **hypoosmotic** fluid leaves the loop of Henle.

Consequences of this mechanism

Due to this arrangement, a strongly **hyperosmotic interstitium** is formed at the bottom of the loop, which helps draw water out of the tubules (in the case of opening aquaporins by ADH) from the distal tubule and collecting duct. It ensures the **production of concentrated urine with minimal water loss**. The longer the Henle loop (juxtamedullar nephrons in the medulla), the more concentrated the urine the nephron is able to produce.

Energy is consumed during the active resorption of solutes from the ascending arm of the Henle loop. However, transport always takes place against a **constant small gradient**, so energy consumption is relatively low.

References

Related articles

- Countercurrent exchange system
- Kidneys
- Nephron
- Tubular processes

External links

- english wikipedia link (https://en.wikipedia.org/wiki/Countercurrent_multiplication)

Sources

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