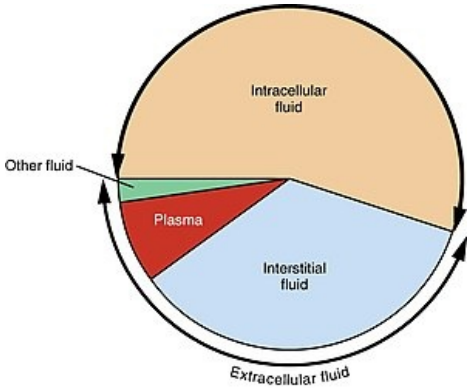
Ensuring constant volume

The extracellular compartment of total body fluid accounts for approximately 20% [1] of the human body weight and consists of two components: **tissue fluid (interstitial fluid)** and **plasma (intravascular fluid)**.

Plasma water makes up approximately 3.5 litres (5% of body weight).[1] Regulation of the proportion of water in plasma affects the total volume of blood in the circulation, filling pressure, and thus venous return. This regulation is identical to the mechanism of overall water and electrolyte regulation. Multiple mechanisms of fluid volume control have evolved over evolution, where this ability is essential for life and is also associated with the maintenance of homeostasis.



Distribution of Water in the Human Body

Mechanical volume effect

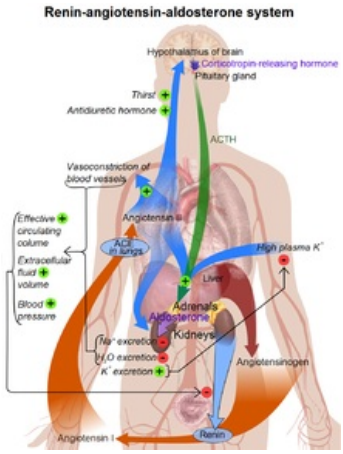
The first type of regulation is the simple influence of **mechanical effect** on a certain volume of fluid that is excreted by the kidneys. An increase in plasma volume will cause an increase in the filtration pressure in the glomeruli of the kidneys (thereby increasing the volume of primary and definitive urine). As a result, the total extracellular fluid volume and blood volume decrease. This, of course, is also associated with a decrease in venous return and blood pressure. The decreased venous return via the Starling mechanism causes a decrease in cardiac output thereby again stabilizing the blood pressure to a physiological value.

Antidiuretic hormone

🔎 *For more information see ADH.*

ADH production is mainly regulated by the **osmolarity of blood plasma** (concentration of osmotically active substances, plasma hypertonicity, volume and arterial pressure, etc.). Plasma osmolarity is detected by specialized cells of the hypothalamus – **osmoreceptors**. These are very sensitive to changes in osmolarity by changing their volume and relaying this information to hypothalamic cells to increase ADH production.

Subsequently, ADH increases water reabsorption in the distal and collecting tubules of the nephron by incorporating aquaporins. The consequence is an increase in blood volume and venous return to the heart. Atrial wall distension causes the production of **atrial natriuretic peptide (ANP)** , which again reduces ADH secretion via negative feedback.



Renin-angiotenzin system

Information about blood volume is detected by volumoreceptors and baroreceptors in the low and high pressure part of the circulation. Subsequently, they transmit signals through **afferent fibres of the n.vagus** to the CNS. The result is a change in sympathetic tonus, which innervates the kidneys, as well as a change in ADH secretion.

Aldosterone

🔎 *For more information see Aldosterone.*

A hormone produced in the adrenal cortex (glomerulosa zone) increases the reverse resorption of Na+ and water. This increases circulating blood volume, subsequently venous return and cardiac output. By increasing natremia, the sensitivity of vascular smooth muscle to angiotensin II and aldosterone is also increased, enhancing the effect of the renin-angiotensin-aldosterone system.

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The above mentioned methods of volume regulation are generally longer lasting - ADH acts on the order of tens of hours, aldosterone only after a few days. Through blood pressure regulation, the renin-angiotensin system and the activity of the nervous system influence blood volume regulation.

Links

Related articles

- Renal blood flow
- Renal function
- Blood pressure regulation
- ADH
- Aldosterone
- Hypothalamo-pituitary system

Used literature

- KITTNAR, Otomar, et al. *Lékařská fyziologie.* 1. edition. Praha : Grada, 2011. 790 pp. ISBN 978-80-247-3068-4.
- SILBERNAGL, Stefan – DESPOPOULOS, Agamemnon. *Atlas fyziologie člověka : překlad 8. německého vydání.* 4. edition. 2016. ISBN 978-80-247-4271-7.

Reference

1. KITTNAR, Otomar, et al. *Lékařská fyziologie.* 1. edition. Praha : Grada, 2011. 790 pp. ISBN 978-80-247-3068-4.