THE ROLE OF WATER IN WORK OF THE CENTRAL NERVOUS SYSTEM

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Abstract: *This article comprises the information about the influence of water on the work of the brain. The process of water absorption in the digestive tract, its transport to the brain and role in the neuron activity are also described here. Great attention is paid to the problem of dehydration and diseases of the CNS connected with it. The scientific work includes a practical part that consists of 4 tests.*

The relevance of the problem: Water is essential for life. It is a universal solvent. Most organic and inorganic substances come in it to form solutions. All biochemical reactions take place only in aqueous solution. Without water, animals cannot survive. A person can still survive without food for several weeks, but would die in a few days from lack of water.

Water is found in all kinds of food. We can absorb water by drinking it, by taking it in with food: fruits, vegetables, eggs, milk, fish, meat, etc. We can also obtain metabolic water through the process of respiration which occurs in all cells. Water is excreted from the body in multiple forms; through urine and feces, through sweating, and by exhalation of water vapor in the breath.

Our brain contains about 85% of water. Optimal brain function depends on a proper amount of water. Water is what keeps the brain signals going. When the quality of water is compromised the signals are short circuited. Water supports DNA and is the largest single source of energy. The brain has no way to store water and dehydration comes if all the water lost in a day is not replaced and this deficiency is accumulated. Brain cells need twice as much energy than other cells in the body. Water supplies energy. Nerve transmission consumes one-half of all the brain's energy (nearly 10% of the whole body's energy). When hydrated, you have more energy. When the brain is functioning on a full reserve of water, it will function at full capacity and you'll think better and faster. Creativity is boosted.

The CNS diseases are very destructive. Parkinson's disease, Alzheimer's disease, Lou Gehrig's disease may confirm these words. The scientists think, that some of the chronic diseases are the result of the human brain dehydration. The dehydration of brain only by 1% will lead to its dysfunction.

The main signs of dehydration of the brain are:

- Feeling tired for no apparent reason.
- Rush of blood to the face.
- Irritability, anger and groundless irascibility. Irritability is an attempt to avoid the performance of brain activity that requires large amounts of energy.
- Anxiety
- The feeling of depression and sadness.

- Depression.
- Lethargy.

(brain cells in the course of its continuing operations produce toxic waste, that must be regularly removed)

- Restless sleep, especially in the elderly.
- Unexplained impatience.
- Inattention.
- Shortness of breath in a healthy person not associated with lung diseases or infections.
- Link to such drinks as coffee, tea, soda and alcohol. Thus the brain tells you about the need to saturate it with water. Such irrepressible desire is based on the conditioned reflex binding water saturation with intake of these drinks, which actually dehydrate the body even more.
- Dreams of oceans, rivers or ponds - it is a form of subconscious brain desire to get to the source of water and quench the thirst.

We wanted to detect the role of water in the activity of the Central Nervous System.

There was a proper list of goals:

To learn all the information about water absorption in the digestive system

To study the transportation of water to the brain

To research the physiology of nerve impulse

To test the brain activity before and after water consumption

To draw the conclusions according to the results of the tests

Water absorption in the digestive system:

9-10 liters of water pass through the intestine (including the digestive juices). 2-3 liters are supplied with food, and 6-7 liters - with digestive juices. A small portion of the water is absorbed in the stomach and large intestine (19%). Water is absorbed mainly in the upper small intestine (80%: 60% - duodenum; 20% - iliac). Only 100-150 ml (1%) pass through the digestive tract and are evacuated with the stool.

Mechanisms of absorption: osmosis, diffusion, active transport.

Water is absorbed in the intestine passively in the direction of the osmotic gradient between the intestinal lumen and intercellular space of the intestinal wall. This gradient is created primarily by active transport of sodium. The basolateral membrane of enterocyte (the basal and lateral parts) has a Na +, K + -ATP pump that sucks sodium from cytoplasm into the extracellular space. This causes the passive entry of sodium from the intestinal lumen into the cell (across the apical membrane), so that the resulting concentration of sodium reduces in the intestinal lumen and increases in the intercellular space. Water follows sodium and appears in the intracellular space and then transfers to the blood. Conversely water can be transported in the opposite direction from the plasma in the chyme. Particularly this occurs when the hypertonic solution comes from the stomach into the duodenum (when the food is rich in salt or poor in water). The necessary quantity of water passes into the lumen of the intestine in several minutes to make isotonic chyme.

The speed of absorption depends on: the temperature of water (the cool water is absorbed faster); the speed of drinking (the slower you drink the better it will be absorbed);

the level of hydration of the body (if the body is dehydrated the water will be absorbed faster).

Absorption of *carbohydrates, amino acids*, and especially *mineral salts*, promotes the simultaneous absorption of water, in contradistinction to coffee, which decreases the level of hydration by stimulating urination.

All the way from mouth to blood takes **7-10 minutes** for water. Its absorption begins as long as water appears in the stomach (that is **nearly half a minute**). This fact has played an important role in our scientific work.

The neuron and nerve impulse

More than 100 billion nerve cells- known as neurons - make up the human brain. The building block for the entire nervous system, these tiny but amazing cells are at the head of every brain and function.

All of the incredible functions that your brain can perform depend on the abilities of this unique type of cell, which can stretch hundreds of times the length of the rest of the cells to make connections with tens or thousands of other neurons. Perhaps the neuron's most extraordinary quality is that it generates electricity, an energy-hungry process that gives the brain its amazing capacity for communication, and explains why it accounts for so much of the body's energy expenditure. **Dendrites** are projections from the main cell body that make connections with other neurons and collect signals from them. These signals are passed to the cell body for "processing". **The cell body** is the main part of the neuron and acts like a computer's central processor, collecting inputs from other cells and determining the output that is produced. Inside the cell are energy-making structures and the nuclear control centre. Charged particles flood in and out of the cell, changing the electrical charge on either side of the cell membrane. This flux triggers the same process in the neighboring part of the axon, to create a wave of electrical activity. Such signals are sent along a series of neurons to relay information from the brain to the body. Nerve cells use up a massive amount of energy as they pump charged particles in and out of the cell to prepare for the next impulse. **An axon** is a long projection that can stretch up to 1 meter to make connections with other neurons. **The myelin sheath** is a layer of fatty insulation that speeds transmission of nerve signals; in section it looks a bit like an onion. **Nodes of Ranvier** are gaps in the myelin sheath. Impulses skip from node to node.

Where one neuron meets another, it makes a connection via a structure known as a **synapse**. A typical synapse is where the end of an axon makes contact with another neuron and spreads out to make a little knob. Between the knob and the next neuron there is a tiny space known as the synaptic gap. Nervous signals cross this gap via special chemicals known as neurotransmitters, which are released by the first neuron. They stream across the space, and on arrival at the other side, they trigger the second neuron to generate its own electrical impulse, which travels down to its axon until the next synapse, and so on. Neurotransmitters are vital in regulating and directing the function of the brain. They are transported ***to the synapse with the help of water-microtubule complex. Water increases the speed of nerve impulse transmission.***

Fast axonal transport Axon has small diameter, but it can spread more then 1 meter long. As we know, almost all proteins are transported from the nucleus to the synapse

and therefore our brain is working all the time! So, why is it so fast? Brain works fast due to the axonal transport.

The "radioactive leucine" has confirmed this theory. It was injected to the dorsal ganglion, joined the proteins and in 2-10 hours the scientists observed radioactivity in the sciatic nerve (166mm to the neuron's body cell, near by the synapse). The axonal transport speed (**410mm/day** (5mkm/sec)) has been determined - it's anterograde transport (from body cell to the synapse). The retrograde transport is contrariwise. All these processes are functioning due to **microtubes and vesicles**.

Philip M. Wiggin has shown that the mechanism that controls and ensures the effective operation of cationic pump uses **water's ability to transform the energy**. *"The source of energy for cation transport and ATP synthesis is the increase in chemical potential caused by the **hydration** of small cations and polyphosphate anions in a structured aqueous phase boundary the existence of two phosphorylated intermediates."* In the state of thirst, when the **concentration** of liquids in the body increases, the water in dehydrated cells loses its ability to produce energy.

✓ Considering the fact that over 98% of people suffer from chronic dehydration we've decided to **test the brain activity** before and after water consumption in order to confirm the unique role of water in brain functioning.

Tests:

1. Schulte's table
2. 5 spots
3. 5 words (32 letters)
4. Computer game «IBrain»

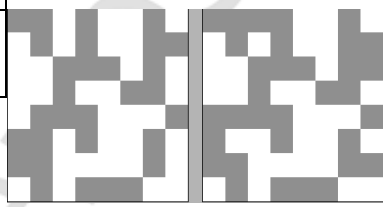
♦Schulte's table

	0		5
	6	2	
4			1
	3		

The participant had to name and show the numbers in the right order. The time He (She) did it was fixed with the stopwatch.

We wanted to test *visual memory, particularly peripheral vision; attention*.

♦5 spots



The participant had to find 5 spots in the picture as fast as it possible. The time He (She) did it was fixed with the stopwatch.

We wanted to test *visual memory, particularly peripheral vision; attention and associative memory*.

♦5 words (32 letters)

The participant was offered 5 words, which consisted of 32 letters (in the Russian language). He (She) had to repeat them after the speaker as fast as possible.

5 words (32 letters) *tested hearing memory, associative memory and the speed of pronunciation.*

♦Computer game «IBrain»

IBrain-test is performed on the device IPad4. The essence of this test is as follows: on the combination of numbers and symbols appear the device (from the 3-digit and 9-digit, and sometimes different characters, for example, the heart) that you have to type on the electronic keyboard. For example: you can see 64pik5, after you've seen this combination, there is a keyboard on which you must enter this combination. The combinations will appear for one (1) minute. After one minute you'll get your result in points. This test is directed at checking one's memory (muscular, associative, visual), attention and motor skills.

The participant had to drink 200 ml of water and 10 minutes later we repeated **similar** tests again.

- **We have tested 30 people**
- **Average age was 21,6 years (from 10 to 58 years old)**

With the help of certain computing we came to the result of *9%* improvement*:*

****The specific of the game "IBrain" was that the points were expected to increase after water consumption unlike the other tests, in which, according to our theory, the run time had to reduce.*

NB! In order to prove the influence of water on the improvement of the results we asked our participants to do similar tests but not the same; and the level of difficulty was much higher than the previous ones to avoid the influence of the acquired skills.

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