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Physiology Of The Hypothalamus In The Human Body.

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ABSTRACT

The hypothalamus is a division of the intermediate brain located downstream from the thalamus under the hypothalamic furrow and is a cluster of nerve cells with numerous afferent and efferent connections, as well as the structure of the intermediate brain that enters the limbic system that organizes emotional, behavioral, homeostatic reactions of the organism. Hypothalamus possesses the most important regulatory functions that determine the vital activity of the whole organism. Its main functions are to control two systems of the body - vegetative and endocrine. It is the highest integrative center responsible for controlling the autonomic functions of the body, as well as behavioral and motivational mechanisms. The hypothalamus has a large number of capillaries that have a high degree of perceptivity, which makes it more sensitive to changes in the body and enables it to respond quickly and adequately to the changes occurring. Being in a complex relationship with the rest of the brain, the hypothalamus takes part in the control of virtually all vital constants of the body, and its defeat can lead to irreversible consequences with the appearance of severe diseases and death. Dosed physical exercise and rational nutrition, including the use of eggs, fatty fish, sea kale, walnuts, vegetables and dried fruits, largely provide optimum functioning of the hypothalamus.

Keywords: hypothalamus, regulation, physiology, nerve centers, neuroendocrinal function.

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INTRODUCTION

The human brain consists of many parts, each of which performs certain functions [1,2]. The hypothalamus, together with the thalamus, is the department of the brain. Despite this, both these bodies perform completely different functions [3]. If the responsibility of the thalamus is to transmit signals from the receptors to the cerebral cortex, the hypothalamus, on the contrary, acts on the receptors in the internal organs, with the help of special hormones, neuropeptides [4,5].

Hypothalamus is the division of the intermediate brain located downstream of the thalamus under the hypothalamic furrow and is a cluster of nerve cells with numerous afferent and efferent connections [6], as well as the structure of the intermediate brain that enters the limbic system that organizes emotional, behavioral, homeostatic reactions of the body [7].

The main function of the hypothalamus is to control two systems of the body - vegetative and endocrine [8]. Proper functioning of the vegetative system allows a person not to think about when he needs to inhale or exhale, when it is necessary to increase blood flow in the vessels, and when, on the contrary, slow down [9]. That is, the autonomic nervous system controls all the automatic processes in the body with the help of two branches - sympathetic and parasympathetic. If the functions of the hypothalamus are violated for some reason, failure occurs in almost all body systems.

Purpose: to summarize the available information about the structure and functions of the hypothalamus in humans.

Fundamentals of the structure of the hypothalamus

In a human embryo at the age of 3 months, there are two furrows on the inner surface of the thalamus, dividing it into three parts: the upper part - epithalamus, the middle - the thalamus and the lower one - the hypothalamus. The gray matter is well developed in the hypothalamus [10].

In humans, the hypothalamus finally ripens to the age of 13-14 years, when the formation of hypothalamic-pituitary neurosecretory bonds ends [11]. Due to the powerful afferent connections with the olfactory brain, basal ganglia, thalamus, hippocampus, cerebral cortex, the hypothalamus receives information about the state of almost all brain structures [12]. At the same time, the hypothalamus sends information to the thalamus, reticular formation, vegetative centers of the brainstem and spinal cord [13].

The hypothalamus is a small part of the intermediate brain with a mass of 4-5 g, but occupies no more than 3 cm^3, its ventral section is located below the thalamus, forming the walls of the lower part of the third ventricle [14]. In this case, the anterior wall of the third ventricle acts as the anterior border of the hypothalamus. The boundary of the posterior wall extends from the posterior spike of the arch of the brain to the corpus callosum [15].

The hypothalamus contains about 50 pairs of nuclei, which have a powerful blood supply. At 1 mm2 of the hypothalamus area, there are up to 2,600 capillaries, while in the same area of the motor cortex there are 440 of them, in the hippocampus - 350, in the pallid sphere - 550, in the visual cortex - 900. Capillaries of the hypothalamus are highly permeable for large-molecule protein compounds nucleoprotsides, which explains the high sensitivity of the hypothalamus to neuroviral infections, intoxications, and humoral shifts [16,17].

The lower part of the hypothalamus, located near the mastoid body, consists of the following structures: a gray hillock; mastoid bodies; funnels and others.

The structure of the hypothalamus includes three separate zones: periventricular or peri-ventricular; medial; lateral [18, 19].

At the general estimation of features of architectonics of nuclei of mastoid bodies of a brain of people of different age it is possible to note presence of gender specificity. In the female group expressed by transformation occurs in the middle of the second period of the mature age (41-45 years), manifested by a sharp increase in the number of glial cells and decrease in the number of microvessels and neurons [20].

Similar changes were also present in the M group, but they are less intensely expressed: increase in the number of glial cells occurs in men is smoothed, gradually increasing to 60 years [21]. In general we can say that the changes occurring in the ratio of neuron-glia-capillary mastoid bodies of men, differ from similar processes in the women's group at the power correlation with age [22]. Despite the fact that the most pronounced changes in the mean values of morphometric parameters occur in both gender groups in the second period of mature age, women's group, they appear five years earlier and expressed different intensity [23].

Thus, it is clear that, in spite of its small size, the hypothalamus is a complex and compact, but powerful structure, without which the human body can not exist. The hypothalamus has a large number of capillaries with high penetration, indicating that it is a very sensitive and adequate organ capable of correctly responding to changes occurring in the human body [24].

Hypothalamic centers and their functions

Under the nuclei in the central nervous system means the accumulation of gray matter (bodies of neurons) in the thick white matter (axon and dendritic terminals - conductive paths). Functionally, the nuclei provide the switching of nerve fibers from one nerve cell to another, as well as analysis, processing and synthesis of information [25].

Three groups of clusters of neuronal bodies forming the nuclei of the hypothalamus are anatomically distinguished: the anterior one, which is located in one of the sections of the visual crossover; Average, located in a gray mound; Back, which is located in the region of mastoid bodies; control over all life processes of man, his desires, instincts and behavior is carried out by special centers located in the nuclei.

To date, the exact number of nuclei of the hypothalamus is difficult to establish, since different data on their number are given in various domestic and foreign literary sources [26].

The most complex variant of the integrative activity of the hypothalamus is the combination of certain vital functions into complex complexes that provide various forms of biologically expedient behavior: food, drinking, aggressively defensive, etc., aimed at the survival of each individual individual and the species as a whole [27, 28]. This behavior is based on the emergence of biological needs in the body, which lead to the formation of motivational excitation in the hypothalamic (and limbic and cortical) structures, which is expressed in the person's emotionally colored desire to satisfy the corresponding need. Satisfaction of the same needs and is carried out through behavior. At the same time, it should be noted that in the implementation of even biological (instinctive) forms of behavior, the hypothalamus provides only basic mechanisms. Socialization of biological behavior is associated with a new cortex, in particular, its frontal lobes [29,30].

The hypothalamus performs the central neuroendocrine function, controlling the anterior pituitary gland, which in turn regulates the secretion of the hormones of certain glands. In the nucleus of the hypothalamus, hormones (releasing factors) are released, which are then transported along the axons to some middle elevation or posterior lobe of the pituitary, where they are stored and released as needed.

The hypothalamus functions as "specialized" hypothalamic centers.

The heat transfer center is located in the anterior and preoptic zones of the hypothalamus. The irritation of these structures causes an increase in heat transfer as a result of the expansion of the vessels of the skin and increase in the temperature of its surface, increasing the separation and evaporation of sweat, the appearance of thermal dyspnea. The destruction of the center of heat transfer leads to the inability of the body to withstand the heat load [31].

The center of heat regulation is localized in the posterior hypothalamus. His irritation causes an increase in body temperature as a result of increased oxidation processes, increased muscle tone (until the onset of muscle tremor), narrowing of the skin vessels. The destruction of these nuclei leads to a loss of ability to maintain body temperature when the body cools [32].

The centers of hunger and saturation cause human food behavior. Nutritional behavior. In medical practice, it is proved that pathological, organic disturbances in the hypothalamus (tumors, hemorrhages, inflammation) cause severe eating disorders (increased consumption of food or complete rejection of food). A small zone in the region of the lateral hypothalamus was defined by scientists as the center of hunger, and part of the hypothalamus in the region of its ventromedial nuclei was called the center of saturation. Also, scientists have shown that some of the neurons in the digestive center have a chemoreceptor sensitivity to certain substances (glucose, amino acids, fatty and organic acids) and blood hormones (insulin, gastrin, adrenaline, etc.) and their level has a certain effect on the impulse activity of these neurons [33].

The center of thirst causes drinking behavior. Drinking behavior. Studies carried out in 1958. B. Anderson showed that electrical stimulation of certain areas of the hypothalamus causes a pronounced activation of drinking behavior and water consumption (polydipsia). This center was called the "center of thirst" by scientists. Its destruction leads to a complete rejection of water intake (adipsy). Also, the activity of the center of thirst is influenced by impulses from peripheral (vascular and tissue) receptors, as well as the concentration in the blood of certain hormones (eg, antidiuretic) [34].

Centers of aggressively defensive behavior. Aggressive and defensive reactions were obtained by scientists under experimental conditions with stimulation of the anterior and posterior, ventromedial and lateral zones of the hypothalamus (Hess study). Trimming the brain stem below the hypothalamus leads to the elimination of aggressive behavior. Scientists conclude that in the implementation of aggressively defensive reactions, the hypothalamus interacts with the gray matter of the midbrain. It was in this brain structure that in 1968 AD Adams discovered "neurons of aggression" that trigger aggressive reactions through the hypothalamus and are not excited with positive manifestations [35].

The center of sleep. The behavior of "wakefulness is a dream." Clinical study of patients with lesions of the hypothalamus allowed scientists to formulate the assumption that the "sleep center" is located in the anterior hypothalamus, and the "wake center" in the posterior hypothalamus. Experimental studies with damage to various parts of the hypothalamus confirmed this conclusion. However, the role of the hypothalamus is not limited only to the formation of sleep and wakefulness mechanisms. Performing the role of the internal clock, the hypothalamus is a specific driver of this circadian rhythm. The regulation of the hypothalamus of circadian biorhythms is carried out together with the epiphysis (the connection between the hypothalamus and the epiphysis is carried out through the system of axon bonds) [36].

Centers for the regulation of blood circulation. Represented by a set of neurons of the nuclei of the medial and lateral hypothalamus. In experimental animals, stimulation of neurons in the middle (tuber) and posterior nuclei of the hypothalamus causes a decrease in the arterial blood pressure and the frequency of cardiac contractions [37].

Thus, with serious damage to the hypothalamus, failures occur in the departments regulating vital processes that occur in the human body, and also, this can lead to disorders of the behavioral spectrum of perceptions.

Pathology of the hypothalamus

In the hypothalamus there arise both functional disturbances and irreversible changes in its nuclei. First of all, it should be noted the possibility of varying degrees of damage to the nuclei (predominantly oversight and peri-ventricular) in diseases of endocrine glands.

Brain injuries leading to a redistribution of the cerebral fluid can also cause changes in the hypothalamic nuclei located near the ependyma of the bottom of the third ventricle [38].

Pathomorphologically, these changes primarily concern neurons and are particularly clearly revealed in Nissl staining and the Homori method. They are expressed by the phenomena of tigrolisis, neuronophagy, vacuolization of protoplasm, formation of cells of shadows. Due to increased permeability of the walls of blood vessels in infections and intoxications. Hypothalamic nuclei can be exposed to pathogenic effects of toxins and chemicals. products circulating in the blood. Especially dangerous are neuroviral infections. The most common inflammatory processes of the hypothalamus are basal meningitis of tuberculous origin and

syphilis [38]. To rare forms of damage to the hypothalamus include granulomatous inflammations (Beck's disease), lymphogranulomatosis, leukemia, and also vascular aneurysms of various origin. Of tumors of the hypothalamus, the most common types of glioma are defined as astrocytomas; craniopharyngomas, ectopic pinealomas and teratomas, as well as suprasellar adenomas of the pituitary gland located above the Turkish saddle, meningiomas and cysts.

Depending on the characteristics of the synthesis of hormones, all diseases of the hypothalamus are divided into three groups: the first group includes diseases characterized by increased production of hormones; the second group includes diseases characterized by a lower production of hormones; the third group consists of pathologies in which the synthesis of hormones is not disturbed.

Given the close interaction of the two brain regions of the pituitary-hypothalamus, as well as the generality of the blood supply and features of the anatomical structure, some of their pathologies are grouped together.

The most common pathology is adenoma, which can form in both the hypothalamus and the pituitary gland. Adenoma is a benign formation that consists of glandular tissue and independently produces hormones [39].

Most often in these areas of the brain are formed tumors that produce somatotropin, thyrotropin and corticotropin. For women, the most typical is prolactinoma, a tumor that produces prolactin, a hormone responsible for the production of breast milk.

Another disease, which often violates the functions of the hypothalamus and the pituitary, is the hypothalamic syndrome. The development of this pathology not only disrupts the balance of hormones, but also causes a malfunction in the autonomic nervous system [30].

CONCLUSION

Hypothalamus possesses the most important regulatory functions that regulate the vital activity of the whole organism. It is the highest integrative center responsible for controlling the autonomic functions of the body, as well as behavioral and motivational mechanisms. Being in a complex relationship with the rest of the brain, the hypothalamus takes part in the control of virtually all vital constants of the body, and its defeat can lead to irreversible consequences with the appearance of severe diseases and death. Dosed physical exercise and rational nutrition, including the use of eggs, fatty fish, sea kale, walnuts, vegetables and dried fruits, largely provide optimum functioning of the hypothalamus.

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