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PHYSICAL ACTIVITY AND SOMATOTROPIC HORMONE

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Annotation. Growth hormone or somatotropic hormone attracts researchers who study its anabolic activity in terms of increasing muscle strength and mass. First of all, this is of interest to coaches, athletes and scientists who are trying to explain the anabolic effect of somatotropin in various variants of the training process. The theoretical analysis carried out demonstrated that at present there is still no logical large-scale picture of the relationships and effects of somatotropic hormone on various functions of the body of athletes, or simply people engaged in physical exercises. There are practically no studies of the relationship and interdependence of the volume and nature of human motor activity and the production of somatotropic hormone. These studies are of fundamental and practical interest, as they will reveal deeper mechanisms of adaptation to motor activity, as well as its influence on the patterns of growth and development of the human body.
Key words: pituitary hormones, somatotropic hormone, physical exercises, motor activity.

Introduction. The endocrine system has a complex co-subordinate organization. This can be seen in any hormonal relationship. All systems are regulated with the help of negative and positive feedbacks [1]. At the same time, each of them (thyroid, hypothalamic-pituitary, etc.) are interconnected with each other. In addition, there are many mechanisms of interaction between the hormonal, nervous and immune systems. There is even a field of knowledge – neuroimmunoendocrinology, which shows the relationship of these three regulatory systems, which accompany the action of their hormones, neurohormones, peptides, any body function (digestion, growth, pregnancy, motor activity, etc.) [2-3]. Intense muscle activity increases the activity of body functions, primarily their neuro-humoral regulation. In this connection, the influence of intense physical activity on the characteristics of hormone production, which determines the growth and development of the body, is of interest.

The aim of the work: theoretical analysis of the mechanisms of influence of physical activity on the production of somatotropic hormone.

Methods and organization. The research work presents the results of a content analysis of research papers by domestic and foreign authors, presented in peer-reviewed scientific publications, on the problem of the influence of physical activity on the production of somatotropic hormone. The mechanisms of hormone production and factors influencing this process were analyzed.

Results and discussion. Nervous regulation of endocrine functions is carried out by several mechanisms. One of them is neurosecretion, i.e. release of hormones from the neuron into the blood. Another mechanism is the direct autonomous innervation of endocrine tissues, which couples nerve signals from the central nervous system with the secretion of hormones, and hormones, in turn, affect the nervous system. Switching of nerve signals to endocrine ones occurs mainly in the functional hypothalamic-pituitary system, which regulates the functional activity of peripheral endocrine glands and other body functions [4-6].

Hypothalamic hormones entering the anterior pituitary gland regulate the secretion of pituitary hormones. Those hormones that stimulate this process are hypothalamic hormones – releasing hormones (RH) or liberins, these include thyrotropin-releasing hormone, gonadotropin-releasing hormone, corticotropin-releasing hormone, somatoliberin (somatotropin-releasing hormone) and others, inhibitory hormones or statins – somatostatin and dopamine

In addition to specialized hormones, the hypothalamus produces neurotransmitters (biologically active amines – dopamine, adrenaline, norepinephrine, serotonin, acetylcholine, gamma-aminobutyric acid (GABA), histamine), neuropeptides (vasoactive intestinal peptide (VIP), neurotensin, components of the renin-angiotensin system (RAS), cholecystokinin (CCK), endothelin, neuropeptide Y). All these substances have a diverse effect on the anterior and posterior lobes of the pituitary gland and the central nervous system (CNS) [7-10].

The secretion of pituitary hormones, in addition to hypothalamic and peripheral hormones that come with the blood, is influenced by external factors such as stress, nutrition, disease, etc. Stress stimulates the secretion of adrenocorticotropic hormone (ACTH), growth hormone (GH), and prolactin (PRL). The secretion of PRL and GH differs from others: it is not regulated by classical feedback. The main regulators of these hormones are hypothalamic liberins and statins. In the regulation of PRL secretion, inhibitory influences play the main role, while stimulating ones have an impact on the growth hormone secretion [11-12].

GH is a protein hormone consisting of 191 amino acid residues with a molecular weight of 21,500 kDa. It is synthesized and secreted by the somatotrophs of the anterior pituitary gland. The main function of GH is to stimulate the linear growth of a person. This stimulation is mediated by insulin-like growth factor-1 (IGF-1) [13-14]. GH affects all types of metabolism: carbohydrate – reduces the absorption of glucose by extrahepatic tissues, increases the production of glucose by the liver, together with glucocorticoids and insulin – glycogen stores in the liver, the level of glucose and ketone bodies in blood plasma; lipid – increases lipolysis in adipocytes, the level of ketone bodies in plasma; protein metabolism – increases the absorption of amino acids and protein synthesis through the action of IGF-1 [15].

The half-life of GH in plasma fluctuates between 20-50 minutes. In the early morning hours, the concentration of growth hormone does not reach 2 ng/ml (90 pmol/mL). The level of IGF-1 in plasma is identified mainly by the radioimmunological method, the determination of its concentration as a mediator of the action of growth hormone allows a more accurate assessment of the biological activity of the latter [16].

The secretion of GH is regulated by two hypothalamic hormones – somatotropin-releasing hormone and somatostatin. Physiological factors that stimulate the secretion of GH are the following: sleep, physical activity, physical or psychological stress, hypoglycemia; pathological – reduced protein levels and starvation, anorexia nervosa, chronic renal failure, acromegaly, obesity, hypothyroidism, hyperthyroidism, etc., there are many pharmacological stimulants. Nervous factors also affect the secretion of GH, for example, increased impulse secretion of GH during sleep is due to nerve impulses. The maximum level of GH is found 1-4 hours after falling asleep in children and decreases with age. Pulsed episodic secretion is typical for all studied pituitary hormones [15].

Disturbances in the secretion and synthesis of growth hormone have a severe effect on the development of the child, manifesting as pituitary dwarfism or vice versa gigantism. But HG is also necessary for adults, because it regulates metabolism, influences mental health and preserves youth, activates the synthesis of RNA and DNA nucleic acids, accelerates wound healing, counteracts aging of the body and the development of obesity [17-21].

Due to the anabolic effect of growth hormone, i.e. its ability to stimulate the formation of proteins, muscle mass is increased, the skeleton of the body is strengthened. STH improves the absorption of calcium and phosphorus by bone tissue, maintaining its density, and promotes fat burning. GH activates vitamin D in the kidneys, which affects the absorption of calcium and phosphorus, prevents their loss in the urine and helps strengthen bones [22-23].

With age, the level of GH decreases, and this is one of the causes of senile sarcopenia (decrease in muscle mass). To improve the situation, it is necessary to create conditions in your body so that GH is produced in the body as long as possible in a natural way. To do this, you need to sleep better, as it helps to stimulate

the production of GH, exercise, eat healthy foods with enough protein, limit simple carbohydrates and foods containing a large amount of cholesterol, since they do not contribute to the synthesis of GH. The importance of physical activity is indicated by the fact that under strict bed rest, bone resorption prevails over bone formation and a negative calcium balance develops rapidly in healthy people.

Skeletal muscles account for about 50% of body mass. They are able to change their energy needs by 20 or more times. During physical activity, a person increases the functional activity of not only skeletal muscles, but also the heart and respiratory muscles, which ensures the delivery of the required amount of oxygenated blood to meet the increased needs of working muscles. Different types of physical activity affect muscle tissue in different ways, in terms of stimulating anabolic processes by changing the concentration of GH.

The influence of strength exercises on the change in the GH concentration was studied. In strength training, a variety of training programs are used in which the choice of programming elements occurs and their interaction can play an important role in identifying the magnitude of the change in the GH level [24-25]. It has been proven that among the external factors that play a certain role in the ability to stimulate an increase in GH are the volume of muscles involved, the magnitude of the load during exercise, its volume and the duration of the rest intervals between the stages of exercise. Despite the large number of combinations of these factors, studies conducted by W.J. Kraemer et al. (1990, 1993) revealed that when comparing training programs, three factors can be distinguished that have the greatest stimulating effect on GH in men and women: this a combination of a large amount of work performed, a short duration of rest intervals (1 minute) and the use of an average weight of 10 RM [25-27]. Further studies have shown that the revealed dependences of the effect of strength exercises on GH stimulation depend on changes in the acid-base balance (increased lactate response) under the influence of these exercises [28]. Blood samples taken from people who performed strength exercises at night showed that the GH concentration in the first half of the night was lower compared to the control group, and in the second half it was higher than in the control samples. The researchers suggested that the observed changes could be the result of the influence of somatostatin or other metabolic or hormonal signals, such as somatoliberin or ghrelin [29-30]. These assumptions are waiting for their researchers.

Experimental data obtained on animals indicate the importance of the influence of physical activity for the GH secretion, which in turn stimulates somatic growth and muscle hypertrophy. Under the influence of an increased wave-like basal level of GH during exercise, an increase in the length of skeletal elements in animals, an increase in body mass and a decrease in adipose tissue were observed compared to control animals in a passive state [31].

When doing aerobic exercises, acute and chronic changes in GH are noted. Stimulation of GH secretion is observed as early as 15 minutes after the start of aerobic exercise. There is a linear dose relationship between the intensity of exercise and the level of GH secretion. In women of all ages, the GH level is noted to be higher than in men of comparable age, and they have a less pronounced undulating nature of secretion. The increase in GH secretion in response to physical activity in young people is higher than in older people. Aging in men leads to a weakening of the effectiveness of physical activity in terms of increased secretion of growth hormone by 3.9 times [32]. It is suggested that possible reasons for the decrease in GH secretion in older people may be an imbalance in the secretion of hormones that regulate the level of GH (somatostatin and somatoliberin or ghrelin)

The intensity and duration of aerobic exercise, the level of physical fitness, gender and age affect the degree of changes in GH in response to physical exercise. Age and obesity lead to a noticeable decrease in the secretory response due to changes in metabolic signals in the regulatory system and the effects of its main components [32]. The gender of a person determines the features of GH secretion in response

to physical activity, regardless of age. Circadian rhythms practically do not affect the effect of physical activity. No dependence of GH changes on the time of workout sessions during the day was found. A decrease in the physiological level of GH secretion in people leading a sedentary lifestyle, obese, elderly people is one of the reasons for the increase in fat deposits in the abdominal region, the occurrence of dyslipidemia, relative insulin insensitivity (insulin resistance), reduction in the mass of muscle and bone tissue (sarcopenia) and a decrease in the quality of life.

Conclusion. Thus, physical activity stimulates the secretion of growth hormone. GH production also depends on factors such as gender, age, lifestyle, obesity, etc. The presented data do not provide a logical large-scale picture of the relationships and effects of GH on various functions of the body of athletes, or simply people engaged in physical exercises. There are practically no studies of interrelations and interdependencies of the volume and nature of human motor activity and GH production. These studies are of fundamental and practical interest, as they will reveal deeper mechanisms of adaptation to motor activity, as well as patterns of growth and development of the human body.

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