Origin Of Hypokinesia and General Impact on the Human Body

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ABSTRACT

Hypokinesia can occur in the human body against the background of diseases of the nervous system (Parkinson's disease, Alzheimer's disease), as well as professional activities associated with a sedentary lifestyle (programmer, operator, accountant, etc.). On this basis, hypokinesia is classified into clinical, climatic-geographical and into types that develop in schoolchildren, depending on living conditions and professional activities. Especially in schoolchildren, it was noted that hypokinesia leads to a decrease in mental development.

It is noted that hypokinesia (decrease in motor activity) leads to the induction of pathological morphofunctional changes in tissue cells of various organs in the body. In this case, hypokinetic syndrome develops under the influence of limited functional activity of skeletal muscles.

Keywords: Cerebrovascular Hypokinesia, Pathogenesis, Motor Neuron Homeostasis, Hypodynamics, Atrophic Osteopenia

Introduction.

The relevance and necessity of the topic of hypokinesia.

According to the latest data from the World Health Organization, in connection with modern development, a person's addiction to a sedentary lifestyle causes many medical and social problems. Ten percent of all deaths in the world are directly related to a sedentary lifestyle. In the world of hypokinesia i.e. a sedentary lifestyle is also observed in 85% of girls and 78% of boys aged 11-17 years. As a result, there is a serious risk of the population developing a number of non-communicable diseases - breast and colon cancer, diabetes mellitus, coronary heart disease. Accordingly, based on the energy metabolism of molecular physiology, it is important to determine the mechanisms of hypokinesia, through which various stressors affect the functional activity of the liver in the human body.

Studies of the effect of hypokinesia on the activity of homeostasis in the liver of rats have been carried out all over the world. Experimental hypokinesia of various durations in experimental animals of these stress factors is aimed at determining the effect of enzyme activity and homeostasis on rat liver tissues. When evaluating the effect of induction on the model of experimental hypokinesia in rats, it is important to study the effect of rat liver tissue homogenate and its amylolytic, lipolytic, aminotransferase (Alat, Asat) enzymatic activity of blood serum on homeostasis. Also in astronautics, under the influence of the hypokinesia complex, a change in the ability of the human body to function, free radicals accumulate in the cells, the processes of peroxidation and the detection of chronic effects by changing the structure of the lipid layer of the cell membrane are accelerated, enzymatic changes in the blood play an important scientific and practical role in identifying pathological processes in hepatocytes .

Methodology for creating a model of experimental hypokinesia (methodology)

In studies, the model of experimental hypokinesia is based on standard conditions for keeping rats in small (14×6×6 cm) plexiglass cases.

Under laboratory conditions, the development of a model of experimental hypokinesia in rats was carried out according to the standard method. The animals were placed in special small cages for a certain period of time. During the first 1–5 days of experimental hypokinesia, a stressful phase of a destructive signal type is recorded in the body of experimental animals. During this period, the animals lose weight, the concentration of catecholamines, glucocorticoids in the blood increases. Also, under stress, an increase in the concentration of specific hormones in the blood leads to the migration of lymphocytes into the blood up to 90% in the thymus. Over the next 10 days of experimental hypokinesia, significant changes develop in the structure and function of the cells of the spleen and liver.

Results Of The Research.

As a result of a sharp decrease in metabolic activity under the influence of experimental hypokinesia, a decrease in the body's resistance to stress, significant changes in the cardiovascular system, respiratory organs and skeletal muscles were revealed. The results obtained were used in the development of a set of measures aimed at reducing the negative impact of stressors on the human body in the department of physical culture and sports of the Andijan region. As a result, in sports games, athletes have the opportunity to increase the value of physical activity.

Experimental hypokinesia made it possible to enrich and strengthen the knowledge of bachelors in the field of physiology of the digestive system based on information and conclusions about changes in the specific features of the body, under the influence of hypokinesia, i.e., there was a sharp decrease in the activity of blood enzymes and liver tissues.

Hypokinesia (from the Greek hypó - down, kínēsis - movement) - a decrease in the activity of the body under the influence of a limited volume and pace of physical movements. Hypokinesia can occur in the human body against the background of diseases of the nervous system (Parkinson's disease, Alzheimer's disease), as well as professional activities associated with a sedentary lifestyle (programmer, operator, accountant, etc.). On this basis, hypokinesia is classified into types depending on physiological, living conditions, professional activities, clinical, climatic-geographical and school. It is noted that hypokinesia leads to a decrease in mental development, especially in schoolchildren [19].

It is noted that hypokinesia (decrease in motor activity) causes pathological morphofunctional changes in tissue cells of various organs in the body. In this case, hypokinetic syndrome develops under the influence of limited functional activity of skeletal muscles.

Under the influence of hypokinesia, the development of pathogenesis diseases associated with dysfunction of the

cardiovascular system and cerebrovascular system is noted [29]. It was also found that under the influence of hypokinesia in the body there are changes in muscle tissue according to the atrophic type, a violation of the structure and function of bones, a violation of Ca2+ homeostasis.

Under the influence of hypokinesia and hypodynamics, a decrease in the level of excitability of motor neurons was revealed, and, in turn, the development of pathological changes in the type of atony in the muscles. Under the influence of a decrease in muscle activity in the human body, dysfunction of anabolism and catabolism occurs in various tissue cells, the DNA-RNA cascade function of protein synthesis reactions is disrupted, which in turn disrupts the homeostasis of the body in a complex state. Under the influence of hypokinesia, complex structural and functional changes in the human body were revealed. It is also noted that under the influence of dysfunction of bioenergetic systems in the body under conditions of hypokinesia, there is a sharp decrease in myocardial activity, circulatory disorders, as well as an imbalance of the prooxidant and antioxidant systems. [27].

Under the influence of hypokinesia, significant dysfunctional changes in metabolism, respiratory organs, circulatory system, endocrine system function, and impaired circulation of K+ and Ca2+ ions in the kidneys were revealed [17]. Hypokinesia is a stress factor. During the period of scientific and technological progress, there is a decrease in the overall motor activity in human society, the development of diseases associated with nervous tension, as well as the development of the pathogenesis of various diseases and premature aging against the background of long-term inpatient treatment. Treatment of some diseases becomes one of the biological problems. Under the influence of hypodynamics, the ability of the human body to adapt and resist environmental factors decreases, and susceptibility to various diseases increases. Thus, under the conditions of hypokinesia and hypodynamics, one of the most urgent social and medical problems is considered to be a decrease in motor activity due to lifestyle, professional activities, prolonged hospitalization and other factors. A decrease in motor activity in the body, depending on the duration of hypokinesia, directly leads to a decrease in the mass of skeletal muscles, disruption of bioenergetic processes and a decrease in protein biosynthesis in various tissue cells.

To date, the negative impact of hypokinesia on the functional activity of the human body has been confirmed by many researchers. Studies have shown that the degree of functional and morphological changes occurring in various tissues of the body is directly related to the duration of hypokinesia [34].

In particular, under the influence of hypokinesia, metabolic disorders in the body are observed for a relatively long time, electrolyte metabolism is disturbed, skeletal muscle atrophy and osteopenia develop. Also, under the influence of hypokinesia, a violation of the vegetative-visceral functions in the body, including the mechanism of neuro-humoral regulation of the cardiovascular system, is noted. Hypokinesia can act as a stress factor in warm-blooded animals and humans. Under the conditions of the modern lifestyle in all physiological age groups, there is a sharp decrease in motor activity and a serious medical and social problem associated with hypokinesia, which, in turn, consists in clarifying the mechanism of hypokinesia and developing a set of measures to prevent it19].

The influence of hypokinesia on the functional activity of the rat liver was established in the form of a decrease in the concentration of glycogen during experimental hypokinesia (1-30 days) in the liver of rats, an increase in the activity of gluconeogenesis. Studies have also shown that under the influence of 1-4 weeks of hypokinesia, there are significant changes in the structure and function of microvessels in the liver of rats. It was noted that in liver cells the reaction of different enzymes to the duration of hypokinesia is expressed differently. In particular, studies have shown that the activity of α-ketoglutarate dehydrogenase and

succinate dehydrogenase enzymes in the liver of rats is close to the norm on the 15th day of hypokinesia and increases on the 30th day. Hyperactivation of pyruvate dehydrogenase and glutamate dehydrogenase in the liver is also noted after 30 days of hypokinesia. Studies have shown an increase in serum cholesterol and lipoprotein concentrations in rats after 1-60 days of hypokinesia, which is believed to adversely affect musculoskeletal and myocardial functional activity. Studies have shown that hypokinesia increases the concentration of acetylcholine in the blood of rats, reduces the amount of catecholamines, which leads to parasympathetic regulation, which in turn indicates a decrease in the level of activity in the body. Also, an increase in the concentration of serotonin and acetylcholinesterase activity under the influence of hypokinesia indicates a decrease in the function of the neurotransmitter system in the brain. Studies have shown that in rats the amount of motor activity decreased to 91.4% under the influence of 45-day hypokinesia.

Studies have shown a significant increase in the formation of nitric oxide (NO) in rat liver cells using electron paramagnetic resonance imaging under conditions of hypokinesia (30, 60 and 90 days) [21]. Under conditions of prolonged hypokinesia, a significant decrease in myocardial function, the development of hypodynamics, the expansion of venous vessels in the liver of rats, and the occurrence of dystrophy are noted. Some researchers conducted experiments to determine the activity of superoxide dismutase (SOD), catalase, glutathione-S-transferase based on models of experimental hypokinesia and gamma-(g)-radiation in the mitochondrial homogenate of rat liver. In this dislocation method, the anesthetized abdominal cavity of rats was surgically opened, the liver was triturated in an ice-cold (+4°C) incubation medium using a homogenizer, and the resulting homogenate was centrifuged at 800 rpm for 5 min. At the next stage, the precipitate is centrifuged at 10500 rpm for 20 min, and the resulting mitochondrial suspension is used to determine the activity of SOD, catalase, glutathione-S-transferase according to the method described in the work of the following authors. It is also used in determining the activity of SOD during experimental hypokinesia according to the method developed by V. I. Chumakov. In particular, studies have shown a decrease in the concentration of ATP and glycogen in rat liver cells during 16-day hypokinesia, a decrease in the activity of the antioxidant system, a decrease in the concentration of vitamins A and E, and an increase in the activity of the SOD enzyme [61]. There is also an activation of nitric oxide (NO) formation, activation of antioxidant enzymes, and activation of the biosynthesis of cytoprotective proteins belonging to the HSP70 group, which are considered universal messengers in intracellular signaling under hypokinesia conditions. In particular, a significant decrease in the ATP concentration in liver mitochondria was observed under the influence of hypokinesia in the range of 15–45 days. The study also found a decrease in the concentration of vitamin A in the blood of rats under conditions of experimental hypokinesia, an increase in the concentration of lipid peroxidation products (LPO) under the influence of γ-irradiation at a dose of 6 Gy.

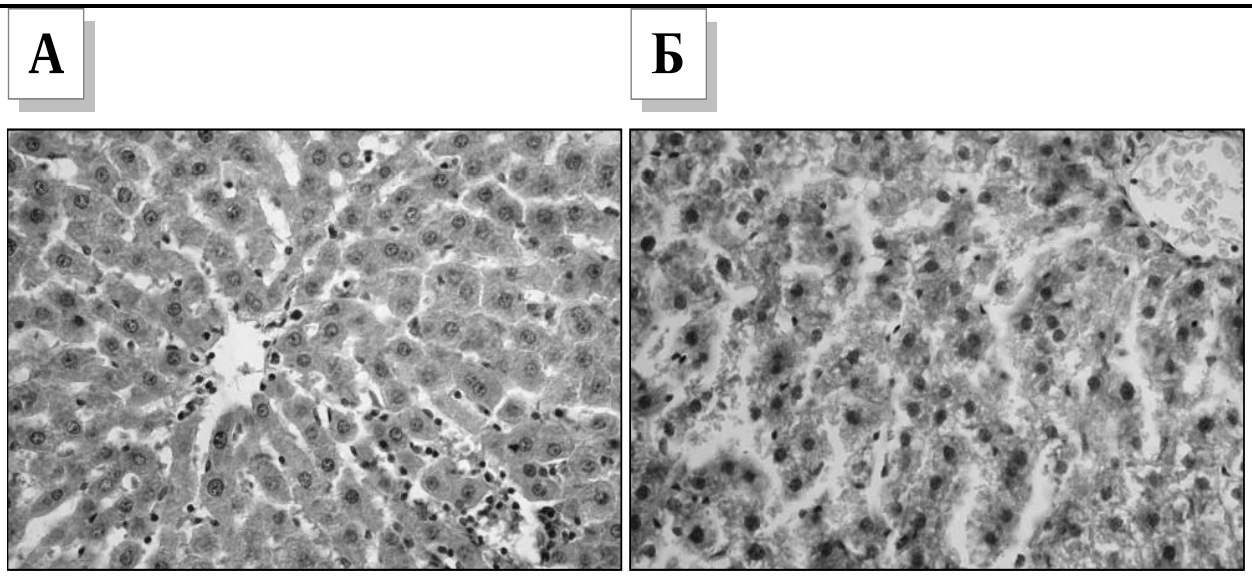
When studying the activity of the prooxidant and antioxidant system of the liver of rats under conditions of experimental hypokinesia, the concentration of the lipid peroxidation product - malondialdehyde (MDA) under incubation with thiobarbutaric acid was studied by Ohkawa and others, who, when studied by the spectrometric method developed in (1979), showed a significant change in activity this system. In studies of the concentration of vitamin A in a homogeneous suspension of rat liver under conditions of hypokinesia, the methods of adsorption chromatography and fluorometry were studied. In particular, the activity of the prooxidant and antioxidant systems in rat liver cells under the influence of experimental hypokinesia (16 days) was recorded by the activity of vitamins A and E, reversible glutathione, SOD activity, as well as the concentrations of ATP and glycogen, aspartate

aminotransferase (AST), alanine. aminotransferase (ALT).

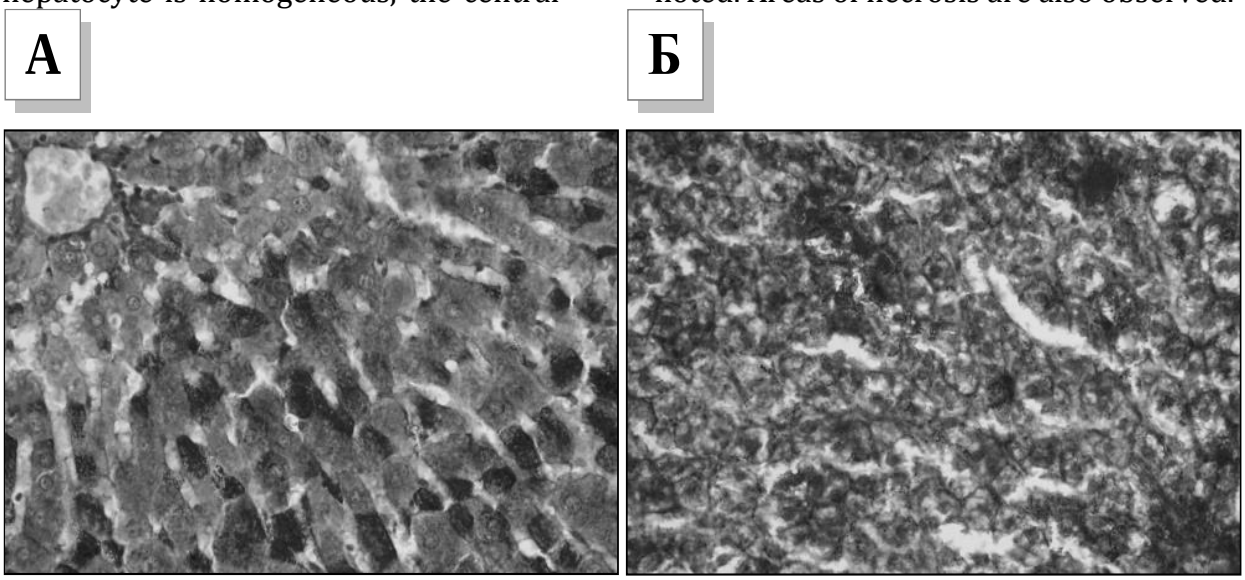
Studies have shown a significant decrease in body weight (145.5±5.8 g) in rats under the influence of hypokinesia compared with the control (153±4.64 g). Hypokinesia was also manifested by a decrease in the concentration of vitamin A in the rat liver suspension, an increase in SOD activity, an increase in AST by 1.4 times, ALT by 1.3 times, and a decrease in ATP. It was noted that an increase in the concentration of Ca2+ ions in mitochondria under the influence of hypoxia leads to a decrease in ATP synthesis.

The study also revealed the narrowing of capillaries under the influence of hypokinesia, the expansion of venous vessels in the liver, which leads to the development of dystrophy in the liver. Under the influence of hypokinesia, a decrease in the concentration of glycogen in the liver was revealed. This condition is explained by a violation of the respiratory process at the tissue level under the influence of hypokinesia and increased breakdown of glycogen due to the activation of the adrenergic system under the influence of stress.

Studies have shown that under the influence of hypokinesia (60-90 days) in rat liver cells due to the activation of NO-synthase, the concentration of NO is up to 2 times higher than the control. Studies have shown that hypokinesia (28-110 days) increases the concentration of NO in rat liver cells due to the activation of NO synthase, which in turn has a blocking effect on the functional activity of the heart. It has been established that a decrease in muscle activity in a biological organism has a direct negative effect on the activity of the upper nervous system. In particular, studies have shown a change in the concentration of norepinephrine, dopamine, and serotonin in brain cells under the influence of hypokinesia in rats [48]. Studies have shown a decrease in the synthesis of messenger RNA in the nucleus of rat liver cells under the influence of hypokinesia. Hypokinesia is one of the factors leading to a deterioration in well-being in the human body, and the study of the dynamics of morphofunctional changes at the level of individual organs is important for describing the general mechanism of hypokinesia. Studies have shown significant changes in morphometric and morphofunctional parameters of the liver of rats under the influence of hypokinesia (16 days) (Fig. 1.1) [62]. Changes in the morphological structure of the liver of rats under the influence of hypokinesia were studied by some researchers using a microscopic method. At the same time, the liver isolated during the study of glycogen granules was fixed in 10% formalin solution, incisions 5-7 μm thick were examined under a microscope when stained with hematoxylin-eosin (under conditions of 100-600× magnification). In particular, under the influence of hypokinesia, a decrease in the glycogen content in rat liver hepatocytes was observed. (pic. 1.2).



Picture 1.1. Ultrastructure of the liver of rats in control (A) and in hypokinesia (B) (image magnification 400 times) [62; 111–114-p.]. Areas of necrosis in the liver tissue in the control group were not observed, with an intact state, the hepatocyte membrane, nucleus and nucleolus are clearly visible, the cytoplasm of the hepatocyte is homogeneous, the central venous vessels are not dilated. Under the influence of hypokinesia, structural changes in the parenchyma around the dilated central venous vessels in hepatocytes, the appearance of cytoplasm in the coagulation type, the appearance of the nucleus in the form of hyperchromia, curvature (karyopyknosis) are noted. Areas of necrosis are also observed.



Picture 1.2. Appearance of glycogen granules (400x catalytic image) in rat liver cells under control (A) and hypokinesia (B) [62].

According to the concept of motor-visceral reflex action, the functional activity of muscles in the human body is one of the main factors that directly determine the balance of the general state of the body. However, the modern development of human society (information technology, mechanization/automation) as a whole leads to a sharp decrease in the motor activity of the human body, which raises the question of the mechanism of hypokinesia/hypodynamics and the development of effective methods for its prevention is relevant from a biochemical point of view.

Studies have been conducted on the effect of hypokinesia on skeletal muscles, the cardiovascular system, the sympathetic regulatory system [68], as well as on indicators of the hemostasis system. Especially against the background of hypokinesia, the dynamics of changes in the morphofunctional activity of the liver, one of the organs important in the processes of anabolism and catabolism in the body, has been relatively little studied, and, in turn, further research in this area is theoretically and practically relevant. [12]

Conclusions

According to the concept of motor-visceral reflex action, the functional activity of muscles in the human body is one of the main factors that directly determine the balance of the general state of the body. However, the modern development of human society (information technology, mechanization / automation) as a whole leads to a sharp decrease in the motor activity of the human body, which raises the question of the mechanism of hypokinesia / hypodynamics and the development of effective methods for its prevention is relevant from a biochemical point of view.

Studies of the effect of hypokinesia on skeletal muscles, the cardiovascular system, the sympathetic regulatory system, as well as the parameters of the hemostasis system were carried out. Especially against the background of hypokinesia, the dynamics of changes in the morphofunctional activity of the liver, one of the organs important in the processes of anabolism and catabolism in the body, has been relatively little studied, and, in turn, further research in this area is theoretically and practically relevant.

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