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Abstracts

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interaction of structural components in the network processes of regulation of redox homeostasis.

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S9.632. Functional state of motor systems during simulated hypogravity and during the readaptation period. Effects of spinal cord stimulation

Fedianin A.O.[1,2*], Baltin M.E.[1,2], Zaytceva T.N.[1], Shulman A.A.[1], Baltina T.V.[1], Eremeev A.A.[1]
[1]*Kazan (Volga region) Federal University;*
[2]*Volga Region State University of Physical Culture, Sport and Tourism;*
* artishock23@gmail.com

The main factors that determine the characteristics of motor systems are assumed to be exogenous gravitational forces and endogenous muscle forces. However, the specific ways and mechanisms of their action remain unclear. The wide prevalence of pathologies accompanied by changes in motor qualities and the intensive exploration of outer space makes it necessary to obtain new knowledge about the mechanisms of reorganization of motor skills, detailing the role and contribution of both peripheral and central structures of neuromotor systems to these processes. No less important is the understanding of the processes of restorative readaptation of the motor apparatus after the normalization of functioning conditions. Therapeutic approaches proposed to increase the speed and efficiency of recovery of motor function.

The aim of the work was to evaluate the effect of electrical and non-invasive magnetic stimulation of the spinal cord on the functional state of the neuromotor apparatus of the soleus (SM) and tibialis anterior muscles (TA) of the rat tibia during gravitational unloading and during the period of posthypogravitational readaptation.

Model experiments were carried out on laboratory male rats weighing 190-210 g in strict accordance with accepted bioethical standards. Animals were divided into the following experimental groups: "HU" - animals with simulated gravitational unloading of the hind limbs (7, 35 days; n=11); "HU+MS" - animals with simulated gravitational unloading of the hind limbs, combined with magnetic stimulation of the spinal cord (7, 35 days; n=10); "HU+ES" – animals with simulated gravitational unloading of the hind limbs, combined with electrical stimulation of the spinal cord (7, 35 days; n=9); "RD" - animals in conditions of readaptation to the action of the support reaction force and axial loads after simulated gravitational unloading (1, 3, 7, 14 days; n=18); "RD+MS" - animals under conditions of readaptation combined with magnetic stimulation of the spinal cord (1, 3, 7, 14 days; n=16); "RD+ES" - animals under conditions of readaptation combined with electrical stimulation of the spinal cord (1, 3, 7, 14 days; n=14).

Modeling of gravitational unloading was carried out by the generally accepted method of antiorthostatic hanging of the rat by the tail. To study the effects of readaptation to the action of the reaction force of the support and axial loads in animals, gravitational unloading of the hind limbs was modeled. Spinal cord stimulation was performed in the area of localization of the motor centers of the studied muscles (L4-S1 segments). Magnetic stimulation (HU+MS, RD+MS groups) was performed with a magnetic stimulator, an 8-shaped inductor. Electrical stimulation (HU+ES, RD+ES groups) was performed through pre-implanted electrodes. Stimulation parameters: daily for 90 minutes in series of 10 minutes with an interval of 10 minutes; amplitude of stimuli - threshold for contraction of the leg muscles; frequency - 3 Hz.

After the expiration of the experimental conditions, the reflex (H) and motor (M) responses of SM and TA were recorded. The threshold of occurrence, maximum amplitude, latency, and duration of evoked potentials were determined. The ratio of the maximum amplitudes of the reflex and motor responses was calculated.

The analysis of H response parameters indicated an increase in the reflex excitability of rat calf motor neurons both during 7-day (for SM) and 35-day (for SM and TA) simulated microgravity. The recorded decrease in the maximum amplitude of the M-response of the SM after prolonged unloading indicated a decrease in the total number of motor units, the development of atrophic processes. Activation of spinal structures under conditions of short-term (7 days) simulated unloading prevented changes in the reflex excitability of spinal motor centers, however, did not exclude hypogravitation-determined transformations during long-term unloading (35 days).

Under the conditions of posthypogravitational readaptation after 7 days of unloading, the reflex excitability of the corresponding motor centers approached the control level by 1 day already. After 35 days of simulated microgravity during readaptation for 1 day, a decrease in the reflex excitability of motor neurons of the SM and TA was observed, then the excitability increased. An increase in the latency and duration of the recorded potentials was noted. The restoration of the morphofunctional state of the muscle after unloading is obviously accompanied by a sharp increase in peripheral afferentation, including from the muscles of antagonists, the motor neuron pools of which are connected by reciprocal relationships; reinnervation processes and, as a result, desynchronization of recruitment of motor units. Under the conditions of spinal cord stimulation during the readaptation period, no sharp changes in the reflex excitability of the motor centers were observed.

On the 1st day of readaptation, an increased level of activity of motor neuron pools remained, however, by the 3rd day of the readaptation period, these indicators approached the control level, and no significant changes were recorded at the next studied stages of readaptation. Also, under conditions of readaptation combined with spinal cord stimulation, no changes in the threshold, latency and duration of the M-response were recorded, and the amplitude of the motor potential was restored to control values already 3 days later.

We conclude that spinal cord stimulation can activate the processes of neuronal plasticity, promote the reactivation of existing and, possibly, the formation of new intraspinal locomotor circuits. Data on the effectiveness of spinal cord stimulation can be taken as a basis for developing a therapeutic protocol for neurorehabilitation of patients after impaired/limited motor function.

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