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COMBINED ELECTROMYOSTIMULATION MODE TO MITIGATION OF SPACE FLIGHT EFFECTS ON CONTRACTILE PROPERTIES OF LOWER EXTREMITIES MUSCLES

Abstract

Passive countermeasures are compact, and especially relevant in the framework of moon crewed missions since the habitable volume of lunar ships is limited. The placement of active countermeasures in this volume is difficult. One of the prospective passive countermeasures is electromyostimulation (EMS). This method restores the electrical activity of muscles through the use of electric current with pulse parameters characteristic of the innervation pattern of fast (about 50 Hz) or slow (about 20 Hz) motor units (Shenkman B.S. et al., 2007; Tanaka M. et al., 2016). A new approach to the EMS frequency choice is the combined EMS protocol – activation of fast and slow motor units. We tested the combined EMS mode in a 7-day Dry Immersion model (DI). The study involved 20 men: 10 – under the 7-day DI without countermeasures, and 10 – under the 7-day DI with combined EMS when low-frequency EMS was in the first half of the day, and high frequency –in the second one. The tensiomyography was used to assess the contractile properties of the lower extremities muscles (mm. biceps femoris, rectus femoris, tibialis anterior, soleus, gastrocnemius): twice before DI, and on the first recovery day. This method is based on tracking the radial displacement of the sensor placed on the muscle belly during muscle response on a stimulation pulse. Thus, an increase in the maximum displacement amplitude (Dm) indicates a decrease in muscle stiffness/rigidity and neuromuscular fatigue (García-Manso J.M. et al., 2011) when a decrease in Dm points to the opposite effects. After DI without countermeasures, we observed trends of an increase in Dm in all muscles studied. A significant increase was observed in the lateral and medial gastrocnemius muscles – by 3.37+/-1.28 and 1.72+/-0.8 mm, respectively. Combined EMS mode not only prevented these effects but also decreased Dm values. For example, this indicator significantly declined in the gravity-dependent triceps surae muscle: by 3.71+/-0.8 mm – in the lateral gastrocnemius, by 2.91+/-1.06 mm – in the medial gastrocnemius, and by 2.11+/-0.65 mm – in m. soleus. The study was supported by the Ministry of Science and Higher Education of the Russian Federation under agreement #075-15-2022-298 from 18 April 2022 about the grant in the form of subsidy from the federal budget to

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