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C60 fullerene nanoparticles improve the nerve conduction after achillotomy-induced muscle soleus atrophy

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The search for new means that would effectively influence the pathological consequences of skeletal muscle immobilization is an urgent priority request of modern biomedicine. Previously, the positive effect of C60 fullerenes, as the strong antioxidants, against the background of muscle ischemia, mechanical muscle injury, and other muscle dysfunctions was established [1-3]. These carbon nanoparticles reliably protected muscle tissue from damage caused by oxidative stress. The nerve conduction under stimulation of the rat muscle soleus after long-term immobilization of the hind limbs was studied using a clinical model - rupture of the Achilles tendon. The analysis of force muscle response was performed on day 45 after the initiation of atrophy by using tensometry. The water-soluble C60 fullerene was used as a therapeutic nanoagent at a daily oral dose of 1 mg/kg during the experiment. The delay in the time of muscle contraction caused by 1 and 2 Hz stimulations revealed a sharp increase from 98 ± 6 ms in control to 443 ± 8 and 487 ± 7 ms after atrophy initiation, respectively (Fig. 1). This delay is associated with a decrease in the conductivity of the nerve stimulus due to destructive changes in the nervous tissue caused by muscle atrophy. In all the tests performed with the administration of water-soluble C60 fullerenes, an increase in nerve conduction by $31 \pm 2\%$ and $36 \pm 2\%$ at 1 and 2 Hz stimulation, respectively, was detected in relation to the atrophy group (Fig. 1). This indicates the presence of compensatory activation of the endogenous antioxidant system by C60 fullerenes in the process of dystrophic changes caused by prolonged immobilization. Thus, the obtained results demonstrate the prospects of using water-soluble C60 fullerene nanoparticles, which can alleviate pathological state in the muscular system that arises from skeletal muscle atrophy.

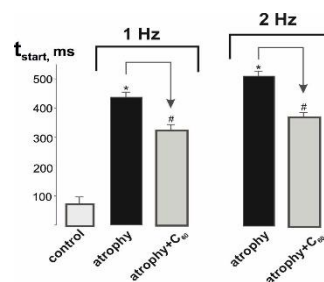


Fig. 1. The time of the start of contraction of the rat muscle soleus after atrophy when using 1 and 2 Hz pools of non-relaxation stimulation lasting 1800 s: atrophy and atrophy+C60 - contraction of the atrophied muscle soleus without the introduction of C60 fullerene nanoparticles and against the background of their introduction; * $p < 0.05$ compared to control; # $p < 0.05$ compared to the atrophy group.

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