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TRANSVERSAL STIFFNESS OF RAT'S SOLEUS MUSCLE FIBERS AND CARDIOMYOCYTES DURING THE FIRST DAY OF THE HINDLIMB SUSPENSION

Abstract

Fluid shift caused by rat's hindlimb suspension results in heart bulk load increase, at least at early stages. On the other hand, suspension cause reduction of load on hindlimb muscles, particularly on m. soleus. Differently directed effect of hindlimb suspension on cardiomyocytes and soleus fibers may be a reason of different structural changes in cytoskeleton. The aim of this study was to measure transversal stiffness of cardiomyocytes and soleus fibers at early stages of gravitational unloading. To simulate gravitational unloading in rodents we used Ilyin-Novikov model of antiorthostatic suspension with Morey-Holton modification. We conducted suspension duration 6, 12, 18, 24 and 72 hours. Atomic force microscopy was used to measure the transversal stiffness, having used contact mode and indentation depth equal to 150 nm. Transversal stiffness of rat's left ventrical cardiomyocytes was shown to be the same in "Control" group and in a group after 6 hours of hindlimb suspension (4.390.14 pN/nm in "Control" and 4.240.18 pN/nm in 6h). This parameter reduced by 42% ($p<0.05$) after 12 hours, and came to control level after 18 hours, being significantly different from "12h" group. Transversal stiffness of cardiomyocytes was growing through 24 hours (exceeded control level by 41% ($p<0.05$)) and 72 hours (exceeded control level by 44% ($p<0.05$)). Transversal stiffness of soleus fibers didn't change after 6 hours of antiorthostatic suspension. It decreased by 56% ($p<0.05$) in comparison with "Control" after 12 hours (3.120.09 pN/nm in "Control" and 1.380.09 pN/nm "12h"), by 74%($p<0.05$) in comparison to "Control" after 72 hours, and by 41% ($p<0.05$) relatively to "12h". Thereby, both cardiomyocytes and soleus fibers stiffness dramatically reduced after 12 hours. But cardiomyocytes showed a growth exceeding control level, whereas soleus fibers lost stiffness more through the experiment's duration time. In other words, increase of cell mechanic tension results in cytoskeleton strengthening, whereas external mechanical load reduction causes cytoskeleton weakening.