Acta Astronautica 68 (2011) 1469–1477

Contents lists available at ScienceDirect

Acta Astronautica

journal homepage: www.elsevier.com/locate/actaastro

Mechanisms of spinal motoneurons survival in rats under simulated hypogravity on earth

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ARTICLE INFO

Article history:
Received 31 July 2009
Received in revised form
1 December 2009
Accepted 2 December 2009
Available online 31 December 2009

Keywords:
Antiorthostatic hind limb suspension
Spinal motoneurons
Ventral root
Retrograde axonal transport
Heat-shock proteins
Apoptosis

ABSTRACT

It was previously shown that different cell types in vivo and in vitro may die via apoptosis under weightlessness conditions in space as well as in simulated hypogravity on the Earth. We assessed survivability of spinal motoneurons of rats after 35-day antiorthostatic hind limb suspension. Following weight bearing, unloading the total protein content in lumbar spinal cord is dropped by 21%. The electrophysiological studies of m. gastrocnemius revealed an elevated motoneurons' reflex excitability and conduction disturbances in the sciatic nerve axons. The number of myelinated fibers in the ventral root of experimental animals was insignificantly increased by 35-day of antiorthostatic hind limb suspension, although the retrograde axonal transport was significantly decreased during the first week of simulated hypogravity. The results of the immunohistochemical assay with antibodies against proapoptotic protein caspase 9 and cytotoxicity marker neuron specific nitric oxide synthase (nNOS) and the TUNEL staining did not reveal any signs of apoptosis in motoneurons of suspended and control animals. To examine the possible adaptation mechanisms activated in motoneurons in response to simulated hypogravity we investigated immunoexpression of Hsp25 and Hsp70 in lumbar spinal cord of the rats after 35-day antiorthostatic hind limb suspension. Comparative analysis of the immunohistochemical reaction with anti-Hsp25 antibodies revealed differential staining of motoneurons in intact and experimental animals. The density of immunoprecipitate with anti-Hsp25 antibodies was substantially higher in motoneurons of the 35-day suspended than control rats and the more intensive precipitate in this reaction was observed in motoneuron neuritis. Quantitative analysis of Hsp25 expression demonstrated an increase in the Hsp25 level by 95% in experimental rats compared to the control. The immunoexpression of Hsp70 found no qualitative and quantitative differences in control and experimental lumbar spinal cords. Taken together our results show that (1) rat motoneurons survived after 35-day antiorthostatic hind limb suspension and the changes in neurons had a mostly functional character, and (2) the increased immunoexpression of Hsp25 can be considered as the anti-apoptotic factor.

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doi:10.1016/j.actaastro.2009.12.001