SPACE LIFE SCIENCES SYMPOSIUM (A1)
Human Physiology in Space (2)

Author: Prof. Victor Baranov
Research Institute of General Pathology and Pathophysiology / Russian Academy of Medical Sciences, Russian Federation

Dr. Julia Popova
FSC RF-IMBP, Russian Federation
Mr. Aleksandr Kovalev
FSC RF-IMBP, Russian Federation
Dr. Mikhail Baranov
Research Institute of General Pathology and Pathophysiology / Russian Academy of Medical Sciences, Russian Federation

CHANGES IN THE SENSITIVITY OF THE CENTRAL RESPIRATION MECHANISM IN SPACE FLIGHT

Abstract

Introduction. Experiments PNEUMOCARD and DYKHANIE-1 (RESPIRATION) combined with the with breath-holding test aboard the International space station showed that extension of the hold-time was reliable during inspiration and trend-like during expiration (I.I.Funtova et al., 2009; V.M.Baranov et al., 2009). In the opinion of some authors, carbon dioxide (2) is a key element of the chemoreceptor loop of the ventilation control and, therefore, it can be hypothesized that space flight subdues the respiration center sensitivity to accumulated endogenous 2 or slows down gas concentration build-up in blood that washes 2–receptors, the majority of which are in the brain. However, this does not comply with the results of testing the ventilation response to hyperkapnia during the Neurolab mission (K.Prisk et al., 2000). To make clear what in fact leads to the breath-holding extension, we combined our investigations with 21-hour bed rest (BR). Methods. Seven volunteers were tested 2 hours before BR, in 5 to 10 minutes after it began, after 20 hours of bed rest, and in 20 minutes after getting up. Breath-holding time was measured during inspiration and expiration; 2 and 2 partial pressure in capillary and venous blood was determined before and in 12 hours since BR commencement.

Results. Equally during inspiration and expiration, breath-holding time was shown to increase significantly within initial 10 minutes of bed rest remaining so till end of the BR period. After BR, not only did the breath-holding time regain baseline values but even grew short. After about 12 hours of bed rest, 2 in capillary and venous blood showed a reliable rise by 2.1 mmHg and 4.0 mmHg, respectively.

Conclusion. Considering that the breath-holding time extension was registered already after 10 minutes of bed rest and regained baseline values in 20 minutes of its completion, it may be deduced that the dominating factor in reduction of sensitivity of the central respiration mechanism (CRM) at 0-g is absence of the hydrostatic pressure gravitational component. The observed increase in blood 2 can be a marker of CRM sensitivity reduction.