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Human Physiology in Space (2)

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NEW WEARABLE TECHNOLOGY FOR SPACE CARDIOLOGY – USEFULNESS DURING THE ONE YEAR SPACE FLIGHT ON BOARD THE INTERNATIONAL SPACE STATION (ISS)

Abstract

The progress in space medicine depends mainly on the successful development of new diagnostic methods. The Russian flight experiment "Cardiovector" is one example for this approach in space medicine, providing the opportunity to assess cardiac function and autonomic cardiovascular and respiratory control. The experiment was part of the first one year space flight on board the ISS and can be compared with the Russian flight experiment "Night", which was carried out almost twenty years ago during the record Russian-Austrian flight on board the space station MIR (438 days) by the Russian cosmonaut Valery Polyakov. During the experiment "Night", measurements of ballistocardiography (BCG) were combined for the first time with the traditional assessment of autonomic cardiovascular autonomic control based on heart rate variability analysis (HRV) for such a long period of weightlessness. Today, after the first one year flight on board the ISS, we have the opportunity to compare the former results with the data obtained using new state-of-the art technology. In fact, the former one-dimensional BCG from the MIR station was replaced by a sensor with 6 degrees of freedom. HRV analysis was performed based on a probability assessment in order to quantify the risk of prenosological signs. The preliminary results of the "Cardiovector" experiment suggest that cardiac function and cardiovascular autonomic control remain stable during the first 6 months in space. However, with longer flight duration parameters of HRV show profound changes in autonomic HR control, which may indicate a transition period to a new functional state. Similar changes occurred during the experiment "Night" after 8 months in space. Results from "Cardiovector" show an increase of the Stress index and of the spectral power in the very low frequency range after 185 days in space, which may indicate a shift from fast reflex mediated HR control towards the dominance of slower, humoral or metabolic mechanisms. Similarities between the two experiments were also found for the BCG. The amplitude of the one-dimensional BCG increased after 250 days in space and was associated with an increase in the stress index of HRV. Comparable changes are detected with the 6D-BCG and HRV during the Cardiovector experiment over one year. These preliminary results support the hypothesis that space flights of 6 months duration may be an optimal time frame for manned space flight. Longer space flight may require more rigorous interventions in order to allow further stable individual adaptation to the specific environment.