

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

Author: Dr. Elena Luchitskaya
Institute for Biomedical Problems, Russian Federation, e.luchitskaya@gmail.com

Prof. Roman Baevsky
SSC RF Institute for bio-medical problems RAS, Russian Federation, rmb1928@mail.ru
Dr. Irina Funtova
SSC RF-Institute of Biomedical Problems RAS, Russian Federation, funtova.imbp@mail.ru
Dr. Anna Chernikova
SSC RF Institute of bio-medical problems RAS, Russian Federation, anna.imbp@mail.ru
Prof. Jens Tank
Hannover Medical School, Germany, tank.jens@mh-hannover.de

RESULTS OF 5-YEAR RESEARCHES OF CARDIOVASCULAR SYSTEM OF CREW MEMBERS AT
THE INTERNATIONAL SPACE STATION

Abstract

Introduction. Since 2007 till 2012 onboard the ISS all Russian cosmonauts carried out space scientific experiments "Pneumocard" and "Sonocard". The purpose of these experiments was to obtain new scientific information for better understanding the adaptation of mechanisms of cardiovascular system as indicator of adaptable reactions of organism in the conditions of long-term space flight. Methods. The experiment "Pneumocard" was conducted at the International Space Station with participation of 25 Russian cosmonauts during 19 long-term expeditions. The five physiological signals (electrocardiogram, impedance cardiogram, seismocardiogram, photoplethysmogram, pneumotachogram) during the condition of rest and breathing tests were analyzed. Pre- and post flight experiments included orthostatic testing. Experiment "Sonocard" has been directed to create new method of estimation of cosmonauts functional state during night sleep on the basis of contactless registration of physiological signals. Onboard device records throughout the night microvibrations of chest wall (seismocardiogram) associated with the heart rate and breathing. The experiment was conducted every month by cosmonauts (n=22) in 17 main ISS missions over the 5 years. Results. Experiment "Pneumocard" provided an opportunity to examine and evaluate the changes in heart rate variability, central hemodynamics and peripheral circulation at different stages of space flight and during the breathing and orthostatic tests. We can see that there are some significant relationship between the individual input parameters of autonomic regulation and the influence of space flight factors on post-flight orthostatic stability in order to predict the possible reactions when crew members came back to the Earth. The research to determine the extent of dependence of the state regulation on the status of each space crew member were conducted. The important data about night sleep of cosmonauts were obtained for the first time. The significant reduction of respiratory rate, decrease of motor activity, increase of the index of centralization during the cosmonauts' sleep was observed. We have developed a method of estimation of cosmonauts' sleep quality based on the differences values of parameters at the beginning and at the end of the sleep time. The investigations of possible application of this method to estimate the processes of recovery after the extravehicular activity (EVA) were carried during the ISS-24, 25 and 26. Conclusion. Results of 5-year researches on ISS with application of devices "Pneumocard" and "Sonocard" allowed to obtain the new unique data about processes of adaptation of cardiovascular system to conditions of long-term space flight.