SPACE LIFE SCIENCES SYMPOSIUM (A1)
Human Health : Countermeasures (2)

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DISSOCIATION OF PERIPHERAL AND CENTRAL CARDIOVASCULAR ADAPTATION DURING LONG TERM SPACE FLIGHT.

Abstract

The device "Pneumocard" was developed to obtain information on cardiovascular regulation in terms of hemodynamic measurements and heart rate variability during standardized tests aboard the International Space Station (ISS). We tested the hypothesis that cardiac function is well maintained during long term space flight based on different individual regulatory patterns including peripheral vasoconstriction. "Pneumocard" was used during in-flight experiments on ISS for autonomic function testing. ECG, photoplethysmography, respiration, impedance cardiography (ICG, modified four-electrode technique) and seismo cardiography were assessed in six male cosmonauts (age: 35-48 years; BMI: 23-30 kg/m*m; flight duration >6 month). Recordings and analysis were made prior to the flight, monthly in-flight as well as post-flight during spontaneous respiration and during maximum voluntary inspiratory apnea. HR remained stable during flight (pre-flight: 62$\pm$2 bpm, late in flight: 65$\pm$3 bpm). Respiratory frequency (RF) tended to decrease during flight (pre-flight: 15$\pm$1 min-1, late in flight: 13$\pm$1 min-1). Diastolic blood pressure (DBP) decreased during flight (pre-flight:77$\pm$2 mmHg, late in flight: 72$\pm$2 mmHg). Pulse wave transit time (PWTT) was shorter during flight compared to pre-flight values (pre-flight: 201$\pm$6 ms, late in flight: 195$\pm$7 ms). Interestingly, in individual astronauts the decrease of pulse wave transit time was more pronounced despite the relative increase of stroke volume. The highest HR, RF, DBP values and the lowest PWTT were measured after flight. Maximum voluntary apnea time was prolonged (pre-flight: 76$\pm$3 s, late in flight: 124$\pm$6 s) during flight. The maximum of the first time derivative of the ICG (dZ/dt), which is directly related to stroke volume, increased during flight (pre-flight: 1.66$\pm$0.15 Ω/s, late in flight: 2.36$\pm$0.25 Ω/s). Changes of dZ/dt during inspiratory apnea were more pronounced during flight, but the minimum value reached during inspiratory apnea was higher compared to preflight values. Post flight values of dZ/dt were similar compared to pre flight values. The increase of dZ/dt during flight at rest, the higher absolute values of dZ/dt during maximum voluntary apnea in-flight as well as the similar values after flight indicate well maintained cardiac function. The decrease of PWTT during flight may suggest increased peripheral vascular tone which may reflect dissociation between central and peripheral adaptational hemodynamic mechanisms to microgravity. Our results show profound inter-individual differences which may have influence on post flight autonomic dysfunction. The results indicate the possibility of an

individual hemodynamic management during and after flight as well as before and after extravehicular activities.