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

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CARDIORESPIRATORY REGULATION IN RESPONSE TO EXERCISE – FIRST RESULTS FROM HERA C4

Abstract

Purpose: Muscular oxygen uptake ($V'O_{2musc}$) kinetics were slowed in astronauts, returning from six months missions onboard the International Space Station (ISS; Hoffmann et al., Eur J Appl Physiol 116:503-511, 2016). Therefore, the effects of 45 d of isolation inside the Human Exploration Research Analog (HERA) facility, including phases of sleep deprivation and restricted physical training on $V'O_{2musc}$ kinetics and cardiovascular regulation during exercise were investigated to identify possible mechanisms for slowed $V'O_{2musc}$ kinetics. **Methods:** To date six healthy individuals (40±8 y, 25±4 kgm^{-2}) were tested 8 d before the mission (M-8), on mission day 22 (M22), mission day 42 (M42) and 4 d after (M+4) a simulated mission to an asteroid. At all test days a cycle exercise test with changing work rates (WR) of 30 and 80 W was completed. On M-8 and M+4 a step protocol to assess peak oxygen uptake ($V'O_{2peak}$) was added. Heart rate (HR) and mean arterial blood pressure (MAP) were measured beat-to-beat and pulmonary oxygen uptake ($V'O_{2pulm}$) breath-by-breath. $V'O_{2musc}$ was estimated from HR and $V'O_{2pulm}$. Kinetics responses were calculated using time series analysis. Higher maxima of the cross correlation function (CCF_{max}) between WR and the respective parameter indicate faster kinetics. During the mission, exercise training sessions were restricted to every other day with a HR below 85%of the age-related maximum. Sleep was restricted to 5 h per weekday and 8 h at the weekends. Statistical analyses on the kinetics parameters (HR, $V'O_{2musc}$, $V'O_{2pulm}$) were performed by means of repeated measures ANOVA (M-8, M22, M42, M+4) and the Friedman-test (MAP). $V'O_{2peak}$ was compared using a t-test. **Results:** HR kinetics did not change significantly throughout the mission (M-8 vs. M22 vs. M42 vs. M+4; mean ± standard deviation [a.u.]: 0.28±0.07 vs. 0.37±0.18 vs. 0.36±0.13 vs. 0.28±0.06; P=0.111) similar to $V'O_{2pulm}$ (0.33±0.09 vs. 0.29±0.08 vs. 0.33±0.10 vs. 0.28±0.05; P=0.363) and MAP (0.34±0.09 vs. 0.37±0.03 vs. 0.37±0.05 vs. 0.36±0.08; P=0.154). $V'O_{2musc}$ kinetics were slowed by trend (0.33±0.06 vs. 0.31±0.08 vs. 0.35±0.06 vs. 0.28±0.03; P=0.063) at MD+4. $V'O_{2peak}$ differed not significantly between M-8 (35.4±7.1 ml min^{-1} kg^{-1}) and M+4 (36.6± 6.1 ml min^{-1} kg^{-1}). **Conclusions:** Preliminary results of this small sample indicate no significant effects of the simulated HERA-mission on HR and $V'O_{2pulm}$ kinetics. Though, a small trend towards slowed $V'O_{2musc}$ kinetics after the mission signifies decreased tolerance to moderate aerobic metabolic demands as observed similarly after ISS missions.