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EFFECTS OF 30 DAYS CONFINEMENT ON HEART RATE VARIABILITY IN THE HUMAN EXPLORATION RESEARCH ANALOG (HERA)

Abstract

Confinement and isolation for long periods (40-500 days) may severely affect cardiovascular autonomic regulation, which can be assessed by heart rate variability (HRV) analysis. Studies on conditioned facilities hold a crucial role concerning simulation of long space missions. Therefore, this study aimed to investigate whether even a shorter period of confinement (30 days) in Earth-based HERA could evoke similar modifications in HRV-parameters. 36 hours of electrocardiogram coupled with accelerometry were recorded on eight HERA crewmembers (age 35±7,4 years; 3 females) [Data as mean±SD] before (10 days pre=d-10), during (d10 and d20), and after (2 days post=d+2) confinement. HRV analysis was performed in supine position, 10 min of duration, at morning, after wake-up and before breakfast. RR intervals in d10 (1006±158 ms) and d20 (1037±74 ms) were longer than post (867±99; $p<0.03$). pNN50 in pre (25.7±16%) and d20 (26.3±13.8%) was higher than post (7.5±5.7% ; $p<0.02$). RMSSD and frequency-domain variables did not show significative differences between phases. Respiratory frequency was steady in 13±0.8 bpm during all measurements. Regarding non-linear variables, differences ($p<0.05$) were founded in SD2 (the standard deviation of the major axis in a Poincaré ellipse) in pre (81.7±26.8 ms) and d20 (81.7±23.2 ms) in comparison with post (48.1± 5.9 ms). The CD (the correlation dimension as a measurement of the system's attractor dimension) during pre (3.2± 1.1) and d20 (3.8± 0.3) was higher than post (1.6± 0.8; $p<0.02$). To the extent of our knowledge, this is the first time that a non-linear HRV analysis is applied to a confinement study. Whereas a decrease in CD has been associated with the suppression of parasympathetic activity, SD2 is a manifest of the general variability. For this reason, our findings show that the transition from confinement to non-confinement is accompanied by a change in the sympathovagal balance due probably to depression of the parasympathetic loop. This is evident for the increase in HR and the decrease of SD2 and CD in post. Although vagal tone increase during confinement was not evident by frequency-domain variables, SD1 and RMSSD, changes in pNN50 could be interpreted as part of this interplay. These findings support the importance of developing strategies to minimize the operational stress caused by the reconditioning process after space missions.