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COMPARISON OF THE SHORT-TERM ACUTE CARDIOVASCULAR RESPONSE BETWEEN HEAD-DOWN (-6 DEGREES) AND HORIZONTAL BED REST

Abstract

Aims. Prolonged weightlessness exposure associated to space flight and inactivity induce reduced functional capacity in multiple body systems, generating cardiovascular deconditioning. Head-Down (HD, -6 degrees) and Horizontal (H) Bed Rest (BR) are ground-based analogue models used to simulate the effects of spaceflight on human body through immobilization, confinement and elimination of Gz gravitational stimuli. Our aim was to compare the effects of 5-day HDBR and HBR on ECG cardiac activity and circadian rhythms, to study possible differences in these experimental models.

Methods. Ten male subjects (23±5 years) were enrolled at the Hospital of Izola (Slovenia) in a 10-day HBR study (acronym MARS-PRE). For each subject, 12-lead 24-hour Holter ECG (H12+, Mortara Instrument Inc.) was acquired before HBR (PRE), and the 5th day of HBR (BR5) with day period 7AM-11PM. As comparison, the PRE and BR5 24-hour ECG data of 61 male subjects (32±7 years) enrolled in non-intervention groups from six previous HDBR campaigns (5, 21 and 60 days duration, performed at MEDES or at :envihab) were used. From beat-to-beat RR and QTend series, day and night median values were computed. Also, RR and QTend circadianity was evaluated by Cosinor analysis, resulting in a value of oscillation amplitude (OA, half variation within a night-day cycle), and acrophase (φ, temporal value at which the amplitude of the fitting sinusoid is maximal). Statistical analysis tested the effects of 5 days of HDBR and HBR vs PRE, and compared the effects of the two maneuvers (Two-Factor ANOVA with Repeated Measures on One Factor). Also, the Zero-Amplitude test ($p<0.05$) was performed to assess the presence of circadianity.

Results. Daily RR and QTend intervals similarly increased both with HBR (RR +13.3%; QTend +3%) and in HDBR (RR +15.7%; QTend +4%) compared to PRE. At night, while RR increased (HBR +5.3%; HDBR +3.2%), QTend was shortened (HBR -1.6%; HDBR -0.2%). Circadian rhythms were preserved in all the subjects. The OA of QTend at BR5 was similarly reduced in both HBR (-36.4%) and HDBR (-37.9%). Interestingly, RR OA flattening was greater in HDBR (-34.9%) than in HBR (-12.3%). Both RR and QTend φ were slightly anticipated at BR5 (RR: HBR 7.5%, HDBR 3.1%; QTend: HBR 8.4%, HDBR 4.3%).

Conclusions. RR and QTend median values and circadian rhythms are similarly affected by HBR and HDBR, except for RR day-night OA, much reduced with HDBR. Possible mismatch in RR-QTend relation could induce increase in arrhythmogenicity risk.