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CARDIOVASCULAR AND CEREBROVASCULAR RESPONSES TO DIFFERENT POSTURES FOLLOWING 5-DAY HDBR WITH AN ARTIFICIAL GRAVITY COUNTERMEASURE

Abstract

Cardiovascular and cerebrovascular deconditioning associated with spaceflight or prolonged bed rest are major health concerns when returning to the gravitational stress of an upright posture. A variety of countermeasures, including artificial gravity (AG) achieved with short arm centrifugation, have been proposed to counteract the deconditioning. However, the ideal protocol for exposure to AG has yet to be determined. Additionally, the impact of microgravity and various countermeasures is generally tested using passive tilt tests or LBNP protocols that may not best represent active gravitational challenges associated with day-to-day life on Earth. PURPOSE: The current study sought to investigate whether a protocol of intermittent AG (iAG) could prevent cardiovascular and cerebrovascular deconditioning during different postures following 5-d head down bed rest (HDBR). METHODS: Seven healthy male subjects (age=327 years) completed two sessions of 5-d HDBR, once in the control group (CONT) with no countermeasures and once in the iAG group. In the latter, participants were exposed to 6 bouts of 5-min AG each day of HDBR. Cardiovascular and cerebrovascular responses to sitting (SIT) and standing (STAND) were measured 3-d before (BDC-3) and 1-d after (R+1) HDBR. Beat-by-beat steady state data were averaged over 15-s for each posture and delta values were calculated from the averaged BDC-3 data to each R+1 condition (CONT and iAG). RESULTS: When a passive tilt test was administered immediately after the completion of 5-d HDBR (R+0), heart rate was 16.53.5 bpm higher during the first 3-min of tilt than before bed rest but did not differ between CONT and iAG. In contrast, testing on R+1 resulted in only a modest increase in heart rate during STAND (+3.46.6 bpm) with no significant difference between conditions. Moreover, the change in mean arterial pressure from BDC-3 to R+1 did not differ between the conditions for each posture (SIT-CONT: +1.410.9 vs. iAG: -1.27.9 mmHg; STAND-CONT: -3.715.4 vs. iAG: -7.79.8 mmHg) and TPR was also unchanged (SIT-CONT: -0.22.5 vs. iAG: -1.21.6 mmHg/L-1/min-1; STAND-CONT: -1.13.8 vs. iAG: -2.42.9 mmHg/L-1/min-1) Mean cerebral blood flow velocity from the middle cerebral artery was likewise not different during SIT (CONT: +0.75.7 vs. iAG: +1.53.6 cm/s) and STAND (CONT: -1.16.1 vs. iAG: -0.43.4 cm/s). CONCLUSION: Artificial gravity, applied intermittently, does not change the cardiovascular or cerebrovascular response to different postures following 5-d HDBR. The data also indicate the rapid recovery of cardiovascular and cerebrovascular responses to sitting and standing. Supported by the Canadian Space Agency 9F007-071471.