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Human Physiology in Space (2)

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THE EFFECT OF ARTIFICIAL GRAVITY DURING SHORT-TERM EXPOSURE TO SIMULATED
MICROGRAVITY ON CARDIOVASCULAR RESPONSES TO ORTHOSTATIC STRESS**Abstract**

Human centrifuge has been proposed as a countermeasure to limit physiological deconditioning during prolonged exposure to microgravity. However, few studies have compared the cardiovascular benefits of continuous vs. intermittent centrifuge exposure. Purpose: This study investigated the response to an orthostatic stress following 5 days of 6-degrees head-down bedrest with and without daily exposure of a 1 G load. Methodology: A supine to 80-degrees upright tilt, in combination with lower body negative pressure, was used as an orthostatic stress pre- and post-bedrest for each condition. The three conditions used in this study were a control (CON), continuous centrifugation for 30 minutes (AG1) and an intermittent centrifugation which involved being rotated for 5 minutes before the centrifuge came to a complete stop and this was repeated 6 times in one session (AG2). Each participant serves as his own control, performing all three conditions in a randomized order with 3 weeks separating trials. Results: Heart rate (HR) and tolerance times were observed for 12 men (aged 34.9 +/- 5.1 years, BMI 23.6 +/- 2.0). No differences between conditions were noted before bedrest. After bedrest, resting HR was elevated in each condition but was lower in the supine position in both countermeasure groups compared to controls ($p < 0.05$). However, due to the high rate of orthostatic intolerance post-bedrest there was a lack of power in the control group to test for statistically significant results. Trends indicating that the countermeasures were beneficial were observed during the tilt test. After 20 minutes of tilt, the number of surviving participants in the pre-bedrest was $n = 8$; post-bedrest, only 3 members of the control group survived to 20 minutes while in both AG1 and AG2 there were 6 survivors. These results suggested an improved orthostatic tolerance for both AG1 and AG2. HR at 20 minutes was elevated HR post-bedrest compared to pre-bedrest, and the centrifuge countermeasures appeared to offer some protection (Pre-bedrest: 93.1 +/- 10.5, Post-bedrest CON: 129.2 +/- 9.8, AG1: 121.4 +/- 8.7, AG2: 113.3 +/- 16.9 bpm). Conclusions: These results suggest that daily exposure to a 1 G load may improve orthostatic tolerance when in a simulated weightless environment. Furthermore, an intermittent centrifuge protocol may reduce resting heart rate when compared to a continuous centrifuge or control protocol. Supported by the Canadian Space Agency