Paper ID: 72595
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IAF/IAA SPACE LIFE SCIENCES SYMPOSIUM (A1)
Interactive Presentations - IAF/IAA SPACE LIFE SCIENCES SYMPOSIUM (IP)

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EXERCISE COUNTERMEASURES DO NOT PREVENT ORTHOSTATIC INTOLERANCE IN OLDER ADULTS AFTER TWO WEEKS OF HEAD-DOWN TILT BED REST

Abstract

Cardiovascular deconditioning and orthostatic intolerance are common side effects of prolonged exposure to microgravity. Accordingly, the cardiovascular system has been the target of different exercise training protocols aimed at mitigating these changes. Extensively, young adults have been relied on to study the effects of spaceflight and microgravity analogs on cardiovascular control, but astronauts remain active beyond 50 years of age and less is known about cardiovascular deconditioning in older adults.

Purpose: We examined the effects of best rest and exercise countermeasures on orthostatic tolerance in older adults.

Methodology: Twenty-one healthy older adults (ten women, age: 55-65 yr) completed two weeks of six-degree head-down tilt bed rest. Ten of the participants were randomized into the exercise group, who exercised 60 min daily throughout the bed rest period including aerobic and high-intensity interval training on a head-down tilt cycle ergometer, as well as resistance training. The other eleven participants were in the control group, and received passive manual therapy. Orthostatic tolerance was assessed using an 80-degree head-up tilt test to a maximum of 15 min, and was conducted before (BDC) and immediately following bed rest (R1).

Results: Tilt tolerance was reduced post-bed rest (14.57±1.36 vs. 7.21±5.12 min; main effect: $p<0.001$), and was not affected by the exercise intervention (interaction: $p=0.566$). Heart rate was higher when the tilt test was terminated at R1 (102±15 beats/min) compared to the equivalent test time at BDC (82±11 beats/min; interaction: $p<0.001$). Arterial vasoconstriction, indicated by total peripheral resistance (TPR), increased from supine to the end of the tilt test (main effect: $p<0.001$), but was not different between when the tilt test was terminated at R1 (23.6±10.8 mmHg/L/min) and the equivalent test time at BDC (22.8±8.8 mmHg/L/min; main effect: $p=0.173$). Four participants (one woman; two control) were able to complete all 15 min of the head-up tilt test immediately post-bed rest largely due to enhanced vasoconstriction (146±24% of pre-bed rest end test response) while five of 17 non-finishers (two women, three control) presented classical vasovagal syncope.

Conclusion: The multi-modal exercise intervention did not prevent the bed rest-induced orthostatic intolerance in older adults; however, participant-specific characteristics, such as the ability to increase vasoconstriction, appear to be important determinants of post-bed rest orthostatic tolerance. These

results suggest increased risk of fainting and falls in older adults after spaceflight analog and point to need to explore other countermeasures such as artificial gravity.

Supported by CIHR, CSA, and NSERC.