VALIDATION OF ON-ORBIT METHODOLOGY FOR THE ASSESSMENT OF CARDIAC FUNCTION AND CHANGES IN THE CIRCULATING VOLUME USING "BRASLET-M" OCCLUSION CUFFS

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BACKGROUND

The transition to microgravity eliminates the hydrostatic gradients in the vascular system. The resulting fluid redistribution commonly manifests as facial edema, engorgement of the external neck veins, nasal congestion, and headache. This experiment examined the responses to modified Valsalva and Mueller maneuvers as measured by cardiac and vascular ultrasound in a baseline microgravity steady state, and under the influence of thigh occlusion cuffs (Braslet cuffs).

METHODS

Nine International Space Station crewmember subjects (Expeditions 16 - 20) were examined in 15 experiment sessions 101±46 days after launch (mean ± SD; 33 - 185). 27 cardiac and vascular parameters were obtained under three respiratory conditions (baseline, Valsalva, and Mueller) before and after tightening of the Braslet cuffs for a total of 162 data points per session. The quality of cardiac and vascular ultrasound examinations was assured through remote monitoring and guidance by Investigators from the NASA Telescience Center in Houston, TX, USA.

RESULTS

Fourteen of the 81 measured conditions were significantly different with Braslet application and were apparently related to cardiac preload reduction or increase in the venous volume sequestered in the lower extremity. These changes represented 10 of the 27 parameters measured. In secondary analysis, 7 of the 27 parameters were found to respond differently to respiratory maneuvers depending on the presence or absence of thigh compression, with a total of 11 differences.

CONCLUSIONS

Acute application of Braslet occlusion cuffs causes lower extremity fluid sequestration and exerts proportionate measurable effects on cardiac performance in microgravity. Ultrasound techniques measuring the hemodynamic effects of thigh cuffs in combination with respiratory maneuvers may serve as an effective tool in determining the volume status of a cardiac or hemodynamically compromised patient in microgravity.