CARDIOVASCULAR MODELS OF SIMULATED MOON AND MARS GRAVITIES: HEAD UP TILT VS LOWER BODY UNWEIGHTING

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Introduction: Models of cardiovascular responses to postural changes in reduced gravity environments should be evaluated prior to exploration class space missions. In this study we compare two models (head-up tilt, HUT, lower body positive pressure, LBPP,) at Moon (20\% body weight (BW) vs 9.5° HUT), Mars (40\% BW vs 22° HUT) and Earth (100\% BW vs 80° HUT). We hypothesized that indexes of healthy human segmental (thorax, abdomen, upper and lower leg) and cardiac fluid volume shifts as well as regulatory (blood pressure, BP, heart rate, HR, vascular resistance, VR) responses to standing would be similarly reduced by LBPP and HUT. Methods: Mean and spectral power values of HR, BP, ECG, segmental fluid shifts, echocardiographic measures of diastolic (passive filling) and systolic cardiac (stroke volume, SV) function, LBPP and ground reaction force were recorded from 20 subjects during 20 minute sessions while subjects were supine and standing at 100\%, 40\%, and 20\% BW in the G-Trainer (Alter_G Corp) and while supine and tilted at 80°, 22°, 9.5° head-up. Results (Mixed Model, p<0.05): Compared to supine, the shift of fluid from the chest to the abdomen, increases in HR and decreases in SV were greater at 100\% BW than at reduced weights, in both LBPP and HUT. However, mean BP, VR and baroreflex effectiveness were increased in response to LBPP but not in response to HUT. Conclusion: Body weight unloading via both LBPP and HUT resulted in fluid shifts and cardiovascular changes similar to those anticipated in actual reduced gravity environments. Similarities between the two models indicate that either can be used for modeling cardiovascular responses to standing on the Moon and Mars. The LBPP model (Alter-G) has the advantage of offering dynamic activity at reduced body weight. Differences in BP need to be addressed. Supported by KY NASA EPSCoR 52611.