Influence of Decompression Rate on Hemodynamic Compensation to Continuous Lower Body Negative Pressure

St. John EJ and Cooke, WH

Laboratory for Applied Autonomic Neurophysiology; Department of Kinesiology, Health, and Nutrition; University of Texas at San Antonio; San Antonio, TX

Category: Undergraduate

Advisor / Mentor: Cooke, William (william.cooke@utsa.edu)

ABSTRACT

We applied lower body negative pressure (LBNP) continuously, at three decompression rates, in an attempt to simulate uncontrolled hemorrhage as might be experienced by victims of traumatic injury. The purpose of our study was to determine whether hemodynamic compensations to simulated hemorrhage depend more on the magnitude, or the rate of change in pressure applied. Forty five (45) young, healthy subjects participated. We recorded the electrocardiogram, beat-to-beat arterial pressure (finger photoplethysmography), and measured cardiac output (inert gas rebreathing to calculate stroke volume) during continuous LBNP applied at three different decompression rates (n = 15 subjects for each rate; slow = 3 mm Hg·min^{-1}; medium = 6 mm Hg·min^{-1}; and fast = 12 mm Hg·min^{-1}) to an ending pressure of -60 mmHg. Slopes relating changes of dependent variable responses to the magnitude of decompression were calculated with linear regression, and group results were compared with ANOVA. LBNP increased (pooled across groups from 0 to -60 mmHg) heart rates (+28%; $p \leq .05$), and decreased mean arterial pressures (-10%; $p \leq .05$) and stroke volumes (-66%; $p \leq .05$). The magnitude of changes induced by LBNP were not different between groups ($p \geq .4$). Slopes (pooled across groups) relating heart rate (.3 bpm/mmHg), mean arterial pressure (-.16 mmHg/mmHg), and stroke volume (-1.3 ml/mmHg) to the level of LBNP applied were not dependent on decompression rate (all ANOVA comparisons, $p \geq .3$). We conclude that hemodynamic changes during continuous LBNP are associated directly with the magnitude of pressure applied, irrespective of the rate of decompression. Our results suggest that hemodynamic compensations to simulated uncontrolled hemorrhage are robust, and are not compromised by increasing the speed of decompression to simulate a greater rate of blood loss.