Effects of Hypovolemia on Cerebral Blood Velocity and Autoregulation During Upright Tilt: Implications for Post-Spaceflight Orthostasis

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Int J Exerc Sci 2(1): S8, 2009. Orthostatic stability depends on maintenance of adequate cerebral blood flow. Orthostatic instability experienced by returning astronauts is associated with microgravity-induced hypovolemia, suggesting that hypovolemia may disrupt the ability of the cerebral vasculature to regulate blood flow. **PURPOSE:** To test the hypothesis that hypovolemia reduces cerebral blood velocity and impairs cerebral autoregulation (CA) during upright tilt. **METHODS:** Nine males (age 23 ± .5 yrs; height 172 ± 2 cm; weight 87 ± 3 kg; mean ± SE) were tilted head-up to 70° on two occasions separated by at least 5 days under euhydration (EUH) and dehydration (DEH) conditions. Dehydration was induced with 40 mg Furosemide and 8 h water restriction. Plasma volumes (PV) and blood volumes (BV) were estimated from venous hemoglobin and hematocrit. ECG, beat-by-beat finger arterial pressures, and cerebral blood velocity (CBV) were measured during a five min supine baseline, and during the first (T1) and last (T2) five min of upright tilt. Dynamic CA was assessed in the frequency domain with cross-spectral analysis of mean arterial pressure (MAP) and mean CBV within the frequency range of 0.07-0.2 Hz. **RESULTS:** Furosemide reduced PV by 10 ± 2 % and BV by 6 ± 2 % (P = .005 and P = .07). MAP decreased during tilt (P < .007), but the reduction was similar between hydration conditions. CBV during DEH was lower during the entire 10-min tilt by about 7 cm/s (P < .004) compared with EUH. Low frequency coherence was higher during DEH T1 compared with EUH T1 (.67 ± .04 vs .51 ± .04; P = .02), but coherence decreased as tilt continued, and was similar to EUH during T2 (P = 0.7). **CONCLUSIONS:** Increased coherence during the first 5 min of tilt suggests that reductions of CBV with hypovolemia might be explained by a reduced autoregulatory capacity. However, maintenance of lower CBV despite reduced coherence during the second 5 min of tilt suggests that disruptions of autoregulatory capacity with hypovolemia are transient. Our results provide evidence that hypovolemic astronauts may be at greatest risk for orthostatic intolerance immediately upon assumption of upright posture.