TACSM Abstract

Within-Day Repeatability of Cerebral Vasomotor Reactivity to Rebreathing-Induced Hypercapnia: Impact of a 15 Minute Recovery

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ABSTRACT

Cerebral vasodilatory responsiveness to elevations in arterial carbon dioxide concentration, termed cerebral vasomotor reactivity (CVMR), is utilized to assess cerebral vascular function and health. An impairment in this response is associated with risk for various cerebral vascular diseases and neurocognitive conditions including stroke, cognitive dysfunction, dementia, and Alzheimer's disease. One commonly utilized methodological approach to assess CVMR is to induce transient hypercapnia by having the participant rebreathe their own expired air. We recently reported very good within-day repeatability when two trials were separated by 2 hr. However, in research protocols, repeat assessments are commonly separated by a shorter duration (i.e., 15 min) that is typically tied to the return of hemodynamic variables (heart rate, arterial blood pressure, etc.) to baseline values. **PURPOSE**: To determine the within-day repeatability of CVMR responses to rebreathing-induced hypercapnia when trials are separated by 15 min. **METHODS:** Eight young healthy males (age: 23 ± 3 years, BMI: 24.4 ± 2.3 kgm^{-2}) were studied following a minimum 4 hour fast. All participants underwent two trials of rebreathing-induced hypercapnia separated by 15 min. Heart rate (ECG), respiration (Pneumotrace), beat-to-beat blood pressure (Finometer), middle cerebral artery mean blood velocity (MCAv; transcranial Doppler) and breath-by-breath end-tidal carbon dioxide concentration ($PETCO_2$; capnograph) were continuously measured. Cerebral vascular conductance index (CVCi) was calculated as MCAv divided by mean arterial blood pressure. CVMR was assessed as the slope of the linear regression between the increase in %MCAv and %CVCi during hypercapnia. The increase in %MCAv and %CVCi was also assessed at a $\Delta PETCO_2$ of 15 mmHg. **RESULTS:** The slope of %MCAv vs ΔPETCO2 demonstrated poor to excellent repeatability between the 2 rebreathing-induced hypercapnia trials (Trial 1: 3.3 ± 1.1 $\%mmHg^{-1}$; Trial 2: 2.7 ± 1.5 $\%mmHg^{-1}$; ICC = 0.84 [0.26–0.97, p = 0.008). The slope of %CVCi vs. ΔPETCO2 showed good to excellent repeatability (Trial 1: 2.2 ± 1.0 $\%mmHg^{-1}$; Trial 2: 2.1 ± 1.1 $\%mmHg^{-1}$; ICC = 0.92 [0.65–0.99], p = 0.002). At a ΔPETCO2 of 15 mmHg from baseline, the % increase in MCAv exhibited poor to excellent repeatability (Trial 1: 45 ± 17%; Trial 2: 37 ± 18%; ICC: 0.87 [0.26–0.97], p = 0.003), while the % increase in CVCi also demonstrated poor to excellent repeatability (Trial 1: 33 ± 15%; Trial 2: 28 ± 12%; ICC: 0.70 [-0.38–0.94], p = 0.069). **CONCLUSION**: These preliminary results suggest that a 15 min recovery between hypercapnia perturbations may not be sufficient in all subjects. While we found good within day repeatability in 4 out of 8 subjects, highly variable responses were found among other individuals. These data are important when considering protocol designs for examining cerebral vasomotor reactivity.