

The Impact of Nasal Breathing During Exercise on Cerebral Blood Flow

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ABSTRACT

Achieving hypercapnic-induced vasodilation while exercising can increase cerebral blood flow (CBF) to a greater extent than during normoxic conditions. Evidence suggests that nasal breathing during a maximal aerobic effort can elicit a hypercapnic condition. **PURPOSE:** To compare the effect of combined (CB), oral (OB), and nasal (NB) breathing on CBF during a graded maximal exercise test (GXT). **METHODS:** Six healthy males (age: 21.83 ± 1.00 years) abstained from physical activity and caffeine for 12+ hours prior to a GXT. Three GXTs were performed (48+ hours between each trial) using a different randomized breathing condition (CB, OB, and NB). After a warm-up, participants completed a GXT until volitional fatigue on a semi-recumbent bicycle. Stages lasted 2 minutes and increased by a pre-set wattage at 70 rpm. Respiratory gases were assessed via a metabolic cart. Throughout the GXT, ultrasound sonography (7.5 MHz linear transducer) was utilized to assess the peak systolic velocity (PSV) and vessel diameter of the internal (ICA) and external (ECA) carotid artery on the right side of the neck. A one-way ANCOVA with mean arterial blood pressure and oxygen uptake ($\text{VO}_{2\text{max}}$) as covariates was utilized to compare the three breathing patterns at 40%, 55%, 70%, 85%, and 100% of $\text{VO}_{2\text{max}}$. Data are presented as mean \pm SEM. **RESULTS:** The partial pressure of exhaled CO_2 (PECO_2) was significantly greater ($p = 0.008$) during NB (33.16 ± 1.37 mmHg) compared to CB (26.63 ± 1.32 mmHg) and OB (26.72 ± 1.37) at 100% $\text{VO}_{2\text{max}}$. While not statistically significant, there was a greater PSV in the ICA during NB (99.72 ± 7.12 cm/s) compared to CB (87.34 ± 9.36 cm/s) and OB (89.63 ± 9.77 cm/s) at 100% $\text{VO}_{2\text{max}}$. Similarly, there was a greater PSV in the ICA during NB (102.53 ± 8.07 cm/s) compared to CB (93.13 ± 7.79 cm/s) and OB (81.25 ± 7.80 cm/s) at 85% $\text{VO}_{2\text{max}}$. In contrast, there was a significantly greater ($p = 0.027$) PSV in the ICA during NB (126.12 ± 7.51 cm/s) compared to OB (92.47 ± 7.34 cm/s) but not CB (111.91 ± 7.14 cm/s) at 70% $\text{VO}_{2\text{max}}$. There were no significant differences in the PSV of the ECA nor the diameter of the ICA and ECA. **CONCLUSION:** NB during a GXT increased PSV in the ICA compared to CB and OB, which might be partly related to an increased systemic concentration of CO_2 . A greater increase in PSV in the ICA represents a greater CBF that might provide greater cognitive health benefits than while exercising with either CB or OB. Studies with a bigger sample size will provide greater statistical power to examine the benefits of increasing the PSV in the ICA and its effect on cognitive health.