The Acute Effect of Heat Therapy on Cerebral Vascular Reactivity to Rebreathing-Induced Hypercapnia

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ABSTRACT

Whole-body heat therapy has numerous benefits on various physiological responses including peripheral vascular function and overall cardiovascular health. Many laboratories, including ours, have investigated cerebrovascular reactivity to hypercapnia, which is physiologically relevant as a blunted response is associated with increased risk for cerebrovascular diseases and neurocognitive conditions including stroke, cognitive dysfunction, and Alzheimer's disease. However, the impact of whole-body heat therapy on cerebrovascular function remains unknown. **PURPOSE:** To test the hypothesis that cerebrovascular responsiveness to hypercapnia would be augmented following a single bout of heat therapy. **METHODS:** Eight young, female participants (age: 23±3 yr; BMI: 27±4 kgm^{-2}) were recruited. Participants ingested a telemetry pill for the measurement of intestinal temperature (HQ, CorTemp) and were fitted with a water-perfused, tube-lined suit (Med-Eng) that covered the entire body except for the head, forearms, hands, and feet. Heart rate (ECG), beat-to-beat blood pressure (Finometer), middle cerebral artery mean blood velocity (MCAv; transcranial Doppler ultrasound) and breath-by-breath end-tidal carbon dioxide concentration ($PETCO_2$; capnograph) were continuously measured before and during a steady-state hypercapnic challenge induced by breathing a 6% CO_2 gas mixture. Measures were conducted before (Normothermia (NT)) and 45 min following a 1 hr period of heat stress (HS) accomplished by circulating 49 °C water through the suit (Post-HS). Cerebrovascular conductance (CVCi) was calculated as MCAv divided by mean arterial blood pressure for both NT and post-HS measures. Cerebral vasodilatory responsiveness was assessed as the increase in %MCAv or %CVCi divided by the change in $PETCO_2$ ($\Delta PETCO_2$). **RESULTS:** HS significantly increased core temperature (Δ1.0±0.2 °C; $p<0.001$ vs. NT**)**, which ultimately returned to the NT value during the post-HS measurement (Δ0.09±0.2 °C; $p=0.30$ vs. NT). The 6% CO_2 gas mixture induced a similar $\Delta PETCO_2$ response between measurement time points (NT: 11±1 mmHg; post-HS: 12±3 mmHg, $p=0.55$). HS did not alter cerebral vascular reactivity as indexed by %MCAv slope (NT: 3.4±0.8 $\%mmHg^{-1}$; post-HS: 3.7 ± 1.2 $\%mmHg^{-1}$, $p=0.48$) and %CVC slope (NT: 2.8±0.6 $\%mmHg^{-1}$; post-HS: 3.0±1.1 $\%mmHg^{-1}$, $p=0.60$). **CONCLUSION:** These preliminary findings suggest that one session of whole-body heat therapy does not impact cerebrovascular function as indexed by the vasodilatory responsiveness to hypercapnia.