Thermoregulatory and cardiovascular responses to hypobaric hypoxia in resting humans

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Abstract of Dissertation

In resting thermoneutral conditions, systemic hypoxia, include changes in the partial pressure of oxygen in inspired air (normobaric hypoxia) as well as changes in the barometric pressure itself (hypobaric hypoxia), can cause modest cutaneous vasodilation. The changes in blood flow increase skin temperature, therefore heat loss increases from the body surface to the environment. Also, cutaneous vasodilation may redistribute the blood flow of other body parts. At high altitudes, hypoxia typically coexists with low ambient temperature. Acute cold stress elicits a sympathetically mediated increase in peripheral vasomotor tone, which attenuates heat loss to the environment. However, when humans encounter cold temperatures at high altitude, lower oxygen levels and cold temperatures may have competing effects on skin blood flow. Therefore, the goal of this dissertation was to perform integrative studies to determine the effects of hypobaric hypoxia on cardiovascular and thermoregulatory responses in thermoneutral and cold environments in human adults.

The first study (Chapter 2) investigated thermoregulatory responses in adult humans during acute exposure to hypobaric hypoxia under thermoneutral environments. The second study (Chapter 3) investigated thermoregulatory and circulatory responses in adult humans during acute exposure to hypobaric hypoxia and cold (19°C). The third study (Chapter 4) evaluated thermoregulatory and circulatory responses in adult humans during acute exposure to hypobaric hypoxia and cold (16°C) with additional cardiovascular measurements.

As discussed in Chapter 2, the rectal temperature in adult humans did not change whereas skin temperature increased during hypobaric hypoxic exposure under thermoneutral environments. However, heat loss did not show significant differences compared with normobaric normoxia due to the decreased convective heat loss in hypobaric hypoxia. In Chapter 3, no effects of hypobaric hypoxia on rectal temperature and mean skin temperature was observed during mild cold exposure. In Chapter 4, no effects of hypobaric hypoxia on rectal temperature, but higher mean skin temperature were observed compared with normobaric normoxia during severe cold exposure. While there was no significant impact of hypobaric hypoxia on rectal temperature, systolic blood pressure, stroke volume, and cardiac output in hypobaric hypoxia were significantly decreased during cold exposure.

Therefore, the studies described herein provide comprehensive evidence that hypobaric hypoxia does not alter core temperature in adult humans in both thermoneutral and cold environments. On the other hand, simultaneous exposure to hypobaric hypoxia and cold deteriorates cardiovascular responses in adult humans.