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MEETING ABSTRACT Open Access

Effect of rising body temperature on respiratory chemosensitivity to CO_2

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Introduction

A rise in body temperature (T_b) is known to cause minute ventilation (V_E) to increase. However, the mechanism of the ventilatory response to rising T_b is still unclear. In the context of the relationship between V_E and T_b, it is known that respiratory chemosensitivity is influenced by T_b, and that a rise in T_b of more than 0.7 °C enhances respiratory chemosensitivity [1]. It is not known, however, whether increases in T_b less than 0.7 °C also influence respiratory chemosensitivity. The aim of this study was to clarify the effect of mild hyperthermia (0.3 °C and 0.7 °C) on respiratory chemosensitivity.

Methods

Eight persons (five males and three females, mean (SD) age 25 (10) years, height 171.5 (8.9) cm, weight 66.9 (8.7) kg) participated in the study. All were lowlanders and had not been exposed to altitude above 1,000 m within the 6 months prior the study. We measured sublingual temperature (T_{sl}) as an index of T_b, and measured respiratory chemosensitivity to CO_2 using a rebreathing method [2]. The subjects wore a mask connected to a closed one-way circuit with a rubber bag containing the test gas (7 % CO_2, 43 % O_2, 50 % N_2). Rebreathing was terminated when the inspired CO_2 fraction reached 9.2 %. This test was performed before heating (ΔT_{sl} = 0 °C) and during heating (ΔT_{sl} = 0.3 °C and 0.7 °C). Measurements were made twice with a 15-min interval between tests at ΔT_{sl} = 0°C, 0.3°C and 0.7°C. During the experiment subjects wore a water-perfused suit. The initial water temperature was 35 °C and was increased to 45 °C.

Results

Before heating mean (SD) T_{sl} was 36.15 (0.22) °C (ΔT_{sl} = 0 °C) and rose to 36.47 (0.21) °C at ΔT_{sl} = 0.3 °C and then to 36.87 (0.21) °C at ΔT_{sl} = 0.7 °C during heating. While subjects breathed the CO_2-rich mixture, V_E was 1.49 (0.68) $L.min^{-1}.mmHg^{-1}$ (ΔT_{sl} = 0 °C), 1.52 (0.75) $L.min^{-1}.mmHg^{-1}$ (ΔT_{sl} = 0.3°C) and 1.75 ± 0.98 $L.min^{-1}.mmHg^{-1}$ (ΔT_{sl} = 0.7°C). The tidal volume was 44.7 (12.4) $mL.mmHg^{-1}$ (ΔT_{sl} = 0°C), 55.4 (24.9) $mL.mmHg^{-1}$ (ΔT_{sl} = 0.3 °C) and 61.9 (19.5) $mL.mmHg^{-1}$ (ΔT_{sl} = 0.7 °C) ($P < 0.06$). The respiratory frequency was 0.47 (0.38) $breaths.min^{-1}.mmHg^{-1}$ (ΔT_{sl} = 0 °C), 0.40 (0.42) $breaths.min^{-1}.mmHg^{-1}$ (ΔT_{sl} = 0.3 °C) and 0.37 (0.41) $breaths.min^{-1}.mmHg^{-1}$ (ΔT_{sl} = 0.7 °C).

Discussion

These results suggest that increases in T_{sl} less than 0.7 °C do not influence respiratory chemosensitivity to CO_2, though the respiratory pattern did tend to change. The ventilatory response to rising T_b has a threshold around 38 °C (esophageal temperature) in the resting state [3]. Moreover, we suggest that increasing the inspired CO_2 fraction did not reduce that threshold to the temperatures reached in the present study (T_{sl} around 37 °C).

Conclusion

Our findings suggest that respiratory chemosensitivity is not affected by mild hyperthermia (~0.7 °C rise in body temperature). It is possible that there is a T_b threshold for changes in respiratory chemosensitivity that is greater than around 37 °C.

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