RATE SENSITIVITY OF TYMPANIC TEMPERATURE THRESHOLDS FOR VENTILATION DURING EXERCISE-INDUCED BODY WARMING IN HUMANS

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Core temperature thresholds for ventilation during body warming induced by either exercise or hot bath immersion have been demonstrated (White & Cabanac, 1996). It was observed at core temperatures greater than these thresholds, that ventilation increased in direct proportion to core temperatures. This supported the hypothesis ventilation behaves as a thermoregulatory response at elevated body core temperatures by giving a response that is proportionate to the increase in core temperature. Based on the rate sensitive responses of temperature sensitive neurons, it has also been suggested that human thermoregulatory responses may be sensitive to the rate of core temperature increase. To test the hypothesis if core temperature thresholds for minute ventilation are sensitive to the rate of core temperature increase, core temperature thresholds for ventilation were determined across at differing rates of core temperature increase. Data from 4 studies and 23 subjects in normothermic conditions (Tambient = 22 to 24°C, Relative Humidity 40 to 50%) were included in this analysis. In each study subjects pedalled on a seated cycle ergometer and workloads were increased until the point of exhaustion. The work load was increased by differing steps of 17.5 W, 20W, 40W and 52.5 W each 2 min to induce differing rates of either tympanic (T_{ty}) or esophageal (T_{es}) core temperature increase. Skin temperatures, expressed as the unweighted mean, were measured at 4 surface sites including the forehead, upper limb, thorax, and lower limb. T_{ty} and T_{es} thresholds for minute ventilation, normalised for carbon dioxide production and oxygen consumption, were determined from scatterplots by two (or three if a discrepancy was evident) separate observers. Results showed that the differing rates of workload increase induced differing rates of increase for T_{ty} (range: 2.82 to 5.10°C/hr) and for T_{es} (range: 3.41 to 6.30°C/hr). The mean skin temperatures were either constant or increasing during the exercise sessions. High and significant negative correlations between the rate of T_{ty} increase and the T_{ty} thresholds for V_E/VO_2 ($r=-0.72$, $p<0.01$) and for V_E/VCO_2 ($r=-0.92$, $p<0.01$) were evident. Correlations between the rate of T_{es} increase and the T_{es} thresholds for V_E/VO_2 and for V_E/VCO_2 were low and not significant. The results supported that T_{ty} thresholds for ventilation are sensitive to the rate of core temperature increase. The same result was not apparent for Tes thresholds for ventilation. In conclusion, the evidence supports that T_{ty} thresholds for ventilation are sensitive to the rate of T_{ty} increase. A higher rate of core temperature increase gave a lower core temperature threshold for minute ventilation in these exercise conditions.

White, M.D. & Cabanac, M. (1996) Exercise Hyperpnea and hyperthermia in human. *J. Appl. Physiol.* 81, 1249-1254.

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