THE CHARACTERISTICS OF HYPERTHERMIC HYPERPNEA AT REST AND DURING EXERCISE IN HUMANS

Nishiyasu, T

Institute of Health and Sport Sciences
University of Tsukuba
1-1-1 Tennodai, Tsukuba, Ibaraki, 305-8574, Japan

In many species of mammals and birds, an elevation in body temperature stimulates ventilation and increases evaporative heat loss for thermoregulation. In humans, also, ventilation is stimulated by an elevation in body temperature, although the characteristics and the physiological significance of this response are unclear. We recently showed that during exercise (50%VO_{peak}) in the heat, minute ventilation linearly increased with increase in core temperature. In the subsequent studies, we further investigated whether the linear relationship (slope value) during the exercise is 1) different from that seen in resting condition, 2) affected by hypohydration, 3) affected by hypocapnia induced by hyperthermic hyperpnea. Additionally, we also investigated whether 4) hypocapnia induced by hyperthermic hyperpnea affects cerebral blood flow in exercising humans. Each experimental protocol and/or results were as follows: 1) The slope value during passive heating at rest was over three times greater than that seen during the exercise (26.7±28.4 vs 7.9±5.2 l min^{-1} °C^{-1}). Further, core temperature threshold for hyperthermic hyperpnea during the exercise was lower from that seen during the passive heating (37.0±0.3 vs 38.1±0.7°C). 2) Subjects performed two bouts of the exercise separated by a rest period, during which they drank water containing sodium in the fluid replacement trial (FR) but not the no fluid replacement trial (NFR). The slope value during second exercise in the NFR (body weight was reduced by 2.5% before second exercise) was not different from that in the FR (9.9±7.6 vs 8.8±6.1 l min^{-1} °C^{-1}), though cutaneous vasodilatory response, which is known as thermoregulatory response, was markedly attenuated in NFR. 3) &4) Subjects exercised with (eucapnic session; EC) and without inhaling hypercapnic air (hypocapnic session; HC). The slope value in the EC was over three times greater than that in the HC (21.3 ± 12.5 vs 7.5 ± 6.5 l min^{-1} °C^{-1}). Further, cerebral blood velocity declined in the HC, but did not decline much in the EC (68.0 ± 35.4 vs 91.9 ± 12.0 %) (100 % cerebral blood velocity was the value at the start of hypercapnic air inhalation). From the results of 1)-4), we will discuss the physiological significance of hyperthermic hyperpnea in humans.