KL-II(1) Hyperventilation induced by the increase in body temperature
Keiji Hayashi
Junior College, University of Shizuoka

It is well known that sweating and cutaneous vasodilation are caused by the increase in body temperature. Furthermore, hyperventilation is also caused by the increase in body temperature. In this hyperthermia-induced hyperventilation, there is a core temperature threshold for hyperventilation around 38°C of esophageal temperature (T_e) at rest, and around 37°C of T_e during exercise. When T_e exceeds that threshold, minute ventilation increases linearly against the increase in T_e. There is large individual difference in hyperthermia-induced hyperventilation, and the extent of hyperthermia-induced hyperventilation has negative relationships with peak oxygen uptake and with the sensitivity of cutaneous vasodilation. However, the characteristic of hyperthermia-induced hyperventilation is largely different from the heat dissipating response, for instance, hyperthermia-induced hyperventilation is not influenced by hypohydration, heat acclimation, changes in skin temperature, and the menstrual cycle phase. Hyperthermia-induced hyperventilation reduces the partial pressure of arterial CO_2 in proportion to an increase in minute ventilation. A reduction of the partial pressure of arterial CO_2 induces a reduction of cerebral blood flow. Because cerebral blood flow removes heat from the brain, lower cerebral perfusion reinforces the increase in brain temperature. Therefore, it is suggested that hyperthermia-induced hyperventilation augments brain temperature and central fatigue.

Key words: hyperthermia, respiration, central fatigue

KL-II(2) Central mechanisms underlying physiological limits to exercise in the heat
Hiroshi Hasegawa
Graduate School of Integrated Arts and Sciences, Hiroshima University

Many major sport events are held in extremely hot conditions. The recent summer Olympic games are no exception, and these took place under high ambient temperatures. This trend is likely to continue as athletes begin to prepare for what will likely be Olympics and Paralympics in Tokyo 2020. Several specific approaches including fluid intake, heat acclimation, and precrowing have been investigated. Hyperthermia has been demonstrated as an important factor limiting endurance performance in the heat in both human and animal studies. While temperature can affect individual peripheral physiological systems such as muscle contraction characteristics directly, a dominant role for central mechanisms for exercise impairment has been proposed over the past two decades. Exercise-induced hyperthermia may have a direct effect on the central nervous system such as brain temperature, cerebral blood flow, brain activity, cognitive function, and brain neurotransmission. In turn, these changes may affect not only the physiological capacity for exercise, but also the athlete’s perception of heat stress, motivation for exercise or pacing strategy. This presentation focused on the central mechanisms underlying physiological limits to exercise in heat. Specifically, the effects of hyperthermia on brain physiology and function were summarized, along with the potential impact of these changes on regulating exercise capacity.

Key words: thermoregulation, endurance exercise, central nervous system, dopamine