ROLE OF THE PREOPTIC AREA, ANTERIOR HYPOTHALAMUS AND MEDIAN RAPHE NUCLEUS ON THERMOREGULATORY SYSTEM IN FREELY MOVING RATS

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It is well established that the preoptic area and anterior hypothalamus (PO/AH) is the center of both heat production and heat loss responses. However, an alternative theory of thermoregulation was suggested by the finding that heat production responses were maintained when the PO/AH was destroyed. Furthermore, electrical stimulation of the ventromedial (VMH) and posterior (PH) hypothalamus increased non-shivering and shivering thermogenesis, respectively. Together, the PO/AH may not be involved in heat production. Several mechanisms are thought to be involved in heat regulation. In this regard, there is sufficient evidence to indicate that serotonin (5-HT) is a major neurotransmitter that mediates heat regulation in the hypothalamus. The hypothalamic serotonergic fibers are derived from cell bodies in the raphe nucleus, particularly the median raphe nucleus (MRN). However, the relationship between 5-HT and body temperature (Tb) remains unclear. The purpose of this study was to clarify the role of the PO/AH in thermoregulation and to examine the effects of serotonergic innervation from the MRN on Tb. We perfused tetrodotoxin (TTX) solution into the PO/AH and MRN using a microdialysis technique at three different ambient temperatures (5, 23, 35°C) in freely moving rats.

Male Wistar rats (250-350 g body weight) were housed separately in plastic cages under controlled conditions of ambient temperature 23°C, relative humidity 50% and a light-dark cycle of 12:12 h (lights on at 0600 h) with free access to food and water. A telemetry device and microdialysis probe were implanted surgically prior to the commencement of the experiments[1, 2]. General anesthesia was induced with Nembutal (50 mg/kg, i.p.), the telemetry device was implanted in the peritoneal cavity, and the tip of a microdialysis probe was stereotaxically placed in the left lateral PO/AH and in the left lateral MRN. Ambient temperatures were set at 23°C (normal environment), and 35°C (heat exposure) or 5°C (cold exposure) for 3 h to elicit changes in thermal balance in rats. In the normal environment, TTX solution (5 μM) was perfused for 1 h in the PO/AH and MRN. In the heat and cold exposure experiments, TTX was perfused during the last one hour of each exposure. At the end of each experiment, the locus of the microdialysis site was verified on histological sections.

In the MRN, perfusion of TTX solution induced significant hypothermia in the normal environment, a greater decrease in Tb during cold exposure and had no effect on Tb during heat exposure. In the PO/AH, perfusion of TTX solution induced significant hyperthemia in normal environment, a greater increase in Tb during heat exposure and had no effect on Tb during cold exposure. Our results indicate that the PO/AH regulates heat loss but not heat production. Heat production appears to be regulated by other areas receiving serotonergic innervation from the MRN.

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