

HYPOTHALAMIC HOMEOTHERMY ACROSS THE ULTRADIAN SLEEP CYCLE

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In the ambient thermal zone for the vasomotor regulation of body temperature (i.e. excluding heavy positive and negative thermal loads above and below ambient thermal neutrality) the hypothalamic temperature of mammals undergoes regular oscillations which, whilst being only a few tenths of a degree in magnitude, precisely mark the single behavioral states of the ultradian sleep cycle (19, 24). A basic question is whether or not this almost perfect homeothermy (cf. "Glossary of Terms for Thermal Physiology": Pflügers Arch. 410: 567-587, 1987) is achieved by specific thermoregulatory controls of heat production and heat loss driven by hypothalamic temperature itself. The hypothesis that hypothalamic temperature may act as the independent variable is conceptually reasonable since (i) the autonomic integrative mechanism for homeostatic temperature regulation is located in the hypothalamus (and in the adjacent preoptic region), (ii) the hypothalamus is known to contain specific thermosensitive neurons which are part of the neuronal network underlying thermoregulation, (iii) the thermosensitivity of such hypothalamic neurons varies in relation to the behavioral states of the ultradian sleep cycle. Therefore in order to have a better understanding of this issue, the mechanisms underlying the behavioral state-dependent changes in hypothalamic temperature should and, in this review, will be taken into consideration.

Without discussing the equally important state of quiet wakefulness (QW; characterized by a desynchronized electroencephalogram, high postural muscle tone and stability of autonomic functions with a sympathetic prevalence), the single sequence of two behavioral states of different duration, which are known as (i) quiet sleep (QS; characterized by a synchronized electroencephalogram, low postural muscle tone and stability of autonomic functions with a parasympathetic prevalence; other current acronyms: SS, synchronized sleep; SWS, slow wave sleep; NREM, non rapid eye movement sleep) and (ii) active sleep (AS; characterized by a desynchronized electroencephalogram, postural muscle atonia with myoclonic twitches, and the instability of autonomic functions; other current acronyms: DS, desynchronized sleep; PS, paradoxical sleep; REM, rapid eye movement sleep), is the basic pattern of the behavioral state organization of the ultradian sleep cycle in adult mammals. With respect to the efficiency of thermoregulation, the behavioral states of the ultradian sleep cycle are different, as AS, in contrast to QS, is characterized by a conspicuous impairment of thermoregulation (15, 16).

Fundamentally, hypothalamic temperature changes are the direct result of an

