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Properties of Hypothalamic Temperature Sensitive and Insensitive Neurones

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Summary

Intracellular recordings show that some hypothalamic neurones are inherently warm sensitive and have branching dendrites that alow synaptic integration of different afferent pathways.

Key words

Neuronal thermosensitivity – Hypothalamus

In the hypothalamus, local neuronal networks sense and regulate various homeostatic systems, including the regulation of body temperature, body water, metabolites and reproduction. Even at the cellular level, there are interactions between these different systems, and some individual hypothalamic neurones respond, not only to temperature, but also to a variety of other endogenous factors (Boulant and Silva 1989).

Electrophysiological studies classify hypothalamic neurones as warm sensitive, cold sensitive or temperature insensitive (Boulant 1980). In the preoptic area and anterior hypothalamus (PO/AH) certain neurones not only sense their own temperature but also receive afferent information concerning skin and spinal cord temperatures (Boulant and Hardy 1974). These integrative neurones communicate with other hypothalamic and brain stem areas and are thought to control several thermoregulatory responses.

While a synaptic network of thermosensitive neurones extends throughout the hypothalamus, there are regional differences in the intrinsic properties of neurones. PO/AH tissue slice studies have shown that, during synaptic blockade, thermosensitivity is usually retained in warm sensitive neurones but is lost in cold sensitive neurones (Kelso and Boulant 1982). On the other hand, during synaptic blockade in diencephalic areas outside the PO/AH, thermosensitivity can be retained in some cold sensitive neurones, but lost in half of the warm sensitive neurones (Dean and Boulant 1989).

Intracellular studies reveal important differences between temperature sensitive and insensitive neurones (Nelson and Prosser 1981, Curras *et al.* 1991). Warm sensitive neurones possess a pacemaker potential that is strongly temperature dependent. Differences in ionic conductances and Na-K pump activity also appear to be important determinants of the different cell types.

Neuronal morphology can also be determined by intracellular filling with Lucifer Yellow (Griffin and Boulant 1991) Temperature insensitive neurones have a variety of dentritic patterns. Warm sensitive neurones, however, display branching dentrites that allow them to integrate synaptic input from both medial and lateral pathways.

Despite morphological distinctions between thermal sensitive and insensitive neurones, electrophysiological studies suggest

that there is some degree of plasticity. For example, during ouabain blockade of the Na-K pump or depolarizing current injection, temperature insensitive neurones can display thermosensitive characteristics. In addition, intracellular second messengers contribute to the distinctions between neuronal types and may also contribute to their plasticity (Griffin *et al.* 1990).

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