

Modulacja cholinergiczna i noradrenergiczna neuronów wzgórzowego jądra tylnego-przyśrodkowego u szczura

Cholinergic and noradrenergic modulation of neurons in the rat's posteromedial thalamic nucleus

Abstract

Neuronal activity in higher order posteromedial thalamic nucleus of the rat (PoM) is affected by cholinergic and noradrenergic neuromodulatory projections from the brain stem. Using whole-cell patch-clamp method in thalamic slices we investigated influence of these neuromodulators on membrane potential and cortically driven responses of PoM neurons. To mimic the activation of appropriate neuromodulatory system we added to the bath cholinergic (carbachol or DMPP) or noradrenergic (norepinephrine) agonists, while GABA-A receptors were at the same time blocked by bicuculline. All modulators induced slow depolarization of membrane potential of about 9 mV. However, both cholinergic agonists, in contrast to norepinephrine, substantially enhanced membrane potential fluctuations, which appeared in the frequency range from 8 to 500 Hz (with more than two-fold increase between 25 and 180 Hz) and could not be blocked by manual membrane repolarization to the control level. The fluctuations induced by cholinergic agents may change firing properties of PoM neurons. We have also shown that cholinergic agonist, carbachol, modulated synaptic transmission from cortical layer 6 to PoM by weakening synaptic responses and enhancing frequency facilitation. Both of these synaptic effects were shown to be due to activation of muscarinic receptors. On the other hand, norepinephrine application decreased the cortico-thalamic frequency facilitation in PoM neurons.

Taken together, our results indicate that cholinergic and noradrenergic neuromodulatory systems differently influence the excitability of PoM cells.