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Peculiarities of synaptic vesicle recycling in frog and mouse motor nerve terminals

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Abstract

Using electrophysiology and fluorescence microscopy with dye FM 1-43, a comparative study of peculiarities of neurotransmitter secretion, synaptic vesicle exo-endocytosis and recycling has been carried out in nerve terminals (NT) of the skin-sternal muscle of the frog *Rana ridibunda* and of the white mouse diaphragm muscle during a long-term high-frequency stimulation (20 imp/s). The obtained data have allowed identifying three synaptic vesicle pools and two recycling ways in the motor NT. In the frog NT, the long-term high-frequency stimulation induced consecutive expenditure of the pool ready to release, the mobilizational, and reserve vesicle pools. The exocytosis rate exceeded markedly the endocytosis rate; the slow synaptic vesicle recycling with replenishment of the reserve pool was predominant. In the mouse NT, only the vesicles of the ready to release and the mobilizational pools, which are replenished predominantly by fast recycling, were exocytosed. The exo- and endocytosis occurred practically in parallel, while vesicles of the reserve pool did not participate in the neurotransmitter secretion. It is suggested that evolution of the motor NT from the poikilothermal to homoiothermal animals went by the way of a decrease of the vesicle pool size, the more economic expenditure and the more effective reuse of synaptic vesicles owing to the high rates of endocytosis and recycling. These peculiarities can provide in NT of homoiothermal animals a long maintenance of neurotransmitter secretion at the steady and sufficiently high level to preserve reliability of synaptic transmission in the process of the high-frequency activity. © 2008 Pleiades Publishing, Ltd.

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Keywords

Frog, Mouse, Nerve terminals, Vesicular cycle