Neuroscience and Behavioral Physiology 2009 vol.39 N3, pages 245-252

The vesicle cycle in motor nerve endings of the mouse diaphragm

Zefirov A., Zakharov A., Mukhametzyanov R., Petrov A., Sitdikova G.
Kazan Federal University, 420008, Kremlevskaya 18, Kazan, Russia

Abstract

Experiments on the mouse diaphragm muscle using intracellular microelectrode recordings and fluorescence microscopy were performed to study the dynamics of transmitter secretion and synaptic vesicle recycling processes (the exocytosis-endocytosis cycle) in motor nerve endings (NE) during prolonged rhythmic stimulation (20 impulses/sec). During stimulation, there were triphasic changes in the amplitude of endplate potentials (EPP): an initial rapid reduction, followed by prolonged (1-2 min) stabilization of amplitude, i.e., a plateau, and then a further slow decrease. Restoration of EPP amplitude after stimulation for 3 min occurred over a period of several seconds. Loading of synaptic vesicles with the fluorescent endocytic stain FM1-43 showed that rhythmic stimulation led to a gradual (over 5-6 min) decrease in NE fluorescence, demonstrating exocytosis of synaptic vesicles. Quantum analysis of the electrophysiological data and comparison of these data with results from fluorescence studies suggested that mouse NE have a high rate of endocytosis and reutilization of synaptic vesicles (the mean recycling time was about 50 sec), which may support the maintenance of reliable synaptic transmission during prolonged high-frequency activity. The sizes of the release-ready and recycling pools of synaptic vesicles were determined quantitatively. It is suggested that vesicle recycling in mouse NE occurs via a short, rapid pathway with incorporation into the recycling pool. Vesicles of the reserve pool are not used for transmitter secretion in the stimulation conditions used here. © 2009 Springer Science+Business Media, Inc.

http://dx.doi.org/10.1007/s11055-009-9122-x

Keywords

Endocytosis, Endplate potentials, Exocytosis, FM1-43, Mouse diaphragm motor nerve ending, Synaptic vesicle recycling