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The role of polyamine-dependent facilitation of calcium permeable ampars in short-term synaptic enhancement

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Abstract

© 2018 Rozov, Zakharova, Vazetdinova and Valiullina-Rakhmatullina. Depending on subunit composition AMPA receptor channels can be subdivided into two groups: GluA2-containing calcium impermeable AMPARs, and GluA2-lacking calcium permeable, AMPARs. These two groups differ in a number of biophysical properties and, most likely, in their functional role at glutamatergic synapses. GluA2-lacking channels have received a lot of attention over the last two decades mainly due to high calcium permeability, which was suggested to play a significant role in the induction of long-term synaptic plasticity in healthy tissue and neuronal death under neuropathological conditions. However, calcium permeable AMPARs possess another property that can contribute substantially to frequency dependent dynamics of synaptic efficacy. In the closed state calcium permeable AMPARs are blocked by endogenous polyamines, however, repetitive activation leads to progressive relief from the block and to the facilitation of ion flux through these channels. Polyamine-dependent facilitation of AMPARs can contribute to short-term plasticity at synapses that have high initial release probability and express calcium permeable AMPARs. During synaptic transmission activity-dependent relief from polyamine block of postsynaptic calcium-permeable AMPARs either counteracts presynaptic short-term depression in a frequency-dependent manner or, under specific stimulation conditions, induces facilitation of a synaptic response. Taking into account the fact that expression of calcium permeable AMPARs is developmentally regulated, depends on network activity and increases in diseased brain states, polyamine-dependent facilitation of calcium permeable AMPARs is an important, entirely postsynaptic mechanism of synaptic gain regulation.

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Keywords

Calcium permeable AMPA, GluA2-lacking AMPA, Homeostatic plasticity, Interneurons, Neurons, Polyamine, Short-term plasticity, Synapse

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