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GABABR-dependent long-term depression at hippocampal synapses between CB1-positive interneurons and CA1 pyramidal cells

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Abstract

© 2016 Jappy, Valiullina, Draguhn and Rozov.Activity induced long lasting modifications of synaptic efficacy have been extensively studied in excitatory synapses, however, long term plasticity is also a property of inhibitory synapses. Inhibitory neurons in the hippocampal CA1 region can be subdivided according to the compartment they target on the pyramidal cell. Some interneurons preferentially innervate the perisomatic area and axon hillock of the pyramidal cells while others preferentially target dendritic branches and spines. Another characteristic feature allowing functional classification of interneurons is cell type specific expression of different neurochemical markers and receptors. In the hippocampal CA1 region, nearly 90% of the interneurons expressing cannabinoid type 1 receptors (CB1R) also express cholecystokinin (CCK). Therefore, the functional presence of CB1 receptors can be used for identification of the inhibitory input from CCK positive (CCK+) interneurons to CA1 pyramidal cells. The goal of this study was to explore the nature of long term plasticity at the synapses between interneurons expressing CB1 Rs (putative CCK+) and pyramidal neurons in the CA1 region of the hippocampus in vitro. We found that theta burst stimulation triggered robust long-term depression (LTD) at this synapse. The locus of LTD induction was postsynaptic and required activation of GABAb receptors. We also showed that LTD at this synaptic connection involves GABAbR- dependent suppression of adenylyl cyclase and consequent reduction of PKA activity. In this respect. CB1+ to pyramidal cell synapses differ from the majority of the other hippocampal inhibitory connections where theta burst stimulation results in long-term potentiation.

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Keywords

GABA R. plasticity A, Inhibition, Interneurons, Perisomatic