

GABA Transporter-1 Activity Modulates Hippocampal Theta Oscillation and Theta Burst Stimulation-Induced Long-Term Potentiation

On Dec 16, 2009, the Journal of Neuroscience published a full research article from Institute of Neuroscience, SIBS, CAS entitled “GABA Transporter-1 Activity Modulates Hippocampal Theta Oscillation and Theta Burst Stimulation-Induced Long-Term Potentiation”. This work was carried out by postdoctoral fellow Dr. Neng Gong from the laboratory of Dr. Tian-Le Xu at ION, and collaborators.

The network oscillation and synaptic plasticity are known to be regulated by GABAergic inhibition, but how they are affected by changes in the GABA transporter activity remains unclear. Here we show that in the CA1 region of mouse hippocampus, pharmacological blockade or genetic deletion of GABA transporter-1 (GAT1) specifically impaired long-term potentiation (LTP) induced by theta burst stimulation (TBS), but had no effect on LTP induced by high-frequency stimulation (HFS) or long-term depression (LTD) induced by low-frequency stimulation (LFS). The extent of LTP impairment depended on the precise burst frequency, with significant impairment at 3–7 Hz that correlated with the time course of elevated GABAergic inhibition caused by GAT1 disruption. Furthermore, in vivo electrophysiological recordings showed that GAT1 gene deletion reduced the frequency of hippocampal theta oscillation. Moreover, behavioral studies showed that GAT1 knockout mice also exhibited impaired hippocampus-dependent learning and memory. Together, these results have highlighted the important link between GABAergic inhibition and hippocampal theta oscillation, both of which are critical for synaptic plasticity and learning behaviors.

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