Urethane anesthesia suppresses hippocampal subthreshold activity and neuronal synchronization.

Yagishita Haruya¹, Yuya Nishimura¹, Asako Noguchi¹, Yu Shikano¹, Yuji Ikegaya¹,²,³, Takuya Sasaki¹,⁴

¹Lab. Chem. Pharmacol., Grad. Sch. Pharmaceut. Sci., Univ. Tokyo, ²Institute for AI and Beyond, The University of Tokyo, ³Center for Information and Neural Networks, National Institute of Information and Communications Technology, ⁴Precursory Research for Embryonic Science and Technology, Japan Science and Technology Agency

Urethane is an anesthetic used in animal experiments and is known to induce slow oscillations, in which a large number of neurons are engaged in rhythmically synchronized activity in the neocortex. However, it is unclear how urethane anesthesia affects hippocampal neuronal activity. In this study, we obtained in vivo patch-clamp recordings from dorsal hippocampal CA1 neurons in mice and found that subthreshold membrane potential fluctuations were reduced during urethane anesthesia, suggesting that hippocampal synaptic activity is reduced. Next, we recorded spike units from dorsal hippocampal CA1 neuron ensembles in rats, and found that the spike rate of the majority of the hippocampal units, especially spatially selective units, was significantly reduced during urethane anesthesia, whereas a subset of non-spatial units increased their spike rate. The overall reduction in neuronal spike rates induced by urethane anesthesia led to a prominent reduction in spike synchronization across neuronal units. Consistently, the magnitude of sharp wave ripples in the hippocampus was also reduced by urethane. The suppression of hippocampal neuronal synchronization by urethane may lead to a disruption of the offline memory reactivation mechanisms.