

Low-intensity Ultrasound Suppresses Epileptiform Discharges in Mouse Hippocampal Slices

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Background, Motivation and Objective

Epilepsy is a common neurological disease, which affects about 50 million people worldwide. For patients with focal onset drug-resistant seizures, surgical resection may offer potential cure effects. However, invasive surgical approach is accompanied by inevitable risks and only suitable for selected patients with focal epilepsy. It has been shown that low-intensity ultrasound (LIUS) can suppress seizures in some laboratory studies. However, the mechanism of the suppression effect of LIUS remains unclear. The goal of this study is to investigate the modulation effects of focused LIUS on epileptiform discharges in mouse hippocampal slices as well as the underlying mechanism.

Statement of Contribution/Methods

Epileptiform discharges in hippocampal slices of 8-day-old mice were induced by low-Mg²⁺ artificial cerebrospinal fluid and recorded by micro-electrode array *in vitro*. LIUS was delivered to hippocampal slices to investigate its modulation effects on epileptiform discharges. Pharmacological experiments were conducted to study the mechanism of the modulation effects.

Results/Discussion

LIUS suppressed the amplitude, rate and duration of ictal discharges (IDs). For inter-ictal discharges (IIDs), LIUS suppressed the amplitude but facilitated the rate. LIUS suppressed the spontaneous spiking activities of pyramidal neurons in CA3, and the suppression effect of LIUS was eliminated by Kaliotoxin. The suppression effect of LIUS on epileptiform discharges was weakened when the perfusion was mixed with Kaliotoxin. Those findings demonstrated that LIUS suppressed the epileptiform discharges in 8-day-old mouse hippocampal slices and the Kv1.1 channel played an important role in the suppression effect, indicating that LIUS can be used to activate K⁺ channel with mechanosensitivity to suppress epileptiform discharges.

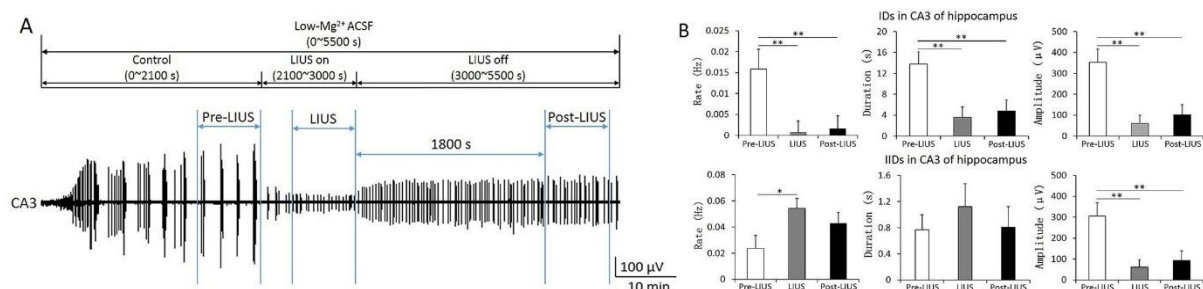


Fig. 1. Statistical analysis results of the LIUS suppression effects on low-Mg²⁺-induced epileptiform discharges. (A) Definition of periods. Each period contains 10 min data. (B) The statistical analysis results of the rate, duration and amplitude of IDs and IIDs.