

The effect of visual stimulation on cortical activity in a mouse model of temporal lobe epilepsy

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Introduction of the project brought into the program

This project is at a near-submission state. Hence, it is presented here currently without figures. The goal is to give a therapeutic implication for temporal lobe epilepsy, which is notoriously difficult to treat.

The cause of epilepsy is essentially the shift of excitation-inhibition balance toward the former one.

Pharmacological treatment targets this but has long-term side effects; surgical treatment removes brain structures with important functionality.

We want to suggest conservative therapy, noting that in severe cases existing interventions might be necessary as well.

Hypothesis and methods

The idea is based on an effect of the excitatory-inhibitory imbalance, namely increased sensitivity.

This means that stimuli that are moderate enough not to have a significant effect on the healthy brain's functioning, can significantly alter the functioning of the epileptic brain. Assuming that imbalance decreases the level of organization, we want to use organized stimuli in this range to make the brain work in a more organized manner. We expect that this will shift the excitatory-inhibitory activity back toward balance.

Methods I: electrophysiology to measure epileptic severity

We will work with mice and excitatory-inhibitory shift toward excitability will be reached by injecting kainic acid into the cortex above the hippocampus.

The kainate model in mice is described in the literature and well studied.

As a measure of severity of the epileptic state, we will use the frequency of interictal spikes.

This is also an accepted measure.

We will collect electrophysiology data with implanted cortical electrodes.

Electrophysiology data will be stored and made public at researchdata.hu.

Methods II: two-photon microscopy to analyze patterns in pyramidal cells' activity in space and time

We will determine the level of organization in the brain's functionality by finding and analyzing patterns in cortical pyramidal cells' activity in layers II/III.

We will analyze patterns in space and in time.

We will study pyramidal cells' activity by collecting two-photon microscopy videos in awake, live mice, from the area near the kainate injection site.

As increased somatosensation is frequent in epilepsy, we will place the craniotomy window for two-photon microscopy to reveal the somatosensory cortex.

We will use visual stimuli for practical reasons; therefore, the craniotomy will also make the visual cortex available for microscopy experiments.

Patterns will be identified using unsupervised machine learning methods.

Microscopy videos will be stored and made public at researchdata.hu.

STAY TUNED, THE RESULTS ARE COMING!