# Neurophysiological effects and mechanism of transcranial direct current stimulation for epilepsy

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Seizure is a transiently abnormal symptom of excessive synchronized neuronal discharge with aberrant oscillations in the brain. Epilepsy is a neurological disorder where the neural network has an enduring tendency to spontaneously generate recurrent seizures. Globally an estimated 5 million people are diagnosed with epilepsy each year which brings vast impacts on medical and social-economic impacts, particularly for those patients with poor-controlled seizures. Current anti-seizure medication can only effectively control seizures in up to two-thirds of patients with epilepsy. For patients with drug-resistant epilepsy, neuromodulations raise novel therapeutic potentials for the clinical unmet need. Transcranial direct current stimulation (tDCS) can modulate cortical excitability and neural plasticity by polarity-dependent constant current stimulations, whereby anodal tDCS and cathodal tDCS provide facilitatory and inhibitory effects in general, respectively. Therefore, tDCS is of therapeutic potential to treat a spectrum of neuropsychiatric disorders. Seizure, an overexcited neural disorder, thereby can be ameliorated by applying cathodal tDCS. However, the mechanisms how tDCS can alleviate seizure from pathophysiological perspectives remains not well known. Our research focuses on the therapeutic effects and neurophysiological mechanisms of neuromodulation applied to seizure disorders and cognitive impairments. Our studies find that (1) in an acute sustained seizure rat model of status epilepticus, repeated cathodal tDCS can mitigate seizure severity, alter ictal EEG pattern and reduce the chronic adverse consequences, supporting the therapeutic potential of tDCS in severe prolonged epileptic seizures, and (2) in a chronic seizure animal model, we reveal an inverse relationship between the changes of delta oscillation and interictal spikes during tDCS on and off stimulation periods indicating that an enhanced endogenous delta oscillation underlies the tDCS inhibitory effect on epileptic excitability. This talk will introduce how tDCS decreases the brain excitability in an epileptic brain via modulating the endogenous neural oscillations.

## References

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