Effects of Ni^{2+} on Spontaneous Neocortical Network Activity in Rat Brain Slices

Chen Meng
State Key Laboratory of Digital Medical Engineering, Southeast University, Nanjing, China

Yang Lu
State Key Laboratory of Digital Medical Engineering, Southeast University, Nanjing, China

Yan Huang
State Key Laboratory of Digital Medical Engineering, Southeast University, Nanjing, China

Zhigong Wang
Institute of RF- & OE-ICs, Southeast University, Nanjing, China

Xiaoying Lü*
State Key Laboratory of Digital Medical Engineering, Southeast University, Nanjing, China

Abstract:

In recent years, the clinical use of nickel-based alloy implants in neurosurgery has expanded significantly, raising growing concern about the neurotoxic potential of Ni^{2+} leached from these devices. While numerous patch-clamp studies have established that Ni^{2+} suppresses intrinsic excitability of individual neurons primarily by blocking T-type Ca^{2+} channels, the impact of Ni^{2+} on emergent network-level dynamics remains poorly understood. To address this gap, we employed microelectrode array (MEA) recordings to quantify changes in spontaneous activity within the neocortical networks of acute rat brain slices before and after short-term (< 70 min), 500 μM Ni^{2+} exposure. We found that, under these conditions, Ni^{2+} did not significantly alter global firing rate, bursting rate, or firing rate in burst. In contrast, Ni^{2+} markedly shortened burst duration, reduced the number of spikes in burst, and decreased the percent of spikes in bursts—indicating a disruption of burst-associated network activity without abolishing overall spiking output.

Keywords:

Burst, microelectrode array (MEA), neuronal network, Ni^{2+}, spontaneous activity.