FORUM

Imaging Epileptic Seizures using Electrical Impedance Tomography

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Abstract

Electrical Impedance Tomography (EIT) is an emerging method that produces tomographic images of the internal impedance of a subject using a box of electronics connected to surface EEG-type electrodes. It is safe, portable, inexpensive, and has been recently marketed for monitoring pulmonary function at the hospital ICU. EIT has the clinical potential to localize seizure foci in epilepsy patients, as it can image millisecond changes in brain impedance caused by neuronal depolarisation and cell swelling, both simultaneously to EEG/ECoG. In this talk I will describe my work at the UCL EIT lab, where I led the development and test of the application of EIT for imaging cortical activity and epileptic seizures. Subdural grid electrodes were implanted over the somatosensory cortex of adult Sprague-Dawley rats under general anaesthesia, and brain impedance was measured by applying an AC current of 60 μA at 1.7kHz using a custom-made current source and recording with an EEG amplifier. Epileptic seizures were induced by intra-cortical injection of 4-aminopyridine, picrotoxin or penicillin. We detected reproducible fast impedance changes of -0.26±0.09% (mean±SD, n=9 rats, 3562 interictal spikes in total) 7 ms prior to the peak of inter-ictal spikes, which were then followed by impedance increases of 0.57±0.32 %, starting 50 ms after each inter-ictal spike and lasting up to 2 s. During seizures, there were significant impedance increases of 2.21±1.16% (201 seizures in total). The impedance changes occurred focally around the injection site and were consistently imaged with a resolution of ~0.4mm. The present method can be ported to the clinical setting with use of subdural electrodes implanted for presurgical evaluation, potentially providing a major improvement in neuroimaging technology for localizing seizure onset zones.

Host: **Hiro Nakahara** Lab for Integrated Theoretical Neuroscience