Functional Network Connectivity Analysis in Absence Epilepsy Using Stargazer Mice

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ABSTRACT

Absence epilepsy is a common childhood disorder featuring frequent cortical spike-wave seizures with a loss of awareness and behavior. Using the calcium indicator GCaMP6 with in vivo 2-photon cellular microscopy and simultaneous electrocorticography, we examined the collective activity profiles of individual neurons and surrounding neuropil patches in layer 2/3 (L2/3) of the visual cortex during spike-wave seizure activity over prolonged periods in 2 different stargazer mice. Our long-term objective is to predict in real-time a seizure. In this work, we focused on identifying the neuronal networks activated during epochs of interictal activity (i.e., between seizure activities) and seizure activity and analyzed their functional network connectivity. During interictal activity, most neurons are functionally connected with a large number of neighbors within the field of view, while in seizure epochs, the connectivity is reduced substantially. We also examined the discriminating power of groups of neurons in identifying seizure events. An SVM model based on the firing activity of neurons can reasonably accurately classify the interictal activity vs. seizure (e.g., 77.9% for the total accuracy with sensitivity equal to 85.3%, and specificity 73%). We are in the process of examining further whether the activity of specific groups of neurons, with distinct temporal dynamics, can further improve the classification of seizure events and enable the prediction of seizure events in real-time.

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