Form 1-3

Japan-U.S. Brain Research Cooperation Program
Researchers Dispatched to the U.S. Program FY2022: Report

Field:_Neurobiology of disease_

1. Researcher

Name: Naoki Ikegaya
Title: Visiting Researcher
Affiliation: Yokohama City University, Department of Neurosurgery

2. Research Title:
The pathogenic effects of temporal lobe epilepsy on deep brain networks

3. U.S. Joint Researchers/Institutes
Please give the name, title and affiliation.

Name: Jorge A. Gonzalez-Martinez
Title: Professor, Vice-chair
Affiliation: University of Pittsburgh, Department of Neurological Surgery

4. Research Period, from/to (yyyy/mm/dd): 2022/09/01 to 2023/03/15

5. Abstract, Results, and Research Significance (300 Words):
Neuronal groups synchronize among distinct areas. Particularly synchronized areas form brain networks, that is the basis of brain functioning. Epilepsy is a chronic brain disorder characterized by neuronal hyperexcitation and hyper-synchronization. Recent studies have suggested that the neuronal hyperexcitation and hyper-synchronization are associated with the broad abnormalities of brain networks. To better understand the pathology of epilepsy, it has become necessary to redefine it as a network disease, focusing on hub regions in the deep brain. The thalamus is a representative structure that plays the role of a hub. In this study, we focused on the pulvinar, which is the largest nucleus of the thalamus and a neglected area in the epilepsy research. First, we investigated different electrical stimulation effects of three different thalamic sub-nuclei, i.e., the centromedian, anterior nucleus, and pulvinar, on the epileptic activities in the patient with bilateral posterior quadrant epilepsy (PQE). Bilateral stereotactic electroencephalograph (sEEG) electrodes were implanted over the bilateral posterior temporo-parieto-occipital regions with some targeting the centromedian, anterior, and pulvinar nuclei. Electrical stimulations were performed and interictal activity 30 seconds and 1 minute following each stimulation was analyzed. Background interictal activities were significantly decreased at 30 seconds and 1 minute after stimulating the pulvinar nucleus. However, no such significant changes were noted after the centromedian and anterior nuclei simulation. This suggested that the optimal location for thalamic stimulation depended on the brain network where seizure arose. Another ongoing study is focusing on the pathological network of interictal epileptiform activities (IED) and its association with the pulvinar. Data were collected on 22 patients who underwent sEEG with at least one electrode implanted in the pulvinar. Visual EEG analysis showed rapid propagation of IEDs to the pulvinar in PQE. These data are ripe for mathematical analysis to further understand the pathological networks in the deep brain.

6. Other (Research-related concerns, particular points to note):
There are no concerns. The research is more concrete and deeper than originally planned. However, since the research has expanded beyond initial expectations, it may take some more period before the results are disseminated.

*Please attach any reference materials as necessary.