Abstract - IBAGS2013
No: 145
Topic: 2 - Physiology

Neural activity in the rat basal ganglia

Y. Zhao[1]*, J. Stegenga*[1]*, T. Heida*[1]*, R.J.A. van Wezel*[1,2]
[1]MIRA Institute for Biomedical Engineering and Technical Medicine, Faculty of Electrical Engineering, Mathematics, and Computer Science, Biomedical Signals and Systems Group, University Of Twente, Enschede, [2]Donders Institute for Brain, Cognition, and Behavior, Department of Biophysics, Radboud University Nijmegen, Nijmegen, The Netherlands

Objectives: Pathological oscillations in the beta frequencies (8-30Hz) have been found in the local field potentials of Parkinson's disease (PD) patients and non-human primate models of PD[1]. In particular, these synchronizations appear in the subthalamic nucleus (STN), a common target for deep brain stimulation (DBS) for medically intractable PD[2]. DBS and dopamine replacement therapy have been shown to reduce these oscillations and ameliorate the motor symptoms of PD. To better understand the origin and mechanisms of these synchronizations, we performed *in vitro* multielectrode recordings from the rat basal ganglia that support the detection of synchronous activity from numerous neurons.

Methods: 300-400 µm basal ganglia slices were obtained from Wistar rats (postnatal days 15-60) using a vibratome and warmed up to room temperature in a holding chamber. The slices were transferred onto a 3D multielectrode array (Ayanda Systems) for recording and continuously perfused with carbogenated artificial cerebral spinal fluid at 36 °C. Neural signals were measured and filtered with a 60 channel amplifier (Multichannel Systems GmbH) and visualized in LabView. Action potentials were detected from the extracellular signal using a 5 standard deviation voltage threshold and sorted into different neuronal units using principal component analysis. Further signal analysis was performed in Matlab to analyze the neuronal firing patterns and measure the extent of synchronous firing.

Results: Our preliminary results identified three distinct firing patterns in the STN and substantia nigra. Most neurons exhibited regular spike trains (60%) while others were random (30%) or bursty (10%). The addition of dopamine however reduced the percentage of cells with bursty and random firing patterns. Additionally, we found a very low incidence of synchronizations. Taken together, these results form the basis with which to compare firing patterns in an animal model of PD.

Conclusions: Multi-electrode array recordings from the basal ganglia can reveal changes in their neurophysiological properties and measure the amount of synchronization between different neurons. We intend to use this technique to investigate pathological firing patterns in the basal ganglia in a rotenone rat model of PD. Using a combination of chemical and electrical stimulation, we will explore contributions from different nuclei of the basal ganglia to the network behavior. This would allow us to build more realistic models of the basal ganglia and lead to better therapies for PD.

References:
1. Brown P *et al* (2001). *J Neurosci*, 21: 1033-1038.
2. Benabid AL *et al* (1987). *Appl Neurophysiol*, 50: 344-346.

Abstract - IBAGS2013
No: 154