Temporal Patterns of Deep Brain Stimulation

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Country

USA

Title of project or programme

Temporal Patterns of Deep Brain Stimulation

Source of funding information

NIH (NINDS)

Total sum awarded (Euro)

€ 2,062,849.54

Start date of award

30/09/2000

Total duration of award in years

3

The project/programme is most relevant to:

Parkinson's disease & PD-related disorders

Keywords

Deep Brain Stimulation, motor symptom, Parkinson Disease, neural patterning, Bradykinesia

Research Abstract

? DESCRIPTION (provided by applicant): Chronic high-frequency electrical stimulation of the brain, called deep brain stimulation (DBS), has emerged as a well-established therapy for the treatment of movement disorders, including essential tremor and Parkinson’s disease (PD). Although the clinical benefits of DBS are well documented, fundamental questions remain about the mechanisms of action, and this lack of understanding will limit the full development and

optimization of this promising treatment. One of the hallmarks of DBS is the strong dependence of symptom relief on the frequency of stimulation. High frequency DBS (> 100 Hz) relieves the symptoms of movement disorders, while low frequency stimulation (< 50 Hz) is generally not ineffective. During the prior grant period we established that the effects of DBS are also strongly dependent on the temporal pattern of stimulation. Now, we seek to exploit this finding - that the effects of DBS are strongly dependent on the temporal pattern of stimulation - both to understand the relationship between temporal patterns of neural activity and the motor symptoms of PD and to improve the effectiveness and efficiency of DBS through the design of novel optimal temporal patterns of stimulation. We will combine computational modeling, quantitative behavior and single unit neural recording in an animal model of PD, and translational experiments in humans with PD to advance both the understanding and application of DBS. First, we will measure the effects on tremor and bradykinesia of symptogenic temporal patterns of DBS, designed to generate neural typified by either theta-frequency or beta-frequency oscillations, and determine the causality between these temporal patterns of neural activity and the motor symptoms of PD. Second, we will use model-based optimization to design novel temporal patterns of stimulation intended to suppress maximally the abnormal synchronous oscillations in the theta- and beta-frequency bands, and measure the effects of DBS with these patterns on tremor and bradykinesia in a rat model of PD and in persons with PD and STN DBS. Third, we will measure the effects of the frequency and temporal pattern of DBS on neural activity the basal ganglia and cortex. We will use innovative hardware that enables recording of local field potentials during the application of DBS and correlate the changes in neural oscillatory activity with changes in symptoms in persons with PD and STN DBS, as well as in a rat model of PD. The temporal pattern of DBS is a novel and important parameter that we will exploit, both to understand the relationship between the patterns of neural activity and motor symptoms of PD, and as a novel way to improve the efficacy and efficiency of DBS. The outcomes of the proposed research will contribute to understanding the relationship between patterns of neuronal activity and the symptoms of movement disorders, to improving the treatment of Parkinsonian symptoms with DBS, and to uncovering the mechanisms of action of DBS.

Lay Summary

PUBLIC HEALTH RELEVANCE: The clinical benefits of deep brain stimulation (DBS) to the motor symptoms of Parkinson’s disease are well established, but fundamental questions remain about the mechanisms of action. The outcomes of the proposed project will advance the understanding of the mechanisms of action of DBS and develop and test an innovative approach to increase the efficacy and efficiency of DBS.

Further information available at:

Types:
Investments > €500k

Member States:
United States of America

Diseases:
Parkinson's disease & PD-related disorders

Years:
2016

Database Categories:
N/A

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