Effect Transformation of the Micro Electrode Recording (MER) Data to Fast Fourier Transform (FFT) for the Main Target Nucleus Determination for STN-DBS

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1. INTRODUCTION

Deep Brain Stimulation (DBS) for movement disorders using implantable systems developed by Medtronic (Mundinger et all., 1977) and further advanced and used in 1986 to treat medically refractory tremor in Parkinson Disease (PD) by Benabid (1).

DBS is in principle “reversible lesion” in the target nucleus and does not interfere with the use of other therapies (2). Subthalamic nucleus (STN) is the main target nucleus for DBS in PD. STN stimulation directly improves and reduces off time, thereby reducing dopaminergic medication requirements by approximately 50%; dyskinesias improve as a consequence (3,4).

Unilateral STN DBS is an effective and safe treatment for selected patients with advanced PD. Unilateral STN DBS provides improvement of contralateral motor symptoms of PD as well as quality of life, reduces requirements for medication and unified Parkinson's disease rating scale (UPDRS) score of the patient. This approach of surgical treatment may be associated with a reduced risk and may provide an alternative to bilateral STN DBS for PD, especially in older patients or patients with persistent asymmetry of parkinsonism.(5)

2. BACKGROUND AND PURPOSE

Advanced PD stimulation of the STN reduces tremor, rigidity, and bradykinesia. Due to hemorrhagic complications the use of micro electrode recordings during DBS operation was still questioning for some of surgeons. But use micro electrodes were still the best choice for the positioning during surgery of DBS. Aim: The aim of the current study was to investigate the effect transformation of the micro electrode recording data to fast fourier transform for the main target nucleus determination. This process needs a multidisciplinary approach from neurosurgery, neurology and specialists on electrophysiology such as biophysics. Case report: We present the case of a 63 year-old male with medically intractable PD is focused on behalf of the surgical treatment. Patient had a 4-year history of progressively severe hand tremor on right side. The patient was successfully treated unilaterally with the STN DBS. Key words: subthalamic nucleus; deep brain stimulation; micro electrode recording; Parkinson's disease; fast fourier transform.
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In the main graphics shows the original recordings (blue in color) while insets of each figure represents and FFT transformation of the recording micro electrode data. A shows both the original and the FFT transformed data of the starting point. B shows the target area which was planned standing on the MRI results. C shows the actual target area depending on the microelectrode recordings.

4. DISCUSSION

DBS is a surgical treatment used to treat a number of neurological conditions such as essential tremor, PD and Dystonia. Preparation of this surgery begins several days before in order to reduce the medical therapy. Procedure needs Magnetic Resonance Imaging (MRI) especially the T2 weighted ones for better STN visualization (6).

Intraoperative stimulation is more widely accepted as a tool for useful for understanding of the complex behavior of the biological signals. To best our knowledge current study is the first that apply the FFT transformations for understanding the complex behavior of the MER data.

5. CONCLUSION

Our findings suggest that the micro electrode recordings were the indispensable part of the DBS surgery. Application of the FFT to MER data may be used for the decrease in the number of micro electrodes used for the surgery. Additionally use of FFT transformations may also eliminate the macro stimulation and neurological examination phases of the surgery.

This view may in turn results in the decrease in surgery period need further investigation.

CONFLICT OF INTEREST: NONE DECLARED.

REFERENCES