FP056 / #252

Topic: *AS01. Movement Disorders*

A SEMI AUTOMATIC ALGORITHM (STIMSEARCH) GUIDED PROGRAMMING OF PARKINSON'S PATIENTS FOLLOWING DEEP BRAIN STIMULATION SURGERY-INITIAL EXPERIENCE

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Introduction: Identifying clinically effective contact configuration and optimizing stimulation parameters after deep brain stimulation (DBS) surgery is a time-consuming and labour-intensive process. Programming has become more complex with the introduction of segmented leads. StimSearch™ is an automated programming algorithm developed by Boston Scientific Neuromodulation, which iteratively optimizes the stimulation setting based on physician's feedback. We conducted a study to investigate the clinical outcome and volume of tissue activated by two programming methods i.e. standard of care (SoC) and StimSearch.

Methods: Ten DBS patients with Parkinson's disease (58.500 ± 5.473 years) who exhibited greater than 50 % reduction in their OFF medication UPDRS III score following SoC programming participated in this study. Informed consent was obtained from all participants before their inclusion in the study. Patients underwent StimSearch based programming, 4-6 weeks after a stable program OFF medication UPDRS III was evaluated per SoC. SoC and Stimsearch settings were compared with respect to the clinical outcome and the volume of tissue activated (VTA) and patient's preference between the two programs was recorded.

Results: Out of the ten patients, seven continued with the StimSearch program, while three reverted to the SOC program. Among these seven patients, the OFF medication UPDRS III scores were 46.857 ± 9.719 at baseline (pre-op), 19.714 ± 4.070 in SOC, and 27.714 ± 10.419 in the StimSearch program. The time required for StimSearch programming the right and left STN was 13.194 ± 16.235 and 15.035 ± 16.476 minutes respectively. The two SFM aggregates had a DICE similarity coefficient of 0.64 bilaterally and 0.79 and 0.48 for right and left hemisphere respectively.

Conclusions: Programming with the StimSearch algorithm was fast and was preferred by the majority of the participants. Despite lower improvement in motor scores with the StimSearch algorithm, patients reported behaviour and mood benefits as a reason of continuance. The stimulation VTA and sites were comparable between the two methods. In this initial exploratory study, StimSearch has been shown to produce results similar to standard of care.

Keywords: DBS programming, Parkinson's disease, UPDRS

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Topic: *AS01. Movement Disorders*

RADIOFREQUENCY LESIONING FOR HEMIDYSTONIA: A SYSTEMATIC REVIEW

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Introduction: Radiofrequency lesioning (RL) has been a mainstay in functional neurosurgery to treat dystonic movement disorders, which was replaced by deep brain stimulation (DBS) in the late 1990s. Studies on RL have shown variable benefit in patients with hemidystonia. The aim of this systematic review is to summarize published reports on RL for hemidystonia and to evaluate clinical outcome.

Methods: A systematic literature review was performed according to PRISMA guidelines in PubMed, Embase, and Web of Science using a customized software (UiPath, NY) to identify all case reports, case series, and cohort studies reporting patients with hemidystonia treated with RF. Manuscripts were then automatically searched for the search term "hemidystonia". The selected manuscripts were manually screened to identify appropriate reports.

Results: More than 20 reports were identified with 118 cases published between the years 1982 - 2022. Thalamotomy was performed in 88 cases, pallidotomy in 27 cases, and both in the remaining 3 cases. Until 1998, improvement in hemidystonia was not quantified using standard rating scale. Qualitatively good improvement was reported in 18/39 (50%) patients with hemidystonia after thalamotomy. In addition, newer reports indicated a 35% benefit in BFMDRS total score in 7 patients and 60% in 15 patients, respectively. With respect to pallidotomy, 4/8 (50%) patients for whom individual patient data were available were classified as responders, when considering a 20% cut-off for improvement. The lack of a standardized assessment of the results contributes to the difficulty in interpreting the outcome.

Conclusions: With recent advances in targeting methods, RL may be reconsidered as a treatment option for hemidystonia as an alternative to DBS. Further studies with standardized assessment of outcomes are needed to better characterize variability in outcome and to identify prognostic factors.

Keywords: Radiofrequency Lesioning, Hemidystonia

FP040 / #442

Topic: *AS10. Novel Therapies*

ARE WE BARKING THE WRONG TREE: A NOVEL WAY OF PROGRAMMING THE DBS IMPLANTABLE PULSE GENERATOR

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Introduction: The evolution of Deep Brain Stimulation (DBS) technology, featuring multi-parametric adjustments and directional leads, has significantly enhanced therapeutic outcomes while also increasing the complexity of programming. This study compares conventional Standard of Care (SOC) programming, which relies on clinical assessment and image-guided programming, with a novel Stimulation-Induced Side-Effect (SISE)-guided programming, which leverages the occurrence of side effects to refine the determination of the stimulation contact point.

Methods: SOC programming is used for all the patients at our center. SISE-guided programming was offered to the patients who failed or had suboptimal responses. SISE-guided programming determines the threshold current that elicits side effects to estimate the DBS lead's anatomical positioning for precise current steering. We present three cases of Parkinson’s disease patients who benefitted from the SISE-guided programming. All patients had undergone DBS using directional lead and Boston Scientific (USA) implantable pulse generator.

Results: The stimulation level with SISE-guided programming was maintained the same for three leads, moved ventrally by 0.5 contact points for two leads and dorsally by 0.6 contact points for one lead relative to SOC programming. SISE-guided adjustments resulted in an average increase in current amplitude of 1.7 mA (range: 0.5 mA - 2.1 mA). Furthermore, the current direction was altered from posterior to medial for two leads and from posterior to lateral for one lead, with adjustments not exceeding 90 degrees. Notably, in two additional instances, the current direction was changed from a circumferential spread to a more focused posteromedial and posterolateral distribution. This precision programming enhanced symptom control in two patients with tremors and one with bradykinesia and freezing gait.

Conclusions: Selecting optimal contact points, current direction, and amplitude is challenging when using SOC programming, especially considering the STN's small size and the VTA's spherical shape. SISE offered a larger margin of safety, which otherwise would not have been realized in SOC-based programming. This provided enhanced clinical benefits without any undue side effects. SISE-guided programming emerges as an alternative approach.

Keywords: Side effects, Programming, Deep Brain Stimulation

FP071 / #446

Topic: *AS11. Basic Science or Technology Development*

NEUROPHYSIOLOGICAL CHARACTERIZATION OF HUMAN SUBTHALAMIC NUCLEUS NEURONS IN PARKINSON'S DISEASE

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Introduction: Subthalamic nucleus (STN) has been established as an effective target for deep brain stimulation in Parkinson's disease (PD). The disease is characterized by aberrant burst firing in STN neurons. Therefore, it is crucial to understand the neurophysiological properties of these neurons before attempting to modulate them. We studied extracellular spike waveforms and discharge patterns to classify the STN neurons and determine their spatial distribution in PD patients. Additionally, we measured neuronal activity near the effective contact points of stimulation.

Methods: Microelectrode recording data was collected from 22 PD patients (11 males and females), sampled at 20 kHz and bandpass filtered at 0.5-5 kHz. Spike detection and analysis were carried out using UltraMegaSort toolbox and Matlab. Single unit clusters were isolated based on consistent waveform, spike amplitude, duration and a refractory period of 2.5 ms in the interspike interval (ISI) histogram. The following metrics were computed to classify the neurons: firing rate (FR), fano factor, burst index (BI), local variance (LV), coefficient of variation (CV), (CV 2), and interspike intervals (ISIs). A scatter plot of peak-trough ratio versus end-slope was used to distinguish between regular (RS) and fast-spiking (FS) neurons.

Results: A total of 323 neurons were isolated from the STN (n =37), of which 66 (20.4 %) displayed tonic discharge, 46 (14.2 %) periodic burst, 99 (30 %) irregular burst and 122 (37.7 %) irregular firing. Five spike waveforms were identified as triphasic 64(19.8 %), negative dominant 137(42.4%), Negative-positive 68 (21 %), positive-negative 40 (12.3%) and compound 14 (0.04 %). The RS neurons are most abundant (47 %) and FS interneurons are less populated (4%).

Conclusions: The irregular discharge pattern with negative waveforms are prevalent and widespread. The majority of tonic firing neurons were found ventrally, whereas irregular bursts were seen laterally. The majority of periodic burst units were found medially along the anteroposterior axis. The FS interneurons were prominent posteriorly and RS neurons are dispersed all over. The gradient of RMS suggests an increase in cell density in the anterior-posterior axis. Maximum therapeutic benefits were seen in the central and lateral regions that exhibited irregular, irregular bursts, and tonic firing patterns.

Keywords: subthalamic nucleus, Firing pattern, Neuronal activity