Bilateral Centromedian Thalamic Nucleus Deep Brain Stimulation for Epilepsy in Children and Adults. 32 Cases and One Spectral Analysis Local Field Potentials During Emotional Stimuli.

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Abstract

Introduction: This study evaluates the clinical efficacy and safety of bilateral deep brain stimulation (DBS) of the centromedian (CM) nucleus of the thalamus in 32 cases in a heterogeneous population of children and adults with drug-resistant epilepsy (DRE) performed in a single center in Hospital San Vicente Fundacion Rionegro Colombia. We also analized the last patient who was implanted with Percept PC battery that allow record local field potential from the centromedianos nucleos In this patient, LFPs were analyzed during both emotional discrimination and motor tasks, providing novel insights into thalamocortical network dynamics in epilepsy. These recordings revealed task-specific oscillatory patterns that may serve as potential biomarkers for future closed-loop neuromodulation strategies.

Method: A retrospective analysis was conducted on 32 patients treated between 2017 and 2024. The primary outcomes included seizure frequency, seizure-free days, and quality of life, while surgical complications and mortality were also assessed. We also analyzes local field potentials (LFPs) in one of the patient who underwent percept PC battery. The recordings were obtained during a task involving the presentation of emotional images (five happy and five sad), with the DBS stimulator turned ON. Signals were segmented according to image presentation times and analyzed using Welch's method. A 1/f correction was applied to the power spectra to compensate for the natural decline in power at higher frequencies.

Results: The general results of DBS demonstrated a significant reduction in seizure frequency, from an average of 331.97 to 21.63 seizures per month ($p = 0.001$), representing a 93.45% median reduction. Seizure-free days increased from 9.1 to 60.77 days per month ($p = 0.012$), and 83% of patients reported improved life satisfaction. Device-related infections occurred in 9.3% of patients, and three deaths unrelated to DBS were recorded. In the patient implanted with percept PC, LFPs were analyzed during both emotional discrimination and motor tasks, providing novel insights into thalamocortical network dynamics in epilepsy. These recordings revealed task-specific oscillatory patterns that may serve as potential biomarkers for future closed-loop neuromodulation strategies.

Discussion: In both hemispheres, DBS ON is associated with increased low-frequency power (especially in theta and alpha bands), suggesting enhanced thalamic responsiveness to positive emotional stimuli under stimulation.The DBS ON condition reveals increased power in both hemispheres, particularly in the low-frequency range (1–5 Hz) and mid-frequency range (15–25 Hz), suggesting that stimulation enhances thalamic responsiveness to emotionally salient stimuli. In contrast, the DBS OFF condition shows reduced spectral power, indicating diminished thalamocortical engagement during passive emotional processing. These findings suggest that DBS in the centromedian thalamus does more than suppress seizures—it may also restore or enhance physiological oscillations that are otherwise dormant or disrupted in epilepsy. The reactivation of low-frequency and mid-frequency bands could reflect a normalization of thalamocortical communication, which is critical for both conscious awareness and emotional processing.

Conclusions: The findings support CM-DBS as a safe and effective therapeutic option for DRE, with significant improvements in seizure control and quality of life. The integration

of Percept RC technology opens new avenues for personalized, biomarker-guided DBS programming. Further prospective studies are warranted to validate these results and explore the long-term benefits of adaptive neuromodulation in epilepsy.

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