Constant Current versus Constant Voltage Subthalamic Nucleus Deep Brain Stimulation in Parkinson's Disease

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Abstract:

Background: Subthalamic nucleus (STN) deep brain stimulation (DBS) is an established therapy for advanced Parkinson's disease (PD). Motor efficacy and safety have been established for constant voltage (CV) devices and more recently for constant current (CC) devices. CC devices adjust output voltage to provide CC stimulation irrespective of impedance fluctuation, while the current applied by CV stimulation depends on the impedance that may change over time. No study has directly compared the clinical effects of these two stimulation modalities. Objective: To compare the safety and clinical impact of CC STN DBS to CV STN DBS in patients with advanced PD 2 years after surgery. Methods: Patients were eligible for inclusion if they had undergone STN DBS surgery for idiopathic PD, had been implanted with a Medtronic Activa PC and if their stimulation program and medication had been stable for at least 1 year. This single-center trial was designed as a double-blind, randomized, prospective study with crossover after 2 weeks. Motor equivalence of the 2 modalities was confirmed utilizing part III of the Unified Parkinson's Disease Rating Scale (UPDRS). PD diaries and multiple subjective and objective evaluations of quality of life, depression, cognition and emotional processing were evaluated on both CV and on CC stimulation. Analysis using the paired t test with Bonferroni correction for multiple comparisons was performed to identify any significant difference between the stimulation modalities. Results: 8 patients were recruited (6 men, 2 women); 1 patient did not complete the study. The average age at surgery was 56.7 years (range 47-63). Disease duration at the time of surgery was 7.5 years (range 3-12). Patients were recruited 23.8 months (range 22.5-24) after surgery. At the postoperative study baseline, this patient group showed an average motor improvement of 69% (range 51-97) as measured by the change in UPDRS part III with stimulation alone. Levodopa equivalent medication was reduced on average by 67% (range 15-88). Patients were poorly compliant with PD diaries, and these did not yield useful information. The minor deterioration in quality-of-life scores (Parkinson's Disease Questionnaire-39, Quality of Life Enjoyment and Satisfaction Questionnaire) with CC stimulation were not statistically significant. Two measures of depression (Hamilton Rating Scale D17, Quick Inventory of Depressive Symptomatology - Self-Report) showed a nonsignificant lower score (less depression) with CC stimulation, but a third (Beck Depression Inventory) showed equivalence. Cognitive testing (Mini Mental State Examination) and emotional processing (Montreal Affective Voices) were equivalent for CC and CV. Conclusion: CC STN DBS is safe. For equivalent motor efficacy, no significant difference could be identified between CC and CV stimulation for nonmotor evaluations in PD patients 2 years after surgery.
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