

Case Report

STN DBS for Advanced Parkinson Disease Simultaneously Alleviates Cluster Headache

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Keywords

Parkinson disease · Deep brain stimulation · Cluster headache · Subthalamic nucleus

Abstract

Background: STB DBS (deep brain stimulation of the subthalamic nucleus) is commonly used to treat advanced Parkinson disease (PD) while posterior hypothalamic DBS for cluster headache (CH) remains experimental. **Methods:** We present a case where a middle-aged man was diagnosed with both CH and PD and received medical treatment for both. The patient was treated with bilateral STN DBS after developing side effects related to L-dopa. **Findings:** STN DBS not only alleviated PD symptoms but also the CH, and hence the CH treatment could be withdrawn. During follow-up PD progressed but the effect on CH symptoms was sustained. **Conclusions:** The anatomical proximity of the medial STN and hypothalamus, their similar connectivity via the hyperdirect pathway, and the autonomic effects of STN DBS could explain symptom relief for both PD and CH.

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Published by S. Karger AG, Basel

Introduction

STN DBS (deep brain stimulation of the subthalamic nucleus) is commonly used to treat advanced Parkinson disease (PD). Cluster headache (CH) is a debilitating unilateral paroxysmal headache disorder that is often difficult to treat medically, and various neuromodulation approaches have been developed such as DBS targeting the hypothalamic area [1] and occipital nerve and pterygopalatine ganglion stimulation. The pathophysiologic mechanism of CH remains incompletely understood. The DBS target for CH was based on a finding that the ipsilateral posterior hypothalamus is activated when CH attacks are triggered by nitrous oxide. A later report examined stimulated neuroanatomic structures [2]. The structures affected by STN DBS have been broadly studied, and it appears that several subthalamic anatomic structures might participate in the therapeutic effect of STN DBS.

Patient

Our patient is a middle-aged man who has had severe right retro-orbital pulsating headache attacks since childhood. After the age of 20 the number of attacks spontaneously remitted to a few attacks a year.

Motor symptoms presented initially as right-sided unilateral upper limb bradykinesia, and PD was diagnosed in 2002. Both the PD symptoms and headache attacks worsened over time. Initially, medical treatment was effective for PD symptoms. The headache attacks proved more difficult to treat. The headache attacks were unilateral on the right side and retrobulbar. There was also lacrimation of the affected eye and sensitivity to smells, and the attacks were triggered, for example, by a change in weather conditions. Several medications were tried including triptans, topiramate, SSRIs, amitriptyline, pregabalin, verapamil, lithium, and indomethacin. The most effective treatment was oxygen therapy, but the CH attacks continued with headache typically 2 days per week with 1–2 attacks per day. The patient was hospitalized or treated in the emergency room for severe CH pain about 1–5 times a year.

PD gradually progressed despite optimal medical treatment. Finally, the patient was evaluated for STN DBS. Electrodes were implanted in Apr 2012 (Medtronic 3389, Activa PC). The location of active electrodes was verified by postoperative CT scan fused to preoperative MRI (Fig. 1). AC-PC coordinates in relation to the mid-commissural point of the active (negative) electrodes were as follows: right lateral 12.2, posterior 3.2, inferior 6.2; left lateral 10.0, posterior 3.5, inferior 3.5. Both objective clinical improvement and patient satisfaction were high with STN DBS therapy. In Feb 2013 the UPDRS III score was 18 (DBS on, medication off). Headache attacks stopped completely after commencing STN DBS. The patient underwent a change to a rechargeable internal pulse generator due to battery depletion, and the therapeutic effect continues to be good for both PD and Horton's headache. The patient experienced no psychiatric or behavioral side effects from STN DBS. All medications including oxygen for CH were discontinued after STN DBS, and the patient reported that he was completely satisfied with the treatment effect on CH. No hospitalizations appeared for CH after DBS. During the follow-up of 5 years, daily motor fluctuations were still alleviated, but the effect of STN DBS on PD symptoms faded slightly with the reappearance of right-sided tremor and dyskinesia and the appearance of axial symptoms probably due to the progression of PD. However, the patient had no CH.

Discussion

We report a unique case of coexisting advanced PD and CH with a positive result of STN DBS for both disorders. To our knowledge, there is no known etiopathogenetic association of PD and CH. PET studies have shown activation of the posterior hypothalamus in CH, and hence it has been the target for DBS treatment in CH and other severe hemicranial headaches [3]. It has also been reported that STN DBS has several autonomic effects [4–6].

The posterior hypothalamus is relatively near to the STN, and both targets are in the immediate vicinity of the nucleus ruber. The border between the medial STN and the hypothalamus is anatomically obscure, and an animal study has shown similar connectivity of the medial STN and hypothalamus to the prefrontal cortex via the hyperdirect pathway [7]. The anatomical proximity of the medial STN and hypothalamus, their similar connectivity via the hyperdirect pathway, and the autonomic effects of STN DBS could explain symptom relief for both PD and CH. The effect of DBS on PD motor symptoms decreased 1 year after stimulation, suggesting a possibility of a suboptimal placement of the DBS electrode medially to the optimal target. This suggests that the effect on CH symptoms might be mediated by the limbic STN which is linked to hypothalamic areas.

Statement of Ethics

The patient gave informed consent for publication of the data. The authors confirm that the approval of an institutional review board was not required for this work.

Disclosure Statement

No specific funding was received for this work. The authors declare that there are no conflicts of interest relevant to this work.

Financial disclosures for the previous 12 months: Dr. Huotari has nothing to disclose for the past 12 months outside the submitted work. Dr. Reich has been a member of the advisory board of Medtronic. He has received grant support and honoraria for speaking from Medtronic and Boston Scientific, outside the submitted work. Dr. Volkmann reports grants and personal fees from Boston Scientific and Medtronic during the conduct of the study, as well as personal fees from Allergan, Merz, UCB, AbbVie, TEVA, Zambon, and Bial outside the submitted work. Dr. Pekkonen reports consulting fees from Nordic Infucare, AbbVie, and Herantis, lecture fees from Abbot, Abbvie, Medtronic, and Orion, and travel support from Abbvie, Abbot, Boston Scientific, Herantis, and Medtronic. He has acted as a consulting neurologist for the Finnish Patient Insurance Center outside the submitted work.

Author Contributions

A.H. was involved in the conception, organization, and execution of the research project: patient data, figures, and writing (first draft, review, and critique). M.R. conducted the execution analysis of electrode location and was involved in the writing (review and critique). J.V. participated in the writing (review and critique). E.P. was responsible for the original re-

search idea and was involved in the conception and organization of the research project and in the writing (review and critique).

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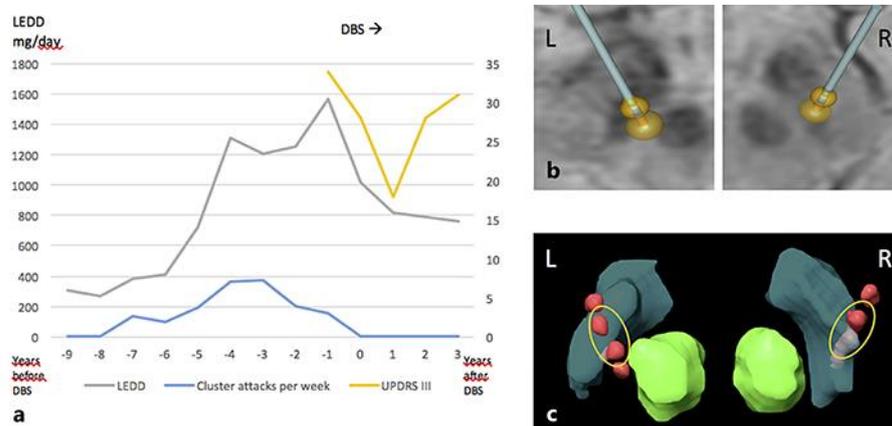


Fig. 1. **a** Average cluster headache attacks per week, levodopa equivalent dose (LEDD) in milligrams, and UPDRS III score before and during STN DBS treatment. **b** Stimulation parameters. Active electrodes were bipolar at both sides (right $-1/2+$, left $+9/10-$, pulse width $60 \mu\text{s}$, 180 Hz, right amplitude 4.7 V, left amplitude 5.7 V). Stimulation with 130 Hz elicited dystonic muscle contractions with no effect on tremor. The use of monopolar contacts caused dysarthria (Medtronic Optivise™). **c** 3D view of electrodes (red), subthalamic nucleus (dark green), and nucleus ruber (bright green). Active electrodes are depicted by orange ellipsoids.