February 2015

Temporary Resolution of Parkinsonian Tremor Resulting from a Periprocedural Intracranial Hemorrhage

Anna Molinari
Vanderbilt University Medical Center, anna.l.molinari@vanderbilt.edu

Amanda Currie
Vanderbilt University Medical Center, amanda.currie@vanderbilt.edu

Maxim Turchan
Vanderbilt University Medical Center, maxim.turchan@vanderbilt.edu

Walter Sidwell
Vanderbilt University Medical Center, Wsidwell@samford.edu

Chris Kao MD
Vanderbilt University School of Medicine, chris.kao@vanderbilt.edu

See next page for additional authors

Follow this and additional works at: http://ejournal.tnmed.org/home
Part of the Medical Education Commons, and the Neurology Commons

Recommended Citation
Molinari, Anna; Currie, Amanda; Turchan, Maxim; Sidwell, Walter; Kao, Chris MD; Riebau, Derek A. MD; and Charles, David MD (2015) "Temporary Resolution of Parkinsonian Tremor Resulting from a Periprocedural Intracranial Hemorrhage," Tennessee Medicine E-Journal: Vol. 1: Iss. 2, Article 1.
Available at: http://ejournal.tnmed.org/home/vol1/iss2/1

This Article is brought to you for free and open access by Tennessee Medicine e-Journal. It has been accepted for inclusion in Tennessee Medicine E-Journal by an authorized administrator of Tennessee Medicine e-Journal.
Temporary Resolution of Parkinsonian Tremor Resulting from a Periprocedural Intracranial Hemorrhage

Authors
Anna Molinari, Amanda Currie, Maxim Turchan, Walter Sidwell, Chris Kao MD, Derek A. Riebau MD, and David Charles MD

This article is available in Tennessee Medicine E-Journal: http://ejournal.tnmed.org/home/vol1/iss2/1
Temporary Resolution of Parkinsonian Tremor Resulting from a Periprocedural Intracranial Hemorrhage

Running title: Resolution of Parkinsonian Tremor Following ICH

Anna L. Molinari, B.A., Amanda D. Currie, Maxim Turchan, Walter V. Sidwell, Chris Kao, M.D., Ph.D., Derek A. Riebau, M.D., David Charles, M.D.*

*Department of Neurology, Vanderbilt University Medical Center, Nashville, TN USA
bDepartment of Neurosurgery, Vanderbilt University Medical Center, Nashville, TN USA

Corresponding Author:
David Charles, MD
(Phone) 615-936-2025
(Email) david.charles@vanderbilt.edu

Keywords: Parkinson’s disease, deep brain stimulation, subthalamic nucleus, intracranial hemorrhage

Abstract
We present the case of a 55-year-old male with Parkinson’s disease who underwent staged DBS surgery. After placement of the electrodes in the left brain, the patient exhibited altered mental status that terminated the procedure and prevented placement of electrodes in the right brain. CT and MRI scans showed a small intracranial hemorrhage in the left dorsolateral STN. The patient recovered with no permanent adverse effects and was successfully implanted one month later. However, the patient reported substantial reduction in his right-sided tremor following the ICH. The stimulator in the left brain was thus left off for approximately one year.

Introduction
Deep brain stimulation (DBS) of the subthalamic nucleus (STN) was approved by the Food and Drug Administration for advanced Parkinson’s disease (PD) in 2002. Although DBS is a relatively safe procedure, it is nonetheless an invasive and complex neurosurgical procedure. Approximately 12.8% of patients experience adverse events, including infection, intracerebral hemorrhage (ICH), lead misplacement, and lead malfunction [1, 2]. ICH, although relatively uncommon, is one of the most serious surgical risks of DBS and can cause permanent and potentially devastating neurologic impairment and even death [1, 3]. To our knowledge, there have been no reports of hemorrhagic strokes occurring during DBS surgery that have produced symptomatic benefit without lasting neurological impairment.

Case Description
A 55-year-old right-handed male with a five-year history of idiopathic PD presented to the movement disorders clinic complaining of worsening symptoms and progressive disability. The patient’s PD initially manifested as a right positional tremor and progressed to bradykinesia, rigidity, and a slow, shuffling gait. History was also significant for anemia and hyperlipidemia, both of which were well managed medically, and a past episode of Bell’s Palsy. Family history was significant for a hand tremor of undiagnosed etiology in his maternal grandfather.
Upon examination, the patient exhibited bilateral resting tremor of the upper extremities of moderate intensity and low amplitude (R>L), moderate rigidity in the left lower extremity, and mild bradykinesia that interfered with activities of daily living. Initiation of levodopa therapy resulted in severe dyskinesias and frequent motor fluctuations that necessitated early retirement. He was maximally medically managed on a medication regimen consisting of entacapone 200 mg, carbidopa/levodopa 25/100 mg and pergolide 0.1 mg, all seven times daily by mouth. Although he responded to levodopa, the patient’s average duration of response was only 60 to 90 minutes. Bilateral STN DBS was recommended and the patient elected to undergo surgery. Pre-operative neuropsychological testing and a complete history and physical revealed no mental, emotional, or other medical contraindications to DBS.

STN DBS was performed in three stages under standard protocol used at Vanderbilt University Medical Center, which is described in Kahn et al., 2012 [4]. Bone markers were placed under general anesthesia in Stage I. One week later, the patient presented awake and off medication (> 24 hours) for Stage II, which involved placement of electrodes in the STN using microelectrode recording (MER). Electrode implantation in the left STN revealed no immediate adverse effects. Tremor, rigidity, and bradykinesia were all substantially reduced with stimulation under an acceptable threshold for adverse events. Final coordinates of the anterior and posterior commissure coordinates in the left brain based on the midcommissural point (MCP) of the DBS lead, between contacts 1 and 2, were: anterior -1.48 mm, lateral +11.31 mm, and vertical -2.18 mm. Figure 1 shows STN neuronal activity from -0.8 mm above to 2.0 mm below the intended target along the trajectory in the left brain. Continuous neuronal firing was observed, and the lead was accurately placed based on the activity and the final position. Contacts 1 and 2 covered the dorsal portion of the STN, contact 3 covered the zona incerta, and contact 0 covered the ventral portion of the STN.

Stimulation was moved to the electrodes in the right brain, at which time the patient exhibited confusion, disorientation, and visual hallucinations that interfered with mapping of the STN and adverse effect monitoring. Stimulation was ceased, and the patient’s symptoms slowly improved but repeat stimulation again induced altered mental status. The neurologist and neurosurgeon, therefore, elected to abort the case and removed the electrode from the right brain.

A postoperative non-contrast CT scan revealed evidence of a small ICH approximately 0.60 cm in diameter around the distal lead in the left STN (Figure 2). The patient was admitted overnight and discharged the next morning with normal mental status and a stable CT scan. A CT scan performed one week later showed complete resolution of the hemorrhage, and the patient did not demonstrate any lingering adverse effects or permanent neurological deficits. Furthermore, the patient noted excellent relief of his right-sided tremor and rigidity following the Stage II procedure while the stimulator was still off.

To allow time for resolution of the hemorrhage, a second Stage II procedure to implant electrodes in the right brain was completed one month later without complication. CT and T1 weighted MRI scans showed no evidence of ICH or other complications. Final coordinates of the anterior and posterior commissure coordinates in the right brain using the MCP of the DBS lead were: anterior -1.48 mm, lateral +11.31 mm, and vertical -2.18 mm. The Stage III procedure, implantation of the pulse generator, was performed one week later without incident.

Four weeks after Stage III, the patient presented off medication > 12 hours for programming and lead interrogation. He again reported substantial reduction in his right-sided tremor with the device still in the off state. The right lead was interrogated in a standardized monopolar fashion, and contact zero was determined to be the optimal contact. The optimal setting for maximum clinical benefit and an acceptable threshold for adverse events was 0.8 V,
130 Hz, and 60 μs. The optimal contact for stimulation in the left brain could not be located, and the stimulator on that side was left in the off state.

The patient was seen in follow-up at four, six, and ten months after implantation. Stimulator settings in the right brain were optimized at each visit, but the stimulator in the left brain was left off because of the sustained reduction in right-sided symptoms. Twelve months after implantation, the patient noted the gradual reappearance of his right-sided tremor. At this time, the left DBS device was turned on with good response and symptomatic relief.

Discussion
We present the case of a patient with advanced PD who suffered a perioperative focal ICH in the left STN while undergoing DBS surgery. To our knowledge, this is the first report of improvement in parkinsonian symptoms unaccompanied by adverse effects following a perioperative ICH during STN DBS surgery. Based on the postoperative MRI, the ICH likely occurred in the dorsolateral STN, resulting in a functional lesion that interfered with the indirect motor pathway, thereby suppressing STN activity and yielding contralateral symptomatic benefit lasting one year. The hemorrhage likely occurred after MER recording, as bleeding would have induced neuronal toxicity and inhibited firing. It is possible that the MER caused the ICH as MER has been reported to increase the risk of cerebral hemorrhage [5]. The area affected by the hemorrhage was small and confined to the STN, which likely explains the absence of new neurological deficits and the reappearance of the tremor after one year.

Figure Legends

Figure 1. STN neuronal activity from -0.8 mm above to 2 mm below the intended target of the MCP along the trajectory.
Figure 2. CT scan (A) and MRI (B) performed after ICH. Evidence of ICH is visible in the left STN.

Acknowledgements
We would like to thank Dr. James Mykytenko for his editorial support during the preparation of this manuscript.

Financial Support
This case report received no financial support.

Authorship Statement
Dr. David Charles and Dr. Chris Kao directly participated in the acquisition of data for this case report. Ms. Anna L. Molinari and Ms. Amanda D. Currie prepared the manuscript draft with important intellectual input and revision from Mr. Maxim Turchan, Mr. Walter V. Sidwell, Dr. Chris Kao, Dr. Derek Riebau, and Dr. David Charles. All authors participated in the interpretation of data and critical revision of the manuscript and approve of the final manuscript. Dr. David Charles will serve as corresponding author and agrees to communicate with all other authors.

Disclosures
Vanderbilt University has received income in excess of $10,000 from grants or contracts with Medtronic, Allergan, Ipsen, Merz, and UCB for educational or research programs led by Dr. Charles. Dr. Charles receives income in excess of $10,000 from Medtronic, Allergan, Ipsen, and the Alliance for Patient Access for education and consulting services. Dr. Kao receives partial salary support from Sentient Medical Services. Ms. Molinari, Ms. Currie, Mr. Turchan, Mr. Sidwell, and Dr. Riebau have no conflicts to disclose.

References:

