



Clinical Study

Postoperative delirium in Parkinson's disease patients following deep brain stimulation surgery



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ABSTRACT

Deep brain stimulation (DBS) surgery is an effective treatment for patients with advanced Parkinson's disease. Delirium in hospitalized Parkinson's disease patients is common and often leads to prolonged hospital stays. This study reports on the incidence and etiology of postoperative delirium following DBS surgery. Patients (n = 59) with advanced Parkinson's disease underwent bilateral (n = 56) or unilateral (n = 3) DBS electrode implant surgery, followed 1 week later with surgical placement of DBS generators. The development of delirium during either hospital stay was evaluated retrospectively from the hospital chart. Potential causes of delirium were evaluated, including history of delirium, opiate equivalents, medication administration delays and missed doses during hospitalization, and Parkinson's disease duration. Delirium following implantation of DBS electrodes was common (22% of patients). It was less commonly associated with generator placement (10%). A history of delirium, age, and disease duration were positive predictors of delirium. Opiate equivalent doses were negatively correlated with delirium. Missed Parkinson's medication doses (53% of patients) and delayed administration (81% of patients) were common, and had a slight relation with delirium. Delirium was not related to complexity of medication regimen or use of dementia medications. Despite the presence of delirium most patients still only required a single night in the hospital post-surgery (67%). Prolonged hospital stay was due not only to delirium but also severe off states and other medical issues. Recognition and expectant management of delirium is best accomplished in a multidisciplinary setting, including the patient's family and nursing, pharmacy and neurological surgery staff.

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1. Introduction

Delirium occurs frequently in hospitalized patients with Parkinson's disease [1,2]. In a more general sense, postoperative delirium (POD) is a common challenge facing hospital providers and families in the elderly population [3,4], and perhaps even more so following surgical treatment of Parkinson's disease with deep brain stimulation (DBS). POD has been studied following hip surgery and cardiac surgery [5–8], and has been shown to not only lead to prolonged hospital stays in these circumstances, but is also a predictor of mortality [3]. Effective treatments for POD can include the use of antipsychotic medications such as haloperidol and geriatric provider consultation [7], but few strategies have proven successful at reducing hospital stay [8].

Management of delirium in hospitalized Parkinson's disease patients is more complicated than the otherwise neurologically healthy patient [2]. Parkinson's disease patients frequently have mild cognitive dysfunction and complicated psychoactive medication regimens. Notably, the common treatment of delirium with antidopaminergic medications can have severe anti-parkinsonian implications.

The causes of POD in Parkinson's disease patients are not clearly understood. One potential cause of delirium could be their complex medication regimens, in both the number of Parkinson's disease medications and the critical timing of administration [9,10]. Complicated medication regimens can lead to errors in Parkinson's disease medicine administration, which may increase the duration and frequency of off states, result in poor mobilization, and cause prolonged hospital stay [11,12]. In fact, it has been reported that patients with Parkinson's disease stay an average of 3.5 days longer when admitted to hospital for medical or other

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surgical reasons when compared to those without Parkinson's disease [12]. A leading cause of prolonged stay in this population is drug-induced psychosis [2].

Surgical treatment of Parkinson's disease with DBS is an effective and now common treatment modality [13]. These patients have moderate to advanced Parkinson's disease typically with motor fluctuations, drug induced dyskinesia, and postural and gait disorders. Patients with Parkinson's disease dementia or concomitant Alzheimer's disease are generally considered poor candidates for this surgical treatment. Many surgical candidates, however, have mild cognitive dysfunction and "sundowning" – evening confusion and mild delirium. This delirium has been anecdotally observed during hospitalization after surgery. Thus, the aims of this study were to (1) measure the incidence of delirium in patients undergoing DBS surgery to treat their Parkinson's disease and (2) determine what factors may contribute to POD. Included in this study was an evaluation of inpatient medication administration accuracy, and medically documented causes of prolonged hospital stay.

2. Methods

This retrospective study was approved by the Institutional Review Board – Spokane in Spokane, WA, USA. Consecutive surgical patients (n = 59) receiving DBS for advanced idiopathic Parkinson's disease from one of two neurosurgeons at the same medical center over a 2 year period were included in the study. Patients included in the study had preoperative MRI to rule out stroke, as well as neuropsychological testing to rule out Parkinson's disease dementia.

2.1. Surgery

Patients underwent two surgeries in this study. In the first surgery, patients underwent stereotactic implantation of DBS electrode(s) (3389, Medtronic Sofamor Danek, Memphis, TN, USA) in the subthalamic nucleus (STN). In the second surgery, the DBS generator and extension lead were placed. In the first surgery patients had a stereotactic halo placed with minimal sedation. They then underwent a CT scan. The electrode trajectory was planned to avoid the ventricular system through an angled approach. The patients were comfortably positioned in the operating room. They then underwent conscious sedation using propofol. During this time the burr hole was drilled. For the remainder of the surgery the patients were awake without the use of anesthetics. The DBS target was confirmed with microelectrode mapping, and macrostimulation survey of the DBS contacts. The typical duration of the surgery was 3 hours. The patients were monitored in the recovery room for up to an hour, and then admitted to the neurosurgery and neurology hospital ward.

The second surgery was conducted 1 week later. Patients were living independently between the first and second surgery. The second surgery was performed under general anesthesia, typically lasting 1.5 hours. During this surgery the DBS generator (Medtronic Sofamor Danek) was implanted in the subclavicular region and the extension wires were tunneled through the neck and connected to the DBS electrode. Patients were monitored in the recovery room for up to an hour, and then admitted overnight to the neurosurgery and neurology hospital ward.

Nursing care on the ward included standard frequent neurological checks, evaluation for signs and symptoms of delirium, as well as interventions to prevent delirium such as prompting the patient to the day of the week, date, and location, which were also written on a marker board directly visible to patients.

2.2. Medication administration

The home medications were entered into the electronic pharmacy record system either via a phone call to the family a day or two prior to surgery, or during admission to the presurgical unit. This medication reconciliation form was printed on paper, and was the basis for ordering home medications following surgery. Parkinson's disease medications were held on the morning of the first surgery, but typically not on the morning of the second surgery.

Administration of medication was typically supplied through the hospital pharmacy, but on occasion the patient took medications from their home supply due to lack of availability due to formulary limitations. Bar coded medication administration data was utilized to note the time of dosing during inpatient stays.

2.3. Data collection and analysis

A retrospective chart review was conducted. The hospital chart daily clinical notes were reviewed as were anesthesia records. Electronically recorded nurse assessments were additionally reviewed. Taken collectively, the surgeon made a blinded retrospective determination of the presence or absence of delirium during the hospitalization. Delirium was broadly defined as the occurrence of any event of hallucinations, delusions, or disorientation to circumstance, even if apparently benign. Formalized testing with delirium scales was not done, so this retrospective chart review used this broader definition. The electronic pharmacy record was reviewed in detail to extract the planned and actual administration timing of all Parkinson's disease medications. L-dopa equivalents were calculated for each patient. Total opioid equivalents were calculated. Hospital stay was defined by the number of midnights spent in the hospital. Statistical analysis was conducted in the Statistical Package for the Social Sciences version 18 (SPSS, Chicago, IL, USA) as well as Excel 2011 (Microsoft, Redmond, WA, USA).

3. Results

All patients underwent either unilateral (n = 3) or simultaneous bilateral (n = 56) STN DBS electrode implantation. One week later they all underwent a second surgery with implantation of DBS generator and extension leads. Patients were hospitalized for at least one night per surgery. Patients had advanced Parkinson's disease with an average disease duration of 10 years (\pm standard deviation of 4.5) and an average age of 65 years (\pm standard deviation of 8.7). There were no cases of intracranial hemorrhage based on review of postoperative MRI taken 3 to 5 days following the first surgery. Electrodes were placed in the STN through an extra-ventricular approach traversing from a frontal location anterior to the coronal suture, and through the internal capsule. None of these patients required surgical revision due to a misplaced electrode.

3.1. Length of stay

Following the DBS electrode implantation surgery, 67% of patients (n = 39) were discharged home the next day. The remaining patients had prolonged hospital stay of 2 days (n = 15), 3 days (n = 1) and 4 days (n = 3) (Fig. 1). Prolonged stay was frequently due to Parkinson's disease related issues including uncontrolled delirium (n = 7, 12%) or severe off state (n = 5, 8%). Other reasons for prolonged stay included medical conditions such as hypertension, pneumonia, or nausea (n = 5) and transportation issues (n = 2).

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