

Chapter 24

Surgery for Parkinson's Disease: Integration of Neurology and Neurosurgery

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INTRODUCTION

The development of chronic deep brain stimulation (DBS) has significantly improved the lives of patients with mid-stage Parkinson's disease (PD) suffering from complications of medical therapy. Outcome from DBS is determined by three factors: proper patient selection, accurate lead placement into the intended brain target, and careful postoperative device programming in conjunction with management of antiparkinsonian medications. For best results, patient selection and postoperative management must be done in conjunction with a neurologist specializing in the treatment of movement disorders. This article will review the current state of the art in DBS for PD, the role of the neurologist in care of the PD patient undergoing surgery, and current barriers to better integration of neurosurgical and neurological care.

DBS FOR PD: CURRENT STATE OF THE ART

The theoretical basis for ablation or chronic electrical stimulation of the basal ganglia in the therapy of PD was presented in a seminal publication by DeLong et al. in 1990 (1). They showed that experimental parkinsonism in nonhuman primates is associated with excessive and abnormally patterned spontaneous single-cell discharge in the subthalamic nucleus (STN) and globus pallidus internus (Gpi) in comparison with the normal state. Interruption of this abnormal activity resulted in a major reduction in parkinsonian motor signs. This discovery led to the first use of STN-DBS for PD in 1993 (5), and the first use of Gpi-DBS for PD in 1994 (7). Although the exact cellular mechanism has not been elucidated, DBS is thought to exert its effect by altering abnormal basal ganglia output, allowing motor controlling cortical areas to function more normally.

Motor function in PD is measured via standard rating scales whose inter-rater reliability has been validated. The most common is the unified PD rating scale (UPDRS) (4). Bilateral STN- or GPI-DBS for PD is consistently associated with 40 to 65% improvements in the UPDRS motor subscore in the unmedicated state, at follow-up times up to 5 years (2, 3). DBS usually reduces medication requirements, although most patients still require anti-PD medications for optimal motor function. The effect of DBS therapy on the continued progression of PD has not been studied in detail, but in a 5-year follow-up study, patients did show progression of their baseline (stimulation off) PD motor signs (3). Thus, at this time, DBS should be considered a symptom-suppressing, rather than a neuroprotective, therapy. Its primary impact on the therapy of PD is in the midstage patient (Stage 3–4 on the Hoehn and Yahr scale, off medication) who has developed complications of medical therapy.

There is presently no Class I evidence to favor the choice of STN versus GPI as the target for DBS in PD, although nonrandomized comparisons have suggested a slightly greater benefit from STN-DBS (2). A large multicenter randomized, double-blinded trial of STN versus GPI DBS is underway in the United States.

ROLE OF THE NEUROLOGIST IN THE MOVEMENT DISORDERS SURGERY TEAM

Optimal outcomes from DBS in PD require the involvement of specialized neurologists at several important steps in this therapy: patient selection and postoperative management of programming parameters in conjunction with changes in antiparkinsonian medications.

Patient Selection

Criteria for patient selection for DBS in PD are summarized in Table 29.1. An accurate diagnosis of idiopathic PD, rather than one of the many other neurological disorders that have similar signs and symptoms but different pathophysiology (atypical parkinsonism), is critical for success. The diagnosis of PD is based on clinical features rather than laboratory tests. The accuracy of diagnosis when made by a movement disorders neurologist is only 80%, and considerably less when made by nonspecialists.

Because DBS is a symptom-suppressing therapy rather than a neuroprotective therapy, the use of DBS can only be justified in patients who have developed disability despite optimal medical management. The major classes of antiparkinsonian medications are dopamine precursors (levodopa in conjunction with carbidopa, sold as sinemet), dopamine agonists, anticholinergics, monoamine oxidase (MAO) inhibitors, and catechol-O-methyl-transferase (COMT) inhibitors. Many PD patients take most or all of these medications every few hours. Surgical treatment is considered when patients develop significant adverse effects of medical therapy at dosages and schedules necessary for suppression of parkinsonian signs. The most common adverse effects are drug-induced dyskinesias, drug-induced motor fluctuations, and the tendency to cycle between an effectively medicated state and an effectively unmedicated state despite very frequent medication dosing.

Another important step in patient selection is careful documentation of the patients' motor improvement with a supratherapeutic dose of sinemet (levodopa/carbidopa), because this predicts the degree of improvement with DBS surgery. This improvement should be quantified using the UPDRS. Because of the complexity of accurate diagnosis and determination of optimal medical treatment, and because of the need for quantitative documentation of response to sinemet by formal neurological examination, the determination of surgical candidacy should be made in conjunction with a movement disorders neurologist who has received specific training in the indications for surgical therapy.

Postoperative Programming and Medical Management

Even when placed perfectly in the motor territory of the relevant nucleus, DBS will not provide benefit unless the devices are properly programmed. This involves selection of best contact configuration in a multicontact array, and setting of the pulse width, frequency, and voltage. Programming is complicated by the fact that not all signs and symptoms respond immediately to DBS, but may require minutes or hours before the full effect is manifested. Thus, a programming session may necessitate considerable office time, and return visits for reassessment. Each programming visit entails readjustment of the patient's schedule of antiparkinsonian medications. In a study of postoperative programming visits based on a survey of high-volume DBS centers, patients had a mean of 5.8 visits for stimulator and medication adjustments in the first 6 months after DBS (6). Neurosurgeons who attempt to provide this level of care on their own will find it extraordinarily time consuming.

In our practice at the University of California, San Francisco, we have had an opportunity to measure the impact of detailed neurological involvement on the care of DBS surgery patients. In the initial 5 years of our DBS program, funding issues precluded the involvement of on-site neurologists in the clinical care of most patients, although neurologists did assess outcomes using the UPDRS. The degree of improvement in the motor subscale of the UPDRS with DBS, in the off medication state for this period was 40 to 45% (8). In the subsequent year, when grant support allowed detailed screening and postoperative management by movement disorders neurologists, the improvement in the UPDRS improved to 60 to 65% (PA Starr, unpublished data).

BARRIERS TO INTEGRATED CARE

As of 2004, in the United States, there are major financial barriers to the better integration of expert neurological care into movement disorders surgery. Because of the significant time requirements and poor reimbursement by third party payers, neurological care of the DBS patient is very difficult to support with clinical revenue alone. In developing a viable program for surgical treatment of movement disorders, other funding mechanisms must be implemented. These may include grant support, philanthropic support, or subsidizing the neurologist by neurosurgical income. Integrated neurological and neurosurgical care is best delivered when neurologists and neurosurgeons who provide this service are administratively united into a single "service line" operating from a single budget.

CONCLUSIONS

Extraordinary advances in the surgical treatment of PD have occurred in the past 10 years and many more may be expected in the next 10 years. DBS in PD offers a highly effective symptomatic treatment for patients with mid-stage disease who are optimally medicated, but who have begun to experience the complications of medical therapy. Best results from DBS require proper patient selection, accurate electrode placement, and careful postoperative programming in concert with the complex adjustments in medication schedules that programming entails. Although accurate electrode placement is primarily the surgeon's responsibility, patient selection and postoperative management are complex endeavors that use skills practiced by expert movement disorders neurologists. For the neurologist in the United States at this time, the economics of healthcare are such that involvement in movement disorders surgery requires funding that is not dependent on clinical revenue.

Finally, there remain many clinically relevant questions in the treatment of PD by DBS, including choice of brain target, best methods of programming, and assessment for potential neuroprotective effects at various stages in disease progression. For maximum rigor and objectivity, outcomes studies that address these questions should be performed in concert with movement disorders neurologists.

References

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