Deep Brain Stimulation in Ireland for Parkinson's disease and Essential Tremor

Abstract:

Deep brain stimulation (DBS) is highly effective neurosurgery for idiopathic Parkinson's disease (IPD), essential tremor (ET) and primary dystonia. DBS involves stereotactic surgical implantation of a battery-operated stimulator into deep brain nuclei. IPD patients are referred abroad for DBS and have to travel repeatedly for pre and post-operative care resulting in stress, anxiety and hardship. Safe and post-operative care of these complex, ageing patients is compromised by the absence of a DBS service in Ireland. Moreover, both DBS surgery and the subsequent post-operative care abroad incurs substantial cost to the state. The Dublin Neurological Institute at the Mater Misericordiae University Hospital (DNI) is a non-profit institute for the care of patients with neurological disorders. We developed, in collaboration with the Mater Private Hospital (MPH) and the Walton Centre, Liverpool, a DBS programme in 2008/2009. We performed DBS at the Mater Campus on three carefully selected patients from a cohort of movement disorder patients attending the DNI and continue to provide pre-operative assessment and post operative care for patients following DBS in Ireland and abroad.

Methods

In 2006, we started a collaborative effort between the DNI, the MPH and the Walton Centre Liverpool to develop DBS in Ireland. A DNI multidisciplinary DBS clinic was set up for assessment of patient suitability for surgery. The multidisciplinary team (MDT) consisted of a consultant neurologist (TL), a DBS trained Irish consultant neurosurgeon (GQ), with a support from the functional neurosurgery unit at the Walton Centre, a senior neurologist (GF), the DBS clinical nurse specialist (DSC), a senior speech and language therapist (RPL), a specialist senior neuro-physiotherapist (EH), a consultant radiologist (EK), and a national expert in MRI imaging (PG). We were assisted by specialists in neural engineering and implanted devices (RR) and information technology (PK, SK).

Patients had Unified Parkinson's Disease Rating scales (UPDRS), ET tremor rating scales (ETTRS) and Hoehn & Yahr scales (HY) and standardised video recordings performed as baseline. Selected patients underwent MRI under general anaesthetic (WPB) to identify the target area. The long scan times (70-80 Minutes) necessitated patient sedation. Axial and coronal spine echo sequences were obtained for planning. CT images were also obtained. CT and MR images were used to guide DBS electrode placement. Patients underwent specialist neurophysiological assessment (GF) to assess cognitive, behavioural and emotional functioning to rule out contra-indications to surgery e.g. dementia or significant mood or behavioural disturbances. Three carefully selected patients (2 IPD, 1 ET) from those attending the Parkinson's disease and Other Movement Disorders clinic and the DBS clinic at the DNI were deemed suitable for DBS. Each patient was fitted with a Medtronics deep brain stimulator at the MPH. More complex patients attending these clinics were referred abroad for DBS during this time period.

Patient 1

A 60 year-old man developed a coarse pill-rolling left hand tremor in 2004 followed by ipsilateral bradykinesia, hypomimia, cogwheel rigidity, slow gait and stooped posture. He was diagnosed with tremor-predominant IPD and started on biperiden and amantadine without benefit. Pramipexole resulted in minimal improvement in tremor but also leg swelling. He later developed a coarse resting tremor of his right hand, making it difficult to perform fine motor tasks. The tremor partially responded to levodopa (Sinemet Plus 250mg/100mg three times daily) and pridocilidine 2.5mg three times daily. Following assessment at the DBS clinic, bilateral STN electrodes were inserted with no complications. He had a remarkable improvement in his right hand tremor and a definite, but less pronounced, improvement in his left arm and leg tremor. He was able to drink from a cup with improved quality of life. Slowness improved and he remains much improved 27 months post DBS surgery.

Patient 2

A former miner developed early-onset IPD at age 48. He initially responded to Levodopa therapy (500mg daily) but developed debilitating dyskinesia at higher doses (625mg daily). He could no longer play golf. Following assessment, bilateral STN electrodes were inserted resulting in significant (50-60%) improvement in symptoms and quality of life. He could get out of a chair without difficulty, walking improved and he resumed golf. Medication requirements were substantially reduced, from 625mg Levodopa daily to 150mg daily. However, following DBS, he developed hypophonia (soft voice) and tachyphonia (rushed speech). Stimulator settings were altered without improvement in his hypophonia. At 24 months post DBS he still reports a 50-60% improvement in his motor symptoms.

Patient 3

A 66 year-old man presented in 2006 with slowly progressive alcohol-responsive postural and intention tremor over 20 years and was diagnosed with ET. By 2008, his tremor was severely disabling. He required a straw to drink and needed assistance with dressing. He complained of social embarrassment. The tremor did not improve with myostat 250mg twice daily, sinemet plus 25mg/100mg three times daily or propanolol 40mg twice daily. He was deemed suitable for DBS and bilateral thalamic electrodes were inserted. Before DBS his handwriting and spiral drawings were markedly abnormal (see Figure 1) and he was unable to pour water. DBS resulted in a marked improvement in his tremor (see Figure 1). On the first post-operative day he held and read a newspaper for the first time in years. He ate peas, buttoned his shirt and cut his meal. He spilled a small amount of water when pouring. One year post DBS placement, he re-presented with recurrence of tremor and a feeling like electric shocks down his left arm due to DBS lead breakage. The shocks stopped once the DBS was switched off but his tremor reemerged. As the mater campus DBS service was on hold due to budgetary constraints, the patient was referred to the Walton Centre for DBS repair, which was performed 9 months later using the HSE Overseas Treatment Scheme. In the interim, he was again disabled by his severe ET. He reports a significant improvement in his quality of life, activities of daily living and self-esteem post DBS.
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Discussion

Safe and effective DBS can be performed in Ireland on carefully selected patients. All our patients had significant improvements in symptoms and quality of life with a decrease in medication requirements. In IPD the subthalamic nucleus (STN) and globus pallidus internus (GPi) are the main targets resulting in reduction of bradykinesia, rigidity and dyskinesias. STN stimulation results in improvement in UPDRS scores of 50% maintained for over 5 years and typically allows for a reduction in levodopa dose. Dyskinesias improve up to 94% after 12 months. In selected patients, there is now Class-I evidence that STN stimulation is more effective than best medical therapy for the treatment of IPD. ET responds well to DBS of the ventral intermediate nucleus of the thalamus (VIM). It is indicated for patients disabled despite best medical therapy. DBS results in an average improvement of 50-80% in tremor and considerable improvement in quality of life with rare, intracranial haematomata. Target specific complications depend on the target site. With STN stimulation, dysarthria, dizziness, depression and diplopia are the main complications.

In our series, patient 3’s DBS lead broke. This complication occurs in roughly 4% of cases and typically delays treatment of our patients lead because of funding issues for the Irish DBS service. Patient 2 developed hypophonia post DBS which occurs in approximately 4% of patients. Despite the potential side effects, there is no increased mortality in IPD patients who have undergone DBS compared to those on medication alone. Current patients who travel abroad for DBS surgery are funded by the HSE overseas treatment fund at a cost of approximately 40,000 euro per patient if DBS is performed. It is difficult to get exact figures but approximately 151 Irish patients were referred abroad for DBS surgery between 2003-2008. DBS, although necessitating a substantial initial investment, is self-financing within 2-2.5 years, through reduced medication costs and reduced healthcare utilisation.

There is a compelling argument for the development of a full DBS service in Ireland for patients with IPD, ET and dystonia. DBS is effective, relatively safe, cost-effective and there is an increasing demand from an ageing Irish population with complex pre and post-op issues. Our ageing population means that many future candidates for DBS may be physically unable to travel abroad for DBS. The pre and post-operative care of patients undergoing DBS is complex and requires a specialised multi-disciplinary team. Having the surgery and the postoperative care carried out in different countries poses multiple problems in terms of continuity of care and risk management. Finally, there now exists in Ireland a substantial resource in the form of a specialist multidisciplinary DBS team at the DNI which has proven expertise for the operation of a safe, efficient and successful DBS programme.

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