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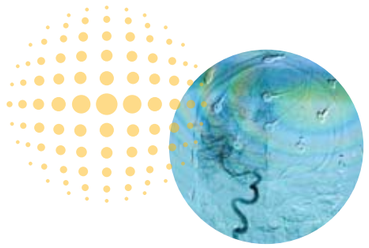

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ABOUT UH NEUROLOGICAL INSTITUTE

University Hospitals Neurological Institute is Northeast Ohio's first designated institute for the comprehensive care of patients with diseases affecting the nervous system. It has fourteen Centers of Expertise that bring together some of the country's foremost experts in neurology, neurosurgery, neuropsychiatry neuroradiology, neuro-oncology, neuro-ophthalmology, neurotology, neuropathology, neuro-psychology and related specialties. Under the direction of Warren Selman, MD, chairman of the Department of Neurological Surgery, and co-director Anthony Furlan, MD, chairman of the Department of Neurology, the Neurological Institute at University Hospitals offers the latest in innovative technology for the diagnosis and treatment of all neurological conditions and diseases.

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Neurological Institute

EFFECTIVE SURGICAL THERAPY IS NOW AVAILABLE FOR THREE COMMON MOVEMENT DISORDERS:
ESSENTIAL TREMOR | PARKINSON'S DISEASE | DYSTONIA

Surgical Management of Movement Disorders

In 1997, the FDA approved the use of high-frequency deep brain stimulation (DBS) of the thalamus for tremor related to Parkinson's disease (PD) and essential tremor (ET). In 2002, approval was extended to include stimulation of the internal globus pallidus (GPi) and subthalamic nucleus (STN) for PD. In 2003, DBS was approved for the management of certain types of dystonia. At University Hospitals Neurological Institute, we perform deep brain stimulation implants on a regular basis for patients with Parkinson's disease, essential tremor, and dystonia.

MOVEMENT DISORDERS TEAM

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ROLES FOR DEEP BRAIN STIMULATION — NOW AND FUTURE

Currently, DBS is in use for PD, ET, and certain patients with dystonia. The number of patients with these diseases who are good candidates for DBS still exceeds the number of patients who undergo the procedure.

Investigational uses at the University Hospitals Neurological Institute.

Future use in psychiatric disorders and other movement disorders.

SURGICAL MANAGEMENT OF MOVEMENT DISORDERS

PATIENT SELECTION & TREATMENT GOALS

PARKINSON'S DISEASE

Necessary Criteria:

- Confirmed diagnosis of PD, with levodopa responsiveness
- Optimized medical management, employing (as appropriate) carbidopa-levodopa, dopamine agonists, COMT inhibitors, amantadine, MAO inhibitors and anticholinergic medication.

Realistic Goals:

- Fewer fluctuations with increased "ON" time
- Improved tremor control (even if medication-refractory)
- Reduced bradykinesia (slowness)
- Reduced dyskinesia
- Possible reduction in medication

Unrealistic Goals:

- Improved freezing that is unresponsive to medications
- Improved balance
- Improved memory
- Improved swallowing or bladder function
- Improved speech/hypophonia

ESSENTIAL TREMOR

Necessary Criteria:

- Attempts to manage medically have proven unsatisfactory
- Patient must be functionally disabled by tremor

Realistic Goals:

- Reduction in contralateral arm tremor
- Improved function of contralateral arm

Unrealistic Goals:

- Reduction in head or voice tremor (may improve in some patients, particularly if bilateral surgery is performed, but is not consistent)

DYSTONIA

- Idiopathic focal (e.g., cervical), or primary generalized dystonia (e.g., DYT1)
- Must have developed substantial limitation to quality of life
- Attempts to manage medically (e.g., with botulinum toxin for focal dystonia or oral medications for generalized dystonia) have proven unsatisfactory
- Goals: reduction of involuntary movements and postures
- Often takes several months to achieve maximum results.

Regardless of Diagnosis

Necessary Criteria:

- No severe cognitive impairment
- Mood disorders if present are optimally managed
- Limited co-morbidity (neurologic and systemic illnesses)
- Medically able to undergo prolonged surgical procedure
- Able to attend follow-up stimulator adjustments
- Adequate social support
- Realistic expectations on part of patient and family

Pre-Op Evaluation:

- Consultation with a movement disorders neurologist and neurosurgeon
- On/Off Testing for Parkinson's disease patients
- Neuropsychological evaluation
- High resolution MRI scanning for target planning

SURGICAL PLANNING & PERFORMANCE

TARGET

- Unilateral or bilateral thalamic (Vim) DBS – for essential tremor
- Unilateral or bilateral GPi or STN DBS for PD or Dystonia

LESION VS. CHRONIC STIMULATOR IMPLANT

- Lesions are effective and less expensive than DBS, but are irreversible. Missed targets or too large a lesion may lead to permanent neurologic deficits.
- DBS allows postoperative fine-tuning of stimulation parameters. If revision is necessary, the electrode may be withdrawn and replaced with minimal, if any, permanent sequelae. If new therapies are developed in the future, DBS produces no lesions which might hinder efficacy of the new therapy.

UNILATERAL OR BILATERAL

- The greatest effect of unilateral DBS is benefit of symptoms contralaterally, however, some benefit is achieved ipsilaterally.
- Parkinson's disease is typically an asymmetric disease
- Some patients with clearly asymmetric symptoms may need only unilateral implantation; some patients with bilateral essential tremor choose to have only one side treated.
- Patients with advanced PD with significant bilateral symptoms may require bilateral surgery to achieve satisfactory results.
- Risks and benefits of unilateral vs. bilateral surgery should be individually assessed.

SURGICAL PROCEDURES

- Stereotactic frame and identification of target coordinates.
- Electrophysiologic recording using a microelectrode wire (as thin as a hair) is used to evaluate activity of individual neurons and identify their location within deep brain regions. This is a critical step that allows correction of errors in anatomically defined coordinates and fine-tuning of the targeting.
- Placement of the 4-contact permanent stimulator electrode, with test stimulation to identify adverse effects (such as stimulation induced muscle contractions) and possible benefit (such as tremor reduction).
- The electrodes are usually implanted on one day; the pulse generators are usually placed a week later.
- The patient is generally awake during lead implantation and under general anesthesia for insertion of pulse generators.

POSTOPERATIVE MANAGEMENT

- After recovering from surgery (usually 3–4 weeks after lead implantation), pulse generators are activated. Stimulus parameters (contacts, polarity, voltage, pulse width, repeat rate) are adjusted in a systematic fashion by the advanced practice nurse.
- Medication regimens are simplified with a reduction in total medication after a stable benefit is achieved with DBS
- The best "ON" state (with stimulator on) is expected to be about the same as the best "ON" state prior to stimulator placement (even with a lower postoperative medication dose). The real advantages of DBS are that the worst "OFF" state is usually significantly better with the stimulators on than prior to the operation, and that there are decreased fluctuations between on and off, resulting in increased daily "ON" time.
- For PD, expect 3–6 visits for adjusting stimulators over 6–8 weeks.
- For ET, expect fewer stimulator adjustments.
- For dystonia, expect benefits to develop slowly but progressively over approximately 3–6 months with adjustments made every 1–2 months with higher energy use and shorter battery life.

COLLABORATIVE EFFORT

PRIMARY NEUROLOGIST

- Long-term relationship with patient; medical management
- Identification of suitable candidate
- Patient returns to primary neurologist after this treatment process

TERTIARY CARE MOVEMENT DISORDERS NEUROLOGIST

- Identification or confirmation of suitable candidate
- Intraoperative monitoring
- Postoperative stimulator and medication adjustment

NEUROSURGEON

- Confirmation of suitable candidate
- Performance of the surgical procedure
- Postoperative surgical management

ADVANCED PRACTICE NURSE

- Postoperative stimulator and medication adjustment
- Patient and family education
- Phone resource

NEUROPSYCHOLOGIST

- Preoperative and postoperative evaluation
- Identification of suitable or high-risk candidate

COMPLICATIONS

- Intracerebral hemorrhage is rare but may lead to permanent disability or even more rarely death.
- Hardware infections are treated with antibiotics but when unresolved may necessitate removal and eventual replacement of the DBS system.
- Cognitive complications may occur but are more common in those with more significant preoperative cognitive deficits. Different surgical approaches may be recommended in patients with higher risk.
- Hardware breakdown can occur, necessitating replacement of the broken component(s). Batteries have a limited lifetime and require replacement every 2–5 years with typical settings.