Palladotomy and Pallidal Deep Brain Stimulation

Parkinson's disease

Parkinson's Disease is a common neurodegenerative disorder that affects about 1:100 individuals over the age of 60. In a small percentage of the population it may be seen before the age of 40.

The etiology of Parkinson's Disease is not known. However, it is know that it is due to a loss of dopamine producing neurons in the substantia nigra, located in the brain stem. Dopamine is an important neurotransmitter required in the production of movement. The degenerative changes in the substantia nigra are thought to begin many years prior to the onset of symptoms. When symptoms do appear it is estimated that 80% of the dopamine producing neurons have been lost.

The Classic Signs of Parkinson's Disease

- Tremor at rest (in arms and legs)
- Bradykinesia (slowness of movement)
  - micrographia (hand writing has become smaller)
  - a masked appearance (or loss of facial expression)
  - general slowing of normal movement (walking, turning, hand movement)
- Cogwheel rigidity (resistance to passive movement, determined by the physician)
- Gait abnormalities (abnormalities related to walking)
  - stooped posture
  - decreased arm swing
  - small shuffling steps
- Unstable posture (tendency to lose balance)

The diagnosis is always made by a physician's clinical assessment. A CT Scan or an MRI may be done to rule out other conditions.

Surgical Considerations

Parkinson's Disease is a slowly progressive condition and, after 5-10 years of medical treatment, the medications will generally not be as effective as they once were. People may experience abnormal involuntary movements, referred to as dyskinesia, a side effect of the medication. It is for this type of person that pallidotomy or pallidal stimulation would be considered.

Neurosurgery for the control of abnormal involuntary movements (dyskinesia) should not be considered unless every attempt has been made to improve the patient's condition with the use of medication. The decision to have surgery should be taken seriously as there is an element of risk. As well, there are certain criteria which must be met before a person can be considered for surgery.

Pallidotomy or Pallidal Stimulation are two surgical options available to those for whom dyskinesia is the most disabling symptom.

The History of Pallidotomy

The basal ganglia, structures deep in the center of the brain, have long been known for control of movement. In Parkinson's disease the globus pallidus, one of the structures in the basal ganglia, is indirectly affected as a result of the loss of the neurotransmitter, dopamine. The globus pallidus becomes overactive producing too much of an inhibitory effect, which in turn makes extra movements for people with Parkinson's disease.

The globus pallidus had been studied and small lesions made in it in the early 1950's by Dr. Spiegel and associates. However, the techniques for finding the exact location were not well developed and the results were questionable. In 1985-1990 Dr. Laitinen of Sweden re-evaluated, and in 1992, published the results of pallidotomies done previously. He found some positive outcomes and then decided to revive the operation using new techniques.
Neurosurgeons now have much improved techniques for brain scanning (CT and MRI), stereotatic head frames, and electrophysiology, to assist in locating the precise target.

Pallidotomy

Pallidotomy is a stereotatic surgical procedure in which a small hole is made in the skull on the opposite side of the affected limbs. A tiny micro-recording electrode is guided down into the target area of the globus pallidus. When the target area has been identified a tiny lesion (destruction of cells) is made. The dyskinesias, which are a side effect of medications, are relieved on the opposite limbs and occasionally on the same side as well. Because the patient's cooperation and assistance is needed during the surgery the patient must be awake throughout the procedure. This treatment is not reversible, nor is it a cure for the underlying condition, however it can significantly improve the patient's quality of life. It is also important to note that it may take up to 3 months to determine the final outcome of the surgery.

Pallidal Deep Brain Stimulation (DBS)

Deep brain stimulation (DBS) is a technique using the same stereotactic procedure as for pallidotomy. The difference is that a small lead (a very thin insulated wire electrode) is implanted into the globus pallidus instead of lesioning the area. The lead is connected to an impulse generator (battery) by way of a small wire. The impulse generator delivers an electrical impulse which stimulates the globus pallidus helping to decrease or eliminate the dsykesisia. It is, therefore, somewhat like a cardiac pacemaker.

This is a two part surgery with the implantation of the lead being the first part of the surgical procedure followed by connection and implantation of the lead extention and the battery a few days later. The patient must be awake during the implantation of the lead as the surgeon requires the patients assistance and cooperation. If all goes well the

patient will return to the operating room on the second day to have the lead extension and the battery implanted under a general anaesthetic. The stimulator lead is tested during surgery and again prior to implanting the battery. With this system the patient can turn the stimulator on or off using a special magnet or controller. The amount of stimulation needed to supress the dyskinesia may need to be adjusted by our nurse-clinician. These adjustments will require visits back to the Movement Disorders Clinic. Initially these adjustments may need to be done frequently (every 1-2 weeks) until the proper settings are determined.

The Risks due to Surgery

All surgery carries some element of risk. For surgery, the risks of complication are low but may include any of the following:

- 1:200 (0.5%) chance of death due to hemorrhage
- 2 to 3 % chance of a major complication such as a stroke, hemorrhage/bleeding
- 10% chance of permanent numbness, weakness, speech and/or swallowing problems, drooped face, bladder urgency or frequency, or difficulty with concentration and memory
- 40% chance of mild, transient occurrences of the above side effects
- Small chance of seizures or infection
- Transient confusion
- Headache

Initially, periodic adjustments in programming the stimulator will be needed. During this adjustment period some people may experience the following side effects:

- Transitory, but mild changes in sensation in a limb or a small area on the face
- Occasional transient dizziness or feeling of being lightheaded

Risks due to the Implanted Stimulator

The overall risk of any these hardware-related complications (all of which are treatable but may require repeat surgery) over 4 years is 20%, meaning about 5% per year.

- Infection / rejection / breakage of hardware
- Malfunction of hardware

The stimulator requires a battery which will last 2-4 years, and replacement will require a minor surgery. It is expected that within the next few years a re-chargeable battery will be developed.

Preparation for Surgery

A decision to consider surgical treatment is made during doctor-patient discussions on management of the condition. The patient is then referred to the neurological/neurosurgical team in the Movement Disorders Program. The patient is assessed by Dr. Kraft, Dr. Kiss, and Karen RN or Pia RN to determine whether the patient will meet the criteria for surgery. If the criteria is met and the patient is agreeable to proceed, a number of baseline assessments are arranged and the patient is

booked for surgery. The baseline assessments may include: a CT Scan or an MRI of the brain, neuropsychological testing, and a video taping session along with some additional testing and counseling by the nurse coordinator. The nurse will review the planned surgical procedure with the patient and family members, providing an opportunity to ask any questions they may have.

In Hospital

The patient will be admitted to hospital early in the morning the day of surgery. After admission the patient will go to a day unit and from there will be taken to the MRI department in radiology where they will be fitted with a very special frame which will be secured to the head. An MRI will be done with the frame on to obtain the necessary coordinates to be used for calculations during surgery.

The patient will then be taken to the operating room where the procedure will take place. It is very difficult to determine exactly how long the surgery will take. Relatives will need to wait patiently for news from the operating room or recovery room. One of the nurses from the Movement Disorder Clinic will keep the relatives informed as to the progress of the surgery. If the surgical procedure is a pallidotomy and there are no complications the patient will be discharged the next day. If a DBS is implanted the patient will stay in hospital until he returns to the operating room within a few days to complete the second part of the procedure.

After surgery Dr. Kiss will either meet with the family or call to discuss the surgery. It may take from one to several hours before relatives can visit with the patient after surgery.

The patient will return to the Movement Disorder Clinic one week after discharge to see the nurse-clinician for suture removal and incision check. The nurse-clinician will keep in touch by telephone to make an appointment in about 1 month for programming.

The Cost

In Canada, the surgical procedures and any support services are covered by the health plans of all provinces. If you are not a resident of Canada, contact the administrator of your health insurance plan to ask if you are eligible for coverage.

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