

DEEP BRAIN STIMULATION AND PARKINSON'S DISEASE

There are a number of medical conditions where symptoms in the body occur because of an abnormal activity of the brain. Epilepsy is the most obvious example – abnormal bursting electrical activity in a small area of the brain causes seizures in a patient. If that abnormal area of the brain is deliberately destroyed by a neurosurgeon, then the seizures stop, and the patient's life can be improved. The difficulty for the surgeon arises in predicting if that area of the brain can be destroyed without hurting the patient. In many cases, it can.

Deep Brain Stimulation (DBS) is a new way of “turning off”, or neuromodulating, a small area of the brain. It involves placing a small platinum electrode or wire into the abnormal area of the brain. Instead of destroying the area, high frequency electrical stimulation is used to “turn it off”. The electrode is connected by a subcutaneous wire to a pacemaker that sits under the skin, usually in the chest. When electrical pulses are produced by the pacemaker and sent to the tip of the electrode, the brain cells in the region of the electrode are “turned off”.

The pacemaker can be adjusted to maximize the benefits (turning off the malfunctioning area), and minimize the side effects (turning off adjacent important areas). That is the greatest strength of DBS – it can be adjusted to maximally benefit an individual patient and if there are unwanted side effects, it can be turned down.

Patients with Parkinson's disease (PD) have areas of their brain that are overactive, and a DBS electrode can be placed in those areas to correct the brain activity. This may be a confusing concept for some, because everyone has been told that Parkinson's disease is due to a loss of the dopamine brain cell. Loss of this cell can result in overactivity (or underactivity) depending on whether the dopamine cell was working as a stimulating or inhibiting cell.

When should one consider DBS?

DBS surgery is reserved for those patients who are having unacceptable side effects from their medications, and is covered by insurance. If you are doing well on your medications, don't have surgery.

What makes someone a good candidate for DBS?

DBS is performed on those for whom the following motor symptoms do not respond to optimal medications:

- Motor fluctuations
- Dyskinesia, or
- Tremor

What is the wait time for DBS in British Columbia?

There are two waiting lists. The first (W1) is the time from when your neurologist puts in a referral for surgery, until the time of your neurological appointment. W1 is approximately 2-3 years. The second (W2) is the time from deciding you want surgery, to the day of surgery. W2 is approaching 2 years.

What are the benefits of DBS?

The benefits of DBS are directly related to the surgical target. Targeting the thalamus will reduce tremor approximately 80-100%. Targeting the pallidum will reduce dyskinesia approximately 80-100%. Targeting the subthalamic nucleus will reduce motor fluctuations. The details are best reviewed with your neurosurgeon, and, of course, vary from patient to patient.

Does DBS improve non-motor symptoms?

DBS does not improve the non-motor symptoms of PD. These include, but are not limited to, dementia, depression, loss of smell, constipation, bladder dysfunction, imbalance (this is complicated, and can be improved in some), impulse control (also complicated, and potentially improved), and REM sleep disorders.

What are the potential complications of DBS?

The rare but devastating complications are stroke or death. The most common complication is infection, though this is easy to treat with antibiotics. There can be temporary stimulation-induced side effects that can be corrected by adjusting the stimulation. These side effects can include personality and behaviour changes. As a result, operations are only done on patients who have a reliable carepartner to accompany them to the clinic after surgery, and report any changes in personality, because the patient themselves may not be aware of the changes.

Do the benefits of DBS last forever?

The electrodes in the brain stay forever. The pacemaker does eventually run out of power, and needs to be changed approximately every 3 years (2-7 year range). The effects of DBS continue forever, but new symptoms may develop that are not controlled by the DBS. For example, if a patient develops dementia years after their DBS surgery, the device will not be able to help this. The patient's quality of life will then deteriorate because of the new dementia, not because the DBS stopped working.

Post-surgery, will follow-up appointments happen on a regular basis, and can the patient control the device themselves?

During surgery, the DBS is implanted but left turned off. Patients then return to the DBS Clinic to have the device turned on after six weeks. Initially, there are weekly appointments to find the best settings. Safe limits are set, within which the patient or carepartner can adjust the stimulation. Later, follow-ups are scheduled every 6-12 months to see how the patient is doing, and to plan for battery replacements as needed.

Who is a poor candidate for DBS?

1. Those with a diagnosis of an atypical parkinsonian syndrome (e.g. progressive supranuclear palsy, multiple system atrophy, dementia with Lewy bodies, corticobasal degeneration, or vascular parkinsonism). These people are often referred for DBS because of poor response to medical therapies, but unfortunately, typically do not respond well to the surgery.
2. People with PD whose primary goals are to improve speech, respiratory and pharyngeal control, postural instability (history of falling), and freezing. Several long-term studies have shown that these dopaminergic-resistant symptoms continue to progress despite changes in stimulation parameters and improvement of other motor symptoms, such as tremor, rigidity, and bradykinesia.
3. People with more than mild cognitive dysfunction, active psychiatric disease, dementia, or significant cognitive impairment. This is mostly due to reports of cognition in PD worsening irreversibly after DBS surgery in patients with pre-existing cognitive impairment. Most centres use detailed neuropsychological testing to screen for dementia.

—

Source: Dr. Christopher Honey, Associate Professor of Neurosurgery at the University of British Columbia, and Board Member at the World Society of Stereotactic & Functional Neurosurgery and the Canadian Neuromodulation Society. Currently, Dr. Honey is the only neurosurgeon in BC qualified to perform DBS.