DEEP BRAIN STIMULATION

Deep brain stimulation or commonly called as DBS surgery is a therapeutic option for management of certain movement disorders to improve quality of living when medications adjustment alone fails to do so. DBS is not a cure and can only provide symptomatic benefits.

What is DBS?

It is a treatment that involves surgery performed by a neurosurgeon to implant special thin insulated wires (also called electrodes or leads) into a very specific and carefully selected brain region. The lead is connected to a pacemaker-like device (also referred to as **battery**) that will be implanted in the chest region beneath the skin. After the lead is placed, the neurologist specialized in movement disorders management, adjust a variety of electrical parameters or settings to control the amount of stimulation provided. These adjustments are referred as "**programming**" allow the clinician to maximize the benefits and minimize the side effects of DBS system.

What are the indications to undergo DBS?

At present the three main indications for DBS surgeries are

1. Advanced Parkinson's disease (PD)
2. Essential tremor
3. Generalized dystonia

There are three main parts of the brain where the lead can be placed

1. Subthalamic nucleus for PD
2. Globus pallidus interna for PD and dystonia
3. Thalamus for tremor

DBS for patients with PD

DBS is considered in patients with advanced PD with significant medication related fluctuation ("ON" and "OFF" states) in their symptoms, having disabling medication related dyskinesia (abnormal dance like movements) and/or those with tremor not controlled by medications.

DBS therapy can benefit motor symptoms of PD which includes tremor (shaking), rigidity (stiffness), and bradykinesia (slowness). DBS can provide the best "ON" (state when medication effect is present) time that you experience with the medications for PD, a reduction in motor fluctuation with improved symptoms during "OFF" state, or reduction in medication induced dyskinesia.

DBS is not predicted to improve non-motor symptoms of PD such as memory and behavioural abnormalities, reduced smell, urinary disturbances, constipation, and sleep difficulties. DBS may not be helpful for those who do not experience any benefit from the medications. Only patients with PD can undergo DBS while DBS is not indicated for other types of parkinsonism such as PSP, MSA etc.

DBS for Essential tremor

DBS for essential tremor will help in significantly reducing the tremor severity thereby improving the quality of living of the patient. However, adequate trial with medications are important before considering DBS and the tremor should be severe enough to impact the quality of life significantly.

DBS for dystonia

DBS is usually considered only in generalized dystonia with no obvious cause (Idiopathic or primary generalized dystonia). Under special circumstances selected cases of genetic dystonia, generalized dystonia due to secondary causes, segmental and focal dystonia, but the degree of improvement may be lower. Adequate trial with medication and botulinum toxin therapy is warranted before considering DBS in dystonia and the dystonia should be severe enough to affect the quality of living.

How do I know if I am a candidate for DBS?

The movement disorder specialist will evaluate you and determine whether or not you are a candidate for this procedure. DBS is considered only when the diagnosis is certain, adequate trial of medications and other non-surgical therapies did not provide satisfactory improvement and the disease is severe enough to significantly affect the quality of living.

What is the usual process?

If the movement disorder specialist considers DBS as an option for you, you will be advised for admission for **pre-surgical evaluation** which may take a week. You will be examined in detail by a movement disorder neurologist to confirm the diagnosis, and estimate the severity and disability of the illness and to look for other comorbidities. Patients with PD will undergo "ON-OFF" assessment. You will be examined without medications and again after a prescribed dose of medication to document the medication effect, disability with and without medication and any medication related side effects. A movement disorder neurologist may videotape your examination with your consent during this evaluation for monitoring and documentation purposes.

Neurosurgeon specialised in DBS surgery will meet you and explain the surgical procedure, review potential risks of surgery and benefits, and evaluate your candidacy for surgery. Imaging of your brain will be done and reviewed for surgical planning and to be sure there are no brain changes that might prevent surgery. The patient will be assessed by neuropsychologist, speech pathologist, physiotherapist and psychiatrist and undergo investigations for pre surgical clearance and to document the extent of your illness. The movement disorder team will discuss regarding your candidacy for DBS and will be conveyed to you regarding the decision. You will also be counselled regarding the procedure, risks and benefits, and what to expect after surgeries. Once you are willing to go ahead with the DBS surgery, you will be given a date for DBS surgery and will be re-admitted around 3-5 days prior to the DBS surgery date.

What to expect during the DBS surgery?

The surgery usually takes several hours and is done in two stages. The first stage involves implanting the DBS leads into the brain and is usually done in awake state. The second stage is connecting these leads to the battery placed beneath the skin in the chest and is done under general anaesthesia. You will be advised to withhold medications on the day of surgery. A frame will be placed around your head and MRI will be done thereafter to plan the exact location and trajectory of the DBS lead. After the surgical planning, you will be taken to the operation theatre. A small hole is drilled in each side of the skull so the electrodes can be placed. Based on specialized equipment and based on the response to the stimulation, the correct location of the lead will be confirmed. Afterward, each of the two electrode wires is tunnelled through the skin and connected to the battery that is placed under the skin in the chest.

What happens after the procedure?

After the surgery, you will be admitted for 5-7 more days for observation and post-operative care. You may have improvement in your symptoms even before the DBS is switched on due to what is called as “lesioning effect”. However, this is temporary and will wear off in 1-2 weeks. DBS will be switched on by the movement disorder specialist once this temporary benefit wears of. Thereafter you will be expected to follow-up every 4-6 weeks for DBS programming based on the response and improvement till the optimal DBS setting and medication dose is determined. This process may take 4-6 months. Once this optimal balance is achieved, you need to follow-up every 3-6 months.

Is it safe?

In general, DBS is a safe procedure. However, there are potential serious side effects such as bleeding or stroke at the time of surgery. There are also potential side effects from the stimulation (that may be reduced by changing the stimulator settings.) Most side effects are mild and temporary, such as: Weight gain, difficulty finding words, decreased quality of speech and pacemakers or electrode infections. The treating movement disorder specialist will discuss regarding the side effects in detail with you during the pre-surgical evaluation.

What results may be expected?

In case of PD you can expect significant improvement in overall motor symptoms in the OFF state, reduction in medication induced dyskinesia in the ON state, reduced degree of ON-OFF motor fluctuation and overall reduction in tremor severity. Additionally, there can be reduction in medication dose in subthalamic nucleus DBS.

In case of dystonia, the severity of dystonia can be expected to come down by 50-70% depending on the underlying illness and the severity of the dystonia. There can be reduction in medication dose if DBS alone can provide significant improvement.

In case of essential tremor, the DBS therapy can significantly improve symptoms of essential tremor, usually superior to the best medical therapy. Typically tremor of hand improve better than head or voice tremor.

Please note that DBS will neither cure nor alter the natural progression of the underlying illness. You still have to continue taking medications albeit the dose may get reduced. Non-motor symptoms of PD is not expected to improve post DBS. Additionally except for reduction in tremor and dyskinesia, DBS in PD cannot improve beyond the best "ON" state.

What are the different types of DBS devices and battery implanted?

At present we use one of the following devices from the approved manufacturers.

1. Activa PC by Medtronic® which has non-rechargeable battery with estimated life expectancy of 3-5 years.
2. Activa RC by Medtronic® which has rechargeable battery with estimated life expectancy of 10-15 years.
3. Vercise™ by Boston Scientific® which has rechargeable battery with estimated life expectancy of 10-15 years.

The pros and cons of each device will be discussed by the movement disorder specialist. The final decision of which device to choose lies with the patient and the care giver. Once the battery life is completed, only the battery placed over the chest needs to be replaced by a new battery which is usually a minor surgery requiring 1-2 days admission. There is no need to replace the DBS lead inserted in the brain.