

Deep Brain Stimulation (DBS) in patients with Parkinson's disease (PD).

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PD-patients in advanced stage of the disease should be referred to a Movement Disorder Clinic where a comprehensive and unbiased evaluation can be made by a neurologist specialized in movement disorders with a vast experience of adjusting oral medication and in the use of deep brain stimulation (DBS), continuous subcutaneous administration of apomorphine and continuous intestinal administration of levodopa.

Background (references 3,4,5,8,9,11,13,15,17,19,20,21)

- Patients with Parkinson's disease, who no longer can be improved by optimizing the oral/transdermal medical treatment, have shown significant benefits from treatment with STN or GPi DBS (Deep Brain Stimulation). If troublesome tremor not responding to medical treatment is present, DBS-Vim (or DBS-Zi) can be an effective treatment option.
- DBS improves cardinal motor symptoms bradykinesia, rigidity, and tremor and reduces motor fluctuations
- DBS decreases use of medication and reduces levodopa-induced dyskinesia
- DBS increases quality of life
- There is a tendency to operate patients at an earlier time of disease than before

Criteria for referral to a specialized Movement Disorder Centre for possible device-aided treatment (references 11,15a,15b).

- Patients with levodopa responsive Parkinson's disease
- Preferably with a duration of Parkinson's disease > 5 years
- **Moderate to severe on-off motor fluctuations
- and/or
- **Moderate to severe dyskinesia
- and/or
- Medically refractory **moderate to severe tremor

- ** Defined as moderate to severe impact on quality of life
- *Patients with tremor-dominant PD can be treated with VIM DBS also >75 years of age

Exclusion criteria (references 1,2,6,7,10,16,18)

- Dementia
- Significant medically resistant psychiatric disease (e.g. severe depression)
- Significant medical conditions with limited life expectancy
- Conditions that prevent surgery or MRI

Patient eligible for DBS

Patient eligibility for DBS is determined at the Movement Disorder Centre after:

- Brain imaging
- Neuropsychological assessment of cognitive function and psychiatric symptoms
- Levodopa challenge test
- NB
 - Cardiac pacemaker is not a contraindication for DBS
 - It is not necessary for the patient to be awake during surgery
 - It is not always necessary to remove all hair

Expected outcome of DBS treatment (reference 14)

Expected outcome corresponds to the effect of an optimal levodopa dosage on the motor symptoms

- Significant reduction of on-off motor fluctuations
- Significant reduction of dyskinesia
- Tremor reduction
- Decreased use of medication depending on surgical target, see below
- Improved quality of life
- Levodopa unresponsive symptoms like
 - Axial symptoms e.g. postural instability
 - Freezing of gait
 - Dysarthria
 - will not improve

Surgery in Parkinson's disease

Target

- The subthalamic nucleus (STN) to treat the cardinal symptoms tremor, rigidity and hypokinesia and reduce motor fluctuations, substantial reduction of medication is usually obtained leading to significant reduction of dyskinesia
- The internal part of globus pallidus (GPi) is an alternative target to treat cardinal symptoms and especially dyskinesia, however, often results in much less or no reduction of medication
- The ventral intermediate nucleus of thalamus (VIM) or zona incerta (Zi) to treat tremor only
- The electrodes are implanted bilaterally and connected to a subcutaneous lead and impulse generator (IPG) localized beneath the clavicle
- Each electrode has several contacts and stimulation contact and parameters are adjusted by computer telemetry

Complications

- Surgical complications
 - Intracranial hemorrhage
 - Seizures
 - Deep Venous Thrombus
 - Pulmonary Embolism
- Hardware complications
 - Infections
 - Skin erosions
 - DBS lead-migration and fractures

Side effects (references 7,9,12)

- Worsening of dysarthria
- Sometimes worsening of gait and balance especially patients > 65 years of age
- Eyelid apraxia
- Dystonia
- Psychiatric symptoms (usually transient, treatable and potentially preventable)
 - Confusion
 - Psychosis
 - Depression
 - Increased risk of suicide
 - Mania
 - Apathy (can be permanent)
- Neuropsychological symptoms
 - Reduced verbal fluency (can be permanent)
 - Increased impulsivity (can be permanent)

Patient management and follow-up

- During the first 3-6 months frequent controls in the outpatient clinic to adjust stimulation parameters and medication to obtain maximum effect of stimulation
- Shared control (referral neurologist and DBS centre) of symptoms and disease development and stimulation effect
- Battery replacement every 3-4 years
- Rechargeable battery available, replacement after 15 years
- DBS is in general a contraindication for MRI. However MRI can be performed in most cases at the DBS centre if the MRI/neurostimulator guidelines elaborated by the manufacturer are followed
- Diathermy including shortwave diathermy, microwave diathermy or therapeutic ultrasound diathermy are contraindicated
- It is safe, however, to perform diagnostic ultrasound examination in a patient with DBS
- In case of surgery in patients with DBS monopolar electrocoagulation should be avoided. Bipolar is recommended.
- If a patient with DBS needs examination by ECG, EEG or EMG the DBS can be temporarily switched off during the procedure to avoid disturbance of the examination

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