Programming PD patients with Deep Brain Stimulation
First programming and early follow-up

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Contents

1) Pre- and intra-operative patient management
2) Immediate postoperative follow-up and complications
3) Introduction to programming and first programming
4) Early follow-up, medical treatment and DBS adjustments
5) Physiotherapy and patient education
Introduction

Objectives

1) Prevent adverse events due to surgical procedure
2) Stabilize patient’s clinical status before discharge
Pre-operative care

General care and medical treatment

- Dental care, treat anxiety and mood disorders, pain & sleep disorders
- Reduce Dopamine Agonist (DA) daily dose and stop rasagiline
- Apomorphine continuous SC infusion (severe OFF dystonia or non-motor OFF phase)
- Clozapine or Quetiapine may be useful to prevent psychosis for patients at risk
Intra-operative care

In the Operating Room

- No antiparkinsonian treatment for at least 12 hours (except apomorphine)
- Saline or glucose infusion, analgesia, prophylactic antibiotics
- Thromboembolism disease prevention (compressive stockings & mobilization)
- Physiotherapy
Immediate postoperative care

Back in the Neurosurgery ward

- Antiparkinsonian treatment to avoid withdrawal syndrome +++
- Saline or Glucose infusion or oral hydration
- Early mobilization +++
- Check blood pressure, pyrexia, neurological exam
Immediate postoperative care

Early Complications: 2 to 4% of DBS patients in the 1st postoperative month.

1) General complications
   - Dopaminergic treatment withdrawal syndrome, post-traumatic stress, psychosis
   - Pneumonia, venous thrombosis, pulmonary embolism

2) Local complications
   - Intracranial bleeding
   - Hardware-related infection

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Immediate postoperative care

Skin care

- Local care /2 days, stitches removal at D10-D12
Initial programming

When to start?

In the following days after lead implantation

OR

After parkinsonian signs recurrence if microlesional effect

In which conditions?

OFF MEDICATION to assess the antiparkinsonian effect of DBS (Vim, GPi and STN)

OFF or ON MEDICATION to assess DBS side effects

ON MEDICATION to assess the antidyskinetic effect of GPi DBS
Initial programming

If ready and before starting...

1) Check the impedances

   Electrical parameters: 3.0 V/210 μs/30 Hz (MEDTRONIC Inc, ACTIVA®)

   Unipolar range: 250-2000 Ω

<table>
<thead>
<tr>
<th></th>
<th>ACTIVA®</th>
</tr>
</thead>
<tbody>
<tr>
<td>Open circuit</td>
<td>R &gt; 3000 Ω, i &lt; 15 μA</td>
</tr>
<tr>
<td>Short circuit</td>
<td>R &lt; 50 Ω, i &gt; 1500 μA</td>
</tr>
</tbody>
</table>

Electrode Impedance

<table>
<thead>
<tr>
<th>Hemisphere</th>
<th>Leads</th>
<th>Model</th>
<th>Results (Ohms)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Left STN</td>
<td>3389</td>
<td>3389</td>
<td></td>
</tr>
<tr>
<td>Right STN</td>
<td>3389</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C &amp; 6</td>
<td>5752</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Initial programming

If ready and before starting...

2) Which lead is connected to which hemisphere (dual channel IPG)?

   Initial settings: 60 µs / 130 Hz, case +, most ventral contact - (for exemple 0-)

   Increase the voltage up to the first SE threshold and check its lateralization
Initial programming

How to proceed?

1) Electrical settings

   Monopolar mode (case as cathode +, each contact as anode -), 60 µs, 130 Hz
   Constant-Voltage or Constant-Current
   Increase by 0.5 V for each contact

2) Testing and contact choice

   Stop testing when you reach the threshold of permanent side effect
   The contact choice is based on the therapeutical window (clinical effect and SE)
Initial programming

What do you assess?

1) Antiparkinsonian effects

   Rigidity is the most reliable sign +++ (STN DBS)

   Improvement is immediate when you switch ON the stimulation
Initial programming

What do you assess?

1) Antiparkinsonian effects
   
   Tremor is not constant

   Improvement in tremor is the famous and most impressive effect of DBS
Initial programming

What do you assess?

1) Antiparkinsonian effects
   - Akinesia is more difficult to assess
   - Improvement may be delayed
Initial programming

What do you assess?

2) Dyskinesia

- GPi DBS improves dyskinesia
- STN DBS induce dyskinesia in the short term.
- The improvement in dyskinesia with STN DBS is associated with LEDD reduction
Initial programming

2) DBS side effects

Motor contraction reflects corticospinal diffusion. It may be difficult to distinguish this side effect from dyskinesia.

Use low frequency stimulation and high pulse width (ex: 3 Hz and 210 µs) to induce synchronous myoclonic jerks in case of corticospinal diffusion.
Initial programming

What do you assess?

2) DBS side effects

Vegetative side effects such as ipsilateral sweating may be observed during initial programming and less frequently in the mid and long-term follow-up.
Initial programming

2) DBS side effects

Conjugate eye deviation is associated with a right location of the electrode in the STN whereas monocular deviation reflects electrode misplacement.
Initial programming

2) DBS side effects

Acute behavioral changes are mainly described with STN DBS
Initial programming

Time course of DBS effects

<table>
<thead>
<tr>
<th>Symptom</th>
<th>Time to improvement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rigidity</td>
<td>Seconds</td>
</tr>
<tr>
<td>Bradykinesia/akinesia</td>
<td>Seconds-hours (days)</td>
</tr>
<tr>
<td>Tremor</td>
<td>Seconds-days (months)</td>
</tr>
<tr>
<td>OFF period dystonia</td>
<td>Seconds-minutes</td>
</tr>
<tr>
<td>DBS induced dyskinesia</td>
<td>Seconds-hours-days</td>
</tr>
<tr>
<td>Improvement in levodopa-induced dyskinesia</td>
<td>Days-months</td>
</tr>
</tbody>
</table>
Initial programming

Mapping of beneficial effects and side effects of STN and STN area stimulation

- Improvement of tremor, rigidity & dyskinesia
- Worsening of akinesia & freezing
- Tetanic contraction
- Dysarthria
- Improvement of: rigidity, bradykinesia & tremor
- Induction of dyskinesia
- Conjugate gaze deviation
- Impulsivity
- Mania
- Ataxia
- Dysarthria
- Heat sensation, homolateral sweating and mydriasis
- Double vision
# Initial programming

## STN, VIM or GPi DBS?

### Clinical effects of Vim, GPi and STN stimulation in Parkinson Disease

<table>
<thead>
<tr>
<th></th>
<th>STN</th>
<th>GPi</th>
<th>Thalamus</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tremor</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>short term</td>
<td>++</td>
<td>++</td>
<td>+++</td>
</tr>
<tr>
<td>long term</td>
<td>+++</td>
<td>++</td>
<td>++</td>
</tr>
<tr>
<td>Akinesia</td>
<td>+++</td>
<td>++</td>
<td>0/-</td>
</tr>
<tr>
<td>Rigidity</td>
<td>+++</td>
<td>++</td>
<td>+</td>
</tr>
<tr>
<td>Gait</td>
<td>+++</td>
<td>+/-</td>
<td>0/-</td>
</tr>
<tr>
<td>OFF Dystonia</td>
<td>+++</td>
<td>++</td>
<td>0/-</td>
</tr>
<tr>
<td>Levodopa-induced Dyskinesia</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>short term</td>
<td>++</td>
<td>+++</td>
<td>+/-</td>
</tr>
<tr>
<td>long term</td>
<td>+++</td>
<td>+++</td>
<td>+/-</td>
</tr>
<tr>
<td>Behavioral effects</td>
<td>+++</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Medical time consuming</td>
<td>high</td>
<td>moderate</td>
<td>moderate</td>
</tr>
<tr>
<td>Battery consumption</td>
<td>low</td>
<td>high</td>
<td>moderate</td>
</tr>
<tr>
<td>Antiparkinsonian drug reduction after DBS</td>
<td>+++</td>
<td>+/0</td>
<td>+/0</td>
</tr>
</tbody>
</table>

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Fraix, 2013
No acute stop in antiparkinsonian drugs.

Objectives:
- Improvement in motor and non motor fluctuations and dyskinesia
- To prevent DBS-induced dyskinesia or behavioral disorders
- To prevent signs of antiparkinsonian drugs withdrawal (RLS, apathy, sleepiness...)

Adjustments:
- Gradually reduce the daily dose of levodopa
- Progressively stop apomorphine pump
- Increase Dopamine agonist daily dose after initial preoperative reduction
- Progressively increase the voltage of DBS when parkinsonian signs re-occur
Physiotherapy

Objective

- Prevent pain and abnormal posture related to DBS system
Patient education

Rechargeable DBS systems
Patient education

Remote control
Patient education

Some advice before discharge....
Conclusion

Programming and management of DBS patients should be done by trained clinicians who know the technical aspects of DBS, who understand PD-related issues, and who are comfortable in pharmacological management.

Optimization of DBS parameters
- Is usually obtained within 3 to 6 months
- May require 4 to 5 programming sessions.