Management of Deep Brain Stimulation

VA PD Consortium Meeting
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Agenda

- Overview of Goals of DBS Programming
- Efficient Approach to DBS Programming
- Troubleshooting
Goal of DBS Programming

- Goal is to deliver the therapy to the brain target of interest, while minimizing stimulation of surrounding structures
  - Using the electrode closest to the desired target provides maximal benefit and minimizes stimulation-induced adverse effects
  - Setting appropriate stimulation parameters ensures that the desired brain target, but not adjacent structures, receives the stimulation
DBS: Targets

Vim Thalamus: Essential tremor & other tremor disorders

Subthalamic nucleus: Parkinson’s disease

Globus pallidus: Parkinson’s disease & dystonia
DBS Lead Electrode Selection

Unipolar

Bipolar
Stimulation Parameters

**Pulse Width**
(usec)
duration of each stimulus

**Amplitude**
(Volts)
intensity of stimulation

**Rate**
(Hertz)
number of pulses per second
Programming: The 6-Step Process

1. Ensure proper logistics & information on hand
2. Verify device function (impedance checks)
3. Check baseline exam
4. Screen each electrode & find the 1 or 2 best
5. Establish initial parameters
   (Repeat for other side)
6. Attend to final tasks
Step 1: Logistics & Info.

- Postpone programming until micro-lesion effect subsides, in about 2-4 weeks following surgery (although early programming can be performed)
- Schedule patient for morning visit if possible, with medications withheld overnight or longer
- Check surgical incisions to identify signs of infection
- Review operative details: lead type, post-op scan
- Review patient details: most troubling symptom(s)
Step 2: Verify Device Function

- Check unipolar electrode impedances to verify proper function
  - **Soletra**
    - Use default parameters on 8840
    - Open circuit if imp > 2000 Ω AND current drain < 12 μA
    - Short circuit if imp < 250 Ω AND current drain > 75 μA
  - **Kinetra**
    - Override parameters on 8840: use 4.0 V
    - Open circuit if imp > 4000 Ω AND current drain < 12 μA
    - Short circuit if imp < 250 Ω AND current drain > 75 μA

- If needed electrode(s) are malfunctioning, repair
Step 3: Check Baseline Exam

- You need to know what you’re starting with to determine when your programming has made an impact.
- **Tremor**: position & task that bring out tremor.
- **PD**: Check muscle tone for rigidity, evaluate motor speed (hand opening, foot tapping), look for tremor, evaluate rising from chair & gait, listen to speech.
- **Dystonia**: not that helpful, since improvements usually not noted during programming session.
Step 4: Screen Each Electrode

- **Goal:** Find the 1 or 2 electrodes that improve key symptoms
- Minimize variables: choose one rate (between 135-185 Hz) & one starting pulse width (60 µs for STN, 90 µs for Vim & Gpi)
- Perform voltage titration in unipolar mode for each electrode (0, 1, 2, & 3) one at a time
  - Increase voltage until stimulation-induced adverse effects occur
  - Note & record voltage at which persistent adverse effects occur
  - Reduce voltage just until adverse effects abate
  - Assess for efficacy on key contralateral signs/symptoms; record
- Based on screening process, return to electrode that produced most obvious beneficial effects
Step 4: continued

• If a single electrode does not produce optimal effect, try unipolar stimulation using **2 adjacent electrodes**

• If stimulation is not tolerated in unipolar mode, switch to bipolar mode using most effective single electrode from unipolar exploration as negative and one adjacent electrode as positive

• **Unipolar**
  - Spherical field
  - Provides robust effect
  - Useful for well-located lead

• **Bipolar**
  - More focused field
  - Less intense effect
  - Helpful in avoiding spread when lead close to other structures
Step 5: Establish Parameters

- **Goal:** identify parameters that provide benefit but produce no unacceptable adverse effects & maximize battery longevity

**Amplitude**
- The main parameter used to control the intensity of stimulation
- Increased amplitude results in increased spread of stimulation
- Avoid > 3.6 V with Soletra so as not to invoke doubler circuit

**Pulse width**
- Secondary parameter contributing to total charge density
- Increased pulse width accentuates effects of stimulation, since charge lingers in tissue longer and may activate additional elements

**Rate**
- The least important factor in controlling stimulation
- Rates between 135-185 Hz seem to exert similar clinical effects for movement disorders; exception may be dystonia, in which some have reported benefit at 60 Hz
The “U-Shaped” Response Curve
Step 6: Attend to Final Tasks

- Reset usage counter
- Re-interrogate to ensure IPG is ON
- Determine medication regimen
- Print current settings and post in medical chart
- Instruct patient to:
  - Use Patient Therapy Controller or Magnet
  - Track symptoms (consider diary)
  - Be alert for increased dyskinesias (with STN)
  - Be aware of device issues (refer to patient manual), e.g., diathermy
  - Read patient manual thoroughly
Follow-Up Programming

• **Review interim changes**
  – Symptom response → functional improvements
  – Medication changes
  – Adverse effects
• **Interrogate device(s)**
• **Assess where the stimulation parameters are within the therapeutic range**
• **Formulate & implement management plan**
  – Adjust stimulation
  – Adjust medication
  – Make no adjustments
Reasons Patients May Not Display Optimal Response

- **Sub-optimal**
  - Lead location
  - Programming parameters
  - Medication regimen
- **Device-related issues or malfunction**
- **Unresponsive disease**