DBS surgery: The role of the Speech-Language Pathologist and Physical Therapist

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DBS and Parkinson Disease

- Delivery of high frequency stimulation to the deep nuclei in the brain (basal ganglia)
- “Electric medication”
  - DBS manages the symptoms of PD
  - DBS manages the side effects of dopaminergic therapy
  - DBS does NOT cure PD
  - DBS does NOT slow down PD

[Diagram of brain showing the trajectory for DBS leads and various brain regions like Thalamus, Putamen, Substantia nigra, Red nucleus, Caudate nucleus, Globus pallidus (ext. segment), Globus pallidus (int. segment), Cerebral peduncle, Internal capsule, and Subthalamic nucleus.]
Parkinson’s Disease Treatment Continuum

Disease Severity

Mild

Bradykinesia
Rest tremor

Patient Symptoms

Moderate

Signs of levodopa “wearing-off”

Dyskinesia, “On-Off” Motor Fluctuations

Severe

Postural Instability, Freezing, Falls, Dementia

Treatment

MAOIs
Dopamine Agonists

Levodopa, COMT inhibitors, amantadine

DBS
How we assess where a patient lands on the risk/benefit continuum?

- **Neurologist**
  - Confirms diagnosis
  - Maximizes medication schedule

- **Neurosurgeon**: Evaluates from a surgical perspective

- **Speech Language Pathologist**
  - Evaluates swallowing and voice quality
  - Educates patient regarding potential impact on communication and swallowing

- **Physical Therapist**
  - Evaluates “off” and “on” medicine
  - Examines gait and balance: fall risk

- **Neuropsychologist**: Evaluates cognition, thinking, memory, mood
Target Selection: lessons from the VA cooperative trial

Subthalamic Nucleus (STN)
- Reduces tremor, rigidity, and bradykinesia
- Reduces dyskinesia and motor fluctuations
- Likely to be able to reduce dopaminergic medications
- Significant decrease in Processing speed index on Wechsler Adult Intelligence Scales*
- Significant worsening of depression as measured by Beck Depression inventory

Globus pallidus pars interna (GPi)
- Reduces tremor, rigidity, bradykinesia
- Reduces dyskinesia and motor fluctuations
- Less likely to be able to reduce dopaminergic medications

Follett et al NEJM 2010; 362: 2077-
Locating the target: Imaging

- The use of either an intraoperative CT or MRI to identify and confirm target location
- Frameless procedure – use of 5 fiducials
- Procedure can be done under general anesthesia; patient does not need to withhold anti-parkinsons meds
What are the effects of DBS on the other PD symptoms?

**Improved (appendicular)**
- Tremor
- Rigidity
- Bradykinesia
- Dyskinesias
- Off/On

**No Change (non-motor)**
- Constipation
- Sense of smell
- Mood
- Fatigue

**Worse (axial)**
- Walking and balance
- Speech and swallowing
- Cognition
Speech-Language Pathologist's Role in DBS
Role of the Speech-Language Pathologist

- Careful documentation of baseline speech function
  - Objective measures
  - Subjective measures

- Preoperative counseling
  - What does pt and family know about PD and available resources?
  - Many rural pts have no experience with rehab
  - Impact of DBS on communication and swallowing

- Speech measurements after programming

- Collaboration with neurology provider
  - Adjustments?
  - Two settings?
50% of DBS respondents were unaware that slurred speech was a possible side effect of DBS

Improved from 70% in 2008 study

-Wertheimer, Gottuso, Nuno, Walton, Duboille, Tuchman, & Ramig (2014)
67% of DBS participants felt their speech worsened due to DBS
52% reported that the decline following DBS was unexpected
Symptoms most frequently endorsed were: slurred speech, low volume, word-finding difficulties and swallowing problems

-Wertheimer, Gottuso, Nuno, Walton, Duboille, Tuchman, & Ramig (2014)
Patient perspective after DBS

Highlights

• DBS groups:
  – Speech problems were more severe
  – Felt they were less intelligible
  – Greater reduction in communicating with others
  – Socializing less often due to speech problems

Patient perspective after DBS

Highlights

- DBS participants reported more speech disturbances than non-DBS participants
  - Slurred speech
  - Festinating speech
  - Rapid speech
  - Difficulty initiating
  - Monotone speech
  - Stuttering

-Wertheimer, Gottuso, Nuno, Walton, Duboille, Tuchman, & Ramig (2014)
Patient perspective after DBS

Highlights

• The more advanced in disease process, the greater communication challenges

-Wertheimer, Gottuso, Nuno, Walton, Duboille, Tuchman, & Ramig (2014)
Stimulation induced dysarthria may change from hypokinetic to a mixed dysarthria

- Strained-hoarse VQ, excess loudness variations, monoloud, monopitch, reduced stress, imprecise artic, distorted vowels, insufficient breath support (Tripoliti et al 2008)

- Breathy and hypernasal voice quality, intermittently continuous voicing of a hyperfunctional character, and slowed lip, tongue, and jaw movements, leading to imprecise articulation (Tripoliti et al 2006)

- Dystonic contractions of the laryngeal and velar muscles may emerge during connected speech only. Tripoliti, et al (2006)
Review Article

Effect of Deep Brain Stimulation on Speech Performance in Parkinson’s Disease

Sabine Skodda

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STN: Subthalamic nucleus, GPI: Globus pallidus internus, cZI: Caudal zona incerta, R: Reference.
STN vs GPi

- Multi center studies

- Fewer adverse effects on speech and word fluency in GPi groups

- This is demonstrated clinically at OHSU

Swallowing Outcomes Following Unilateral STN vs. GPi Surgery: A Retrospective Analysis
Troche, Brandimore, Foote, Morishita, Chen, Hegland, and Okun (2014)

- No adverse effects on swallowing with unilateral GPi target
  - No change in PA scores from pre to post MBS

- Increased adverse effects on swallowing with unilateral STN target
  - Increased PA scores from pre to post MBS
Psychiatric and Cognitive Effects of DBS for PD
-Nassery, Palmese, Sarva, Groves, Miravite & Kopell (2016)

• Cognition is evaluated by the Neuropsychologist at OHSU
• Meta analysis including all DBS targets (PD, ET, dystonia)
  – Cognition improved in 31%, deteriorated in 12%, unchanged in 13%
• Executive Function (STN DBS)
  – Variable results from no change to impairment in decision making
  – 36% surgical pts w cog decline 1 year after surgery
  – Preop exec dysfunction is predictor for cog decline
• Verbal Fluency (STN DBS)
  – Most studies show decline
  – Less decline in unilateral vs bilateral STN DBS
• Memory
  – B STN: 50% non-verbal memory impairment at 2 yrs post op –
    20% higher than medically managed PD pts (Williams et al 2011)
• STN: greater bradyphrenia
• GPi: greater list learning deficits
• Cognitive outcomes may be better when surgery completed earlier in disease
What I do

- Evaluation
  - Perceptual speech and voice
  - Assessment of Intelligibility of Dysarthric Speech
  - DDK
  - Fundamental frequency
  - Intensity
  - Perturbation
  - Communicative Effectiveness Survey
  - Voice Handicap Index
  - Communication Participation Item Bank
  - Dysphagia screening questions – MBS as needed
Programming

• Get to know and work closely with your programmer
• Educate the pt regarding his/her role in programming
• Communicate with programmer regarding pt’s communicative demands and impact of DBS on communication
Allowing for speech disturbance

- Compromise: motor improvements at the cost of speech production

- Decrease in stimulation intensity below the threshold for stimulation-induced dysarthria and hypophonia may decrease motor improvements

- Optimal programming to minimize adverse effects on speech while maximizing motor improvement
PT implications on DBS
Role of the Physical Therapist with DBS

• Careful documentation of baseline gait and balance measures
  – Objective measures
  – Subjective measures

• Preoperative counseling
  – What does pt and family know about PD and available resources?
  – Impact of DBS on gait and balance
  – Many rural pts have no experience with rehab

• Balance/gait measurements after programming

• Collaboration with neurology provide
Pre-op and Post-op testing: OHSU protocol

• **Pre-op:** assist in determining if appropriate candidate/target site
• **Post-op:** assist in determining if settings/medications optimized
• **Testing procedure:**
  – UPDRS: determine motoric benefit ON/OFF
  – Dyskinesia Scale
  – Mini BEST: determine fall risk
  – Timed tests: TUG/dTUG/360 degree turn
  – Freezing of Gait Questionnaire
  – Falls in last 6 months
Programming

• Get to know and work closely with your programmer
• Educate the pt regarding his/her role in programming
• Communicate with programmer regarding
  – Patient’s communicative demands and impact of DBS on communication
  – Motor symptoms
  – Balance/Gait
DBS and pain

- Decrease in dystonia
- Decrease in dyskinesia
- Decrease in rigidity
- STN: may decrease pain perception and/or increase pain tolerance

Geroin Curr Neurol Neurosci Rep 2016
DBS and balance

• Postural sway when standing: **improved**
• In place postural responses: STN and GPi: **improved**
• Stepping responses to external perturbations
  • GPi: **no change**
  • STN: **decrease** in postural preparation → delay in stepping
• More severe falls STN vs GPi
• GPi: improved balance confidence (ABC scale)

Follett K N Engl J Med 2010
St George RJ Movement Disorders 2014
St George RJ J Neurophysiol 2015
DBS and FOG

- Recent meta-analysis
  - Improvement in FOG by STN-DBS in Med-OFF/Stim-ON condition (no improvement in Med-ON state)
  - Strongest predictor of improvement on gait was large change in UPDRS pre-op between ON/OFF
- Studies beginning to look at PPN (Pedunculopontine Nucleus): appears promising

Schlenstedt C et al Eur J Neurol 2017
DBS Targets
DBS PT restrictions

- Diathermy: contraindicated
- Ultrasound, TENS: do not use over leads
- Soft tissue and joint mobilization: precautions over leads
- MRIs: precaution/often contraindicated
  - *Implications on testing for painful conditions
- Activity: No restrictions
  - Wear helmets for skiing, riding bike, horseback riding, etc
DBS Overview

• Great for...
  – Motor fluctuations: Increase ON time/decrease OFF time
  – Decrease dyskinesias
  – Tremor
  – Rigidity

• Not Great for..
  – Talking
  – Walking: including balance and FOG
  – Thinking
  – Sleep
  – Sweating
  – Bowel/bladder
Summary: Role of Rehab on DBS

- Advocate for patient: identifying appropriate candidates
- Education of patient: understanding how speech and balance will be affected
- Evaluation of patient: objective and subjective testing to help determine candidacy
- Pre-hab vs post-DBS treatment
- Part of interdisciplinary team for ongoing management
Thank You