DEEP BRAIN STIMULATION IN THE TREATMENT OF DYSTONIA

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WHAT IS DEEP BRAIN STIMULATION?
WHAT CAN A NEUROSURGEON DO FOR PATIENTS WITH DYSTONIA?

“Functional Neurosurgery”

DYSFUNCTIONAL IS THE NEW FUNCTIONAL.

KEEP CALM
I AM (a functional) NEUROSURGEON
FUNCTIONAL NEUROSURGERY MODIFIES ABNORMAL ACTIVITY IN THE NERVOUS SYSTEM

• **OPTION 1:** Permanently disrupt dysfunctional areas (lesioning):
  • Cutting overactive nerves supplying the neck muscles to treat cervical dystonia (denervation)
  • Alcohol or heat to damage overactive parts of the brain (e.g., pallidotomy)

• **OPTION 2:** Take advantage of the brain’s electrical nature by using **electrical stimulation** to influence dysfunctional areas:
  • HOW?
DEEP BRAIN STIMULATION (DBS): PACEMAKERS FOR THE BRAIN

All the components are under the skin. There are no restrictions on your day-to-day activities.

1. Electrodes
2. Leads
3. Extension
4. Neurostimulator
5. Patient programmer

http://professional.medtronic.com
DEEP BRAIN STIMULATION (DBS): PACEMAKERS FOR THE BRAIN

DBS was invented in France in 1987

Has been widely used over the last 15 years (200,000 patients world-wide)

Most commonly used for Parkinson’s Disease and Tremor
MANY STIMULATION OPTIONS

- 4 key factors
  - Voltage/current
  - Pulse width
  - Frequency
  - Electrode configuration
    - Monopolar/bipolar

- Many options to modify the size and shape of the generated electrical field
  - Maximize stimulation to target
  - Minimize excitation of surrounding structures

Krigelbach et al., Nat Rev Neuroscience 2007
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**DBS is reversible and adjustable**
WHICH PATIENTS WITH DYSTONIA ARE CANDIDATES FOR DBS?
KEY QUESTIONS

• What type of dystonia does the patient have?

• How disabling is the dystonia?

• Is the dystonia being controlled with medications (including Botox)?

• What are the main symptoms of the dystonia?

• Is the patient healthy enough to safely undergo brain surgery?
WHAT TYPE OF DYSTONIA DOES THE PATIENT HAVE?

• Classification:
  • Primary
  • Secondary (e.g., due to stroke)

• Types:
  • Focal: blepharospasm, writer’s cramp, musician’s cramp
  • Segmental: cervical (torticollis)
  • Generalized: DYT-1
WHAT TYPE OF DYSTONIA DOES THE PATIENT HAVE?

- Primary generalized dystonia responds best to DBS (>80%)
  - DYT-1 mutation

- Primary segmental dystonia responds well (>70%)
  - cervical dystonia/torticollis

- PKAN, Lubag, tardive dystonia, myoclonic dystonia have variable response (>60%)

- Secondary dystonia responds more poorly
HOW DISABLING IS THE DYSTONIA?

- Good candidate patients are functionally disabled
- Moderate disability

- However, we also consider patients who may be at risk of developing serious disability

DBS is not necessarily the treatment of last resort in dystonia
IS THE DYSTONIA BEING CONTROLLED WITH MEDICATION?

- Maximized on oral medications?
- Side effects?
- Botox
  - Durability of effect
  - Predictability of effect
WHAT ARE THE MAIN SYMPTOMS OF THE PATIENT’S DYSTONIA?

- Pain
- Abnormal movements (including tremor)
- Body/head position
- Fixed postures/contractures
IS THE PATIENT HEALTHY ENOUGH FOR BRAIN SURGERY?

- Age
- Healthy heart and lungs
- Blood thinners
HOW DO WE DO DBS SURGERY?
DBS TEAM AT UNIVERSITY HOSPITAL

Dr. Fang Ba
Neurology

Karen Toore, RN
DBS coordinator

Multi-disciplinary approach

Dr. Tejas Sankar
Neurosurgery

Dr. Jorge Perez-Parada
Psychiatry

• ALSO: neuropsychology, PT, OT, SLP
Community Neurologist or Family MD identifies potential candidate

Referral to Movement Disorders Program

Screening by Dr. Ba

Screening by Dr. Sankar

DBS meeting

DECISION TO PROCEED WITH DBS
Pre-surgery workup
  • MRI
  • Swallowing/speech
    • Visual testing
    • Neuropsychology
    • Psychiatry
  • Functional assessment

SURGERY

Post-operative programming
DBS SURGERY

- **STEP 1:** APPLY A STEREOTACTIC FRAME (Co-ordinate system)
DBS SURGERY

• **STEP 2:** IMAGE PATIENT’S BRAIN AND IDENTIFY TARGET

Most common target for dystonia is globus pallidus interna (Gpi)—both sides of brain.
DBS SURGERY

• **STEP 3: RECORD FROM, AND STIMULATE, THE BRAIN**

Patient is usually awake during surgery.
DBS SURGERY

• **STEP 4:** AFFIX THE ELECTRODES AND IMPLANT PACEMAKER

DBS system is turned on after 4 weeks
DBS PROGRAMMING

- Stimulator turned on 4-6 weeks after surgery
- Monthly programming sessions for at least 6 months

IN DYSTONIA, IT CAN TAKE TIME BEFORE POSITIVE EFFECTS OF DBS ARE SEEN
SAFETY/RISKS

• HEMORRHAGE/STROKE
  • Should be <2% incidence

• Infection (5%)

• Hardware-related problems (10% in some series)
  • Lead fracture
  • Lead migration
  • Extension erosion
  • Extension fracture
  • Pulse generator malfunction (and non-rechargeable ones require periodic replacement)

• Stimulation-related side effects
  • LOCATION, LOCATION, LOCATION
HOW WELL DOES DBS WORK?
LARGE, WELL-CONDUCTED CLINICAL TRIALS NOW SHOW THAT DBS FOR DYSTONIA IS MORE EFFECTIVE THAN MEDICATION FOR QUALITY OF LIFE

• BUT: We have to select the right patients for the treatment