Stimulating the Brain: Surgery for Parkinson’s Disease

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History

• Early Pre- Stereotactic Era (up to 1940s)
  – Open surgery to remove parts of brain
  – Open surgery to cut fiber tracts
  – Some success, esp for tremor
  – High mortality (15%)

History

• Early Stereotactic Era (1950s-1960s)
  – Surgery through a Burr Hole
  – Mechanical System for Targeting
  – Treatment by Lesion (pallidotomy, thalamotomy)
  – Low Mortality (1-2%)
  – Improved success (positive & negative symptoms)

History

• L-Dopa (1968- 1990s)
  – First effective drug for PD
  – Virtual no surgeries for PD
  – Surgery to treat disease, not symptoms
    • transplantation

History

• Late Stereotactic Era (1990s)
  – Laitinen, et al, resurrected the pallidotomy
  – Treat symptoms of PD
  – Treat side effects of L-Dopa
  – Improvements in stereotaxy and microelectrodes

History

• Modern Era (late 1990s- now)
  – Benabid reports improved PD symptoms in patient with deep brain stimulator for pain
  – Rise in popularity in the science of Movement Disorders
  – Rise in popularity of Stimulation
  – Increased Applicability of Stimulation Surgery
Surgery for Parkinson Disease

- Targets

• Treats both tremor and rigidity/bradykinesia
• Stimulating Electrode implanted into Subthalamic Nucleus or Globus Pallidus
• Generator implanted over pectoral muscle
• Extension wire behind ear

Implant

Precautions

• Diathermy/Cautery
  — Electrical, ultrasound, or radiofrequency therapeutic devices
  — Surgery – electrocautery
  — Lithotry
• Body coil MRI (heating effect)
• Magnetic fields
  — Metal/Steel detectors
  — Stone refrigerators, industrial microwave ovens
  — Arc welding equipment, high voltage power lines
• Effect on other medical devices (external defibrillation, cardiac pacemakers)

Surgical Risks

• Bleeding- usually insignificant
• Infection- <0.5%
• Seizure- <1%
• Brain Injury- <1%
• Ineffective- rare
• Stroke/ Hemorrhage- <1%
• Mechanical/ Electrical Complication- uncommon
Surgical Procedure
• Apply Frame
• Obtain localizing image (MRI, CT, both)
• Calculate Coordinates
• Place electrodes
  – Macroelectrode recording
  – Microelectrode recording
• Implant Stimulating Electrode
• Implant Generator
• Frameless Methods

CRW Frame

MRI with Frame

Calculate Coordinates

Arc System

Microelectrode Recording
Stimulation Side Effects

- Paresthesias & other sensory phenomena
- Dorsal lateral medial ventral paresthesias & other sensory phenomena
- Effective changes

Thalamus

PACU- Anesthetic Issues

- Two stages of surgery, two anesthetics
  - Implant intracranial electrode
    - IV Sedation
  - Implant generator
    - General Anesthesia
- Two stages may be combined (one operation)
- Two stages may be separate (two operations)

PACU- Neurological Issues

- Parkinson’s Disease
  - Patients are off all medications
  - Patients may be very “OFF” - severe PD symptoms
  - Patients may be slow to “wake up”
- Neurological Complications
  - Intracranial hemorrhage
  - Seizures

PACU- Medical Issues

- Most patients relatively healthy
  - Other than PD
- Cardiac, Pulmonary problems may occur
PACU - Stimulator Issues

- Patients may have contralateral stimulator
  - May be on or off
  - May need to be turned on
    • Similar to AICD or pacemaker

PACU - Surgical Issues

- Wounds
  - One to three
  - Relatively small (5cm or less)
- Bleeding - minimal
- Pain
  - Mild incisional pain
  - Moderate neck pain (tunneling)

Other Diseases

- Essential tremor
  - Thalamic target
- Dystonia
- Investigational
  - Alzheimer’s Disease
  - OCD
  - Depression
  - Weight Loss

Other Diseases

- Vagal Nerve Stimulator
  - Cautionary tale

Surgery for Parkinson’s Disease

- SAFE
- EFFECTIVE
- AVAILABLE

Questions?