Introduction to Neurosurgical Subspecialties:

Functional Neurosurgery

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Functional Neurosurgery

- Functional neurosurgery is about optimizing the function of patients
- Functional neurosurgeons treat patients with:
  - Movement disorders such as Parkinson’s disease and tremor
  - Spasticity
  - Psychiatric disorders
  - Chronic pain syndromes
Functional Neurosurgery

• Fellowship not required for neurosurgeons, but some neurosurgeons opt for specialized training in functional surgery via fellowship
  • Different fellowships may have different emphasis (e.g. deep brain stimulation > epilepsy resections)
Functional Neurosurgery

• Deep brain stimulation
  • FDA approved for:
    • Essential tremor (1997)
    • Parkinson’s disease (2002)
    • Dystonia (2003)
    • Obsessive compulsive disorder (2009)
  • Emerging indications:
    • Tourette’s syndrome
    • Major depression
    • Alzheimer’s disease

Okun MS, NEJM 2012
72 y/o right handed male with 25 year history of bilateral upper extremity intention tremor. Failed medical therapy (propranolol, primidone). Unable to perform ADLs.
Pre-operative
Functional Neurosurgery
Case Illustration #1

Right hand

Left hand
Functional Neurosurgery
Case Illustration #1

• **Essential tremor**: characterized by gradually increasing-amplitude postural and kinetic tremor of the forearms and hands (with or without involvement of other body parts)

• Surgical plan: Implantation of single DBS lead into left VIM thalamus
Intraoperative
Functional Neurosurgery
Case Illustration #1
Post-operative
Epilepsy Neurosurgery

- Epilepsy neurosurgeons treat patients with:
  - Seizure disorders
  - Lesions causing seizures
  - Lesions requiring cortical mapping and/or monitoring
Epilepsy Neurosurgery

- Fellowship not required for neurosurgeons, but some neurosurgeons opt for further specialized training in epilepsy surgery via fellowship.
Hippocampal Sclerosis

Pre-op

Post-op

THE SOCIETY OF NEUROLOGICAL SURGEONS
Hippocampal Sclerosis

CA1  /  CA2  /  CA3  /  CA4  /  DG  /  Subiculum
Depth Electrodes
Defining Physiology/Function

- EEG/ECoG
- MEG
- Wada
- Mapping
- fMRI
- Ictal SPECT

Tuberous Sclerosis
Subdural Electrodes

Define seizure onset
Stimulation mapping
Disorders of Cortical Development

- Cortical Dysplasia
- TS
- Heterotopia
- Pachygyria
- Schizencephaly
- Polymicogyria
- Hemimegalencephaly
Hemispherectomy: Indications

- Sturge Weber
- Perinatal MCA stroke
- Hemimegalencephaly
- Rasmussen’s encephalitis
Functional Hemispherectomy
Case Illustration #1

- 37 yo male
- Sz onset 7 yo
- Semiology: Supplementary Motor Area
- EEG right frontal
- Neuro exam: Normal
Case Illustration #1

Pathology = Cortical Dysplasia

Subdural Grids

Post-op
Chronic Pain Conditions and Procedures

• Cranial neuralgias
  • Trigeminal neuralgia
  • Occipital neuralgia
  • Glossopharyngeal neuralgia
• Radicular leg pain without compressive cause
• Somatic cancer pain
Trigeminal Neuralgia

- Lancinating, excruciating episodic facial pain
- Carbamazepine first line agent
- Surgical procedures for medically intractable TN
  - Microvascular decompression (MVD):
    - Posterior fossa craniotomy to remove small vessels compressing the trigeminal nerve
    - First advocated by Dr. Peter Jannetta
    - Indicated for patients who can undergo craniotomy
  - Trigeminal rhizotomy: involves selective destruction of trigeminal nerve
    - Relieves pain but also creates numbness
    - Typically reserved for patients who aren’t good candidates for craniotomy or MVD
    - Can be accomplished with thermocoagulation, glyceral injection, direct compressive injury with a balloon, or radiosurgery
Radicular Chronic Pain

• Pain typically resulting from radicular scarring or prior spinal surgery
• Can be done for upper and lower extremity pain
• Spinal cord stimulation may decrease extremity pain
  • Electrode “paddle” inserted typically epidural location
  • Wire connectors
  • Subcutaneous pulse generators
Conclusions

• Functional neurosurgery is a highly reward subspecialty of neurosurgery

• Functional procedures can significant improve patients lives

• While many neurosurgical procedures can be highly technical, functional procedures can be very highly technical in the interface with radiology, intraoperative navigation, intraoperative electrophysiology, and intraoperative mapping of neurological function