Surgical Aspects of Pediatric Epilepsy

Matthew M. Pearson, MD
Assistant Professor of Neurosurgery
Vanderbilt University Medical Center
Epilepsy

- Prevalence approx. 1%
- 50% of cases begin before age 5
- ~10% medically intractable
Epilepsy Types

- Partial
  - Simple
    - Motor
    - Sensory
    - Psychic
    - Autonomic
  - Complex
    - Auras
  - Secondary Generalized
    - Jacksonian

- Generalized
  - Absence
  - Myoclonic
  - Clonic
  - Tonic
  - Tonic-Clonic
  - Atonic
  - Infantile Spasms
Epilepsy Types

- Absence
  - Blank Stares
  - No aura
  - Prompt recovery
  - 3 Hz spike and slow wave
  - “Atypical” very similar to partial complex

- Infantile Spasms
  - 3 mo – 2 ys
  - Flexion of head, neck, arms with raising of legs
  - “Hypsarrhythmia”
    - Continuous high voltage asynchronous and synchronous slow wave and spikes
Epilepsy Types

- Mesial Temporal Sclerosis
  - Temporal Lobe
- Neurocutaneous Disorders
  - Tuberous Sclerosis
  - Sturge-Weber Syndrome
- Lennox-Gastaut Syndrome
  - Multiple sz types: tonic, tonic-clonic, atypical absence, atonic
  - Slow (<2.5 Hz) spike and wave
Pediatric Factors

- Cognitive and Behavioral Delay
- “Malignant” or “Catastrophic” - Deterioration
- “Child may grow out of it”
- Medical Intractability
  - Appropriate Doses / Combinations
  - Compliance
- Plasticity
Basic Surgical Principles

• Resection
• Disconnection
• Stimulation

We have options!
Evaluation

- Is the child having seizures?
  - EEG
Localization

Where are the seizures coming from?
Radiology

- Every child with seizures deserves a scan!
  - MRI, preferably with contrast
• Is there an abnormality?

• Does it match the EEG?

• If so, consider further evaluation.
Evaluation

- EEG
- Video-EEG
- MRI – T1 and FLAIR
  - Hippocampal Volumetrics
  - fMRI
- PET / SPECT – ictal and intraictal
- WADA – language and memory
- Neuropsychological Testing
• What have we found?

• What can we do?
• Localized lesion or seizure activity

• Can we find the source of the seizure and safely remove it?
Resection
Is it a clear lesion matching to the EEG?
Temporal Lobectomy

- Partial Complex Seizures, esp. with Aura
- Multiple Etiologies (Mesial Temporal Sclerosis)
- Selective Amygdalohippocampectomy
- 75-85+% Marked Reduction or Complete Resolution of Seizures
Cortical Dysplasia

Figure 61–2. Imaging in a 7-year-old male with a few years history of complex partial seizures that have worsened over the past year. (A) Coronal MR (T2 weighted) and (B) coronal MR (FLAIR) showing a high signal abnormality in the left mediobasal temporal lobe. Following temporal resection, histopathologic diagnosis revealed cortical dysplasia.
Figure 61–3. Coronal MR (T2 weighted) showing a high signal abnormality in the right inferior temporal lobe of a 12-year-old female with a 1 year history of complex partial seizures. Following temporal resection, histopathologic diagnosis revealed a low grade glioma.
Temporal Lobectomy
Selective Amygdalohippocampectomy
Selective Amygdalohippocampectomy
• What if the lesion is away from the surface where the seizures occur?
Intracranial Monitoring
Subdural Grids and Strips

• Open craniotomy to place EEG electrodes directly on the brain.

• Can be closed and the child awakened for long-term monitoring.
Intracranial Monitoring
Subdural Grids and Strips

• Record / Localize Seizure Focus
• Stimulation Mapping – Motor, Sensory, Language (Plasticity)
• Not Painful

• Intra-operative Electrocorticography
Subdural Grids
Pathology

- Cortical Dysplasia
- Neuronal
  - Heterotopia
  - Ectopia
- Gliosis
- Encephalitis

- Tumor
  - DNET
  - Gangliocytoma
  - Ganglioglioma
- Hamartoma
- Infarct
- AVM / Cavernous Malformation
Cavernous Malformation
Outcome

• Lesion
  – 60-80% seizure free
  – 80-90+% significant gain

• Non-lesional
  – 50% seizure free (variable)
Complications

• Mortality <0.5%
• Morbidity 5-10%
  – Stroke
  – Infection
  – Subdural Hematoma
  – Transient or Permanent Neurological Injury
Disconnection
Multiple Subpial Transections

- For Treatment of Focal Seizures Beginning in Eloquent Cortex
- Prevent Horizontal Spread of Seizure
- Preserve vertical pathways
Corpus Callosotomy

• For seizures of bilateral EEG onset
  – Diminish total number of synchronously firing neurons
• Drop Attacks (atonic-tonic seizures)
• Lennox-Gastaut
• Recommendation of Exclusion
  – Recurrent Status Epilepticus
  – Disabling Seizures without Focus
Corpus Callosotomy

- Complete vs. Anterior 2/3
Corpus Callosotomy (Anterior 2/3)
Corpus Callosotomy

- Disconnection Synd.
  - Mutism – marked but clears
  - Non-dominant
  Apraxia – may be permanent
  - Inattention
  - Urinary Incontinence

- Posterior
  - Interhemispheric Sensory
    Disconnection
  - Split Brain Syndrome – cannot coordinate hands
Corpus Callosotomy
Outcome

- Drop Attacks
  - 80-100% Sig.
    Better or Cure
- GTC
  - 50% improvement

- Complete vs. Partial
  - Better control but increases side effects

- If functional –
  Anterior 2/3 only;
  monitor 6-12 mo.
  Then complete if not improved
Hemispherectomy

The Big Kahuna

Dramatic Surgery for Dramatic Results
Hemispherectomy

- Intractable Seizures
  - Unilateral
  - Contralateral Hemiparesis (plegia)
  - Contralateral Hemisphere Normal
  - Rasmussen's Syndrome
    - Epilepsia partialis continua
    - Progressive hemispheric encephalitis
  - Sturge-Weber Syndrome
  - Hemimegalencephaly
Hemispherectomy

• Anatomic vs Functional

• Hemosiderosis; Subdural Hematoma
• Hydrocephalus
• 80% >80% reduction in sz frequency
• Good rehab potential (gait, helper hand)
• Improved schoolwork with reduction in seizures
Functional
Hemispherectomy
Vagus Nerve Stimulation

- A mechanical Drug
- Adjunct to Pharmacotherapy
- Approved for refractory partial seizures after age 12 (used younger)
Vagus Nerve Stimulation

- Left Vagus Nerve accessed in Carotid Sheath between Carotid and Jugular
- Leads secured to Nerve
- Generator in Subcutaneous or Subpectoral Pocket
- Battery lasts 5-9 ys.
Vagus Nerve Stimulator

- Negative Electrode
- Positive Electrode
- Anchor Tether
Vagus Nerve Stimulation

- 50+% Reduction in 1/2 of patients
- Not a cure
- Rare monotherapy
- May reduce doses of other AED’s
Surgical Aspects – An Exciting time

- Multiple options to help our children
- Multiple indications
- Good results
- Risks Relative

- Need a comprehensive team and thorough understanding of individual seizure disorder
Every Child with Epilepsy Deserves a Scan!