Presurgical Epilepsy Eval:
A multidisciplinary approach to intractable epilepsy

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Candidates for Epilepsy Surgery

- Persistent seizures despite appropriate pharmacological treatment (usually at least two drugs at limits of tolerability)
- Impairment of quality of life due to ongoing seizures

Presurgical Evaluation

- History and exam
- MRI scan
  - Mesial Temporal Sclerosis (MTS), tumor, vascular malformation, dysplasia
- Video/EEG monitoring with scalp EEG
  - interictal epileptiform discharges
  - ictal
    - Seizure semiology
    - Ictal EEG discharge
  - Additional electrodes

Presurgical Evaluation

- Functional Imaging
  - PET
    - hypometabolism interictally
  - SPECT
    - hypoperfusion interictally
    - hyperperfusion ictally
    - subtraction and co-registration with MRI

Figure 1a

Right hippocampal sclerosis (arrow)

Figure 1b

Left mesial temporal sclerosis

Figure 1c
Presurgical Evaluation

**Presurgical Evaluation**

- **SISCOM Result in a patient with extratemporal epilepsy**

- **Neuropsychological testing**
  - Pre-operative baseline
  - Aid in localization
  - Predicting risk of cognitive decline with surgery
  - Wada (intracarotid amobarbital) test
    - language
    - lateralization
    - Memory
    - prediction of postoperative decline

- **Intracranial EEG when needed**
  - Grids and strips, most commonly subdural, SEEG
  - Parenchymal “depth” electrodes, especially for recording from hippocampus
  - Identification of ictal onset
  - Brain mapping
    - cortical stimulation
    - SSEPs
    - Functional MRI

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**Presurgical Evaluation**

- **Types of Surgical Procedures**
  - **Resective Surgery: single seizure focus in non-eloquent region.**
  - **Palliative Surgery:**
    - For drop attacks: corpus callosotomy
    - For Rasmussen's encephalitis or hemimegalencephaly: hemispherectomy

**Surgical Treatment of Epilepsy**

**Curative**

<table>
<thead>
<tr>
<th>Pathologies</th>
<th>Procedures</th>
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</thead>
<tbody>
<tr>
<td>Lesionectomy</td>
<td>Lobectomy</td>
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<tr>
<td>Low Grade Glioma</td>
<td>Cia. Malformation</td>
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**Palliative**

- Lesionectomy
- Lobectomy
- Hemispherectomy
- Disconnection
- Terpectomy
- (Callosotomy)

**Surgical Treatment of Epilepsy**

- MRI frameless stereotactic localization of focal cortical dysplasia at the base of the central sulcus (center of cross hairs).

Surgical Treatment of Epilepsy

- Functional hemispherectomy: extent of cortical resections in temporal and central cortex with disconnection of residual frontal and occipital cortex by transecting white matter fibers (not shown).

Neuro Imaging: MRI

- Higher Resolution & Better Tissue Differentiation than CT scan.
- Improve The sensitivity for Tuberous Sclerosis, Neuronal Migration Disorders
- Volumetric
- FLAIR
- T2 Relaxometry

Neuro Imaging: FDG-PET

Focal Neocortical Hypometabolism

- Abnormal cortex has lower metabolic rate interictally
- Positron Emission Tomography can detect gamma ray emitted by radioactive tracer e.g. Fluoro-deoxy glucose which map out the hypometabolic area: temporal lobes epi. & infantile spasms

Neuro Imaging: Ictal SPECT

- SPECT: Single Photon Emission Tomography
- Map the increased blood flow to the brain in the abnormal cortex.
- Best when compare interictal-ictal scans
Magnetoencephalograph

- Measure magnetic field which runs perpendicular to the electrical field
- Provide additional data, can be registered with MRI
- Expensive, need special room and equipment, interictal only

Functional MRI

fMRI Show hand area not overlapping with the lesion, allows complete resection

Case III JJ : MRS

Invasive Monitoring

A) Grid B) Peg C) Fovale D) Depth

Invasive Monitoring
Cortical Mapping

- Penfield & other authors use electrical stimulations to avoid eloquent areas & further the understanding of the generation of Clinical Seizure Semiology

Electrical Stimulation

Convergence of the Data

- In Epilepsy Surgery, data on History, PE, EEG, Seizure semiology, MRI, PET & Ictal SPECT + WADA & neuro-psychiatric testing are compared
- The patient has the best chance of becoming seizure free with congruous data in temporal >> extratemporal epilepsy
- Computer assisted “co-registration” can be done on various imaging modalities & EEG source localization.
Surgically Treatable Epilepsy in Pediatrics
- Infant & Toddler: Catastrophic Epilepsy only:
  - Infantile spasms with focal lesion or foal PET hypometabolism (HT. Chugani): Lesionectomy
  - Lennox-Gastaut: Corpuscallosotony
- Children
  - Rasmussen's Encephalitis: Functional hemispherectomy
  - Temporal Lobe Epilepsy: Temporal lobectomy
  - Lesional Extratemporal Epilepsy: lesionectomy
  - Non-lesional Cases: May need ictal SPECT, MRS, Invasive Monitoring

Benefit of Early Surgery
- Better intellectual outcome, Pts can be rehabilitated with no or low seizures frequency => Better Social Integration
- More "Plasticity" ie. surgery involve functioning areas may be performed with less disability
- May be more "Economical" when all hidden expenses are calculated eg: care taker, special educations, loss of wages.

Ped. Intractable Epilepsy is not hopeless!

Conclusion
- In the rapidly evolving field of epilepsy, the improved understanding of the basic mechanisms and the availability of various diagnostic technology would allow us to make a more accurate diagnosis and improve the outcome in both medical & surgical treatment of epilepsy.

Pediatrics Epilepsy Surgery
- Resection of epileptogenic zone
  - Cortical resection e.g. cortical dysplasia
  - Lesionectomy e.g. tumor, AVM, hamartoma
  - Amygdalohippocampectomy
  - Hemispherectomy

Tumor Resection: PM DNET
- Seizure starte at age 8 year old, uncontrolled with PHT, PHENO and CBZ
- MRI: Right temporal lobe tumor with cystic component
- EEG ictal and interictal right temporal lobe origin

Dysembryoplastic neuroepithelial tumor (WHO 2000 grade I).
SC : AVM Lesionectomy

- An 11 year old, Sz started at age10
- Resect to remove the visible lesion & surrounding epileptic cortex

Hypothalamic Hamartoma

Case FCD w/ Rt Hemiparesis

- A 2 year old who had Sz since 8 months
- Intractable to PT, Peno, TPM, Kreppa, LTG
- CT scan suspected tumore of right frontal lobe
- MRI -> Lt FCD
- Focal resection with EcoG 2004 Nov
- Sz free d/c TPM on PHT only

Severe FCD with balloon cell
Epilepsy Surgery

- Disconnection
  - Corpus callosotomy
  - Hemispherotomy
  - Multiple subpial transection

Corpus Callosum

- Anterior (2/3) callosotomy
- Complete callosotomy
  - One stage
  - Two stages (6-12 mo. apart)

Case SH Corpus Callosotomy

- Disconnect the two hemisphere without removal of the connection to the body
- Done to reduce secondary spreads esp in Lennox-Gastaut Syndrome with frequent falls
Functional Hemispherectomy

Case PP Hemispherectomy

- A five month old girl who started having clonic jerking of the right arm at age four month
- NSVD, Uneventful prenatal history
- G+D Regrad face 2 m, Follow 3 m, Sit with support 5 m
- The Sz frequency increased gradually from 1-2/day to 25-45/day. Rx VPA, Phenobarbital, DZP
- All are without fever

- She was lethargic, had 1-4 seizures/ hour, (+) aspiration pneumonia
- Clonic jerking Rt side with grimance of the face lasted 10-45 seconds.
- Med : Phenobarbital 20 mg/kg/day, Bl level 130 uG/ml
- PHT, CBZ, Vigabatrin, Topiramate
- B6 100 mg trial
- Video-EEG monitoring:
  - Interictal > 90 % Lateralized left hemisphere 10 % Rt C4 P4
  - Ictal EEG > 90 % Lateralized Lt Hemisphere
Severe cortical dysplasia and hemimegalencephaly.

Multiple Subpial Transection

Epilepsy Surgery

• Neuroaugmentation
  • Vagal nerve stimulation (VNS)
  • Deep brain stimulation (DBS)

The Vagus Nerve Stimulator: NCP 101 generator (with leads attached). Cyberonics, Webster, Texas.
Vagus Nerve Stimulation
Percentage Change – All Seizures
Results of two randomized, controlled trials in medically refractory partial seizures.

Vagus Nerve Stimulation
“Responder Rates”
Responder rates from the randomized controlled trials

Metaanalysis of AEDs and VNS Efficacy

Ketogenic Diet
- Main experience with children, especially with multiple seizure types
- Anti-seizure effect of ketosis (beta hydroxybutyrate)
- Low carbohydrate, low protein, high fat after fasting to initiate ketosis
- Long-term adverse effects unknown