Video EEG monitoring & Epilepsy Surgery

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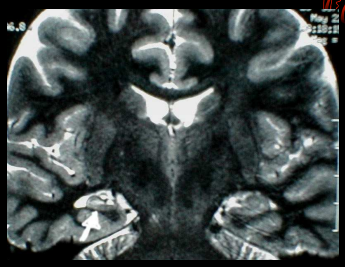
Candidates for Epilepsy Surgery

- 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



Right hippocampal sclerosis (arrow)

Figure 1a

Presurgical Evaluation

Left mesial temporal sclerosis

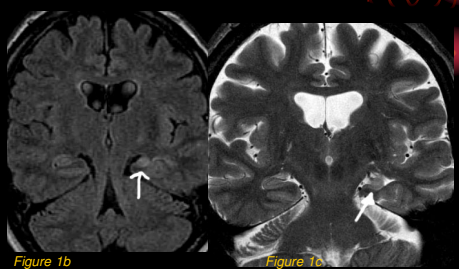


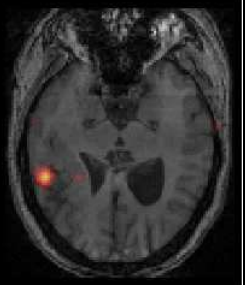
Figure 1b

Figure 1c

Presurgical Evaluation

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

Presurgical Evaluation



SISCOM Result in a patient with extratemporal epilepsy

Presurgical Evaluation

- 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

Presurgical Evaluation

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

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

Figure 2

Curative ⟷ *Palliative*

Pathologies

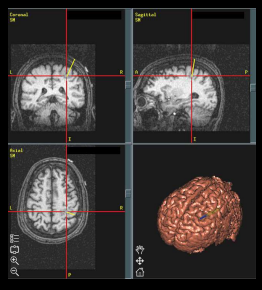
MTS TLE	Non-MTS TLE
Lesional	Frontal Lobe epilepsy
- Low Grade Glioma	SMA/cingulate epilepsy
- Cav. Malformation	Malformations of cortical development

Procedures

Lesionectomy	Hemispherectomy	Disconnection
Lobectomy	Topectomy	(Callosotomy)
	MST's	

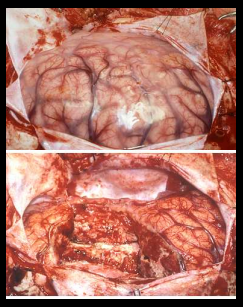
Modified from McKhann G.M. and Howard M.A.: Epilepsy Surgery: Disease Treatment and Investigative Opportunity, in Diseases of the Nervous System: Clinical Neurobiology, 2002.

Surgical Treatment of Epilepsy



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

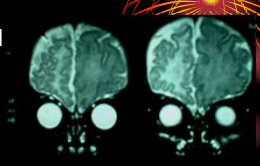
Surgical Treatment of Epilepsy



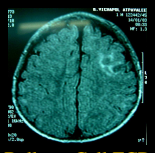
- Functional hemispherectomy: extent of cortical resections in temporal and central cortex with disconnection of residual frontal and occipital cortex by transecting white matter fibers (not shown).

Neuro Imaging: MRI

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

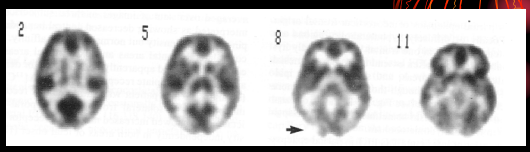


Left hemimegalencephaly



Balloon Cell FCD

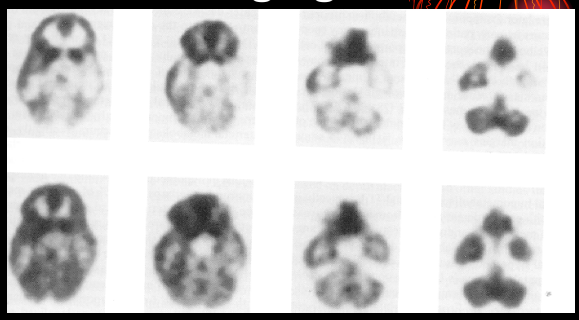
Neuro Imaging: FDG-PET



Focal Neocortical Hypometabolism

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

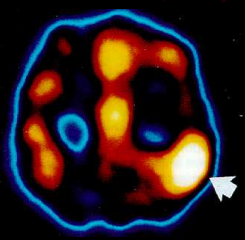
Neuro Imaging: FDG-PET

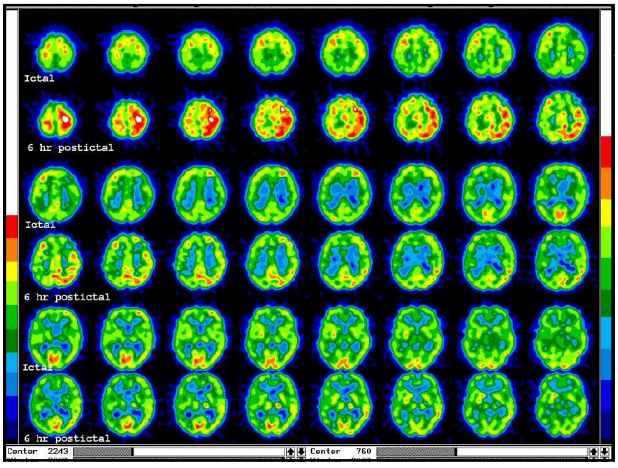


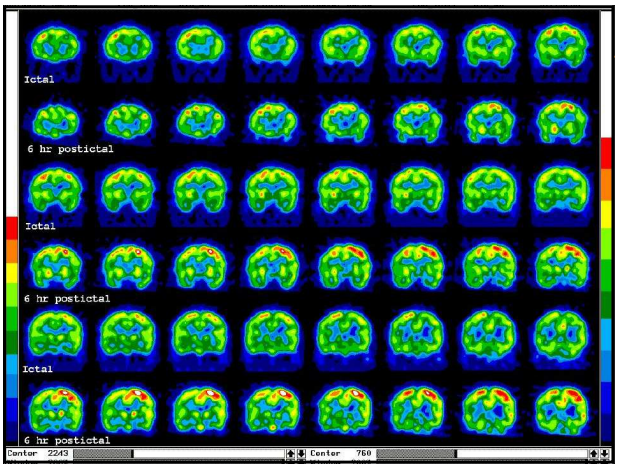
Upper: interictal, Lower: peri-ictal (Sz at 2 minutes post injection)

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

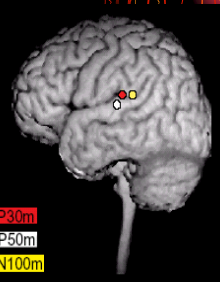






Magnetoencepalograph

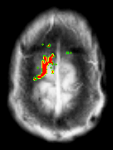
- Measure magnetic field which runs perpedicular to the electrical field
- Provide additional data, can be registered with MRI
- Expensive, need special room and eqipment, interictal only

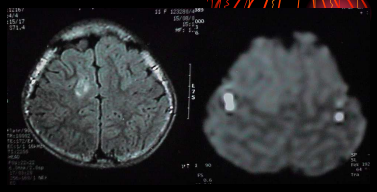


P30m
P50m
N100m

Functional MRI

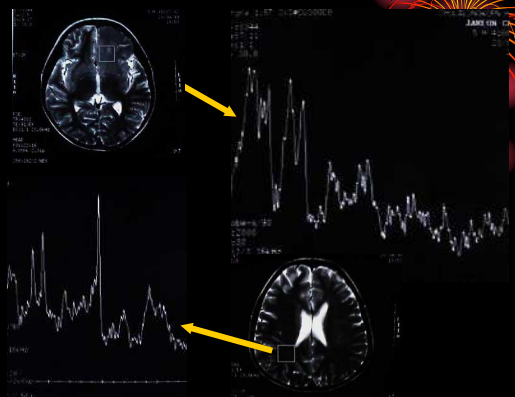
LH



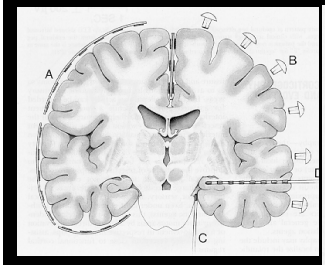


fMRI Show hand area not overlapping with the lesion, allows complete resection

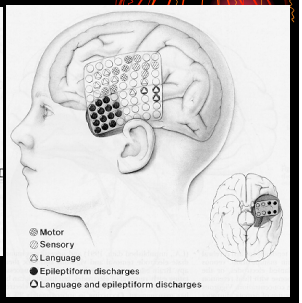
Case III JJ : MRS



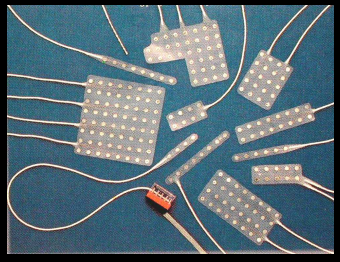
Invasive Monitoring

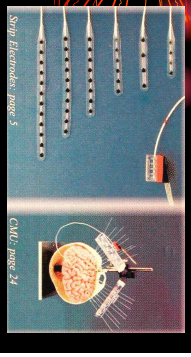


A)Grid B)Peg C)F.ovale D)Depth



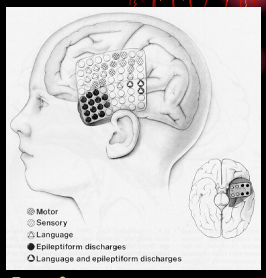
Invasive Monitoring





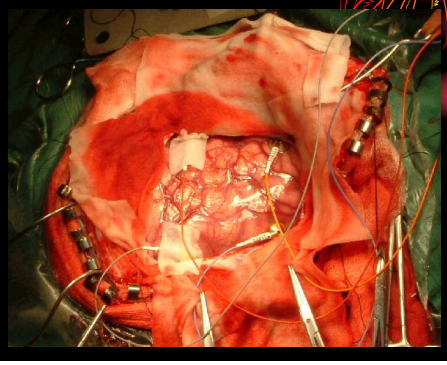
Cortical Mapping

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

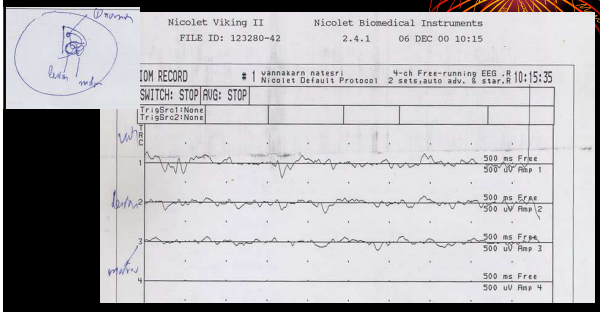


Electrical Stimulation

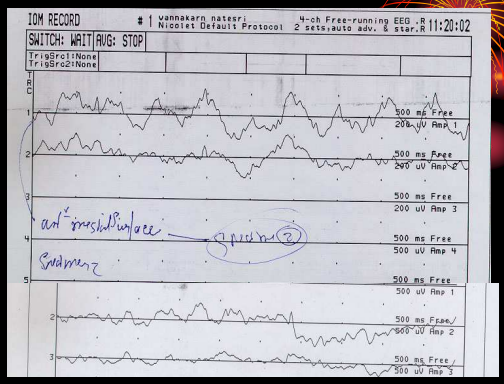
Intraoprative monitoring /Mapping/Awake Craniotomy



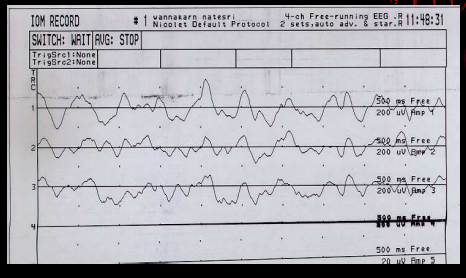
Case IV WN : EcoG : preop



Case IV WN : EcoG : during resection



Case IV WN : EcoG After resection



Convergence of the Data

- In Epilepsy Surgery, Data on History, PE, EEG, Seizure semiology, MRI, PET & Ictal SPECT + WADA & neuro-psycitric testing are compared
- The patient has the best chance of becoming seizure free with conguourous data in temporal >> extratemporal epielpsy
- Computer assisted "Co-registration" can be done on various imaging modalities & EEG source localization.

Surgically Treatble Epilepsy in Pediatrics

- Infant & Toddler : Cataltrophic Epilepsy only:
  - Infantile spasms with focal lesion or foal PET hypometaboslim (HT. Chugani) : Lesionectomy
  - Lennox-Gastaut : Corpuscallosotomy
- 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

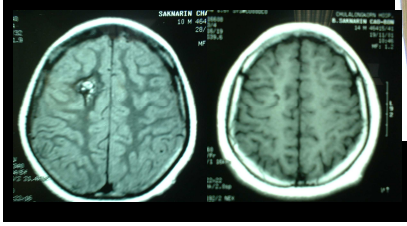
- Better intellectual outcome, Pts can be rehabilitated with no or low seiures frequency => Better Social Integration
- More "Plasticity" ie. surgery involve functioning areas may be performed with less disability
- May be more "Economical" when all hidden expenses are calculated eg : care taker, special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

Conclusion

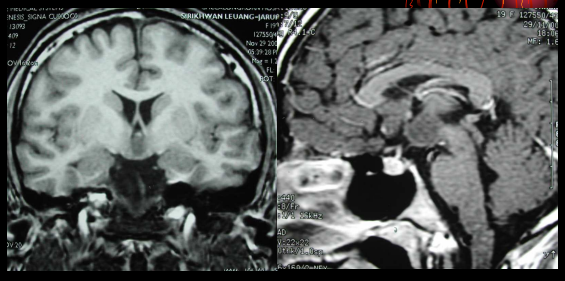
- In the rapidly evolving field of epilepsy, the improved understanding of the basic mechanisms and the avaialbility of various diagnostic technology would allow us to make a more accurate diagnosis and improve the outcome in both medical & surgical treatment of epilepsy.

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 rigt frontal lobe
- MRI -> Lt FCD
- Focal resection with EcoG 2004 Nov
- Sz free **d/c TPM on PHT only**