

ROLE OF NEUROIMAGING IN OPTIMIZING EPILEPSY CARE

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OUTLINE

- Role of Imaging in Epilepsy
- Indication of Imaging
- Imaging Modalities and Updates

Role of Imaging

- Pre-surgery
 - Identify structural abnormality
 - Localize
- Plan for surgery
 - Help confirm epileptogenicity
 - Relationship with eloquent areas
 - Predict resectivity and Prognostication
- Post-surgery
 - Evaluate residual lesion
 - Surveillance

Goal of Epilepsy Care

- Seizure free
- Acceptable quality of life

Treatment

- Medication
- Surgery
- Psychosocial support and Rehab

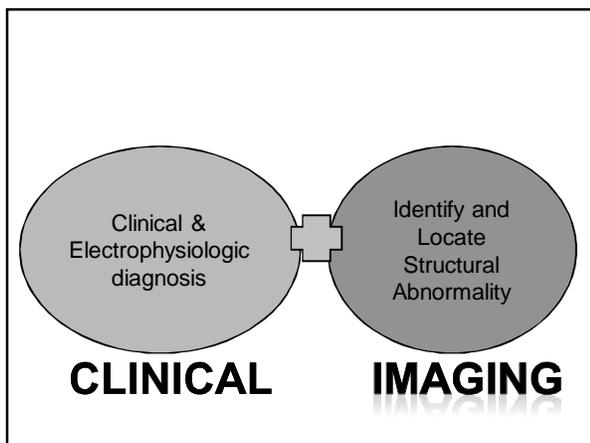
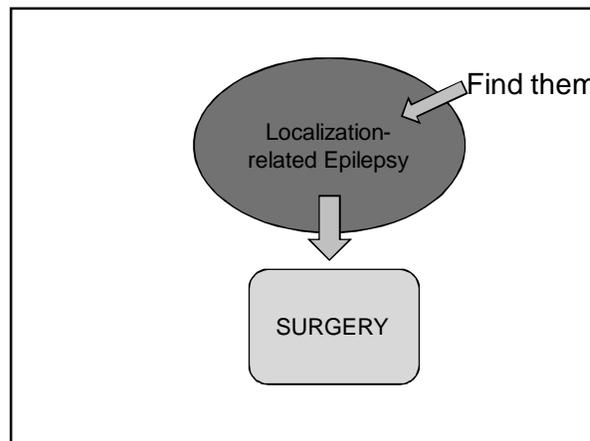
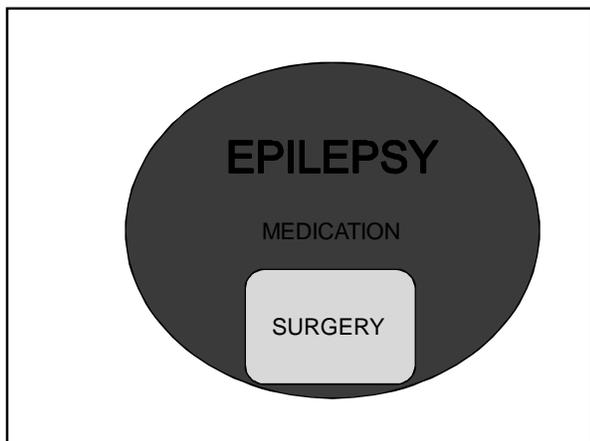
 **How to
select patient?**

How?

- Find patients who will get the most benefit and lowest treatment-related complication.

MEDICATION

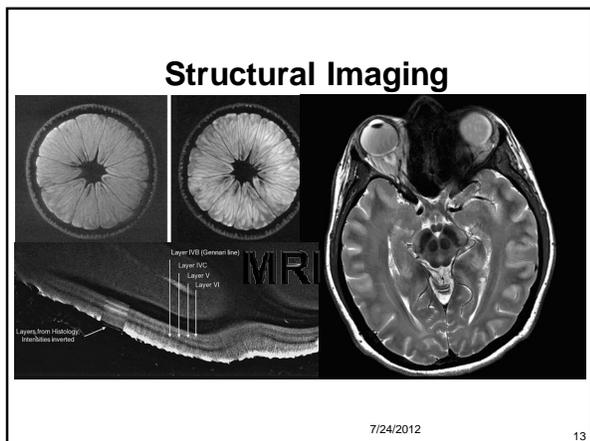
SURGERY



- ### Ideal Imaging
- Distinguish abnormal from normal -> **High resolution**
 - Tell etiology/nature of abnormality -> **Good Characterization**
 - Allow assessment of relationship with eloquent structures -> **Functional/Microstructural derangement**
 - Evaluate epileptogenicity -> **Physiologic data**

- ### Reality
- No single method can do all
- Combine data from multiple sources**
- Multimodal imaging co-registration**

- ### Type of IMAGING
- **Anatomy**
 - **Physiology and Function: SPECT, PET, MEG, MRS, DTI, fMRI, Perfusion CT/MRI**
- 



Etiologies/Epileptogenic Substrates Identifiable with MRI

PEDIATRIC	ADULT
<ul style="list-style-type: none"> • Birth-related • Congenital Malformation • Inborn-error of metabolism • Neoplasm • Infection • Post trauma • Vascular (malformation) • MTS 	<ul style="list-style-type: none"> • Vascular (Stroke, AVM, cavernoma) • Tumor (primary and mets) • MTS • Prior brain injury

TO MAXIMIZE MRI SENSITIVITY

- Appropriate MRI Protocol
- High performance MRI equipment
- Updated software
- Experienced (Neuro)radiologist

Clinical History, EEG finding

EPILEPSY MRI MNEMONIC

- **H** ippocampal size and signal
- **I** AC & atrium (check correct plane and positioning)
- **P** eriventricular heterotopia
- **P** eripheral
 - Sulcal morphology abnormality
 - Atrophy
 - Gray matter thickening
 - Encephalocele
- **O** bvious lesion

HIPPO SAGE

ADD-ON MRI SOFT-WARES

- Volumetry
- T2 Relaxation calculation
- SISCOM

Conventional MRI: Pros

- Good spatial resolution
- Soft tissue contrast
- Multiplanar
- No ionizing radiation
- Continuous development of techniques and softwares

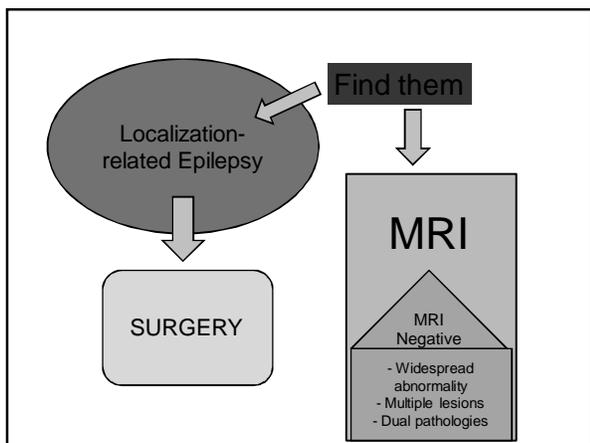
Conventional MRI: Cons

- Long Imaging time
- Contraindications:
 - Cardiac pacemaker, intracranial aneurysm clip, cochlear implant
 - Poor renal function.....Gd
 - Attention deficit, mental disability
 - Claustrophobia
- Cannot assess epileptogenicity or functionality

CT: Indication

- Emergency or First unprovoked seizure with neurologic abnormality

- CT results change management in patients with acute seizure.
- For refractory seizures: MRI sensitivity 95% CT sensitivity 32%



Solution for MRI Negative

Combine data from multiple sources

Multimodal imaging co-registration



- Anatomy: MRI

- Physiology and Function: SPECT, PET, MEG, MRS, DTI, fMRI, Perfusion CT/MRI

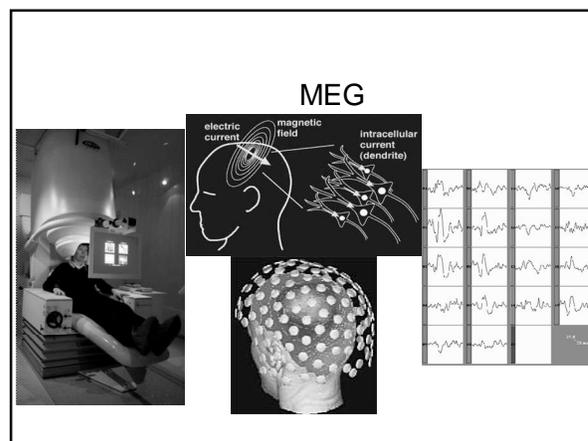


Physiologic Imaging

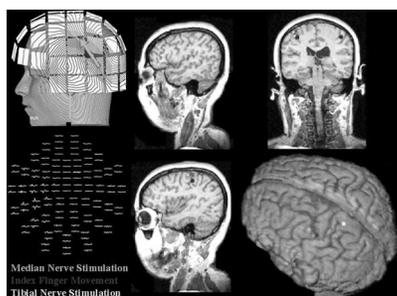
- SPECT
 - Ictal SPECT
 - Post-ictal SPECT
 - Interictal SPECT
- PET
 - FDG PET

Emerging Imaging Techniques

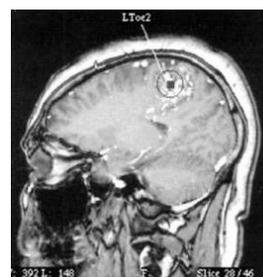
- MEG (MagnetoEncephaloGraphy) & MSI (Magnetic Source Imaging)



MEG/MSI



MEG/MSI



7/24/2012

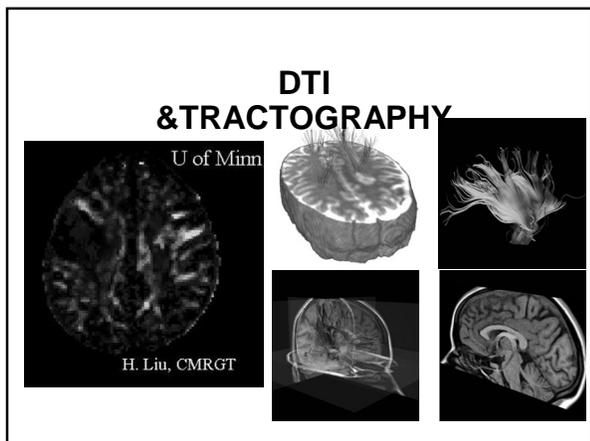
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Emerging Imaging Techniques

- MEG (MagnetoEncephaloGraphy) & MSI (Magnetic Source Imaging)
 - Localize epileptogenic substrate
 - Evaluate functioning cortex

Emerging Imaging Techniques

DTI



Emerging Imaging Techniques

DTI in Epilepsy Imaging

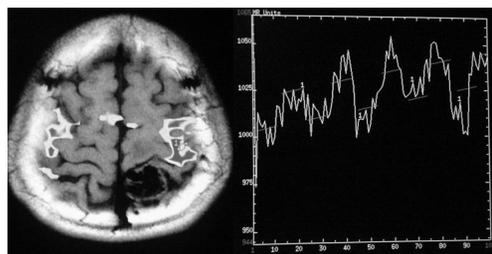
Research

- Assess epileptogenic zone in LRE
- DTI abnormality (Decreased FA) in TLE in ipsilateral brain

Emerging Imaging Techniques

- BOLD (Blood Oxygen Level Dependent) fMRI

BOLD Functional cortical mapping



Sensorimotor task : Finger tapping

fMRI



Emerging Imaging Techniques

- fMRI in Epilepsy Imaging

– Evaluate functioning cortex/eloquent area:
Motor cortex, Language lateralization,
Memory

Emerging Imaging Techniques

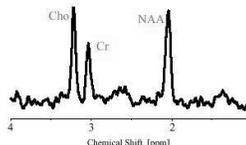
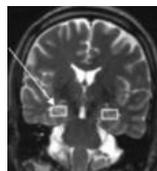
- 1-H MR Spectroscopy (MRS) in Epilepsy Imaging

- Lateralization in TLE

Decreased absolute NAA, Decreased NAA/Choline, NAA/Creatine, NAA/Choline+Creatine ratios

Ipsilateral to lesion

MRS



- NAA (2.0 ppm): Neuronal marker
- Creatine (3.0 ppm): Cellular energy
- Choline (3.2 ppm): Cell membrane
- ml (3.5 ppm): Astrocyte/glia cell marker
- Lactate (1.3 ppm): Anaerobic metabolism

Emerging Imaging Techniques

- Perfusion CT/MRI

- Not well established role in epilepsy imaging

Summary: Role of Imaging

- Pre-surgery
 - Identify structural abnormality
 - Localize
- Plan for surgery
 - Help confirm epileptogenicity
 - Relationship with eloquent areas
 - Predict resectivity and Prognostication
- Post-surgery
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Emergency	CT	Summary: Imaging of choice		
General	Conventional MRI (Standard protocol)			
-Identify obvious epileptogenic substrates				
-Follow up				
Special Attention	Conventional MRI - Special Protocol	MRS DWI	SPECT PET	MEG + MSI
-Identify subtle epileptogenic substrates	- Experienced radiologist			
-Lateralization	- 3T > 1.5T			
	- Special coil			
Specific Attention	fMRI			
- Pre-surgical evaluation of risk, potential complication	DTI			
- Research	DWI			
	MRS			

THANK YOU