

Epilepsy

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Seizure

- Symptom
- Transient event
- Paroxysmal
- Temporary physiologic dysfunction
- Caused by self-limited, abnormal, hypersynchronous electrical discharge of cortical neurons
- May occur only during course of an acute medical or neurologic illness (not persisting after resolution of acute illness)

Epilepsy

- Chronic disorder
- Recurrence of seizure
- Unprovoked and unpredictable
- Distinct form with own natural history and response to treatment
- Seizure type(s) in a pt
 - stereotyped

Epidemiology

- Prevalence
 - 1-2% of population
- Incidence
 - Age-adjusted annual incidence rate
 - 31 to 57 per 100,000
- Incidence rates highest among young children and elderly

Epidemiology

- 60-70% achieve control of seizures with antiepileptic medications
- 30-40% refractory to medication
- Mortality
 - Risk incurred by underlying disease
 - Accidental deaths
 - Sudden unexplained death is 25 times more common in epilepsy pts than in general population

Classification

- Developing a rational plan of investigation
- Making sound decisions about
 - When and how long to treat
 - Choosing appropriate antiepileptic drug
 - Considering surgical treatment
- Providing prognosis
- International League Against Epilepsy (1981 & 1987)

Simple partial seizure (partial onset epilepsy)

- Pts interact normally with environment
- Discharge occurs in limited and circumscribed area of cortex
- Symptom
 - Subjective ("Aura")
 - Déjà vu, jamais vu, epigastric rising sensation, fear, feeling of unreality or detachment, olfactory hallucination
 - Unilateral sensory disturbance
 - Observable manifestation
 - Focal motor
 - "Jacksonian march"

Video

Complex partial (Partial onset epilepsy)

- Impaired consciousness
- Automatism
 - Repetitive, complex, purposeless motor activity
 - Lip-smacking, repeated swallowing, chewing, picking motions with hands
- Staring
- Post-ictally – pts confused and disoriented for several minutes
- 70-80% of complex partial seizures arise from temporal lobes
- Remainder arise from frontal and occipital lobes

Video

Secondarily generalized tonic clonic seizure (partial onset epilepsy)

- Contralateral
 - Head deviation
 - Gaze deviation
 - Arm elevation
 - Followed by bilateral extension (tonic)
 - Bilateral clonic activity (clonic)
 - Post-ictal lethargy

Video

Absence seizure

(Generalized epilepsy)

- Momentary lapses in awareness
- Motionless staring
- Arrest of ongoing activity
- No warning
- No postictal period
- Characteristic EEG finding during seizure
 - 3 Hz generalized spike wave
- Ethosuximide
- Seizure can be induced with hyperventilation in office

Generalized tonic clonic

(Generalized epilepsy)

- Abrupt loss of consciousness
- Loud vocalization as air forced across contracted vocal cords (ictal cry)
- Bilateral tonic extension of trunk and limbs (tonic)
- Synchronous muscle jerking (clonic)
- Post-ictally
 - Unarousable, then lethargic and confused
 - Prefer to sleep

Other generalized seizure types

- Myoclonic seizure
 - Rapid brief muscle jerk
 - Bilaterally, synchronously
 - Asynchronously, unilaterally
 - Myoclonic jerks range from isolated small movements of face, arm or leg to massive bilaterally jerks
- Atonic seizure
 - Drop attacks
 - Sudden loss of muscle tone resulting in falls

Video

Temporal lobe epilepsy

- Age of onset: 7-20
- History of febrile seizure as infant
- Seizure types:
 - Simple partial ("Aura")
 - Complex partial
 - Secondarily generalized tonic clonic
- Characteristic EEG finding
 - Focal spike waves over temporal lobe
- Structural abnormality on MRI
 - Mesial temporal lobe sclerosis
- Often refractory to medication

Juvenile Myoclonic Epilepsy

- Idiopathic generalized epilepsy
- Age of onset: 12-20
- Neurologically and intellectually normal
- Seizure types:
 - Generalized tonic clonic seizures
 - Myoclonic seizures
- Sensitivity to sleep deprivation and alcohol
- Characteristic EEG finding
 - 4-5 Hz generalized spike wave discharges
- Valproate, lamotrigine
- Avoid drugs like carbamazepine or phenytoin
- Usually lifelong

Childhood Absence Epilepsy

- Idiopathic generalized epilepsy
- Age of onset: 4-12 years
- Neurologically and intellectually normal
- Recurrent absence seizures
- If untreated, absence seizures can occur hundreds of times a day
- EEG during absence characteristic 3-Hz generalized spike wave
- Ethosuximide and valproate
- 60% terminal remission

Identifiable cause of epilepsy as a function of age

Neonate to 3 yr	3-20 yr	20-60 yr	Over 60 yr
Prenatal Injury	Genetic predisposition	Brain tumors	Vascular disease
Perinatal Injury	Infections	Trauma	Brains tumors
Metabolic defects	Trauma	Vascular disease	Trauma
Congenital malformation	Congenital malformation	Infection	Systemic metabolic derangement
Infection	Metabolic defect		Infections

Metabolic causes of acute (symptomatic) seizure

- Low calcium
- Low sodium
- Low glucose
- Liver failure
- Renal failure
- Anoxia
- Nonketotic hyperglycemic state

Medical Treatment

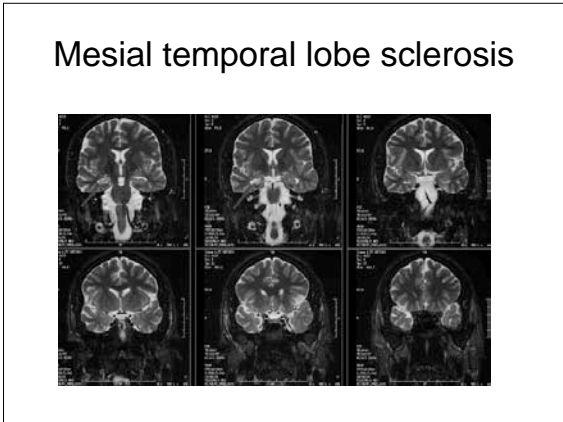
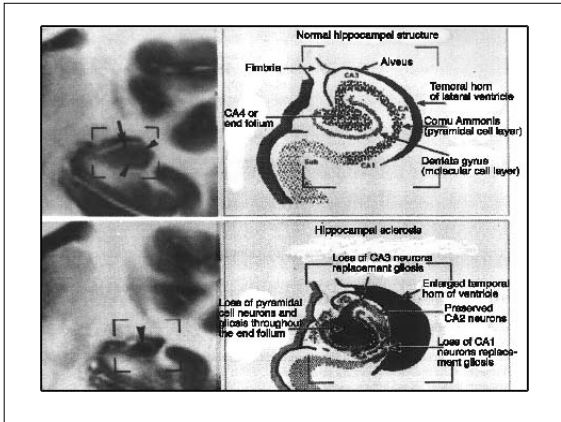
- Acute symptomatic seizures
 - Childhood febrile seizure
 - Metabolic or toxic encephalopathy
 - If conditions resolve without permanent brain damage, seizures usually self-limited
- Single unprovoked seizure
 - Only 25% later develop epilepsy
- Epilepsy

Outline

- Surgically remediable epilepsies
- Criteria for surgical candidacy
- Surgical evaluation
- Goals of surgery
- Types of surgery
- Surgical Outcomes

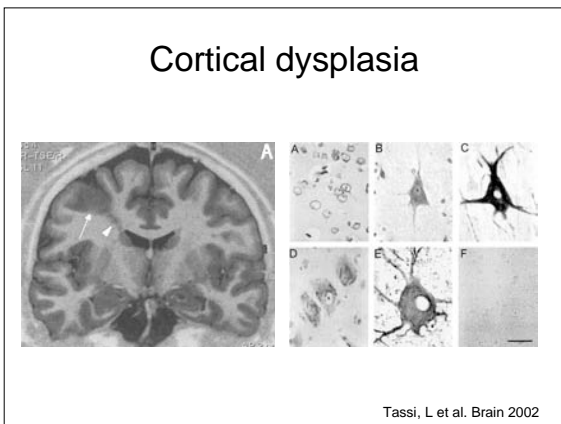
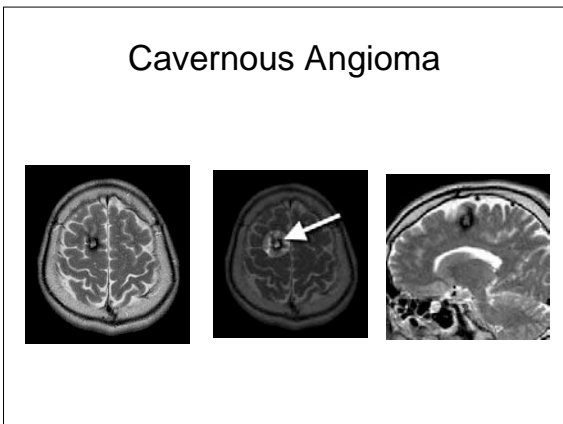
Mesial temporal lobe epilepsy

- Most common and widely recognized
- H/o febrile seizures
- CPS begins in 1st or 2nd decade
- Ant or midtemporal spike on EEG
- Hippocampal atrophy and inc signal on MRI
- <20% undergo spontaneous remission of sz



Lesional neocortical epilepsy

- Discrete neocortical lesion
- Examples: tumor, vascular malformation, focal cortical dysplasia
- Surrounding cortex –occult pathology and be epileptogenic



Tassi, L et al. Brain 2002

“Nonlesional” neocortical epilepsy

- Most challenging
- Temporal vs. extratemporal
- Phase II evaluation tailored to patients
- Microscopic pathology
- Relationship to eloquent cortex

Goals of surgery

- Identify discrete and localized area of seizure focus
- Establish lack of vital function
- Curative
 - Eradicates seizures and need for med
- Palliative
 - Lessens seizure severity and frequency

Criteria for surgical candidacy

- Medical Intractability
- Surgically remediable syndrome
- Contraindications
 - Underlying degenerative or metabolic disorders
 - Primary generalized epilepsy syndrome
 - Benign epilepsy syndromes with potential for spontaneous remission
 - Medication noncompliance
 - Interictal psychosis
 - Severely dysfunction family dynamics

Tests important in pre-surgical evaluation

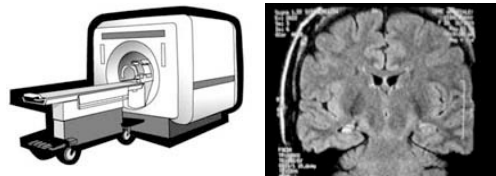
- Video-EEG, including recording typical seizures
- MRI
- Neuropsychological testing
- Wada test
- PET
- Ictal SPECT
- Functional MRI
- Intracranial EEG

Video-EEG Monitoring

- To record seizures, and interictal (between seizures) EEG activity
- 24 hr monitoring, ~7 days.
- Withdraw medications
- Activation (HV, photic, sleep deprivation)



Magnetic Resonance Imaging



Wada test

- To identify language and memory function in each hemisphere separately
- Helps predict risks of surgery
 - memory
 - language
- Helps predict success of surgery
- Same day procedure

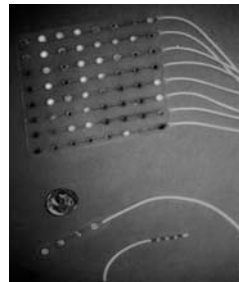
Other test

- PET
- SPECT
- Neuropsychological test

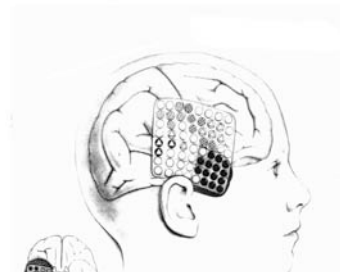
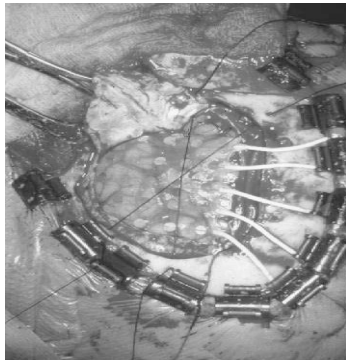
Invasive Monitoring

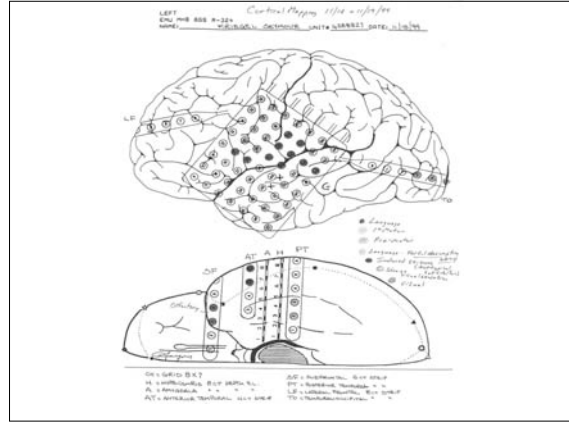
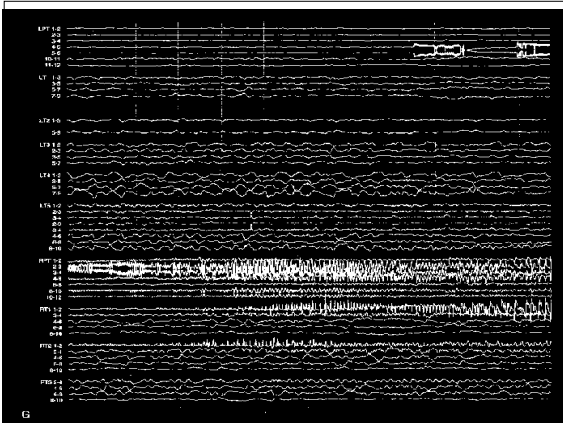
- Negative non-invasive tests
- A discrete lesion located near region of seizure onset
- If non-lesional, estimate and place intracranial electrodes based on all non-invasive test results

Invasive monitoring



- EEG electrode placement (intracranial monitoring)
- Record seizure with video/EEG in Epilepsy Monitoring Unit
- When area of seizure onset is not precisely defined during phase I evaluation



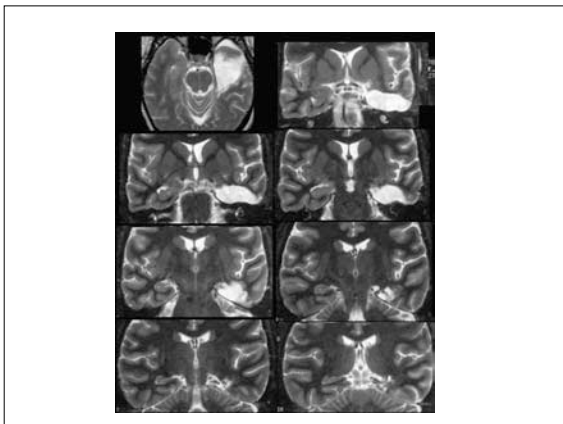


Epilepsy surgery

- History of Brain surgery for epilepsy
 - > 100 years old
- The most common operation
 - resection of the anterior portion of either the right or left temporal lobe
- The rest
 - resections of portions of the frontal, parietal and occipital lobes, and section of the anterior two-thirds of the corpus callosum

Surgical Outcome

- Dependent on syndrome and concordance of findings
- Anterior temp resection 70-90%
- Lesionectomy 75%
- Non-lesional resection <50%
- ~5% complication rate in temporal lobectomy, most temporary; ~1% permanent complication



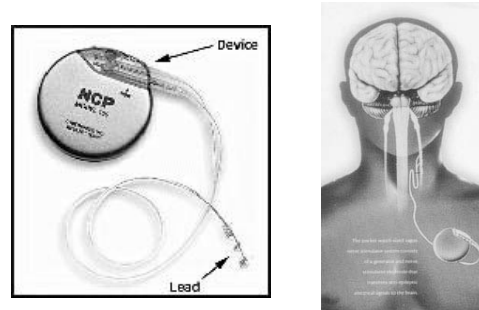
What options exist for patients with patients who are not surgical candidates?

- Multiple regions of seizure onset
- Seizure starts in a region with intact functioning
- Cannot undergo surgery safely because of multiple factors such as age, concurrent medical problems

Vagus Nerve Stimulation (VNS)

- First done 1988, FDA approved 1997
- Surgical implantation
- Periodic adjustments of stimulation to maximize benefit and minimize side effects
- Magnet allows self-activation
- Being studied for depression as well

Vagal Nerve Stimulator



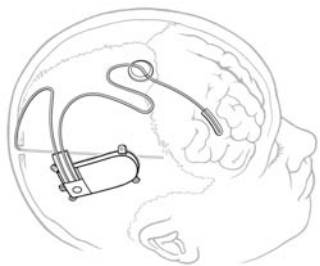
Experimental: Current clinical trials

- Brain Stimulation with implanted device
 - Responsive Neurostimulator
 - Detects seizures
 - At seizure focus
 - Deep brain stimulation
 - Bilateral anterior nuclei of Thalamus

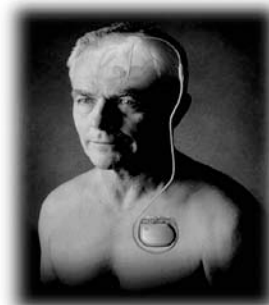
Responsive Neurostimulator



Responsive Neurostimulator



Stimulation of the Anterior Nucleus of the Thalamus for Epilepsy



Example: AF

- Presented age 21, college student
- seizure onset age 10
- feeling of “disorientation”, inability to speak, preservation of consciousness, oral automatisms, presently 4-7/week
- febrile seizure @ 10 mo; normal exam
- EEG rare left sharp waves, MRI normal
- had failed phenytoin, carbamazepine

Neuropsychological test

- FSIQ 101; VIQ 101; PIQ 102
- mild left dysfunction on specific language tasks

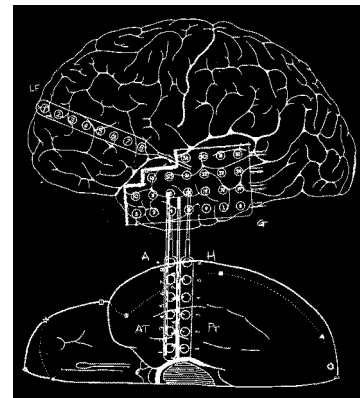
Wada

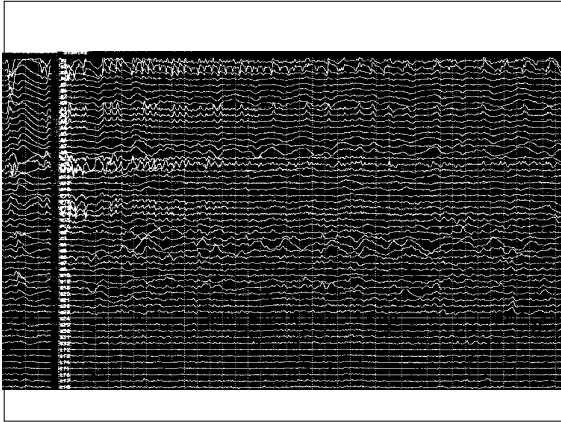
- left language dominance
- left injection: 7/8 recall
- right injection: 6/10 recall



Summary

- temporal appearing seizures, intractable
- concordant ictal EEG
- no MRI abnormality
- minimal interictal spikes
- Wada suggestive of left mesial dysfunction
- unclear whether mesial or neocortical





Follow-up

- standard left temporal lobectomy 1-20-99
- no further seizures
- mild decline in verbal memory, improvement in naming, receptive language, arithmetic
- carbamazepine discontinued 2-99
- gabapentin discontinued 2-00
- working as financial analyst

Conclusion

- Epilepsy surgery is an underutilized procedure
- Surgically remediable syndrome and medically refractory
- Noninvasive evaluation should be considered early in disease