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, epigastic rising sensation, fear, feeling of unreality or detachment, olfactory hallucination
  - Unilateral sensory disturbance
  - Observable manifestation
    - Focal motor
    - "Jacksonian march"

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

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

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

Video
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

<table>
<thead>
<tr>
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<th>Neonate to 3 yr</th>
<th>3-20 yr</th>
<th>20-60 yr</th>
<th>Over 60 yr</th>
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<tbody>
<tr>
<td>Prenatal Injury</td>
<td>Genetic predisposition</td>
<td>Brain tumors</td>
<td>Vascular disease</td>
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<tr>
<td>Perinatal Injury</td>
<td>Infections</td>
<td>Trauma</td>
<td>Brains tumors</td>
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<tr>
<td>Metabolic defects</td>
<td>Trauma</td>
<td>Vascular disease</td>
<td>Trauma</td>
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<td>Congenital malformation</td>
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<td>Infection</td>
<td>Systemic metabolic derangement</td>
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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
Mesial temporal lobe sclerosis

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

Cavernous Angioma

“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
<table>
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<tr>
<th>Wada test</th>
<th>Other test</th>
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<tr>
<td>To identify language and memory function in each hemisphere separately</td>
<td>PET</td>
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<tr>
<td>Helps predict risks of surgery</td>
<td>SPECT</td>
</tr>
<tr>
<td>• memory</td>
<td>• Neuropsychological test</td>
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<tr>
<td>• language</td>
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<tr>
<td>Helps predict success of surgery</td>
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<td>Same day procedure</td>
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<th>Invasive Monitoring</th>
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<td>Negative non-invasive tests</td>
<td>• EEG electrode placement (intracranial monitoring)</td>
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<tr>
<td>A discrete lesion located near region of seizure onset</td>
<td>• Record seizure with video/EEG in Epilepsy Monitoring Unit</td>
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<tr>
<td>If non-lesional, estimate and place intracranial electrodes based on all non-invasive test results</td>
<td>• When area of seizure onset is not precisely defined during phase I evaluation</td>
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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 or 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

Experiemental: 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

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 considered early in disease