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, epigatric 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

**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
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>
<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><strong>Prenatal Injury</strong></td>
<td>Genetic predisposition</td>
<td>Brain tumors</td>
<td>Vascular disease</td>
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<tr>
<td><strong>Perinatal Injury</strong></td>
<td>Infections</td>
<td>Trauma</td>
<td>Brains tumors</td>
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<td><strong>Metabolic defects</strong></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
Cortical dysplasia

“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 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 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