Diagnosis and Treatment of Seizures in Children

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Introduction

- Seizures:
  - Most common neurological symptom in children and adolescents.
  - Most common visit to pediatric neurologist.
  - Impact in patients, family and society.
Introduction

Impact of seizures:
- Frightening experience.
- Social embarrassments.
- Frequent school absenteeism.
- Lack of control.
- Loss of privileges, limited activities.
- Economical impact.
Seizures Vs. Epilepsy

Seizures:
*Definition:
- clinical symptom.
- Sudden, involuntary alteration in behavior, consciousness, sensation, motor and autonomic function.
Seizures

- Abnormal excessive, synchronous discharge of neurons.

- Electrophysiological evidence of abnormal electrical activity.
Seizures

- Insult to cerebral cortex
  - Neocortical gray matter (Neuronal cell bodies)
  - Limbic system (Hippocampus, Amygdala)

- Not capable of seizures:
  Thalamus, basal ganglia, brainstem, cerebellum.
Epidemiology

- Seizures:
  10%: one seizure by age 20 years.

- Febrile Seizures:
  5% by 5 years of age.
  30% recurrent febrile seizures
  3-4% epilepsy.
Seizures

- Most are Physiologic
  - Fever
  - Infections: sepsis, meningitis, encephalitis.
  - Toxins: cocaine, amphetamines.
  - Trauma (child abuse, accidents)

- Metabolic: hypocalcemia, hypoglycemia, hyponatremia.
- Perinatal events.
- Hypoxia/Ischemia
- Tumors, abscesses.
Epilepsy

- Greek: “to be seized”, “to be attacked”

- Definition:
  - Multiple, recurrent, unprovoked seizures.
  - >24 hours apart.
  - Cause: unknown.
  - Genetics, brain malformations, degenerative/metabolic disorders.
Epidemiology

**Epilepsy:**
- 2.5 million Americans
- 500,000 children/adolescents.

- 1% of all seizures.
- Males > Females.
- Peak: 1st decade, >50 years.
- 35%: Developmental delays
Facts about Seizures

1) Spontaneous
2) Stereotyped
3) Discrete beginning and ending
4) Brief <5 minutes
5) Resolve spontaneously
6) Return to baseline
Facts about Seizures

7) Awake, sleep, awakening
8) Post-ictal phase: common
9) Todd’s paralysis: common
10) Involuntary control.
Clinical Manifestations

- Confusion
- Unconsciousness
- Behavior changes
- Staring spells
- Loss of muscle tone
- Falls
- Shaking, jerking

- Automatism
- Eyes: dazed, glassy, blinking, rolling.
- Incontinence: bowel/bladder.
International Classification of Seizures

1) Generalized Seizures
2) Partial (focal) Seizures
3) Unclassified
International Classification of Seizures

- **Generalized Seizures**:  
  - Bilateral hemispheres  
  - Bilateral body parts  
  - Unconsciousness: common

- Tonic, Clonic, Tonic-Clonic, Myoclonic

- Atonic (drop attacks)

- Absence (Petit Mal)
International Classification of Seizures

**Partial Seizures:**
- Activation of restricted/limited group of neurons.
- Part of one hemisphere
- One side of body
- Unconsciousness: common.
Partial Seizures

A) Simple Partial: no loss of consciousness

B) Complex Partial: loss of consciousness

C) Secondary Generalization.
Partial Seizures

- Clinical Presentation:
  a) *Motor*
  b) *Somatosensory*: visual, auditory, tactile, olfactory, gustatory
  c) *Psychic*: fear, illusion, hallucination, Deja-Vu, dysphasia, time distortions.
  d) *Autonomic*: sweating, pupillary dilation, piloerection.
Unclassified Seizures

- Incomplete data.
- Defy above descriptions.
Differential Diagnosis

- Tics
- Chorea
- Dystonia
- Athetosis
- ADD/ADHD
- Stereotyped habits
- Narcolepsy
- Breath holding spells
- Benign sleep Myoclonus
- Shuddering attacks
- Night terrors.
Differential Diagnosis

- Migraine Syndromes
- Cardiac Dysrhythmias
- Syncope

- Hysteria
- Pseudoseizures
- GERD
Diagnosis

- History:
  - Present, past, family, birth, development
  - New or recurrent spells?
  - Witnesses, Video cameras.
Physical Exam

- General appearance: dysmorphic
- Skin: rash, hypopigmentation, hyperpigmentation, facial angioma.
- Eyes/Fundi: hemorrhage, papilledema, Chorioretinitis.
- Cardiac: murmur, rhythm
- Abdomen: hepatosplenomegaly.
Neurological Exam

- Head Circumstance
- Skull shape
- Mental status
- Cranial Nerves
- Motor

- Sensory
- Reflexes
- Babinski
- Clonus
- Gait/Balance
Diagnostic Tests

- Electroencephalography (EEG):
  - All first unprovoked non-febrile seizures.
  - Determine seizure type
  - Epileptic syndrome
  - Localization
  - Treatment options
  - Risks of recurrence
EEG

- Ideal Procedure:
  - Sleep deprived
  - Awake, drowsy, sleep
  - Photic stimulation
  - Hyperventilation
  - Chloral Hydrate: sedation
EEG

- Normal: can not rule out seizures
- Abnormal: can not rule in seizures
- May repeat
- 24 hours ambulatory EEG
- Video EEG: 24-72 hours.
Neuroimaging

Routine:
- Focal seizures
- Abnormal neurological exam
- Developmental delay
- Remote neurological insult
- Focal findings on EEG
- No cause identified.
Neuroimaging

MRI of Brain:
- Preferred study.
- Detailed anatomy.
- Small lesions.
- Malformations, acute stroke, vessels.
Neuroimaging

- **Head CT scan:**
  - Emergencies: hemorrhage, stroke, edema, mass lesions.
  - Fast, convenient, accessible, preliminary findings.
Laboratory Tests

- Not routinely suggested.
- Individual cases: H & P
Laboratory Tests

- CBC and differential
- Electrolytes
- Glucose, Ca, Mg, Phos
- Urinalysis
- CSF
- CK, Prolactin
- Serum Amino Acids
- Urine Organic Acids
- Lactic Acids
- Pyruvate
- Ammonia
- Chromosomes
- Fragile X
Management and Treatment

- Symptomatic Seizures:
  - Correct/treat causes.
  - Antiepileptics:
    - Seizures persist beyond resolution of the cause.
    - Recurrent.
    - Short term if needed.
Treatment

- Single unprovoked Seizures:
  a) Normal child:
    - Abnormal EEG: (+) treatment.
  b) Neurologically impaired:
    - Normal EEG: suggested.
    - Abnormal EEG: (+) treatment.
Factors in choosing AED

- Seizure type
- Epilepsy syndrome
- EEG results
- Recurrence risks
- Developmental delay
- Age
- Efficacy

- Laboratory monitoring
- Compliance
- Side Effects
- Toxicity
- Cost
- Preparations
- Liver/Renal function
Antiepileptic Drugs

- Phenobarbital
- Valproic Acid (Depakote)
- Phenytoin (Dilantin)
- Carbamazepine (Tegretol)
- Benzodiazepines (Valium, Clonazepam)
- Ethosuxamide (Zarontin)
- ACTH
- Oxcarbazepine (Trileptal)
- Topiramate (Topamax)
- Levetiracetam (Keppra)
- Lamotrigine (Lamictal)
- Zonisamide (Zonegran)
- Gabapentin (Neurontin)
- Felbamate (Felbatol)
Monotherapy in Children

General Seizures:
- Phenobarbital
- Valproic Acid (>3 y.o.)
- Ethosuxamide (Absence)
- Phenytoin
Monotherapy in Children

Partial Seizures:
- Carbamazepine
- Oxcarbazepine (>4 y.o.)
- Topiramate (>10 y.o.)
- Phenytoin
- Phenobarbital
Monotherapy

- Majority respond well.
- Start low dose
- Increase slowly
- Minimize side effects, toxicity
- Reach full maintenance
- Increase as needed
Adjunctive/Polytherapy

- Minority of patients
- Minimal/no response to monotherapy
- More than one seizure type
- Different mechanism of action
- Adjust doses
- Minimize toxicity/side effects
Adjunctive/Polytherapy

- Oxcarbazepine (>2 y.o.)
- Topiramate (>2 y.o.)
- Gabapentin (>16 y.o.)
- Zonisamide (>16 y.o.)
- Levetiracetam (>16 y.o.)
- Lamotrigine (>4 y.o.)
- Felbamate (Refractory)
Complications

- Phenobarbital: cognitive/speech delays
- Carbamazepine: Leukopenia
- Valproic Acid: hepatotoxicity, pancreatitis
- Felbamate: Aplastic Anemia
- Lamotrigine: Stevens Johnson Syndrome
- Topiramate: renal stones, acidosis, weight loss
- Ethosuxamide: Leukopenia
- Phenytoin: gingival hyperplasia, hirsutism
Treatment

- **Duration:**
  - Individual cases
  - Seizure free: minimum two years

- **EEG:**
  - Normal: may wean AED
  - Abnormal: continue longer
Treatment

Ketogenic Diet:
- Ketosis: antiepileptic effect.
- High fat, low carbohydrate, low protein
- Refractory seizures:
  Decrease frequency by 40%
  Decrease AED doses and numbers
- Two years duration
Vagal Nerve Stimulator

- FDA approved 1988
- Children >12 years
- Refractory seizures
- Not candidates for surgery
- Decrease seizure frequency, duration and medications by 40%
Epilepsy Surgery

- Refractory seizures
- Adverse cognitive/psychosocial impact

Procedures:
- Type of seizure
- Localization
Epilepsy Surgery

Procedures:
- Lobar resection (Temporal lobectomy)
- Hemispherectomy
- Corpus Callosumomy
- Multiple Subpial transection
- Stereotactic radiosurgery
Conclusion

- Accurate diagnosis is essential
- Epilepsy: remains challenging
- No cure available
- Optimize patient safety and function
- Optimize family and caregiver support