Stop That Seizure Activity

Cynthia Bautista, PhD, RN, CNRN, SCRN, CCNS, ACNS-BC, FNCS
Nursing Brains, LLC
cabbrain@aol.com

Discovered by…..

- 19th-century physician
- John Hughlings Jackson
- Based solely on clinical observations
- His contributions to the field of epilepsy continue to be recognized by modern medical sciences.

Statistics

- Affects almost 3 million Americans of all ages
- Estimated annual cost of $15.5 billion in direct and indirect costs
- Approximately 200,000 new cases occur/year
- 10% of the American population will experience a seizure in their lifetime
- 3% will develop epilepsy by age 75

Definitions

- Seizure
  - Sudden, single event, excessive disorderly discharge of neurons
- Epilepsy (Recurrent Seizures)
  - Chronic condition in which seizures are recurring

Pathophysiology

- Neurotransmitters generally have one of two special functions
- One type is responsible for encouraging cell-to-cell communication - referred to as an “excitatory” neurotransmitter
- Second type is able to slow down, or even stop cell-to-cell communication called an “inhibitory” neurotransmitter
- Seizure due to overactivity of excitatory neurotransmitters or underactivity of inhibitory neurotransmitters
  - Allowing an uncoordinated flow of electrical activity in the brain.

Etiology

- Idiopathic (70% of all cases)
- “Essential” epilepsy - primarily genetic
- “Acquired” epilepsy
  - Trauma, CNS infection, tumors, cerebral vascular, alcohol withdrawal
- Other Causes
  - Fever, electrolyte imbalance, medications
Triggers

- Missed medication
- Sleep and wake cycles
- Hormonal fluctuations
- Pregnancy (depends on pre-pregnant frequency)
- Menstrual cycles
- Excessive use/withdrawal from alcohol or drugs
- Illness
- Fever
- Adding/removing prescription medications

Triggers (con’t)

- Flickering lights (photosensitive epilepsy)
- Emotional stressors
  - Worry, anxiety, and anger
  - Combined with fatigue or chronic sleep loss
- Unpredictable changes in metabolic factors
  - Vomiting, diarrhea, hypoglycemia, electrolyte imbalance, hypoxia, and physical stress

Febrile Seizures

- Brought on by fever (> 102°F)
- Small infant or child (6 months/5 years old)
- Usually 1st day of fever
- Loses consciousness, shakes
- Lasts 1 to 2 minutes (up to 15 minutes)

Febrile Seizures (con’t)

- Stay calm, observe
- Place on side
- Once ended take to MD
- Lasts > 10 minutes call 9-1-1
- MD to check source of fever
- No treatment needed
- May give AED (diazepam) during fever

Focal Seizures

- 80% of people who have seizures
- Starts in only one part of the cerebral cortex
- Altered/no change in consciousness
- Develop into generalized seizure (Secondarily Generalized Seizure)

Classification - Focal Seizures

- Simple Focal Seizure
  - Hand may shake
  - “Feel strange”
  - Mouth may twitch uncontrollably
  - Lasts up to 90 seconds
  - Doesn’t affect consciousness (aware & alert)
  - Auras before seizure
    - Dizzy, unusual feeling, smell, sound, or sight
Classification - Focal Seizures

- Complex Focal Seizure
  - Staring straight ahead, looking around
  - Fidgeting with clothes
  - Lip smacking
  - Aimless wandering
  - Pats or rubs arms repeatedly (automatisms)
  - LOC is impaired (confused, no memory)
  - Last 1-2 minutes

Auras

- Warning signs of an impending seizure
- Usually some kind of sensory experience
  - Smell, taste, auditory or visual hallucination, feeling in stomach or déjà vu
  - "It's just a feeling"

Generalized Seizures

- 20% of people who have seizures
- Begins in widespread fashion
- Sudden onset
- Loss of consciousness

Classification - Generalized Seizures

- Tonic - Clonic Seizure
  - Grand Mal
  - Entire cerebral cortex is involved
  - Unconscious
  - Tonic Phase and Clonic Phase
  - Cry out – Ictal cry
  - Incontinent
  - Doesn’t feel, see, or remember anything during seizure
  - Lasts 1-2 minutes

Classification - Generalized Seizures

- Myoclonic Seizure
  - Layers of cerebral cortex affecting movement
  - Generalized jerking of an extremity
  - Less than 5 seconds
  - Brief, easy to miss period of unconsciousness
  - DO NOT LOSE CONSCIOUSNESS!!!
  - Occur in clusters

Classification - Generalized Seizures

- Tonic Seizure
  - Muscles become stiff
  - Fall backwards
  - Brief
  - Happen without warning
  - Recover quickly
Classification
Generalized Seizures

- Clonic Seizure
  - Body does not get stiff at the start
  - Recover quickly

- Absence Seizure
  - Petit Mal
  - Brief loss of consciousness
  - Staring or blanking out spells
  - May exhibit rapid blinking, chewing, or aimless movements of head or limbs
  - Last 2 - 15 seconds
  - More often in children

- Atonic Seizure
  - Drop attack
  - Sudden loss of muscle tone (fall)
  - Loss of consciousness
  - Recover quickly

Classification
Status Epilepticus

- Continuous seizure
- Lasting at least 5 minutes “OR”
- Two or more discrete seizures between which there is incomplete recovery of consciousness
- Medical emergency
- 20% mortality rate

Treatment of Status Epilepticus
Columbia University Protocol - 2006

<table>
<thead>
<tr>
<th>First 5 minutes</th>
<th>ABCs</th>
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<tbody>
<tr>
<td>6-10 minutes</td>
<td>Ativan 4mg IVP over 2’  Repeat in 5’</td>
</tr>
<tr>
<td>10 – 20 minutes</td>
<td>Fosphenytoin 20mg/kg IV at 150mg/minute  Dilantin 20mg/kg (rate 50mg/min)</td>
</tr>
<tr>
<td>If persist, give one of the following</td>
<td>Versed, Propofol, Valproate, Phenobarbital</td>
</tr>
<tr>
<td>&gt; 60 minutes</td>
<td>Pentobarbital</td>
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IM vs. IV Therapy for Prehospital Status Epilepticus

- 2012 in NEJM
- Patients in status epilepticus treated with IM midazolam by paramedics arrived at ED still in status less often than those treated by IV lorazepam.
Unconventional Therapies Refractory Status Epilepticus

- **Ketamine**
  - Non-competitive NMDA receptor antagonist
  - Fewer hemodynamic effects (↑BP)
  - Bolus and Infusion
- **Lidocaine**
  - Antiarrhythmic, blocks sodium channels
  - Lack of sedative effect, abrupt onset
  - Bolus 100mg

Classification Non-Convulsive Seizure

- Mental status change or subtle eye movement from baseline of at least 30-60° with continuous ictal discharges on EEG
- 30% of NICU patients in seizure
- 16% are TBI
- 8% of patients in coma
- Monitor with continuous EEG for 24 hours
- Difficult to treat with AEDs
  - Try phenytoin, lorazepam, or levetiracetam (Keppra)

Nonepileptic Seizures

- Looks like a seizure
- Treated on average 7 years for seizure
- 70% are women (History of Trauma)
- Compare EEG tracing and audio-video monitoring
- Physiologic event
  - Cardiac, respiratory, metabolic, or drug disturbance
- Psychogenic event
  - Emotional upset, needing attention

Nonepileptic Seizures (con’t)

- Psychogenic
  - Onset is dramatic, bizarre, gradual, in the presence of witness
  - Emotional upset before nonepileptic seizure
  - Last longer then real seizure
  - Dramatic, violent flinging of extremities, wiry movement, inconsistent pattern
  - Screaming throughout with eyes closed
  - Does not occur during sleep

Differentiation Epileptic - Nonepileptic

<table>
<thead>
<tr>
<th>Epileptic</th>
<th>Nonepileptic</th>
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<tbody>
<tr>
<td>Clear start, evolution and stopping point</td>
<td>May slow down and start again</td>
</tr>
<tr>
<td>Eyes open and deviated</td>
<td>Eyes closed</td>
</tr>
<tr>
<td>Stereotypical events</td>
<td>Variation from one event to another</td>
</tr>
<tr>
<td>Improve with use of antiepileptic drugs</td>
<td>No change with use of antiepileptic drugs</td>
</tr>
<tr>
<td>Duration is seconds to minutes</td>
<td>Duration can be minutes to hours</td>
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</tbody>
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Epileptic Seizure Characteristics

<table>
<thead>
<tr>
<th>Common</th>
<th>Not Common</th>
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<tbody>
<tr>
<td>Incontinence</td>
<td>Side to side shaking head</td>
</tr>
<tr>
<td>Tongue biting</td>
<td>BILATERAL asynchronous movements</td>
</tr>
<tr>
<td>Significant injury</td>
<td>Weeping</td>
</tr>
<tr>
<td>Significant postictal confusion</td>
<td>Stuttering</td>
</tr>
<tr>
<td></td>
<td>Arching back</td>
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<tr>
<td></td>
<td>Forward pelvic thrusting</td>
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<td></td>
<td>Lack of rigidity</td>
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Think About for Nonepileptic Seizure

- Appropriateness of level of concern
- Over dramatization or hysteria
- History of abuse
- Co-existing, poorly defined conditions
  - Fibromyalgia
  - Chronic pain
  - Chronic fatigue

Prehospital Care

- Mostly supportive; most seizures are of SHORT duration, especially pediatric simple febrile seizures
- Provide ABCs as necessary
- Assess temperature, blood glucose, and spinal precautions.
- IV access should be obtained for almost all patients
  - Defer with simple febrile seizures
- EMS protocols should include benzodiazepines (IV, IM or PR) for prolonged seizures or Status Epilepticus

Differential Diagnosis

- Delirium Tremens
- Delirium, Dementia, and Amnesia
- Eclampsia
- Encephalitis
- Epidural and Subdural Infections
- Febrile Seizures
- Heatstroke
- Hyperventilation Syndrome
- Hypoglycemia
- Hypothalamic
- Hypothyroidism and Myxedema
- Coma
- Meningitis
- Movement Disorders in Individuals with Developmental Disabilities
- Hemorrhagic Stroke
- Ischemic Stroke
- Subarachnoid Hemorrhage
- Syncope
- Anticholinergic Toxicity
- Antidepressant Toxicity
- Antihistamine Toxicity
- Carbon Monoxide Toxicity
- Cardiac Arrhythmias
- Cyclic Antidepressant Toxicity
- Isoniazid Toxicity
- Transient Global Amnesia
- Transient Ischemic Attack
- Withdrawal Syntheses

Diagnostic Evaluation

- History
- CT/MRI
- EEG
- Video/EEG Monitoring
- PET/SPECT
- Neuropsychological testing
- Glucose level (< 40 mg/dL)

Seizure History

- How long having seizures?
- Frequency (particular time of day)
- Precipitating factors (sleep deprivation, alcohol use)
- How long do they last?
- Aura
- Explain the seizure clinical activity
- Previous falls

Electroencephalogram

- Records electrical activity of the brain
- Multiple scalp electrodes
  - Even #’s on the RIGHT, Odd #’s on the LEFT
- Assess
  - Increasing or decreasing frequency (cycles/seconds)
  - Amplitude
    - Low < 20, Medium 20-50, High > 50microvolts
    - Isoelectric or burst suppression
  - Symmetry (compare right and left hemispheres)
**EEG**

- Epileptiform abnormalities
  - Spikes/sharp waves
  - Slow and fast waves combined in paroxysmal runs

**Video- EEG Monitoring**

**PET/SPECT**

- Metabolic activity
- Seizure in hypometabolic area

- Blood perfusion
- Seizure increased blood perfusion

**Assessment**

<table>
<thead>
<tr>
<th>Before</th>
<th>During</th>
<th>After</th>
</tr>
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<tbody>
<tr>
<td>Aura</td>
<td>Type of movement</td>
<td>Behavior</td>
</tr>
<tr>
<td>Began where</td>
<td>Change in pupil size</td>
<td>Weakness/paralysis</td>
</tr>
<tr>
<td>Conjugate gaze</td>
<td>Injuries</td>
<td></td>
</tr>
<tr>
<td>Duration</td>
<td>Sleepy</td>
<td></td>
</tr>
<tr>
<td>Unconscious</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Incontinence</td>
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**Priorities of Care in the ED**

- Recognize a seizure
- Control seizure activity aggressively
  - Neurologic dysfunction is theorized to occur after 20 minutes of continuous seizure activity
  - Aggressive treatment of any seizure activity that lasts over 5 minutes
- Consider underlying etiology
  - Medication noncompliance
  - Subtherapeutic medication levels
  - Screen for underlying infectious or metabolic causes
  - Consider laboratory and imaging studies

**Nursing/Medical Management**

- **Immediate Interventions**
  - If aura....
  - Note time of onset,....
  - Stay with patient, head-tilt, chin-lift
  - Turn patient on side
  - Move objects
  - Administer AEDs as ordered
  - PRN benzodiazepines
  - Airway management if needed
Ictal Assessment

- Responsiveness
  - Describe how you are feeling
  - Assess orientation (name, where are you?)
- Awareness
  - Give word/phrase to remember (color/object) "blue elephant"
- Language
  - Name an objects (pencil, watch)
- Motor Function
  - Stick out your tongue
  - Show me two fingers

Nursing/Medical Management

- After Seizure
  - Reorient patient, "what just happened?"
  - Ask about aura, "Can you remember the object?"
  - Assess postictal paralysis (smile, drift)
  - Test language (name object, "no ifs, ands or buts"
  - Assess for injuries
  - Allow to rest, patient may be lethargic
  - Institute seizure precautions(siderails of bed are up and padded, suction setup is available, and bed is kept in lowest position)

Antiepileptic Medication

- 60% of patient will be seizure free on a single medication
- 50% achieve seizure freedom on the first medication used
- 70% seizure free with adherence to medication use

Antiepileptic Medication

- Possible Side Effects
  - Dose-Related
    - Double vision, unsteadiness, dizziness, sleepiness, headache, stomach upset, slowness
  - Idiosyncratic
    - Rash, blood disorders, liver failure, psychosis, depression
  - Chronic
    - Weight gain, vitamin deficiencies, change in facial appearance, acne, mood swings, sedation

Reasons for Noncompliance (50%)

- Frequency of dosing medication
- Financial difficulties
- Misunderstanding of instructions
- Lack of information
- Inconvenience of time of medication dosing
- Undesirable side effects
- Prescription expires/delay to refill

Reasons for Noncompliance (con't)

- Doing well
- Forgetfulness
- Poor family support
- Dependency
- Feeling powerlessness
- Embarrassment seen taking medication
- Lack of knowledge
- Poor patient-doctor relationship
Selecting Primary Drug for Seizure Type

<table>
<thead>
<tr>
<th>Partial Seizure</th>
<th>Generalized Seizure</th>
</tr>
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<tbody>
<tr>
<td>Carbamazepine</td>
<td>Valproate</td>
</tr>
<tr>
<td>Valproate</td>
<td>Phenytoin</td>
</tr>
<tr>
<td>Phenytoin</td>
<td>Lamotrigine</td>
</tr>
<tr>
<td>Lamotrigine</td>
<td>Phenytoin (Dilantin)</td>
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Phenytoin (Dilantin)

- **Indications for use**
  - Generalized tonic-clonic seizures
  - Limit spread of seizure activity
- **Dose**
  - 15-20mg/kg load
  - Not to exceed 50mg/min
- **Therapeutic level**
  - Total level: 10 to 20 ug/dl (treat the patient)
  - Free level (unbound drug): 1-2 µ/dl

Phenytoin (Dilantin)

- **Patient care considerations**
  - Administered IV in normal saline only with filter
  - Cardiac monitoring required
    - Arrhythmia, hypotension, hyperglycemia
  - Consider food/drug interaction with liquid phenytoin when patient is receiving enteral feedings
  - Monitor serum concentrations closely
  - Monitor LFTs
  - Side effects include gingival hyperplasia, nystagmus, dizziness, and drowsiness

Fosphenytoin (Cerebyx)

- **Indications for use**
  - Control of status epilepticus
- **Dose** — IV or IM
  - Load 10-20 mg PE/kg
  - 150mg PE/min
  - Maintenance 4-6mg PE/KG (2 doses)
- **Therapeutic level**
  - Converts to phenytoin, so measure phenytoin levels

Fosphenytoin (Cerebyx)

- **Patient care considerations**
  - Doses are always written in phenytoin equivalents (PEs)
  - Continuous cardiac monitoring is required through time when maximum serum phenytoin concentrations occur (10-20 minutes following end of infusion)
  - Inhibits insulin release, check hyperglycemia

Levetiracetam (Keppra)

- **Indications for use**
  - Focal and tonic-clonic seizures
  - Broad-spectrum antiepileptic drug
- **Dose**
  - 1,000 – 3,000 mg/day PO
  - Oral tablets, extended release, solution, and IV
- **Therapeutic levels**
  - None established
Carbamazepine (Carbatrol, Tegretol, Tegretol-XR)

- **Indications for use**
  - Partial, generalized, and mixed type seizures
  - Elevates seizure threshold
- **Dose**
  - 400-2400 mg PO
  - Suspension, chew tabs, extended release, sprinkles
- **Therapeutic levels**
  - 4-8 (4-12)µg/dl

Patient care considerations
- Baseline lab work should be obtained and ongoing monitoring of CBC
- Blurred or double vision, nystagmus, dizziness, drowsiness may occur
- May decrease effectiveness of lamotrigine and valproic acid

Valproic Acid (Depakote, Depakene)

- **Indications for use**
  - Absence and partial seizures
- **Therapeutic level**
  - 50-100 µg/dl
- **Patient care considerations**
  - Weight gain, platelet dysfunction, possible hepatic toxicity
  - Monitor liver function, CBC

Phenobarbital (Luminal)

- **Indications for use**
  - Generalized tonic-clonic seizures
  - Elevates seizure threshold
- **Dose**
  - 100 – 240mg/kg
- **Therapeutic levels**
  - 15-40 µg/dl
- **Patient care considerations**
  - Monitor for sedation, respiratory compromise

Lamotrigine (Lamicatal)

- **Indications for use**
  - Partial, generalized
- **Dose**
  - 300 – 500 mg/day
- **Patient care considerations**
  - Titrate slowly assess for Stevens-Johnson rash

Adjunctive AEDs

- Zantac
- Celontin
- Klonopin
- Topimax
- Tiagabine
- Neurontin
- Mylosine
- Felbatol
- Keppra
- Zonegran
- Trileptal
Breakthrough/Rescue Medications

- Generalized Seizure
  - Diastat
- Partial Seizure
  - Klonopin

Ketogenic Diet

- Developed at John Hopkins – 1940
- High-fat, low-carbohydrate, low-protein
- Results in ketosis
  - Change in pH, lack of glucose affects neuronal firing rates, decrease seizure
- Effective for seizure not controlled by AEDs or intolerable side effects from AEDs
- Diet for 2 years...wean off

Social Issues

- Employment
  - Cannot be denied a job
  - Ability to do a job must be evaluated individually
- Driving
  - Rules vary from state to state
  - Seizure free for a specified period of time
  - Six states require MD to submit newly diagnosed
- Family
  - Role changes

Social Issues (con't)

- Activities
  - Avoid high-risk activities (scuba diving, hang gliding, mountain climbing)
  - Do not swim alone
- Relationships
  - More isolated than normal
  - Inform partner about seizure activity
- Psychiatric Disease
  - Not uncommon
  - Anxiety, depression, paranoia, schizophrenia

Brain Pacemaker (NeuroPace)

- Responsive Neurostimulator
- Monitors brain’s electrical activity
- Seizure activity is detected
  - Slowing of EEG
- Stimulator responds - delivers mild electrical stimulation
- Stopping seizure activity

Questions????