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VIRGINIA COMMONWEALTH UNIVERSITY

Department of
Emergency Medicine
Pediatric Seizures
Initial Approach

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Faculty Disclosure

I have no relevant financial relationships with industry to disclose

-and-

I will not discuss off label use and/or investigational use in my presentation

Objectives



- To recognize pediatric seizures
- Differentiate the different types of pediatric seizures
- Develop a differential diagnosis and management plan to pediatric patients with seizures

Are seizures common?

- Seizures are common, frightening events in the pediatric population, and are likely to prompt a 911 call
- 4-6% of all children will have at least one seizure in the first 16 years of life;
- 0.5% to 1% will develop epilepsy

Definition

Seizure- Convulsion- Epilepsy

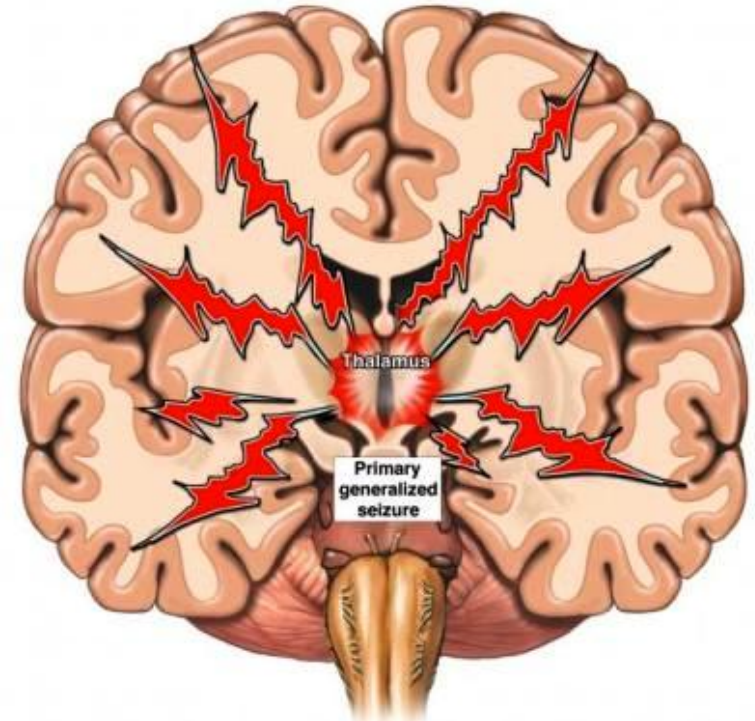
SUDDEN

TRANSIENT

INVOLUNTARY

ALTERATION of

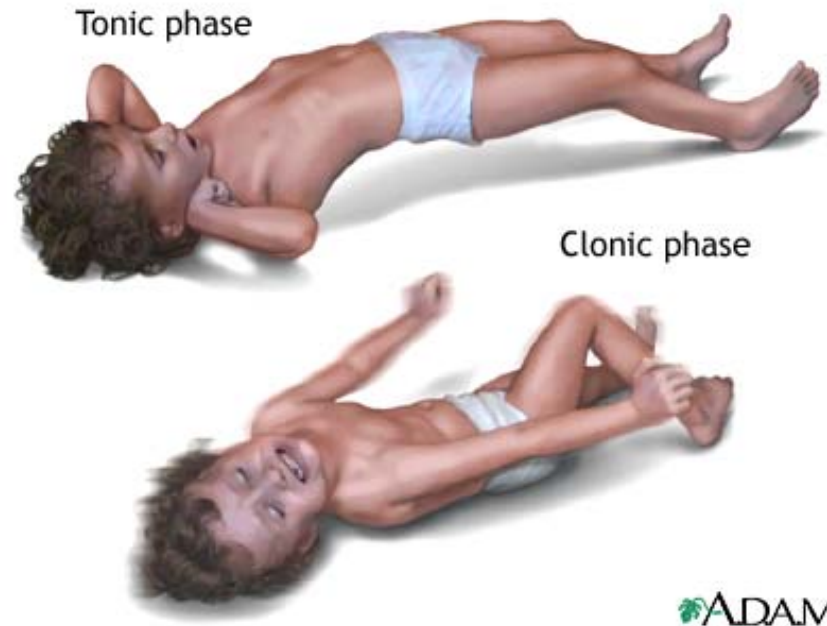
consciousness, behavior,
motor activity, sensation
and/or autonomic function
caused by EXCESSIVE RATE
AND HYPERSYNCHRONY OF
DISCHARGES from a group of
cerebral neurons.



Definition

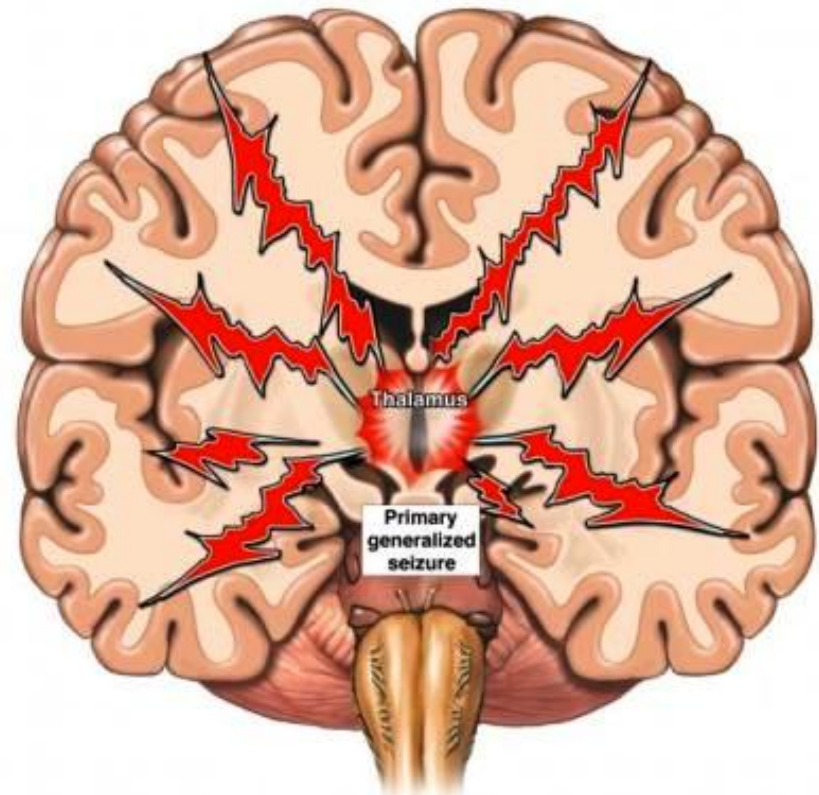
Seizure- **Convulsion**- Epilepsy

Seizure with prominent
**ALTERATIONS of MOTOR
ACTIVITY**



Definition Seizure- Convulsion- Epilepsy

A condition of
RECURRENT SEIZURES

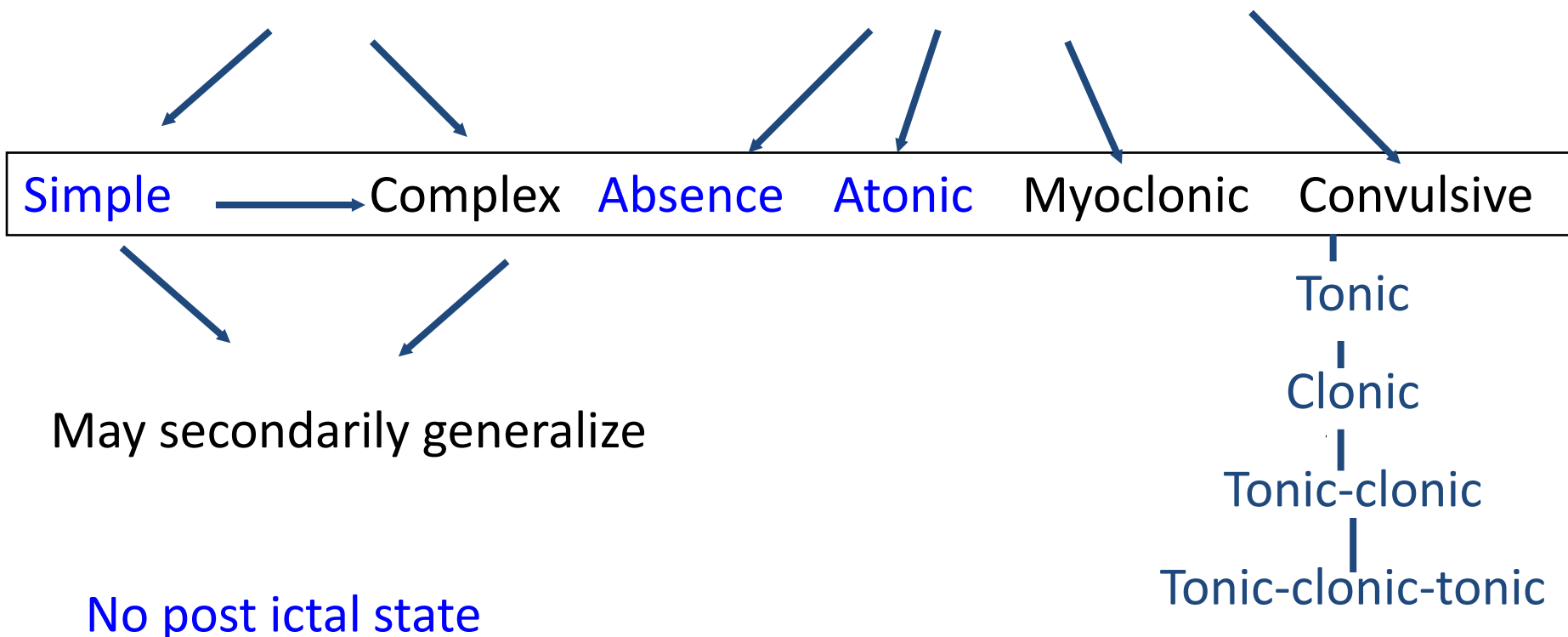


Seizure Classification



Partial (Focal)(40%)

Primary Generalized (60%)



Seizure Classification



GENERALIZED

- Impairment of Consciousness may be initial manifestation
 - Atonic= Drop attack (1sec)
 - NO POSTICTAL STATE
 - Absence
 - NO POSTICTAL STATE

PARTIAL (Focal)

- AURA
- SIMPLE no change in consciousness- NO POSTICTAL STATE
- COMPLEX- Change in consciousness

Generalized Seizure Classification: Descriptions



- Absence - Abrupt lapses of consciousness lasting a few seconds
- Atonic - Abrupt, unexpected loss of muscle tone
- Myoclonic - Rapid short contractions of one or all extremities
- Tonic-Clonic (grand Mal) – the combined event is rare in infancy, more common during childhood
- **Besides febrile seizures most seizures in the younger age groups are either tonic or clonic**
- Tonic – Generalized muscle stiffening, loss of consciousness, fall, back arching, vocalization
- Clonic – Muscles spasm and jerking. Flexion of elbows, legs and head followed by rapid relaxation. Frequency of the spasms gradually subside until they cease

- Small groups
- work on case 1

Initial Evaluation

- Helpful clinical features
 - Age
 - Fever?
 - Generalized or focal
 - Prior hx
 - Post seizure exam
 - Duration of seizure
 - Hx of trauma?

Case 1



- 2-year old boy at preschool loss of consciousness
- Jerking of arms and legs 1-2 minutes
- The teacher calls 9-1-1
- Drowsy, opens eyes but does not answer questions and cries when touched
- No abnormal airway sounds, no increased work of breathing and skin color is normal
- RR= 30 breaths/minute
- HR= 100 beats/minute
- BP= 110/58
- No focal neurologic findings.
- The child feels warm.
- He becomes more responsive during your assessment and begins to ask for his father

Case 1

Stable?

Likely diagnosis?



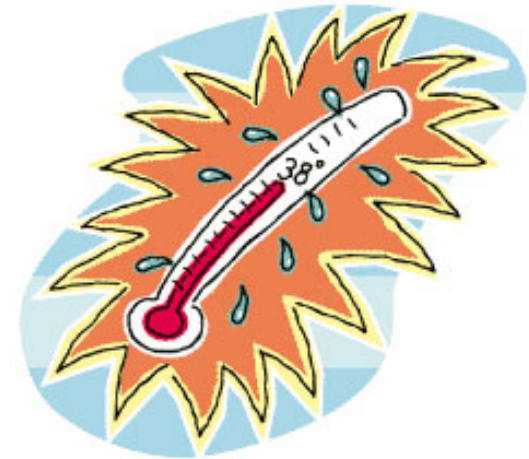
Case 1



- Management
 - Address caregiver's fears
 - Education regarding fever and seizure
 - Focused history
 - TRANSPORT
 - Do NOT diagnose febrile seizure in the field
 - If still febrile → No cool bath, no ice or cold water or alcohol / they lead to shivering and increase core temperature

What is a Febrile Seizure?

- 6 through 60 months
- Seizure accompanied by fever (temperature $\geq 100.4^{\circ}\text{F}$ or 38°C by any method), (before, during or after)
Without
 - Central nervous system infection
 - Metabolic disturbance
 - History of previous seizure disorder
- Benign



Febrile Seizure

- Caused by the increase in the core body temperature greater than 100.4F or 38C
- Threshold of temperature which may trigger seizures is unique to each individual
- Can occur within the first 24 hours of an illness
 - Can be the first sign of illness in 25 - 50% of patients

Are Febrile Seizures Common?

- They occur in 2% to 5% of all children
- Most common convulsive ever in children younger than 60 months
- May be either simple or complex type seizure

Febrile Seizure



A **Febrile seizure** also known as a **fever fit** or **febrile convulsion** is a generalized convulsion caused by a fever in infants or small children. During a febrile seizure, a child often loses consciousness and shakes

Febrile Seizures

SIMPLE vs COMPLEX



- SIMPLE

- Febrile Child
- Generalized tonic clonic seizure
- <15 mins

- COMPLEX

- Febrile Child
- focal and/or
- prolonged (>15 minutes)
- and/or occur in a series over 24 hours

Febrile Seizure Management/Evaluation Guidelines



- AAP practice guidelines (2011)
- Simple Febrile Seizures
 - Identify the cause of fever
 - Consider Meningitis in the differential
 - Perform LP if the child is ill-appearing or if there are clinical signs or symptoms of concern
 - LP is an option in a 6 to 12 mo deficient in Hib and S pneumoniae immunizations or unknown immunization status
 - LP is an option if pretreated with antibiotics
 - Does not require EEGs, blood studies, or neuroimaging
- Complex Febrile Seizures
 - No consensus guidelines for complex febrile seizure management



Febrile Seizures

Recurrence Risk Factors

- 4 risk factors for recurrence :
 - age of onset < 18 months
 - low fever < 102 degrees
 - brief duration of fever < 1 hour
 - family history of febrile seizures
- 14% of children with no risk factors, vs. 64% with with 3 or 4 risk factors [Berg]

Febrile Seizures

Risks associated with febrile seizures

- Decline in IQ?
 - No
- Increased risk of epilepsy?
 - By 7 yo, same as general population ~1%
 - If multiple events, <12 months first time, family history of epilepsy: ~2.4% generalized afebrile seizures by 25 yo
 - No evidence that simple febrile seizures cause structural damage to the brain
 - Increased risk of epilepsy is likely the result of genetic predisposition

Febrile Seizures

Risks associated with febrile seizures

- Risk of Recurrent febrile seizures?
 - Yes
 - varies with age
 - If <12 months at the time of first simple febrile seizure : ~50% probability of having recurrent febrile seizures.
 - If > 12 months at the time of first event: ~30% probability of a second febrile seizure;
 - If had a 2nd event: ~50 % have a chance of having at least 1 additional recurrence
- Death?
 - Not reported to date. Theoretical risk

Febrile Seizures Prevention



- Continuous anticonvulsant therapy
 - Valproic acid and phenobarbital significantly more effective than placebo
 - Adverse effects outweigh the benefits (hepatotoxicity, behavioral effects)
- Intermittent anticonvulsant therapy
 - oral diazepam (given at the time of fever) could reduce the recurrence of febrile seizures
- Antipyretics
 - No studies have demonstrated that antipyretics, in the absence of anticonvulsants, reduce the recurrence risk of simple febrile seizures

Febrile Seizure: Question 1



1. Simple Febrile Seizures:
 - A. Indicate an underlying neurological condition
 - B. Require anticonvulsant medication
 - C. Occur in children 6 months to 5 years of age
 - D. Frequently lead to epilepsy

Febrile Seizure: Question 2



- 2. Which of the following are important history questions?
 - A. Was there trauma ?
 - B. What did the seizure look like?
 - C. Medications and herbal supplements?
 - D. All of the above

Febrile Seizure: Question 3



- 3. Diagnostic workup in the ED is based on suspicions of:
 - A. Meningitis
 - B. Trauma
 - C. Unknown immunization status
 - D. All of the above



- Small Groups Work on Case 2

Case 2

- 24 month old m is unconscious and has generalized body shaking with jerking of upper and lower extremities
- Patient was sitting in bed this morning when mom noted that he started losing interest in surroundings, eyes deviated to the left and then started having the jerking movements

Case 2

Pediatric Assessment Triangle



- Appearance: Pale, Not responding, eyes deviated to the left, generalized jerking of arms and legs, arms flexed
- Work of Breathing: Rapid, Shallow respirations
- Circulation : Perioral cyanosis, capillary refill 5 sec
- HR 190 Temp 39C (102.2) BP 130/65 RR 50 Pox 85%

Case 2



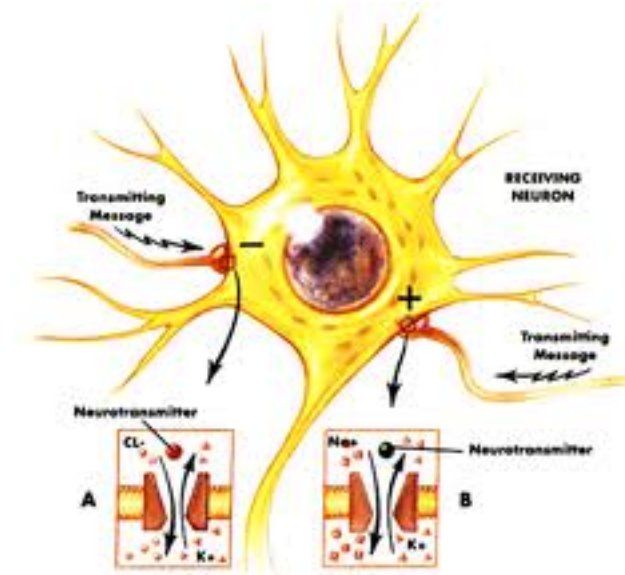
- What questions do you ask?
 - Duration?
 - Prior seizures?
 - Febrile earlier?
 - Family hx of seizures?
 - Trauma?
 - Medical problems?
 - Medications?
 - Immunizations?
 - Started 5 mins ago/ongoing
 - No prior seizures
 - Yes for 4 days
 - No
 - No
 - No
 - No
 - Not immunized

Status Epilepticus

Prolonged seizure activity (More than 5-20/30 minutes)

OR

Repetitive seizures without recovery of consciousness in between



Status Epilepticus



- May be child's 1st seizure
- Risk of brain injury most closely related to the cause of the seizure not the length of the seizure
- Progressive causes: Hypoxia, infection, toxic ingestion (<3 year old patients)
- Chronic static causes: Epilepsy, inadequate treatment (older children)
- **MEDICAL EMERGENCY TREAT UPON ARRIVAL**

Significance of Early Treatment

- ↑ seizure duration →
 ↑ treatment resistance
- Earlier treatment →
 ↑ treatment success
- q1 minute seizure →
 ↑ SE risk 5%

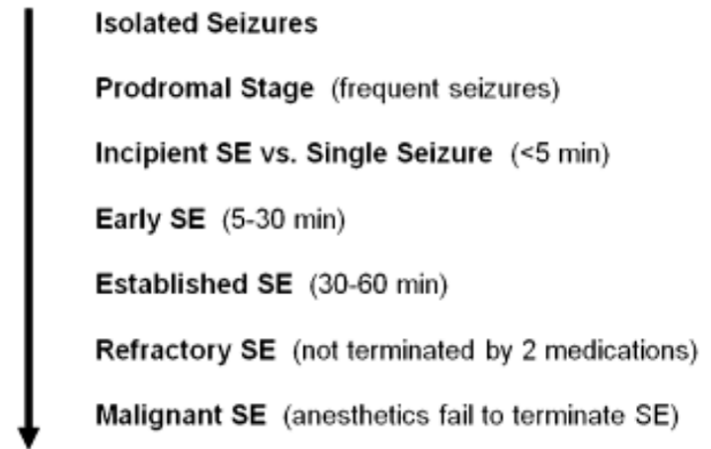


FIGURE 1. Continuum of seizures to status epilepticus.

Abend et al, Ped Emerg Care, 2008

Assessment and Treatment of the Actively Seizing Child



- Open the airway
 - Do not attempt to intubate a seizing child
 - Consider C spine protection in post-traumatic seizure
- Breathing- OXYGEN, Assist ventilation
- Circulation-IV/IO access IV fluids not necessary unless sepsis or trauma
- Disability-Check bedside glucose and treat hypoglycemia



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Assessment and Treatment of the Actively Seizing Child



- Anticonvulsants
 - First Line: Benzodiazepine: Diazepam, midazolam, lorazepam
 - Second Line: phenytoin, fosphenytoin, phenobarbital
- Transport (ongoing assessment, detailed physical exam)

Status Epilepticus: First Line Agent: Diazepam

- Diazepam (Valium)
 - Fat-soluble
 - Can't be mixed
 - Delivered IV or PR
 - IV: 0.1mg/kg
 - PR: 0.5mg/kg
 - Onset in 1-3 minutes,
duration 20-30 minutes
(side effects longer)



Status Epilepticus

First Line Agents: Lorazepam



- Lorazepam (Ativan)
 - Fat-soluble, but less so than diazepam
 - Should be refrigerated or replaced every 30 days and kept away from heat and extreme temperature
 - can't be mixed
 - Delivered IV/IO/IM
 - IV dose 0.05-0.1 mg/kg
 - Rapid Onset: 3-5 minutes
 - Long half life

Status Epilepticus

First Line Agents: Midazolam



- Midazolam (Versed)
 - Water-soluble
 - Can be mixed
 - Delivered IV, IN, IM, PR
 - IV: 0.1 mg/kg
 - IM: 0.05-0.1mg/kg
 - IN: 0.2 mg/kg
 - PR: 0.5 mg/kg
 - Onset: Rapid

Status Epilepticus: First Line Agents



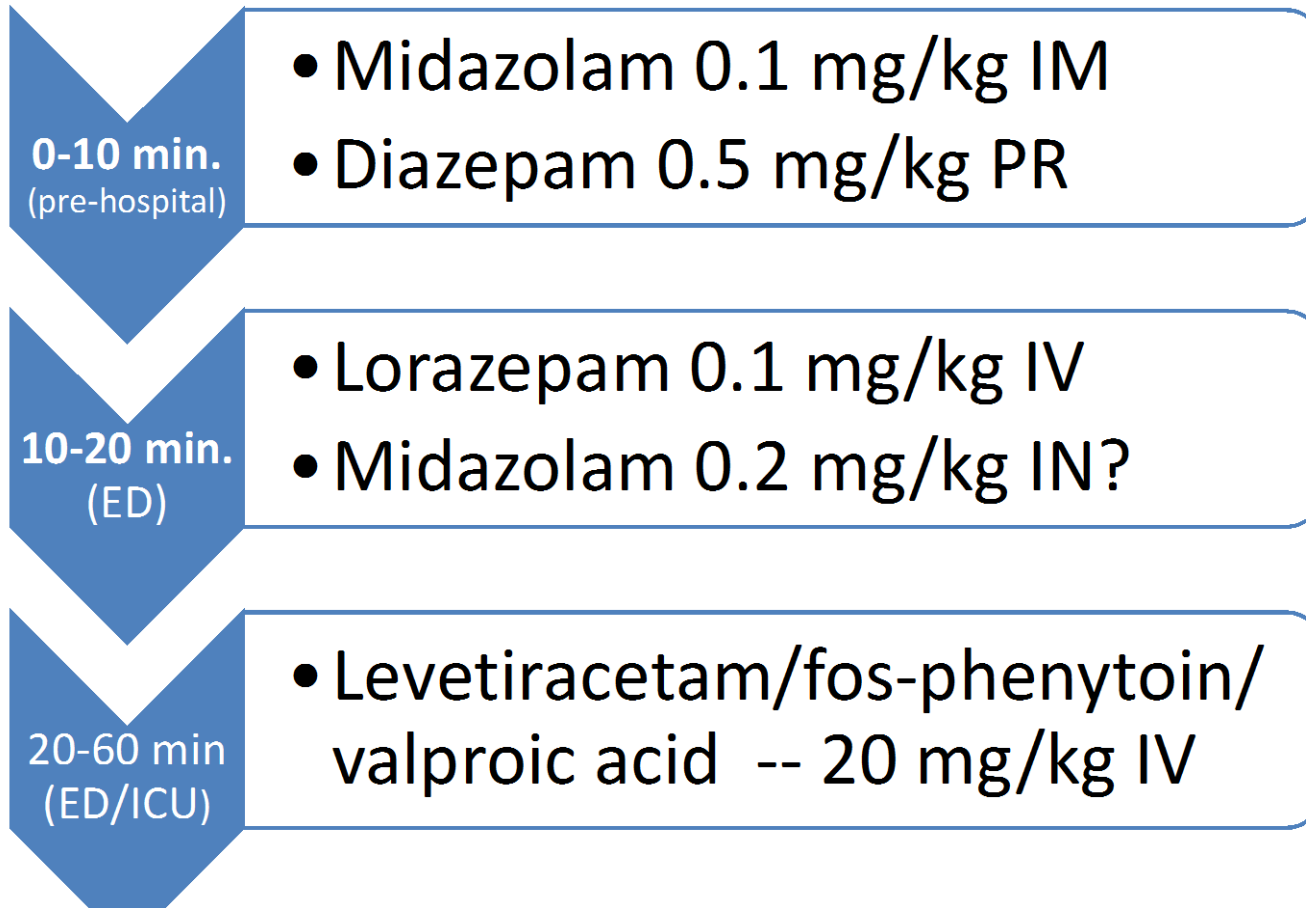
- Timing
 - Benzodiazepine doses may be repeated every 3 to 5 minutes; BE PATIENT!
 - If seizures continue beyond 15 minutes after adequate benzodiazepine dosing, a second agent should be added (Second line agents)
- Prior medication by parent?



Status Epilepticus: First Line Agents: Adverse Effects



- Complications of benzodiazepines
 - Transient Respiratory depression → Bag-mask ventilation
 - Prolonged sedative effect
 - Hypotension, especially in combination with other drugs
- Benzodiazepine reversal (Flumazenil) may precipitate seizure activity and is not recommended



*Advanced Pediatric Emergency Medicine Assembly Disney's Contemporary Resort | March 12-14, 2013
Status Epilepticus Management Strategies: The Latest on the Use of Levetiracetam*

Thomas H. Chun, MD, MPH Associate Professor Departments of Emergency Medicine and Pediatrics The Alpert Medical School of Brown University

60-90 min.
(ED-ICU)

- Levetiracetam/fos-phenytoin/
valproic acid -- 20 mg/kg IV

90-120 min.
(ED-ICU)

- Midazolam/propofol/bariturate
drip
- General anesthesia

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Dextrose administration guidelines during seizures



- Indications:
 - Infant and child with glucose level $<60\text{mg/dl}$
 - Newborn with glucose level $<40\text{mg/dl}$
- Treatment:
 - Neonate: D10W 5ml/kg IV or IO (1 part D50W w 4 parts of sterile water or NS)
 - Child <2 years: D25W, 2ml/kg IV or IO (1 part of D50W, 1 part sterile water or NS)
 - Child >2 years:

Assessment of the Post-Ictal Child

- Decreased responsiveness
- Lethargy
- Confusion
- Fatigue
- Irritable
- Headache
- Vomiting
- Muscle soreness
- The longer the seizure, the longer the post ictal period
- Todd's Paralysis: Transient focal neurologic deficits may occur in the post ictal period

Status Epilepticus

Question 1



1. You respond to a 9-1-1 call for a 4-year-old child. You find the child on the floor of the playroom, unresponsive to voice with rhythmic movements of both the upper and lower extremities. The parents report that the child has had seizures, starting at age 2. The seizure activity has always lasted only about 1 minute. The parents called 9-1-1 when the initial seizure stopped, but the seizure started again with about one minute in between. They estimate the child has been seizing for about 15 minutes.

Your FIRST response is to:

- A. Move the child to the bed
- B. Establish vascular access
- C. Protect/position the airway
- D. Give rectal diazepam

Status Epilepticus

Question 2



2. How quickly should the first benzodiazepine be given after status epilepticus begins?

- A. At 30 minutes
- B. At 20 minutes
- C. Within 5 minutes
- D. After 60 minutes

Status Epilepticus

Question 3



3. What drugs are used first in status epilepticus?
- A. Lorazepam
 - B. Fosphenytoin
 - C. Diazepam
 - D. A and C



Status Epilepticus

Question 4



4. Who is likely to have status epilepticus?
- A. Child with a history of epilepsy
 - B. Child with encephalitis
 - C. Child with a traumatic brain injury
 - D. All of the above



Case 3



- 8 year old F
- Cerebral palsy, developmental delay from anoxic brain injury at 2 years old when she drowned
- G tube dependent
- Tracheostomy dependent
- Having seizures now



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Case 3

- HR 190 Temp 37C (98.6F) BP 140/65 RR 48 Pox 88%
- General Appearance : generalized jerking of arms and legs, arms flexed, head deviated to the right and eyes rolled up, drooling



Case 3



- Started 3 mins ago/ongoing
- Several- similar
- No fever
- No fam hx of seizures
- No trauma
- Epilepsy, GERD, Breathing issues, constipation
- Valproic Acid, & many more
- Immunizations are up to date



Case 3

What is highest on the differential diagnosis?

1. Breakthrough
2. Metabolic abnormalities
3. Meningitis

Case 3 What is the next best step?



- a. Oxygen, rectal diastat, blood glucose check, transport
- b. Oxygen, IV, fluid bolus, valproic acid, transport
- c. Rectal diastat, transport

Case 3



- Before arriving to the hospital & after diastat the convulsions stop
- In the ED, the mom reports that because the patient was having diarrhea, she stopped giving her the seizure medication
- The total serum valproic acid level is found to be: 10 μ g/ml (therapeutic range: 50-125 μ g/ml)



Case 4

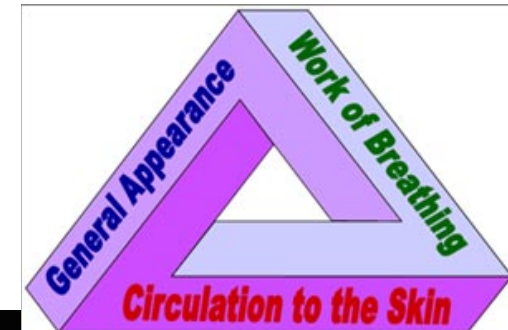
- 8 week old F
- “tensed up her body for a few seconds and shivered”
- Now she is asleep



Case 4



- HR 130 Temp 37C (98.6F) BP 85/40 RR 40 Pox 95%
- General Appearance : Sleeping in no acute distress, skin is pink, there is no increased work of breathing, capillary refill is 2-3 seconds
- Anterior fontanel is full
- Skin no rash
- Small purple circular contusion on the right cheek



Case 4



- Lasted a few seconds, stopped
- No prior seizures
- Not febrile
- No fam hx of seizures
- No trauma
- Has Reflux and colic
- No medications
- Vaccines are up to date



Case 4 Assessment



- As you're assessing the patient, she tenses her body again and seems to be lip smaking



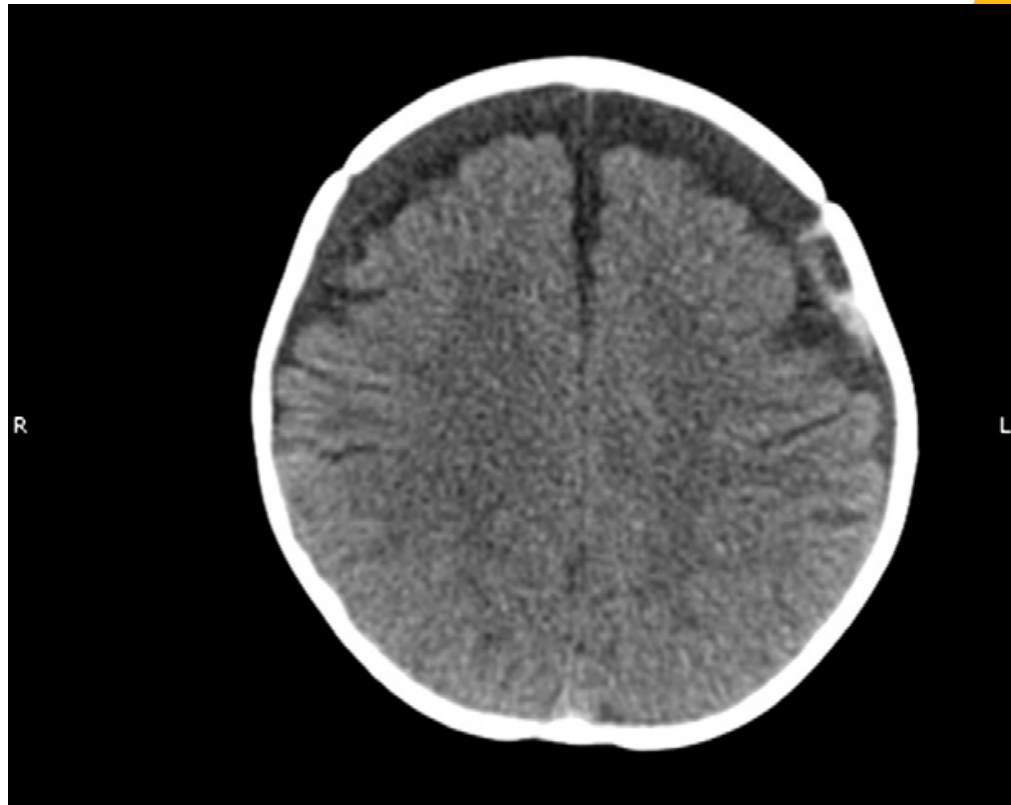
Case 4

Of the following what test is most likely to yield the diagnosis?

1. Blood glucose
2. Blood culture
3. Head CT



Case 4



Bilateral mixed density subdural collections with an area of acute hemorrhage in the left temporal area

Case 4 Management



- Supportive care, ABC
- Immobilize C spine (concern for trauma)
- Transport to hospital
- Neurosurgical evaluation
- Pediatric ICU

Case 4 Abusive Head Trauma (Shaken Baby Syndrome)



- Often missed initially
- Most common mis-diagnosis: gastroenteritis
- Need a high index of suspicion
- Observe the scene, document
- Open ended questions to caregivers
- In the hospital: lab work, skeletal survey, ophthalmologic exam



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What is Shaken Baby Syndrome ?



- Happens when an adult or older child violently shakes an infant or young child
- The baby's brain moves back and forth inside the skull, causing bleeding
- Results in brain injury, cerebral palsy, blindness, hearing loss, learning and behavior problems, seizures, paralysis, and death



Morbidity Related to Shaken Baby Syndrome

- One out of every four children who is shaken dies from their injuries
- 80% of survivors suffer permanent damage

Immediate symptoms of SBS include

- Baby seems very tired or cannot stay awake
- Baby is very irritable or fussy
- Poor appetite
- No smiling or talking
- Difficulty swallowing, sucking, or breathing
- Baby can't lift head
- Unequal pupils
- Stiff baby
- Vomiting



Case 5



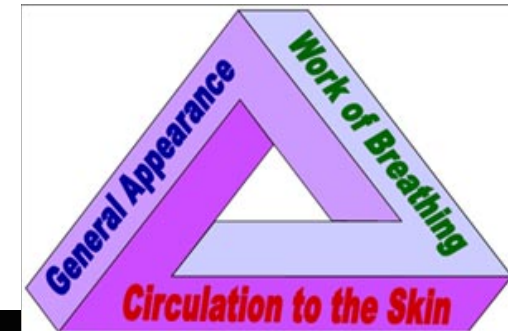
- 4 month old m
- Having generalized tonic clonic-seizures
- Appears dry, skin is mottled
- No fever



Case 5



- HR 180 Temp 37C (98.6F) BP 70/55 RR 60 Pox 88%
- General Appearance: shaking of upper and lower extremities, perioral cyanosis, pale skin, shallow breathing
- Anterior fontanel soft and flat, constricted pupils



Case 5



- What questions do you ask?
 - Duration?
 - 5 minutes
 - Prior seizures?
 - None
 - Febrile earlier?
 - No
 - Family hx of seizures?
 - No
 - Trauma?
 - No
 - Medical problems?
 - No
 - Medications?
 - None
 - Immunizations?
 - Up to date

Case 5

What other information do we need?

- PMhx:
 - Born full term. No complications
- Caregiver?
 - Mom is only caregiver
 - They live at the shelter at the moment

Case 5

What Is Your Next Best Step?

- a. Blood glucose, c spine immobilization, transport
- b. IV access, IV bolus, blood glucose check, transport
- c. Airway/oxygen, benzodiazepine, blood glucose check, IV/IO access, transport

Case 5 Progress



- The seizure doesn't stop despite repeated doses of benzodiazepines
- Patient experiences respiratory depression upon arrival to the ED
- Intubated
- Serum sodium level was 116 mEq/L (normal: 135-145 mEq/L)

Case 5

Diagnosis



- Diagnosis: Status epilepticus secondary to hyponatremia
- To economize formula mom was mixing 1 scoop of formula to 4oz of water instead of 2 scoops
- Infant was water intoxicated
- Treatment: 3%NaCl at 3-5ml/kg to stop symptoms(seizure)
- The remaining electrolytes were appropriately corrected
- The infant was discharged after 5 days and recovered fully





Events that can be mistaken for seizures



- Breath-holding spells
- Chills/ “Shudders”
- Syncopal/Cardiac events
- Gastroesophageal reflux
- Migraine headaches
- Tics/Benign myoclonus
- Pseudoseizures

Summary Comments



- 4-6% of all children will have at least one seizure in the first 16 years of life
- Pediatric status epilepticus is a common and serious condition, pre-hospital intervention reduces morbidity
- Evaluation and treatment should take place **SIMULTANEOUSLY**
- High index of suspicion is needed not to miss abusive head trauma
- Medication non compliance is often a major reason for breakthrough seizures
- Hyponatremic seizures will not resolve until the metabolic derangement is corrected
- In the pre hospital setting an organized, protocol-based approach is most likely to be successful



Thank You!