EM CASES SUMMARY

Episode 73 – Pediatric Seizures

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Pediatric seizures are a common chief complaint in the emergency department. Approximately 5% of all children will have a seizure by the time they're 16 years old. Although the vast majority will be benign simple febrile seizures, the emergency physician must distinguish these from other, more dangerous causes and manage them appropriately as well as the high mortality condition – status epilepticus.

Case 1

ID: 8mo girl, fully immunized
CC: Sudden LOC and seizure activity.
HPI: Parents report 4 days of fever but no respiratory or GI symptoms.
She has a history of febrile seizures as a toddler.
O/E: fatigued, alert, no distress or signs of dehydration.
Vitals within normal limits, temp 37.4, normal capillary refill and color. Her respiratory, abdominal and ENT exams are unremarkable. Her neck is supple and the neurological exam is normal

As you finish your exam, she starts to seize again in ED.

Case 2

ID: 2mo boy, bottle fed, born 40wks gestational age.
CC: Presents via EMS for a tonic clonic seizure lasting 3min at home.
HPI: Previously well, lethargic over the course of the day and 1 episode of vomiting before the seizure. The parents deny fever, respiratory or GI symptoms apart from the vomiting episode.
O/E: Lethargic but rousable, HR elevated, Temp 35.1.
PERL, fontanel is soft and non-bulging, neck is supple. The tone and reflexes are normal.
What is your differential diagnosis and workup of this child?

Step 1: Distinguishing Seizures vs. Seizure mimics

Much of the distinction between true seizures and mimics will hinge on elements gathered from the history. Ask about the onset, duration, nature of the movements, tongue biting, eye findings and details of the recovery phase. A history of incontinence can be helpful in older children who are no longer in diapers. The presence or absence of an aura will only be helpful in children who are able to provide a clear account of their experience. Be sure to ask the parents what the eyes, neck and head were doing at the time of the seizure. The recovery phase is also important since a rapid return to normal activity speaks against a true seizure.

Elements that are highly suggestive of true seizure activity include:

1. Lateralized tongue-biting (high specificity)
2. Flickering eye-lids
3. Dilated pupils with blank stare
4. Lip smacking
5. Increased heart rate and blood pressure during event
6. Post-ictal phase

Distinguishing Breath-holding spells from Seizure

Breath holding spells are most common in the 6-18month age range. One of the key differentiating factors is that there is usually a clear trigger for a breath holding spells such as emotional distress or pain, whereas seizures typically do not have such precipitants. This pattern of an initiating trigger, followed by emotional upset, crying, pallor, and occasionally LOC is highly suggestive of a breath holding spell. The breath holding and LOC can lead to brief seizure activity given the decrease cerebral blood-flow. However, the recovery from a breath-holding spell is rapid and complete without a post-ictal phase.

Distinguishing Pseudo-Seizures from True Seizure

These tend to be seen in the adolescent population since younger children cannot feign seizure activity for secondary gain. Features that distinguish these events from true seizures include side-to side head, arm or leg movements with eyes closed. If the eyes are open, the eye movements are normal as opposed to deviated. A bicycling movement of the legs is highly suggestive of pseudo-seizure.

Distinguishing Syncope from Seizure

Syncopal episodes may or may not have a clear precipitant but the LOC always precedes any perceived seizure activity. Observers may note some brief twitching episodes as opposed to true tonic-clonic movements. The recovery from a syncopal episode is rapid and complete.

Step 2: Distinguishing Simple vs. Complex Febrile Seizure

Once you have established that the child did in fact have true seizure activity in the context of a fever, the next step is to clearly define whether it fits the pattern of a simple or a complex febrile seizure. A diagnosis of complex febrile seizures is made if there is any deviation from the criteria of a simple febrile seizure. This distinction is important because complex seizures may indicate a more serious disease process and usually require a work-up.

	Simple Febrile Seizure	Complex Febrile Seizure
Age	6mos to 5yrs	Any
Frequency	Single seizure in 24hrs	Multiple seizures in 24hrs
Nature	Generalized	Focal or generalized
Duration	Lasting < 15 min	Can be prolonged
Recovery	Post- ictal with return to baseline and normal neurological exam	Post- ictal, may not fully return to normal if multiple seizures

Simple febrile seizures tend to occur early in the illness within 24hrs of onset of fever – if the seizure occurs >24hrs after the onset of fever, the suspicion for a bacterial cause of the fever and a pathologic cause for the seizure should be heightened.

Which Patients with Febrile Seizures Require a Work-up?

If the child meets the criteria for a simple febrile seizure, *no dedicated seizure workup is required* and you evaluate the patient as if they solely had a fever. It is clear in the literature that children who have suffered a simple febrile seizure are at *no greater risk for serious bacterial infection* than age-matched controls who have not seized. A child who fits the criteria for a simple febrile seizure should be worked up as if they presented with fever and no seizure. Studies have shown that measurement of serum electrolytes or glucose in particular has no role in the workup of simple febrile seizures. A workup beyond a basic febrile workup should be considered if the child appears unwell or meets any of the criteria of a complex febrile seizure.

Work-up of Complex Febrile Seizures – A Step-Wise Approach

Our experts recommend the *workup of complex febrile seizures* to be a *step wise approach*, keeping in mind that the younger the child the more aggressive the work-up should be. Children who return to baseline after a complex seizure and at no point displayed any focal neurologic symptoms usually do not require an extensive work-up. Even though studies have shown that febrile seizures do not increase the risk of serious bacterial infection compared to fever alone, meningitis should always be on the differential diagnosis in a child with complex febrile seizures. About 25 % of children with meningitis will present with a new onset febrile seizure, however they will almost always display persistent mental status abnormalities along with other signs of meningitis such as nuchal rigidity, focal siezures and petechia.

Counseling Parents about Pediatriac Seizures

Safety – place the child in the recovery position and do not place anything in the child mouth

Risk of recurrence is approximately 33% overall with a *higher* risk in children

- <18 months of age
- temperature < 40.0°C at first convulsion
- <1hr between onset of fever and first seizure
- family history of febrile seizures

If they have all 4 of the factors, their risk of recurrence is 70%. If they don't meet any criteria, their risk falls to 20%.

Risk of Epilepsy is approximately 2% after a simple febrile seizure and 5 % after a complex febrile seizure (compared to 1% in the general population)

Parents will often blame themselves for not treating the seizure appropriately or quickly enough to prevent the seizure. It is important to educate them that the height of the fever or rapidity of onset does not predict risk of suffering a seizure and that prophylactic antipyretics do not have any effects on the rate of seizure recurrence.

Non-febrile Pediatric Seizures

The differential diagnosis of non-febrile pediatric seizures is extensive, encompassing metabolic derangements to mass lesions to non-accidental trauma.

Hyponatremia secondary to over-dilution of infant formula

One particular diagnosis that is one of the more common causes of non-febrile seizure in children under 6months of age and that is relatively easy to pick up thus avoiding an extensive invasive work-up is hyponatremia secondary to formula over-dilution. In a paper from the Annals of EM, hyponatremia was the cause of seizures in 70% of 47 infants younger than 6 months who lacked other findings suggesting a cause. They found that a temperature of 36.5°C or less as the best predictor of hyponatremic seizures.

If a pediatric patient with hyponatremia as a cause for their seizures seizes in the ED, they should be treated with 3cc/kg of hypertonic (3%) normal saline.

Physical Examination Pearls for Non-febrile Pediatric Seizures

Looking for the following signs can help in the workup of a non-febrile seizure:

1. ***Skin*** Look for lesions such as cafe au lait spots (neurofibromatosis), adenoma sebaceum or ash leaf spots (tuberous sclerosis), and port wine stains (Sturge-Weber syndrome). Unexplained bruising should raise the suspicion of a bleeding disorder or child abuse.
2. ***Head*** Examine for bulging fontanelle, microcephaly, dysmorphic features, signs of trauma, presence of a VP shunt.
3. ***Eyes*** Examine for papilledema and retinal hemorrhages
4. ***Neck*** Examine for signs of meningeal irritation.
5. ***Hepatosplenomegaly*** May indicate a metabolic or glycogen storage disease.

It is important to realize that in patients who have no identifiable risk factors, an accurate and thorough history and physical examination have been shown to yield more diagnostic information than a laboratory evaluation.

Work-up of Non-febrile Pediatric Seizures

Lab tests may not be necessary in a child who is alert and has returned to a baseline level of function and should be based on clinical suspicion.

Consider ordering laboratory studies on pediatric patients who:

1. Have prolonged seizures,
2. < 6 months of age (specifically for hyponatremia)
3. History of diabetes, metabolic disorder, dehydration, or excess free water intake
4. Altered LOC

What is the role of a CT head in the work up of non-febrile pediatric seizures?

For non-febrile seizures, emergent neuroimaging is not necessary in children who have suffered their first non-febrile seizure and have returned to their baseline.

High risk factors on history of physical exam that should prompt consideration of neuroimaging include:

1. Focal seizure or persistent seizure activity
2. Focal neurologic deficit
3. VP shunt
4. Neurocutaneous disorder
5. Signs of elevated ICP and history of trauma or travel to an area endemic for cysticercosis.
6. Patients who have immunocompromising diseases (malignancy or HIV),
7. Hypercoagulable states (sickle cell disease), or bleeding disorders

Disposition of non-febrile seizures depends on age, serial physical examinations, initial work-up and follow-up capabilities

Under 6months of age - generally require a full workup and are usually admitted for observation.

6 months and 2 years of age - disposition will depend on blood work, reassessment and the ability to have close follow-up.

Over 2 years of age – those who have returned to baseline, have a normal neurological exam with normal workup are often safe to be discharged to close outpatient follow-up. Otherwise, admit.

Parents should be informed that approximately 50% of children who have a non-febrile seizure will have a recurrence.

Status Epilepticus

Status Epilepticus (SE) was historically defined as any seizure activity lasting longer than 30mins, but this has changed in recent years. Given that we strive to terminate seizure activity long before 30min, SE is now more conservatively defined as a:

1. Seizure lasting > 5 minutes, *OR*
2. Consecutive seizures without a return to baseline in between

When you are faced with a seizing child, the priorities are the same as with any resuscitation: ABCs. Start by evaluating the airway and provide supplemental oxygen, then establish cardiac monitoring. The next steps will focus on terminating the seizure and the goal is to terminate all seizure activity within 60 seconds.

Administration of early benzodiazepines is a priority!

In an actively seizing child, IV and IO access can be difficult and time-consuming. For your first dose of benzodiazepines, consider either intranasal, buccal, intramuscular or rectal dosing of the following medications:

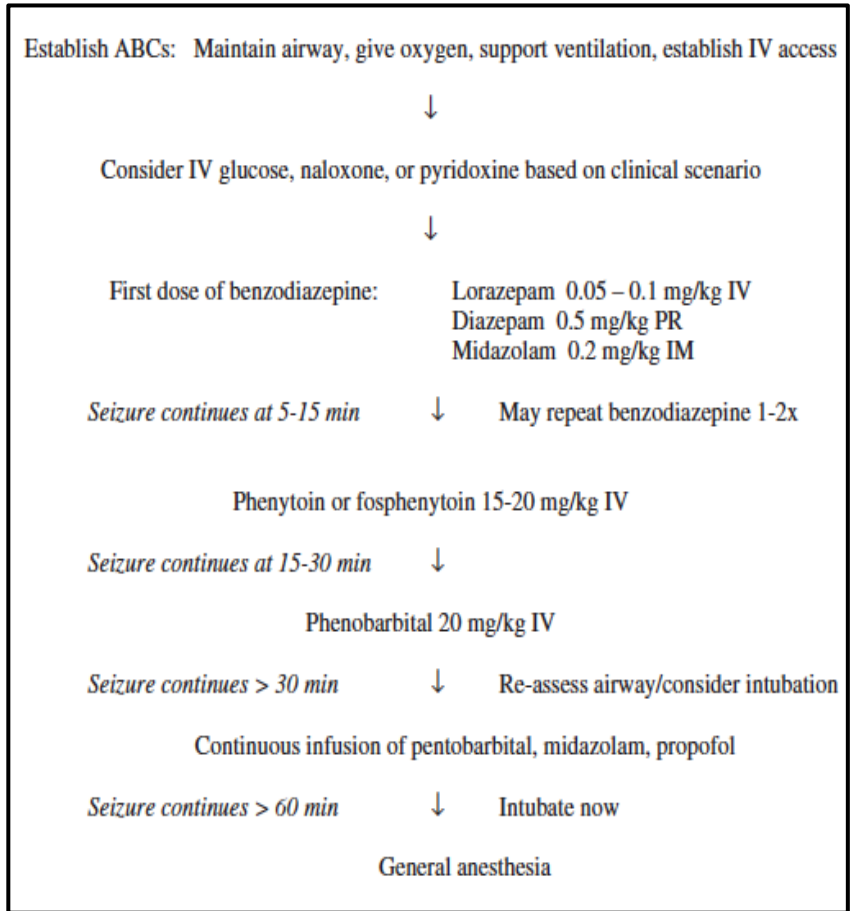
Agent	Route	Dosing
Midazolam	Buccal	0.2mg/kg (max 10 mg)
	Intranasal	0.2mg/kg (max 5 mg/ nare)
	Intramuscular	0.1-0.2mg/kg (max 10 mg)
Lorzapeam	Buccal	0.1mg/kg (max 4mg)
	Rectal	0.1mg/kg (max 4mg)
Diazepam	Rectal	0.5 mg/kg (max 20 mg)

The choice of benzodiazepine and the choice of route is not the major determinant of efficacy. Rather, the most important determinant of benzodiazepine efficacy in stopping seizures is ***time to administration****.*

There have been many studies evaluating the different benzodiazepines and routes of administration. For example, in a pre-hospital setting, intramuscular midazolam was shown to be as effective at terminating seizures as intravenous lorazepam. In another randomized trial, buccal midazolam was superior to rectal diazepam at stopping seizure activity.

Once you have started giving your antiepileptic medications start drawing up the next dose of medication so that it is ready to administer if seizure activity continues to persist.

Pediatric Status Epilepticus Algorithm



Second Line Agents - Phenytoin vs. Fosphenytoin

Phenytoin and fosphenytoin are the same active medication. The difference between the two preparations lies in the side effect profile and the manner in which it can be administered. For these reasons *fosphenytoin is the preferred second line agent for treatment of SE*.

Phenytoin	Fosphenytoin
Active drug	Pro-drug
Only IV	IV/ IM
Slower rate of infusion	Faster rate of infusion
Can precipitate in IV solutions	Does not precipitate
Can cause cardiac arrhythmias or hypotension	Fewer cardiac side effects
If extravasates, may cause purple-glove syndrome and tissue necrosis	Fewer tissues side effects

Phenytoin and fosphenytoin are less effective for the treatment of seizures due to toxins or drugs and may intensify seizures caused by cocaine, other local anesthetics, theophylline, or lindane. In such cases, an alternative second-line drug such as phenobarbital or valproate should be used.

Refractory status epilepticus

If, despite all the medications and efforts described above, your patients is still seizing, initiate continuous IV infusions of:

1. Midazolam (120mcg/kg/hr and titrate upwards)
2. Pentobarbital
3. Propofol (contraindicated with ketogenic diet)

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