PedsCases Podcast Scripts

This is a text version of a podcast from Pedscases.com on "Seizures Types and Epilepsy." These podcasts are designed to give medical students an overview of key topics in pediatrics. The audio versions are accessible on iTunes or at www.pedcases.com/podcasts.

Seizure Types and Epilepsy

Developed by Michelle Bischoff, Drs Francois Bolduc and Melanie Lewis for PedsCases.com.
August 28, 2010

Introduction

Hi my name is Michelle Bischoff and I'm a medical student at the University of Alberta. This podcast was reviewed by Dr. Francois Bolduc a Pediatric Neurologist and Assistant Professor and Dr. Melanie Lewis, a General Pediatrician and Associate Professor - both at the Stollery Children's Hospital and University of Alberta in Edmonton, Alberta, Canada.

This podcast will describe different types of seizures seen in pediatrics and management of epilepsy. In another podcast, I will talk about the clinical approach to status epilepticus.

Objectives

The objectives of the podcast are as follows:

1. First, to describe the pathophysiology of seizures
2. Second, to identify possible etiologies
3. Third, to distinguish the various types of seizures focusing on the pediatric clerkship objectives
4. Last, to give an approach to a child presenting with a history of two or more seizures

Background

Seizures are a common condition encountered in pediatric acute care and experienced by approximately 3% of children. Seizures have been described in documents dating back thousands of years, and at the time, attributed to possession by evil spirits. We are a little wiser today, and know that a seizure is due to abnormal activity of brain cells and may be a sign of a serious medical condition – either a neurological injury or disease or a physiological condition originating outside the brain. Conversely, it may be an isolated unprovoked event. In any case, it is a condition that must be investigated.

What is the mechanism of a seizure?

A seizure can be defined as the abnormal synchronized firing of electrical impulses in the brain causing a change in motor activity and/or behavior. Essentially, excitation of cortical neurons overcomes normal inhibition. Abnormal discharging from one region of the brain

may produce manifestations concurrent to that functional area. For instance, if seizure activity originates in the visual cortex, the patient may present with visual disturbances.

Some precipitating factors include neuronal damage and a genetic predisposition. Neonatal age is another important risk factor for seizures. Infants less than one month of age have the highest incidence of seizures compared to any other age group, which suggests that the immature brain is more susceptible to seizure activity.

What causes a seizure?

There are many etiologies of seizures – when a cause may be identified in the brain, we say the seizure is symptomatic. When no cause is found -the seizure is said to be idiopathic.

Symptomatic seizures may be linked to genetic causes, neurological conditions like a stroke, tumor, or head trauma, or may be provoked by fever and infection, drug withdrawal, metabolic or electrolyte disturbances, hypoxia, and cardiac arrhythmias.

Less than 1/3 of children experiencing a seizure will be diagnosed with epilepsy. Epilepsy diagnosis is given when the patient experiences at least two seizures.

There are various types of seizures—I will describe the following:

- The classification of seizures as either generalized or partial depending on the clinical presentation. And, the two types of partial seizures – simple or complex – depending on the child's level of consciousness.
- Some special conditions -namely, febrile seizures and status epilepticus
- Seizure imitators, specifically breath-holding spells and other vagal events or potentially deadly ventricular arrythmias

Seizure Classification

Seizures are classified based on spread in the body and level of consciousness. First, when we talk about extent of brain involvement, we mean seizures can be either focal or diffuse. Seizures produced by focal areas are termed PARTIAL seizures. Those that involve both cerebral hemispheres are called GENERALIZED seizures.

Partial seizures are further classified based on whether or not the patient is conscious during the episode. If the patient is conscious, we call this a SIMPLE partial seizure. If the patient is unconscious, we say the seizure is a complex partial seizure.

Generalized seizures

Generalized seizures, again, are seizures that involve bilateral cerebral hemispheres. There are 4 main types of generalized seizures: tonic-clonic (grand-mal), absence seizures (also known as petit mal seizures), myoclonic, and atonic seizures.

Generalized tonic-clonic seizures, also known as grand mal seizures, are extremely common. These seizures involve the entire body from onset and are characterized by tonic posture (meaning tensing and extension of the extremities) followed by clonic movements, which are rhythmic movements of flexion and extension. Sometimes, the child may experience just a clonic or just a tonic generalized seizure. In any case, a

generalized tonic-clonic seizure may occur alone or may be preceded by a partial seizure or an aura. When preceded by an aura, we may call this a partial onset seizure with secondary generalization.

During a generalized tonic-clonic seizure, the child may be apneic and cyanotic, incontinent, and may vomit. The patient is usually amnesic in the post-ictal period, the time immediately following the seizure.

The second type of generalized seizure is called an absence seizure, also known as a petit mal seizure – in French, meaning a smaller seizure. In an absence seizure, the child is suddenly unresponsive and may stare into space. There is no movement or stiffening in the body. Lapse of consciousness lasts a few seconds or longer, and can occur with blinking or facial twitching. After a few seconds of staring, the child will suddenly be back to normal. The absence of a post-ictal state will help differentiate it from the other staring spells caused by partial complex seizures. Absence seizures usually occur multiple times a day, often occur in school-age children, and may be mistaken for inattention or daydreaming.

The third type of generalized seizure is known as a myoclonic seizure, "myo" meaning muscle and "clonus" meaning muscle jerking. Myoclonus seizures produce muscular contractions either in a single muscle, in one area of the body, or the entire body - the patient may or may not lose consciousness. In some instances, myoclonic seizures in teens may lead to a diagnosis of juvenile myoclonic epilepsy.

The last type of generalized seizure is the atonic seizure. An atonic seizure is a brief loss of muscle tone, lasting only a few seconds that may cause injury for instance if the patient falls, or the head drops unexpectedly. If the patient falls, this is commonly referred to as a "drop attack".

That concludes types of generalized seizures. Next, we'll talk about Partial seizures.

Partial Seizures

Partial seizures are seizures that originate in an isolated area of the cerebral cortex and therefore manifest with focal neurological signs. There are essentially two types of partial seizures – simple partial and complex partial -both of which can be preceded by an aura. In simple partial, the child is conscious and in complex partial, the child is not. Symptoms of partial seizures depend on the focal location of the abnormal electrical firing in the brain, and include motor, sensory, autonomic and psychic manifestations. For instance, if the motor cortex is affected, the child may experience tonic or clonic movements in one extremity only. Alternatively, numbness suggests activity in the sensory cortex. Partial seizures are often confused with psychiatric symptoms when they occur with fear, deja vu or hallucinations.

An aura is a sensation experienced at the onset of a seizure, also known as a partial seizure with sensory or psychological manifestations. For instance, the patient may experience a distinct smell or see flashes of light at the onset of a seizure; and these perceptions are usually stereotyped with each seizure.

Developed by Michelle Bischoff, Drs. Francois Bolduc and Melanie Lewis for PedsCases.com.
August 28, 2010

Febrile seizures

Now let's discuss the most common type of seizure seen in pediatrics – febrile seizures. By definition, these seizures occur in children 3 months to *5* years of age.

There are two types of febrile seizures: simple and complex. Simple febrile seizures are the most common type of febrile seizure. To be a simple febrile seizure, it must be generalized, last less than 15 minutes, and must not recur within a 24 hour period. The child must have a normal developmental history, and there must be no evidence of a CNS infection or any other cause. Children experiencing simple febrile seizures often have a family history of febrile seizures.

The other type of febrile seizure is a complex febrile seizure. A complex febrile seizure is either focal, prolonged or recurs within 24 hours. Complex febrile seizures can indicate a more serious underlying etiology such as encephalitis, meningitis, or an underlying seizure disorder.

What is the risk of recurrence? Approximately 113 of children who experience a typical febrile seizure will have a subsequent febrile seizure. Therefore, in most children, this is an isolated event.

Status epilepticus

When a seizure lasts longer than 30 min, it is defined as status epilepticus and is considered a medical emergency and must be treated aggressively with anticonvulsants. The longer the child seizes, the greater the chance of brain cell death and mortality. These seizures are usually generalized tonic clonic, but sometimes present as focal. With time, the body will stop seizing but the brain will still have epileptic seizure activity, a condition known as electromechanical dissociation. Causes of status epilepticus include infection, an underlying neurologic disorder like a cerebral malformation, and metabolic or electrolyte disturbances like hypocalcemia, hyponatremia or hypoglycemia.

Seizure imitators

There are certain conditions a child may present with that mimic a seizure but that are not caused by abnormal brain activity. One case is a breath-holding spell. A breath-holding spell is a nonintentional episode of apnea following prolonged expiration -and it usually happens after a painful, upsetting or startling experience. The child cries, then after forcible expiration, rapidly loses consciousness and becomes either pale or cyanotic, and may jerk or become rigid and arch his or her back – also known as opisthotonos. Breath-holding spells usually occur in children ages 6 months to 6 years and the vast majority outgrow episodes. If the child becomes pale with the episode, this is known as a pallid spell and is usually caused by vasovagal syncope, however, a cardiac pathology, like a ventricular arrhythmia, must be ruled out.

It is important to differentiate a breath-holding spell from a seizure. If a child has experienced a breath- holding spell, there is an antecedent event, heart rate decreases and the child becomes pale, and there is NO post-ictal period. If the child has experienced a seizure, there is NO antecedent event, heart rate increases but the child remains pink and well-perfused, and there can be a post-ictal period.

Developed by Michelle Bischoff, Drs. Francois Bolduc and Melanie Lewis for PedsCases.com.
August 28, 2010

Approach to a child who has experienced a seizure

Important points regarding history

Does the child have a history of seizures or epilepsy or is this an isolated event? Ask If the child had been ill previously or currently, any history of fever or infectious contacts, any injuries or trauma, ingestion of drugs or toxins, recent antibiotic use or current use of any other medications. If the child is on antiepileptics, has he or she been taking them as scheduled, any changes to dosage or administration?

It is important to ask what preceded the seizure, if there was any warning (a sign that would suggest a focal onset), or signs/symptoms beforehand? Were there any provoking conditions beforehand, such as lack of sleep, food or water deprivation, recent illness or fever,

Ask if anyone witnessed the event, and speak to that person. Sometimes the person will be able to act out the event with accuracy. Be careful with events that have only been partially observed, since you may miss crucial information about the onset of the event. Find out what the patient did during the seizure – Were there tonic and clonic movements, were the movements unilateral, bilateral, localized or diffuse – to ascertain whether the seizure is focal or generalized. Or were there any other abnormal movements, i.e. eye turning or lip smacking. Was the patient conscious and able to talk or respond?

Enquire about duration, and level of consciousness or confusion after the event. Was the patient unresponsive and does he or she remember anything about the event? Describe the recovery period and how long before the child seemed back to normal, if he or she is back to baseline now.

Children with epilepsy can have a normal or abnormal developmental history - abnormalities may indicate an underlying brain pathology. Question about a history of developmental delay, neurological problems, or any other health issues that might be clues to seizure activity.

Also ask about a family history of seizures, as there are genetic causes of seizures and epilepsy.

Think of other possible occurrences as part of the differential such as syncope, breath-holding, rigors due to fever, etc.

Physical Examination

The physical examination should include your ABCDFGs – airway, breathing, circulation, and don't forget glucose – also vital signs and level of consciousness. Then a general cardio-respiratory and skin exam should be performed. Look for signs of infection, sepsis and meningitis. If the patient is stable, conduct a neurological exam, looking specifically for focal neurological signs and asymmetry.

Developed by Michelle Bischoff, Drs. Francois Bolduc and Melanie Lewis for PedsCases.com.
August 28, 2010

Investigations

When you are uncertain of an etiology, investigations are vast - so use your clinical judgment.

Biochemical tests should be performed to rule out underlying metabolic causes. This includes blood sugar, CBC and differential, calcium, magnesium, lytes, liver function tests and metabolic studies. These tests are also required as a baseline before starting most antiepileptics, so do them all at once to avoid poking the child again if medication is to be started.

If the patient has a history of seizures and is taking medication, order anticonvulsant levels to check therapeutic drug levels.

To help diagnose epilepsy, an EEG or electroencephalogram should be ordered to get a graphical depiction of cortical electrical activity. Small sensor cups are attached to the patient's scalp and recordings compare electrical activity in all regions of the cerebral cortex. The American Academy of Neurology recommends that an EEG be obtained in all children in whom a nonfebrile seizure has been diagnosed, to predict the risk of recurrence and to classify the seizure type and epilepsy syndrome

A CT scan or MRI of the brain may also be ordered if a structural abnormality or lesion such as a hemorrhage, stroke, abscess, or tumor is suspected. The MRI is the preferred imaging modality, however often logistically unattainable in acute scenarios.

And lastly, a lumbar puncture may be done if CNS infection -meningitis or encephalitis – is suspected. This should be done especially in young children where clinical assessment is limited. A CT scan should always be performed before lumbar puncture to make sure there is no risk of brain herniation.

Treatment

Generally, first-time seizures are not treated with long-term therapy. However, if a diagnosis of epilepsy is made by finding on history that this is not the first event, the child will be placed on an anticonvulsant. The patient is started on a single drug chosen based on the seizure presentation and the EEG pattern; if unsuccessful, a second is added and the first is tapered or discontinued. Some patients will require treatment with up to three medications at the same time. Most patients will be controlled with antiseizure meds but about 5% will not.

Generalized tonic-clonic seizures respond well to valproic acid, topiramate or lamotrigine.

Absence seizures are usually treated with ethosuximide – a calcium channel blocker. If absence seizures occur with other types of seizures,valproic acid, topiramate or lamotrigine may be given.

Myoclonic seizures are best treated with valproic acid, lamotrigine, and topiramate.

Partial onset seizures are usually treated with carbamazepine or clobazam.

Developed by Michelle Bischoff, Drs. Francois Bolduc and Melanie Lewis for PedsCases.com.
August 28, 2010

Regular follow-up is necessary after discharge. Make sure the seizures are being controlled -If not, an adjustment of dose or medication type may be required. Monitor antiepileptic drug levels, CBC, and liver function tests about every 6 months or if there is seizure recurrence or side effects. Perform behavioral and learning assessments to screen for toxicity and repeat the neurological exam.

The first 6 months after a seizure is the time of maximum risk of recurrence. And most children that suffer a recurrence do so within the first two years. If the child has been seizure-free for 2 years, you may consider taking him or her off the anticonvulsant. Some forms of epilepsy manifest in certain age groups and resolve later in life. An EEG may help assess risk of recurrence.

Surgery, in the form of localized resections, is considered for children with epilepsy in which seizures cannot be controlled with anticonvulsants and when a focal epileptic lesion is identified.

Another controversial treatment option for intractable seizures is the ketogenic diet, in which the child is given a diet high in fats and protein and low in carbohydrates. In some children with genetic disorders of glucose transport to the brain, the ketogenic diet is a successful treatment option.

For teens with epilepsy, education on driving is important. Also, consider birth control as most antiepileptics can cause malformations to a fetus and thus planning is important. Remind teens that sleep deprivation, alcohol and drugs should be avoided.

Important take-home points

1. Seizures are a frequent health issue in pediatrics affecting approximately 3% of children.
2. Multiple types of seizures exist. As well, there are conditions that mimic a seizure but are not caused by abnormal brain activity, such as breath-holding spells and vagal events or arrhythmias.
3. Epilepsy is diagnosed when the child has experienced 2 or more seizures.
4. Important things to ask about on history include recent infections, developmental history, concurrent health issues and a family history of seizures.
5. A seizure can be a sign of cerebral infection, lesions or a genetic propensity or problem. When ruling out an organic cause, investigations are numerous. An EEG is typically used to help diagnosis epilepsy. Brain imaging may identify structural lesions causing seizures.
6. There are several treatment options for seizures, and these depend on the seizure presentation, the EEG pattern, and the individual child. Regarding antiepileptics in treatment of epilepsy, monotherapy is the goal.
7. And finally, council the parents about first aid measures if the child experiences another seizure: Put the patient on his or her side, don't put anything in the mouth and check the time. If a seizure lasts more than 3 minutes, an ambulance should be called. Also, teach parents not to leave the child unattended in water, close to fire, or at a high level where the patient could fall.

Developed by Michelle Bischoff, Drs. Francois Bolduc and Melanie Lewis for PedsCases.com.
August 28, 2010