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Neurological Disorders

Seizures and Epilepsy

What is a seizure?

The brain is the center that controls and regulates all voluntary and involuntary responses in the body. It consists of nerve cells that normally communicate with each other through electrical activity.

A seizure occurs when part(s) of the brain receives a burst of abnormal electrical signals that temporarily interrupts normal electrical brain function.

What are the different types of seizures?

There are several different types of seizures in children, including the following:

- **partial seizures**
  Partial seizures take place when abnormal electrical brain function occurs in one or more areas of one side of the brain. In about one-third of children with partial seizures, the child may experience an aura before the seizure occurs. An aura is a strange feeling, either consisting of visual changes, hearing abnormalities, or changes in the sense of smell. Two types of partial seizures include the following:
  - **simple partial seizures**
    The seizures typically last less than one minute. The child may show different symptoms depending upon which area of the brain is involved. If the abnormal electrical brain function is in the occipital lobe (the back part of the brain that is involved with vision), the child's sight may be altered. The child's muscles are typically more commonly affected. The seizure activity is limited to an isolated muscle group, such as fingers or to larger muscles in the arms and legs. Consciousness is not lost in this type of seizure. The child may also experience sweating, nausea, or become pale.
  - **complex partial seizures**
    This type of seizure commonly occurs in the temporal lobe of the brain, the area of the brain that controls emotion and memory function. This seizure usually lasts between one to two minutes. Consciousness is usually lost during these seizures and a variety of behaviors can occur in the child. These behaviors may range from gagging, lip smacking, running, screaming, crying, and/or laughing. When the child regains consciousness, the child may complain of being tired or sleepy after the seizure. This is called the postictal period.
- **generalized seizures**
  Generalized seizures involve both sides of the brain. There is loss of

consciousness and a postictal state after the seizure occurs. Types of generalized seizures include the following:

- **absence seizures (formerly known as petit mal seizures)**
  These seizures are characterized by an altered state of consciousness and staring episodes. Typically the child's posture is maintained during the seizure. The mouth or face may move or the eyes may blink. The seizure usually lasts no longer than 30 seconds. When the seizure is over, the child may not recall what just occurred and may go on with his/her activities, acting as though nothing happened. These seizures may occur several times a day. This type of seizure is sometimes mistaken for a learning problem or behavioral problem. Absence seizures are uncommon before the age of 5 and occur more often in girls.

- **atonic**
  With atonic seizures, there is a sudden loss of muscle tone and the child may fall from a standing position or suddenly drop his/her head. During the seizure, the child is limp and unresponsive.

- **generalized tonic-clonic seizures (GTC or formerly known as grand mal seizures)**
  This seizure is characterized by five distinct phases that occur in the child. The body, arms, and legs will flex (contract), extend (straighten out), tremor (shake), a clonic period (contraction and relaxation of the muscles), followed by the postictal period. During the postictal period, the child may be sleepy, have problems with vision or speech, and may have a bad headache, fatigue, or body aches.

- **myoclonic seizures**
  This type of seizure refers to quick movements or sudden jerking of a group of muscles. These seizures tend to occur in clusters, meaning that they may occur several times a day, or for several days in a row.

- **infantile spasms**
  This rare type of seizure disorder occurs in infants from before six months of age. There is a high occurrence rate of this seizure when the child is awakening, or when they are trying to go to sleep. The infant usually has brief periods of movement of the neck, trunk, or legs that lasts for a few seconds. Infants may have hundreds of these seizures a day. This can be a serious problem, and can have long-term complications.

- **febrile seizures**
  This type of seizure is associated with fever. These seizures are more commonly seen in children between 6 months and 6 years of age and there may be a family history of this type of seizure. Febrile seizures that last less than 15 minutes are called "simple," and typically do not have long-term neurological effects. Seizures lasting more than 15 minutes are called "complex" and there may be long-term neurological changes in the child.

What causes a seizure?

A child may experience one or many seizures. While the exact cause of the seizure may not be known, the more common seizures are caused by the following:

- in newborns and infants:
    - birth trauma
    - congenital (present at birth) problems
    - fever
    - metabolic or chemical imbalances in the body
- in children, adolescents, and young adults:
    - alcohol or drugs
    - trauma to the head
    - infection
    - unknown reasons
- other possible causes of seizures may include:
    - brain tumor
    - neurological problems
    - drug withdrawal
    - medications

What are the symptoms of a seizure?

The child may have varying degrees of symptoms depending upon the type of seizure. The following are general symptoms of a seizure or warning signs that your child may be experiencing seizures. Symptoms or warning signs may include:

- staring
- jerking movements of the arms and legs
- stiffening of the body
- loss of consciousness
- breathing problems or breathing stops
- loss of bowel or bladder control
- falling suddenly for no apparent reason
- not responding to noise or words for brief periods
- appearing confused or in a haze
- sleepiness and irritable upon waking in the morning
- nodding the head
- periods of rapid eye blinking and staring

During the seizure, the child's lips may become bluish and breathing may not be normal. The movements are often followed by a period of sleep or disorientation.

The symptoms of a seizure may resemble other problems or medical conditions. Always consult your child's physician for a diagnosis.

How are seizures diagnosed?

The full extent of the seizure may not be completely understood immediately after onset of symptoms, but may be revealed with a comprehensive medical evaluation and diagnostic testing. The diagnosis of a seizure is made with a physical examination and diagnostic tests. During the examination, the physician obtains a complete medical history of the child and family and asks when the seizures occurred. Seizures may be due to neurological problems and require further medical follow up.

Diagnostic tests may include:

- **blood tests**

- **electroencephalogram (EEG)** - a procedure that records the brain's continuous, electrical activity by means of electrodes attached to the scalp.

- **magnetic resonance imaging (MRI)** - a diagnostic procedure that uses a combination of large magnets, radiofrequencies, and a computer to produce detailed images of organs and structures within the body.

- **computed tomography scan (Also called a CT or CAT scan.)** - a diagnostic imaging procedure that uses a combination of x-rays and computer technology to produce cross-sectional images (often called slices), both horizontally and vertically, of the body. A CT scan shows detailed images of any part of the body, including the bones, muscles, fat, and organs. CT scans are more detailed than general x-rays.

- **lumbar puncture (spinal tap)** - a special needle is placed into the lower back, into the spinal canal. This is the area around the spinal cord. The pressure in the spinal canal and brain can then be measured. A small amount of cerebral spinal fluid (CSF) can be removed and sent for testing to determine if there is an infection or other problems. CSF is the fluid that bathes your child's brain and spinal cord.

Treatment of a seizure:

Specific treatment for a seizure will be determined by your child's physician based on:

- your child's age, overall health, and medical history
- extent of the condition
- type of seizure
- your child's tolerance for specific medications, procedures, or therapies
- expectations for the course of the condition
- your opinion or preference

The goal of seizure management is to control, stop, or decrease the frequency of the seizures without interfering with the child's normal growth and development. The major goals of seizure management include the following:

- proper identification of the type of seizure
- using medication specific to the type of seizure
- using the least amount of medication to achieve adequate control
- maintaining good medicating levels

Treatment may include:

- **medications**
  There are many types of medications used to treat seizures and epilepsy. Medications are selected based on the type of seizure, age of the child, side effects, the cost of the medication, and the adherence with the use of the medication.

  Medications used at home are usually taken by mouth (as capsules, tablets, sprinkles, or syrup), but some can be given rectally (into the child's rectum). If the child is in the hospital with seizures, medication by injection or intravenous (IV) may be used.

  It is important to give your child his/her medication on time and as prescribed by your child's physician. Different people use up the medication in their body differently, so adjustments (schedule and

dosage) may need to be made for good control of seizures.

All medications can have side effects, although some children may not experience side effects. Discuss your child's medication side effects with his/her physician.

While your child is taking medications, different tests may be done to monitor the effectiveness of the medication. These tests may include the following:

- **blood work** - frequent blood draws testing is usually required to check the level of the medication in the body. Based on this level, the physician may increase or decrease the dose of the medication to achieve the desired level. This level is called the "therapeutic level" and is where the medication works most efficiently. Blood work may also be done to monitor the affects of medications on body organs.

- **urine tests** - these tests are performed to see how the child's body is responding to the medication.

- **electroencephalogram (EEG)** - a procedure that records the brain's continuous, electrical activity by means of electrodes attached to the scalp. This test is done to monitor how the medication is helping the electrical problems in the brain.

- **ketogenic diet**
  Certain children who are having problems with medications, or whose seizures are not being well controlled, may be placed on a special diet called the ketogenic diet.

What is a ketogenic diet?
The ketogenic diet is sometimes offered to those children who continue to have seizures while on seizure medication. When the medications do not work, a ketogenic diet may be considered. No one knows exactly how the diet works, but some children do become seizure-free when put on the diet. However, the diet does not work for everyone.

What does the diet consist of?
The ketogenic diet is very high in fat (about 90 percent of the calories come from fat). Protein is given in amounts to help promote growth. A very small amount of carbohydrate is included in the diet. This very high-fat, low-carbohydrate diet causes the body to make ketones. Ketones are made by the body from protein. They are made for energy when the body does not get enough carbohydrates for energy. If your child eats too many carbohydrates, then his/her body may not make ketones. The presence of ketones is important to the success of the diet.

High-fat foods:

- butter
- heavy cream
- oil
- mayonnaise
- cream cheese
- bacon
- cheese

High-carbohydrate foods:

- fruit and fruit juice
- breads and cereals
- vegetables (corn, peas, and potatoes)
- beans
- milk
- soda
- snack foods (chips, snack cakes, crackers)
- sweets

Your child's physician will determine if this diet is right for your child. When the ketogenic diet is started, your child will be admitted to the hospital. It may take four to five days in the hospital to get the diet started and for you to learn how to plan the diet.

While in the hospital, your child may not be able to eat for one to two days until ketones are measured in the urine. Once ketones are present in the urine, special high-fat, low-carbohydrate shakes may be started. These are sometimes called "keto shakes." After several meals of keto shakes, your child will be started on solid foods.

You may also be taught how to check your child's urine for ketones. The dietitian will help determine how much fat, protein, and carbohydrate your child is allowed to have, usually divided into three meals a day. The ketogenic diet can by very challenging to prepare and requires that all foods be weighed using a food scale. The ketogenic diet is not nutritionally balanced, therefore, vitamin and mineral supplements are needed.

Some medications and other products, such as toothpaste and mouthwash, contain carbohydrates. It is important to avoid these products if your child is on the ketogenic diet. Your child may not make ketones in their urine if too many carbohydrates are included in the diet. Your child's physician and dietitian can give you a list of medications, and other products, that are free of carbohydrates.

How long is the diet used?
Children usually stay on the diet about two years. The diet is then slowly changed back to a regular diet.

Sample ketogenic meal:	**Sample ketogenic shake:**
60 g heavy cream	500 g Ross Carbohydrate-free Formula (concentrate)
21 g strawberries	270 g heavy cream
53 g eggs	13 g Egg Beaters®
10 g cheddar cheese	
10 g bacon	
21 g butter	

Additional treatment options:

- **vagus nerve stimulation (VNS)**
  Some children, whose seizures are not being well-controlled with seizure medications, may benefit from a procedure called vagus nerve stimulation (VNS). VNS is currently only used for children over the age of 12 who have partial seizures that are not controlled by other methods.

  VNS attempts to control seizures by sending small pulses of energy to the brain from the vagus nerve, which is a large nerve in the neck. This is done by surgically placing a small battery into the chest wall. Small wires are then attached to the battery and placed under the skin and around the vagus nerve. The battery is then programmed to send energy impulses every few minutes to the brain. When the child feels a seizure coming on, he/she may activate the impulses by holding a small magnet over the battery. In many people, this will help to stop the seizure.

  There are some side of the effects that may occur with the use of VNS. These may include, but are not limited to, the following:

  - hoarseness
  - pain or discomfort in the throat
  - change in voice

- **surgery**
  Another treatment option for seizures is surgery. Surgery may be considered in a child who:

  - has seizures that are unable to be controlled with medications.
  - has seizures that always start in one area of the brain.
  - has a seizure in a part of the brain that can be removed without disrupting important behaviors such as speech, memory, or vision.

  Surgery for epilepsy and seizures is a very complicated surgery performed by a specialized surgical team. The operation may remove the part of the brain where the seizures are occurring, or, sometimes, the surgery helps to stop the spread of the bad electrical currents through the brain.

  A child may be awake during the surgery. The brain itself does not feel pain. With the child awake and able to follow commands, the surgeons are better able to make sure that important areas of the brain are not damaged.

  Surgery is not an option for everyone with seizures. Discuss this with your child's physician for more information.

More information regarding the child with seizures or epilepsy:

- Make sure you and your child (if age appropriate) understand the type of seizure that is occurring and the type of medication(s) that are needed.
- Know the dose, time, and side effects of all medications.
- Consult your child's physician before giving your child other

medications. Medications for seizures can interact with many other medications, causing the medications to work improperly and/or causing side effects.

- Young women of childbearing age, who are on seizure medications, need to be informed that seizure medications are harmful to a fetus, and the medication may also decrease the effectiveness of oral contraceptives.
- Check with your state to understand any laws about people with epilepsy or seizures operating a motor vehicle.
- If a child has good control over the seizures, only minimal restrictions need to be placed on the child's activities. The child should always wear a helmet with sports and bike riding (including in-line roller-skating, hockey, and skateboards). The child should also always have a buddy or adult supervision while swimming.
- Specific follow-up will be determined by your child's physician.
- Medications for seizures may not be needed for the entire life of the child. Some children may be taken off their medications if they have been seizure-free for one to two years. This will be determined by your child's physician.

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