

## Epilepsy basic level

### Overview

A seizure (often called a fit, spell, convulsion, or attack) is a visible sign of a problem in the electrical system that controls your brain. A single seizure can have many causes. Those who continue to have unprovoked seizures may have a chronic disorder called epilepsy. The term "seizure disorder" is often used as another way to describe epilepsy.

### What is epilepsy?

Epilepsy is a disorder of the brain in which seizures occur repeatedly. A seizure is caused by an abnormal electrical discharge in the brain. This abnormal "short circuit" can cause a change in behavior without your being aware of what is happening. During a seizure you may fall down, stare off into space, or make jerking movements. Some people get a warning, called an aura that tells them when a seizure is about to happen. You cannot control what is happening while a seizure is occurring. If you witness someone having a seizure, see [What to Do During a Seizure](#).

The most common seizure types are classified as either partial or generalized. Partial seizures arise from one part of the brain and include simple, partial, and complex partial seizures. Generalized seizures appear to involve the entire brain and include generalized tonic-clonic, absence, myoclonic, tonic, and atonic seizures (see [Seizures](#)).

### What are the symptoms?

An epilepsy syndrome is a collection of abnormal signs such as seizure type, age of onset, symptoms, severity, and EEG patterns that commonly occur together. While some types of "symptomatic" epilepsy may be caused by a brain tumor, stroke, or other neurological disorder, "idiopathic" epilepsy syndromes have no identifiable causes. Common syndromes include:

#### Temporal lobe epilepsy

- onset in childhood, 6-10 years
- two thirds have complex partial seizures; one third have generalized seizures
- auras are very common (>80%)
- mouth behaviors, motor automatisms
- seizures last more than one minute followed by confusion or amnesia

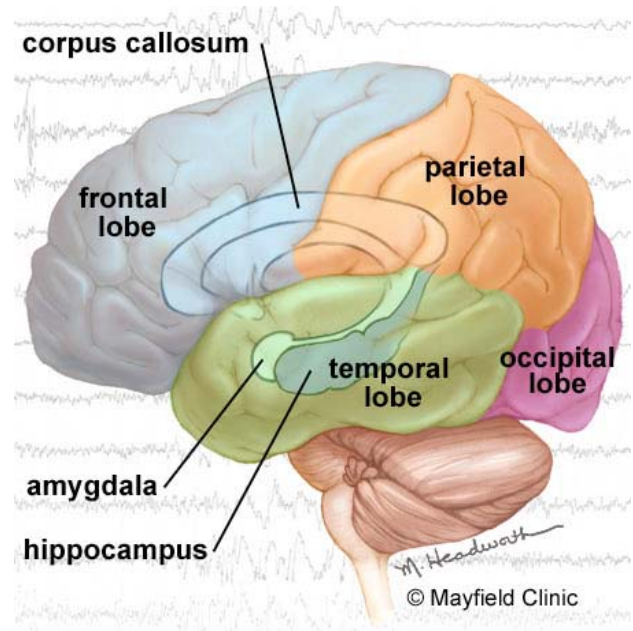


Figure 1. A seizure is an abnormal electrical discharge in the brain. Symptoms of a seizure vary depending on which lobe of the brain is affected and whether the seizure is partial or generalized.

#### Frontal lobe epilepsy

- sudden onset and short duration seizures
- rapid recovery of consciousness
- prominent motor automatisms
- risk for complex partial status epilepticus
- usually sporadic (not inherited)
- seizures more common during sleep

#### Reflex epilepsy

- seizures triggered by the environment
- photosensitivity (seizures in response to flashing lights, strobe lights, video games)
- begins in childhood, associated with absence seizures, may disappear in adulthood

#### Juvenile myoclonic epilepsy

- most common (5%) epilepsy
- onset in puberty, 8-30 years
- myoclonic, absence and generalized tonic clonic seizures; jerking of arms and legs
- seizures occur on awakening or sleep deprivation

### Benign Rolandic epilepsy

- represents one third of childhood epilepsy
- onset 3-13 years; outgrow it by age 15
- seizures occur during sleep
- symptoms include parasthesia in the lips, gums and inner cheeks
- simple partial seizures of face
- drooling, speech arrest and generalized tonic-clonic seizures

### Lennox-Gastaut syndrome

- represents 1% epilepsy, difficult to treat
- onset in childhood, 1-8 years
- mixed seizures: absence, tonic seizures causing stiffening, often during sleep; drop attacks, seizures on waking
- frequent seizures; status epilepticus risk
- often have developmental problems

### What are the causes?

There are many causes of epilepsy, including head trauma, stroke, birth injury, brain tumors, and infections. However, for approximately 70% of patients with epilepsy, the cause is unknown.

### Who is affected?

Epilepsy affects 2.5 million people in the US and 15,000 to 25,000 people in Greater Cincinnati. Nationwide, 181,000 new cases of epilepsy are diagnosed every year, and the disorder affects slightly more men than women. New cases more commonly occur in the young around the age of 1 and then again later in life around the age of 55. Epilepsy can begin at any age.

### How is a diagnosis made?

Your doctor will take a complete medical history. This includes a review of medicines you've tried for seizure control (including side effects and effectiveness), a description of the seizure activity, and any history of other family members with neurological problems. The doctor will also perform a detailed neurologic examination, which tests specific functions of the central nervous system. The following diagnostic tests may also be included in your evaluation.

**Electroencephalogram (EEG)** is a test that records electrical patterns in your brain called brain waves. Electrodes are placed on your scalp and then the signals picked up by the electrodes are amplified and recorded. The procedure lasts about 40 minutes. An EEG is of value for diagnosing epilepsy only if it picks up patterns typical of epilepsy. If it doesn't pick up the right patterns, you may still have epilepsy and ambulatory monitoring (longer term EEG) may be necessary. Twenty four hour video/EEG monitoring, available in centers that specialize in treating patients with frequent seizures, allows you to be observed during seizure activity so that your behavior can be monitored at the same time as your EEG.

## Epilepsy Emergency Status Epilepticus

Status epilepticus is a medical emergency! It occurs when seizures do not stop or happen repetitively without regaining consciousness in between. It is possible for brain damage to occur as a result of lack of oxygen to the brain. Call 911 if seizures last longer than is typical for that person, or if they last longer than 5-10 minutes. Timing the seizure with a watch is helpful because a brief seizure may seem longer than it really is.

If you have any suspicion that something is wrong, **CALL**. It is better to call too frequently than to avoid calling.

**Blood tests** are performed to assess your general health and check for infections, anemia, and chemical imbalances. These tests are helpful in ruling out a chemical cause of your seizures. When you start a new anticonvulsant medication, blood levels (electrolytes, liver & kidney function, blood cell counts, and drug levels) are checked frequently and will gradually taper to every month or so, depending on your dosage or your doctor's protocols.

**Magnetic resonance imaging (MRI)** is a noninvasive test that uses a magnetic field and radiofrequency waves to give a detailed view of your brain. It allows your doctor to view your brain 3-dimensionally in slices, as if it were sliced layer-by-layer like a loaf of bread with a picture taken of each slice. The pictures can be taken from the side or from the top as a cross-section. It may or may not be performed with a dye (contrast agent) injected into your blood stream. MRI is helpful to determine if a tumor, arteriovenous malformation, or genetic defect of the brain is causing your seizures.

**Positron emission tomography (PET) and single-photon emission computed tomography (SPECT) scans** allow the doctor to study the function of your brain by observing how glucose is metabolized. You are injected with a "tracer," which is a small amount of radioactive substance attached to glucose, and a computer creates pictures of the brain. A scan taken while you are having a seizure typically demonstrates "hypermetabolism," or increased use of glucose. A scan taken when you are not having a seizure can show a specific area of "hypometabolism," or decreased use of glucose. These results may help show the location of focal areas of your brain that are not working properly or other differences that may correspond to EEG test results. Because SPECT equipment is more widely available and less expensive than PET, it may be used instead of PET.

## Who treats epilepsy?

A primary care doctor, pediatrician, family practitioner, internist, or neurologist may treat epilepsy. Neurologists who specialize in treating epilepsy, called epileptologists, are available in specialized epilepsy centers across the nation to treat patients with seizures that are not well controlled.

## What treatments are available?

Epilepsy is usually treated with anti-epileptic medications. Approximately 70% of people with epilepsy have either complete or very good seizure control with medication. About 30% of people with epilepsy cannot control their seizures with medicine. Treatment options for these patients include epilepsy surgery, vagus nerve stimulation, participation in clinical drug trials, and the ketogenic diet (used primarily in children).

## Medication

Once the exact seizure type and epilepsy syndrome has been determined, your doctor usually chooses the best medication effective for that type of seizure. Several other factors are considered such as cost, dosing schedule, patient age, previous drug interactions, other existing health conditions, and child bearing potential. Monotherapy is the ideal type of therapy to manage side effects and dosing more easily. Approximately 50% of patients are free of seizures with one medication. It may be necessary to add a second drug if one drug does not control your seizures. The goal is to control the seizures with the fewest possible side effects.

Common anti-epileptic drugs (AED)

- **Phenytoin** (Dilantin) is one of the oldest and most commonly used drug to treat seizures. It is most effective for tonic-clonic seizures or complex partial seizures.
- **Phenobarbital** is a barbiturate used to treat tonic-clonic and simple partial seizures. It was the first drug used to treat epilepsy and causes drowsiness. It is rarely used for new cases of epilepsy.
- **Valproic acid** (Depakote, Depakene) is used for partial and tonic/clonic seizures.
- **Carbamazepine** (Tegretol, Carbatrol) is another drug to treat some types of seizures. It's also used to treat pain caused by trigeminal neuralgia.

Since 1992, nine new medications have been approved to treat epilepsy:

- **Felbamate** (Felbatol) is restricted to patients with severe intractable partial and secondary generalized seizures and in patients with Lennox-Gastaut syndrome who have not responded to other medication.
- **Gabapentin** (Neurontin) is used for partial seizures with or without secondary generalization.

- **Lamotrigine** (Lamictal) is used for partial seizures and in generalized seizures of Lennox-Gastaut syndrome in children and adults.
- **Topiramate** (Topamax) is used in adults with partial onset, generalized tonic-clonic seizures, and in generalized seizures of Lennox-Gastaut syndrome in children and adults.
- **Tiagabine** (Gabitril) is used in adults and children more than 12 years old with partial seizures.
- **Levetiracetam** (Keppra) is used for partial onset seizures.
- **Oxcarbazepine** (Trileptal) is used in adults and children 4 to 16 years old with partial seizures.
- **Zonisamide** (Zonegran) is used for partial seizures.
- **Pregabalin** (Lyrica) is used for partial seizures.

The new formulations and drug delivery systems include an extended-release form of carbamazepine, fosphenytoin, an intravenous formulation of valproic acid, and diazepam rectal gel.

As with all drugs, there are side effects and drug interactions. Most common side effects include fatigue, drowsiness, nausea, gum problems, weight gain, and blurred vision. If you have unacceptable side effects with your medication, changing to another medication may improve these adverse effects. Also, these drugs may reduce the effectiveness of birth control pills. If you are pregnant or thinking about getting pregnant, you should not take any anti-seizure medications that are known to cause birth problems. You need to discuss this with your physician.

## Surgery

When medication fails to control your seizures or the side effects become unacceptable, surgical treatments may be considered.

- **Vagus Nerve Stimulation** offers a unique treatment option and may help you if your seizures cannot be controlled or you experience unacceptable side effects with medication. It may also be used if you are not a candidate for surgery. A pacemaker-like device is implanted in your chest connected to a wire that is wrapped around the vagus nerve in your neck. The stimulator sends a small electrical current to the vagus nerve. The stimulator can be programmed to deliver current intermittently or on demand. If you feel a seizure beginning, a magnet placed over the device provides additional stimulation to possibly stop a seizure in progress. Why the vagus nerve stimulator works is not completely understood but is has been shown to reduce seizure frequency. The success rate is comparable to the newer medications. You may experience some minor side effects, such as a tingling or change in voice

during stimulation. VNS is not a cure for seizures. It is important to decide if epilepsy surgery is a better option for you before the stimulator is implanted.

- **Epilepsy surgery** may be a treatment option if you have seizures that cannot be controlled by medications. Most commonly, a portion of the brain that generates seizures is removed during the surgical procedure (see Epilepsy Surgery). In addition to operations that remove a small part of the brain where seizures begin, other procedures may be done to interrupt the spread of electrical energy/discharges in your brain. You can be considered for surgery only if you have seizures that arise from one focal area of the brain or that can be isolated from the other parts of the brain. Depending on the site of seizure onset and the underlying cause, 50-80% of patients who have epilepsy surgery can become seizure free. Surgery is especially beneficial for those with temporal lobe epilepsy (3).

### **Ketogenic diet**

A ketogenic (high-protein/fat) diet may be a treatment option for children who have many side effects from anti-seizure drugs, or whose seizures cannot be controlled by them. This special restricted-calorie diet tricks the body into burning fat, instead of glucose, for energy. The diet is very high in fats and low in protein and carbohydrates. It produces a change in the body's chemistry called ketosis, which has the effect of controlling seizures or reducing their frequency in two of three children placed on the diet. Although not all children benefit, parents report that children who do benefit are more alert and active than before.

The ketogenic diet must be developed by a dietitian, weighed out in grams by the family, and monitored by a doctor just as if it were a course of drug treatment. Like other treatments, the ketogenic diet has some side effects, which are monitored through blood and urine tests and follow-up visits. The diet is used primarily to treat children for a limited period of time, after which the diet may be slowly tapered and regular food slowly re-introduced. If seizures return, the diet may be re-instituted. Studies are underway to see whether the ketogenic diet may also work for some adults. Early results suggest that it may, but the long-term effects of such a high-fat diet are unknown.

### **Clinical trials**

Clinical trials are research studies in which new treatments—drugs, diagnostics, procedures, and other therapies—are tested in people to see if they are safe and effective. Research is always being conducted to improve the standard of medical care. Information about current clinical trials, including eligibility, protocol, and locations, are found on the

Web. Studies can be sponsored by the National Institutes of Health (see [clinicaltrials.gov](http://clinicaltrials.gov)) as well as private industry and pharmaceutical companies (see [www.centerwatch.com](http://www.centerwatch.com)).

## **Recovery & prevention**

What can I do if medications don't control my seizures? Current recommendations (1) state that a patient who continues to have seizures after treatment with three anti-epileptic drugs should be evaluated at a comprehensive epilepsy treatment program. Such programs are staffed by full-time epileptologists (neurologists who specialize in epilepsy) and neurosurgeon(s) who specialize in epilepsy surgery. These programs include an epilepsy monitoring unit with 24 hour video/EEG monitoring of your seizures. This testing requires hospitalization. The specialized testing completed as part of epilepsy monitoring can help your doctor more successfully treat you in three ways:

1. Video/EEG monitoring can define the specific type of seizure and help the doctor choose the best medication.
2. The monitoring can define the precise brain location of your seizure onset and lead to curative epilepsy surgery in selected patients.
3. Some patients have attacks that are not seizures; monitoring can provide the doctor with a more accurate diagnosis that leads to improved therapy.

### **Healthy habits**

1. Take your medication every day as directed. Your medication helps to control seizures, but missing a dose can cause seizures.
2. Eat a healthy diet. Low blood sugar levels can cause seizures, so try not to miss a meal, especially if you take part in sports.
3. Get enough sleep. Lack of sleep can be a seizure trigger.
4. Limit your use of alcohol. It can be risky to drink alcohol if you take certain medications. Talk to your doctor.
5. Avoid illegal drugs. They can cause seizures and interact poorly with your anti-epilepsy medication.
6. Exercise regularly. You'll feel good about yourself, alleviate depression, and control weight.
7. Learn relaxation techniques. Some seizures are triggered by stress.

### **Physical activity**

Exercise and sport activities are encouraged so long as common sense and basic safety precautions are practiced. Limitations vary depending on seizure type and frequency; the risk of injury should be measured against the benefit of participation. Water sports require additional precautions such as the use of life preservers, buddy system, and increased supervision.

## Driving

When first starting AED medication you will not be able to drive. Each state has different rules as to how long a person must be seizure free before being allowed to drive (anywhere from 3 to 12 months) and may require a doctor's evaluation of your ability to drive.

## Work & school

Informing others around you about your medical condition is your decision. However, if your seizures are only moderately controlled someone may eventually witness you having a seizure. Educate your co-workers and teachers about how to recognize your specific kind of seizures and what to do when one occurs. Always wear your medical identification bracelet. It is against the law for you to be discriminated based on your medical condition.

## Sources & links

If you have more questions, please contact the Mayfield Clinic at 800-325-7787 or 513-221-1100. For information about the Epilepsy Center at the UC Neuroscience Institute, call 886-941-8264.

## Sources

1. Browne TR, Holmes G: *Handbook of Epilepsy*. Philadelphia, Lippincott-Raven Publishers, 1997, pp. 175
2. Pellock JM, Dodson WE, Bourgeois F: *Pediatric epilepsy, diagnosis and therapy*. New York, Demos Medical Publishers, 2001, pp. 73-76
3. Wiebe S, Blume WT, Girvin JP, Eliasziw M: A randomized, controlled trial of surgery for temporal-lobe epilepsy. *N Engl J Med* 345: 311-8, 2001

## Links

Epilepsy Foundation of America, 800-EFA-1000  
[www.efa.org](http://www.efa.org)  
American Epilepsy Society  
[www.aesnet.org](http://www.aesnet.org)  
National Society for Epilepsy  
[www.epilepsynse.org.uk](http://www.epilepsynse.org.uk)  
[www.epilepsy.com](http://www.epilepsy.com)  
[www.epilepsyandhealth.com](http://www.epilepsyandhealth.com)

## Glossary

**antiepileptic drug (AED):** a medication used to control epileptic seizures.

**aura:** a "warning" that a seizure may be imminent, the beginning of a seizure. Auras range from abnormal smells or tastes, to a funny feeling in the stomach, to sounds, colors, or emotional rushes.

**automatism:** things people do during a seizure in a state of diminished consciousness, such as pulling at their clothes or chewing.

**efficacy:** the effectiveness of a drug therapy in accomplishing its intended purpose.

**epileptologist:** a neurologist who specializes in the treatment of epilepsy.

**generalized seizure:** a seizure involving the entire brain.

**hypermetabolism:** faster than normal metabolism.

**hypometabolism:** slower than normal metabolism.

**ictal:** that which happens during a seizure.

**idiopathic:** of unknown cause.

**interictal:** that which happens between seizures.

**intractable:** difficult to control.

**localization:** finding the location in the brain where epileptic seizures start.

**monotherapy:** treatment with only one drug.

**partial seizure:** a seizure involving only a portion of the brain.

**status epilepticus:** a seizure that lasts more than 5 minutes and requires immediate medical attention due to lack of oxygen to the brain.

**video EEG monitoring:** simultaneous monitoring of a patient's behavior with a video camera and the patient's brain activity by EEG.

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reviewed by > Maureen Gartner, RN  
and David Ficker, MD



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