Epileptic seizures are divided into two broad categories: generalized and partial (or focal). Classifying the type of seizure is very important, and will help your doctor plan the treatment you need.

**Generalized seizures** are produced by abnormal electrical activity throughout the brain. They can result from a genetic predisposition in an otherwise healthy person or as a consequence of widespread disturbance of brain function. You may experience different types of generalized seizures, or the type may vary from one seizure to another.

<table>
<thead>
<tr>
<th>GENERALIZED SEIZURES</th>
<th>TYPICAL SYMPTOMS</th>
</tr>
</thead>
<tbody>
<tr>
<td>“Grand mal” or generalized tonic-clonic</td>
<td>Loss of consciousness, rigid muscles, whole-body convulsions; can cause a fall if you are standing</td>
</tr>
<tr>
<td>Absence</td>
<td>Staring with brief loss of consciousness; fluttering eyelids</td>
</tr>
<tr>
<td>Myoclonic</td>
<td>Sporadic or repeated, brief jerks of the limbs</td>
</tr>
<tr>
<td>Clonic</td>
<td>Repetitive, rhythmic jerking movements of head or limbs</td>
</tr>
<tr>
<td>Tonic</td>
<td>Loss of consciousness, stiffness and rigidity of the whole body; can cause a fall if you are standing</td>
</tr>
<tr>
<td>Atonic</td>
<td>Loss of muscle tone in head or body; can cause a fall if you are standing</td>
</tr>
</tbody>
</table>
**Partial** or **focal seizures** are produced by electrical impulses that start in a relatively small region of the brain. The part of the brain generating the seizures is sometimes called the focus. In simple partial seizures, the patient retains awareness, whereas complex partial seizures cause the patient to lose awareness.

Partial seizures can vary in type in the same patient, or go from simple partial to complex partial, or even to generalized seizures. Partial seizures imply some localized brain disease caused by head injury, stroke, tumor, scar or developmental anomaly. The cause can sometimes be detected on imaging tests but, in many instances, it remains unknown. Rarely are partial seizures related to a genetic predisposition.

<table>
<thead>
<tr>
<th>PARTIAL (FOCAL) SEIZURES</th>
<th>TYPICAL SYMPTOMS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Simple partial (no loss of awareness)</td>
<td><strong>Simple motor</strong>: Jerking, stiffening confined to one side of head or body</td>
</tr>
<tr>
<td></td>
<td><strong>Simple sensory (auras)</strong>: Unusual sensations affecting vision, hearing, smell, taste or touch, or memory or emotional disturbances; possibility of racing heart, hot and cold feelings</td>
</tr>
<tr>
<td>Complex partial (impaired awareness)</td>
<td>Staring, unresponsiveness; automatisms such as lip smacking, chewing, fidgeting, and other repetitive, involuntary but coordinated movements</td>
</tr>
<tr>
<td>Partial with secondary generalization</td>
<td>Milder seizure symptoms listed above lead to loss of consciousness and convulsions</td>
</tr>
</tbody>
</table>

Two other types of attacks can look very much like an epileptic seizure, but are not epileptic in nature because they do not involve abnormal electrical activity in the brain:

- **Non-epileptic seizures** can involve loss of consciousness, abnormal movements, jerks and falls. They are usually related to psychological or emotional stress.
- **Convulsive syncope** describes fainting from a cardiac or circulatory cause, accompanied by stiffening or jerks that can mimic epilepsy.

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**Cleveland Clinic Neurological Institute**

The Epilepsy Center is part of the Cleveland Clinic Neurological Institute, a multidisciplinary institute that combines more than 250 medical, surgical and research specialists dedicated to the diagnosis and treatment of adult and pediatric patients with neurological and psychiatric disorders. This structure allows for a disease-specific, patient-focused approach to care. Our unique, fully integrated model is beneficial to our current standard of care, allows us to measure quality and outcomes on a continual basis, and enhances our ability to conduct research.
First Aid FOR Seizures

Learn to recognize common symptoms of seizures:
- staring and unresponsiveness
- confusion
- jerks and twitches
- wandering
- shaking or falling
- picking or lip smacking
- whole-body convulsions (grand mal seizure)

First aid steps: Non-convulsive seizures
- watch the person carefully to recognize the seizure
- speak quietly and calmly to the person
- explain to others what is happening
- guide the person gently to a safe area away from any danger such as water, machinery or fire
- don’t restrain the person or try to stop the movements
- stay with the person until he or she regains complete consciousness

Additional first aid steps: Grand mal (convulsive) seizure
- time the seizure
- look for an “Epilepsy” or “Seizure Disorders” bracelet
- place the person on his or her side, away from hazardous objects
- don’t put anything in the person’s mouth
- remove eyeglasses and any tight objects around the person’s neck
- call 9-1-1 if the seizure lasts more than five minutes or results in injury
- stay with the person until help arrives

Learn more:
For more information on epilepsy and epilepsy treatment options, visit clevelandclinic.org/epilepsy or call 216.636.5860.

Cleveland Clinic
If you are evaluated for suspected seizures or epilepsy, your doctor will seek to answer several questions:

- Have you had an epileptic seizure or something else?
- What is the cause? If a cause is identified, can it be treated?
- What is the seizure type?
- What is the outlook?

To answer these questions, your doctor will need to take a detailed medical history, including major illnesses or injuries you have suffered and medications you have taken or are currently taking. Your doctor will also need to know about family members who have had seizures or other similar conditions and any medications they are taking.

**Diagnostic Steps**

Important questions that you should prepare for include:

- At what age did the seizures begin?
- What circumstances surrounded your first seizure?
- What factors seem to bring on the seizures?
- What do you feel before, during and after the seizures?
- How long do the seizures last?
- Have you been treated for epilepsy before?
- Which medications were prescribed and at what dosages?
- Was the treatment effective?

Others who have seen you when you had a seizure, such as family and close friends, should be present to provide details because you may not have been aware of what was happening.

As part of the evaluation, your doctor will need to perform a number of tests, including:

- a complete physical and neurological examination of muscle strength, reflexes, eyesight, hearing and ability to detect various sensations.
- imaging studies of the brain, such as those provided by magnetic resonance imaging (MRI).
- blood tests to measure red and white blood cell counts, blood sugar, and blood calcium and electrolyte levels, and to evaluate liver and kidney function. Blood tests help rule out the presence of other illnesses.
- an electroencephalogram (EEG), which measures electrical impulses in the brain.

The EEG is an especially important part of the evaluation because seizures are defined by abnormal electrical activity in the brain. This test is useful not only to confirm a diagnosis of epilepsy, but also to determine the type of epilepsy. However, it is not uncommon for routine outpatient EEGs to be normal in patients with epilepsy. Repeat EEGs after sleep deprivation can increase the chance of finding an abnormality.

When routine outpatient EEG studies fail to provide the needed information, prolonged EEG monitoring may be necessary. This approach involves continuous EEG recording of brain activity, with simultaneous visual and audio monitoring of body movements and behavior. Prolonged monitoring is the definitive way to diagnose epilepsy because it increases the likelihood that you will be observed during a seizure. This type of EEG may require you to spend several days in a special hospital facility.

clevelandclinic.org/epilepsy
Confirming the Diagnosis

Only with complete information can your doctor come to a diagnosis. Sometimes, the tests reveal an abnormality that serves to confirm the diagnosis of a seizure disorder. Many other times, however, the diagnosis must be based on historical features alone. When there is uncertainty, repeat testing may be required.

Conditions that can be confused with epilepsy include fainting (syncope), sleep attacks, anxiety spells and non-epileptic seizures, among others. Getting the right diagnosis is critical because the treatments for these conditions differ from those for epilepsy. Often, an alternative diagnosis is obtained only after seizure-like attacks do not respond to treatment with seizure medications, prompting further testing.

Defining the seizure type requires all available data as well, and is possible in a majority of patients. Knowing the seizure type helps your doctor narrow the choice among anti-epileptic medications.

The more information obtained, and the more accurate the diagnosis of seizure type and epilepsy syndrome, the more likely your doctor can help you know what to expect in terms of treatment length and outcome. Nevertheless, even the most experienced epilepsy specialist will admit that, while we have some knowledge of how certain types of epilepsy affect an average group, it is very difficult to give exact information on an individual.

Contact Us

If you have questions or wish to schedule an appointment, please call 866.588.2264, or visit clevelandclinic.org/epilepsy.
Epilepsy is a chronic medical condition marked by recurrent seizures (an event of altered brain function caused by abnormal or excessive electrical discharges from brain cells). Epilepsy is one of the most common neurological disorders, affecting up to 1 percent of the population in the United States. More than 45,000 children ages 18 and younger are diagnosed with epilepsy every year.

How is epilepsy diagnosed?
The evaluation of patients with epilepsy is aimed at determining the type of seizures (epileptic vs. non-epileptic) and their cause because epilepsies respond best to some medications. A diagnosis is based on:

- Medical history, including family history of seizures, associated medical conditions and current medications. The physician may ask the following questions:
  - At what age did seizures begin?
  - What circumstances surrounded the first seizure?
  - What factors seem to bring on seizures?
  - What is felt before, during and after seizures?
  - How long do seizures last?
  - Has there been previous treatment for epilepsy?
  - Which medications have been prescribed and in what dosages?
  - Was treatment effective?

- Eyewitness accounts from family or friends who can describe the seizures

- A complete physical and neurological examination of higher mental functions, muscle strength, reflexes, eyesight, hearing and ability to detect various sensations, so physicians may better understand the cause of seizures

- Electroencephalogram (EEG), which records the electrical activity of the brain and gives useful information regarding the location and type of epileptic discharges

- Additional testing, which often includes:
  - Imaging studies of the brain, such as high-resolution magnetic resonance imaging (MRI)
  - Other brain scans, including positron emission tomography (PET), single photon emission computed tomography (SPECT) and functional magnetic resonance imaging (fMRI)
  - Neuropsychological testing to determine the impact of epilepsy on the child’s language function, memory, intelligence, attention span, organizational skills and mood
  - Blood and urine tests to measure blood cell counts, blood sugar and electrolyte levels; liver and kidney function tests; and additional blood and urine tests to look for metabolic or genetic diseases

Can my child lead a normal life after being diagnosed with epilepsy?
Epilepsy is a treatable disorder, with two-thirds of patients becoming seizure free on medication. Even for those who may not respond to medication, epilepsy surgery and electrical brain stimulation may be options. Advancements in our understanding of the causes of epilepsy and new treatments continue to offer hope to ever more patients.

Depending upon the degree of seizure control, patients who have epilepsy can participate in many of the same activities that other
people do. We recommend that patients engage in an active and healthy lifestyle, including outdoor and indoor sports. Reasonable seizure precautions are advisable, however, to prevent injury due to falls, drowning or motor vehicle accidents. The treating physician can guide you regarding which activities are safe.

Some patients with epilepsy do have learning or memory difficulties and alterations in mood or behavior, which should be brought to the attention of the treating neurologist for appropriate diagnostic testing and treatment. Cleveland Clinic Epilepsy Center offers a comprehensive and multidisciplinary treatment approach for managing such issues. Specialists in Pediatric Neuropsychology and Child and Adolescent Psychiatry are an integral part of the treatment team.

**How effective is medication in treating epilepsy?**

Success, defined as seizure freedom, is achieved in about 50 percent of patients treated with the first antiepileptic medication. After failure of the first drug, the seizure-free rate drops to 11 percent to 15 percent when the patient is placed on another drug or uses a combination of two drugs. After two or more antiepileptic medications fail, there is only a 5 percent to 10 percent chance that future medication trials will result in seizure freedom. Overall, between two-thirds and three-quarters of all patients will become seizure free. The remaining group of patients is much harder to control; the term for their condition is "medically refractory" or "intractable epilepsy."

Why some patients respond well to a given medication and not to another is not fully understood. Precise identification of the exact seizure type with Video-EEG monitoring and determination of the underlying cause of epilepsy are important factors when considering the best form of treatment.

**If my child needs to have surgery, can he fully recover afterward?**

Once considered a last resort, epilepsy surgery in the hands of experts has become a safe and highly effective method of treatment for selected patients whose epilepsy cannot be controlled with anticonvulsant medication. Our epilepsy surgery program identifies patients who are appropriate candidates for surgical intervention. Testing is carried out to localize the seizure focus and determine whether it can be removed safely. Seizure-free rates after surgery can range from 50 percent to 90 percent, depending upon many factors. Pediatric patients are often best suited for epilepsy surgery, due to the fact that their still developing brains can better adjust to surgery. Each year, our neurosurgeons perform more than 80 pediatric surgical procedures.

Following epilepsy surgery at Cleveland Clinic, children are cared for by an expert team of physicians and nurses. Soon after recovering from anesthesia, children are observed in the Pediatric Intensive Care Unit for one or two days, followed by another three to five days in the hospital. Most children are able to go home, returning in about 10 days for removal of sutures. Some children may need rehabilitative therapy for one to two weeks at Cleveland Clinic Children’s Hospital for Rehabilitation. By two weeks after surgery, patients can stay awake most of the day. At six weeks, they usually are able to return to school or work a full day. Some patients may have mild cognitive difficulties, but these improve and stabilize three to six months after surgery. Patients should continue taking their seizure medications after surgery.

To make an appointment for an evaluation with a Cleveland Clinic pediatric epileptologist, please call 866.588.2264. To learn more about pediatric epilepsy and Cleveland Clinic Epilepsy Center, visit us online at clevelandclinic.org/epilepsyeducation.
In most patients with epilepsy — between 60 and 70 percent — anti-epileptic or anticonvulsant medications control seizures. Today, there are more than 20 approved medications for epilepsy. The seizures associated with epilepsy result from abnormal or excessive electrical activity in the brain, and these medications act to dampen or diminish that activity.

Some people have seizures that do not respond to medication(s), or they experience intolerable side effects. When epilepsy does not respond fully to medication(s), it is called medically intractable, or pharmaco-resistant, epilepsy. If you are among these people, talk to your doctor. Surgery or alternative therapies may help.

How do I choose which drug to take?

There are many types of epilepsy and many anti-epilepsy drugs, and each person responds differently to a given drug. The choice is influenced by factors specific to the patient, such as side effect profile, seizure types, frequency and severity of seizures, age, sex, overall health and medical history. You and your doctor can discuss which drugs will best treat your epilepsy. You may have to try more than one drug before you find the one that works best for you.

Should I take more than one medication?

Monotherapy refers to treatment with a single drug, which is preferred if possible. But sometimes no single drug is effective, so you and your doctor may consider a combination. Many newer medications approved by the Food and Drug Administration are licensed as “add-on” treatments to help boost the effectiveness of older medications. However, combinations of more than two drugs increase the risk of complications and should be used with caution.

How often and when do I take my medications?

All the approved medications for epilepsy are taken orally — as tablets, coated pills, capsules, syrups or liquids. They differ according to how often they have to be taken. If your schedule makes it difficult to take a medication several times a day, you may want to consider one that can be taken once a day.

Flexibility may be important to you. Some drugs stay in the bloodstream longer than others; if you are taking one of these, it is less important to take it at a precise hour.

If you have seizures at night, you may be able to take extra doses of your medication before bedtime.

What happens if I miss a dose?

The more regularly and consistently you take your medication(s), the better your chance of controlling your seizures. But it’s human to forget a dose or take it late, so don’t panic if it happens.

If you forget a dose and realize your mistake within 24 hours, take the dose immediately, then delay the next scheduled dose by four hours. Let’s say you are supposed to take an anti-epilepsy pill twice a day. At 6 p.m., you realize you forgot to take your morning dose. What should you do?

Take the missed dose immediately and wait until at least 10 p.m. to take the second dose.
Always take medicine at the same time each day, best fitted to your daily routine. A weekly pillbox is a must so you can see if a dose has been missed. Other strategies include using alarms on watches, cell phones or clocks. Of course, family members and friends can help with reminders as well.

What kinds of side effects should I expect?

Typical side effects include fatigue, sleepiness, mental fogginess or unsteadiness. These tend to occur an hour or two after a dose of medication, especially if the medicine is taken on an empty stomach.

Other, rarer side effects are unique to specific medications. For instance, Dilantin may cause your gums to swell, while Depakote can cause hair loss, weight gain or tremor. Keppra sometimes causes mood swings and Topamax can cause a tingling sensation or kidney stones. These side effects typically develop over time with long-term treatment.

Finally, there are some very rare, unpredictable side effects that can be quite serious. These include skin rashes, low blood cell counts and liver problems.

Of course, you may not experience any side effects, or they may be minor. Their severity will likely depend on the type of medication, dose and length of treatment. Side effects are worse at higher doses, but they become less severe over time as your body adjusts to the medication.

A simple, effective way to avoid or reduce side effects is to always take your medication with food. This helps the body adjust by slowing absorption of the medicine in the bloodstream.

How long will I have to take medication?

The answer depends on the type of epilepsy you have and your response to medication. Some patients need treatment for a few years, while others require medication their entire lives. Some patients who are treated for a single, first seizure and who do not have other risk factors for epilepsy may go off treatment as soon as one year.

With some exceptions, patients who are seizure free for some years should be re-evaluated to determine whether the drug can be discontinued. How long the seizure-free period should be varies among the types of epilepsy. The decision to discontinue a medication depends on additional factors, including whether the patient has normal neurological function, prior MRI evidence of brain problems and EEG findings. If a medication is going to be stopped, it should be weaned — gradually lowered in dose — to avoid triggering a seizure.

Contact Us

If you have questions or wish to schedule an appointment, please call 866.588.2264, or visit clevelandclinic.org/epilepsy.
Stereoelectroencephalography (SEEG) is an invasive surgical procedure that is used to identify areas of the brain where epileptic seizures originate. With SEEG, doctors place electrodes in targeted brain areas, which are then monitored to precisely locate seizure source. When the seizure onset is localized, a surgical resection and a good seizure outcome may be possible.

In March 2009, Cleveland Clinic launched the first SEEG program in North America. If you or a loved one has found no medical or surgical option for uncontrollable epileptic seizures, you may want to know more about this promising technique.

Who can benefit from SEEG?
SEEG may help you if you:
• have focal epilepsy and seizures (complex partial seizures) that do not respond to two medications or medical treatment.
• are a potential candidate for epilepsy surgery.
• have seizures of undetermined origin.

Who cannot benefit from SEEG?
If you have generalized epilepsy, SEEG surgery is not an option.

Is there an age limit?
The average age of SEEG patients at Cleveland Clinic is 25 to 30, but children as young as 2 can safely undergo the surgery.

What are the advantages of SEEG?
SEEG is a minimally invasive approach for epilepsy localization:
• to implant the electrodes, the surgeon makes 10 to 20 small incisions in the scalp, with no blood loss.
• while SEEG surgery lasts five to six hours and requires general anesthesia, removal of the electrodes is a simple procedure that takes 10 to 15 minutes under local anesthesia.

Why does it take so long to place the SEEG electrodes?
Electrode placement goes quickly, but it takes time to plan for that placement. Success in identifying seizure source depends on being extremely precise. In approximately 90 percent of SEEG cases, we are successful.

SEEG is a big leap forward in our ability to be precise. It’s the difference between sitting in the back of the stadium, where you can barely see what the players are doing, and having a front-row view. SEEG puts us in the front row.

What other benefits does SEEG offer?
Through SEEG, we can reach areas of the brain that are off limits with subdural grids:
• Grids are placed directly on the surface of the brain and they are good for localizing surface seizures, but they are not effective for seizure sites deep in the brain. SEEG can go deep.
• SEEG can cover larger brain areas and, very importantly, it can be used to monitor both sides of the brain. Until now, when seizures were coming from both hemispheres, we could do nothing to localize them.

(Continued on back)
How long must SEEG patients stay in the hospital?

After surgery, patients go to our Epilepsy Monitoring Unit, where they are observed for seizure activity. The Cleveland Clinic Epilepsy Center has dedicated adult and pediatric monitoring units, both staffed around the clock with teams of specialists and equipped with the latest technology.

The average stay is one week, but some patients may remain longer while we watch for seizure onset. The electrodes should be removed as soon as the information is captured to minimize the risk of infection.

What happens next?

Any subsequent epilepsy surgery depends on what is learned from the monitoring. SEEG is a tool that provides more accurate localizing information, which is shared with patients.

SEEG Step by Step

If doctors decide you are an appropriate candidate for SEEG to treat your focal epilepsy, here is what will happen immediately before, during and in the period after the procedure.

DAY BEFORE SURGERY

After you are admitted to the hospital:

> You will meet with your doctor or a nurse, who will glue markers called fiducials to your head. Fiducials are reference points that show up on magnetic resonance imaging (MRI) to help guide the neurosurgeon in the operating room.

> Then, you will undergo an MRI and laboratory work.

DAY OF SURGERY

You will meet with the anesthesiologist, who will administer general anesthesia. After you are asleep:

> A stereotactic frame will be placed on your head.

> A computed tomography (CT) exam will be performed.

> A cerebral angiogram will be performed in the operating room. In this procedure, a catheter will be threaded through your groin and up into an artery in your neck. Then, a special contrast dye will be injected into the catheter. The dye will highlight the circulatory system of your brain.

> Doctors will use all this information as they plan to place electrodes in the part of your brain where they think your seizures are originating.

> Once doctors have placed the electrodes, the head frame will be removed.

> You will be awakened and transported to the recovery area.

> A postoperative CT scan and skull X-ray will be performed in the recovery room.

> You will spend the night in the recovery room or in one of our stepdown units.

DAY AFTER SURGERY

You will be transferred to the Epilepsy Monitoring Unit, where the electrodes will be connected to monitoring equipment that will begin to record your brain activity.

NEXT ONE TO FOUR WEEKS

The length of the monitoring phase varies, depending on the frequency of your seizures, but lasts no longer than a month. After recording has been completed:

> The electrodes will be removed under local anesthesia and sedation, usually in the operating room. Typically, this simple procedure takes 10 to 15 minutes.

> Your recorded data will be reviewed and epilepsy specialists will form a plan for surgical removal of the seizure site, if indicated.

> You will be discharged the next day with instructions to return in eight weeks for the surgery, if recommended. This “holiday” period will allow for better results and fewer complications after surgery.