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# Epilepsy

Epilepsy is a chronic neurological disorder characterized by a tendency to have recurrent seizures. Seizures are transient disruptions of brain function caused by uncontrolled excessive electrical activity. They produce a wide range of symptoms, including changes in behaviour, shaking (convulsion) or sudden movements, strange sensations in parts of the body and changes in consciousness.

Seizure may be provoked by multiple medical or neurological conditions, such as acute electrolyte disturbances, hypocalcaemia, hypoglycaemia, fever, alcohol withdrawal, kidney failure, hypertension, meningitis, head trauma, brain tumour or abscess, and stroke. Provoked seizures account for 25-30 percent of cases. Unprovoked seizures occur in the absence of any clear cause. Episodes of seizure can be a onetime event—some 10 percent of people worldwide experience a single seizure in their lifetime—or a recurring event. The time after the seizure and prior to the return of normal neurological function, is called the postictal period. During this period, patients may show weakness, confusion, or unresponsiveness.
Duration of a seizure varies, some lasting 30 seconds and others lasting two minutes. A seizure that is more than five minutes in duration or having more than one episode that occur over that same amount of time, with no return to consciousness between episodes, is known as status epilepticus. Status epilepticus can result in brain damage or death.

Epilepsy is a relatively common disorder affecting about 40 million to 50 million people worldwide; it is slightly more common in males than females. Several types of epileptic disorders are hereditary, others are due to congenital or developmental abnormalities. Cysticercosis, a parasitic infection of the brain, is a common cause of epilepsy in the developing world. About half of epileptic seizures have an unknown cause and are called idiopathic.

In 1981 the International League Against Epilepsy developed a classification scheme for seizures based on their mode of onset. This work resulted in the formation of two major classes: partial seizures and generalized seizures.

## Partial Seizures

Partial (focal) seizures begin in a small localized region of the cerebral cortex or deeper structures of the cerebrum and brain stem, that can propagate to variable regions in the same side or both sides of the brain (Figure 11.1). Clinical manifestations reflect the function of the affected areas and include abnormal sensations or movements; a brief loss of consciousness may occur.

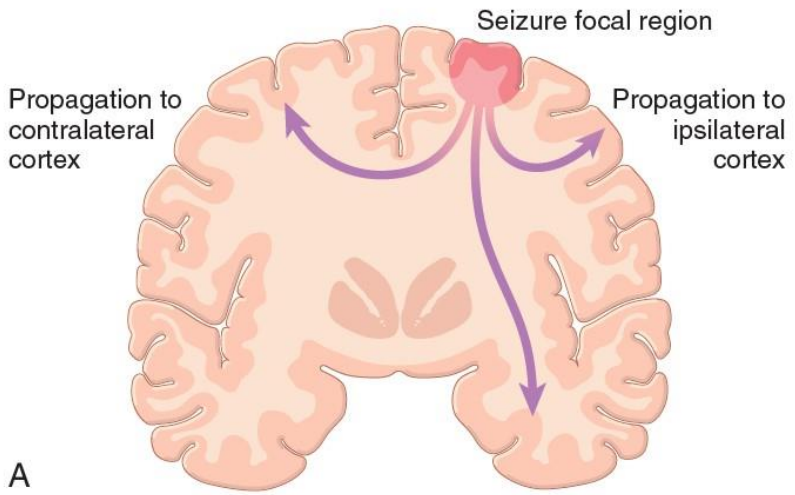


Figure 11.1 Propagation of seizures from focal regions of the cortex can occur through fibres in the same cerebral hemisphere or fibres that connect to the contralateral cortex.

Epileptic individuals with partial seizures may experience unusual sensations called auras that precede the onset of a seizure. Auras may include unpleasant odours or tastes, the sensation that unfamiliar surroundings seem familiar (déjà vu), and visual or auditory hallucinations that last from a fraction of a second to a few seconds. The individual may also experience intense fear, abdominal pain or discomfort, or an awareness of increased respiration rate or heartbeat. The form of the onset of a seizure is, in most cases, the same from attack to attack. After experiencing the aura, the individual becomes unresponsive but may examine objects closely or walk around. Focal seizures are often classified as simple partial when there is no major change in consciousness or as complex partial when consciousness is impaired.

Jacksonian seizures are partial seizures that begin in one part of the body such as the side of the face, the toes on one foot, or the fingers on one hand. The jerking movements then spread to other muscles on the same side of the body. This type of seizure is associated with a lesion or defect in motor cortex—the area of the cerebral cortex that controls voluntary movement.

Complex partial seizures, also called psychomotor seizures, are characterized by a clouding of consciousness and by strange, repetitious movements such as chewing or lip smacking called automatisms. On recovery from the seizure, which usually lasts from one to three minutes, the individual has no memory of the attack, except for the aura. Occasionally, frequent mild complex partial seizures may merge into a prolonged period of confusion, which can last for hours with fluctuating levels of awareness and strange behaviour. Complex partial attacks may be caused by lesions in the frontal lobe or the temporal lobe.

## Generalised Seizures

Generalised epileptic seizures are characterized by diffuse, excessive, and uncontrolled neuronal discharges that at the outset spread rapidly and simultaneously to both cerebral hemispheres through interconnections between the thalamus and cortex (Figure 11.2). This type of seizure is characterized by convulsions, short absences of consciousness, generalized muscle jerks (clonic seizures), muscle stiffening (tonic seizures), and loss of muscle tone with falling. Generalised seizures are subdivided primarily on the basis of the ictal motor manifestations, into generalised tonic-clonic seizure and absence seizure. This classification relies on the extent to which subcortical and brain stem regions participate in the seizure.

Generalised tonic-clonic seizures, sometimes referred to by the older term grand mal, are commonly known as convulsions. In this case, there is an abrupt and extreme neuronal discharge in all areas of the brain—the cerebral cortex, the deeper parts of the cerebrum, and even the brain stem.

A person undergoing a convulsion loses consciousness and falls to the ground. After the fall, the body stiffens because of generalized tonic contraction of the muscles; the lower limbs are usually extended and the upper limbs flexed. During the tonic phase, which lasts less than a minute, respiration stops because of sustained contraction of the respiratory muscles. Following the tonic stage, clonic (jerking/shaking) movements occur in the arms and legs. The tongue may be bitten during involuntary contraction of the jaw muscles, and urinary incontinence may occur. Usually, the entire generalized tonic-clonic seizure is over in less than five minutes. Immediately afterward, the individual is usually confused and sleepy and may have a headache but will not remember the seizure.

Absence seizures are characterised by repeated attacks of unconsciousness or diminished consciousness that generally last less than 15 seconds each and usually occur many times a day.

This type of seizure is sometimes referred to by the older term petit mal. Typical episodes appear as brief staring spells; however, minor movements such as blinking may be associated with absence seizures. After the short interruption of consciousness, the individual is mentally clear and able to resume previous activity. Absence seizures occur mainly in children and do not appear initially after age 20; they tend to disappear before or during early adulthood. At times absence seizures can be nearly continuous, and the individual may appear to be in a clouded, partially responsive state for minutes or hours.

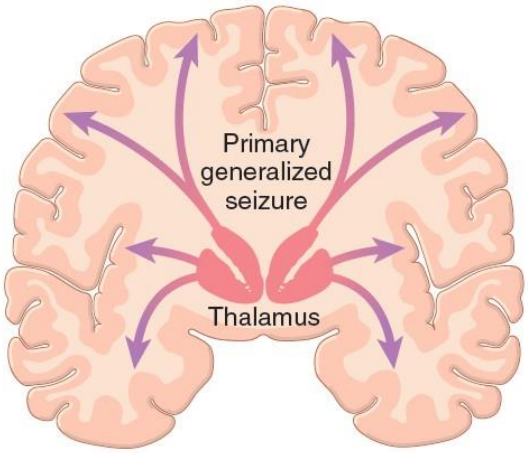


Figure 11.2 Primary generalized seizure spreads rapidly and simultaneously to both cerebral hemispheres through interconnections between the thalamus and cortex.

## Diagnosis

A person with recurrent seizures is diagnosed with epilepsy. Complete physical examination and a set of blood tests are done to determine any metabolic or inflammatory and infective disorders. Routine laboratory investigation includes:

- Urea and electrolytes
- Blood glucose
- Liver function test
- Serum calcium

On the other hand, a neurological evaluation may be necessary to identify the cause of the disorder. Electroencephalogram (EEG) monitoring is performed to detect abnormalities in the electrical activity of the brain (Figures 11.3).

Brain imaging cannot establish a diagnosis of epilepsy but identifies any structural cause. While CT excludes major anatomical abnormalities, MRI is required to demonstrate minor changes in deep white mater of the brain.

## Treatment

Most people with epilepsy have seizures that can be controlled with antiepileptic medications. The currently available drugs appear to block the initiation or spread of seizures. Some of the major effects of various antiepileptic drugs include:

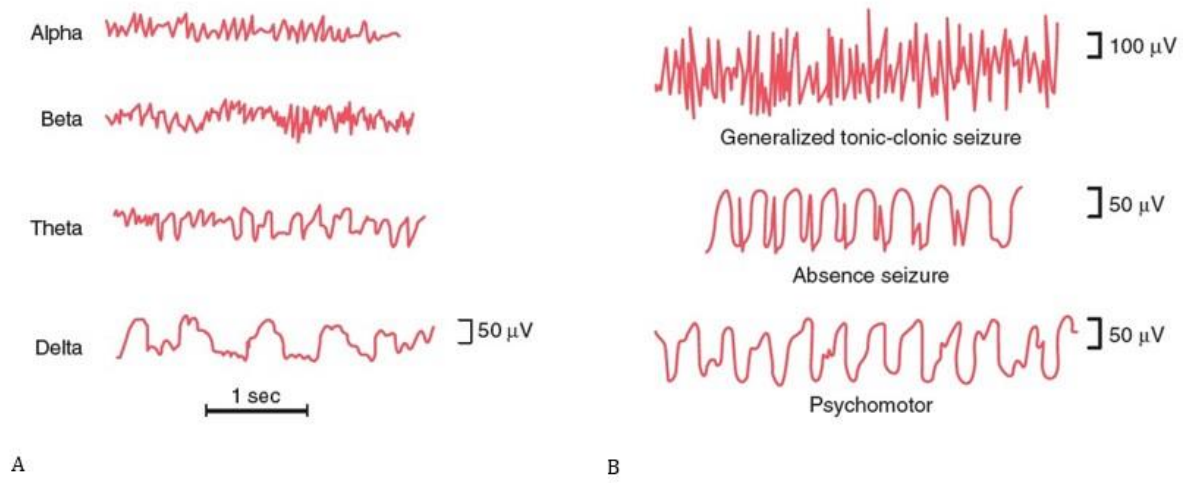


Figure 11.3 **A** Different types of brain waves in the normal electroencephalogram. **B** Electroencephalograms in different types of epilepsy.

- Blockade of voltage dependent sodium channels:
  - Carbamazepine
  - Phenytoin
- Alteration of calcium currents:
  - Ethosuximide
- Increasing GABA activity (major inhibitory neurotransmitter that reduces nervous system excitability):
  - Phenobarbital
  - Benzodiazepines
- Inhibition of receptors for glutamate (the most prevalent excitatory neurotransmitter):
  - Perampanel
- Multiple mechanisms of action (block voltage-dependent sodium channels and increase GABA levels in the brain):
  - Valproate
  - Topiramate

Epileptic seizures that cannot be treated with medications may be reduced by surgery that removes the epileptogenic area of the brain. Vagus nerve stimulation is another treatment strategy. It may be necessary for epileptic individuals to refrain from driving, operating

hazardous machinery, or swimming because of the temporary loss of control that occurs without warning.

Family and friends of an epileptic individual should be aware of what to do if a seizure occurs. During a seizure the clothing should be loosened around the neck, the head should be cushioned with a pillow, and any sharp or hard objects should be removed from the area. An object should never be inserted into the person's mouth during a seizure. After the seizure, the head should be turned to the side to drain secretions from the mouth.

## Status Epilepticus

Status epilepticus is seizure activity not resolving spontaneously, or recurrent seizure with no recovery of consciousness in between. Persisting seizure activity has a recognised mortality and is a medical emergency. Diagnosis is usually clinical and can be made on the basis of the description of prolonged rigidity and/or clonic movements with loss of awareness. As seizure activity becomes prolonged, movements may become more subtle. Cyanosis, pyrexia, acidosis and sweating may occur, and complications include aspiration, hypotension, cardiac arrhythmias and renal or hepatic failure.

Treatment involves oxygen to prevent cerebral hypoxia, and multiple doses of antiepileptic medications via intravenous route. If there has been no response and seizures continue, the patient is transferred to the intensive care unit for intubation, ventilation and general anaesthesia using propofol or thiopental.

## Prognosis

The outcome of newly diagnosed epilepsy is generally good. Overall, generalised epilepsies and generalised seizures are more readily controlled than focal seizures. The presence of a structural lesion reduces the chances of freedom from seizures. Broadly, epilepsy outcome after 20 years is as follows:

- 50% are seizure-free, without drugs, for the previous 5 years
- 20% are seizure-free for the previous 5 years but continue to take medication
- 30% continue to have seizures in spite of antiepileptic therapy