

CNS: Brain Disorders

Convulsions

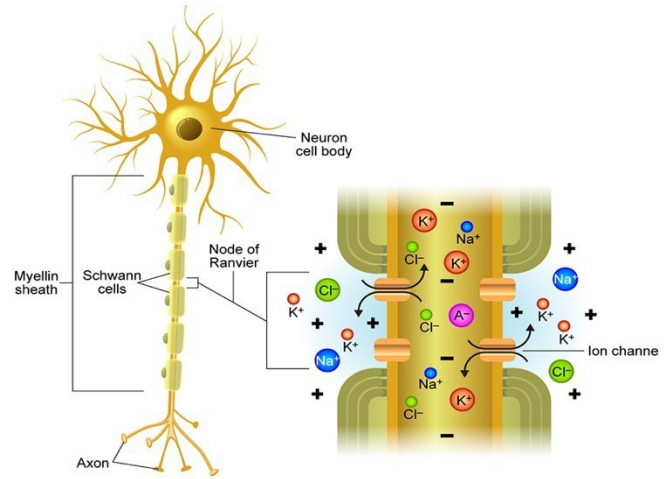
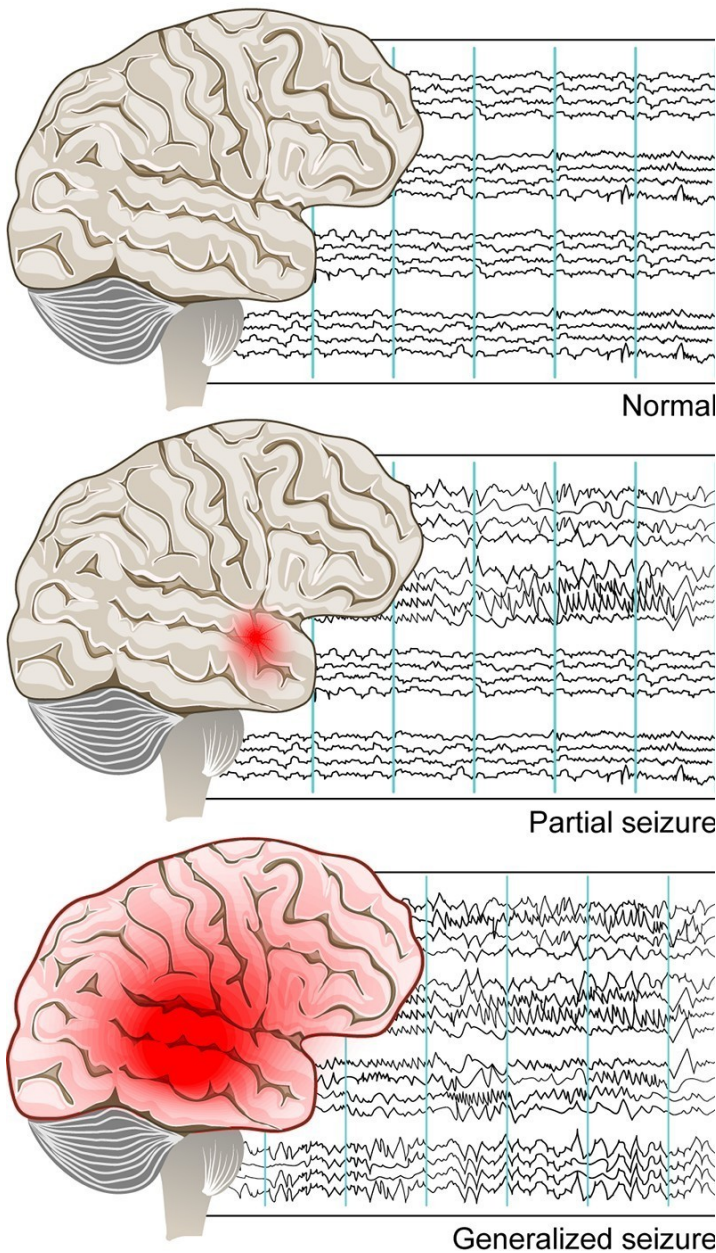
Epilepsy is a disorder that is due to one or more chronic conditions in the body. It is characterized by disturbed nerve cell activity in the brain. This leads to recurrent seizures. Seizures may occur due to brain trauma that leads to disturbed and uncontrolled nerve activity in the brain. It is important to differentiate between epilepsy and seizure.

Seizure is a condition that occurs due to excessive and uncontrolled neuronal activity in the brain. The uncontrolled neuron activity can be generalized or localized to one area of the brain. For example, it can be localized just to the area that perceives the touch sensation. Whether it is generalized or localized, the excessive neuronal activity lead to the seizure. The type of seizure will depend on the area of the brain affected.

Mechanisms of Seizure Development

Normally there exists a balance between the excitation and inhibition of neurons in the CNS. Neuronal activity is regulated by acetylcholine (ACH) and gamma-Aminobutyric acid (GABA).

Epilepsy



Neurons are synchronously active at the same time when they are not supposed to be. The term active denotes neuron firing where they are sending electrical signals from neuron to neuron. A microscope view of a neuron will demonstrate that each electrical signal that passes through it are just ions floating in and out through protein channels (see diagram below). The ion flow is controlled through neurotransmitters. Neurotransmitters bind to the receptors to tell the cell to either open the ion channels to relay the chemical message (excitatory neurotransmitters) or close the ion channels to inhibit the electrical message (inhibitory neurotransmitters).

Phases of Seizures

During a seizure, clusters of neurons in the brain become temporarily impaired. Seizures develop in a group of neurons when there is hyperexcitability and usually happens in two phases:

1. **Initiation phase:** Some neurons become hyperexcited and start to have excess neuron discharges. One of the most important reasons relates to the body's sodium level as in the case of hyponatremia.
2. **Propagation phase:** Normally the neurons that have neuronal discharges are surround by a zone of inhibitory neurons called the zone of hyperpolarization. This zone prevents the spread of excessive neuron discharges to other parts of the brain. But due to some abnormality in the brain, as in the case of decreased sodium levels, the zone of hyperpolarization gets depolarized that allows the spread of neurons to other parts of the brain.

In the diagram to the left, the electrical activity in the normal brain is displayed. Seizures can be partial or generalized in


terms of the extent of the neuronal discharges. In a partial seizure, a portion of the brain is involved. During a generalized seizure, the neuronal discharge encompasses the entire cerebral cortex.

Etiology of Seizures

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- V**ascular causes associated with the blood supply of the brain. These include stroke, bleeding and A-V malformations.
- I**nfections. These include meningitis and brain abscesses.
- T**rauma. Is one of the leading causes of seizures. Are due to road accidents and penetrating head injuries.
- A**utoimmune diseases that includes CNS vasculitis and SLE.
- M**etabolic disorders. These include hypoglycemia, hyponatremia as well as many other metabolic disorders.
- I**diopathic. The cause is unknown.
- N**eoplasms. These include all of the space-occupying lesions.
- P**sychediatric disorders.
- D**rugs. Includes alcohol, cocaine.

Types and Classifications of Seizures

Generalized seizures: Generalized seizures usually start at one place in the brain and due to widespread neuronal networks, they spread through that whole cerebral cortex. The main characteristic of a generalized seizure is that there is spread of the seizure. One of the major structures that helps in the spread is the corpus callosum. It connects the right and left-brain hemispheres and because of this the seizure spreads to the other hemisphere of the brain.

Below are the different types of generalized seizures. Match each type to their proper characteristics.

- Generalized tonic-clonic seizures: there is wide-spread and uncontrolled neuron activity in the entire cerebral cortex. These occur in 10% of patients who have epilepsy. There is excessive neuronal discharge in the motor nerves through the brain.
 - Tonic-clonic phase (lasts 10-20 seconds): Due to the excessive discharge of neurons in the motor nerves that results in:
 - the muscles of the body become contracted. without any relaxation.
 - loss of consciousness.
 - ictal cry. This is a typical sound produced by the tonic contractions of the laryngeal muscles and muscles of expiration.
 - respiratory impairment that results in cyanosis.
 - tonic contraction of the jaw muscles that can cause tongue biting.
 - Increased sympathetic activity. This will cause increased heart rate and blood pressure
 - Clonic phase (lasts one minute): continuous discharge of neurons gets interrupted. It is characterized by small durations of relaxation. This occur because of inhibitory mechanisms of the brain to try to control the wide-spread neuronal activity. The patient will exhibit spasms and jerking. This is perceived as violent shaking of muscles.
 - Post-ictal phase (lasts one to two hours): this stage is characterized by confusion, unresponsiveness and muscle flaccidity. Following the post-ictal state, there will be a return to normal state of consciousness.
- Generalized tonic seizures: this seizure is characterized by unconsciousness and muscle rigidity.
- Generalized clonic seizures: this seizure is characterized by muscle spasms.
- Generalized absence seizure: this seizure is most common in children. It is caused by a genetic abnormality. They are characterized by sudden and brief loss of consciousness without muscle tone and last for only a few seconds.

There is no associated post-ictal confusion.

Post-Seizure Symptoms

1. Post-ictal confusion.