

Seizures and Epilepsy

Biomedical Engineering - URJC

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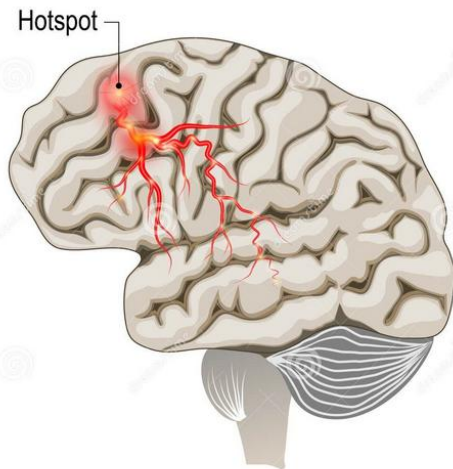
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Overview

Overview of seizures

- **Definition:** Uncontrolled, abnormal electrical activity in the brain.
- **Manifestations:** Varying from tonic-clonic to absence seizures.
- **Duration:** Typically less than two minutes.

Characteristics



Introduction

Definition of seizures

- **Seizure:** Abnormal, excessive, synchronized **electrical discharge**.
- **Epilepsy:** Defined by **two or more** unprovoked seizures.
- **Status Epilepticus: Enduring** epileptic condition, a medical emergency.

Terms (I)

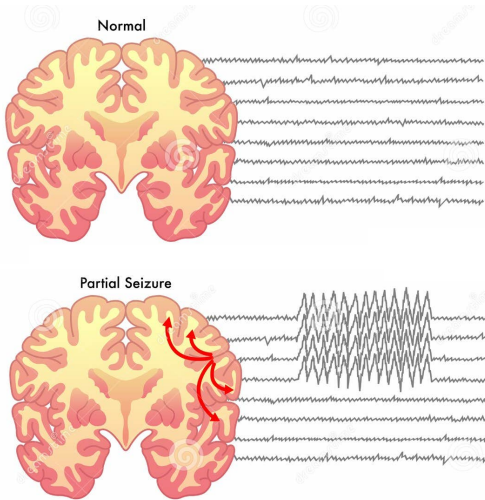
■ Seizures:

- 1 They are only one manifestation of neurologic or metabolic diseases
- 2 Paroxysmal phenomenon caused by electric hyper-excitability of a **group of neurons**
- 3 Many causes, including a genetic predisposition, head trauma, stroke, brain tumors, alcohol or drug withdrawal, hypoglycemia.

■ Epilepsy:

- 1 Medical disorder marked by recurrent (more than two), unprovoked seizures
- 2 Chronic condition

Characteristics



Terms (II)

Status Epilepticus

- Single generalized convulsion lasting **more than five minutes** or a series of generalized seizures **without full return of consciousness**.
- Enduring epileptic condition.
- There are many types of status epilepticus.
- Generalized convulsive status epilepticus is a medical emergency.

Etiology

- **Provoked Seizures:** Result from various causes like electrolyte disorders, head injury, toxins, etc.
- **Unprovoked Seizures:** It's the definition of **epilepsy**, occur without an apparent cause.
- **Incidence:** 25-30 % provoked, 70-75 % idiopathic (unknown origin).

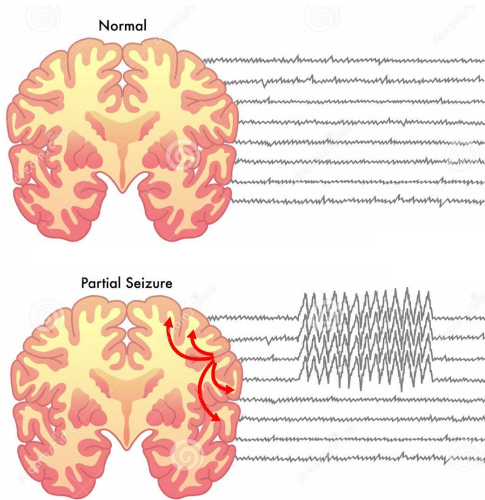
Epidemiology

- Epilepsy incidence is highest in **younger** and **older** age groups and increases steadily after 50 years of age.
- The most common cause of seizures and epilepsy in **older** people is **cerebrovascular disease**.

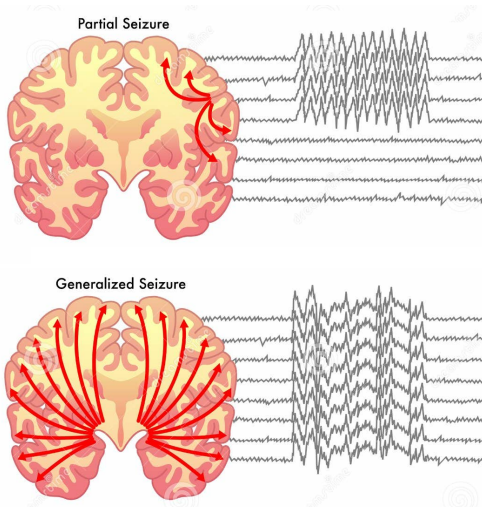
- **Seizure Threshold:** Everyone has **some propensity** to have seizures. Influenced by medications, genetics, electrolyte imbalances, etc.
- **On a cellular Level:** Excitation of cerebral neurons, involving neurotransmitters like glutamate and GABA, that can **trigger epileptiform activity**.
- **Disbalance** of neurotransmitters, for any cause: **electric discharge**.
- **Status Epilepticus:** If prolonged over time: can cause systemic changes, damaging to the brain.

- Seizures occur due to an **epileptogenic lesion**, and then **they can propagate or not**.
- Some focal onset seizures can be preceded by an **aura**, which refers to symptoms and signs that occur before the onset of seizure activity. These symptoms may include vision changes, dyspepsia, *déjà vu*, paresthesias, hearing disturbances, and sensation of abnormal taste or smell.

Pathophysiology



Pathophysiology



Type of Seizures

Type of movements

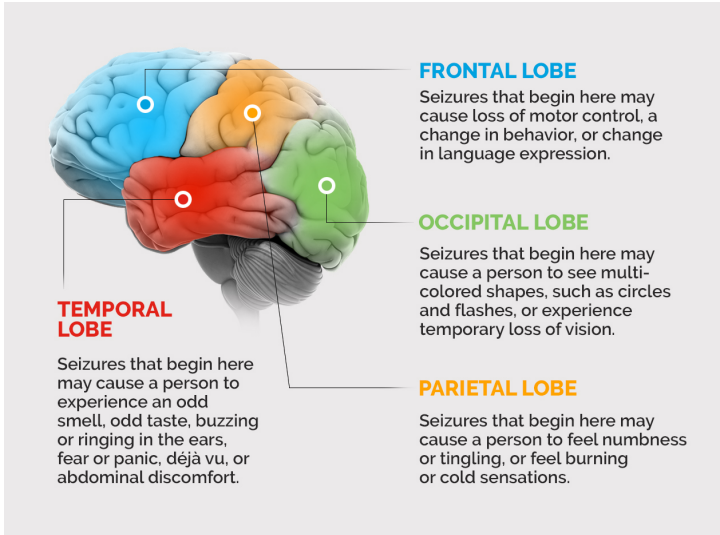
- 1 **Motor Onset:** Focal and generalized seizures with motor manifestations.
- 2 **Non-Motor Onset:** Focal and generalized seizures with non-motor manifestations.

Level of awareness

- 1 Conscious: it's called **SIMPLE**.
- 2 Unconscious: it's called **COMPLEX**.

The term "complex" means that the patient loses consciousness. "Simple" means that the patient remains aware (i.e., conscious).

Type of Seizures



Partial or focal seizure

Partial or focal seizure

A focal onset seizure refers to abnormal neural activity in only one brain area within one brain hemisphere with a fixed focal or localized onset. They can be divided in:

- 1 **Simple Partial Seizures.** The patient loses consciousness.
- 2 **Complex Partial Seizures.** the patient remains aware (conscious).

Partial or focal seizure

Motor symptoms

Motor manifestations of focal motor onset seizures include abnormal movements, like the following:

- Tonic movements.
- Clonic movements are characterized by repeated, short contractions.
- Atonic movements are characterized by loss of tone in a limb.
- Myoclonic movements are characterized by irregular, nonrhythmic jerking of the limbs.

Partial or focal seizure

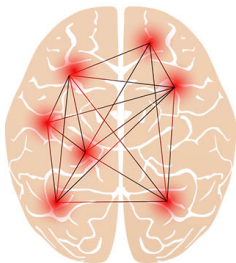
Non-motor symptoms

The clinical manifestations of focal non-motor seizure include autonomic, behavioral arrest, cognitive, emotional, or sensory symptoms:

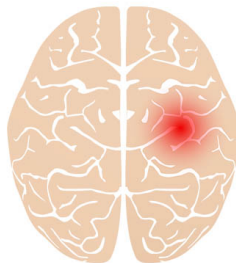
- Changes in blood pressure, heart rate, sweating, or digestive upset.
- Behavioral seizures: weird behaviors.
- Cognitive seizures: abnormal language or thinking, *jamaïs vu*, *déjà vu*, hallucinations.
- Emotional changes such as fear, dread, anxiety, or pleasure.
- Sensory seizures: abnormal sensations of vision, paresthesias, hearing, smell, or pain.

Partial or focal seizure

A focal seizure can rapidly spread and evolve into a bilateral tonic-clonic seizure, that is, becomes a **secondary generalized seizure**.



Generalized Seizure



Focal Seizure

Generalized seizures

Generalized seizures

- A generalized tonic-clonic seizure, also known as **grand mal** seizure, is defined as a seizure that has a tonic phase followed by clonic muscle contractions.
- Among patients, families, and observers, they are most feared of seizure types.
- They are usually associated with impaired awareness or complete loss of consciousness.

Generalized seizures



Generalized seizures

Generalized seizures

- They result from diffuse cortical activation at seizure onset (**primarily generalized**)...
- or generalization of partial seizure activity (**secondary generalized**).

Absence seizures consists of generalized, **non-convulsive** seizures characterized by impairment of awareness and intermittently has other manifestations such as automatisms or subtle myoclonic, tonic, atonic, or autonomic phenomena.

Special Types of Seizures

- **Absence Seizures:** Brief, unresponsive seizures, common in children.
- **Febrile Seizures:** Associated with fever, typically in young children.
- **Juvenile Myoclonic Epilepsy:** Involves absence, myoclonic, and tonic-clonic seizures.
- **Lennox-Gastaut Syndrome:** Rare, severe childhood epilepsy with multiple seizure types.

Evaluation and management

Evaluation and management

- **Clinical Assessments:** History, physical examination, laboratory work, neuroimaging, EEG.
- **EEG:** Biomarker for epilepsy, helps in risk stratification.
- **Treatment:** Address reversible causes, medication options for chronic seizure disorders.

Diagnosis

- **Testing:** Electrolytes, serum glucose, sodium.
- **Consider Lumbar Puncture:** For fever, immunosuppression, or signs of CNS infection.
- **Neuroimaging:** Suspicion of acute intracranial process, focal findings on neurologic examination, head trauma, malignancy history, etc.

Electroencephalography (EEG)

- **Biomarker for Epilepsy:** Identifies focal or generalized epileptiform discharges.
- **Risk Stratification:** Assists in determining the likelihood of future seizures.
- **Follow-up:** Abnormal EEG may prompt MRI to locate structural abnormalities.

Treatment Options

- **Addressing Reversible Causes:** Correcting abnormalities like hypoglycemia, alcohol withdrawal. **NO NEED OF MEDICATION.**
- **Medication if indicated:** Carbamazepine, benzodiazepines, topiramate, valproic acid, phenytoin, etc.