# Pathophysiology of Epilepsy

* Seizures
* Epilepsy

# Definition

* Seizure (Convulsion)
  - Clinical manifestation of synchronised electrical discharges of neurons
* Seizures are symptoms of a disturbance in brain function , which can be due to epilepsy or other causes
* A seizure is a sudden surge in electrical activity in the brain that causes an alteration in sensation, behavior, or consciousness

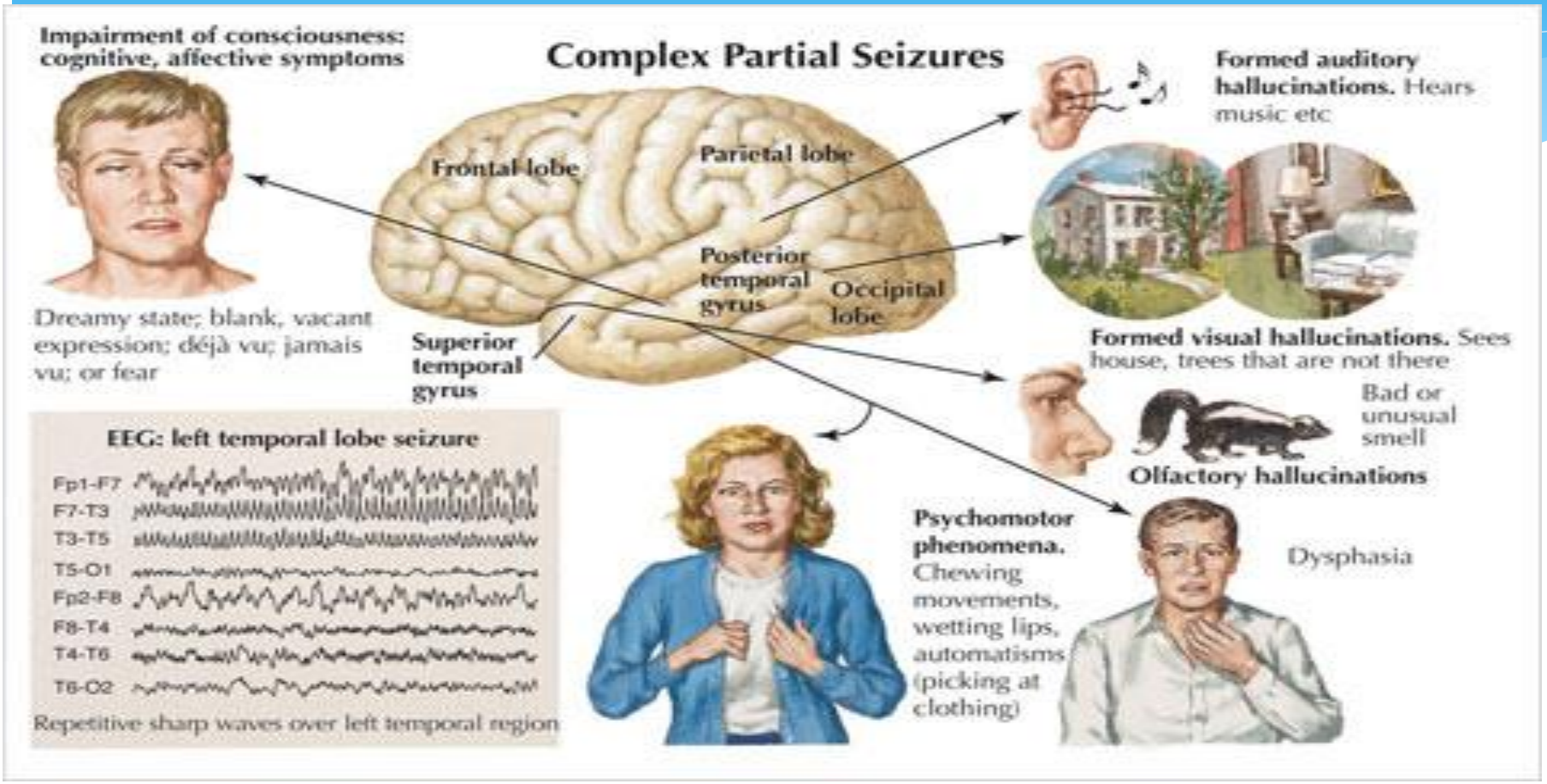
# Epilepsy

* Present when 2 or more unprovoked seizures occur at an interval greater than 24 hours apart
* Sudden recurrent episodes of sensory disturbance
* Loss of consciousness, or convulsions
* Associated with abnormal electrical activity in the brain

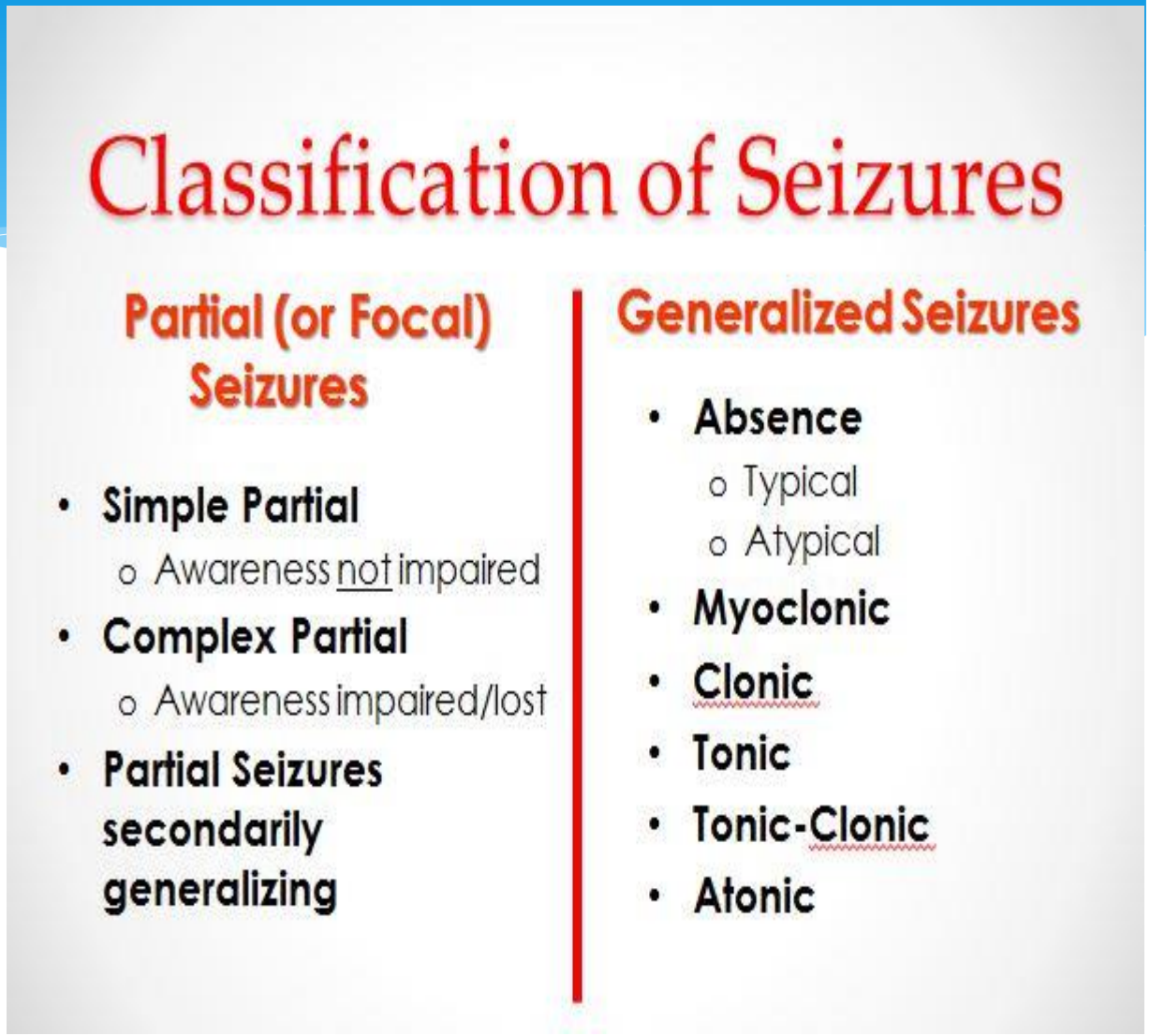
* Abnormal , excessive electrical discharge of a group of neurons within the brain.
* When a person has recurrent ( 2 or more) , unprovoked seizures → " epileptic ".
* Hence seizures can be a symptom of epilepsy

# Definition

- Provoked seizures
  - Seizures induced by somatic disorders originating outside the brain
  - E.g. fever, infection, syncope, head trauma, hypoxia, toxins, cardiac arrhythmias


Complex Partial Seizures
Impairment of consciousness: cognitive, affective symptoms
Dreamy state; blank, vacant expression; déjà vu; jamais vu; or fear
Frontal lobe
Parietal lobe
Posterior temporal gyrus
Occipital lobe
Superior temporal gyrus
Formed auditory hallucinations. Hears music etc
Formed visual hallucinations. Sees house, trees that are not there
Bad or unusual smell
Olfactory hallucinations
Psychomotor phenomena. Chewing movements, wetting lips, automatisms (picking at clothing)
Dysphasia
EEG: left temporal lobe seizure
Fp1-F7
F7-T3
T3-T5
T5-O1
Fp2-F8
F8-T4
T4-T6
T6-O2
Repetitive sharp waves over left temporal region

* Seizures
* Partial
* or
* Generalized



* a. Simple partial seizures

manifest

motor, somatosensory, and psychomotor symptoms

without impairment of consciousness

* b. Complex partial seizures

manifest

impairment of consciousness with or without simple partial symptoms

* c. Generalized seizures
* manifest a loss of consciousness

concvulsive or non-convculsive

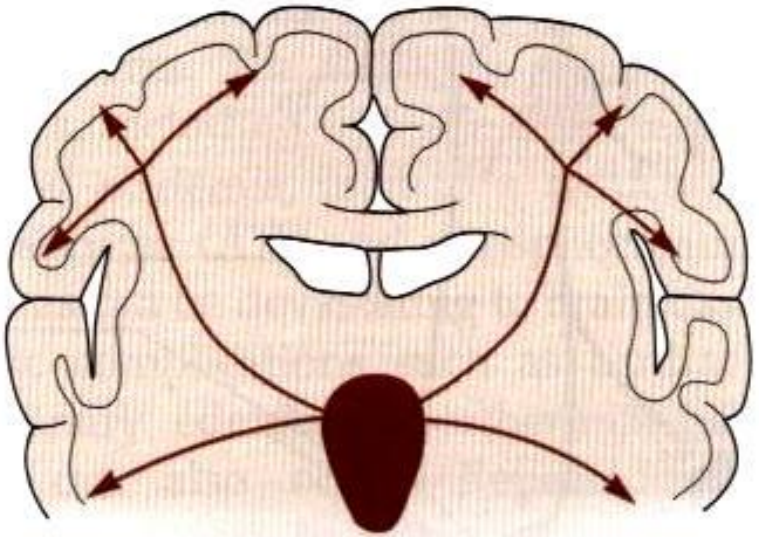
* Generalized seizures include →
* (1) generalized tonic-clonic seizures
* (Grand Mal epileptic seizure )
* (2) Absence seizures

(Petit mal epileptic seizures)

# Seizure Classification & Clinical Manifestations

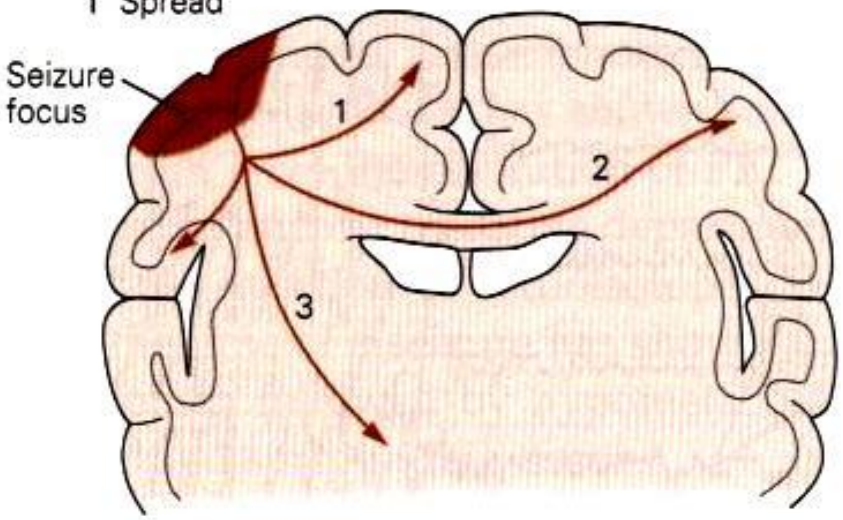
1. Focal / Partial seizures → their onset ( start) is limited to part of the cerebral hemisphere
2. Generalized seizures → those that involve the cerebral cortex diffusely ( whole of it ) from the beginning (*generalized* seizures)

Primary generalized seizure

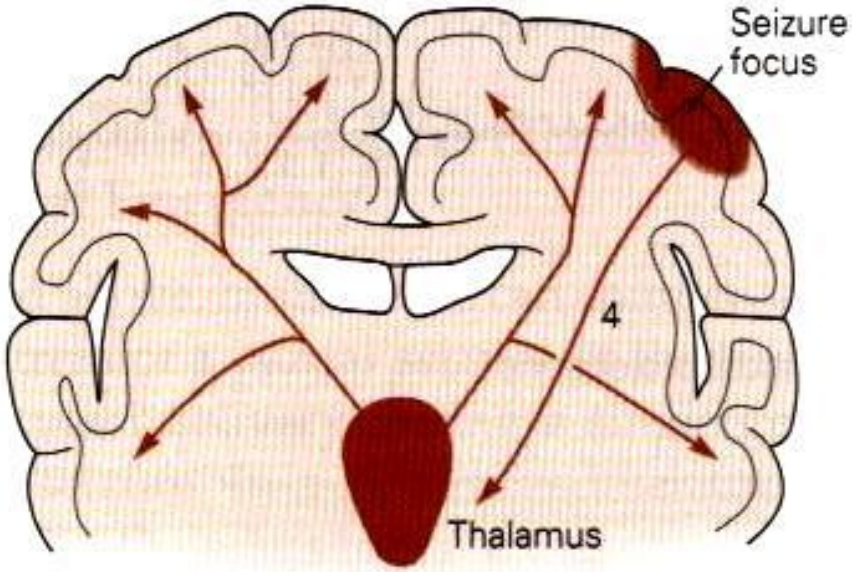


A Partial seizure

1 Spread




2 Secondary generalization



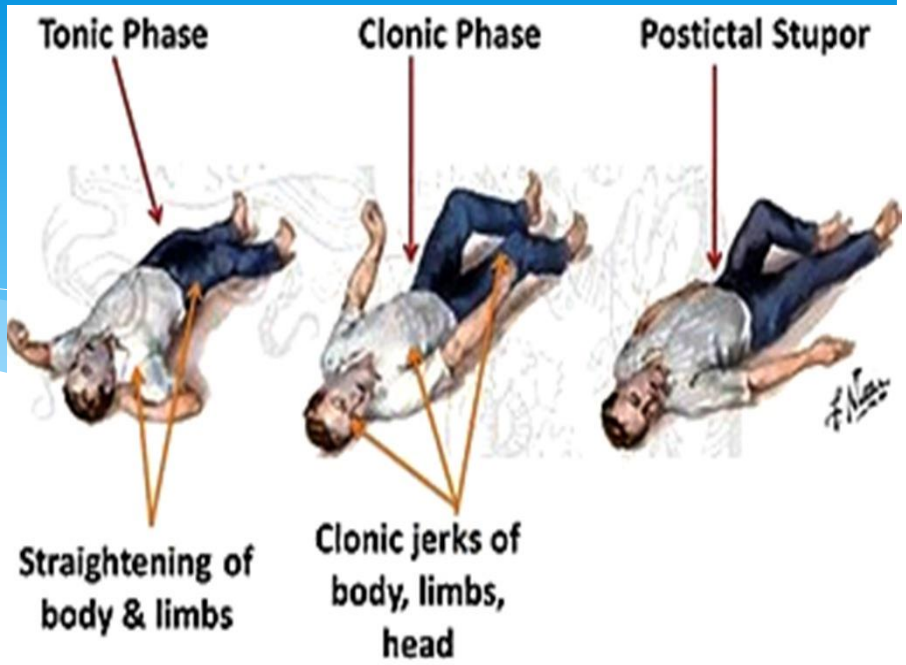
* The onset of a seizures:

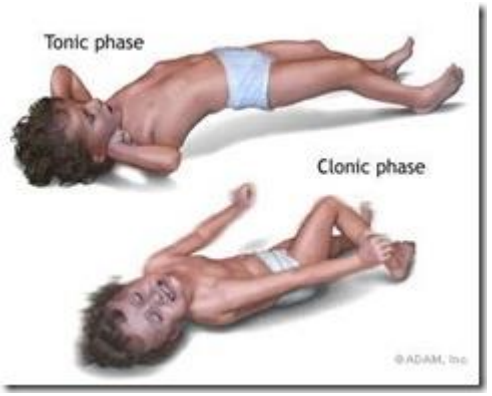
Small group of abnormal neurons undergo

- Prolonged depolarizations
- Rapid firing of repeated action potentials

* Spread to adjacent neurons or neurons with which they are connected into the process.

* A clinical seizure occurs when the electrical discharges of a large number of cells become abnormally linked together, creating a storm of electrical activity in the brain.
* Seizures may then spread to involve adjacent areas of the brain or through established anatomic pathways to other distant areas.



# Generalized

* 1- Generalized tonic-clonic (grand mal) seizure

* a. +/- **aura**
* (peculiar sensation or dizziness; then sudden onset of seizure with loss of consciousness)
* **tonic phase** : Rigid muscle contraction in which clenched jaw and hands; eyes open with pupils dilated; lasts 30 to 60 seconds

* **clonic phase**: Rhythmic, jerky contraction and relaxation of all muscles in with incontinence and frothing at the lips; may bite tongue or cheek, lasts several minutes.
* **postictal state**: Sleeping or dazed for up to several hours.

# Generalized

* 2. Absence ( petit mal) seizure
* a. Loss of contact with environment for 5 to 30 seconds.
* b. Appears to be day dreaming or may roll eyes, nod head, move hands, or smack lips.
* c. Resumes activity and is not aware of seizure.

* The clinical manifestations of a seizure reflect the area of the brain from which the seizure begins (i.e., seizure focus) and the spread of the electrical discharge.

* Clinical manifestations accompanying a seizure are numerous and varied, including →
* (1) indescribable bodily sensations,
* (2) "pins and needles" sensations,
* (3) smells or sounds,
* (4) fear or depression,
* (5) hallucinations,
* (6) momentary jerks or head nods,
* (7) staring with loss of awareness, and
* (8) **Convulsions** → i.e., involuntary muscle contractions) lasting seconds to minutes.

# Aetiology of seizures

- Epileptic
  - Idiopathic (70-80%)
  - Cerebral tumor
  - Neurodegenerative disorders
  - Secondary to
    - Cerebral damage: e.g. congenital infections, intraventricular hemorrhage
    - Cerebral dysgenesis/malformation: e.g. hydrocephalus

# Aetiology of seizures

- Non-epileptic
  - Febrile convulsions
  - Metabolic
    - Hypoglycemia
    - HypoCa, HypoMg, HyperNa, HypoNa
  - Head trauma
  - Meningitis
  - Encephalitis
  - Poisons/toxins

# Pathophysiology of Epilepsy ( at molecular level)

- Cortical cell membrane level
- Instability of the nerve cell membrane → Polarization abnormalities (excessive polarization ,hypopolarization , or lapses in repolarization), allowing the cell to be more susceptible to activation → Hypersensitive neurons with lowered thresholds for firing and firing excessively , related to →

- (1) Excess of Excaitatory ( acetylecholine- or Glutamate –related activity )
- (2) Decreased inhibitory ( GABA –related activity)

➢ Together and/or (2) above → leading to instability of cell-membrane & lowered threshold for exciatation → excessive polarization, hypopolarization allowing the cell to be more susceptible to activation spontaneously or by any ionic imbalances in the immediate chemical environment of neurons

## Electroencephalogram ( EEG)

- EEG ›››› diagnosis, classifying seizures ›››› therapeutic decisions
- **spikes** or **sharp waves (**Epileptiform EEG patterns)

- Focal epileptiform discharges indicate focal epilepsy
- Generalized epileptiform activity indicates a generalized form of epilepsy.

* Some types liked to genes
* (run in families)
* Genetic abnormalities ›››› increasing a person's susceptibility to seizures_that are triggered by an environmental factor
* Several types of epilepsy have now been linked to defective genes for **ion channels, the "gates"** that control the flow of ions in to and out of cells and that regulate neuron signaling.

# Pathophysiology

* Genetic factors
  * At least 20 %
  * Some examples
    * Benign neonatal convulsions--20q and 8q
    * Juvenile myoclonic epilepsy--6p
    * Progressive myoclonic epilepsy--21q22.3