

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

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- * 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

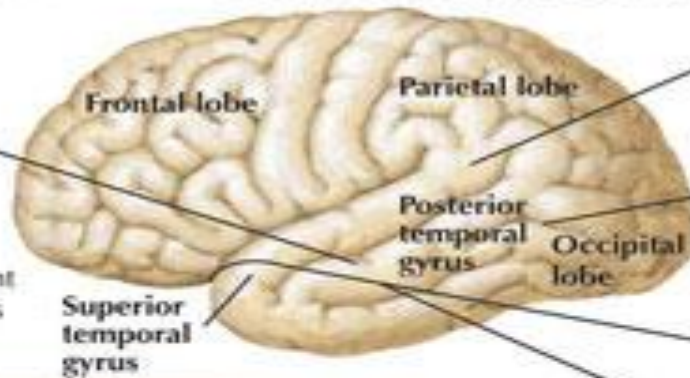


Impairment of consciousness:
cognitive, affective symptoms



Dreamy state; blank, vacant expression; déjà vu; jamais vu; or fear

Complex Partial Seizures



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



Repetitive sharp waves over left temporal region

- * Seizures
- * Partial
- * or
- * Generalized

Classification of Seizures

Partial (or Focal) Seizures

- **Simple Partial**
 - Awareness not impaired
- **Complex Partial**
 - Awareness impaired/lost
- **Partial Seizures secondarily generalizing**

Generalized Seizures

- **Absence**
 - Typical
 - Atypical
- **Myoclonic**
- **Clonic**
- **Tonic**
- **Tonic-Clonic**
- **Atonic**

* Focal / Partial seizures → their onset (start) is limited to part of the cerebral hemisphere

* Generalized seizures → those that involve the cerebral cortex diffusely (whole of it) from the beginning (*generalized seizures*)

* partial seizures

* a. Simple partial seizures

manifest

motor, somatosensory, and psychomotor symptoms
without impairment of consciousness

* b. Complex partial seizures

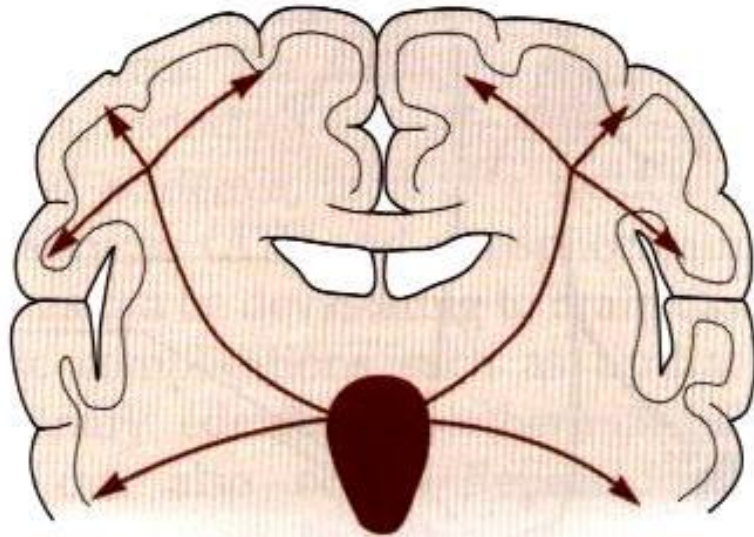
manifest

impairment of consciousness with or without simple partial
symptoms

Generalized seizures

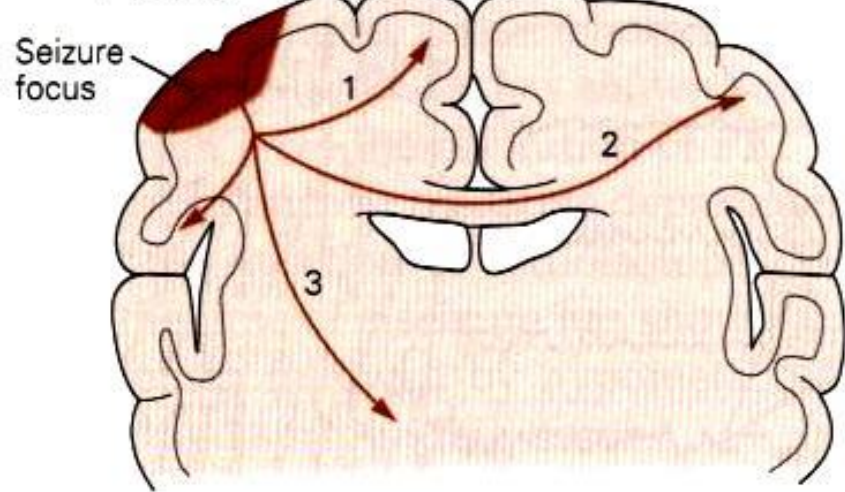
- * Manifest a loss of consciousness
Convulsive or non-convulsive
- * (1) Generalized tonic-clonic seizures
(Grand Mal epileptic seizure)
- * (2) Absence seizures
(Petit mal epileptic seizures)

Primary generalized seizure

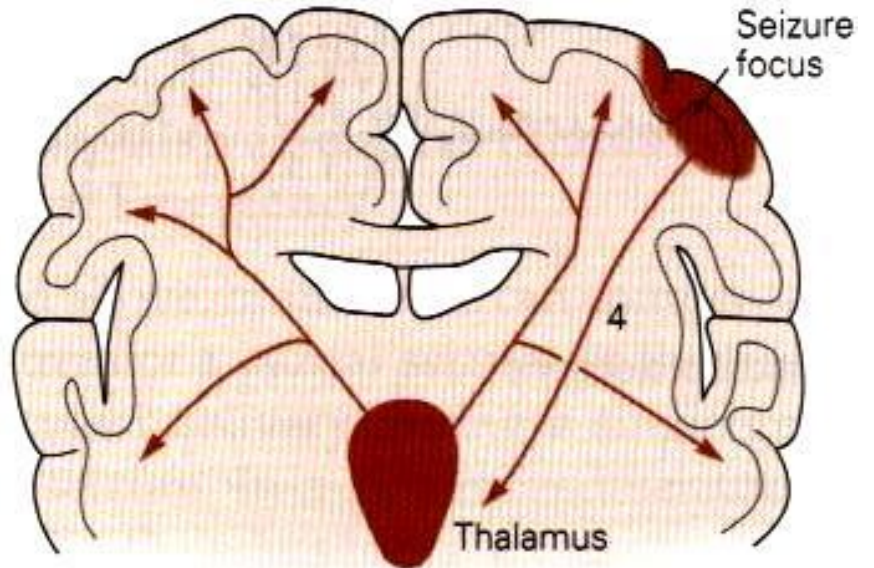


A Partial seizure

1 Spread



2 Secondary generalization





* The onset of a seizure:

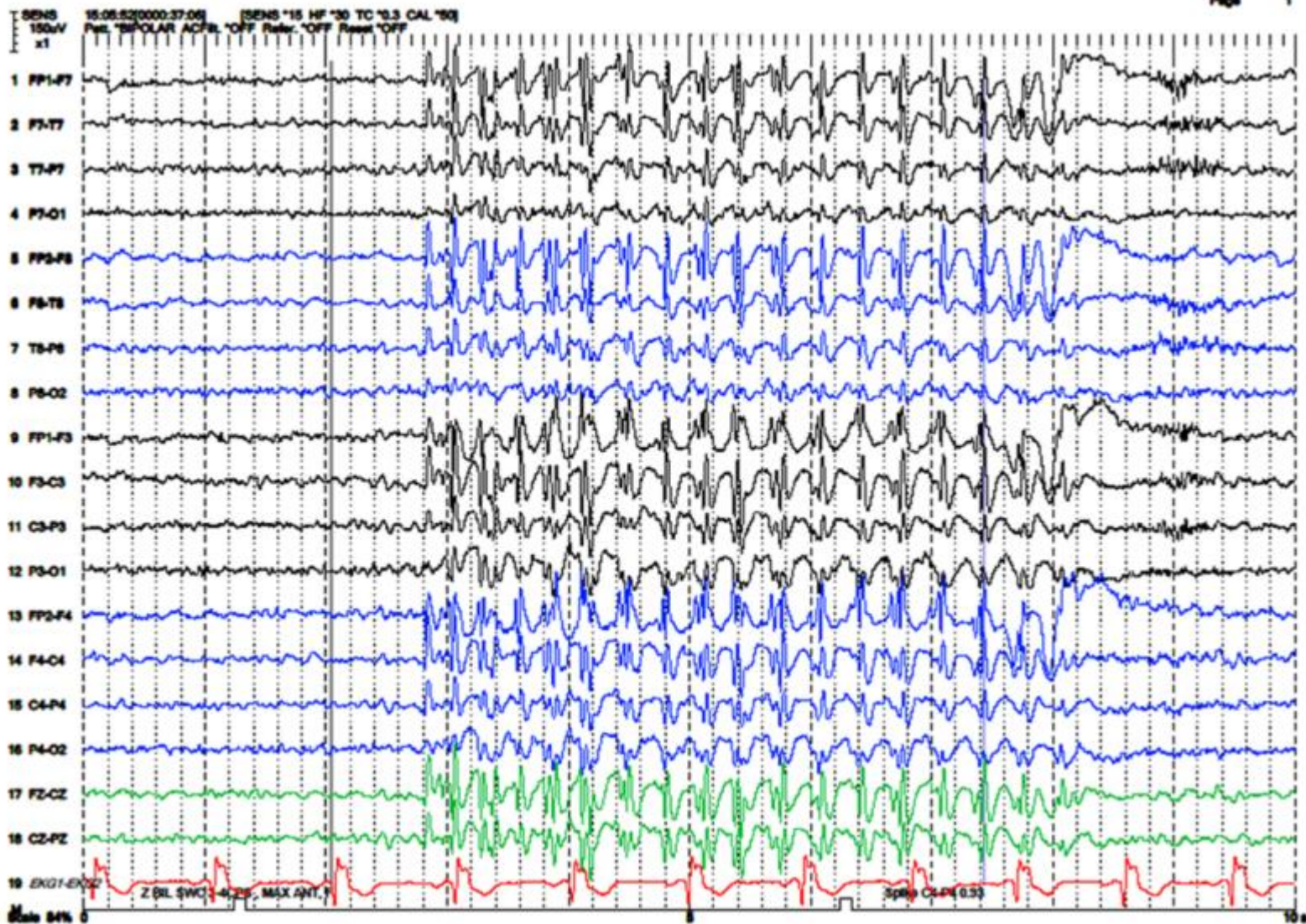
Small group of abnormal neurons undergo

- Prolonged depolarizations
- Rapid firing of repeated action potentials

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

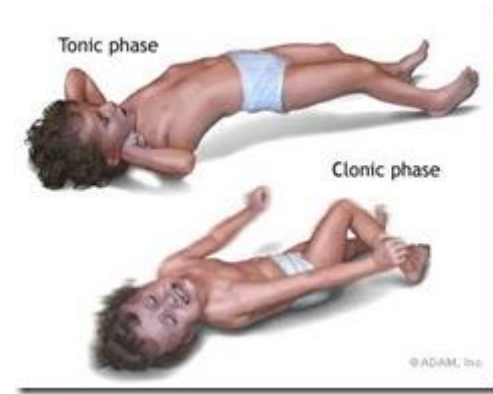
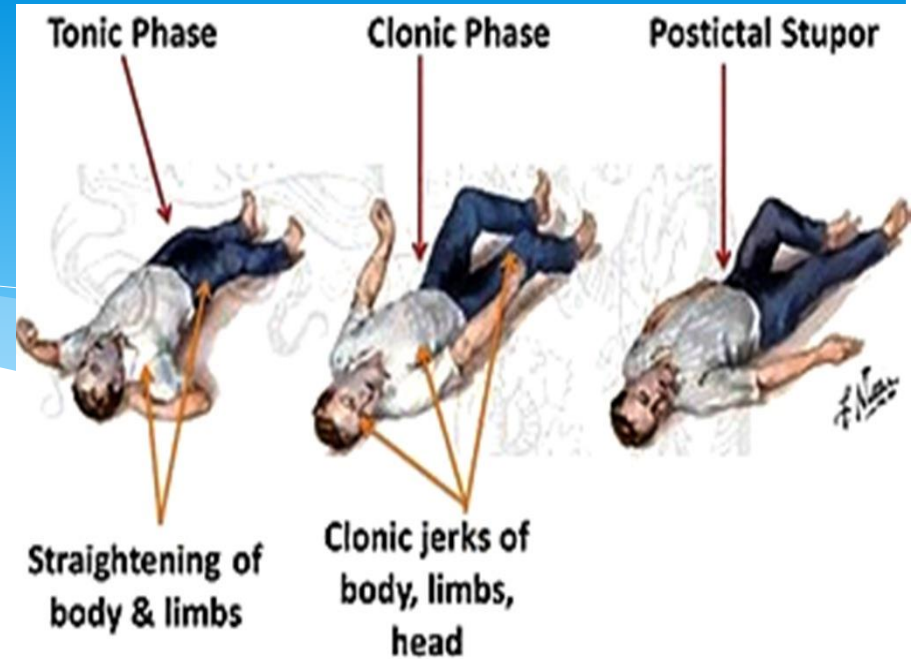
Generalized

- * 1- Generalized tonic-clonic (grand mal) seizure
- * +/- 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.



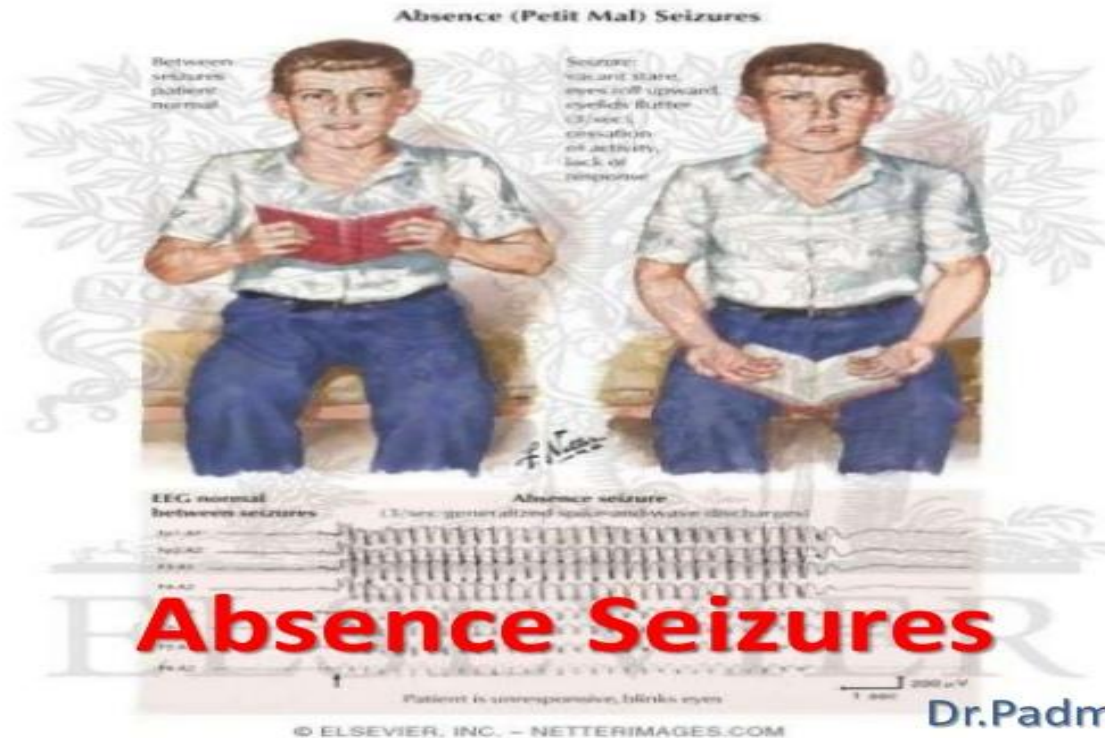
A clinical seizure occurs when the electrical discharges of a large number of cells become abnormally linked together, creating a storm of electrical activity in the brain.


- * Seizures may then spread to involve adjacent areas of the brain or through established anatomic pathways to other distant areas.



* 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.



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- * 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 →

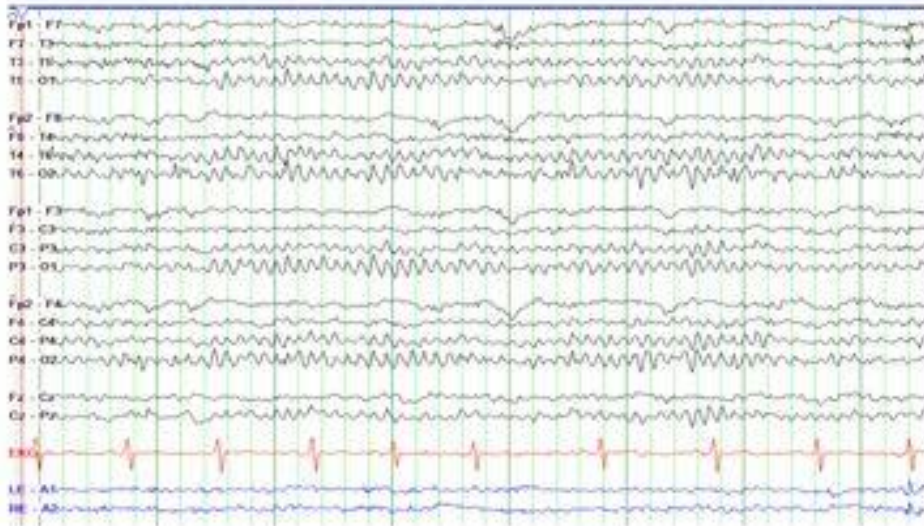
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- (1) Excess of Excitatory (acetylcholine- or Glutamate - related activity)
 - (2) Decreased inhibitory (GABA -related activity)
 - Together and/or (2) above → leading to instability of cell-membrane & lowered threshold for excitation → excessive polarization, hypopolarization allowing the cell to be more susceptible to activation spontaneously or by any ionic imbalances in the immediate chemical environment of neurons



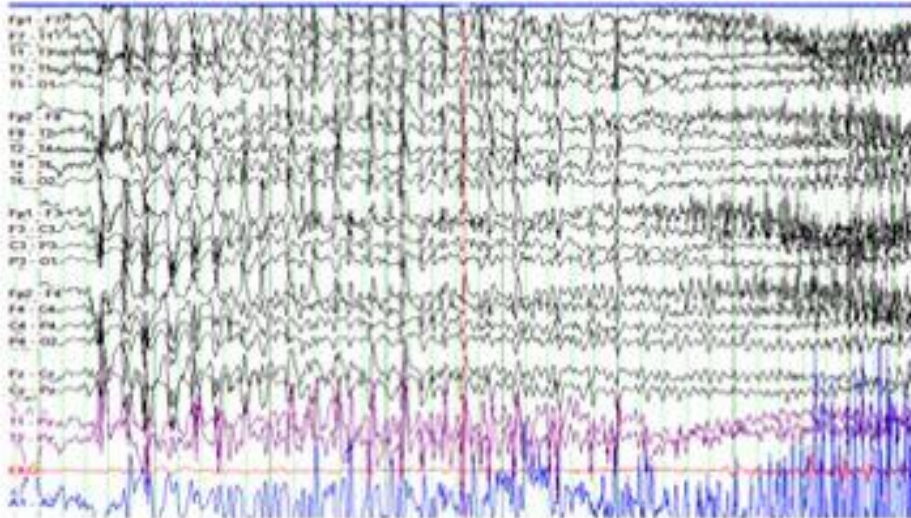
* Electroencephalogram (EEG)

- * 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.

Normal EEG Awake



Generalized Tonic Clonic



EEG: Partial Seizures



- * Some types linked 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**

