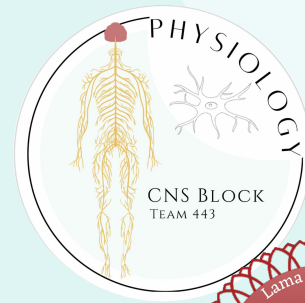




Pathophysiology of epilepsy



Color Index:

- Main text
- **Important**
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- Extra

[Editing File](#)



Objectives

1

Define epilepsy

2

Types of epilepsy

3

Etiopathology of epilepsy

4

Clinical features

5

Role of genetic in epilepsy

6

Role of Electrophysiological tests in the diagnosis of epilepsy



A really helpful video from osmosis
It will give you a better understanding of the lecture



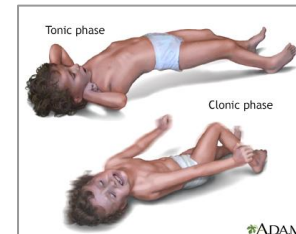
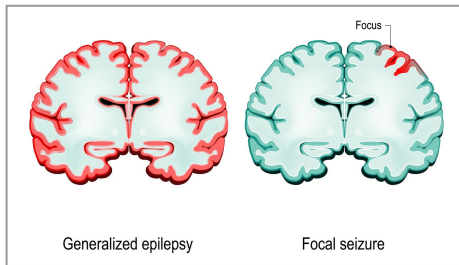
Definition of seizures and epilepsy

Epilepsy:

- When a person has recurrent 2 or more unprovoked seizures without a known cause separated by at least 24 hours → " epileptic " .
- Present when 2 or more unprovoked seizures occur at an interval greater than 24 hours apart. same definition.
- 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.
- Hence Seizures can become / is a symptom of epilepsy.

Seizures:

- **Clinical manifestation** of Abnormal, excessive ,synchronous **electrical discharge** of cortical 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 **disturbances of movement**, an alteration in sensation, behavior, or **consciousness**.
- 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.
- Seizure affect all ages. Most cases of epilepsy are identified in **childhood**, and several seizure types are particular to children





Definition of seizures and epilepsy

1

Seizures due to a physical cause, induced by somatic disorders originating outside the brain (ex: hypoglycemia in kids).
It occurs in up of 5% of people at some point at their life time.

2

The provoking cause has an effect on the brain that lead to seizure i.e. Infection, trauma, fever.

3

Seizures due to a physical cause setting of acute medical and neurological illnesses in people with no prior history of seizures.

Provoked seizures

Seizure
Seizures happen in two main ways, generalized and focal. This example shows a focal seizure.

Neuron
Your brain has billions of cells called neurons that all connect to create electrical networks. This network would be similar to roads and traffic lights.

Those networks make up and connect different parts of your brain, like different towns.

Seizures happen when the neurons malfunction and electrical signals fire uncontrollably. Think of traffic lights short-circuiting.

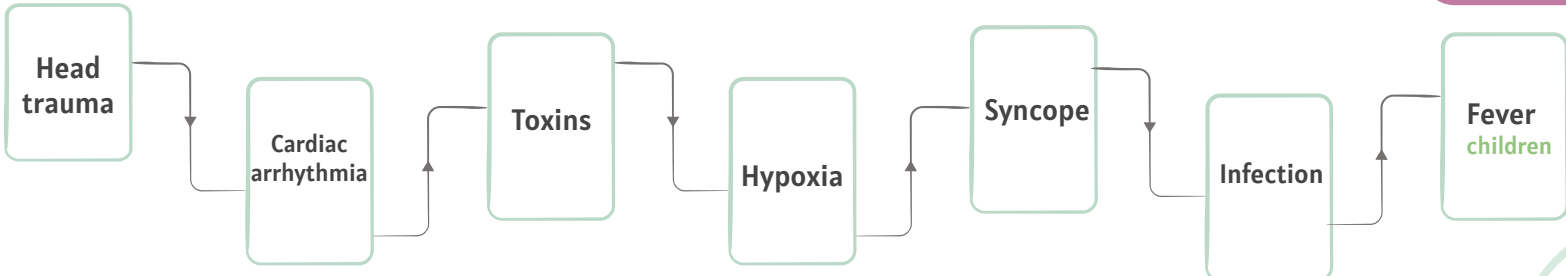
The more neurons (traffic lights) that go haywire, the more intense or widespread the seizure and bodily effects.

Focal seizure

Cleveland Clinic ©2022

Female slides

Causes:





Classification of seizures

Seizures

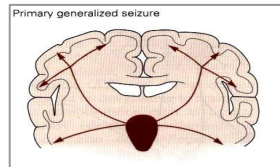
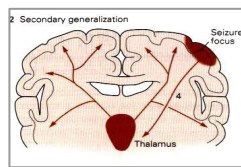
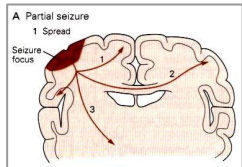
Partial (focal):
Involves only 1 part of cerebral hemisphere

Primary generalized:
Involves the entire cerebral cortex.

Simple:
Awareness is not impaired

Complex:
Awareness impaired/lost

Partial with secondary generalization: Seizures may spread to adjacent areas and progress to complex partial seizures that can secondarily become generalized.



Absence:
- Typical
- Atypical





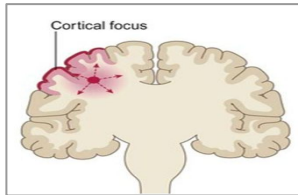
Classification of seizures



partial seizures (Focal)

Their onset (start) is limited to part of the cerebral hemisphere
-it can be caused due tumor or malformation

- A) Simple partial seizures
- B) Complex partial seizures



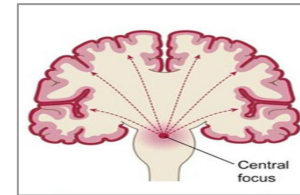
Definitions:

Types:

Generalized seizures

- Those that involve the cerebral cortex diffusely (whole) from the beginning.
- Manifest a **loss of consciousness**
- It usually originate from thalamus or brain stem and involve both cerebral hemisphere at onset
- Convulsive or non-convulsive
- The onset of a seizures: Small group of abnormal neurons undergo:
 - A. Prolonged depolarization
 - B. Rapid firing of repeated action potentials.This will lead to Spread to adjacent neurons or neurons with which they are connected into the process.

- A) Absence seizures (Petit mal epileptic seizures)
- B) Generalized tonic-clonic seizures GTC (Grand Mal epileptic seizure)
 - GTC are convulsive and Absence are non-convulsive .





Manifestations of partial seizures:

Simple partial seizures

based on where the focus is

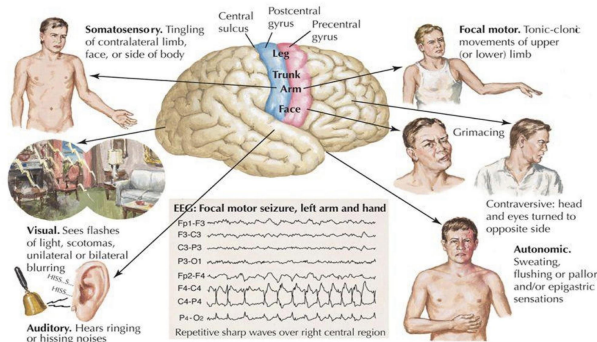
Motor, somatosensory, and psychomotor symptoms without impairment of consciousness (e.g. Jacksonian seizures)

Simple partial seizures can progress to complex partial seizures, and complex partial seizures can secondarily become generalized

Complex partial seizures

same as simple partial but with loss of consciousness

Impairment of consciousness with or without simple partial symptoms



From team 438

Complex Partial Seizures

Impairment of consciousness: cognitive, affective symptoms

Frontal lobe

Parietal lobe

Posterior temporal gyrus

Occipital lobe

Superior temporal gyrus

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

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

EKG: 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

manifestation
تعتمد على مكان ال Seizure



Manifestations of generalized seizures:

Absence seizures (Petit mal epileptic seizures)

- Loss of contact with environment for **5 to 30 seconds**.
- Appears to be day dreaming or may roll eyes, nod head, move hands, or smack lips.
- Resumes activity and is not aware of seizure.**
usually affects children and it doesn't involve muscle tone or posture Very difficult to diagnose



Generalized tonic-clonic seizures (Grand Mal epileptic seizure)

A-Aura (+/-): (احساس غريب او هالة، المريض يبحث ان فيه شي غلط)

peculiar sensation or dizziness; then sudden onset of seizure with loss of consciousness.

B-Tonic phase: مرحلة التصلب

Rigid muscle contraction in which clenched jaw and hands, eyes open with pupils dilated, **epileptic cry, cyanosis**, lasts 30 to 60 seconds

in tonic phase there might be an epileptic cry or/and cyanosis due to spasm of respiratory muscles which will lead to pushing the air out

C-Clonic phase: مرحلة الانقباض والانبساط

Rhythmic, jerky contraction and relaxation of all muscles in with **incontinence** and frothing at the lips; may **bite tongue** or cheek, lasts several minutes.

any seizure with biting of the tongue is usually epileptic in origin

D-Postictal state: مرحلة الراحة والتعافي

Sleeping or dazed for up to several hours. **depression of CNS activity**

The postictal state is the altered state of consciousness after an epileptic seizure. It usually lasts between 5 and 30 minutes or more



Aura:

Definition :

the first part of a focal seizure (there is a mistake in Dr slides, it should be part of **generalized** seizure not focal!!) before consciousness is impaired.

Examples of auras include:

- 1 A sudden sense of unprovoked fear or joy
- 2 A deja vu experience — a feeling that what's happening has happened before
- 3 A sudden or strange odor or taste
- 4 A rising sensation in the abdomen, similar to being on a roller coaster

Common symptoms before a seizure:

Numbness or tingling	Unusual sounds
Lightheadedness	Headache
Feelings of fear or panic	Nausea
Loss of vision or blurred vision	Deja Vu
Racing thoughts	Jamais Vu
Unusual tastes	Dizziness



Epilepsy Education and Support

Followed by the seizure symptoms:

Loss of awareness of surroundings
Staring

Lip smacking

Repeated swallowing or chewing

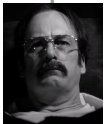
Unusual finger movements, such as picking motions



Types of focal partial seizure:

Partial psychomotor (temporal lobe)

- Epileptic seizures which originate in the **temporal lobe** of the brain.
- Involve sensory changes, for example smelling an unusual odour that is not there, and disturbance of memory.
- Visual* , auditory , olfactory or visceral hallucinations, déjà vu (over familiarity), strange feeling of unfamiliarity (jamais vu)
- The most common cause is **mesial temporal sclerosis** (also known as hippocampal sclerosis) **deep scarring of the temporal lobe**



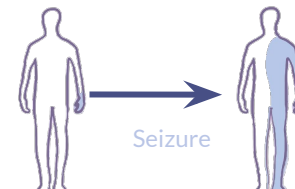
441:بيجاو: تعني بالفرنسي (شوه من قبل)، و هي حالة يشعر بها الشخص انه قد عاش أو شاهد لحظة جديدة رغم انه لم يرها أو يعيشها من قبل، مثل أن تدخل مكانا لأول مره وتحسن أنك قد زرتة من قبل .
جاميس فو: تعني بالفرنسي (لم أره من قبل)، و هي حالة نفسية يكون فيها الإنسان غير قادر على تذكر شيء مأوف له،
مثل أن يكون أحدهم في منزله ويشعر فجأة أنه في مكان غريب لا يعرفه مثل خويبا ←

*the damage is in the temporal lobe, so why there is a visual hallucination ?

Dr:because part of the visual association area is in the temporal lobe

Jacksonian epilepsy

- Focal motor seizures begin in motor areas of cerebral cortex, usually begins with twitching of the thumb or finger, toe or the angle of the mouth.
- Spreading to involve the limbs on the side opposite the epileptic focus.
- Clinical evidence of this spread of activity is called the **march of the seizure**.
- Jacksonian March is a phenomenon where a simple partial seizure spreads from the distal part of the limb toward the ipsilateral face (on same side of body).





Clinical features 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.

Aura (أهالة)

2

"pins and needles" sensations.

3

Smells or sounds.

4

Fear or depression.

5

Hallucination. *auditory or visual*

6

Momentary jerks or head nods.

7

Déjà vu (over familiarity).

8

Staring with loss of awareness. *like in petit mal seizures*

9

Convulsions
i.e., involuntary muscle contractions lasting seconds to minutes.



Aetiology of seizures:

Epileptic usually with recurrent seizures	Non-epileptic no tendency for recurrence
Idiopathic (70-80%)	Febrile convulsions usually with children
Cerebral tumour	Metabolic: Hypoglycemia, HypoCa, HypoMg, HyperNa, HypoNa
Neurodegenerative disorders (Alzheimer, Multiple sclerosis)	Head trauma
Secondary to cerebral damage: e.g. congenital infections, intraventricular haemorrhage	Meningitis/Encephalitis Renal failure/Eclampsia
Secondary to cerebral dysgenesis malformation: e.g. hydrocephalus	Drugs(cocaine), Poisons/toxins like in drug withdrawal



Genetic Factors:

Some types linked to genes (run in families)

Genetic factor plays at least 20 %

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.

Some examples

Benign familial neonatal convulsions:

(20q and 8q) Autosomal dominant voltage gated potassium ion channelopathy.

channelopathy affecting K channels

Juvenile myoclonic epilepsy

(6p)

Autosomal dominant nocturnal frontal lobe epilepsy

Mutation of nicotinic Acetylcholine receptors

Progressive myoclonic epilepsy syndrome

(21q22.3)





Pathophysiology of Epilepsy (at molecular level:

Cortical cell membrane level:

1	Instability of the nerve cell membrane		
2	Polarization abnormalities (excessive polarization, hypopolarization, or lapses in repolarization)		
3	Allowing the cell to be more susceptible to activation		
4	Hypersensitive neurons with lowered thresholds for firing and firing excessively , related to:		
4A	Excess of Excitatory (acetylcholine or Glutamate– related activity)	4B	Decreased inhibitory (GABA –related activity)
5	Both or any one of 4A & 4B can lead to instability of cell-membrane & lowered threshold for excitation		
6	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 is helpful for:

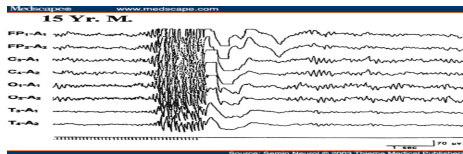
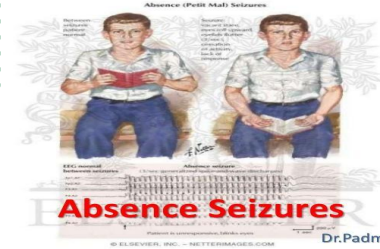
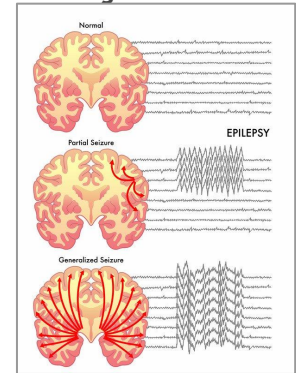
Establishing the diagnosis

Classifying seizures correctly

Making therapeutic decisions

In combination with appropriate clinical findings, epileptiform EEG patterns termed **spikes** or **sharp waves** strongly support a diagnosis of epilepsy.

- EEG in patients with seizures:
 - Focal epileptiform discharges indicate → **focal** epilepsy.
 - Generalized epileptiform activity indicate → **generalized** form of epilepsy.
- Most EEGs are obtained between seizures, and interictal abnormalities alone can never prove or eliminate a diagnosis of epilepsy
- Epilepsy can be definitely established only by recording a characteristic ictal discharge during a clinical attack. to diagnose epilepsy with EEG it has to be done **during the seizure**, not before or after
- **3Hz spike-and-wave (spike and dome pattern) activity occurs specifically in petit mal**





TEST YOURSELF !

1) Patient came ER and was having Visual , auditory , olfactory , visceral hallucinations, déjà vu and feelings of unreality (jamais vu), What's the most likely diagnosis?

A) Partial psychomotor (temporal lobe) seizure

B) Jacksonian epilepsy

C) Absence seizure

D) Myoclonic seizure

2) Seizure that begins with twitching of the thumb or finger , toe or the angle of the mouth then spread to involve the limbs on the side opposite to the epileptic focus is called?

A) Jacksonian epilepsy

B) Absence seizure

C) Partial psychomotor (temporal lobe) seizure

D) Myoclonic seizure

Which of the following is a seizure that occurs in one part of the brain and can cause impairment of consciousness ?

A) Generalized tonic

B) petit mal

C) complex partial

D) Simple partial

A seizure that suddenly stops the person from what they are doing and look as though they are daydreaming for a few seconds is called:

A) Tonic clonic

B) Absence

C) Atonic

D) Grand mal

answers

1: A

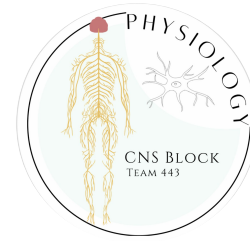
2: A

3: C

4: B



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Khalid Alanezi

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Abdullah alzamil

Mohammed Alqutub

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