

# PATHOPHYSIOLOGY OF EPILEPSY

## Objectives:

- ❖ Define Epilepsy.
- ❖ Etio-pathology of Epilepsy.
- ❖ Types of Epilepsy.
- ❖ Role of Genetic in Epilepsy.
- ❖ Clinical Features.
- ❖ Role of Electrophysiological tests in the diagnosis of Epilepsy.

## ( Girls Slides Version )

الزيادات من سلايدات الطلاب كم سطر فقط، أضفناها باللون البنفسجي

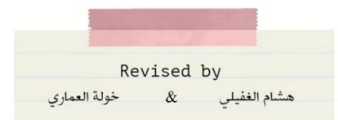
## Done by:

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## ★ References:

- 435 girls & boys slides and notes.



**Color index:** Important - Further explanation - Doctors Notes - Numbers.

\*Please check out [this link](#) before viewing the file to know if there are any additions or changes.

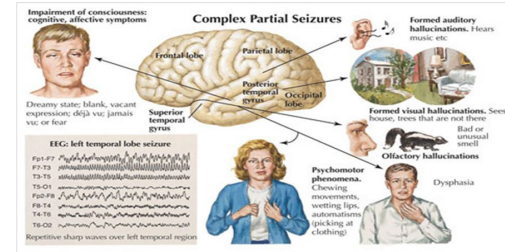
## Definition of seizure and Epilepsy

**Seizure:** Abnormal, **excessive** and sudden **synchronised** electrical discharge of a group of neurons within the brain that causes an alteration in sensation, behavior, or consciousness. **if it affect the limbic system or reticular activating system it may alter behavior.**

- Seizures are symptoms of a disturbance in brain function, which can be due to epilepsy or other causes. **Seizure is a symptom, Epilepsy is a disease.**
- Seizures affect all ages. Most cases of epilepsy are identified in childhood, and several seizure types are particular to children.
- Seizures are either provoked or unprovoked.
- **unprovoked: nothing irritating or abnormal happened. provoked seizures : External factors that trigger the seizures like alkalosis and temperature.**

### ★ **Provoked Seizures:**

- Induced by **somatic** disorders originating **outside** the brain.
- **Examples:** Fever, infection, syncope, head trauma, **hypoxia**, toxins, **cardiac arrhythmia**.



### ❖ **When can we say this patient is epileptic?**

- ★ When he has **recurrent (2 or more)**, **unprovoked** seizures within 24 hours with recurrent sensory\motor disturbances that can cause convulsions and loss of consciousness.

- مهم تفهمون هذا الكونسيبت، السيجر (نوبة) قد تكون محفزة provoked يعني متعمدة أو معروف سببها (أحياناً الأطباء يتعمدون يسببون للمريض سيجر لأسباب تشخيصية) وقد تكون غير محفزة unprovoked. السيجر هي عرض مرضي، قد تكون وحدة وقد تكون متعددة، متى نعتبر السيجرز جزء من مرض (يعني تعتبر مرض صرع epilepsy)؟ إذا تكررت unprovoked seizure مرتين خلال أقل من يوم.. يعني ممكن الشخص يصاب بسيجر مرة وحدة فقط كعرض لأي سبب كان ولا يعتبر مصاب بمرض الصرع

## 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. (when the exceed the threshold)
- **Seizures may then spread** to involve adjacent areas of the brain or through established anatomic pathways to other distant areas.

## Classification of Seizures



### **Types of Seizures and Epilepsy** (GREAT EXPLANATION YOU SHOULDN'T MISS IT)

(Duration: 8:49) **افتحوه قبل جدًا رائع ويرتب الأفكار**

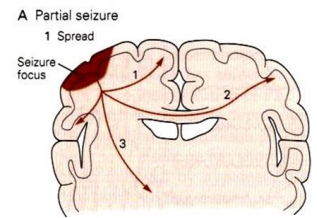
### ❖ **Partial/Focal Seizures**

- Their onset is limited to **part** of the cerebral hemisphere.
- Simple partial seizures can progress to complex partial seizures, and complex partial seizures can secondarily become generalized due to the increase electrical discharge going on and on, and because the brain cells are all connected together ; therefore it spread throughout the brain (spatial summation)

### Classification of Seizures

Partial (or Focal) Seizures	Generalized Seizures
<ul style="list-style-type: none"> <li>• Simple Partial               <ul style="list-style-type: none"> <li>○ Awareness <u>not</u> impaired</li> </ul> </li> <li>• Complex Partial               <ul style="list-style-type: none"> <li>○ Awareness impaired/lost</li> </ul> </li> <li>• Partial Seizures secondarily generalizing</li> </ul>	<ul style="list-style-type: none"> <li>• Absence               <ul style="list-style-type: none"> <li>○ Typical</li> <li>○ Atypical</li> </ul> </li> <li>• Myoclonic</li> <li>• Clonic</li> <li>• Tonic</li> <li>• Tonic-Clonic</li> <li>• Atonic</li> </ul>

- **Simple partial seizures**
  - Manifest motor, somatosensory, and psychomotor symptoms **without impairment of consciousness**.
- **Complex partial seizures**
  - Manifest impairment of consciousness with or without simple partial symptoms.

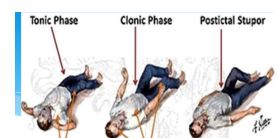
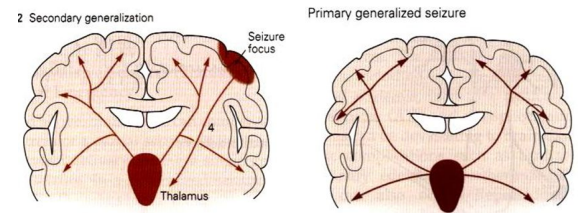


#### ❖ Partial psychomotor (temporal lobe) seizure:

- ◇ Epileptic seizures which originate in the temporal lobe of the brain.
- ◇ The seizures involve sensory changes, for example smelling an unusual odour that is not there, and disturbance of memory.
- ◇ Gustatory & visceral hallucinations, déjà vu (over familiarity)
- ◇ The most common cause is mesial temporal sclerosis

#### ❖ Generalized Seizures

- Those that manifest a **loss of consciousness** and involve the **cerebral cortex diffusely** (whole of it) from the beginning.
- They are either convulsive or non-convulsive (GTC are convulsive and Absence are nonconvulsive). بمعنى تشنج كامل أو بدون تشنج "البعض مكون فكرة خاطئة أن كلها ينصرع المريض ع الأرض"
- Generalized seizures include:



#### ★ Generalized **tonic-clonic** seizures (**Grand Mal** epileptic seizure).

- a. +/- aura بمعنى أن بعضهم يقدر يعرف بتجيبه نوبة تشنج من الخبرة، طبعًا مو الكل
- Peculiar sensation or **dizziness**; then **sudden** onset of seizure with **loss** of consciousness. EEG: Showing **high frequency high voltage** discharges.
- **Has phases**: two phases, first phase manifest as muscle tension (عضلة يابسة) and then it moves on to clonic which is contraction of muscle



Tonic Phase	Clonic Phase	Postictal
<ul style="list-style-type: none"> <li>● Rigid muscle contraction.</li> <li>● clenched jaw and hands.</li> <li>● <b>eyes open</b> with <b>pupils dilated</b>.</li> </ul>	<ul style="list-style-type: none"> <li>● Rhythmic, <b>jerky contraction and relaxation</b> of all muscles.</li> <li>● incontinence and <b>frothing at the lips</b>.</li> <li>● <b>may bite</b> tongue or cheek.</li> </ul>	Sleeping or <b>dazed</b> .
<b>30-60 seconds.</b>	<b>Several minutes.</b>	<b>Up to Several Hours.</b>

- ❖ **Clinical Link:** **Status Epilepticus**: if the seizure lasted more than 5 minutes, or the patient didn't return to normal. This is a medical emergency treated with benzodiazepine to enhance GABA (inhibit the neuronal activity).

#### ★ Absence seizures (**Petit mal**<sup>1</sup> epileptic seizures).

- Loss of contact with environment for **5 to 30 seconds**.

<sup>1</sup> From the French for "little illness"

- Appears to be day dreaming or may roll eyes, nod head, move hands, or smack lips. p:تقريباً مثل ريفن بمسلسل ذاتس سو ريفن، عشان تتذكرها اربط ريفن ببيباكستر بكلمة بتيت
- Resumes activity and is **not aware of seizure**.

يكون قاعد مع الناس وفجأة ما يتحرك ولا يرد عليهم ولا يسمعهم. الي يشوفه يحسبه "مفهي" او منتج. بعض الأهل يودون الطفل لطبيب نفسي يحسبون عنده مرض نفسي وتكون مشكلته تشنج نوعه absence.



### Types of Seizures (demonstration without explanation) (Duration: 3 mins)

## The Clinical Manifestations of a Seizure

### ❖ What do they reflect?

- Reflect the **(Seizure focus)** which is the area of the brain from which the seizure begins and the spread of the electrical discharge.

indescribable bodily sensations	"pins and needles" sensations	momentary jerks or head nods	staring with loss of awareness
Hallucinations (see or hear things which aren't there)	<b>Convulsions</b>	smells or sounds	fear or depression

- **Convulsions:** involuntary muscle contractions lasting seconds to minutes.

## Pathophysiology of Epilepsy (at a 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 (due to changes of ion channel in membrane and can be due to NT disturbance balance) for firing and firing excessively, related to →
- Excessive neuronal activity by either:
  - **↑ Excess of Excitatory** (acetylcholine- or Glutamate –related activity)
  - **↓ Decreased inhibitory** (GABA –related activity)
- Together and/or those lead to instability of cell-membrane & **lowered threshold** (easier to excite) for excitation excessive polarization, **hypopolarization** (depolarization) allowing the cell to be more susceptible to activation spontaneously or by any ionic imbalances in the immediate chemical environment of neurons.

## Etiology of Seizures

Epileptic	Non-Epileptic
<b>Idiopathic</b> (70-80%)	Head trauma
Cerebral Tumor	Meningitis
Neurodegenerative disorders	Encephalitis

## Secondary to:

- Cerebral damage: e.g. congenital infections, intraventricular hemorrhage
- Cerebral dysgenesis/malformation: e.g. **hydrocephalus**

## Poisons/toxins

## Febrile convulsions

## Metabolic:

- **Hypoglycemia**
- HypoCa, HypoMg, HyperNa, HypoNa

## Seizures and Genetics

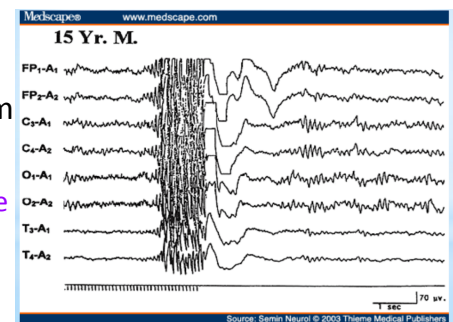
### ❖ Some types of seizures are linked to genes (run in families):

- 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 into and out of cells and that regulate neuron signaling.
- **Genetic factors account for at least 20%** of the seizures. **Some examples:**
  - Benign neonatal convulsions (**20q and 8q**).
  - Juvenile myoclonic epilepsy (**6p**).
  - Progressive myoclonic epilepsy (**21q22**).
  - Example : Lafora's disease, has been linked to a gene that helps to break down carbohydrates.

## Electroencephalogram ( EEG )

### ❖ Why is it important?

- EEG → diagnosis and classifying seizures → therapeutic decisions.
- In combination with appropriate clinical findings, **Spikes** or **sharp waves** (Epileptiform EEG patterns). **strongly support a diagnosis of epilepsy.**
  - Focal epileptiform discharges indicate focal epilepsy.
  - Generalized epileptiform activity indicates a 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.



## رسالة شكر وتقدير!

لحظات شكر وتقدير لمجهود كل شخص ساهم في إخراج هذا العمل، من أخذت الملاحظات والتلخيصات وحتى العمل على السلايدات. والله كنا فخورين جدًا بالعمل معاكم.. اقرؤوا الأسماء ثم اذكروهم بدعوة! الله يبارك في وقتهم ويسهل عليهم الاختبارات كلها..

- فريق العمل في الإجازة الصيفية (نعم.. اشتغلوا بالإجازة!)

- شهد العنزي - ملاك الحامدي - بدور جليدان - جواهر الحربي - رغد المنصور - نوره الرميح - دانيا الهنداوي.

\*نشكر عمر العتيبي ورواف الرواف على مساهمتهم في شغل اول ٥ محاضرات.

- فريق العمل أثناء البلوك:

<ul style="list-style-type: none"> <li>● ر هف بن عبّاد</li> <li>● سها العنزي</li> <li>● منيرة العمري</li> <li>● منيرة السلولي</li> <li>● مي العقيل</li> <li>● كوثر الموسى</li> <li>● سمر العتيبي</li> <li>● سارا الحسين</li> <li>● رهام العبيدان</li> <li>● رغه القاسم</li> <li>● غدير عسيري</li> <li>● لمى الزامل</li> <li>● لمياء الصقهان</li> </ul>	<ul style="list-style-type: none"> <li>● أفنان المالكي</li> <li>● اسرار باطرفي</li> <li>● دلال الحزيمي</li> <li>● ريما اللحيان</li> <li>● علا النهير</li> <li>● فرح مندوزا</li> <li>● العنود إبراهيم العمير</li> <li>● لجين جابر السواط</li> <li>● ملاك الشريف</li> <li>● ملاك اليحيا</li> <li>● خوله العريني</li> <li>● لينا اسماعيل</li> <li>● منيره السلطان</li> </ul>	<ul style="list-style-type: none"> <li>● ملاك الحامدي</li> <li>● شهد العنزي</li> <li>● رغد المنصور</li> <li>● دانيا الهنداوي</li> <li>● نوره الرميح</li> <li>● جواهر الحربي</li> <li>● بدور جليدان</li> <li>● نجود الحيدري</li> <li>● حصه المزيني</li> <li>● رزان السبتي</li> <li>● روان الضويحي</li> <li>● منيرة الحسيني</li> <li>● لولوه الصغير</li> </ul>
<ul style="list-style-type: none"> <li>❖ عبدالله الجعفر</li> <li>❖ حسن علي البلادي</li> <li>❖ عمر الشهري</li> <li>❖ عبدالرحمن البركه</li> <li>❖ عبدالله الضبيبي</li> <li>❖ محمد ابونيان</li> </ul>	<ul style="list-style-type: none"> <li>❖ عبدالرحمن السيارى</li> <li>❖ عمار آل منصور</li> <li>❖ عبدالعزيز الحماد</li> <li>❖ محمد الفواز</li> <li>❖ حسن الشماسي</li> <li>❖ وائل العود</li> </ul>	<ul style="list-style-type: none"> <li>❖ رواف الرواف</li> <li>❖ عمر العتيبي</li> <li>❖ عبدالله الضحيان</li> <li>❖ حمزة الفعر</li> <li>❖ خليل الدريبي</li> <li>❖ احمد الخياري</li> </ul>

تم بحمد الله الانتهاء من محاضرات فريق علم وظائف الأعضاء في بلوك الجهاز العصبي النفسي .. تحياتنا

قادة الفريق