MEDICINE
KING SAUD UNIVERSITY

تمت المراجعة
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Physiology Team 436

CNS PHYSIOLOGY

- Text
- Important
- Formulas
- Numbers
- Doctor notes
- Notes and explanation

Lecture No.29

الحمدلله ☺آخر محاضرة لهذا البلوك على التمام

Pathophysiology and epilepsy

Objectives:

1. Define Epilepsy.
2. Etio-pathology of Epilepsy.
3. Types of Epilepsy.
4. Role of Genetic in Epilepsy.
5. Clinical Features.
6. Role of Electro Physiological tests in the diagnosis of Epilepsy.

Definition of seizure and epilepsy

Definition of seizure and Epilepsy

Epilepsy

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.

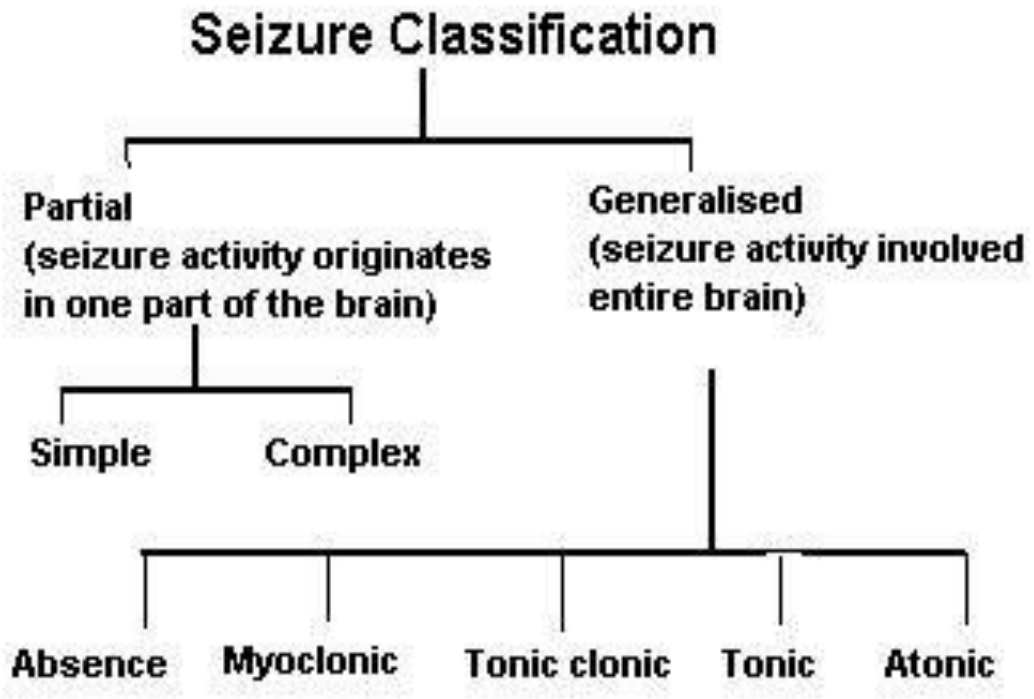
Loss of consciousness, or convulsions.

Seizure

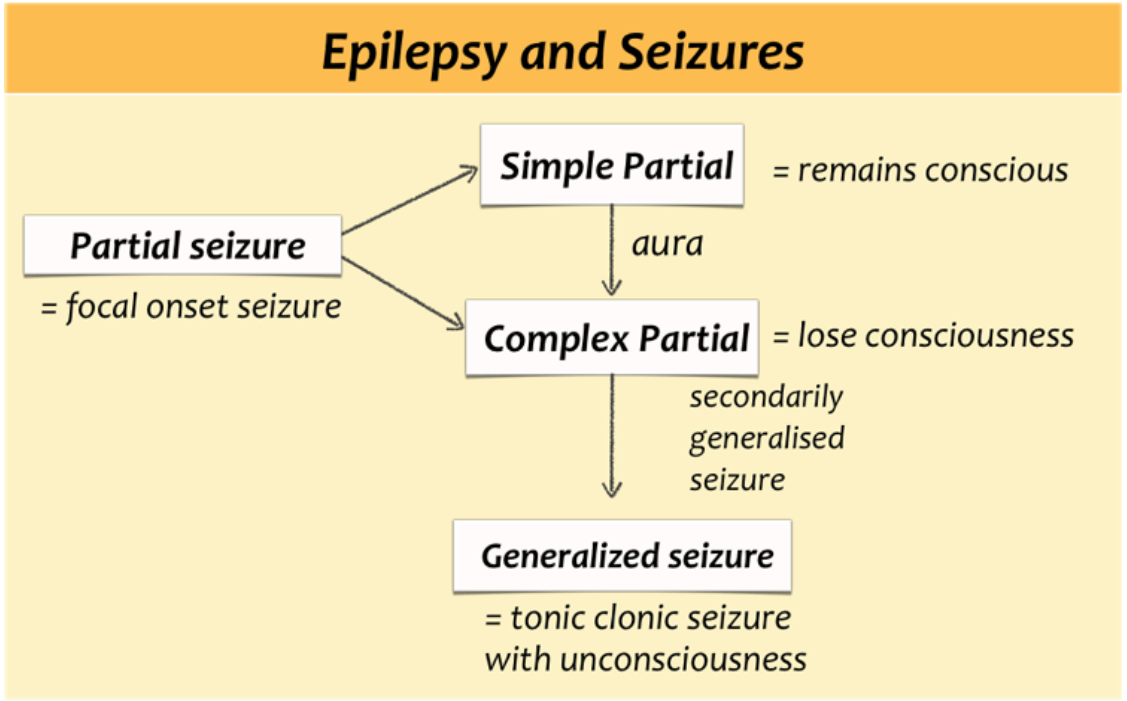
Seizures are symptoms of a disturbance in brain function , which can be due to epilepsy or other causes.

A seizure is a sudden surge in electrical activity in the brain that causes an alteration in sensation, behavior, or consciousness.

Seizure classification



Epilepsy & seizures

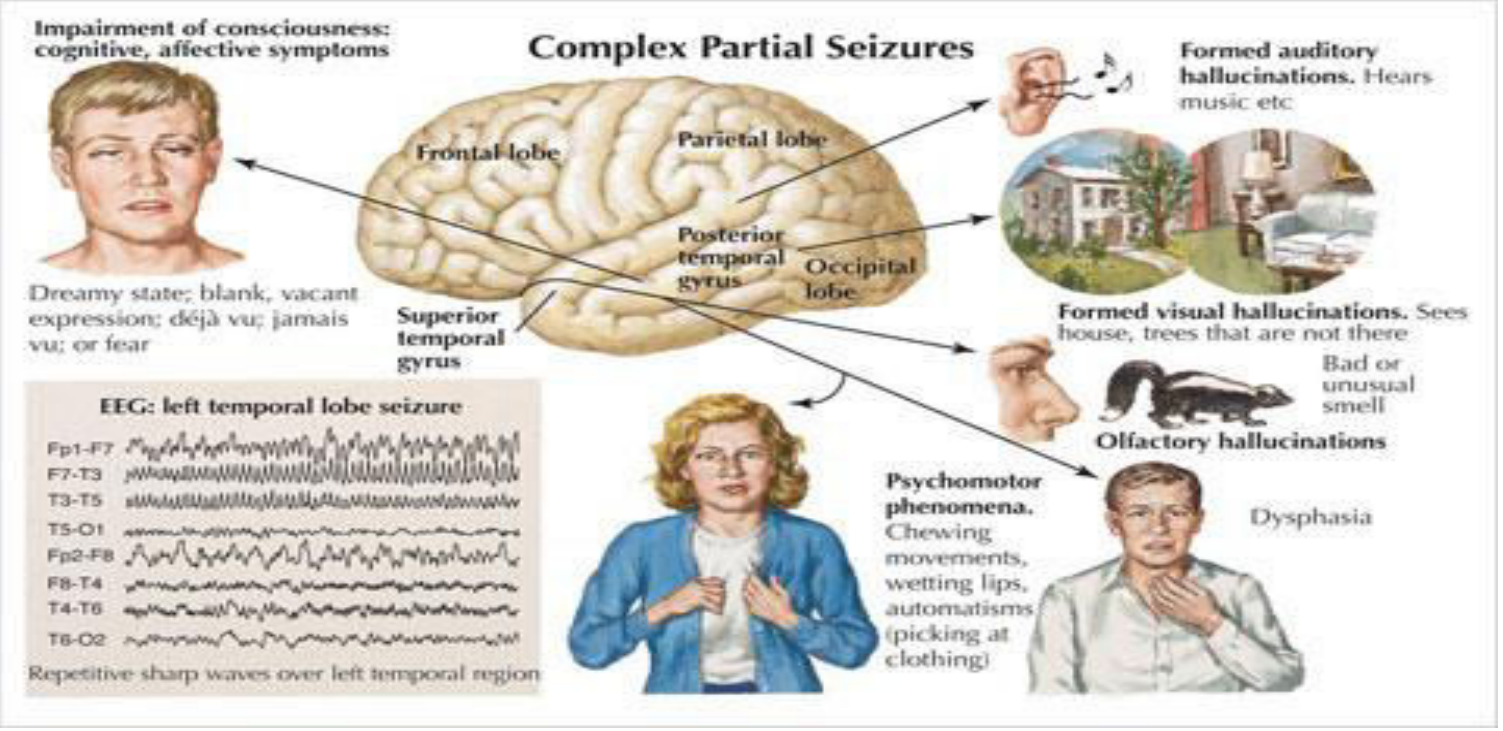


Provoked seizures

- Definition:

Seizures induced by somatic disorders originating outside the brain.

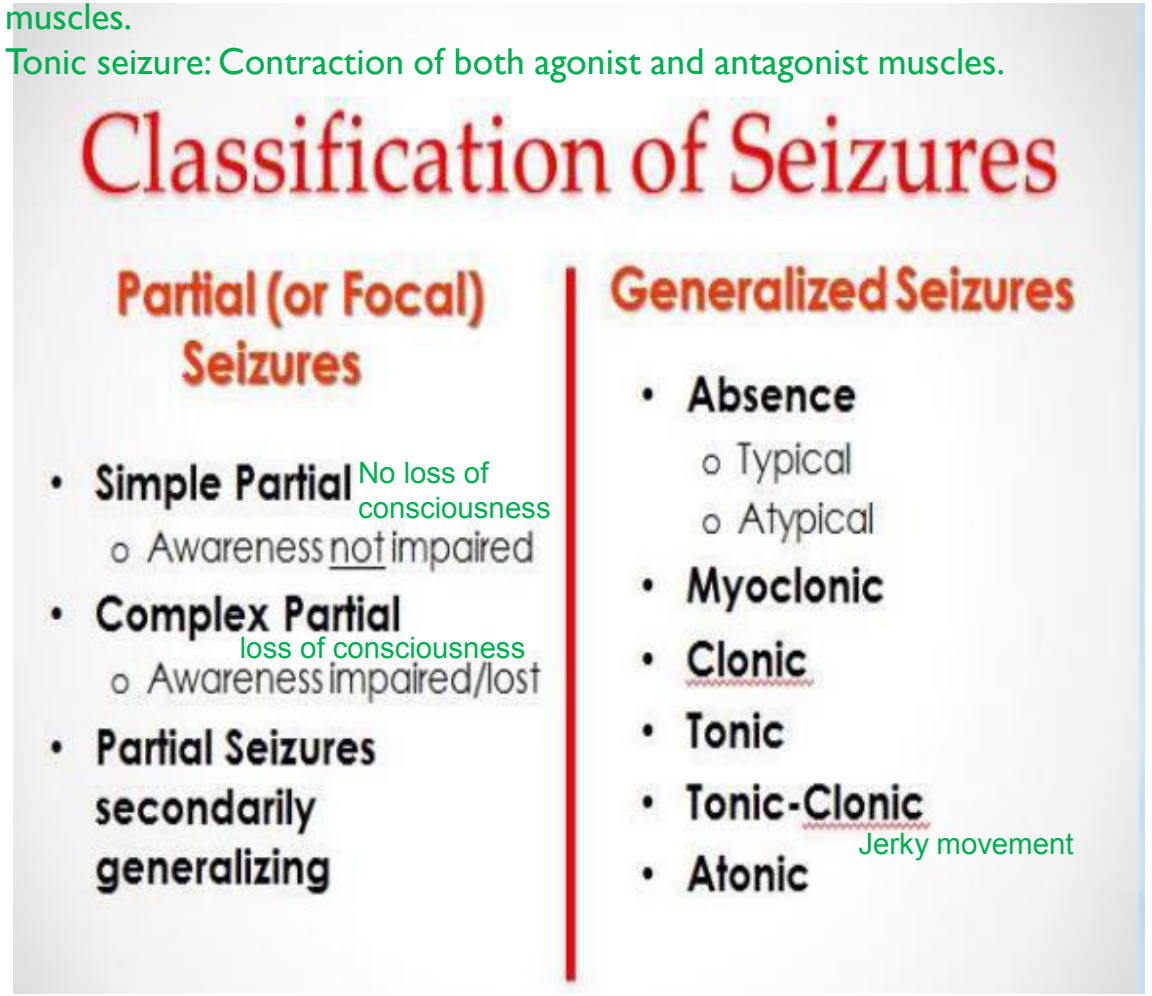
E.g. fever, infection, syncope, head trauma, hypoxia, toxins, cardiac arrhythmias



Partial seizures

- 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.
- Focal/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 odor that is not there, and disturbance of memory.
  - Auditory & visceral hallucinations, déjà vu (over familiatry).
  - The most common cause is mesial temporal sclerosis.

Clonic seizure: Contraction of agonist and relaxation of antagonist muscles.
Tonic seizure: Contraction of both agonist and antagonist muscles.



Generalized seizures

- Generalized seizures definition:

Manifest a loss of consciousness (convulsive or non-convulsive).

- Generalized seizures include:

(1) Generalized tonic- clonic seizures (GTC) (grand mal epileptic seizure).

(2) absence seizures (petit mal epileptic seizures).

- GTC are convulsive and absence are nonconvulsive .
- Simple partial seizures can progress to complex partial seizures, and complex partial seizures can secondarily become generalized.
- Seizures affect all ages. Most cases of epilepsy are identified in childhood, and several seizure types are particular to children.
- Generalized seizures cause a loss of consciousness due to the involvement of the thalamus.

Cont.

- Manifest a loss of consciousness:
  - Generalized seizures include:

1. Myoclonic (are brief shock-like jerks of a muscle or group of muscles).
2. Clonic (rapidly alternating contraction and relaxation of a muscle, in other words, repeated jerking).
3. Tonic (the tone is greatly increased and the body, arms, or legs make sudden stiffening movements).
4. Tonic-clonic seizures (Grand Mal epileptic seizure).
5. Atonic (Lose of muscles strength).
6. Absence seizures (Or non-convulsive).

   (Petit mal epileptic seizures)

   a. Loss of contact with environment for 5 to 30 seconds.

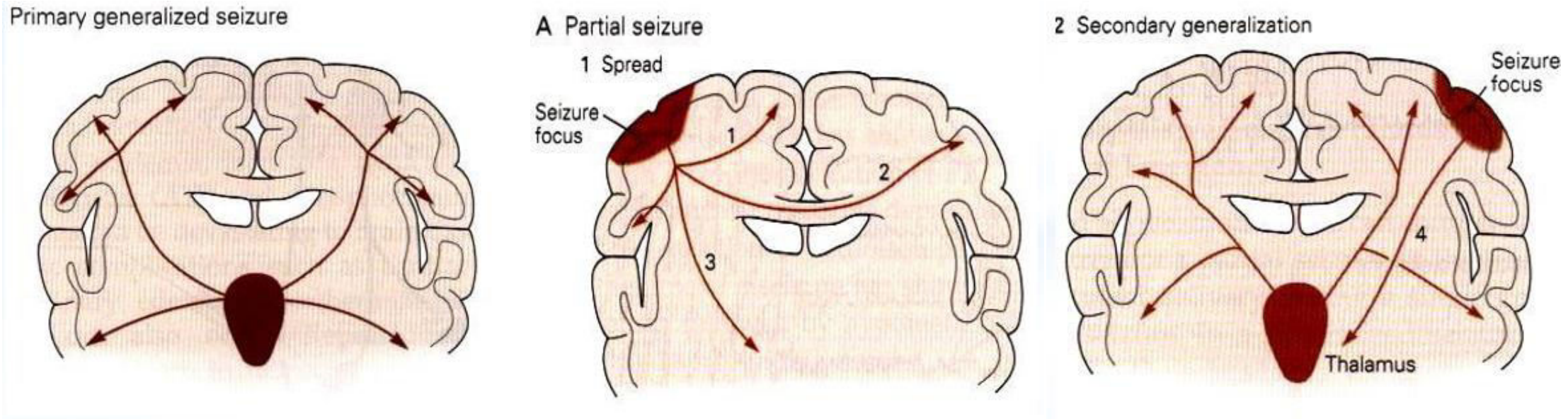
   b. Appears to be day dreaming or may roll eyes, nod head, move hands, or smack lips.

   c. Resumes activity and is not aware of seizure.

Seizure classification & clinical manifestations

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

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



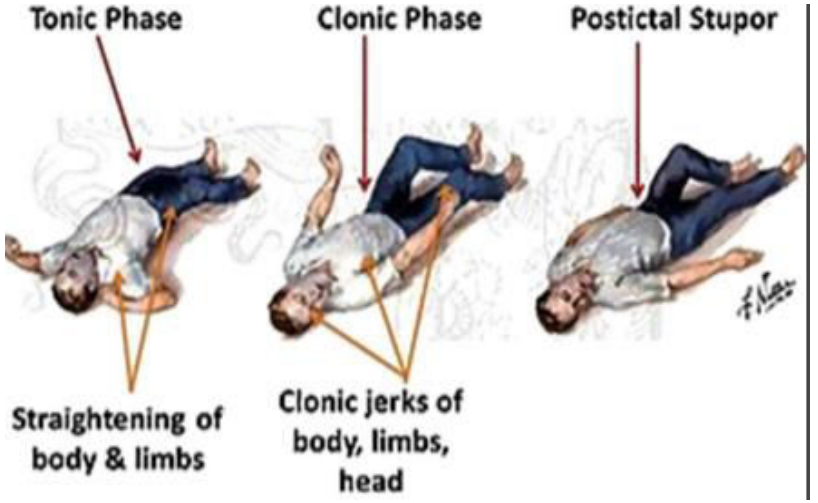
Cont.

- The onset of a seizures:

Small group of abnormal neurons undergo:

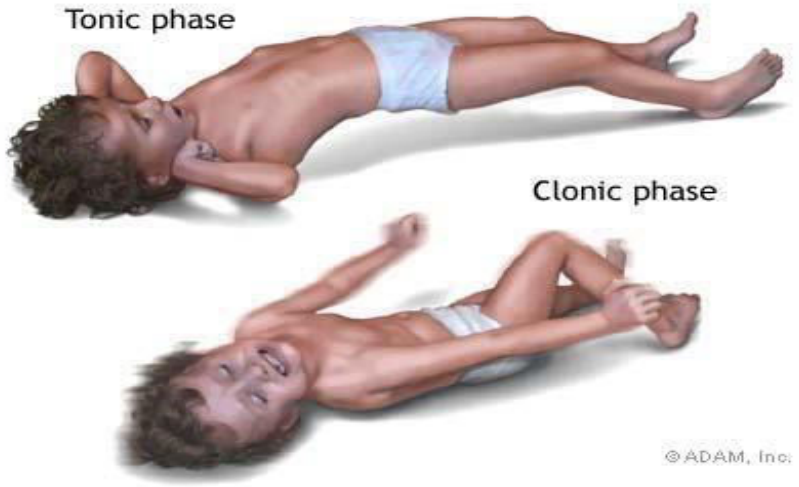
  - prolonged depolarizations.
  - Rapid firing of repeated action potentials.

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



- Clinical seizure:

  - 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.



ONLY IN MALES' SLIDES

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.

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.

Clinical manifestation 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
(8) Convulsions → i.e., (involuntary muscle contractions) lasting seconds to minutes.

Aetiology of seizures

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

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

Pathophysiology of epilepsy (at molecular level)

- Cortical cell membrane level.

ONLY IN FEMALES' SLIDES

- 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→

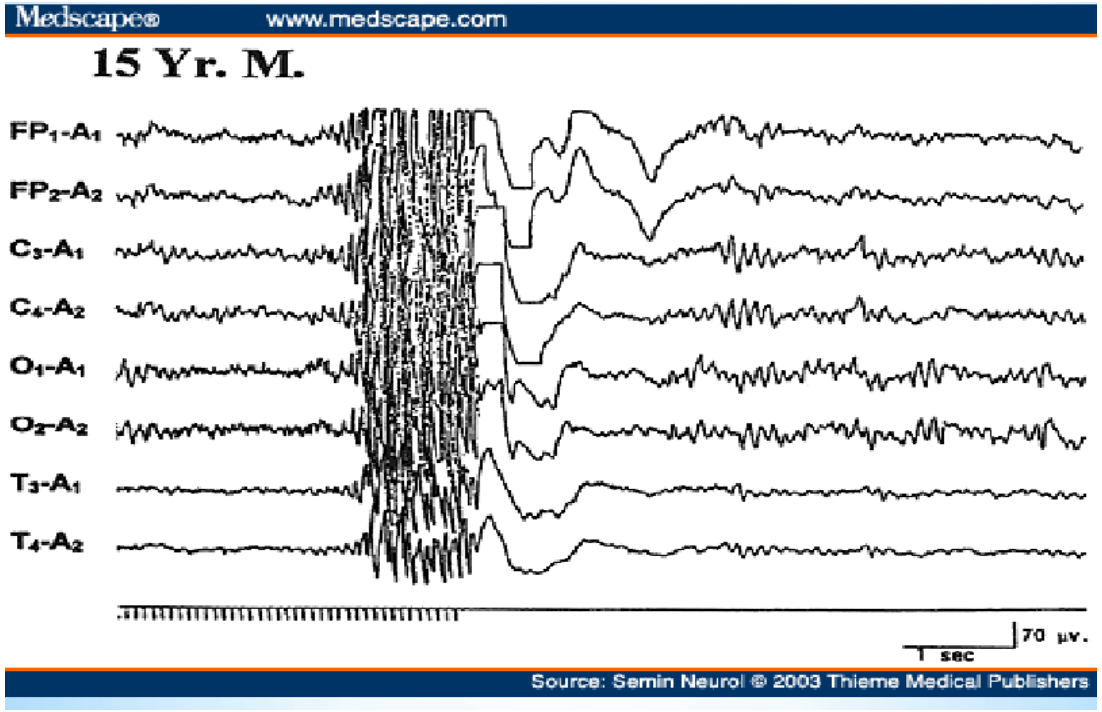
1. Excess of Excitatory (acetylcholine - or Glutamate – related activity).
2. Decreased inhibitory (GABA – related activity).

- 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)

- Purple Color Refer To (Both In Males' And Females' Slides).
- Pink Color Refer To (Only In Females' Slides).

- Measuring electrical activity of the brain (without stimulation).
- EEG › diagnosis, classifying seizures › therapeutic decisions.
- EEG is helpful for establishing the diagnosis, classifying seizures correctly, and 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 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.



Genetic Epilepsy

- 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.

Example: Lafora's disease, has been linked to a gene that helps to break down carbohydrates.

ONLY IN MALES' SLIDES

- Jacksonian epilepsy:

Focal motor seizures begin in motor areas of the cerebral cortex, usually begins with twitching of the thumb, finger, toe, or angle of the mouth.

Functional neurophysiological investigation

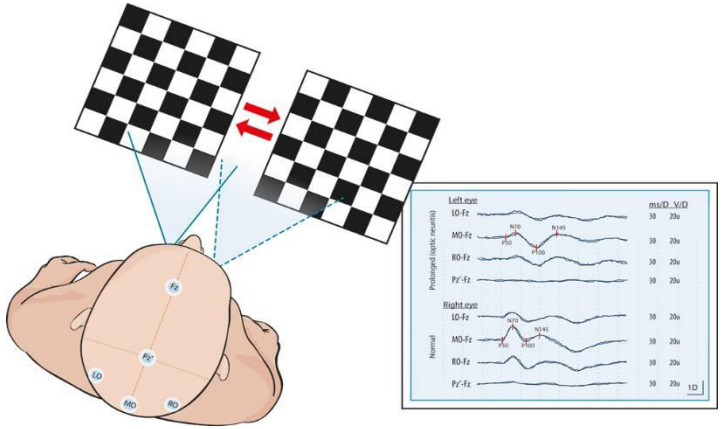
ONLY IN FEMALES' SLIDES

- Electromyography (EMG) and nerve conduction studies.
- Electroencephalography (EEG).
- Evoked potentials (EP).
- Polysomnography (sleep study to diagnose disorders associated with abnormal sleep).
- Intraoperative monitoring, Intraoperative neurophysiologic monitoring.
- Functional MRI.

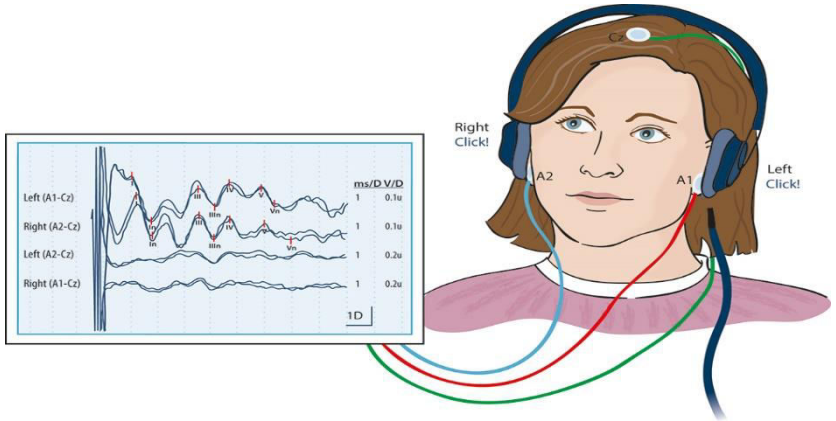
Evoked potential (EP) Cont.

- Measure the electrical activity of the brain in response to stimulation of specific sensory nerve pathways.
- Detect the slowing of electrical conduction caused by damage.
- Auditory EP.
- Visual EP.

- Visual evoked potential:



- Auditory evoked potential:



شكر وعرفان

من لا يشكر الناس لا يشكر الله..

لحظات من الشكر والتقدير والعرفان، لكل من ساهم بإخراج وإنجاز هذا العمل من الإجازة الصيفية وحتى انتهاء البلوك.

شكر عظيم لأعضاء الفريق وللقادة الأكاديميين على إخلاصهم وجهدهم وتفانيهم في العمل ولا تنسوهم من دعواتكم، الله يسهل لهم أمرهم ويبارك لهم بوقتهم.

تم بحمد الله وتوفيقه وتيسيره الإنتهاء من محاضرات فريق علم وظائف الأعضاء في بلوك الجهاز العصبي النفسي .. نسأل الله أن نكون قد وفقنا في تقديم الأفضل، ونعتذر عن أي تقصير...

تحياتنا...

قادة الفريق

CNS PHYSIOLOGY

Thank you!

اعمل لترسم بسمة، اعمل لتمسح دمعة، اعمل و أنت تعلم أن الله لا يضيع أجر من أحسن عملا.

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QUIZ

اقتراحات وشكاوي

References:

- Females' and Males' slides.
- Guyton and Hall Textbook of Medical Physiology (Thirteenth Edition.)