seizures and epilepsy

Summary

A seizure is a transient manifestation of abnormal excessive or synchronous electrical brain activity that causes convulsions, loss of consciousness, and/or lapses of consciousness. The underlying cause of seizures is a state of neuronal hyperexcitability, which may be temporary (e.g., due to electrolyte imbalances) or long-lasting (e.g., due to inherited or acquired neural abnormalities). Provoked seizures occur as a result of various seizure triggers and underlying conditions (e.g., stroke, traumatic brain injury, alcohol withdrawal), while unprovoked seizures occur in the absence of an identifiable cause. Seizures can also be classified by onset and degree of CNS involvement (e.g., focal seizures, generalized seizures). Epilepsy is a chronic neurological disorder with diagnostic criteria that are based on seizure type, frequency, risk factors, and underlying conditions (e.g., epilepsy syndromes).

Acute complications of seizures include physical trauma and CNS tissue damage due to hyperthermia, cardiorespiratory deficits, or excitatory toxicity. Status epilepticus is a potentially life-threatening condition characterized by continuous seizure activity for more than 5 minutes that requires immediate management and stabilization. Acute seizures and status epilepticus in adults and children are most often initially treated with parenteral benzodiazepines, and then with the addition of other parenteral antiepileptic drugs (e.g., fosphenytoin) if there is no resolution. Rapidly reversible causes of seizures (e.g., hypoglycemia) should also be managed concurrently. The underlying cause is investigated based on a combination of clinical evaluation (e.g., seizure classification, identifying seizure triggers), laboratory studies, and neuroimaging. Electroencephalography (EEG) can provide additional evidence to support the diagnosis, although a normal EEG between seizures does not rule out epilepsy. Important antiepileptic drugs for the long-term treatment of epilepsy include lamotrigine (first-line treatment in focal seizures), valproate (first-line treatment in generalized seizures), and ethosuximide (first-line treatment in absence seizures). Appropriate medical treatment allows the majority of patients to remain seizure-free in the long term and prevents long-term complications such as psychiatric conditions (e.g., anxiety, depression, psychosis), sleep disorders, and sudden unexpected death in epilepsy (SUDEP); however, patients must be monitored for adverse effects of medications (e.g., bone disease). Epilepsy in certain groups (e.g., pregnant individuals, children) also may require specific considerations for management.

First:Seizures

A. Definitions

1. A **seizure** is a transient occurrence of signs and/or symptoms due to abnormal excessive or synchronous neuronal activity in the brain.

Seizures

Definition: Paroxysmal , time limited , involuntary change of motor activity and /or or behavior due to abnormal electric activity of the brain (Nelson 2008)

Convulsions

Definition: Excessive abnormal muscle contractions , usually bilateral , that may be sustained or interrupted (motor seizures)

- **Seizure**: an excessive and/or hypersynchronous activity of cortical neurons that results in transient neurological symptoms
- **Acute symptomatic seizure** (provoked seizure): a seizure that occurs at the time or soon after the onset of an acute systemic or CNS condition. Examples include: [2]
  - Within 1 week of stroke, traumatic brain injury (TBI), anoxic encephalopathy, or intracranial surgery
  - Subdural hematoma
  - Acute CNS infection
  - Exacerbation of multiple sclerosis or other autoimmune diseases
  - Metabolic disturbances
  - Drug/alcohol intoxication or withdrawal
- **Reflex seizure**: a seizure constantly evoked by a particular stimulus (trigger) that lowers seizure threshold (e.g., flashing lights; see "Seizure triggers")
- **Unprovoked seizure**: a seizure that occurs in the absence of an identifiable cause or beyond the specified interval after an acute CNS condition [1]
- **Descriptors**: the following terms are used to describe events, clinical features, and EEG signs related to seizures [3]
  - **Ictal**: occurring during a seizure
  - **Interictal**: occurring between the seizures
  - **Postictal**: occurring signs after a seizure

B. Epidemiology

1. One percent of children have a single unprovoked seizure before 16 years of age.
2. After a single unprovoked seizure, approximately 40% of children will have a second seizure.

C. Etiology

1. The seizure discharge is caused by an imbalance between excitatory and inhibitory input within the brain, or abnormalities in the membrane properties of individual neurons.
2. In some children, the cause of seizures is known (Table 12-2); however, in many, the cause remains unknown.

TABLE 181.2 Causes of Seizures

PERINATAL CONDITIONS
Malformation of cortical development
Intrauterine infection
Hypoxic-ischemic encephalopathy*
Trauma
Hemorrhage*
INFECTIONS
Encephalitis*
Meningitis*
Brain abscess
METABOLIC CONDITIONS
Hypoglycemia*
Hypocalcemia
Hypomagnesemia
Hyponatremia
Hypernatremia
Storage diseases
Reye syndrome
Degenerative disorders
Porphyria
Pyridoxine dependency and deficiency
POISONING
Lead
Drug toxicity
Drug withdrawal
NEUROCUTANEOUS SYNDROMES
Tuberous sclerosis
Neurofibromatosis
Sturge-Weber syndrome
Incontinentia pigmenti
SYSTEMIC DISORDERS
Vasculitis
Systemic lupus erythematosus
Hypertensive encephalopathy
Hepatic encephalopathy
OTHER CAUSATIVE DISORDERS/CONDITIONS
Accidental trauma*
Child abuse*
Increased intracranial pressure
Tumor
Remote brain injury
Febrile illnesses*
Cryptogenic* (no underlying disorder found)
Familial*

*Common.

Seizure triggers [9]

Seizure triggers are stimuli that can precipitate seizures both in people with and without epilepsy. [10]

- Excessive physical exertion
- Alcohol consumption
- Fever (febrile seizures)
- Sleep deprivation
- Flashing lights (e.g., strobe lights, video games)
- Music [11]
- Hormonal changes (e.g., at different phases of the menstrual cycle, after menopause)
- Medication-related issues in patients with known epilepsy: e.g., poor adherence, recent changes in drug doses or formulation, new medication interactions

Causes of acute symptomatic seizures [2]

- TBI
- Stroke
- Anoxic encephalopathy
- Intracranial surgery
- Acute CNS infections (e.g., meningitis, encephalitis)
- Electrolyte imbalance (e.g., hypoglycemia, hypocalcemia)
- Acute metabolic disturbances (e.g., uremia)
- Alcohol withdrawal
- Recreational drug use
- Prescription drug toxicity
- Exacerbations of autoimmune disorders (e.g., SLE)

Table 12-2

Causes of Acute Seizures During Childhood

Head trauma	Cerebral contusion, subdural hematoma
Brain tumor	Astrocytoma
Toxins	Amphetamines, cocaine
Infections	Meningitis, encephalitis, brain abscess, neurocysticercosis
Vascular	Cerebral infarction, intracranial hemorrhage
Metabolic disturbances	Hypocalcemia, hypoglycemia, hypomagnesemia, hypo- or hypernatremia, pyridoxine deficiency
Systemic diseases	Hypertension, hypoxic–ischemic injury, inherited metabolic disorder, liver disease, renal failure, neurocutaneous disorders (e.g., tuberous sclerosis, neurofibromatosis and Sturge-Weber syndrome)

D. **Classification of seizures.** Criteria for the classification of seizures include the presence or absence of fever, the extent of brain involvement, whether consciousness is impaired, and the nature of the movements (**Figure 12-2**).

1. **Febrile seizures** are a common but benign type of seizure associated with fever [see section V.K].

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2. **Afebrile seizures** are either generalized (starting throughout the entire brain) or partial (starting from a single part or "focus" in the brain).
   a. **Generalized seizures** are caused by the discharge from a group of neurons in **both cerebral hemispheres** and are *associated with an alteration of consciousness.* Two common types are tonic–clonic and absence seizures.
      1. **Tonic–clonic seizures** are the **most common type of generalized seizure.** These seizures are characterized by increased thoracic and abdominal muscle tone, followed by clonic movements of the arms and legs, eyes rolling upward, incontinence, decreased consciousness, and a **postictal state** of variable duration.
      2. **Absence seizures** are brief staring spells that occur without loss of posture and with only minor motor manifestations (e.g., eye blinking or mouthing movements). The seizure lasts <15 seconds, and there is **no postictal state.**
      3. **Other generalized seizures** include tonic, clonic, myoclonic, and atonic.
   b. **Focal (partial) seizures** are caused by the discharge from a group of neurons in **one hemisphere.** Seizure symptoms may have predominately **motor, sensory, or psychomotor features.** There are two types:
      1. In **focal seizures** (prior term: simple partial seizure), consciousness is **not** impaired.
      2. In **focal dyscognitive seizures** (prior term: complex partial seizure), **consciousness is altered.**

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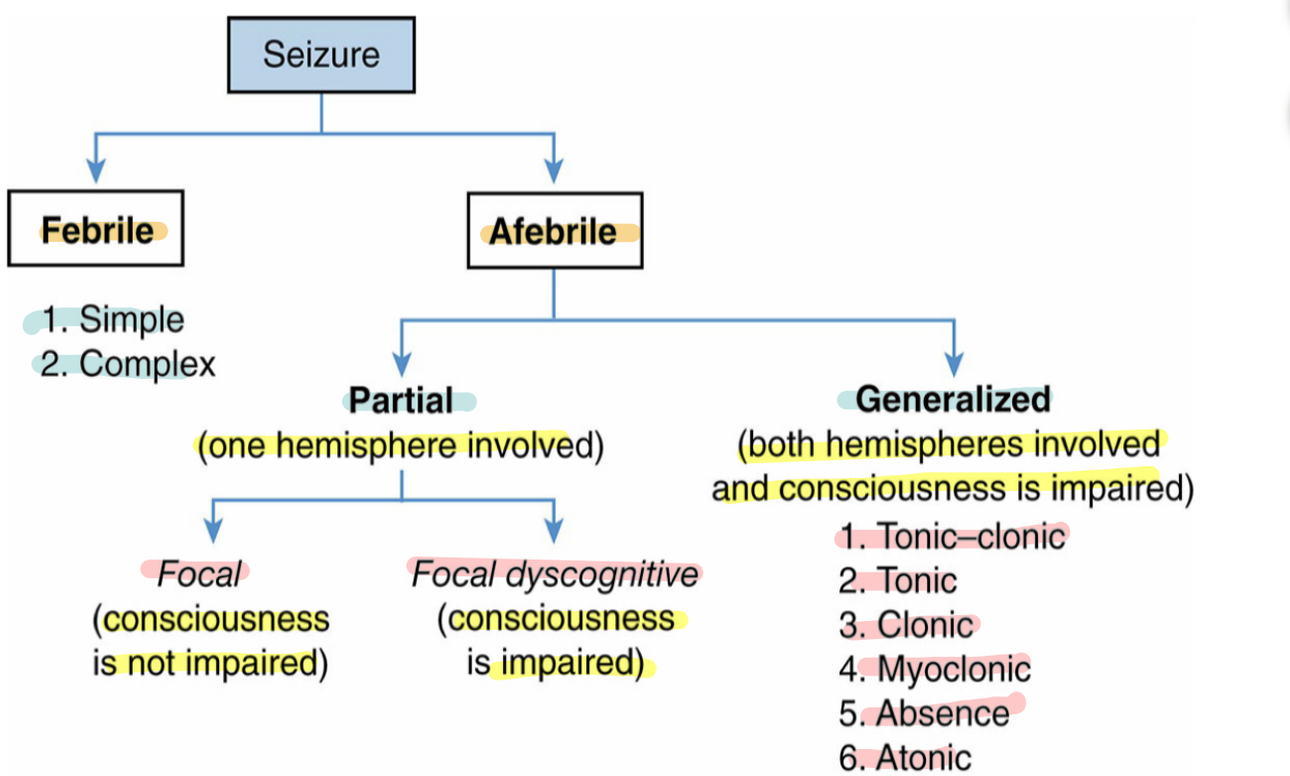

FIGURE 12.2 Classification of seizures.

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About Afebrile seizures:

FOCAL SEIZURES

Focal seizures with retained awareness (previously termed simple partial seizures) arise from a specific anatomical focus and may or may not spread to surrounding brain regions. Clinical symptoms include motor (tonic, clonic, myoclonic), sensory, psychic, or autonomic abnormalities, but consciousness is preserved. The location and extent of spread of the seizure focus determine the clinical symptoms.

Focal seizures with altered awareness (previously termed complex partial seizures) can have similar sensorimotor signs, but also have associated alteration of consciousness. Although the child may not be completely unresponsive, subtle slowing or alteration of mental status (*dyscognitive* features) may occur. Along with altered responsiveness, patients may have automatisms or stare during these seizures. Automatisms are automatic semipurposeful movements of the mouth (lip smacking, chewing) or extremities (rubbing of fingers, shuffling of feet). Focal seizures that manifest only with psychic or autonomic symptoms, such as a feeling of déjà vu during a temporal lobe seizure, can be difficult to recognize.

When focal seizures spread to involve both cerebral hemispheres, they are said to have *evolved to a bilateral convulsive seizure* (previously called a secondarily generalized seizure). It is often difficult to distinguish primary generalized tonic and clonic seizures from those that evolved from focal seizures on purely clinical grounds. This distinction is important, however, because evaluation and treatment for focal or generalized epilepsy syndromes are quite different.

GENERALIZED SEIZURES

Tonic, clonic, and biphasic **tonic-clonic** seizures may occur alone or in association with other seizure types. Typically the seizure begins abruptly but occasionally is preceded by a series of myoclonic jerks. During a tonic-clonic seizure, consciousness and control of posture are lost, followed by tonic stiffening and upward deviation of the eyes. Pooling of secretions, pupillary dilation, diaphoresis, and hypertension are common. Clonic jerks follow the tonic phase. In the post-ictal phase, the child might be hypotonic. Irritability and headache are common as the child awakens.

Absence Seizures

Seizures in which the primary clinical feature is staring can be either absence (generalized) or focal seizures. The clinical hallmark of absence seizures is a brief (<15 seconds) loss of awareness accompanied by eyelid fluttering or simple automatisms, such as fumbling with the fingers and lip smacking. Absence seizures usually begin between 4 and 6 years of age. Neurological examination and brain imaging are normal. The characteristic electroencephalographic (EEG) patterns consist of **generalized 3-Hz spike-and-wave activity.** An absence seizure can often be provoked by **hyperventilation.** Differentiating absence from focal seizures with altered awareness can be difficult but is essential for appropriate evaluation and treatment

Atypical Absence, Myoclonic, and Atonic Seizures

Atypical absence seizures manifest as episodes of impaired consciousness with automatisms, autonomic phenomena, and motor manifestations, such as eye opening, eye deviation, and body stiffening. They are associated with slower EEG discharges (2 Hz) and accompany other seizure types. **Myoclonus** is a sudden jerk of all or part of the body; not all myoclonus is due to epilepsy. Nonepileptic myoclonus may be benign, as in sleep

FOCAL SEIZURES

With retained awareness
- With observable motor signs (can be tonic, clonic, myoclonic)
- With sensory phenomena (visual, auditory, olfactory, gustatory, vertiginous, somatosensory)
- Autonomic

With impaired consciousness (dyscognitive features)
- Psychic (déjà vu, jamais vu, fear)
- Impaired consciousness at onset
- Development of impaired consciousness

Focal seizures with evolution to bilateral convulsions
- Jacksonian seizures

GENERALIZED SEIZURES

Absence (staring, unresponsiveness)

Convulsive seizures
- Tonic (sustained contraction)
- Clonic (rhythmic contractions)
- Tonic-clonic (tonic phase followed by clonic phase)

Atonic (abrupt loss of tone)

Myoclonic (rapid, shock-like contraction)

Epileptic spasms (flexion or extension of trunk and extremities for <2 sec)

Basic classification of seizures

	Focal	Generalized	Unknown
Location of abnormal neuronal activity	• Originates within the networks of a single hemisphere	• Originates from both hemispheres	• Determination of focal or generalized onset is not possible
Awareness	• Aware • Impaired awareness	• N/a	• N/a

Symptoms	• Motor onset
	• Nonmotor onset
		• Motor
		  ◦ Tonic-clonic
		  ◦ Other motor
		• Nonmotor
			• Motor
			  ◦ Tonic-clonic
			  ◦ Other motor
			• Nonmotor

Other	• Focal to bilateral tonic-clonic: focal progresses to a tonic-clonic pattern (characteristic of bilateral brain involvement)	• N/a	• Unclassified [16]

*** Note: An expanded version of the ILAE 2017 classification also considers further subtypes of motor and nonmotor categories.**

To sum up

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Partial Seizures

Simple

- **Asynchronous tonic or clonic movements; most of the face, neck, and extremities;** average duration 10–20 seconds
- Some have **an aura** and may verbalize during the attack; **no postictal period**
- EEG—**spike and sharp waves or multifocal spikes**
- Treatment—phenytoin and other anticonvulsants

Complex seizures

- **Impaired consciousness at some point,** may be very brief; one-third with aura (always indicates focal onset)
- **Automatisms** common after loss of consciousness (lip-smacking, chewing, swallowing, increased salivation)
- Interictal EEG—**anterior temporal lobe shows sharp waves or focal spikes**
- **MRI—many will show abnormalities in temporal lobe** (sclerosis, hamartoma, cyst, infarction, arteriovenous malformation [AVM], glioma)
- Treatment—**carbamazepine (drug of choice)** and other add-ons

Clinical features of focal seizures

Type	Awareness	Ictal	Postictal

Focal	• May manifest with **intact or impaired** awareness
	• Focal seizures with impaired awareness most frequently originate from the temporal lobe.
		• Prodromal symptoms: **aura** [19]
		  ◦ Neuropsychiatric symptoms (e.g., anxiety, fear, déjà vu)
		  ◦ Usually lasts seconds to minutes
		• Aware seizures and seizures with impaired awareness are possible
		• Motor symptoms
		  ◦ **Automatisms** (e.g., lip smacking, blinking, tapping, exploratory movements with hands)
		  ◦ Abrupt loss of tone in a muscle group (atonic seizure)
		  ◦ Myoclonus: brief involuntary twitching of muscle groups
		  ◦ Clonic, involuntary, repetitive movements of the contralateral limbs or facial muscles.
		  ◦ Tonic contraction of the contralateral limbs
		  ◦ Jacksonian march (march of convulsions): progressive involvement of different muscle groups
		  ◦ Irregular large amplitude movements such as pedaling, jumping, pelvic thrusting (hyperkinetic seizure)
		• Nonmotor symptoms
		  ◦ Autonomic (e.g. flushing, sweating)
		  ◦ Behavioral arrest
		  ◦ Cognitive (e.g., dyslexia, aphasia, anomia, anterograde amnesia)
		  ◦ Emotional (e.g., laughing, crying, feeling fear)
		  ◦ Sensory
		  ▪ Visual (e.g., hallucinations, micropsia, macropsia)
		  ▪ Somatosensory (e.g., paresthesias)
		  ▪ Vestibular (e.g., vertigo)
		  ▪ Auditory (i.e., hearing simple sounds like ringing)
		  ▪ Olfactory (e.g., unusual or intense smells)
		  ▪ Gustatory hallucinations
		• See "Focal seizures and syndromes" for features according to cortical origin.
			• Residual transient neurologic deficits depending on the affected cerebral region
			• **Todd paralysis**: postictal weakness or paralysis of the involved limb or facial muscles (can last for minutes or up to 36 hours)

Focal to bilateral tonic-clonic	• Progresses to loss of consciousness	• Prodromal aura may be present.
		• Starts as unilateral, localized focal symptoms that then progress into a bilateral generalized phase: Initial focal symptoms may go unnoticed if the condition progresses rapidly, leading to a potential misdiagnosis of generalized-onset seizures and inappropriate therapy.
		• Bilateral generalized phase
		  ◦ **Loss of consciousness**
		  ◦ Motor symptoms: See "Tonic-clonic seizure" in the table below.
		  ◦ Bladder or bowel incontinence
			• Confusion
			• Drowsiness
			• Agitation
			• Fatigue
			• May not recall the focal onset

Generalized Seizures

Absence (petit mal)

- **Sudden cessation of motor activity or speech with blank stare and flickering eyes**
- **More in girls; uncommon <5 years of age**
- **No aura**; usually <30 seconds; **no postictal period**
- EEG—**3/second spike and generalized wave discharge**
- Treatment—**ethosuximide (drug of choice)**, valproic acid (second line)

Tonic-clonic seizures

- May have **aura (focal onset; may indicate site of pathology)**; loss of consciousness, eyes roll back, tonic contraction, apnea
- **Then clonic rhythmic contractions** alternating with relaxation of all muscle groups
- Tongue-biting, loss of bladder control
- Semicomatose for up to 2 hours afterward with vomiting and bilateral frontal headache
- Treatment—**valproic acid, phenobarbital, phenytoin, carbamazepine**, and other add-ons

Myoclonic Seizures

- Repetitive seizures—**brief, symmetric muscle contraction** and loss of body tone with falling forward
- Five types, with variable severity, morbidity, and prognosis
- **Treatment—valproic acid** and others

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Clinical features of generalized seizures

Type	Ictal	Postictal
Generalized motor seizure		
Tonic-clonic seizure (grand mal)	• Prodromal symptoms may occur up to hours before seizure onset (e.g., sleep disturbances, lightheadedness, mood changes, anxiety/irritability, impaired concentration) • Loss of consciousness (sudden and without warning) • **Motor symptoms** 1. Tonic phase ▪ Generalized muscle contractions: **rotated eyes, apnea, lateral tongue biting**, pooled oral secretions, cyanosis, and characteristic loud moan (ictal cry) ▪ Increased sympathetic tone: dilated, unresponsive pupils, ↑ heart rate, ↑ blood pressure 2. Clonic phase: rhythmic muscle twitching • Bladder or bowel incontinence • Tongue-bite lacerations • Usually lasts 1–3 minutes	• Unresponsiveness • Confusion • Amnesia of the event • Aphasia • Fatigue • Muscular flaccidity and muscle pain • Headache • Hypersalivation with or without airway obstruction
Clonic seizure	• Loss of consciousness • Bilateral **rhythmic** jerking (of the entire body or only a part)	• Amnesia of the event
Tonic seizure	• Often occurs when the patient is drowsy, asleep, or after waking • Loss of consciousness • **Muscle stiffening** (extension or flexion of the head, trunk, and/or extremities) ◦ Contraction can be bilateral or unilateral • Can be accompanied by autonomic symptoms (e.g., tachycardia, flushing) • Can be followed by atypical absence seizure	• Amnesia of the event • Drowsiness or confusion may occur
Myoclonic seizure	• Positive myoclonus: sudden jerk-like muscle twitching • Negative myoclonus: a brief loss of muscle activity during tonic contraction of a muscle • Myoclonus can affect the entire body or only a part. • Myoclonic seizures are **nonrhythmic** (i.e., jerks occur at different intervals) and **irregular** (i.e., jerks are asymmetric and may change laterality)	• Amnesia of the event
Myoclonic-atonic seizure	• Myoclonus followed by a brief loss of tone	
Myoclonic-tonic seizure	• Myoclonus followed by a brief increase in tone	
Atonic seizure (also known as "drop seizure" or "drop attack")	• Sudden loss of muscle tone: sudden head drop or collapse (lasts < 15 seconds) • Frequently mistaken for syncope	
Generalized nonmotor seizure (absence seizure)		
Typical	• Interrupted motion or activity, **blank stare**, **unresponsiveness** • Can occur several hundred times a day and usually lasts < 10 seconds • Subtle automatisms (often go unnoticed): lip-smacking, eye fluttering, or head nodding are common. • Sudden onset and stop • Triggers: hyperventilation, flashing lights	• None • Consciousness returns rapidly, without any impairment • Amnesia is common
Atypical	• Interrupted motion or activity, blank stare • Patients may be responsive • Automatisms: lip-smacking, eye fluttering, chewing • Small hand movements (e.g., rubbing of the fingers) • Longer than typical form (10–30 seconds) • Gradual onset and stop	

Diagnosis:

- **History**
  - History of present illness: description of the event by the patient (aware seizure) and/or witnesses (seizure with impaired awareness)
    - Potential triggers (e.g., sleep deprivation, excessive alcohol intake)
    - Prodromal symptoms (e.g., aura)
    - Ictal symptoms
    - Postictal symptoms
  - Past medical history
    - History of epilepsy (including current antiepileptic drugs and adherence)
    - History of other potential underlying conditions (e.g., head trauma, stroke, tumor, CNS infection)
- **Physical examination**: attention should be paid to visual inspection (e.g., for bruises from falls, tongue bites, phakomatosis-specific skin manifestations) and evaluation for cardiovascular disorders
- **EEG**
  - Performed in individuals who present with first seizure, with insufficient information for seizure classification, and/or treatment-refractory seizures
  - Characteristic EEG findings help to establish the diagnosis of epilepsy; the absence of such findings cannot, however, rule out epilepsy.
    - During the seizure (ictal)
      - **Epileptiform discharges** (e.g., spikes, sharp waves, spike waves) are usually detected.
      - Certain types of conditions characterized by seizures have characteristic discharge patterns (e.g., hypsarrhythmia in West syndrome, 3 Hz spike-and-wave in typical absence seizures, burst suppression in anoxic encephalopathy or barbiturate administration)
      - If no epileptiform discharges are detected during a seizure, alternative diagnoses (e.g., psychogenic nonepileptic seizures) should be considered.
    - After a seizure or between seizures (postictal or interictal)
      - **Often normal findings** (even after provocation via sleep deprivation, hyperventilation, or visual stimuli)
      - May show **epileptiform activity** (bursts of abnormal discharges featuring spikes and/or sharp waves, hypsarrhythmia in West syndrome)
    - Video-EEG telemetry in hospitalized patients
    - Continuous EEG in ambulatory patients

An electroencephalogram would not be the right answer unless all of these tests were done and were normal including a CT or MRI of the head.

> Nonconvulsive status epilepticus is diagnosed based on the clinical presentation (e.g., changes in behavior and/or mental status from baseline) and the demonstration of seizure activity on EEG.

Evaluation for underlying conditions

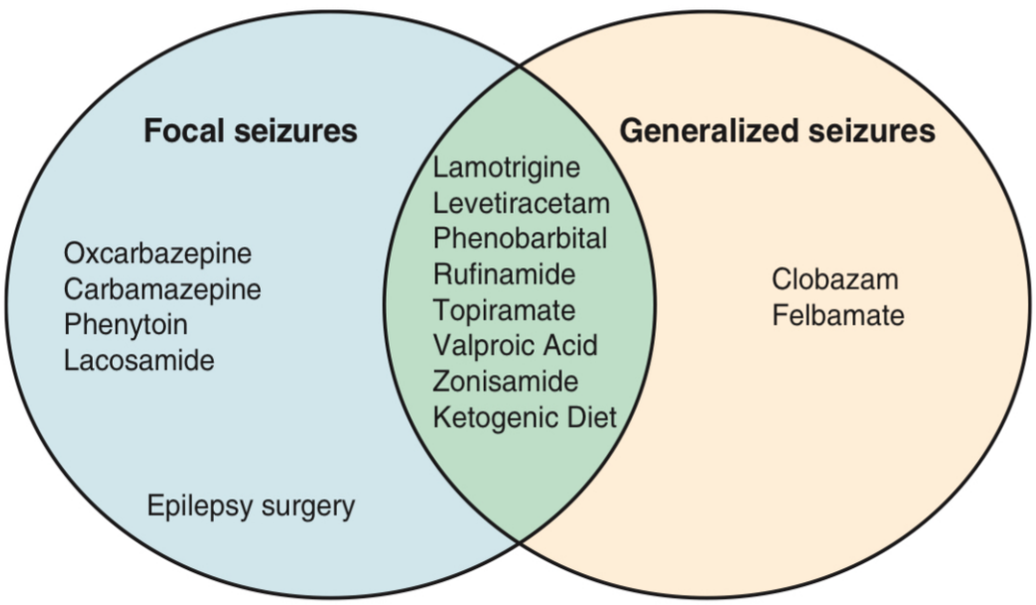
- **ECG**: Rule out cardiogenic causes (e.g., cardiac arrhythmias resulting in cerebral hypoxia) in all patients with loss of consciousness during a seizure.
- **MRI**: Modality of choice for investigating potential underlying structural abnormalities. [24]
  - All patients with first-time focal seizures
  - Exception: children with history and examination suggestive of benign seizure or characteristic epilepsy syndrome
- **CT**: May be used if MRI is not available, but is less sensitive for identifying soft-tissue lesions [24]
- **Angiography**: if vascular cause (e.g., cerebral arteriovenous malformation) is suspected
- **Laboratory screening**: to identify metabolic disorders and infectious diseases, if suspected
  - Blood
    - CBC
    - **Glucose**
    - **Electrolytes**
    - Prolactin
    - **Toxicology screening**
    - ESR
    - Rapid plasma reagin
    - Creatine kinase
    - Renal and liver function tests
    - Antiepileptic drug levels (e.g., phenytoin, carbamazepine, phenobarbital) [25]
  - Urinalysis
  - Bacterial cultures
  - Cerebrospinal fluid analysis
  - Endocrine studies
    - Thyroid function tests
    - Adrenal function tests
    - Pituitary function tests

There is no point in doing an EEG to identify the cause of a seizure if there is a clear metabolic, toxic, or anatomic defect causing the seizure. In other words, what would be the point of doing an EEG if the patient had hyponatremia or a brain lesion? You have already found the cause of the seizure.

I. Management

1. **Treatment of status epilepticus requires intravenous anticonvulsants,** such as a **short-acting benzodiazepine (e.g., lorazepam or diazepam)** followed by a loading dose of either **phenobarbital or phenytoin.**
2. **Treatment of epilepsy**
   a. **Pharmacotherapy.** Once the type of seizure has been determined, **single-drug therapy** is started with the antiepileptic drug that has the best combination of high efficacy and low toxicity. **Examples of commonly recommended drugs** for the following seizure types:
      1. **Generalized epilepsy:** valproic acid, lamotrigine, levetiracetam
      2. **Absence epilepsy:** ethosuximide, valproic acid, lamotrigine
      3. **Focal epilepsy:** carbamazepine, lamotrigine, levetiracetam
      4. **Lennox–Gastaut:** felbamate, rufinamide, lamotrigine, topiramate
   b. **Surgery**
      1. **For medically intractable epilepsy,** surgery to remove epileptic tissue may be an option.
      2. The best prognosis is for patients with temporal lobe lesions, >75% of whom have complete seizure control or remission after surgery.
   c. **Vagal nerve stimulator** is a pacemaker-sized device that sends an electrical impulse to the vagus nerve. A common side effect is hoarseness.
   d. **Ketogenic diet (a high-fat, low-carbohydrate diet)** is thought to suppress seizure activity by producing a **state of ketosis.**

J. **Prognosis.** Epilepsy is not necessarily a lifelong disorder. About 70% of epileptic children can be weaned off their medications after a 2-year seizure-free period and normalization of the EEG.



Special circumstances:
1. For absence epilepsy, ethosuximide is the first-line treatment.
2. Adrenocorticotropic hormone, oral corticosteroids, or vigabatrin are used to treat infantile spasms.

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Convulsion : types according its shape =
1. generalized — كل الجسم بتشنج
2. partial / Focal — جزء من الجسم بتشنج

* partial convulsion = 2 types
1. Simple : patient conscious.
2. Complex : altered conscious level to coma.
* aura = حركات قبل التشنج
* إذا هو كبير، المريض هيقول آه عندي تشنجات.
* إذا هو صغير، أهله هيقولو عنو تشنج.

أي ايش هاي الحركات : Drowsy
- pallor
- epigastric pain
- hallucination (visual/hearing.)

مش لازم كلها تيجي مع المريض، كل مريض بجيب أعراض معينة هو بيكون عارفها.

* automatism = حركات أثناء التشنج

أي ايش هاي الحركات :
- lip smacking
- chewing
- swallowing

automatism specific for complex partial.

Partial convulsion
- motor
- Sensory
- autonomic

⇒ mostly partial convulsions are [motor].

1. Sensory partial convulsion :
- any pain : abdominal pain
  - عشان هيك قلّي بـ abd. Epilepsy واجت متأخر بتعمل evaluation of abdominal pain.
- hallucination : Not Common.

2. autonomic partial convulsion :
- tachycardia
- bradycardia
- hypertension
- hypotension

3. motor partial convulsion :
- حسب الحركة إلي بيعملها المريض حكيلنا نوعها

* Generalized convulsion =
شروطها إنو كل الجسم يتشنج / المريض فاقد الوعي.
بنعمش يتشنج وهو صاحي. التقسيمة حسب الشكل

1. generalized tonic clonic : most common type.
← loss of consciousness
← tonic : hypertonia of the extremity [بيشد]
- lower limb ⇓ extension
- upper limb ⇓ Flexion
- عادة : جسم الـ motor وين أقوى.
- Few seconds 10 - 20 - 30 sec then
← clonic : uncontrolled jerking.

* generalized tonic clonic occur in pt with mature CNS., So it Not occur in infant patients. [infant الـ صعب يصير في]
100 % Not occur in neonate.

2. Tonic seizure
3. Clonic seizure → - Rhythmic. - Rapid. - large amplitude movement.
4. absent seizure :
↳ typical =
الأهل ما بتنتبهولها ، الولد بيكون قاعد بيكتب أو عالكمبيوتر فجأة بنقد وعيه بس بيضل على نفس الـ position ما بيقع ولا بيوقع.
- loss of consciousness
- Starring بيبلق
- fluttering of eyelids.
- Nystagmus العين بتروح وبتيجي

Duration = 10 - 20 - 30 sec.
Can be repeated 100 time / Day
parents complain : الولد دايما سرحان
↳ atypical = - loss of consciousness
- Starring
- Flattering eyelids
- Nystagmus
+ - myoclonic movement of the face and extremities

How to differentiate between typical / atypical absent seizure ?
1. Clinical manifestation
2. E.E.G. :

typical	atypical
three per second	one to two per second
spike and wave	spike and wave

* ttt : 1st choice = Ethosuximide — 1st choice = Valproic acid

5. myoclonic seizure :
عكس الـ clonic
- Not Rhythmic = بتخفف وبتزيد
- very small amplitude = زي رعشة
- slow

tonic / clonic / Myoclonic can be generalized or partial.

6. atonic seizure :
مريض قاعد أو واقف ← فجأة بيفقد الوعي ← بصير زي الشريطة
7. Infantile spasm — حنحكي عنها لقدام ☺
في أولاد صغيرة — in infant , peak = 4 months
→ Causes : - idiopathic
- Secondary to underlying dz
- Neurodegnrative dz. [TB] :
↳ typical convulsion = infantile spasm. بيجي على شكل عقد

⇒ in Infantile spasm Do EEG.
primary أو Secondary سواء

Sun

بنرجعلكم بعد م نشوف الepileptic syndromes😉

Infantile spasm 3 types :

1. Flexor type = Salam spasm — ترى سلام العيشيه لبعض الطفل لما كان أو عنده reflux — هيعمل نفس الحركة
2. extensor type — لو واحد بيقع أو بعمل حاجته حركة كانت هيوقع بيفرد ايديه ورجليه
3. Mixed — بعمل الحركتين وبعض

∴ DDx :
cough - reflux

⊛ Meckel Gruber Syndrome :
- encephaly
- occipital encephalocele
- renal cystic lesions
- liver defects
- infantile spasm

⊛ West Syndrome :
- Infantile spasm
- mental retardation
- hypsarrhythmia : EEG abnormali
  - شبه خرابيش الدجاج
  - كانت عنده multi focal lesions
  - وكل وحدة بتطلع amplitude مختلف
  - لغيت هردفن عنده

west syndrome قلي على طول ← TB, neurological disability, hypsarrhythmia

→ infantile spasm ttt :
- vigabatrin Lic مش موجود أمريكا حوا
- A.C.T.H
- prednisolone هادة البستانم عندنا

⊛ what to do with convulsion case :
in Emergency room 1- ABC
2- O_2 حتى لو مش محتاج
3- Brief History

جايلنا أحطلو O_2 على طول
- convulsion
- shock

أول مرة ؟ — معها حمارة ؟ — لو فيه حرارة بيي أعلى ب meningoencephalitis — epilepsy عنده ؟ — ماخذ حوا / متسمم ؟ — تعرض إلى trauma ؟ — حدا معه نتفة ؟

∴ ملاحظة عن الفاسيل : Parathion can cause toxicity with Fever.

3- Canulation : [النقطة هاي بنفس وقت السابقة]
- ✓ CBC → WBC : infection, RBC : hemorrhage, platelets : thrombocytopenia → intracranial hemorrhage → convulsion
- ✓ Chemistry
- ✓ electrolyte
  - شو هاشوف ؟! مين بيعمل convulsion :
  - hypoglycemia
  - hypo/hypernatremia
  - hypocalcemia
  - hypomagnesemia
  - urea عالية جدا
    - 200 - 400
    - toxic encephalopathy
  - well known renal failure بس عندو
  - hypo/hyperkalemia ← convulsion لهيك عالجوا عالعجلة لانو بتعمل

⊛ Common poisoning اللي منشوفها (ممكن تكون نوع من أنواع الpoisoning) 1st attack + Fever

الحالة إذا كانت موجودة ، ايش حالو يا ترى ؟
ماخذ carbamazepine = tegretol وقاعد بالشارع .
شو بيعمل ؟ → cardiac depression
respiratory depression
encephalopathy
trauma ما بينفي عدم وجود الhistory إنه ما عندش حوا أو ما صارلو شي
لأنه في غزة 1% من الناس إلي معكم بحكالو بالربط شو صار .

← لو واحد جايبلك عالER :
- convulsion
- motor Focal lesion

على طول بأفكر ب acute traumatic hemorrhage . imaging فبأعمل

← لو واحد جايبلك عالER :
- convulsion
- Frothy secretion
- hypotension / tachycardia

على طول بأفكر ب poisoning

⊛ post ictal state = [1/2 - 1] hour
المريض إذا مريض بهيك بيصير ؟ لو ما صار شي
re-evaluation
- poisoning أو trauma حوّل على
  - history
  - clinical manf.
  - imaging study
  - CBC

شو بيسبب ؟ كتير الpoisoning إذا أعطى شي :
- antidepressant
- organophosphate حوا العراعير / البق
  - can cause encephalopathy + convulsion
- antihistamine
- anticonvulsant
- tegretol
- tramdol
- cocaine

⊛ بعد الstory الطويل المريض لازم بشتبه وجود trauma و poisoning وعنده الحالات التالية :
1. recurrent vomiting
2. poor gain wt.
3. Faliure to Thrive
4. Family history + → اخوة الصغار بنفس هادة السبب من غير ما حدا يعرف الsimilar condition
5. Convulsion

لازم لو معظوم اجو بمرضين
∴ inborn error of metabolism

⊛ ما لقيت حاجة من هادي كلها ، المريض post ictal بس وفش error و well و good intake و N. defirat
∴ Diagnosis = 1st unprovoked seizure
24 observation طبعاً هادي بعد
؟ Epilepsy لسه ما كتبت التشخيص
وذلك لأنه تعريف الepilepsy بقول

نصبر وقت م نصل للepilepsy الجميلة😊

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Let's talk about Febrile Convulsion(seizure):

Summary

Febrile seizures are one of the most common pediatric emergencies and are usually associated with high fever in children between six months and five years of age. The exact pathophysiology is unknown. Simple febrile seizures are the most common type; they are usually generalized, last under 15 minutes, and do not recur within 24 hours. Complex febrile seizures have a focal onset, last longer than 15 minutes, or recur within 24 hours. Diagnostic examination of simple febrile seizures focuses on addressing the cause of fever. Further diagnostics are required for patients with complex febrile seizures, particularly to exclude herpes encephalitis, and include lumbar puncture, CT scan, and/or EEG. Most febrile seizures end spontaneously and do not require any treatment. If seizures persist for longer than five minutes or present as complex febrile seizures, however, IV benzodiazepines are the treatment of choice. Caregivers should be reassured as the prognosis of febrile seizures is good, with the risk of epilepsy being less than 10%.

1. **Definition.** Seizures that occur in children between **6 months and 6 years of age** accompanied by a fever (temperature > 38°C), in whom CNS infection, metabolic imbalance, and history of afebrile seizure are excluded.
2. **Epidemiology.** Febrile seizures are the **most common childhood seizure type, occurring in 2–4%** of all children.

Definition: Convulsions in age vulnerable children due to:
- Rapid rise of body temperature.
- Due to extracranial causes(mostly viral)

Incidence:
- Affect 4% of children.
- Family history in about 20 % of cases (genetic base do exist)
- Recurrent in 30-50% of cases specially in those with family history

3. Etiology
   a. The **pathophysiologic mechanism is unknown.**
   b. Febrile seizures can be inherited, and several gene mutations have been found.
4. Classification
   a. **A simple febrile seizure** lasts less than 15 minutes and is generalized.
   b. **A complex febrile seizure** lasts more than 15 minutes, has focal features, or recurs within 24 hours.
5. **Risk factors for first febrile seizure** include having a first- or second-degree relative with a history of febrile seizures, neonatal hospital stays >30 days, developmental delay, attendance at daycare, high frequency of febrile episodes, peak body temperature and recent vaccination.
6. Diagnosis
   a. **The diagnosis of a febrile seizure is based on history, a normal neurologic examination, and the exclusion of CNS infection.**
   b. An LP is necessary if meningitis is suspected at any age. For a child 6–12 months of age, an LP should be seriously considered if the child is deficient in vaccination for *Haemophilus influenzae* type b (HIB) or *Streptococcus pneumoniae* or when immunization status cannot be determined.
   c. **Neither neuroimaging nor EEG is needed** unless the neurologic examination is abnormal.

Diagnostic criteria

1- Age: 9 months - 5 years (rare before **or** after this age)
2- Temperature: Usually > 39°C, fits occur within 8-12hrs from onset of fever.
3- No evidence of CNS infection (e.g. meningitis, abscess)
4- Evidence of extracranial infection (e.g. tonsillitis, otitis media, roseola)
5- Type of convulsions:

Typical (simple)	Complex
- Generalized tonic-clonic. - Last < 15 min. - One fit only in the same illness. - The commonest form	- Focal - Last > 15 min - Recurring during the same illness - Uncommon.

6- Investigations
* Usually not needed in children with simple febrile convulsion.
* For complex form:
- Lumber puncture and CSF analysis (specially if consciousness is clouded after a short post ictal phase)
- Neuro imaging (CT, MRI)
- Others : blood glucose , serum electrolyte , toxicology screen and EEG

Differential diagnosis

From other causes of convulsions with fever :
1- Meningitis.
2- Viral meningeo encephalitis (commonly herpes simplex)
3- Brain abscess.
4- Epileptic fit precipitated by associated fever.

7. Management
a. **First-time or occasional febrile seizures** are not treated with anticonvulsants.
b. **Antipyretic treatment during subsequent febrile illnesses is unlikely to prevent febrile seizures.**
c. **Frequent, recurrent, or prolonged febrile seizures** do pose a risk and may require additional treatment with daily anticonvulsant prophylaxis or the use of rescue medications (e.g., rectal diazepam).

Treatment

1- Fever control by paracetamol and tepid sponges or cold bath.
2- Diazepam (I.V. **or** rectal 0.5 mg/kg) if the fit lasts more than **5** minutes.
3- Treat the underlying cause → antibiotics.
4- Parent advice about fever control
5- At the onset of each febrile illness oral diazepam 0.3 mg/kg q8 hours is given for for 2-3 days to reduce risk of recurrence
6- Prophylactic anti-convulsants therapy (**Na valproate**) was used for cases that carry risk to develop epilepsy (e.g Complex form or with positive family history of epilepsy) .However , it is controversial now and no more recommended.

8. **Prognosis. Approximately 30% of patients will have a recurrence.** Recurrence risk decreases with increasing patient age. The risk of epilepsy is low (2–10%).

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نشوف بقى تلخيص النصر

Peak :

Febrile convulsion : most common in children [6months - 5years]

convulsion + Fever for extracranial cause

- يعني ايه [meningitis
- يكونش [meningioencephalitis

- Common infection cause convulsion with Fever :
  - URTI
  - otitis media
  - roseola infantum : infection dz due to Human Herpis virus 6,7
    - Fever Few days.
    - high grade Fever
    - وبأي حاجة تانية
    - بتظهر الـ maculopopular rash ٦ ساعات بتروح لوحدها
    - أثناء الحرارة بيكون المريض risky for febrile convulsion
  - gastroenteritis : shigellosis
    - cause encephalopathy in 40% of cases

Febrile convulsion (2 types)

1 Simple	2 complex
- generalized tonic clonic	- Not generalized
- Duration < 15 mint	- Duration > 15 mint
- once في 24 h	- > once في الليل
	لو وحدة منهم complex يبقى

الباقي السابقة بنفس واحد منهم

When to do LP in febrile convulsion ؟

- below 1 year,
  - You must do LP because we can't exclude meningitis.
- [1 year - 1.5 year],
  - if complex especially focal You must do LP
  - C.T Brain بنعمش تعمله الا بعد ما تعمل
- > 1.5 year,
  - You must evaluate pt clinically, وبقرر وقتها
  - signs of meningitis عندي ولا لأ
  - meningitis شك : post - ictal لو المريض مدمج وتمام
  - but You must search for source of infection
  - إذا مش شايف سبب للحرارة ممكن تعمل LP
  - [بس هاي بيننا]

⊛ Family reassurance :

لو في recurrent واحد قبل كدة ممكن تعطيه

assival : oral tablet

- 1 mg / Kg / Day
- 3 Doses in the Day.
- for few days during febrile illness
- that Not affect morbidity, recurrency, risk for epilepsy,
- but affect recurrency during Febrile illness.
- بعد ما أوقف السوا وبرجع يسخن تاني
- بيأثر على إنه يجيب febrile convulsion

⊛ recurrent Risk of febrile convulsion :

Major :	Minor :
- < 1 year	- male
- fever 38 : 39	- Family history of febrile
- fever < 24 h	- " " epilepsy
	- Day care
	- Na^+ low during attack
	- complex
	إذا عندي risk واحد من دول

No. Risk → recurrent risk for febrile convulsion = 12 %

- 1 Risk = 25 - 50 %
- 2 Risk = 50 - 59 %
- 3 Risk = 73 - 90 %

⊛ Risk Factors for epilepsy : (مهم كتاب برس)

- Neurodevelopmental delay مثل : CP 33 %
- Neurological deficit
- Complex (focal) 29 %
- Family History for epilepsy 17 %
- recurrence
- simple 4 %

⊛ incidence of febrile convulsion in its age peak = 2-4 %

" " epilepsy in population = 0.8 - 1 %

- imaging in focal lesion Not needed.
- febrile convulsion with focal cause, No need for CBC, Chemistry.
- febrile convulsion , WBC طبيعي , No focus lesion
  - Do LP.
- Febrile convulsion investigations : 1 CBC.
  - 2 Chemistry.
  - 3 لو في Hg بيساعدني

[hemorrhage جوه meningitis لا]

- hemorrhage
  - Trauma
  - meningitis

⇒ bleeding can cause Local manifestation

if diffuse can cause diffuse

وكل الأحوال ما بتعمله لي عندك اعمل C.T

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ملخص لكل الseizures

Condition	Risk factors and triggers	Clinical features	Duration	Diagnostics
Focal-onset seizure	• Prior seizure • Excessive physical exertion • Sleep deprivation • Flashing lights	• Aura is **common** • Symptoms variable, depending on location of epileptogenic focus • Jacksonian march • Postictal paralysis	• Usually < 2 minutes	• Interictal EEG: may show abnormal brain activity • Ictal EEG: focal repetitive spikes or sharp waves, with or without slow waves • MRI: may demonstrate structural lesion
Generalized-onset motor seizure		• Aura is **uncommon** • Loss of consciousness • Tongue biting • Bladder and bowel incontinence • Postictal phase: confusion, amnesia, fatigue • Eyes often open or do not resist opening	• Usually < 5 minutes	• Interictal EEG: usually normal • Ictal EEG: generalized spike-and-wave complex • MRI: usually normal

Febrile seizure	• Young age (6 months to 5 years)
	• Genetic predisposition
	• High fever (> 40°C/104°F)
	• Viral infection (e.g., HHV-6, influenza)
	• Postimmunization fever
		• Generalized, symmetrical, usually tonic-clonic seizures
		• No further apparent neurologic disorders
			• < 15 minutes
			• No more than 1 seizure per day
			• Simple (80% of cases)
			  ◦ < 15 minutes
			  ◦ < 1 seizure per 24 hours
			• Complex (20% of cases)
			  ◦ > 15 minutes
			  ◦ > 1 seizure per 24 hours
				• Tests to determine the cause of fever (e.g., blood and/or urine culture, lumbar puncture)

Second:Epilepsy

Epilepsy [1]

- **Epilepsy**: a chronic neurologic disorder characterized by a predisposition to seizures as defined by one of the following: [4][1]
  - Two or more unprovoked or reflex seizures separated by more than 24 hours
  - One unprovoked or reflex seizure in an individual with a high risk of subsequent seizures (e.g., after traumatic brain injury, stroke, CNS infections)
  - Diagnosis of an epilepsy syndrome: a group of epileptic disorders characterized by a set of features typically occurring together.
    - Common features include triggers, age of onset, EEG patterns, radiological findings, and associated conditions (e.g., depression and other mood disorders, psychosis, and anxiety disorders)
    - For more information about individual epilepsy syndromes, see "Generalized epilepsy in childhood."
- **Reflex epilepsy**: Epilepsy in which seizures are consistently provoked by a certain trigger (e.g., lights, music, hormonal changes during menstrual cycle). Subtypes can be determined based on the trigger and include:
  - **Photosensitive epilepsy**
  - **Musicogenic epilepsy**
  - **Catamenial epilepsy**
- **Drug-resistant epilepsy**: epilepsy in which at least two antiepileptic drugs (administered as sequential monotherapies or as combination therapy) have failed to prevent seizures [5][6]
- **Resolved epilepsy**
  - An age-dependent epilepsy syndrome that has not recurred in individuals who are now past the applicable age.
  - No recurring seizures for 10 years in individuals who have not taken antiepileptic drugs for at least the last 5 years.

> A single seizure or multiple provoked or triggered seizures (e.g., febrile seizures) without an underlying predisposition to seizures do not suffice for the diagnosis of epilepsy.

Epilepsy is diagnosed if any of the following three scenarios occur:

a. The patient has at least two unprovoked seizures >24 hours apart
b. The patient has one unprovoked seizure and the probability of further seizures occurring over the next 10 years (i.e., the patient has another diagnosis that predisposes to an increased risk of seizures, such as a brain tumor)
c. The patient is diagnosed with an epilepsy syndrome (e.g., childhood absence epilepsy)

Status epilepticus is defined as 5 or more minutes of continuous seizure activity, or repetitive seizures without recovery of consciousness.

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Common causes of epilepsy [12]

- **Genetic**
  - Genetic mutations affecting ion channels or transmitter receptors (e.g., mutations in KCNQ2 or SCN1A genes)
  - Chromosomal abnormalities (e.g., Angelman syndrome, Prader-Willi syndrome, Rett syndrome)
  - Genetic metabolic disorders (e.g., **PKU**, congenital disorders of glycosylation, lysosomal storage diseases, peroxisomal biogenesis disorders)
  - Mitochondrial diseases (e.g., MELAS)
- **Structural**: chronic cerebral lesion or abnormality
  - Perinatal injury, e.g., hypoxic-ischemic injury
  - Brain tumors and metastases [13]
  - Traumatic brain injury (TBI)
  - Hippocampal sclerosis
  - Tuberous sclerosis
  - Congenital cerebral or arteriovenous malformations
  - Microcephaly, megalocephaly, cortical dysgenesis
  - Cranial radiation therapy
- **Metabolic**
  - Inborn errors of metabolism (e.g., organic acidemias, phenylketonuria)
  - Porphyrias
- **Immune**: autoimmune encephalitides (e.g., anti-NMDA receptor encephalitis), Rasmussen encephalitis
- **Infectious**: chronic CNS infection (e.g., toxoplasmosis, malaria, neurocysticercosis) or complication of acute CNS infection (e.g., viral or bacterial meningitis or encephalitis)

Causes

1. Idiopathic (primary) in 80% of cases
   - Genetic basis exist for many epileptic syndromes
2. Organic (secondary) in 20% of cases
   - Congenital cerebral malformation.
   - Degenerative brain diseases.
   - Post-traumatic.
   - Post-hemorrhagic.
   - Post-infection.
   - Post-toxic.
   - Post-anoxic.

Classification

الكلام دا نفس الي درسناه فنمر عليه مش غلط😌😇

A. Focal (partial) seizures

* Only one part of the body is involved i.e. focal.
* Types:

a- Simple partial seizures (SPS)	b- Complex partial seizures (CPS)
- No aura	- Preceded by aura (e.g. headache)
-May be motor, sensory or autonomic	- Only motor fits
- No automatism	- Automatism may occur → automatic behaviors as chewing, suckling, lip smacking or aggressive actions as rubbing & pulling of clothing.
- Consciousness is intact.	- Consciousness is impaired.

c- Partial seizures with secondary generalization.

B. Generalized seizures

The whole body is affected.

1- Absence seizures (petit mal)

Incidence: More in girls, uncommon below 5 years.

Description:

- Sudden cessation of all motor activities or speech with a blank facial expression and flickering of eye lids
- Precipitated by hyperventilation for 3-4 min or photic stimulation.
- Last < 30 seconds; after seizure patient resume preseizure activity.
- Frequently recurrent; may occur countless daily
- No aura , loss of consciousness nor postictal phase
- EEG → typical 3/second spike and generalized wave discharge.

2- Generalized tonic clonic seizures (Grand mal).

*** The commonest form; pass in 3 phases.**

Aura (pre ictal phase)	Attack (ictal phase)	Post ictal phase
A warning signs before the attack may exist suggesting a focal origin of the epileptiform discharge: e.g. localized muscle spasm or paraesthesia.	- Sudden loss of consciousness - Tonic phase: tonic contraction of whole body → rigid posture, apnea, cyanosis, rolling of eyes & drolling of saliva. - Clonic phase: rhythmic contraction. & relaxation of all muscles groups → tongue biting & loss of sphincter control.	- Semiconscious for 30 min-2hr. - Headache - Sleep.

3- Myoclonic epilepsies

- Sudden shock like repetitive contractions of group of muscles → with loss of body tone.
- Intact consciousness.
- EEG → 4-6 /sec. irregular polyspike waves.

4- Infantile spasms

- Starts in the 1st year of life ; peaking between 4- 8 months
- Brief symmetric tonic contractions of the neck ,extremities & trunk
- Which may be flexor, extensor or mixed
- Repetitive; usually in the morning
- A cry may precede or follow the spasm ; so may be confused with colic
- May be associated with developmental delay (West syndrome)
- EEG → commonly show hypsarrythmias (irregular, high amplitude waves)

5- Atonic seizures: sudden loss of body tone.

- **Levels of classification**
  - For level 1, first determine the seizure type (see "Classification of seizures" above).
  - For level 2, then determine the epilepsy type, which can be:
    - Focal
      - The lobe from which seizures originate should be determined.
      - Epilepsy with focal-to-bilateral tonic-clonic seizures is classified as focal.
    - Generalized: diagnosed in patients with generalized-onset seizures as evidenced by generalized ictal activity (e.g., 3 Hz spike-wave activity in absence seizures) and/or typical interictal discharges on EEG.
    - Combined generalized and focal: diagnosed in patients who have both focal-onset and generalized-onset seizures (seen, e.g., in Dravet syndrome and Lennox-Gastaut syndrome)
    - Unknown: diagnosed if there is not enough clinical information to classify seizures as focal, generalized, or combined
  - For level 3, consider epilepsy syndromes (see "Focal seizures and syndromes" and "Generalized epilepsy in childhood" for discussion of specific syndromes)

حنحكي عنه كمان شوي

Investigation

1- EEG (Electro Encephalogram).
2- Metabolic screen: Serum Na, Ca, Mg, glucose
3- CSF examination in suspected CNS infections.
4- CT brain in - Focal lesions
- Increased intra cranial pressure
- Resistance to treatment
5- Serum anticonvulsant level for:
- At the onset of anti convulsant therapy to confirm therapeutic range
- Polytherapy
- Status epilepticus
- Drug toxicity

Diagnosis. Epilepsy is diagnosed on the basis of **history** and **physical examination,** as well as testing for **genetic mutations.** Other studies (EEG, MRI) may be useful.

1. **EEG** is useful to evaluate the background rhythms as well as seizures, particularly in determining the location of onset of focal seizures. **However, an abnormal EEG is not required for the diagnosis of epilepsy** (in particular, focal seizures may have a normal EEG during the interictal period between seizures).
2. **Video-EEG monitoring** is a useful tool when clinical information is inadequate or incomplete (e.g., when patients are <3 years of age, when events concerning for seizures occur during sleep, or when the history is unclear). Video-EEG monitoring is also useful to capture and characterize focal seizures for possible surgical intervention.
3. **Neuroimaging studies** (primarily MRI) may be useful in children with epilepsy. Children diagnosed with absence seizures or benign rolandic epilepsy [see sections V.L.4 and V.L.5] do not require imaging.

Differential diagnosis: from conditions mimic epilepsy

1- Syncopal attacks: - Fainting with loss of consciousness due to brief brain ischemia.
- Due to vagal stimulation (or arrythmia).
2- Breath holding attacks: - Occur between 3 mo - 6y.
- The child cries → hold his breath → turn cyanotic → becomes limp → rapid recovery.
3- Hystrical fits

Treatment of epilepsy

a. **Advise the parent** → to watch the child during swimming, passing traffic, ….
→ never to stop the antiepleptic drug suddenly.

b. **Anti-epileptic drugs**

* Rules - Only **one** drug is used with small dose → if no response → gradually increase the dose.
- In resistant cases a 2nd drug can be used alone or in combination.
- Duration of therapy is at least 2 years after last attack

	Na valproate	Carbamazepine	Phenytoin	Phenobarbitone
Use	Broad spectrum	- Generalized tonic colonic - Partial	Same	Same
Dose	20-40 mg/kg/d	10-20 mg/kg/d	3-5 mg/kg/d	Same
Side effect	drowsiness	+ GIT upset + anemia & leucopenia	hepatotoxic ataxia & rickets	drowsiness rickets

* Absence: Ethosuximide, Clonazepam(Rivotril), Nitrazepam (Mogadon), or Valproate
* Infantile spasm: ACTH or prednisone, or Vigabatrin (Sabril 30 mg /kg once daily)
* Adjunctive to poorly controlled seizures (add on drugs):
- Lamotrigine (Lamictal) - Topiramate(Topimax) - Gabapentin (Neurontin)
* Adjunctive to complex partial seizures : Tiagabine (Gabitril)

c. **Ketogenic diet:** - For infants < 2year with resistant myoclonic epilepsy.
- Most calories given form fat.(never used with valproate)

Let's talk about status epilepticus

- ongoing seizure activity for greater than 20 minutes or repetitive seizures without return of consciousness for greater than 30 minutes.
- Other definition: two or more sequential seizures without full recovery of consciousness between seizures or more than 30 minutes of continuous seizure activity.
- Any convulsive seizure associated with reductions in oxygen saturations and cortical perfusion produces a risk for irreversible brain injury.
- ***50%, there is no etiology***, but in 50% of this group, status is associated with fever.
- 25% of children presenting with status epilepticus have an acute brain injury, such as meningitis, encephalitis, electrolyte disorder, or acute anoxia.
- 20-% have history of brain injury or congenital malformation.
- Sudden cessation of anticonvulsant medication is another frequent cause.
- Overall the mortality rate of status epilepticus is less than 10% and related to the etiology of the seizure pattern.

Definition: Seizures continuous for more than 20-30 minutes or repetitive serial convulsions without return of consciousness.

Etiology

1. Prolonged febrile seizures (the commonest cause)
2. Sudden withdrawal of anticonvulsants in epileptic patients.
3. CNS anomalies or infections (e.g. encephalitis) or tumors.
4. Metabolic disorders e.g hypoglycemia, hypocalcemia and intoxications.
5. Inborn errors of metabolism.

Clinical types

1. Generalized (common): - Convulsive (tonic, clonic, myoclonic).
   - Non convulsive (absence, atonic).
2. Partial (simple or complex).

Management

a. Initial treatment: ABCs

a) Airway: - Maintain airway.
- Section of secretions.

b) Breathing: - O_2 inhalation , assisted ventilation

c) Circulation: - I.V. fluids.

d) Samples of :

i- CSF to rule out CNS infections:

ii- Blood for: - CBC & arterial blood gases.
- Electrolytes (calcium, magnesium, Na).
- Glucose, urea, creatinine.
- Anticonvulsant level.
- Metabolic & toxicology screen.

e) Give glucose 10% 5ml/Kg for hypoglycemia.

- Treatment of Status Epilepticus:

A. Benzodiazepine.
B. Fosphenytoin.
C. Phenobarbital.
D. General anesthesia (midazole or propafol).

b. Anticonvulsant drugs

1. Control convulsions by:

IV line available	- Diazepam or Midazolam 0.3 mg/Kg slow I.V. - If convulsions persist , repeat the dose (no more 3doses) - Alternative : Lorazepam 0.1 mg/kg slow iv
IV line un available	- Diazepam gel (Diastat) rectal or - Sublingual lorazepam or - Rectal diazepam or lorazepam diluted in 3 ml saline

↓

- Give immediately phenytion loading 15-30 mg/kg in 10 mg increments under ECG monitor (Phosphenytion ; Cerebyx is alternative).
- Some centers use phenobarbitone instead of phenytion

↓

If seizures un controlled	If seizures controlled
* Intubate and assist respiration * Drug options: - Midazolam infusion 20-400 µg/kg/hr - Propfol 2-10 mg/kg/hr - Barbiturate coma for 48 hours - Paraldehyde in glucose 5 % 150 – 200mg/kg slow iv - General anesthesia	Use maintenance dose of phenytion 3-5mg/kg in two equal doses started 12 hours later (or phenobarbitone)

2. After control:

1. Maintenance of phenytoin & phenobarbitone 3-5 mg/Kg/day, devided/12hrs.
2. Search for & correct underlying cause e.g:
   - Antibiotics for infection.
   - Electrolyte disturbances.

نوتس جميلة 👌👇

- The definition of status epilepticus is any single seizure lasting >5 minutes or a cluster of seizures with the patient not recovering a normal mental status in between.
- Recent studies have suggested that a brain that has seized for >5 minutes (status epilepticus) is at increased risk of developing permanent injury due to excitatory cytotoxicity. Cortical laminar necrosis is the hallmark of prolonged seizures and can lead to persistent neurologic deficits and recurrent seizures.
- Once an adequate airway is established, breathing is assured, and the patient is hemodynamically stable, then simultaneously evaluate and treat any precipitating cause of seizure.
- The best initial therapy for a persistent seizure is a benzodiazepine such as lorazepam or diazepam intravenously.
- If the seizure persists, then give phenytoin or fosphenytoin. Fosphenytoin and phenytoin have the same efficacy, but fosphenytoin has fewer adverse effects compared to phenytoin.
- Like lidocaine, phenytoin is a class 1b antiarrhythmic medication. When given intravenously, it is associated with hypotension and AV block. Fosphenytoin does not have these adverse effects and can therefore be given more rapidly.
- If benzodiazepines and fosphenytoin do not stop the seizure, then administer phenobarbital.
- Finally, the ultimate therapy for unresolving seizure is to use a neuromuscular blocking agent such as succinylcholine, vecuronium, or pancuronium to allow you to intubate the patient and then give general anesthesia such as midazolam or propofol. The patient must be placed on a ventilator before the administration of propofol, which can stop breathing.
- Neuromuscular blocking agents (succinylcholine) do not stop the seizure; they just stop muscular contraction or the external manifestations of the seizure.

Finally🤗, Epileptic Syndromes

Summary

Pediatric generalized epilepsy syndromes are a diverse group of conditions with onset in infancy or childhood. The International League Against Epilepsy (ILAE) classifies generalized epilepsy syndromes according to the etiology as either idiopathic, symptomatic, or cryptogenic. In idiopathic generalized epilepsy syndromes, the most common form of childhood epilepsy, genetic causes are suspected. The symptomatic forms are associated with metabolic or structural abnormalities, while the etiology of cryptogenic epilepsies is unknown. The syndromes are further classified according to the patient's age at onset, as well as clinical and EEG characteristics. A detailed patient history, including a description of seizures, offers vital diagnostic clues. The diagnosis may be confirmed with an EEG. With adequate treatment, idiopathic epilepsy syndromes have a good prognosis. In comparison, symptomatic epilepsy syndromes do not respond well to treatment and have a relatively poor prognosis, often resulting in developmental delays and cognitive impairments.

Etiology

Etiology of seizures according to age

- **Infants**
  - **Congenital** (idiopathic; genetic association)
  - Secondary to
    - Perinatal or postnatal infections
    - Head trauma
    - Metabolic disorders
- **Children**
  - **Idiopathic** (genetic association suspected)
  - Secondary to
    - Metabolic disorders
    - Structural abnormalities of the cerebrum
    - Infections
    - Head trauma
    - Febrile seizures

These syndromes include:

First: Benign Focal epilepsy

BENIGN FOCAL EPILEPSY (ROLANDIC EPILEPSY)

- 5 and 10 years
- Comprising 16% of all afebrile seizures in children younger than age 15 years (most common childhood epilepsy syndrome)
- usually focal motor seizures involving the face and arm
- tend to occur only during sleep or on awakening in ↑50%
- Symptoms: abnormal movement or sensation around the face and mouth with drooling and a rhythmic guttural sound.
- Speech and swallowing are impaired
- Family history of similar seizures is found in 13% of patients.
- The disorder is called benign because seizures usually respond promptly to anticonvulsant therapy; intellectual outcome and brain imaging are normal,
- *Epilepsy resolves after puberty.*

Second:Juvenile Myoclonic Epilepsy

Childhood absence epilepsy is another common syndrome. Absence seizures typically begin in the early school years and usually resolve by late childhood or adolescence. If absence does not remit, 44% will go on to develop JME (see later discussion). Ethosuximide is the first-choice medication. A subset of patients also has generalized tonic-clonic seizures. For these children, valproic acid is the first choice as it can prevent both absence and convulsive seizures. Comorbid learning disabilities and ADHD are common. There is no contraindication to treating these children's ADHD with stimulant medication.

JUVENILE MYOCLONIC EPILEPSY ("OF JANZ")

- occurs in adolescence
- autosomal dominant disorder localized on chromosome 6 with variable penetrance.
- The patient may have absence, generalized tonic or clonic, and myoclonic seizures.
- *The hallmark is morning myoclonus occurring predominantly within 90 minutes of awakening.*
- Seizures usually resolve promptly with therapy with valproic acid
- therapy must be maintained for life.

JME is the most common generalized epilepsy among adolescents and young adults. Onset is typically in early adolescence with myoclonic jerks (exacerbated in the morning, often causing the patient to drop objects), generalized tonic-clonic seizures, and absence seizures. Seizures usually resolve promptly with antiseizure medication. JME is classically treated with valproic acid; however, there are concerns about side effects and teratogenicity. Levetiracetam has a much lower risk of teratogenicity and is generally well tolerated. As such, levetiracetam is now favored, particularly for girls and women since treatment of JME is usually lifelong.

Third:Infantile spasm

INFANTILE SPASMS (WEST SYNDROME)

- Brief contractions of the neck, trunk, and arm muscles, followed by a phase of sustained muscle contraction lasting 2 to 10 seconds.
- Description:
  - contraction of the whole body (0.5-2 seconds)
  - repeated clusters/cluster= few number of spasms
  - between clusters= muscle relaxation of 5-20 seconds
  - each group of cluster is attack
  - may cry between attacks
  - no loss of consciousness
  - Types

1. inflexion 75% salam spasm, like moror reflex.
2. inextension 25%

- in both contraction of flexor and extensor with predominance of once.
- No difference in prognosis
- any asymmetry (head and eyes) → cerebral lesion

- The initial phase consists of flexion and extension in various combinations such that the head may be thrown either backward or forward. The arms and legs may be either flexed or extended.
- Spasms occur most frequently when the child is awakening from or going to sleep.
- Each jerk is followed by a brief period of relaxation, then repeated multiple times in clusters of unpredictable and variable duration.
- Many clusters occur each day.
- The EEG:
  1. waking state, **hypsarrhythmia**, is dramatically abnormal, consisting of high-voltage slow waves, spikes, and polyspikes accompanied by background disorganization.
  2. during sleep: Burst suppression patterns are seen
- The peak age of onset is 3 to 8 months,
- 86% of infants experience the onset of seizures before age 1 year.
- D/D: awaking manifestations, generalized contractions due to abdominal pain, moro reflex beyond 4 months.
- The etiology is not determined in 40% of children.
- This idiopathic or "cryptogenic" group (normal development before seizures; no etiology) has a better response to therapy than the group with a clear etiology, and 40% have a good intellectual outcome.
- Etiology is determined in 60%.***Tuberous sclerosis*** *is the most common cause.*
- Infantile spasms have a poor prognosis.
- Treatment of infantile spasms includes ACTH IM most effective, 4-8 weeks,Valporic acid , clonzepem and oral corticosteroids.
- Irritability, swelling, hypertension, glycosuria, and severe infections are complications to be anticipated with steroid therapy.
- FDA not yet approved vigabatrin, promising drug, because it cause visual field deficits.

Fourth: Lennox-Gastaut Syndrome

LENNOX-GASTAUT SYNDROME

- variable age of onset. Most before age 5 years.
- Multiple seizure types-including atonic-astatic, partial, atypical absence, and generalized tonic, clonic, or tonic-clonic varieties-characterize the disorder.
- *Many children have underlying brain injury or malformations*.

- These seizures usually respond poorly to treatment, but some patients have a good response to valproic acid.

Fifth: Benign Neonatal Comvulsion

BENIGN NEONATAL CONVULSIONS

- autosomal dominant genetic disorder localized to chromosome 20.
- Generalized clonic seizures occur toward the end of the first week of life ("3-day fits" or familial 5th day fits).
- Response to treatment varies, but the outlook generally is favorable.

Sexth:Acquired Epileptic Aphasia

ACQUIRED EPILEPTIC APHASIA (LANDAU-KLEFFNER SYNDROME) is

- Characterized by the abrupt loss of previously acquired language in young children.
- Some patients develop partial and generalized epilepsy.
- The EEG is highly epileptiform in sleep.
- The peak area of abnormality often in the dominant perisylvian region (language areas).
- The cause is unkown if caused by frequent temporal lobe seizures or inflammatory temporal lobe pathology.

To sum up:

نصحصح بقى☺️🤗

	Age at disease onset	Clinical findings and characteristics	Ictal EEG	Treatment	Prognosis

Childhood absence epilepsy (pyknolepsy)	• 6–7 years
	• Sex: ♂ < ♀
		• **Absence seizures** lasting **5–10 seconds** up to 100x/day
		  ◦ **Brief unresponsiveness** without convulsions
		  ◦ **Amnestic** during seizures; children appear to be **staring** or **daydreaming**
		  ◦ **Lip smacking, eye fluttering or head nodding are common**
		  ◦ **No postictal phase**
		• **Atypical absence seizure**: more gradual onset and ending, duration of > 30 seconds.
		• Triggers: hyperventilation, lights
			• **3 Hz spikes and waves** in all regions of the brain	• **1st line**: **ethosuximide**
				• **2nd line**: sodium valproate
				• **3rd line**: lamotrigine
					• 80% of children are seizure-free with treatment
					• Usually subsides before adulthood

Juvenile absence epilepsy	• 9–13 years • Sex: ♂ = ♀	• Absence seizures • **Tonic-clonic seizures** (on awakening) are common • Photosensitivity less common	• Regular 3–4 Hz spikes and waves in all regions of the brain		• 60% are seizure-free under treatment • Transition to juvenile myoclonic epilepsy possible

Juvenile myoclonic epilepsy (Janz syndrome)	• 12–20 years	• **Triad of seizures**:
		  ◦ Bilateral symmetrical **myoclonic jerks**, primarily **after awakening**, without impaired consciousness
		  ◦ **Generalized tonic-clonic seizures**
		  ◦ Absence seizures with impaired consciousness
		  ◦ **Triggers**: sleep deprivation, alcohol consumption, flickering lights
			• Irregular 3–5 Hz polyspikes and waves with frontocentral predominance	• **1st-line**: **valproic acid**
				• Avoid triggers: sleep deprivation, alcohol, drugs, flickering lights
					• Responds well to antiseizure drug therapy; seizures become less frequent in adulthood
					• Life-long treatment usually required (high risk of recurrence)
					• Increased risk of psychiatric comorbidities

Infantile spasms (West syndrome)	• 3–7 months • Sex: ♂ > ♀	• **Perinatal infections** • **Hypoxic-ischemic injury** • PKU • Tuberous sclerosis complex • Idiopathic	• Sudden **symmetric**, **synchronous spasms**, usually in clusters of 5–10 • **Jerking flexion** (jackknife movement) **or extension** of the neck, torso, and extremities • Followed by a tonic phase	• **Hypsarrhythmia**: characteristic finding in **interictal EEG**; high-voltage delta waves with irregular multifocal spikes and slow waves • Ictal EEG: very heterogeneous	• **First-line treatment**: **ACTH**, **prednisone**, or **vigabatrin**	• Poor; increas mortality • **Neurodeve delay, regr psychomot abilities** in cases • In ~ 50% of c cease before • Most cases d other forms
Lennox-Gastaut syndrome	• 3–5 years • Sex: ♂ > ♀	• Majority of cases due to **structural brain abnormalities** • 40% of cases are cryptogenic	• **Multiple** types of **seizures**: myoclonic, tonic, atonic, absences • Developmental delays • Frequently periods of **status epilepticus**	• Multifocal sharp and slow waves • Abnormal interictal EEG: slow spike-wave pattern	• Attempt anticonvulsive treatment, e.g., valproic acid, clobazam, lamotrigine, felbamate [13] • Ketogenic diet, vagus nerve stimulation, surgery (see therapy of epilepsy)	• Poor; only 1C seizure-free treatment • **Developme delay, cogn impairmen** psychotic syr • Mortality rat

وأخيييراً ، نمر على تلخيص النصر🤞😴🤒

Epilepsy = 2 convulsions apart 24 h between
EEG يعني ما أعمل epilepsy صح؟ أعمل
→ I can't diagnose 1st seizure as epileptic 🤔
لأنه 50٪ من إلي بتشنجوا مرة ممكن ما تروح لعلوم تاني

⊛ Other investigation :

EEG

- indicated in 1st unprovoked seizure
- after 2 weeks in febrile convulsion (gap اللي بيقولو بعد)
- other than febrile convulsion, EEG done at the same day

Imaging : controversial

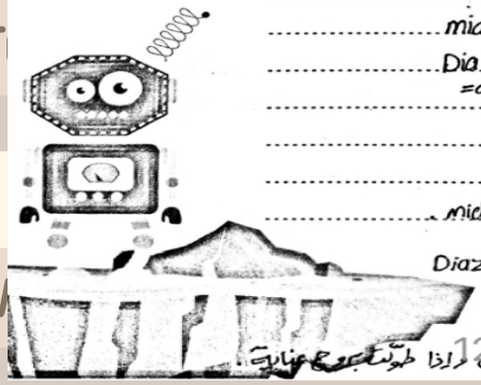
- Normal pt, well, normal EEG, No neurological deficit
  ∴ Not needed
- weak motor, You must do imaging study

EEG ← INfant → Imaging
كل ما عمليات أكتر وتتفهم حسب الوضع

⊛ treatments used :

1st choice = lorazepam ← in acute insult
midazolam مش موجود بغزة
Dia.zepam =assival مرتبة حسب الأحسن
ليش؟
Short action
Short duration
less side effect
أحسن شي عنا بنستخدم الـ lora أحسن من الـ mida

Diazepam SE : Resp. depression.
Bradycardia.
hypotension
وإذا أخطأ بـ apnea بتضل تعطيه O2 لحد ما يرجع



نحو جيل مبدع تحفزه قيم العدل والإحسان والأمانة والإخلاص والرحمة
ISLAMIC RELIEF

125

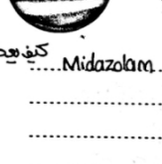
حق الـ midazolam ممكن نعمل ميك حضوراً بالـ infant وأعطيه سريعة.
دائماً أعطي الجرعة المعقولة ببطء slowly

كيف يعطى

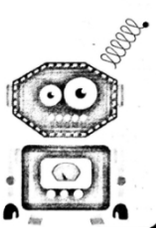
Midazolam : buccal	Diazepam : IV
Nasal mucosa	Rectal
IM	يعطى بجرعة أكبر
IV (لو لازم) in emergency	0.5 mg / kg

Dose = 0.1-0.2 mg / kg / dose
slowly during 2-3 mint
بعطيها أستني 5-10 دقائق، إذا وقفت خلص وقف
another dose ← ما وقفت (في ناس بتعمل) ممكن مرة ثانية كمان
ما زبطت بروحة

2nd line = phenytyine OR phenobarbital
Before You should call the senior.
phenytyine is the 1st choice except 2 conditions :
① poisoning, because poisoning effect heart and phenytyine affect heart ⇒ cardiac depression : bradycardia hypotension arrest
② epileptic pt, and maintained on phenytyine.
⇒ phenytyine Dose = 15-20 mg / kg / dose
يعطى على مهل 1-1½ : سالين
Rate = 1 mg / kg / mint
يعطى مع Normal Saline مش مع dextrose أو water
You should monitor vital signs.
⇒ phenobarbital alternative :
Dose = 15-20 mg / kg / dose
بتنين بستخدم لما يكون effect أطول 15-30 دقيقة







Not Respond ∴ I.C.U =
+ give bolus midazolam 0.1-0.2 mg/kg
وبالسريع drip

Not Respond ∴ anasthesia
thiopental [short acting] — phenobarbital [long acting]
→ bolus = 2-4 mg / kg
→ Drip = 2-4 mg / kg during 1 hour.
⊛ Thiopental cause sedation, So ⇒ elective intubation
مشان نحط المريض على mechanical ventilation
it cause depression in conscious level, so he can't maintain airway → aspiration, upper airway obstruction.
Not Respond ∴ halathane, inflorane
هادي الدرجة ليرا
لا لا لا

Not Respond ∴ hemispheric ectomy ليش؟
in intractable convulsion / severe atrophy, malformation
إلي فيه مشاكل كتير

⊛ Status Epilepticus :
- persistant convulsion for more than 20-30 mint
- intermittent convulsion for more than 20-30 mint
In between patient Not regain consious

