Epileptic seizure
VS
Seizure mimickers

Peerasit Treesuthacheep, MD.
Chulalongkorn Comprehensive Epilepsy Center of Excellence
Division of Neurology, Department of Medicine, Chulalongkorn University

Talk overview

- **Seizure mimics in children and adult**
- **Psychogenic non-epileptic seizures**
- **Pseudopseudoseizures**

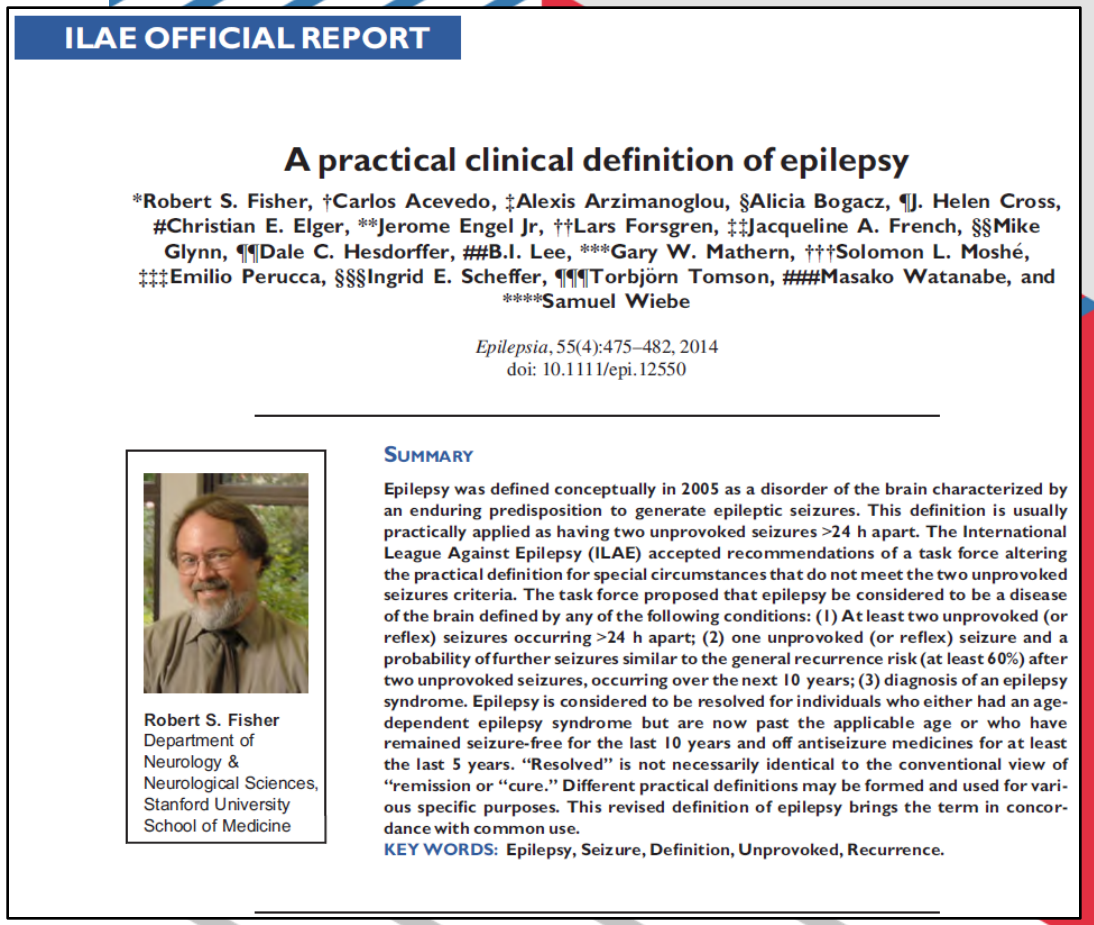
Seizure VS Epilepsy

Seizure:

A transient occurrence of signs and/or symptoms due to abnormal excessive or synchronous neuronal activity in the brain

Epilepsy:

A disorder of the brain characterized by an enduring predisposition to generate epileptic seizures



ILAE OFFICIAL REPORT

A practical clinical definition of epilepsy

*Robert S. Fisher, †Carlos Acevedo, ‡Alexis Arzimanoglou, §Alicia Bogacz, ¶J. Helen Cross, #Christian E. Elger, **Jerome Engel Jr, ††Lars Forsgren, ‡‡Jacqueline A. French, §§Mike Glynn, ¶¶Dale C. Hesdorffer, ##B.I. Lee, ***Gary W. Mathern, †††Solomon L. Moshé, ‡‡‡Emilio Perucca, §§§Ingrid E. Scheffer, ¶¶¶Torbjörn Tomson, ###Masako Watanabe, and ****Samuel Wiebe

Epilepsia, 55(4):475–482, 2014
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Robert S. Fisher
Department of Neurology & Neurological Sciences, Stanford University School of Medicine

SUMMARY

Epilepsy was defined conceptually in 2005 as a disorder of the brain characterized by an enduring predisposition to generate epileptic seizures. This definition is usually practically applied as having two unprovoked seizures >24 h apart. The International League Against Epilepsy (ILAE) accepted recommendations of a task force altering the practical definition for special circumstances that do not meet the two unprovoked seizures criteria. The task force proposed that epilepsy be considered to be a disease of the brain defined by any of the following conditions: (1) At least two unprovoked (or reflex) seizures occurring >24 h apart; (2) one unprovoked (or reflex) seizure and a probability of further seizures similar to the general recurrence risk (at least 60%) after two unprovoked seizures, occurring over the next 10 years; (3) diagnosis of an epilepsy syndrome. Epilepsy is considered to be resolved for individuals who either had an age-dependent epilepsy syndrome but are now past the applicable age or who have remained seizure-free for the last 10 years and off antiseizure medicines for at least the last 5 years. "Resolved" is not necessarily identical to the conventional view of "remission or "cure." Different practical definitions may be formed and used for various specific purposes. This revised definition of epilepsy brings the term in concordance with common use.

KEY WORDS: Epilepsy, Seizure, Definition, Unprovoked, Recurrence.

Fisher RS, Acevedo C, Arzimanoglou A, et al. ILAE official report: a practical clinical definition of epilepsy. Epilepsia 2014; 55: 475–482.

Paroxysmal non-epileptic events

- Heterogenous group of time-limited events
- Changes in motor or behavioral activity beginning abruptly and ending in a short time
- Without abnormal ictal EEG changes
- Found in 5-10% of epilepsy patient

Lagorio I, Brunelli L, Striano P. Paroxysmal Nonepileptic Events in Children: A Video Gallery and a Guide for Differential Diagnosis. Neurol Clin Pract. 2022 Aug;12(4):320-327.

Seizure mimics in children

Seizure mimics in children

- Age-based approach
- The differentiation of seizure mimic from a seizure relies solely on a proper history and review of video recordings
- Investigations rarely help in the diagnosis
  - EEG for rule out epileptic phenomena

TABLE 1. Key features of seizures and seizure mimics.

Green Flags for Seizure Mimics	Red Flags for Seizures
Shaking is **suppressible** by tactile stimulation	**Non-suppressible** movements
Triggered by a specific event, location, or emotion	**Occur when coming out of sleep**
Staring or movements **stop with distraction**	**Loss of consciousness** during event
	Period of **fatigue and confusion afterwards**
	PMH of **developmental delay, regression, or neurologic injury**

Sankhyan N. Non-epileptic paroxysmal events mimicking seizures. Indian J Pediatr. 2014 Sep;81(9):898-902.

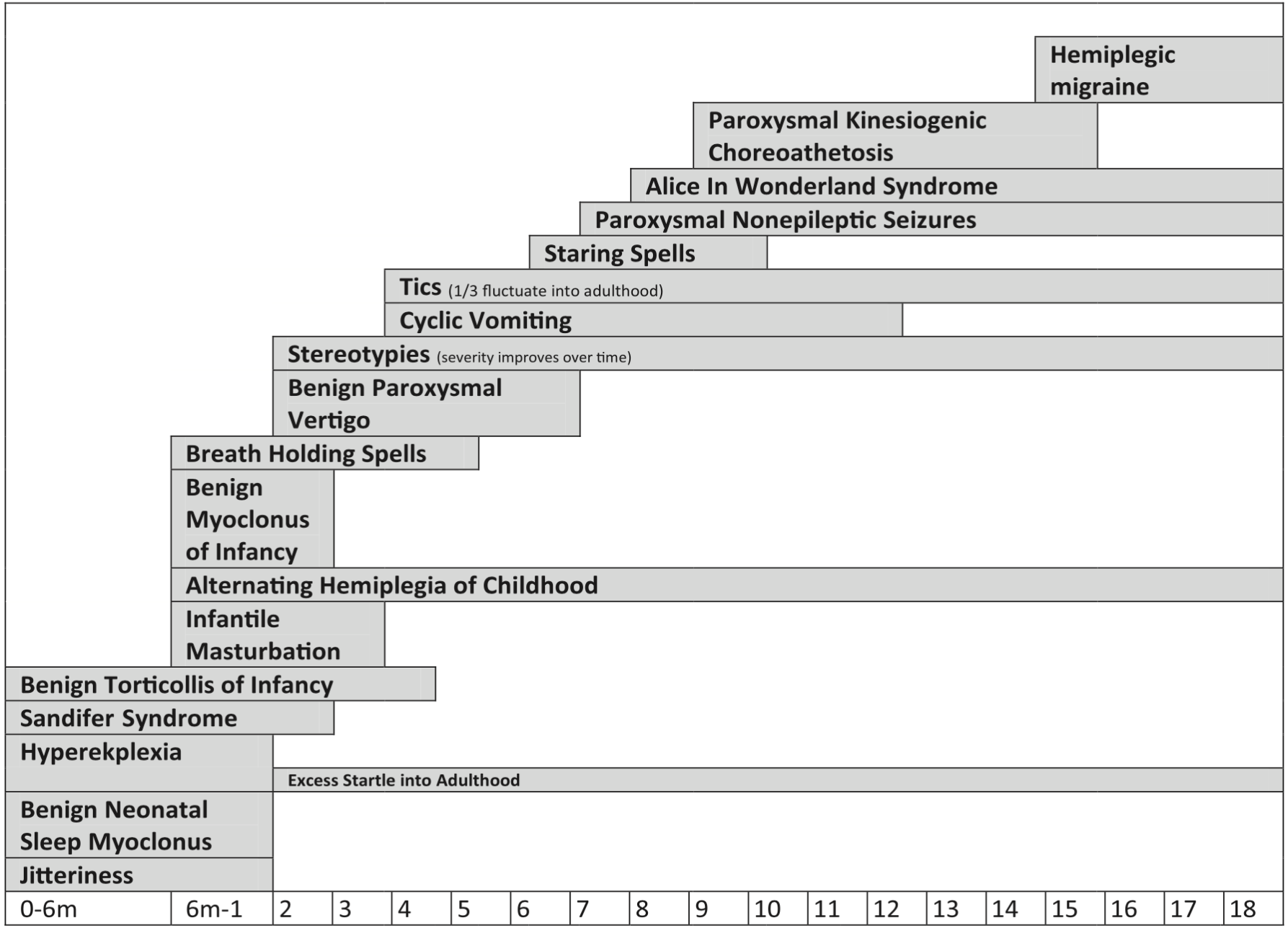

Figure 1. Age ranges (months and years) of seizure mimics, typical onset and resolution.

Stainman RS, Kossoff EH. Seizure mimics in children: An age-based approach. Curr Probl Pediatr Adolesc Health Care. 2020 Dec;50(12):100894. doi: 10.1016/j.cppeds.2020.100894. Epub 2020 Nov 10..

Seizure mimics in children

Neonates (Birth - 1 month)

Infants and young children (1 month – 2 years old)

School-aged children (2– 12 years old)

Sankhyan N. Non-epileptic paroxysmal events mimicking seizures. Indian J Pediatr. 2014 Sep;81(9):898-902.

Neonates: birth - 1 month

- Jitteriness
- Benign neonatal sleep myoclonus
- Hyperekplexia (Excessive startle response)

Jitteriness

- Rhythmic, oscillatory movements
  - High frequency, low amplitude
- Exacerbated by crying, stress or sudden movements and resolve with change in position
- May be seen within the first days after birth and significantly improves by 2 weeks of life and resolves by 1 years
- Can be present as a sign of drug withdrawal, maternal CBD use, HIE, hypoglycemia, hypocalcemia or vitamin D deficiency

Stainman RS, Kossoff EH. Seizure mimics in children: An age-based approach. Curr Probl Pediatr Adolesc Health Care. 2020 Dec;50(12):100894. doi: 10.1016/j.cppeds.2020.100894. Epub 2020 Nov 10. PMID: 33183978.

Benign Neonatal Sleep Myoclonus

- Bilateral or unilateral brief jerking movements
- Involve one, several or all limbs
- Movements can occur in clusters up to 30 minutes
- Only occurs in sleep
- Not always suppressible, do not stop with light touch
- May be seen as first few days of life
- Often resolve by 3-6 months

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Hyperekplexia

- "Excess startle response"
- 3 components
  - Baseline generalized stiffness
  - Excess startle
  - Followed by transient stiffness
- Auditory, visual or tactile stimulation induces a startle episode
- Symptoms may appear at birth, should resolve by 1 year
- EEG helps to exclude seizures
- Imaging to rule out secondary conditions: brain stem compression, anoxic injury, tetanus
- Genetic defects: GLRA1, GLRB, SLC6A5
- Treatment: clonazepam

Stainman RS, Kossoff EH. Seizure mimics in children: An age-based approach. Curr Probl Pediatr Adolesc Health Care. 2020 Dec;50(12):100894. doi: 10.1016/j.cppeds.2020.100894. Epub 2020 Nov 10. PMID: 33183978.

Infants and young children: 1 month – 2 years old

- Sandifer syndrome
- Benign paroxysmal torticollis of infancy
- Infantile masturbation
- Benign myoclonus of infancy

Sandifer Syndrome

- Back arching and stiffening of the neck or arms
- Resolve within three minutes
- Consistently occur after feedings, likely within 30 minutes
- Rarely occur in sleep
- Most cases occur in children under 2 years old
- Should evaluation for GERD

Stainman RS, Kossoff EH. Seizure mimics in children: An age-based approach. Curr Probl Pediatr Adolesc Health Care. 2020 Dec;50(12):100894. doi: 10.1016/j.cppeds.2020.100894. Epub 2020 Nov 10. PMID: 33183978.

Benign Paroxysmal Torticollis of Infancy: BPT

- Painless torticollis
- Last minutes to weeks
- Side shifting
- The events occur on awakening or precipitated by changes in posture
- May be preceded by irritability, pallor, vomiting and ataxia
- Presents in first few months of life to 4.5 years old
- Strongly family history of migraine (55%)
- Self-limited by age 3-4 years
- Topiramate as an effective preventive agent
- Risk factors for developing BPPV, cyclic vomiting and migraine

Stainman RS, Kossoff EH. Seizure mimics in children: An age-based approach. Curr Probl Pediatr Adolesc Health Care. 2020 Dec;50(12):100894. doi: 10.1016/j.cppeds.2020.100894. Epub 2020 Nov 10. PMID: 33183978.

Infantile Masturbation

- Self-stimulatory behaviors
- Wide range of movements
  - Torsional movement
  - Arched back
  - Body rocking
  - Vocalization such as grunting
  - Flushing or sweating
- No loss of consciousness
- Mean duration is 9 minutes (30s to 2h)
- Median age at onset is 12.5 months (3mo to 3y)
- Considered as normal, healthy behavior

Stainman RS, Kossoff EH. Seizure mimics in children: An age-based approach. Curr Probl Pediatr Adolesc Health Care. 2020 Dec;50(12):100894. doi: 10.1016/j.cppeds.2020.100894. Epub 2020 Nov 10. PMID: 33183978.

Benign Myoclonus of Infancy

- Nearly identical to infantile spasms
- Brief jerking movements with flexion or extension of limbs and head
- Only occur during awake period
- Onset between 3 to 15 months
- EEG to rule out infantile spasm
- Benign condition, no long-term neurodevelopmental impairment

Stainman RS, Kossoff EH. Seizure mimics in children: An age-based approach. Curr Probl Pediatr Adolesc Health Care. 2020 Dec;50(12):100894. doi: 10.1016/j.cppeds.2020.100894. Epub 2020 Nov 10. PMID: 33183978.

School-aged children: 2–12 years old

- Breath-holding spells
- Staring episodes

Breath-holding Spells

- Pallor or cyanosis from involuntary breath-holding episode which is normally preceded by a loud cry
- Can be accompanying body stiffness or convulsions, or transient loss of consciousness
- 0.1 – 4.6% of healthy children
- Onset between 6 to 18 months
- Spells gradually increase over time, reaching peak by 12 to 14 months
- Positive family history of breath-holding in 20 – 35%
- Association with iron deficiency anemia or iron deficiency
- Spells normally resolve spontaneously by around 5 years old

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Staring Episodes

- Absence seizure like episode with preservation of awareness
  - Patient is easily distractable and responds to light touch or sound
- Typically occur in elementary school-aged children
- Occur in specific situations or settings: e.g. classroom
  - May resolve on weekends or vacations
- Self-limiting, no negative developmental outcome

Stainman RS, Kossoff EH. Seizure mimics in children: An age-based approach. Curr Probl Pediatr Adolesc Health Care. 2020 Dec;50(12):100894. doi: 10.1016/j.cppeds.2020.100894. Epub 2020 Nov 10. PMID: 33183978.

Movement disorders

- Tics
- Motor stereotypies

Tics

- On-rhythmic brief rapid movements or vocalizations lasting several seconds
  - Eye blinking
  - Head jerking
  - Shoulder shrug
  - Vocal tics: grunting, throat clearing, vocalizing a syllable or word
- Often preceded by a premonitory urge that resolves after completing the tic
- Suppressible
- Triggers: stress, excitement, fatigue, fever or infection

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Tics

- Onset begin between 4 and 8 years old, more common in male (3-4:1)
- Significant comorbidities: ADHD, OCD, GAD, Sleep disorders, Mood disorders
- Treatment for patients with socially impacted: topiramate, clonazepam
- 1/3 will resolve, 1/3 will improve, 1/3 continue to fluctuate into adulthood

Stainman RS, Kossoff EH. Seizure mimics in children: An age-based approach. Curr Probl Pediatr Adolesc Health Care. 2020 Dec;50(12):100894. doi: 10.1016/j.cppeds.2020.100894. Epub 2020 Nov 10. PMID: 33183978.

Motor stereotypies

- Involuntary rhythmic purposeless movements
- Lasting up to several minutes
- Present in a fixed pattern
  - Leg shaking
  - Thumb sucking
  - Nail biting
  - Teeth clenching
  - Head bobbing
  - Body rocking
- Children are typically unaware while doing the action

Stainman RS, Kossoff EH. Seizure mimics in children: An age-based approach. Curr Probl Pediatr Adolesc Health Care. 2020 Dec;50(12):100894. doi: 10.1016/j.cppeds.2020.100894. Epub 2020 Nov 10. PMID: 33183978.

Motor stereotypies

- Suppressible by distraction or tactile stimulation
- Specific emotional triggers: excitement, boredom
- Onset earlier than tics, 24 to 36 months old
- High comorbidity rate for ADHD, learning disorders, tics, OCD
- Not harmful, reassurance is most important
  - Habit reversal training
  - Medications: fluoxetine, risperidone

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Seizure mimics in children and adults

Other seizure mimics

- Syncope
  - Cardiac
  - Reflex
  - Orthostatic
- Sleep disorders
  - Narcolepsy
  - Parasomnias
- Migraine
- Transient ischemic attack
- Movement disorders
- Hydrocephalic attack
- Psychogenic non-epileptic seizure

Convulsive syncope

Cerebral hypoperfusion

- Cortex ischemia/hypoxia → loss of muscle tone and collapse
- Brainstem release phenomena
    - Asynchronous
    - Asymmetric
    - Proximal involvement

Non-REM parasomnias VS Nocturnal seizures

Table 2 Clinical Differences between Parasomnias and Frontal Lobe Seizures

	Non-REM Parasomnias (Somnambulism, Nocturnal Terrors)	Nocturnal Frontal Lobe Epilepsy
Age of onset	Usually < 10 years	Variable, generally childhood or adolescence
Positive family history	60–90%	< 40%
Mean number of attacks per day	1–2	> 3
Monthly frequency of episodes	Less than 1–4	20–40
Clinical course over time	Tendency to disappear in adolescence	Frequency of episodes generally stable over time
Mean duration of disorder	Around 7 years	Around 20 years
Duration of the episodes	Seconds to 30 minutes	Seconds to 3 minutes (usually less than 2 minutes)
Clinical features of the episodes	Variable complexity; not stereotyped in video recordings	Very stereotyped in video recordings, frequently vigorous or even violent movements
Triggering factors	Sleep deprivation, fever, alcohol, stress	Frequently no triggering factors are identified
Associated conditions	Obstructive apneas of sleep	Frequently none are identified
Ictal EEG	Slow waves, no epileptiform activity	Frequently normal or obscured by muscle artifact; clear EEG ictal pattern associated to episodes in < 10% of patients
Temporal occurrence during sleep	First half of the night, generally after 90 minutes of sleep	At any time during sleep, may happen in first 30–60 seconds
PSG stage	Stage III–IV	Generally stage II sleep, occasionally in stages III or IV

Myoclonus VS Myoclonic seizure

Myoclonus

- Cortical myoclonus
- Thalamocortical myoclonus
- Brainstem (Reticular) myoclous
- Spinal myoclonus
- Peripheral myoclonus

Hirokazu Oguni. Myoclonus and myoclonic seizures. Neurology Asia 2004; 9 (Supplement 1) : 25 –26

Myoclonus VS Myoclonic seizure

- Cortical myoclonus
  - Homunculus representation → distal involvement
  - May producible by movement or sensory stimuli
  - Small cortical spike discharges on EEG
  - Epilepsia partialis continua, Focal myoclonic seizure
- Thalamocortical myoclonus
  - Generalized and synchronous
  - Generalized bilaterally synchronous spike and wave complexes
  - Most common form of myoclonus in epilepsy
- Brainstem (Reticular) myoclous
  - Brainstem release phenomena
  - Proximal involvement
  - Producible by auditory and tactile stimuli
- Spinal myoclonus
  - Segmental, confined to spinal cord segments
- Peripheral myoclonus
  - Nerve distribution

Hirokazu Oguni. Myoclonus and myoclonic seizures. Neurology Asia 2004; 9 (Supplement 1) : 25 –26

Psychogenic non-epileptic seizure

PNES

- **Definition**
  - Paroxysmal changes in behavior, consciousness and autonomic function that resemble epileptic seizures but lack the electroencephalographic (EEG) signature of epileptic seizures
- **Challenging in diagnosis**
  - Average of 7 years between the manifestation of spells and definite diagnosis
- **Often misdiagnosed and consequently are exposed to unnecessary antiepileptic drugs**

Jafari A, Rezaei Tavirani M, Parvareshi Hamrah M, Ahmadi Karvigh S, Bashi Zadeh Fakhar H. Psychogenic Non-Epileptic Seizures; a Narrative Review. Arch Acad Emerg Med. 2020 Jan 20;8(1):e10. PMID: 32607501; PMCID: PMC7286438.

PNES

- Estimated incidence around 1.4-3 per 100,000
- Commonly in young adulthood (20-40 years)
- 75% of patients are females
- Increase the risk in patients with epilepsy

Jafari A, Rezaei Tavirani M, Parvareshi Hamrah M, Ahmadi Karvigh S, Bashi Zadeh Fakhar H. Psychogenic Non-Epileptic Seizures; a Narrative Review. Arch Acad Emerg Med. 2020 Jan 20;8(1):e10. PMID: 32607501; PMCID: PMC7286438.

Psychogenic non-epileptic seizure

Table 1 Behaviors to distinguish psychogenic nonepileptic and epileptic seizures

Behavior	Psychogenic nonepileptic seizures	Epileptic seizures
Eye movement	Eyes closed during seizure onset for approximately 20 s; geotropic eye movements may be observed	Eyes open during seizure onset; may close for approximately 2 s
Weeping	May be present	Not present
Postictal nose rubbing and cough	Not present	May be present
Stertorous breathing postictally	Not present	May be present
Ictal stuttering and postictal whispering	May be present	Not present
Body movements	Pelvic thrusting; out-of-phase or side-to-side oscillatory movements; chaotic and disorganized thrashing	Pelvic thrusting; quick, tonic posturing; vocalization
Self-injury	May be present	May be present
Tongue laceration	May be present	May be present
Incontinence	May be present	May be present

Clinical clues

TABLE 2. Six-item tool for differentiating PNES from ES[23]

Item	Epileptic seizures	PNES
Eyes	Opened	Closed
Head	Fixed/unilateral	Side-to-side movements
Limbs	In phase/same direction	Out of phase
Body (axis)	Straight	Opisthotonus
Body (movement)	No rotation	Intense rotation in bed
Evolution of seizure	Continuous	Fluctuating

PNES, psychogenic non-epileptic seizures; ES, epileptic seizures.

Omair H. Abbasi, MD, TsungWai Aw, MD. Psychogenic Non-Epileptic Seizures: Clinical Issues for Psychiatrists. **Psychiatric Times**, Vol 34 No 3, Volume 34, Issue 3

Psychiatric comorbidities in PNES

TABLE 1. Psychiatric comorbidities in PNES compared with ES[22]

Comorbidity	Rates of comorbidity with PNES (%)	Relative risk of comorbidity when compared with ES
Total	53 - 100	1.3, statistically significant
Depression	8.9 - 85	1.6, statistically insignificant
Anxiety	4.5 - 70 (higher number from panic disorder)	1.82, statistically significant
PTSD	7 - 100	3.21, statistically significant
Personality disorders	5.4 - 74.3	1.73, statistically significant
Psychosis	0 - 15	
Substance abuse	9.8 - 29.5	

PNES, psychogenic non-epileptic seizures; ES, epileptic seizures.

Omair H. Abbasi, MD, TsungWai Aw, MD. Psychogenic Non-Epileptic Seizures: Clinical Issues for Psychiatrists. **Psychiatric Times**, Vol 34 No 3, Volume 34, Issue 3

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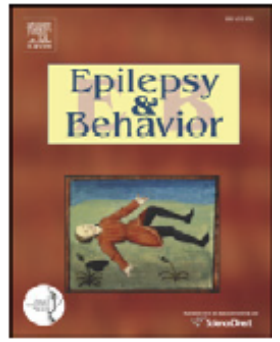

The yield and clinical utility of outpatient short-term video-electroencephalographic monitoring: A five-year retrospective study

Udaya Seneviratne [a,b,*], Zebunnessa Rahman [a], Amanda Diamond [a], Maria Brusco [a]

[a] Department of Neuroscience, Monash Medical Centre, Melbourne, Australia
[b] Department of Medicine, Southern Clinical School, Monash University, Melbourne, Australia

Yield of vEEG and PNES

- Highest yield in psychogenic nonepileptic seizures (37.1%), interictal epileptiform discharges (17.2%) and epileptic seizures (6.9%)
- The provisional diagnosis was epilepsy 77.7% and PNES 22.3% before vEEG
- Changed the pre-test diagnosis in 30.9% of patients

Pseudopseudoseizures

Take home messages

- History taking and physical examination are still the most important
- Smartphone always helpful
- Seizure mimics are not equal to malingering
- Both epileptic and non-epileptic phenomena may coexist