



Volume 2 Number 2, July 2022

Electroencephalogram in Children who Experienced Unprovoked Seizure

Arinda Putri Auna Vanadia*, Prastiya Indra Gunawan**^{ID}, Abdurachman***, Martono Tri Utomo **, Hanik Badriyah Hidayati****^{ID}

* Faculty of Medicine, Universitas Airlangga, Surabaya, Indonesia

** Department of Pediatrics, Faculty of Medicine, Universitas Airlangga; Dr. Soetomo General Academic Hospital, Surabaya, Indonesia

*** Department of Anatomy and Histology, Faculty of Medicine, Universitas Airlangga; Dr. Soetomo General Academic Hospital, Surabaya, Indonesia

**** Department of Neurology, Faculty of Medicine, Universitas Airlangga; Dr. Soetomo General Academic Hospital, Surabaya, Indonesia

Article info

Article History:

Received Feb 8, 2022

Revised Apr 6, 2022

Accepted Jun 21, 2022

Published Jul 31, 2022

Keywords:

Children

Disease

EEG

First unprovoked seizure

ABSTRACT

Introduction: The first unprovoked seizure is defined as a series of seizures that occur within 24 hours and are followed by recovery of consciousness with unknown triggering causes such as head trauma, central nervous system infections, tumors, or hypoglycemia. The first unprovoked seizure is a thing that cannot be underestimated. According to a previous study, less than half of those who experience their first unprovoked seizure will have another. An electroencephalogram (EEG) is one of the supporting examinations for the first unprovoked seizure. **Objective:** This study aims to determine the EEG as the first unprovoked seizure supporting examination. **Method:** This is a retrospective, descriptive, observational study with sampling from the patient's medical record at Dr. Soetomo General Hospital Surabaya from January 2017 to December 2018 based on predetermined inclusion and exclusion criteria. **Result:** The EEG results in children who experienced their first unprovoked seizure were more abnormal (52.9%) than normal (47.1%), with an abnormal EEG breakdown of abnormal II (17.6%) and abnormal III (35.3%). There were no patients in this study who had EEG abnormal I. All patients with EEG abnormal II (17.6%) had an intermittent slow EEG waveform, while all patients with EEG abnormal III (35.3%) had a sharp waveform. The most common location of EEG wave abnormalities was temporal (55.6%). **Conclusion:** In the first unprovoked seizure, an EEG examination can assist clinicians as a seizure diagnostic assistant tool. It is hoped that the results of the EEG can provide better management of the first unprovoked seizure.

Corresponding Author

Hanik Badriyah Hidayati

Department of Neurology, Faculty of Medicine, Universitas Airlangga, Dr. Soetomo General Academic Hospital, Surabaya, Indonesia

Email: hanikhidayati@fk.unair.ac.id

Available at <https://e-journal.unair.ac.id/index.php/aksona>



This work is licensed under a Creative Commons Attribution-ShareAlike 4.0 International License

INTRODUCTION

Using the International League Against Epilepsy (ILAE) criteria, the American Academy of Neurology defines a first unprovoked seizure as a series of seizures that occur within 24 hours and are followed by recovery of consciousness, with unknown trigger factors such as head trauma, central nervous system infections, tumors, or other known precipitating factors such as hypoglycemia.¹

Seizures are common among children, accounting for 4-10% of pediatric neurological diseases. It is projected that 10% of the population in the United States will have at least one seizure during their lives.² Stroke is the leading cause of disability in the world. Unprovoked seizures in children are prevalent during childhood and adolescence. The incidence of first unprovoked seizures in children aged 1 to 14 years ranges from 30 to 50 per 100,000.³ An electroencephalogram (EEG) is a recording of brain activity used to investigate a first unprovoked seizure.⁴ Epileptiform abnormalities on the EEG provide additional clinical information about seizures that may aid in the diagnosis and classification of seizures.⁵

OBJECTIVE

This study aimed to determine the EEG activity as a supporting examination in children who had their first unprovoked seizure.

METHODS

This study was conducted using a retrospective, descriptive, observational method to obtain the patient's history retrieved from the patient's medical record. Data from medical records of children who experienced their first unprovoked seizure was examined. Samples were taken from the medical records of 17 patients at RSUD Dr. Soetomo Surabaya from January 2017 to December 2018.

The total sampling method was used to determine a sample of all patients who met the inclusion and exclusion criteria. The inclusion criteria in this study were children aged 0-18 years who experienced their first unprovoked seizure on an EEG examination. Meanwhile, the exclusion criteria included patients with incomplete medical record data.

RESULTS

Based on the obtained data, the majority of

patients were male (58.8%), and the most common age group was 1 month – 2 years (35.3%) (Table 1). Among 17 patients who experienced a first unprovoked seizure, 9 patients (52.9%) had abnormal EEG results, and 8 patients (47.1%) had normal EEG results (Figure 1). Among patients with abnormal EEG results, there were no patients with EEG abnormal I, 3 patients (17.6%) with EEG abnormal II, and 6 patients (35.3%) with EEG abnormal III (Figure 2).

Patients with EEG abnormal II showed intermittent slow EEG waves, while patients with EEG abnormal III had sharp waves. Based on the location of the EEG abnormalities, most occurred in the temporal (55.6%) than in other parts such as frontal, central, temporo-occipital, and multifocal (11.1%) (Table 1).

DISCUSSION

Seizures are clinical symptoms or behavioral changes caused by abnormal electrical activity in the brain. Provoked and unprovoked seizures are the two forms of seizures.⁶ Provoked seizures, also known as acute symptomatic seizures, occur due to triggering factors such as intoxication, a metabolic abnormality, trauma, or fever. Meanwhile, unprovoked seizures occur without an accurate trigger.^{3,7} Unprovoked seizures can refer to single or recurring seizures (epilepsy).⁷

Seizures are generally dominated by male patients. The majority of pediatric patients in this research who experienced their first unprovoked seizures were also men. This is in line with a study conducted in Jordan in 2004, which found that most patients were male (56.6%).⁸ Maia *et al.*, also suggested that first unprovoked seizures were more common in boys (52.4%) than in girls (47.6%).⁹ Previous studies revealed that steroid hormones were involved in the predisposition to seizures. Men and women have different GABA-A receptor expression and function, which affects each person's susceptibility to seizures. Neurosteroids that inhibit brain transmission to prevent seizures are mediated via GABA-A receptors. Neurosteroids are the result of the brain metabolism of steroid hormones in the blood. The existence of catamenial seizures during the phase of declining progesterone is also explained by the role of steroids in the incidence of seizures.¹⁰

The highest age group distribution of pediatric patients who had their first unprovoked seizure in this study ranged from 1 month to 2 years (35.3%). In line with a study conducted in Singapore, which found that the first unprovoked seizures were most common in the ages of 0–2 years, as many as 39 patients (40.6%).¹¹ Elisa Baldin *et al.*, also suggest that the

incidence of first unprovoked seizures mostly occurred in children older than a year old.⁵ Seizures at a young age are impacted by physiological and pathological processes. The developing brain is more susceptible to seizures because of the physiological process by which excitatory synapses form before inhibitory synapses.¹²

The electroencephalogram is very useful in classifying seizure types and determining long-term prognosis.¹³ EEG data in patients who have had their first unprovoked seizure are uncommon.¹⁴ It has been shown that epileptiform abnormalities are associated with seizure disorders and can predict the recurrence of spontaneous seizures (in other words, the clinical definition of epilepsy).⁴

The International League Against Epilepsy (ILAE) updated its clinical definition of epilepsy in 2014. According to these revised practical criteria, a patient with a single seizure that occurs at least one month after a stroke or a child with a single seizure who has an EEG epileptiform abnormality and a remote symptomatic or structural etiology may be diagnosed with epilepsy.⁶ Therefore, detection of an epileptiform abnormality can aid in better management of the first unprovoked seizure.⁴ The primary risk factor for epileptiform abnormalities was higher in younger age groups, which was true for the 1–19 year age group compared to older people after adjusting for seizure frequency, suggesting that EEG studies are most useful in children.⁵

This study was dominated by abnormal EEG (52.9%) compared to normal EEG (47.1%). In line with a retrospective study in Thailand, the most common finding was abnormal EEG (57.4%).¹⁵ Pereira *et al.*, also reported that 41 of 56 cases (73%) had abnormal EEG results.¹⁶ All patients with EEG abnormal II (17.6%) had intermittent slow EEG waves. This is not in line with another study in India conducted by Bhuyan *et al.*, about EEG, where 41 patients (36.28%) had intermittent IEDs (interictal epileptiform discharges), 10 patients (8.85%) had IEDs and background slowing, 3 patients (2.65%) had background slowing, 10 patients (8.85%) had slow waves, 11 patients (9.73%) had IEDs + fast background, 1 patient (0.88%) had IEDs + irregular waves, and 37 patients (32.74%) normal.¹⁷ Meanwhile, patients with EEG abnormal III results had sharp waves. In line with Buyan *et al.*, 56 patients (88.89%) had sharp waves, 2 patients (3.17%) had spikes, 4 patients (6.35%) had spike and wave, and 1 patient (1.59%) had polyspikes.¹⁷

The location of EEG wave abnormalities in patients with first unprovoked seizures was most common in the temporal area (55.6%). This is consistent with research in the Lebanese population, which stated that EEG waves focused more on the temporal area (37.25%) than the frontal (21.56%) and

multifocal (13.73%). It is concluded that the main spatial focus of the EEG waves is temporal.¹⁸

CONCLUSION

An EEG examination as a diagnostic support tool can help clinicians to provide information about the appearance of seizure waves in first unprovoked seizures, which may lead to better treatment.

REFERENCES

- Hirtz D, Ashwal S, Berg A, Bettis D, Camfield C, Camfield P, et al. Practice parameter: Evaluating a first nonfebrile seizure in children: Report of the quality standards subcommittee of the American Academy of Neurology, the Child Neurology Society, and the American Epilepsy Society. *Neurology*. 2000;55(5):616–23.
- Sadeq H, Karim J, Marwan Y, AlSaleem T. Neuroimaging evaluation for first attack of unprovoked nonfebrile seizure in pediatrics: When to order? *Med Princ Pract*. 2016;25(1):56–60.
- Sansevere AJ, Avalone J, Strauss LD, Patel AA, Pinto A, Ramachandran M, et al. Diagnostic and therapeutic management of a first unprovoked seizure in children and adolescents with a focus on the revised diagnostic criteria for epilepsy. *J Child Neurol*. 2017 ;32(8):774–88.
- Debicki DB. Electroencephalography after a single unprovoked seizure. *Seizure*. 2017;49:69–73.
- Baldin E, Hauser WA, Buchhalter JR, Hesdorffer DC, Ottman R. Yield of epileptiform electroencephalogram abnormalities in incident unprovoked seizures: A population-based study. *Epilepsia*. 2014;55(9):1389–98.
- Chen T, Si Y, Chen D, Zhu L, Xu D, Chen S, et al. The value of 24-hour video-EEG in evaluating recurrence risk following a first unprovoked seizure: A prospective study. *Seizure*. 2016;40:46–51.
- Hauser WA, Beghi E. First seizure definitions and worldwide incidence and mortality. *Epilepsia*. 2008;49(1):8–12.
- Daoud A, Ajloni S , El-Salem K, Horani K, Ootom S, Daradkeh T. Risk of seizure recurrence after a first unprovoked seizure: a prospective study among Jordanian children. *Seizure*. 2004 Mar;13(2):99–103.
- Maia C, Moreira AR, Lopes T, Martins C. Risk of recurrence after a first unprovoked seizure in children. *J Pediatr (Rio J)*. 2017;93(3):281–6.
- Kipnis PA, Sullivan BJ, Kadam SD. Sex-dependent signaling pathways underlying seizure susceptibility and the role of chloride cotransporters. *Cells*. 2019;8(5):448.
- Chan D, Phuah HK, Ng YL, Choong CT, Lim KW, Goh WHS. Pediatric epilepsy and first afebrile seizure in singapore: Epidemiology and investigation yield at presentation. *J Child Neurol*. 2010;25(10):1216–22.
- Stafstrom CE, Carmant L. Seizures and epilepsy: An overview for neuroscientists. *Cold Spring Harb Perspect Med*. 2015;5(6):a022426.
- Ghofrani M. Approach to the first unprovoked seizure- Part II. *Iran J child Neurol*. 2013;7(4):1–5.
- Mizorogi S, Kanemura H, Sano F, Sugita K, Aihara M. Risk factors for seizure recurrence in children after first unprovoked seizure. *Pediatr Int*. 2015;57(4):665–9. doi: 10.1111/ped.12600
- Dusitanond P. Abnormal electroencephalography in first unprovoked seizure in Rajavithi Hospital. *J Med Assoc Thai*. 2013;96 Suppl 3:S42-6.

16. Pereira C, Resende C, Fineza I, Robalo C. A 15-year follow-up of first unprovoked seizures: A prospective study of 200 children. *Epileptic Disord.* 2014;16(1):50–5.
17. Bhuyan R, Jahan W, Upadhyaya N. Interictal wave pattern study in EEG of epilepsy patients. *Int J Res Med Sci.* 2017;5(8):3378–84.
18. Jomaa NA, Haddad M, Adwane GY, Zaylaa AJ, Rahbani A. Dedicated magnetic resonance imaging sequences: Contribution in the diagnosis of focal epilepsy in the Lebanese population. *J Heal Sci.* 2018;6(6):439–45.

ATTACHMENT

Table 1. Description of Interview Responses of 579 Patients

Characteristics	Frequency (n)	Percentage (%)
Gender		
Male	10	58.8
Female	7	41.2
Age		
0 months-1 months	1	5.9
1 months- 2 years	6	35.3
2 years - 6 years	5	29.4
6 years – 12 years	5	29.4
12 years – 18 years	0	0
EEG Results		
Normal	8	47.1
Abnormal	9	52.9
Abnormal I	0	0
Abnormal II	3	17.6
Intermittent slow	3	17.6
Intermittent slow + slow background	0	0
Continuous slow wave	0	0
Abnormal III	6	35.3
Sharp waves	6	35.3
Spikes	0	0
Spike and wave	0	0
Polyspikes	0	0
Location of EEG abnormality		
Temporal	5	55.6
Frontal	1	11.1
Central	1	11.1
Temporo-occipital	1	11.1
Multifocal	1	11.1

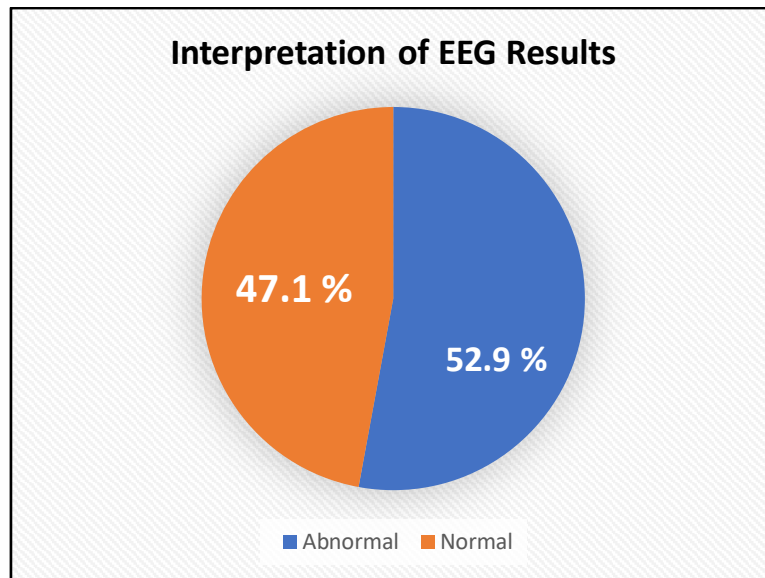


Figure 1. Distribution of EEG results of First Unprovoked Seizure patients

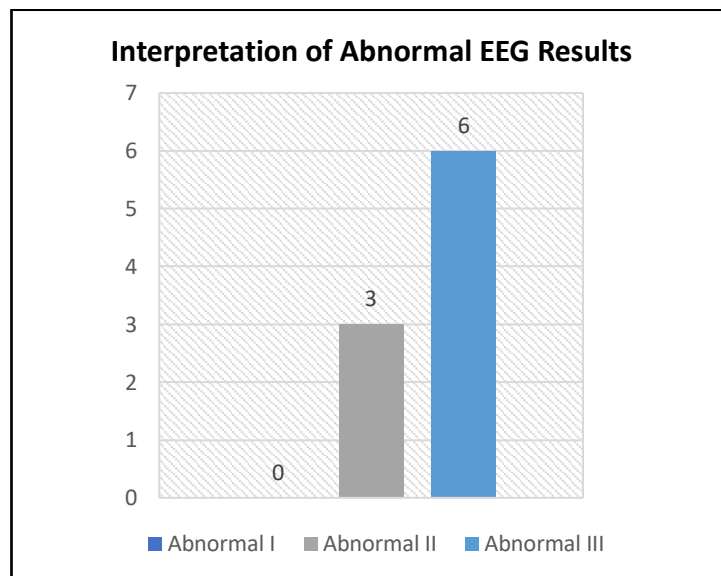


Figure 2. Distribution of abnormal EEG results of First Unprovoked Seizure patients