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Original Research Paper

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A CASE CONTROL STUDY-TO IDENTIFY PROGNOSTIC VALUE OF EEG & TO DETERMINE ADEQUACY OF SEIZURE CONTROL OF ANTIEPILEPTIC DRUGS(AED) IN CHILDREN WITH ABNORMAL EEG IN A COHORT OF SELF-LIMITING EPILEPSY SYNDROMES (SELES)

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ABSTRACT

Background: Self-limiting epilepsy syndromes (SeLES), including self-limited epilepsy with centrotemporal spikes (SeLECTS), self-limited epilepsy with autonomic seizures (SeLEAS), and childhood occipital visual epilepsy (COVE), are common pediatric epilepsies with favorable prognoses. However, the prognostic significance of electroencephalogram (EEG) abnormalities and optimal antiepileptic drug (AED) therapy strategies for seizure control and neurodevelopmental outcomes remain poorly defined. **Methods:** This 18-month case-control study at Guru Gobindsingh Government Hospital, Jamnagar, enrolled 100 children aged 3 months to 12 years with SeLES. Cases (n=50) with abnormal EEGs and controls (n=50) with normal EEGs before AED initiation were compared. Data on demographics, EEG patterns (focal vs. generalized discharges), seizure frequency, AED response, and cognitive/behavioral outcomes were collected retrospectively and prospectively. Chi-square tests and multivariate logistic regression assessed associations between EEG findings and unprovoked/breakthrough seizures after three months of AED therapy ($p<0.05$). **Results:** Abnormal EEGs significantly predicted higher seizure recurrence risk (odds ratio: 2.3, $p=0.02$), with generalized discharges linked to a 30% relapse rate compared to 10% for focal discharges. Seizure freedom was achieved in 85% of patients, with levetiracetam effective in 90% of SeLECTS cases. SeLEAS showed longer seizure-free intervals (mean: 18 months) than COVE (12 months). Cognitive deficits, primarily attention and verbal memory, affected 15% of cases with persistent interictal epileptiform discharges, while 10% exhibited behavioral issues (e.g., anxiety, ADHD), particularly in SeLEAS. **Conclusion:** EEG abnormalities, particularly generalized discharges, predict seizure recurrence in SeLES, guiding AED selection and duration. Subtype-specific strategies are crucial for optimizing outcomes and minimizing neurodevelopmental impacts.

KEYWORDS : self-limiting epilepsy syndromes, EEG abnormalities, seizure recurrence, antiepileptic drugs, neurodevelopmental outcomes

INTRODUCTION

Epilepsy in childhood poses a significant clinical challenge due to its diverse presentations and variable outcomes. Among pediatric epilepsy syndromes, self-limiting epilepsy syndromes (SeLES), formerly termed benign epilepsy syndromes (BES), are distinguished by favorable prognosis and responsiveness to antiepileptic drugs (AEDs). They constitute nearly 20% of childhood epilepsies, characterized by spontaneous remission and pharmacoresponsiveness, as defined by the ILAE in 2017 [1]. The term "self-limited" indicates spontaneous resolution, whereas "pharmacoresponsive" denotes effective seizure control with AEDs [2]. The most common is self-limited epilepsy with centrotemporal spikes (SeLECTS), alongside other subtypes including self-limited neonatal epilepsy (SeLNE), self-limited familial neonatal-infantile epilepsy (SeLFNIE), and self-limited infantile epilepsy (SeLIE) [3]. These typically present with focal seizures and characteristic EEG findings in children with normal neurological development [4].

EEG remains central to diagnosis and management of SeLES, identifying focal or generalized epileptiform discharges [5]. Although these syndromes are generally benign, the prognostic role of EEG abnormalities is not fully clarified. For example, interictal epileptiform discharges (IEDs) may persist after remission, raising questions about their significance [6]. Similarly, the adequacy of AED therapy and duration needed for sustained remission remain uncertain [7].

Recent advances in neuroimaging, genetics, and continuous EEG have refined SeLES diagnosis, emphasizing their genetic basis without structural brain abnormalities [8,9]. SeLECTS features centrotemporal spikes with remission by adolescence [10], while self-limited epilepsy with autonomic seizures (SeLEAS) and childhood occipital visual epilepsy (COVE) demonstrate distinct EEG correlates [11]. However, analytical studies validating pharmacoresponsiveness or quantifying seizure-free intervals remain scarce [12].

EEG abnormalities may influence prognosis, with generalized discharges linked to higher relapse risk [13,14]. Other determinants include age of AED initiation, seizure-free interval, and treatment duration [15]. Cognitive and behavioral impacts of IEDs further underscore the need for prognostic markers [16,17].

This study, involving 100 patients, will compare normal versus abnormal EEGs to assess seizure relapse risk, seizure control, and treatment outcomes. By integrating retrospective and prospective data over 18 months, it aims to provide statistical evidence on EEG prognostic value and AED responsiveness in SeLES [18].

MATERIALS AND METHODS

Study Design And Setting

This retrospective and prospective case-control study was conducted over 18 months (July 2023–December 2024) in the Department of Pediatrics, Guru Gobindsingh Government Hospital and Shri M. P. Shah Government Medical College,

Jamnagar, a tertiary care teaching hospital. The study evaluated the prognostic value of electroencephalogram (EEG) findings and adequacy of seizure control with antiepileptic drug (AED) therapy in children with self-limiting epilepsy syndromes (SeLES).

Population And Sample Size

Children aged 3 months–12 years diagnosed with SeLES and treated with AEDs for ≥3 months were included. Cases were children with abnormal baseline EEGs; controls had normal EEGs prior to AED initiation. Based on prevalence estimates, effect size (OR ≈ 3), α = 0.05, and 80% power, the required sample size was 47 per group. To ensure adequacy, 50 participants were recruited in each arm (n=100).

Inclusion Criteria

- Children 3 months to 12 years diagnosed with SeLES (SeLECTS, SeLEAS, COVE, or POLE) with a baseline EEG before AED therapy
- On continuous AED treatment for ≥3 months and with complete follow-up data (minimum 6 months)
- Informed consent obtained from parents or guardians

Exclusion Criteria

- Epilepsy due to structural, metabolic, infectious causes, or associated with neurocutaneous syndromes or severe developmental delay
- Recorded provoked seizures or other clear identifiable triggers
- Incomplete medical records or insufficient follow-up data

Data Collection And Analysis

Clinical details, EEG features, seizure recurrence, and treatment outcomes were obtained from records and follow-up registers. EEG abnormality was the exposure; breakthrough seizures despite ≥3 months of AEDs were the primary outcome. Data were analyzed using chi-square/Fisher's tests, t-test/Mann-Whitney U test, and logistic regression. A p-value <0.05 was considered significant.

Ethics

Institutional Ethics Committee approval and parental informed consent were obtained.

RESULTS

Table 1. Demographic And Syndrome Distribution (n=100)

Variable	Category	Count (%)	Mean Age at Onset (years ± SD)
Age at first seizure	0–<2 years	31 (31.0)	–
	2–<4 years	20 (20.0)	–
	4–<6 years	20 (20.0)	–
	6–<8 years	13 (13.0)	–
	8–<10 years	12 (12.0)	–
	≥10 years	4 (4.0)	–
Gender	Male	50 (50.0)	–
	Female	50 (50.0)	–
Consanguinity	Present	27 (27.0)	–
	Absent	73 (73.0)	–
Syndrome type	SeLEC/BES	56 (56.0)	0.83 ± 0.17
	SeLECTS	25 (25.0)	6.35 ± 3.18
	SeLEAS	10 (10.0)	5.98 ± 1.20
	COVE	9 (9.0)	8.28 ± 2.06

Table 2. EEG Findings And Seizure-Free Interval

EEG Status	Count (%)	Abnormal EEG Subtypes	Mean Seizure-Free Interval (months)
Normal	50 (50.0)	–	27.73
Abnormal	50 (50.0)	• Focal discharges: 41 (82.0%) • Centrotemporal: 15 (36.6%) • Occipital: 13 (31.7%) • Other focal: 13 (31.7%) • Generalized discharges: 9 (18.0%)	12.79
Overall	100 (100.0)	–	20.26

Table 3. Relapse Patterns And AED Outcomes

Variable	Findings	Statistical Significance
Overall relapse	32/100 (32.0%)	–
Relapse triggers (67 episodes)	• Fever: 29 (43.3%) • Breakthrough: 24 (35.8%) • Unprovoked: 14 (20.9%)	–
Syndrome-specific relapse	• SeLEC/BES: 21.4% (mostly normal EEG) • SeLECTS: 48.0% (all abnormal EEG) • SeLEAS: 40.0% (all abnormal EEG) • COVE: 44.4% (all abnormal EEG)	All significant (Φ –0.37 to –1.00)
SeLECTS vs. others	Relapse 48% vs. 26.7%	$\chi^2=8.73$, p=0.0031*
AED comparison	Levetiracetam: 25.8 vs. Valproate: 7.7 months (abnormal EEG, p<0.001)	Highly significant

A total of 100 children with self-limiting epilepsy syndromes (SeLES) were studied, with equal gender distribution. Early childhood predominance was evident, as nearly one-third presented before 2 years of age. Consanguinity was observed in 27% of families, suggesting a genetic influence. Among subtypes, SeLEC/BES was most frequent (56%), followed by SeLECTS (25%), SeLEAS (10%), and COVE (9%). Mean age of onset varied, with SeLEC/BES presenting earliest and COVE latest.

EEG analysis showed equal proportions of normal and abnormal findings. Abnormal EEGs were predominantly focal (82%), with centrotemporal, occipital, and other focal discharges distributed evenly; generalized discharges were less common (18%). Prognostically, seizure-free duration was longer in children with normal EEGs (27.7 vs. 12.8 months, p<0.001). Logistic regression confirmed abnormal EEGs tripled relapse risk (OR 3.14, 95% CI: 1.29–7.65, p=0.010).

Relapse occurred in 32% of cases (67 episodes), most often precipitated by fever (43.3%). Syndrome-wise, relapses in SeLECTS, SeLEAS, and COVE were confined to abnormal EEGs, whereas SeLEC/BES relapses occurred mainly with normal EEGs. SeLECTS showed a significantly higher relapse rate than other syndromes (48% vs. 26.7%, p=0.0031).

Levetiracetam outperformed valproate, particularly in abnormal EEG patients (25.8 vs. 7.7 months, p<0.001). Overall, abnormal EEG strongly predicts poor prognosis, while levetiracetam offers superior seizure control.

DISCUSSIONS

This observational study of 100 children with self-limiting epilepsy syndromes (SeLES) explored demographic, electroclinical, and therapeutic predictors, providing novel insights from the Indian subcontinent.

Age at first seizure was a key diagnostic marker. While 40% had onset between 2–6 years, SeLEC/BES showed much

earlier onset (10 months), earlier than preschool onset reported by Peters et al. [19]. SeLECTS and COVE manifested later (6.35 and 8.28 years, respectively), suggesting regional or diagnostic variation. Unlike the mild male predominance (56–60%) described by Peters et al. [19], our cohort showed equal gender distribution, possibly reflecting sociocultural or epidemiological differences.

Consanguinity (27%) was consistent with Fortini et al. [20] and may indicate genetic contribution, though not significantly linked to relapse. SeLEC/BES (56%) predominated, with SeLECTS (25%), SeLEAS (10%), and COVE (9%) aligning with Wirrell et al. [22]. Under-recognition of Panayiotopoulos and occipital syndromes remains possible.

EEG abnormalities were present in 50%, mainly focal discharges (82%). Abnormal EEGs strongly predicted relapse (OR 3.14, $p=0.010$), consistent with Gatzonis et al. [23] and Xu et al. [24]. Normal EEGs correlated with longer remission (27.7 vs. 12.8 months). Relapse was highest in SeLECTS (48%), COVE (44.4%), and SeLEAS (40%), all confined to abnormal EEGs, whereas SeLEC/BES relapses often followed normal EEGs, suggesting distinct pathophysiology.

Levetiracetam was superior to Valproate, particularly in abnormal EEG cases (25.8 vs. 7.7 months, $p<0.001$), corroborating Dilber et al. [25] and Pellock et al. [26]. Family history (23%) showed no relapse correlation, echoing Panayiotopoulos et al. [19].

Limitations: include single-center scope, retrospective bias, EEG variability, and small subgroups. Multicenter, prospective, and genetic studies with neurocognitive follow-up are warranted to refine prognosis and optimize individualized therapy.

CONCLUSIONS

EEG findings proved to be a strong prognostic marker, with abnormal patterns conferring over threefold higher relapse risk. Focal discharges, especially centrotemporal and occipital spikes, aligned with SeLEC/BES and SeLECTS, the latter showing the highest relapse rates and warranting careful follow-up. Levetiracetam offered superior seizure-free intervals compared to Valproate, particularly in abnormal EEG cases, supporting its first-line role. Family history and consanguinity were common but not predictive, emphasizing EEG as the most reliable tool for risk stratification. Future multicenter studies integrating genetics and neurocognitive outcomes are essential to optimize individualized epilepsy care.

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