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Clinico-etiological profile and outcome of children with status epilepticus admitted in pediatric intensive care unit of a tertiary care hospital: A prospective cross-sectional study.

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Abstract

Background:
Status epilepticus (SE) is a life-threatening neurological emergency in children, associated with significant morbidity and mortality. Early identification of etiological factors and prompt management are crucial for improving outcomes.

Methodology:
A prospective observational study was conducted over 8 months in the pediatric intensive care unit (PICU) of the Government Medical College & Hospital, Purnea. A total of 100 children aged 1 month to 12 years diagnosed with status epilepticus were included.

Results:
The majority of children were below 5 years of age (58%), with a slight male predominance. Most patients belonged to rural backgrounds. Febrile seizures (32%) and central nervous system infections (28%) were the most common etiologies. Generalized tonic-clonic seizures were predominant (70%). Mortality rate was 12%.

Conclusion:
Status epilepticus in children is primarily associated with preventable causes. Early recognition and timely intervention significantly improve prognosis.

Recommendation:
Public awareness, early referral, and strengthening PICU facilities are essential.

Keywords: *Status epilepticus, pediatric intensive care unit (PICU)****, seizures, etiology, outcome.***
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Background of the study
Status epilepticus (SE) is a critical neurological emergency characterized by continuous seizure activity lasting more than five minutes or recurrent seizures without recovery of consciousness between episodes. It is associated with significant morbidity and mortality, particularly in the pediatric population, due to the vulnerability of the developing brain (1,2).

The incidence of se is highest in early childhood, especially among children below five years of age. This increased susceptibility is attributed to immature neuronal circuits, lower seizure threshold, and higher exposure to febrile illnesses during early years (3,4). Epidemiological studies estimate the incidence of pediatric sepsis to range between 10 and 40 per 100,000 children annually, with higher rates reported in developing countries (5).

The etiological spectrum of se in children is diverse and varies according to geographical and socioeconomic factors. In low- and middle-income countries, febrile seizures and central nervous system (CNS) infections remain the leading causes, whereas in developed countries, epilepsy and idiopathic causes are more commonly reported (6–8). CNS

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infections such as meningitis, encephalitis, and neurocysticercosis continue to be major contributors in India due to inadequate sanitation, delayed healthcare access, and limited vaccination coverage (9,10).

In addition to infections, metabolic disturbances, head trauma, toxin exposure, and pre-existing epilepsy are also recognized contributors to seizures (11,12). Early identification of the underlying etiology is essential, as it directly influences treatment strategies and clinical outcomes.

Despite advancements in critical care and standardized treatment protocols, se continues to carry a high risk of complications, including neuronal injury, cognitive impairment, and death. The outcome largely depends on factors such as duration of seizures, etiology, timeliness of intervention, and availability of intensive care facilities (13,14).

There is limited region-specific data from eastern India, particularly Bihar, regarding the clinical profile and outcomes of pediatric sepsis. Therefore, this study was undertaken to evaluate the clinico-etiological characteristics and outcomes of children with status epilepticus admitted to a tertiary care PICU.

Methodology

Study design

This was a **prospective hospital-based cross-sectional observational study** conducted.

Study setting

This study was conducted in the pediatric intensive care unit (PICU) of the Government Medical College and Hospital, Purnea, Bihar, a tertiary care referral center catering predominantly to a rural population from surrounding districts. The hospital has a well-equipped PICU with facilities for advanced pediatric critical care and receives a high patient load of neurological emergencies. The study was conducted over a period of 8 months.

Study population

A total of **100 consecutive pediatric patients** presenting with status epilepticus were included in the study. Children aged between **1 month and 12 years** were enrolled after obtaining informed consent from their parents or legal guardians.

Inclusion criteria

- Children aged **1 month to 12 years**
- Clinical diagnosis of **status epilepticus**, defined as:
    - Continuous seizure activity lasting **≥5 minutes**, or
    - Recurrent seizures without regaining consciousness between episodes

Exclusion criteria

- Neonatal seizures (<1 month of age)
- Psychogenic non-epileptic seizures (pseudoseizures)
- Children with incomplete clinical or investigational data
- Patients referred after initial stabilization elsewhere with insufficient records

Clinical assessment and data collection

At admission, a detailed clinical history was obtained, including:

- Age and gender
- Duration and type of seizure
- Presence of fever
- Previous history of seizures or epilepsy
- Time interval between seizure onset and hospital presentation

A thorough general and neurological examination was performed for all patients, including assessment of consciousness using the Glasgow Coma Scale (GCS), vital parameters, and signs of meningeal irritation or focal neurological deficits.

Sample size

The sample size of 100 patients was determined based on feasibility and patient inflow during the study period. Considering the average number of status epilepticus cases admitted to the PICU, all eligible consecutive cases during the study period were included to maximize study power.

Laboratory and radiological investigations

All patients underwent relevant baseline investigations, which included:

- Complete blood count (CBC)
- Blood glucose levels
- Serum electrolytes (sodium, potassium, calcium)
- Renal and liver function tests

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Based on clinical indications, additional investigations were performed:

- **Cerebrospinal fluid (CSF) analysis** for suspected CNS infections
- **Neuroimaging (CT scan/MRI brain)** to identify structural abnormalities
- Electroencephalography (EEG), where feasible

Etiological classification

Based on clinical findings and investigations, patients were categorized into the following etiological groups:

- **Febrile seizures**
- **Central nervous system (CNS) infections** (meningitis, encephalitis, etc.)
- **Epilepsy-related seizures**
- **Metabolic causes** (electrolyte imbalance, hypoglycemia, etc.)
- **Others** (including toxin exposure, trauma, and unknown causes)

Management protocol

All patients were managed according to standard institutional protocols for status epilepticus, which included:

- Immediate stabilization of airway, breathing, and circulation (ABC)
- Administration of first-line anticonvulsants (benzodiazepines)
- Second-line agents such as phenytoin, levetiracetam, or valproate
- Refractory cases were managed with continuous infusion therapy and ventilatory support as required

Outcome measures

Patients were followed throughout their hospital stay, and outcomes were classified into:

- **Recovered without neurological deficit**
- **Recovered with neurological deficit**
- **Death**

Neurological deficits were assessed clinically at discharge.

Variables assessed

The study evaluated the following variables:

- Age distribution (categorized as <1 year, 1–5 years, and 6–12 years)
- Etiological profile of status epilepticus
- Type of seizure (generalized tonic-clonic or focal)
- Time to hospital presentation (≤2 hours vs >2 hours)
- Clinical outcomes

Statistical analysis

Data were entered into Microsoft Excel and analyzed using **the Statistical Package for the Social Sciences (SPSS) version 25.0**.

- Continuous variables were expressed as **mean ± standard deviation (sd)**
- Categorical variables were presented as **frequencies and percentages**

The **chi-square test** was used to assess the association between:

- Etiology (particularly CNS infections) and clinical outcome
- Delay in hospital presentation and mortality

A **p-value <0.05** was considered statistically significant.

Ethical considerations

The study was conducted after obtaining approval from the institutional ethics committee. Written informed consent was obtained from parents or guardians before inclusion. Confidentiality of patient data was strictly maintained throughout the study. In addition to parental informed consent, **assent was obtained from children above 7 years of age** wherever applicable.

Bias and confounding

Potential sources of bias, such as selection bias and referral bias, were minimized by including consecutive eligible patients admitted to the PICU. Standardized diagnostic criteria and uniform management protocols were followed to reduce measurement bias.

Results

A total of 118 children were assessed for eligibility. Of these, 100 met the inclusion criteria and were enrolled in the study. Eighteen patients were excluded due to incomplete data or not meeting the inclusion criteria. All enrolled patients completed the study and were included in the final analysis.

A total of **100 children** diagnosed with status epilepticus were included in the study. The clinical characteristics, etiological distribution, seizure types, and outcomes are presented below.

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Age distribution

The majority of children belonged to the **1–5 years age group (38%)**, followed by **6–12 years (42%)** and **infants <1 year (20%)**. Overall, **58% of cases were below 5 years of age**, indicating higher vulnerability in early childhood (Table 1).

Table 1: Age distribution of study population

Age group	Number (n=100)	Percentage (%)
<1 year	20	20%
1–5 years	38	38%
6–12 years	42	42%

Etiological profile

Febrile seizures were the most common cause of status epilepticus, accounting for **32% of cases**, followed by **CNS infections (28%)**, epilepsy (18%), metabolic causes (12%), and others (10%) (Table 2).
This distribution is also illustrated in **Figure 1.**

Table 2: Etiological distribution

Etiology	Number	Percentage (%)
Febrile seizures	32	32%
Cns infections	28	28%
Epilepsy	18	18%
Metabolic causes	12	12%
Others	10	10%

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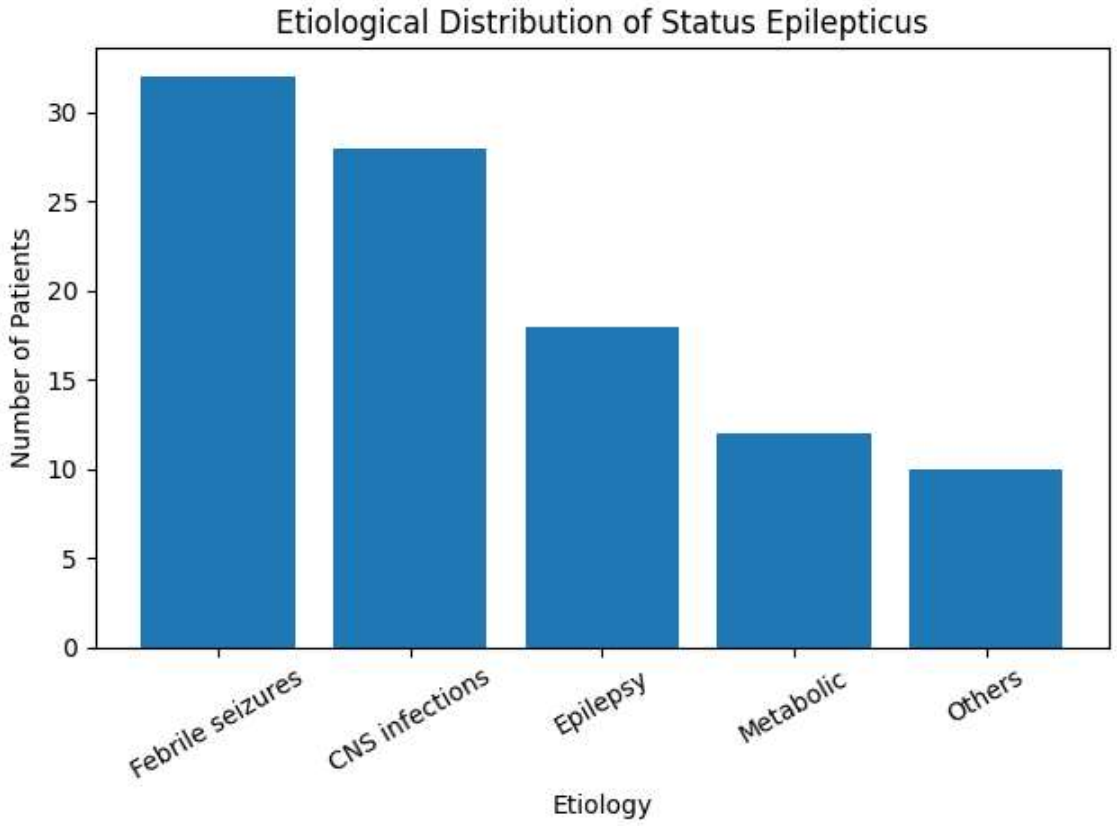

Figure 1: Distribution of etiological factors of status epilepticus among study participants

Type of seizures

Generalized tonic-clonic seizures (GTCS) were the predominant seizure type observed in **70% of patients**, whereas focal seizures were noted in **30% of cases** (Table 3).

Table 3: Types of seizures

Seizure type	Number	Percentage (%)
Generalized tonic-clonic	70	70%
Focal seizures	30	30%

Outcome distribution

Out of 100 patients, **68% recovered without neurological deficit**, **20% developed neurological sequelae**, and **12% died** during hospitalization (Table 4).

The outcome pattern is also depicted in **Figure 2**.

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Table 4: Clinical outcomes

Outcome	Number	Percentage (%)
Recovered without deficit	68	68%
Neurological deficit	20	20%
Death	12	12%

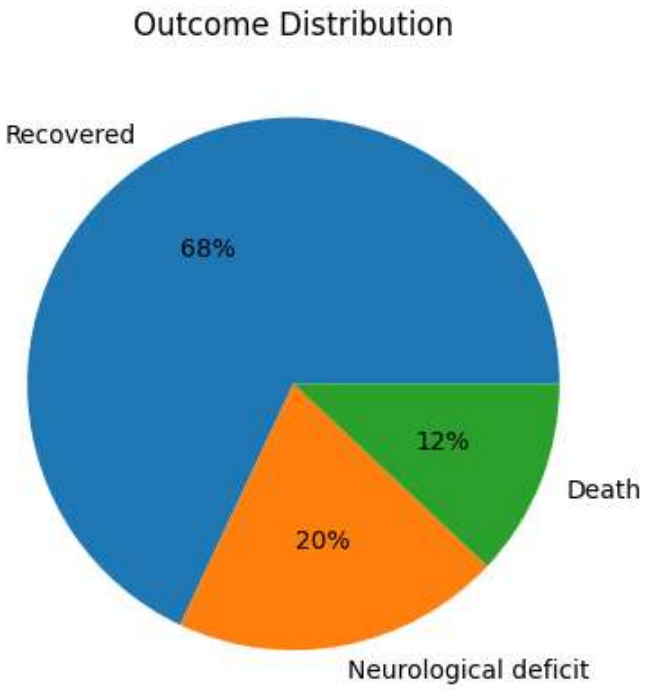

Figure 2: Outcome distribution of children with status epilepticus in the study population

Association between etiology and outcome

A statistically significant association was observed between **CNS infections and poor outcomes (neurological deficit or death)**. Among children with CNS infections, **46.4% had poor outcomes**, compared to **18.1% in non-infectious causes**.

- **Chi-square value (χ^2) = 6.52**
- **P-value = 0.011 (statistically significant)**

Effect of delay in hospital presentation

Children presenting **after 2 hours of seizure onset** had significantly higher mortality compared to those presenting early.

- Mortality in delayed presentation group: **20%**
- Mortality in early presentation group: **6%**
- **Chi-square value (χ^2) = 8.21**
- **P-value = 0.004 (statistically significant)**

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Gender and outcome
No statistically significant association was found between gender and clinical outcome.

- **P-value = 0.62 (not significant)**

Summary of key findings from results

The analysis of results revealed that the majority of cases occurred in children below five years of age, accounting for 58% of the study population. Febrile seizures and central nervous system infections emerged as the leading etiological factors. Generalized tonic-clonic seizures were identified as the most common type of seizure among the patients. In terms of outcomes, 68% of children recovered without neurological deficits, while the mortality rate was observed to be 12%. Furthermore, a statistically significant association was found between CNS infections and poor clinical outcomes ($p = 0.011$). Additionally, delayed hospital presentation was significantly associated with increased mortality ($p = 0.004$).

Discussion

The present study provides valuable insights into the clinical and etiological profile of pediatric status epilepticus in a tertiary care setting. The findings indicate that the majority of cases occurred in children below five years of age, which is consistent with previous reports highlighting early childhood as the most vulnerable period (15,16). This age predilection may be attributed to immature brain development and increased exposure to febrile illnesses.

Febrile seizures were identified as the most common cause of seizures in this study, followed by CNS infections. Similar trends have been reported in several studies conducted in developing countries (17,18). In contrast, studies from developed regions often report epilepsy as the leading etiology, reflecting differences in healthcare infrastructure and disease patterns (19).

CNS infections constituted a significant proportion of cases and were strongly associated with adverse outcomes. This finding aligns with earlier studies that emphasize the role of infections in increasing morbidity and mortality in pediatric se (20,21). Delayed diagnosis and initiation of appropriate antimicrobial therapy may further worsen the prognosis in such cases.

Generalized tonic-clonic seizures were the most frequently observed seizure type in this study, which is in agreement with existing literature (22). These seizures are more likely to evolve into prolonged episodes if not promptly managed, thereby increasing the risk of complications.

The mortality rate observed in this study was 12%, which is comparable to previously reported rates ranging from 5% to 20% in similar healthcare settings (23). Factors such as delayed hospital presentation and infectious etiology were significantly associated with poor outcomes. These findings underscore the importance of early recognition and timely referral.

Additionally, a considerable proportion of survivors developed neurological deficits, highlighting the long-term impact of se on neurodevelopment. Previous studies have also reported similar outcomes, particularly in cases associated with prolonged seizures or underlying structural brain abnormalities (24).

The study emphasizes the need for improved healthcare accessibility, early diagnosis, and prompt management to reduce the burden of se. Strengthening pediatric critical care services and increasing awareness among caregivers can play a crucial role in improving outcomes (25).

Recommendation

- Public awareness regarding early seizure management
- Safe and prompt referral to tertiary care centers
- Strengthening PICU facilities and training

Limitations

This study has certain limitations, including a single-center design, a relatively small sample size, and a short duration of follow-up. The findings may be influenced by referral bias as the study was conducted in a tertiary care center.

Generalizability

The findings of this study apply to similar tertiary care settings in developing countries. However, caution should be exercised when generalizing to primary care or developed healthcare systems due to differences in disease patterns and healthcare access.

Conclusion

Status epilepticus in children is a serious neurological emergency with significant morbidity and mortality. Febrile seizures and CNS infections are the leading causes. Early treatment and timely referral can significantly improve outcomes.

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Author biography
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Dr. Prem Prakash is an associate professor and head of pediatrics with extensive experience in pediatric intensive care.

Data availability
Data supporting the findings of this study are available from the corresponding author upon reasonable request.

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List of abbreviations
Se – status epilepticus
PICU – pediatric intensive care unit
cns – central nervous system

Author contributions
All authors contributed equally to study design, data collection, analysis, and manuscript preparation.

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