e-ISSN: 0976-822X, p-ISSN:2961-6042

Available online on http://www.ijcpr.com/

International Journal of Current Pharmaceutical Review and Research 2025; 17(9); 216-220

Original Research Article

Prospective Study of Clinico-etiological Cause of Neonatal Seizure and Its Outcome in Neonatal Intensive Care Unit

Satish Vemunuri[1], G. Ram Mohan[2]

[1]Asistant Professor, Department of Paediatrics, Chalmeda Anand Rao Institute of Medical Sciences, Karimnagar, Telangana

[2]Associate Professor, Department of Paediatrics, Chalmeda Anand Rao Institute of Medical Sciences, Karimnagar, Telangana

Received: 07-07-2025 / Revised: 05-08-2025 / Accepted: 07-09-2025

Corresponding Author: Dr. G Ram Mohan

Conflict of interest: Nil

Abstract:

Background: Neonatal seizures are the most common neurological emergency in the neonatal period and often indicate serious underlying pathology. Their clinic-etiological profile varies across populations, and early recognition is critical for improving outcomes.

Aim and Objectives: To evaluate the clinical presentation, etiological factors, and short-term outcomes of neonatal seizures in a tertiary care Neonatal Intensive Care Unit (NICU).

Materials and Methods: This prospective observational study was conducted over one year in the NICU of Chalmeda Anand Rao Institute of Medical Sciences, Karimnagar. A total of 53 neonates with clinically suspected or confirmed seizures were included. Detailed clinical history, examination, and relevant investigations such as laboratory tests, neuroimaging, and EEG were performed. Data were analysed using SPSS version 25.0, with descriptive and inferential statistics applied as appropriate.

Results: Of the 53 neonates, males predominated (58.5%), and most were term (67.9%). The majority had seizures between 2–7 days of life (50.9%). Subtle seizures (37.7%) were the most common type, followed by clonic (28.3%) and tonic (20.8%) seizures. Hypoxic-ischemic encephalopathy was the leading cause (39.6%), followed by metabolic disturbances (18.9%), intracranial hemorrhage (15.1%), and CNS infections (13.2%). At discharge, 67.9% recovered without sequelae, 20.8% had neurological deficits, and mortality was 11.3%, primarily among neonates with HIE and intracranial hemorrhage.

Conclusion: HIE remains the predominant cause of neonatal seizures, with subtle seizures as the most frequent clinical type. Despite most neonates recovering, a significant proportion developed neurological impairment or died. Early etiological diagnosis and timely management are essential to improve neonatal outcomes in NICUs.

Keywords: Neonatal Seizures, Hypoxic-Ischemic Encephalopathy, Etiology, Outcome, NICU, Subtle Seizures.

Introduction

Neonatal seizures are the most common and distinctive neurological emergency in the neonatal period, often reflecting significant underlying pathology and carrying implications for morbidity and mortality [1]. Unlike seizures in older children and adults, neonatal seizures are frequently subtle and may present as eye deviation, chewing movements, tonic posturing, or apnea rather than overt convulsions, making timely recognition a clinical challenge [2]. The incidence of neonatal seizures has been reported to range between 1.5 to 5 per 1,000 live births, with higher rates observed in preterm and low birth weight neonates [3,4].

The etiological spectrum of neonatal seizures is broad, including hypoxic-ischemic encephalopathy, intracranial hemorrhage, metabolic disturbances (such as hypoglycemia, hypocalcemia, and hypomagnesemia), central nervous system infections, and structural brain malformations [5,6]. Hypoxic-ischemic encephalopathy remains the leading cause worldwide, particularly in resource-limited settings where perinatal asphyxia is prevalent [7]. Infections such as meningitis and sepsis continue to contribute significantly to seizure burden in developing countries [8].

Seizures in neonates are not merely transient events but may herald long-term neurological sequelae, including cerebral palsy, developmental delay, and epilepsy (9). Early identification of the clinico-etiological profile of neonatal seizures is crucial for guiding targeted interventions, optimizing neuroprotective strategies, and improving prognostic outcomes [10]. Studies from different regions have demonstrated variability in the

etiological pattern, reflecting differences in perinatal care, prevalence of infections, and diagnostic facilities [11].

Despite advances in neonatal intensive care, neonatal seizures remain associated with high mortality and adverse neurodevelopmental outcomes [12]. Therefore, systematic evaluation of their clinico-etiological profile and outcomes in the neonatal intensive care unit (NICU) is essential to improve clinical management and reduce long-term complications. This prospective study aims to investigate the clinical presentation, underlying etiological factors, and outcomes of neonatal seizures among neonates admitted to the NICU, thereby contributing to evidence-based neonatal care and region-specific health strategies.

Materials and Method

This was a prospective observational study conducted in the Neonatal Intensive Care Unit (NICU) of Chalmeda Anand Rao Institute of Medical Sciences, Karimnagar, a tertiary care teaching hospital. The study was carried out over a period of one year, after obtaining approval from the Institutional Ethics Committee. Written informed consent was obtained from the parents or guardians of all enrolled neonates prior to inclusion.

All 53 neonates admitted to the NICU with clinically suspected or confirmed seizures during the study period were eligible for inclusion.

Inclusion Criteria:

1. Neonates (≤28 days of life) presenting with clinical seizures (subtle, clonic, tonic, or myoclonic).
2. Both term and preterm infants admitted to NICU.

Exclusion Criteria:

1. Neonates with transient jitteriness without associated autonomic changes.
2. Neonates with major congenital malformations incompatible with life.
3. Infants with metabolic derangements corrected prior to seizure onset.

Method

A detailed clinical history was obtained, including antenatal, intranatal, and postnatal details, with emphasis on risk factors such as perinatal asphyxia, maternal infections, prolonged labor, instrumental delivery, and family history of seizures.

Clinical examination included neurological assessment, seizure type classification, and systemic examination. Seizures were classified according to Volpe's criteria (subtle, clonic, tonic, and myoclonic).

Investigations: All neonates underwent baseline and specific investigations as indicated:

- Laboratory tests: Blood glucose, serum calcium, magnesium, sodium, potassium, urea, creatinine, and complete blood count.
- Sepsis screen: C-reactive protein, blood culture, and cerebrospinal fluid (CSF) analysis, where indicated.
- Neuroimaging: Cranial ultrasound for all cases; CT/MRI brain was done when required to evaluate structural lesions or intracranial hemorrhage.
- Electroencephalography (EEG): Performed where feasible for confirmation and classification of seizures.

Management and Follow-up: All neonates received standard NICU care, including stabilization of airway, breathing, circulation, and correction of metabolic abnormalities. Anticonvulsant therapy (phenobarbitone, phenytoin, levetiracetam, or midazolam) was administered as per NICU protocol. The clinical course, response to therapy, duration of NICU stay, and complications were recorded.

Statistical Analysis: All data were entered into Microsoft Excel 2016 and subsequently analyzed using SPSS version 25.0 (IBM Corp., Armonk, NY, USA). Descriptive statistics were applied to summarize the demographic and clinical characteristics of the study population. Continuous variables were presented as mean ± standard deviation (SD) or median with interquartile range (IQR), depending on the distribution of the data, while categorical variables were expressed as frequencies and percentages. Based on the normality of distribution. A p-value of less than 0.05 was considered statistically significant.

Observation and Results

Table 1: Demographic Profile of Neonates with Seizures (n = 53)

Parameter	Frequency	Percentages
Sex		
Male	31	58.5
Female	22	41.5
Gestational Age		
Term (≥37 weeks)	36	67.9
Preterm (<37 weeks)	17	32.1
Birht Weight		

<2.5 kg	21	39.6
≥2.5 kg	32	60.4
Mode of Delivery		
Vaginal	34	64.2
Cesarean section	19	35.8
Age at onset of seizure		
≤24 hours	18	34
2–7 days	27	50.9
>7 days	8	15.1

Out of the 53 neonates included in the study, 31 (58.5%) were males and 22 (41.5%) were females, showing a male preponderance. The majority of neonates were term babies (67.9%), while 32.1% were preterm. With respect to birth weight, 32 (60.4%) neonates had a birth weight ≥2.5 kg, whereas 21 (39.6%) weighed less than 2.5 kg. Vaginal delivery was the predominant mode of birth in 34 (64.2%) cases, compared to 19 (35.8%) delivered via cesarean section. The age at onset of seizures was mostly within the 2–7 day period (50.9%), followed by ≤24 hours of life (34%), and a smaller proportion presented after 7 days (15.1%)

Table 2: Type of Seizures Observed (n = 53)

Type of Seizures	Frequency	Percentages
Subtle	20	37.7
Clonic	15	28.3
Tonic	11	20.8
Myoclonic	7	13.2

The most frequent seizure type was subtle seizures, observed in 20 neonates (37.7%), followed by clonic seizures in 15 (28.3%), tonic seizures in 11 (20.8%), and myoclonic seizures in 7 (13.2%). This distribution highlights that subtle seizures, often difficult to diagnose clinically, were the most common presentation in this cohort

Table 3: Etiological Distribution of Neonatal Seizures (n = 53)

Etiology	Frequency	Percentages
Hypoxic-ischemic encephalopathy	21	39.6
Intracranial hemorrhage	8	15.1
Metabolic disturbances	10	18.9
• Hypoglycemia	6	11.3
• Hypocalcemia	3	5.7
• Hypomagnesemia	1	1.9
CNS infections (sepsis/meningitis)	7	13.2
Structural malformations	3	5.7
Miscellaneous/undetermined	4	7.5

The leading cause of neonatal seizures was hypoxic-ischemic encephalopathy (HIE), identified in 21 neonates (39.6%). Intracranial hemorrhage accounted for 15.1% (8 cases), while metabolic disturbances contributed to 18.9% of seizures, mainly due to hypoglycemia (11.3%), followed by hypocalcemia (5.7%) and hypomagnesemia (1.9%). CNS infections such as sepsis or meningitis were responsible for 7 cases (13.2%), and structural malformations were found in 3 neonates (5.7%). A small proportion, 4 cases (7.5%), remained under miscellaneous or undetermined causes. These findings emphasize that perinatal asphyxia leading to HIE remains the predominant cause in neonatal seizures

Table 4: Outcome of Neonates with Seizures (n = 53)

Outcome	Frequency	Percentages
Recovered without sequelae	36	67.9
Recovered with neurological deficits	11	20.8
• Hypotonia	5	9.4
• Abnormal reflexes	3	5.7
• Developmental delay signs	3	5.7
Death	6	11.3

At the time of discharge, the majority of neonates, 36 (67.9%), had recovered without any neurological sequelae. However, 11 neonates (20.8%) developed neurological deficits, of which 5 (9.4%) had hypotonia, 3 (5.7%) exhibited abnormal reflexes, and 3 (5.7%) showed early signs of developmental delay. Mortality was observed in 6 neonates (11.3%), reflecting the serious prognostic implications of neonatal seizures, particularly in cases associated with HIE and intracranial hemorrhage

Discussion

In this prospective NICU cohort of 53 neonates with seizures, we observed a male preponderance (58.5%), predominance of term births (67.9%), and onset clustering in the 2–7 day window (50.9%). Subtle seizures were most frequent (37.7%), followed by clonic (28.3%) and tonic (20.8%) events. Hypoxic-ischemic encephalopathy (HIE) was the leading etiology (39.6%), with additional burdens from intracranial hemorrhage (15.1%), metabolic disturbances (18.9%; chiefly hypoglycemia 11.3%), and CNS infections (13.2%). At discharge, 67.9% recovered without sequelae, 20.8% had neurological deficits, and 11.3% died

Our clinico-etiological pattern aligns closely with large contemporary cohorts. Glass et al. (multicenter, prospective) reported HIE as the commonest cause (38%), followed by ischemic stroke (18%) and intracranial hemorrhage (11%); mortality during admission was 17%, and 49% of survivors had abnormal neurologic examination at discharge—figures broadly comparable to our HIE predominance but with somewhat higher mortality and morbidity, likely reflecting higher electrographic seizure burden and inclusion of arterial/venous stroke in their series [12]. Tekgül et al. likewise identified a strong association between global hypoxia-ischemia and poor neurodevelopmental outcome, consistent with the higher risk we noted for adverse outcomes among asphyxial and hemorrhagic etiologies[7].

Indian and regional series echo our findings. Kumar et al. (New Delhi) highlighted HIE as the dominant cause and emphasized the diagnostic value of EEG in refining etiologic categorization [8]. Nair et al. (Kerala) reported male predominance (65%), term majority (70%), subtle seizures as most common (≈39%), and HIE as leading etiology (52%)—a pattern strikingly similar to our cohort's demographics and seizure semiology, with HIE at the top of the etiologic spectrum [13]. Other South Asian/LMIC reports consistently place HIE first, with metabolic causes (especially hypoglycemia and hypocalcemia) and hemorrhage contributing substantially, mirroring our distribution [14].

The predominance of subtle seizures in our series is well-described in neonatal literature, where motor automatisms and autonomic phenomena commonly outnumber overt convulsions; this phenotype contributes to delayed recognition and under-treatment if EEG monitoring is limited. Glass et al. documented high electrographic seizure burdens and frequent need for multiple antiseizure medications, underscoring the importance of continuous EEG to avoid missing subclinical events—an implication pertinent to resource-constrained NICUs [12].

Our outcome profile (11.3% mortality; 20.8% neurological deficits at discharge) appears somewhat more favorable than several tertiary-care reports (e.g., 17% mortality in Glass et al.; ≈20% mortality in some Indian series), though cross-study comparisons must account for referral bias, case-mix (e.g., proportion of severe HIE, stroke, extreme prematurity), access to neurocritical care (therapeutic hypothermia, ventilatory/inotropic support), and the availability of EEG/neuroimaging[12]. Notably, LMIC-focused reviews attribute outcome differences to perinatal care quality, time-to-treatment for correctable metabolic derangements, and infection control, all of which likely modulate our observed mortality and morbidity [14].

Metabolic etiologies in our cohort—hypoglycemia (11.3%) and hypocalcemia (5.7%)—track with Indian and regional reports where prompt screening/correction is repeatedly emphasized to prevent secondary brain injury [15]. The hemorrhagic fraction (15.1%) also aligns with contemporary series, although centers with broader MRI access report higher detection of parenchymal bleeds and periventricular hemorrhage, suggesting that imaging resources influence etiologic ascertainment [12].

Conclusion

In this prospective study of 53 neonates with seizures, hypoxic-ischemic encephalopathy emerged as the leading cause, followed by metabolic disturbances, intracranial hemorrhage, and CNS infections. Subtle seizures were the most common clinical type, often preceding overt manifestations. While the majority of neonates recovered without sequelae, a significant proportion developed neurological deficits (20.8%), and mortality was 11.3%, particularly among those with HIE and hemorrhagic etiologies. These findings highlight the importance of early recognition, prompt etiological diagnosis, and targeted management to improve neonatal outcomes in NICU settings.

References

1. Mizrahi EM, Watanabe K. Symptomatology and classification of neonatal seizures. Epilepsia. 2011;52 Suppl 8:3-9.

2. Scher MS. Controversies regarding neonatal seizure recognition. Epileptic Disord. 2002; 4(2): 139-58.
3. Ronen GM, Penney S, Andrews W. The epidemiology of clinical neonatal seizures in Newfoundland: a population-based study. J Pediatr. 1999;134(1):71-5.
4. Lanska MJ, Lanska DJ, Baumann RJ, Kryscio RJ. A population-based study of neonatal seizures in Fayette County, Kentucky. Neurology. 1995;45(4):724-32.
5. Pisani F, Spagnoli C. Etiology and prognosis of neonatal seizures. Curr Treat Options Neurol. 2016; 18(7):39.
6. Glass HC, Shellhaas RA, Wusthoff CJ, Chang T, Abend NS, Chu CJ, et al. Contemporary profile of seizures in neonates: a prospective cohort study. J Pediatr. 2016;174:98-103.
7. Tekgul H, Gauvreau K, Soul J, Murphy L, Robertson R, Stewart J, et al. The current etiologic profile and neurodevelopmental outcome of seizures in term newborn infants. Pediatrics. 2006;117(4):1270-80.
8. Kumar A, Gupta A, Talukdar B. Clinico-etiological and EEG profile of neonatal seizures. Indian J Pediatr. 2007;74(1):33-7.
9. Pisani F, Cerminara C, Fusco C, Sisti L. Neonatal seizures and postneonatal epilepsy: a 7-year follow-up study. Pediatr Res. 2012; 72(2): 186-93.
10. Abend NS, Wusthoff CJ. Neonatal seizures and status epilepticus. J Clin Neurophysiol. 2012; 29(5): 441-8.
11. Sahana KS, Anjaiah B. Clinical profile of neonatal seizures in a tertiary care hospital in South India. Int J Contemp Pediatr. 2017; 4(2): 486-90.
12. Glass HC, Kan J, Bonifacio SL, Ferriero DM. Neonatal seizures: treatment practices among term and preterm infants. Pediatr Neurol. 2012;46(2):111-5.
13. Nair, Bipin K.; Sharma, Jyoti; Chaudhary, Sanjeev. Clinicoetiological Profile of Neonatal Seizure in a Newborn Care Unit of a Tertiary Care Teaching Hospital in Northern India. Journal of Clinical Neonatology 9(1):p 27-31, Jan–Mar 2020. | DOI: 10.4103/jcn.JCN_70_19]
14. Vegda H, Krishnan V, Variane G, Bagayi V, Ivain P, Pressler RM. Neonatal Seizures-Perspective in Low-and Middle-Income Countries. Indian J Pediatr. 2022 Mar;89(3):245-253. doi: 10.1007/s12098-021-04039-2. Epub 2022 Jan 20. PMID: 35050459; PMCID: PMC8857130.
15. Syed AM, Shasidhar YR, Belavadi GB. Study on etiology and clinical course of neonatal seizures and their outcome. Int J Contemp Pediatr 2019;6:1985-90.