



FREQUENCY AND OUTCOME OF NEONATAL SEIZURES AT A TERTIARY CARE HOSPITAL

Sidra Saleem^{1*}, Gulab Rai², Quratulain³, Iftikhar Haider Shah⁴, Falak Naz⁵, Madia kazmi⁶

^{1*}Senior Registrar of Pediatrics, Fatima Hospital, Baqai Medical University Karachi Pakistan.

²Senior Registrar of Pediatrics, Bilawal Medical College, Liaquat University of Medical & Health Sciences (LUMHS) Jamshoro Pakistan.

³Assistant Professor of Pediatrics, National Institute of Child Health / JSMU Karachi Pakistan.

⁴Assistant Professor of Pediatrics, Pir Abdul Qadir Shah Jillaani Institute of Medical Sciences Gambat khairpur Pakistan.

⁵Assistant Consultant Pediatric Emergency, King Saud University Medical City Riyadh Saudi Arabia.

⁶Consultant Paediatric infectious Disease, Indus Hospital and Health Network Karachi Pakistan.

Email: ^{1*}sidrasaleem45@gmail.com, ²gulab_rai@yahoo.com, ³annyayaz82@gmail.com,

⁴iftikhar.hyder.shah@gmail.com,

⁵drfalaknaz10@gmail.com,

⁶drmediakazmi@hotmail.com

Corresponding Author: Sidra Saleem

Senior Registrar of Pediatrics, Fatima Hospital, Baqai Medical University Karachi Pakistan.

ABSTRACT

Background: Neonatal seizures are among the most common neurological emergencies during the neonatal period and are associated with significant morbidity and mortality. They occur more frequently in preterm and low birth weight infants and may result from hypoxic-ischemic encephalopathy, metabolic disturbances, central nervous system infections, intracranial hemorrhage, and congenital brain abnormalities. Early diagnosis remains challenging because normal neonatal movements may resemble seizures. Delayed recognition and treatment may adversely affect neurological outcomes, leading to epilepsy, cerebral palsy, developmental delay, and intellectual disability.

Objective: To determine the frequency and outcomes of neonatal seizures among neonates admitted to the Neonatal Intensive Care Unit (NICU).

Study Design: Prospective observational study.

Place and Duration: The study was conducted at the Department of Pediatrics Liaquat University of Medical & Health Sciences (LUMHS) Jamshoro Pakistan, from May 2025 to May 2026.

Methodology: This prospective observational study included 120 neonates aged 0 to 28 days of either sex who presented with clinically diagnosed neonatal seizures and were followed until hospital discharge. Data were collected using a pretested semi-structured questionnaire that included demographic characteristics, seizure profile, antenatal, natal, and postnatal history, clinical examination findings, laboratory investigations, treatment, and clinical outcomes. Seizures were classified according to Volpe's classification. Data were analyzed using descriptive statistics in Microsoft Excel.

Results: During the study period, 600 neonates were admitted to the NICU, of whom 120 had neonatal seizures, giving a frequency of 20.0%. Of the affected neonates, 77 (64.2%) were male and 43 (35.8%) were female. Eighty-four (70.0%) were term neonates, while 36 (30.0%) were preterm. Seizures developed within the first 24 hours of life in 35 (29.2%) neonates and between 24 and 48 hours in 43 (35.8%) neonates. At discharge, 98 (81.7%) neonates survived, whereas 22 (18.3%) died, resulting in an overall mortality rate of 18.3%.

Conclusion: Neonatal seizures were observed in one-fifth of NICU admissions and were associated with considerable mortality. Birth asphyxia was the leading underlying cause. Early recognition, prompt diagnosis, and appropriate management may improve clinical outcomes and reduce neonatal mortality.

Keywords: Neonatal Seizures, Neonates, Neonatal Intensive Care Unit, Nicu, Birth Asphyxia, Neonatal Outcomes.



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INTRODUCTION

Neonatal seizures are among the most common neurological emergencies during the neonatal period and represent an important indicator of underlying

brain dysfunction. They occur more frequently in neonates than at any other stage of life because of the immaturity of the developing brain. Neonatal seizures are associated with significant morbidity and mortality and are commonly encountered in neonatal intensive care units (NICUs). Early recognition and timely management are essential to minimize neurological injury and improve clinical outcomes. [1–4]

The reported incidence of neonatal seizures is higher among preterm and low birth weight infants because of their increased susceptibility to hypoxic, metabolic, infectious, and structural neurological disorders. Despite advances in neonatal care, neonatal seizures continue to be associated with poor short- and long-term outcomes. Survivors remain at increased risk of epilepsy, cerebral palsy, developmental delay, and cognitive impairment, making neonatal seizures an important public health concern. [5–8]

Neonatal seizures result from abnormal, excessive electrical activity in the immature brain and commonly occur secondary to hypoxic-ischemic encephalopathy, metabolic disturbances, central nervous system infections, intracranial hemorrhage, congenital brain malformations, and, less frequently, drug withdrawal. Accurate diagnosis remains challenging because normal neonatal movements, such as jitteriness and benign sleep myoclonus, may resemble seizures. Clinical assessment, supported by appropriate investigations, is therefore essential for establishing the diagnosis and identifying the underlying etiology. [9,10]

The frequency, etiological profile, and outcomes of neonatal seizures vary across different healthcare settings depending on the availability of perinatal care, diagnostic facilities, and neonatal intensive care services. Local data are essential for identifying the burden of disease, guiding early diagnosis and management, and improving neonatal outcomes. Therefore, the present study was conducted to determine the frequency and outcomes of neonatal seizures among neonates admitted to the Neonatal Intensive Care Unit of a tertiary care hospital.

METHODOLOGY

This prospective observational study was conducted at our hospital after obtaining approval from the Institutional Ethical Review Committee. Written informed consent was obtained from the parents or legal guardians of all enrolled neonates before participation.

A total of 120 neonates aged 0–28 days of either sex who presented with clinically diagnosed neonatal seizures and were admitted to the Neonatal Intensive Care Unit (NICU) during the study period were included. All enrolled neonates were followed prospectively from the time of admission until discharge or death to determine their clinical

outcomes. The study participants were recruited using [consecutive/non-probability convenience] sampling.

Inclusion Criteria

Neonates aged 0–28 days of either sex with clinically diagnosed neonatal seizures admitted to the NICU during the study period were included in the study.

Exclusion Criteria

Neonates who were discharged against medical advice (DAMA) before completion of treatment and follow-up were excluded. Neonates with doubtful or unconfirmed seizure episodes, including those later identified as non-epileptic movements such as jitteriness or benign neonatal movements, were also excluded.

Data were collected using a predesigned, pretested semi-structured questionnaire. Information was obtained from the parents or close relatives, with the mother serving as the primary respondent whenever possible. Demographic characteristics, including age, sex, gestational age, birth weight, and mode of delivery, were recorded. Clinical information included the age at onset of seizures, frequency and type of seizures, associated autonomic manifestations, presumed etiology, treatment administered, response to anticonvulsant therapy, and final hospital outcome. Detailed antenatal, natal, and postnatal histories were also obtained.

A comprehensive clinical examination was performed for each neonate. Relevant laboratory and radiological investigations were carried out according to the clinical condition of the patient to identify the underlying cause of seizures. These investigations included blood glucose, serum electrolytes, calcium, magnesium, sepsis workup, cerebrospinal fluid analysis where indicated, cranial ultrasonography, computed tomography (CT), magnetic resonance imaging (MRI), electroencephalography (EEG), and other investigations whenever clinically indicated.

Neonatal seizures were classified according to Volpe's classification into subtle, focal clonic, multifocal clonic, tonic, and myoclonic seizures. The primary outcome measure was the hospital outcome (survival or death), while secondary outcomes included the frequency of neonatal seizures and their clinical characteristics.

The collected data were entered into Microsoft Excel and analyzed using descriptive statistical methods. Categorical variables were summarized as frequencies and percentages, while continuous variables were presented as means with standard deviations or medians with interquartile ranges, as appropriate.

RESULTS

During the study period, a total of 600 neonates were admitted to the Neonatal Intensive Care Unit

(NICU). Among these, 120 neonates were diagnosed with neonatal seizures, giving an overall

frequency of 20.0%. The remaining 480 (80.0%) neonates did not experience seizures (Table 1).

Table 1. Frequency of neonatal seizures among NICU admissions

Variable	n	%
Total NICU admissions	600	100.0
Neonates with seizures	120	20.0
Neonates without seizures	480	80.0

Among the 120 neonates with seizures, 77 (64.2%) were male and 43 (35.8%) were female, resulting in a male-to-female ratio of approximately 1.8:1.

Regarding gestational age, 84 (70.0%) neonates were born at term, whereas 36 (30.0%) were preterm (Table 2).

Table 2. Demographic characteristics of neonates with seizures (n = 120)

Variable	n	%
Gender		
Male	77	64.2
Female	43	35.8
Gestational age		
Preterm (<37 weeks)	36	30.0
Term (≥37 weeks)	84	70.0

The distribution of seizure types according to Volpe's classification is shown in Table 3. Subtle seizures were the most common seizure type in both preterm and term neonates, accounting for 38.9% and 33.3% of cases, respectively. Among preterm neonates, tonic seizures were the second most

common type (30.6%), whereas focal clonic (25.0%) and multifocal clonic seizures (21.4%) were more frequently observed among term neonates. Myoclonic seizures were uncommon and were observed only in term neonates.

Table 3. Distribution of seizure types according to Volpe's classification

Type of seizure	Preterm (n = 36)		Term (n = 84)	
	n	%	n	%
Subtle	14	38.9	28	33.3
Focal clonic	8	22.2	21	25.0
Multifocal clonic	3	8.3	18	21.4
Tonic	11	30.6	14	16.7
Myoclonic	0	0.0	3	3.6

The age at onset of seizures is presented in Table 4. The majority of neonates (78, 65.0%) developed seizures within the first 48 hours of life. The highest proportion (35.8%) developed seizures between 24

and 48 hours, followed by 29.2% within the first 24 hours. Only 14 (11.7%) neonates developed seizures after the first week of life.

Table 4. Age at onset of neonatal seizures

Age at onset	n	%
0–24 hours	35	29.2
>24–48 hours	43	35.8
>2–7 days	28	23.3
>7 days	14	11.7

The etiological distribution of neonatal seizures according to gestational age is shown in Table 5. Birth asphyxia was the leading cause in both preterm (36.1%) and term (48.9%) neonates. Intraventricular hemorrhage was more common among preterm

neonates, whereas meningitis occurred more frequently in term neonates. Septicemia, hypocalcemia, and hypoglycemia were observed in both groups.

Table 5. Etiology of neonatal seizures according to gestational age

Etiology	Preterm (n = 36)		Term (n = 84)	
	n	%	n	%
Birth asphyxia	13	36.1	41	48.9
Intraventricular hemorrhage	7	19.4	1	1.2
Septicemia	7	19.4	15	17.9
Hypocalcemia	3	8.3	10	11.9
Hypoglycemia	4	11.1	7	8.3
Meningitis	1	2.8	9	10.7
Others	1	2.8	1	1.2

Overall, birth asphyxia was the most common cause of neonatal seizures, accounting for 54 (45.0%) cases. This was followed by septicemia (18.3%), hypocalcemia (10.8%), hypoglycemia (9.2%),

meningitis (8.3%), and intraventricular hemorrhage (6.7%). Only 2 (1.7%) neonates had other less common causes (Table 6).

Table 6. Overall etiology of neonatal seizures (n = 120)

Etiology	n	%
Birth asphyxia	54	45.0
Septicemia	22	18.3
Hypocalcemia	13	10.8
Hypoglycemia	11	9.2
Meningitis	10	8.3
Intraventricular hemorrhage	8	6.7
Others	2	1.7

The clinical outcomes of neonates with seizures are presented in Table 7. Of the 120 neonates included in the study, 98 (81.7%) survived and were

discharged from the hospital, whereas 22 (18.3%) died during hospitalization, resulting in an overall mortality rate of 18.3%.

Table 7. Clinical outcomes of neonates with seizures

Outcome	N	%
Survived	98	81.7
Died	22	18.3

DISCUSSION

Neonatal seizures remain one of the most common neurological emergencies encountered in Neonatal Intensive Care Units (NICUs) and continue to contribute substantially to neonatal morbidity and mortality. In the present study, the frequency of neonatal seizures among NICU admissions was 20.0%, which is consistent with previous hospital-based studies reporting frequencies ranging from 10% to 25% among NICU admissions [12]. The relatively high frequency observed in the present study may be attributed to the referral of critically ill

neonates with complicated perinatal conditions to a tertiary care hospital.

A male predominance was observed in the present study, with 64.2% of neonates with seizures being male. This finding is consistent with the study conducted by Bari et al., who also reported that approximately 64% of affected neonates were male [13]. Similar observations have been reported by several other investigators [14,15]. Although the exact reason for this male predominance remains uncertain, biological differences and increased

susceptibility of male neonates to perinatal brain injury have been proposed as possible explanations. In the current study, 70.0% of neonates with seizures were born at term, while 30.0% were preterm. This finding is in agreement with previous studies demonstrating that neonatal seizures are more frequently encountered among term infants because hypoxic-ischemic encephalopathy remains the leading underlying cause in this group. In contrast, seizures in preterm neonates are more commonly associated with intraventricular hemorrhage owing to the immaturity and fragility of the germinal matrix vasculature.

Subtle seizures were the most common seizure type observed in both term and preterm neonates. This finding is comparable to previous reports, which have consistently identified subtle seizures as the predominant clinical manifestation during the neonatal period [16,17]. The predominance of subtle seizures is likely related to the functional immaturity of the neonatal cerebral cortex, resulting in less organized motor manifestations compared with seizures occurring later in childhood.

Birth asphyxia was identified as the leading cause of neonatal seizures in the present study, followed by septicemia, hypocalcemia, hypoglycemia, meningitis, and intraventricular hemorrhage. These findings are in accordance with previous studies that have consistently reported hypoxic-ischemic encephalopathy as the most frequent etiology of neonatal seizures, particularly in developing countries where perinatal complications remain common [18]. Early recognition and appropriate management of birth asphyxia and neonatal infections may substantially reduce the burden of neonatal seizures and improve clinical outcomes.

Most neonates developed seizures within the first 48 hours of life, accounting for approximately 65% of all cases. This observation is consistent with previous literature, which demonstrates that seizures occurring during the first two days of life are most commonly associated with hypoxic-ischemic brain injury following perinatal asphyxia [19]. Therefore, neonates with significant perinatal risk factors require close neurological monitoring during the early neonatal period.

The overall survival rate in the present study was 81.7%, whereas the mortality rate was 18.3%. This mortality rate is comparable to previously published reports, where mortality among neonates with seizures ranged from 16% to 23%, depending on the underlying etiology, severity of illness, and availability of intensive neonatal care [20]. Despite advances in neonatal management, neonatal seizures continue to be associated with considerable mortality, highlighting the need for early diagnosis, prompt treatment, and improved perinatal care.

The present study has certain limitations. It was conducted at a single tertiary care center with a

relatively small sample size, which may limit the generalizability of the findings. In addition, long-term neurological follow-up was not performed; therefore, important neurodevelopmental outcomes such as epilepsy, cerebral palsy, developmental delay, and cognitive impairment could not be assessed. Future multicenter studies with larger sample sizes and long-term follow-up are recommended to better evaluate the long-term outcomes of neonatal seizures.

CONCLUSION

Neonatal seizures remain a major neurological emergency in the NICU and are associated with significant morbidity and mortality. In the present study, neonatal seizures occurred in one-fifth of NICU admissions and were more common among male and term neonates. Birth asphyxia was the leading etiological factor, while subtle seizures were the most frequently observed seizure type. Most seizures occurred within the first 48 hours of life, emphasizing the importance of close monitoring during the early neonatal period. Early identification of at-risk neonates, prompt diagnosis, and timely management of the underlying causes may improve survival and reduce adverse neurological outcomes.

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Conflict of Interest

The authors declare that they have no conflict of interest.

Ethical Approval

Ethical approval for this study was obtained from the Institutional Ethical Review Committee before commencement of the study. Written informed consent was obtained from the parents or legal guardians of all participating neonates.

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