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Original Research Article

Study of the clinical profile and etiology of neonatal seizures in a tertiary care centre of Bundelkhand region

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ABSTRACT

Background: Neonatal seizures are among the most common neurological emergencies, contributing to significant morbidity and mortality. Their causes vary, including hypoxic-ischemic encephalopathy (HIE), infections, metabolic disorders, and intracranial hemorrhage. Seizures in neonates often result in long-term neurodevelopmental challenges, making early diagnosis and intervention crucial. This study aims to assess the prevalence, clinical presentation, etiological factors in neonatal seizures in a tertiary care center in the Bundelkhand region.
Methods: This prospective observational study was conducted at the neonatal intensive care unit (NICU) of Maharani Laxmi Bai Medical College, Jhansi, Uttar Pradesh, from May 2023 to April 2024. A total of 140 neonates diagnosed with seizures and hospitalized for more than 24 hours were included. Data collection involved seizure type, onset, clinical and neurological assessments, and investigations such as electroencephalography (EEG), cranial ultrasound, and metabolic screening.
Results: Among the 140 neonates, 69.3% were outborn, with HIE (65.7%) being the most common cause, followed by septicemia (20.7%) and metabolic disorders (5%). Multifocal clonic seizures (37.9%) were most frequent, followed by subtle seizures (34.3%).
Conclusions: Neonatal seizures remain a major concern, with HIE being the leading cause. A significant proportion of affected neonates experience neurodevelopmental delays, emphasizing the need for early recognition, timely intervention, and long-term follow-up. The findings draw attention to Improved neonatal care and early intervention at the time of delivery in form of widespread neonatal resuscitation training program for all the health care staff who care for newborn at the time of delivery.

Keywords: Neonatal seizures, Hypoxic-ischemic encephalopathy, Tertiary care, Bundelkhand region

INTRODUCTION

Neonatal seizures are among the most frequently encountered neurological emergencies in the neonatal period. These seizures are defined as paroxysmal alterations in neurological function, including motor, behavioral, and autonomic dysfunction, occurring within the first 28 days of life. The incidence of neonatal seizures varies globally, with a reported rate of approximately 10.3 per 1000 live births in India. However, due to their often subtle and clinically ambiguous manifestations, the true incidence remains underestimated.[1,2]

Neonatal seizures differ significantly from those seen in older children and adults. The immature neonatal brain exhibits heightened excitability due to an imbalance between excitatory and inhibitory neurotransmission. GABA, which functions as an inhibitory neurotransmitter in mature neurons, has an excitatory role in neonates due to the immaturity of chloride transport mechanisms. This results in an increased risk of seizure activity in response to various stressors, such as hypoxia, metabolic imbalances, and infections. Additionally, neonatal seizures are often resistant to conventional antiepileptic drugs, making their management more challenging.[3,4]

The etiology of neonatal seizures is diverse and multifactorial. Hypoxic-ischemic encephalopathy (HIE) remains the leading cause, accounting for nearly 50–65% of cases. Other common etiologies include metabolic disturbances (hypoglycemia, hypocalcemia, and electrolyte imbalances), intracranial hemorrhage, infections such as neonatal meningitis and sepsis, congenital brain malformations, and genetic disorders, including channelopathies like KCNQ2-related epilepsy. The timing of seizure onset is also a crucial determinant of prognosis, with early-onset seizures (within the first 24 hours of life) often associated with more severe underlying conditions.[5,6]

Clinically, neonatal seizures can present in various forms, including clonic, tonic, myoclonic, and subtle seizures. Subtle seizures, characterized by ocular deviations, sucking movements, apnea, and autonomic instability, are particularly common and may be difficult to recognize without continuous electroencephalographic (EEG) monitoring. EEG remains the gold standard for diagnosing neonatal seizures, as it can detect both clinical and subclinical seizures, aiding in early intervention and management. Neuroimaging, including cranial ultrasound and magnetic resonance imaging (MRI), is often required to determine the underlying cause.

Despite advances in neonatal intensive care, neonatal seizures continue to be associated with high morbidity and mortality. The burden of neonatal seizures is particularly high in low-resource settings like the Bundelkhand region, where inadequate perinatal care and delays in neonatal resuscitation contribute significantly to the incidence of HIE-related seizures.[7,8]

Given the significant impact of neonatal seizures on long-term neurodevelopmental outcomes, there is a pressing need for improved detection, timely intervention, and comprehensive follow-up. This study aims to assess the clinical profile, etiology in neonates diagnosed with seizures at a tertiary care center in the Bundelkhand region. Understanding the etiology and early predictors of adverse outcomes will aid in optimizing neonatal care, thereby improving survival and neurodevelopmental prognosis in affected neonates.

METHODS

Study/research design

A prospective observational study was employed.

Sample selection

Inclusion criteria

Consecutively admitted term babies of less than 1 month of age with neonatal seizure at our NICU who stayed for >24 hours was included.

Exclusion criteria

Infants born prematurely, those experiencing seizures after the age of one month, cases of neonatal tetanus, and infants with apparent congenital abnormalities were excluded from the current study. Additionally, mothers who declined to participate and cases of neonatal death were also excluded.

Sample size

By taking the help of non-probability purposive sampling, we have taken the sample size to be 140.

Study method

A prospective observational study was conducted in the NICU of the Department of Pediatrics, Maharani Laxmi Bai Medical College, Jhansi (May 2023–April 2024). Neonates admitted between May and November 2023 were enrolled after informed written consent and followed up to 6 months of age.

Clinical data included seizure type, neonatal age, maternal history (drug intake, infections), delivery details (mode, Apgar scores, resuscitation), family history, and feeding patterns. All neonates underwent thorough physical and neurological examinations.

Laboratory investigations included blood glucose, electrolytes (Na^+, K^+, Ca^{2+}, Mg^{2+}, phosphate), sepsis markers, CSF analysis (for suspected meningitis), and blood cultures. Imaging (cranial ultrasound, X-rays, CT/MRI), EEG, thyroid profile, CBC, liver and renal function tests were performed as needed. HIE was staged using the Sarnat and Sarnat classification, and data were recorded in a structured proforma.

RESULTS

Table 1 shows the distribution of patients with respect to neonatal seizure. The number of cases with neonatal seizure were 367 out of the 1607 cases admitted to the SNCU. We have prevalence of neonatal seizure in our study as 22.83%.

Table 1: Distribution of participants with respect to neonatal seizure.

Parameter	N
Neonatal seizure	367
Number of infants admitted to SNCU	1607

Table 2 shows the distribution of patients according to inborn/out born. The major proportion of cases included in the present study were out born (69.3%), while the rest were inborn (30.7%).

Table 2: Distribution of participants with respect to Inborn and out born (n=140).

Parameter	N (%)
Inborn	43(30.7)
Out born	97 (69.3)

Table 3 presents the distribution of study participants based on their gender. According to the data presented in the table, the study included 140 participants, with a majority of them being males (65.7%), while the remaining participants were females (34.3%).

Table 3: Distribution of study participants in terms of gender (n=140).

Gender	Number of patients (N)	Percentage (%)
Male	92	65.7
Female	48	34.3

Table 4 displays the distribution of study participants according to their diagnosis. Based on the information provided in the table, it can be observed that the highest proportion of the study participants were diagnosed as having HIE (65.7%). This was followed by septicemia (20.7%), neonatal jaundice (7.9%), metabolic derangement (5%) with one case (0.7%) of intracranial haemorrhage.

Table 4: Distribution of study participants in terms of etiology (n=140).

Etiology	Number of patients (N)	Percentage (%)
Hypoxic ischemic encephalopathy	92	65.7
Septicemia	29	20.7
Neonatal jaundice	11	7.9
Metabolic derangement	7	5
Intracranial hemorrhage	1	0.7
Total	140	100

Table 5: Distribution of study participants in terms of type of seizure (n=140).

Diagnosis	Number of patients (N)	Percentage (%)
Multifocal clonic	53	37.9
Subtle	48	34.3
Focal clonic	23	16.4
Tonic	15	10.7
Generalised tonic clonic	1	0.7
Total	140	100

Table 5 displays the distribution of study participants according to type of seizure. Based on the information provided in the table, it can be observed that the highest proportion of the study participants were diagnosed as having multifocal clonic (37.9%), followed by subtle type of seizure (34.3%), focal clonic (16.4%), tonic (10.7%) and generalized tonic clonic (0.7%).

DISCUSSION

Inborn versus outborn distribution

In our study, 69.3% of the neonates with seizures were outborn, while 30.7% were inborn. This significant predominance of outborn neonates underscores the challenges faced by facilities with limited neonatal care resources, leading to referrals to tertiary care centers. The disparity highlights the need for improved perinatal care and early intervention at primary and secondary healthcare levels.

The study by Salehiomran et al similarly reported a higher incidence of neonatal seizures among outborn neonates, with 65.4% of the cases being outborn compared to 34.6% inborn. The study emphasized that outborn neonates often arrive at tertiary centers with more severe conditions due to delayed or inadequate initial care, which contributes to the higher incidence of seizures. The study also highlighted the importance of strengthening neonatal care at lower-tier healthcare facilities to prevent such outcomes.[9]

In contrast, the study conducted by Sudia et al found that outborn neonates constituted 58.3% of the total cases, with inborn neonates accounting for 41.7%. While the proportion of outborn cases was still higher, the difference was less pronounced than in our study. This study attributed the slightly better outcomes in inborn neonates to the immediate availability of neonatal intensive care at the place of birth, which likely resulted in quicker interventions and reduced the severity of seizures.[10]

Gender distribution

In our study a significant gender disparity in the incidence of neonatal seizures, with males representing 65.7% of cases, a trend that aligns with existing research, such as Kang et al, who found a similar male-to-female ratio of 1.6:1.[11] The underlying causes for this male predominance are not fully understood, though genetic and hormonal factors, as well as a higher susceptibility to perinatal complications like HIE, are proposed explanations. This trend has been observed in other studies, including those by Abhishek et al and Saral et al, both of which report higher seizure incidences and perinatal complications in male neonates, particularly among outborn referrals.[12,13] These findings underline the importance of considering sex-specific factors in neonatal seizure research and highlight the need for improved maternal and neonatal care at peripheral centers.

Hypoxic ischemic encephalopathy

In our study, HIE was identified as the cause of seizures in 65.7% of neonates, consistent with the findings of Ferriero reporting poor outcomes, including cerebral palsy and severe cognitive impairment, in 65% of cases.[14] Additionally, Rutherford et al observed that 70% of neonates with HIE-induced seizures had significant motor and cognitive impairments by age two, underscoring the critical need for early intervention.[15]

Seizure types

Multifocal clonic seizures were observed in 37.9% of the study participants. These seizures are characterized by rhythmic jerking movements that can occur in multiple muscle groups and are typically asynchronous. This type of seizure is often seen in neonates and is considered a common form due to the immature neurological development during the neonatal period. According to a study by Kumar et al, multifocal clonic seizures are prevalent among neonates admitted to intensive care units, reflecting a similar distribution as seen in our study. Another study by Volpe also highlights the frequency of multifocal clonic seizures, noting their significance in early neurological assessment.[1]

CONCLUSION

Neonatal seizures are a critical neurological emergency requiring early detection and management to prevent long-term neurodevelopmental complications. This study highlights HIE as the leading cause, followed by septicemia, neonatal jaundice, and metabolic derangements. Multifocal clonic seizures were the most common type, with subtle seizures following closely. Gender differences in developmental outcomes were minimal, and no significant variation was noted between male and female neonates. The findings draw attention to improved neonatal care and early intervention at time of delivery in form of widespread neonatal resuscitation training program for all the health care staff who care for newborn at the time of delivery.

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