MAK HILL Publications Research Journal of Medical Sciences

Research Article
doi: 10.36478/makrjms.2024.10.347.351

OPEN ACCESS

Key Words
Neonatal seizures, hypocalcemia, hypoglycemia, biochemical abnormalities, metabolic acidosis, NICU

Corresponding Author
Sai Brigisha Kyasa,
Kamineni Institute of Medical Sciences, Narketpalle, Telangana, India
saibrigisha.kyasa@gmail.com

Author Designation
[1]Associate Professor
[2]MBBS Graduate

Received: 20 August 2024
Accepted: 19 September 2024
Published: 21 September 2024

Citation: Kyasa Srinivas and Sai Brigisha Kyasa, 2024. A Study to Assess Biochemical Abnormalities in Neonatal Seizures. Res. J. Med. Sci., 18: 347-351, doi: 10.36478/makrjms.2024.10.347.351

A Study to Assess Biochemical Abnormalities in Neonatal Seizures

[1]Kyasa Srinivas and [2]Sai Brigisha Kyasa
[1]Département of Paediatrics, Chalmeda Anand Rao Institute of Medical Sciences, Karimnagar. Telangana, India
[2]Kamineni Institute of Medical Sciences, Narketpalle, Telangana, India

ABSTRACT
Neonatal seizures are a significant neurological concern that often indicate an underlying disorder. Prompt identification and treatment of biochemical abnormalities contributing to seizures are crucial to reducing morbidity and long-term neurological impairment. The study aimed to identify common metabolic disturbances that could guide timely and targeted interventions. This hospital based cross sectional observational study was conducted in a neonatal intensive care unit (NICU) over a period of 12 months. Neonates who presented with clinically diagnosed or electrographically confirmed seizures were included in the study. Detailed clinical histories were recorded. Biochemical investigations, including serum electrolytes, blood glucose, calcium, magnesium and arterial blood gas (ABG) analyses, were performed to identify metabolic causes. The data were analyzed to determine the frequency of abnormalities and their correlation with neonatal seizures. Out of 76 neonates, 82% exhibited at least one biochemical abnormality. hypoglycemia was the most common finding (34.2%), followed by Hypocalcemia (25%) and Hyponatremia and hypernatremia were observed in 11.8% and 9.2% of cases, respectively. Metabolic acidosis was detected in 18% of neonates. Early-onset seizures (<72 hours) were more frequently associated with hypoglycemia and hypocalcemia. Biochemical abnormalities are prevalent in neonates with seizures, with hypocalcemia and hypoglycemia being the most common. Routine biochemical screening in neonatal seizures can facilitate prompt treatment and improve neurological outcomes.

INTRODUCTION

Neonatal seizures are a significant neurological concern in the neonatal period, often signaling underlying pathologies and requiring prompt attention and intervention. Seizures in neonates, defined as abnormal electrical activity in the brain, are typically a manifestation of diverse etiologies ranging from metabolic disturbances to structural brain abnormalities, infections and genetic disorders. These seizures may present subtly, often with non-specific clinical signs such as jitteriness, apnea, or abnormal posturing, making diagnosis challenging. Early identification and management are crucial, as untreated neonatal seizures can lead to long-term neurodevelopmental sequelae, including cerebral palsy, intellectual disabilities and epilepsy.

Biochemical abnormalities are among the most common causes of neonatal seizures, contributing to a significant proportion of cases, particularly in the early neonatal period. Electrolyte imbalances, metabolic disorders and abnormalities in blood glucose levels are key biochemical disturbances that can precipitate seizures in neonates. These disturbances can occur as a result of various perinatal complications, including birth asphyxia, maternal metabolic conditions, or premature delivery, all of which can affect the neonate's delicate biochemical balance.

Hypoglycemia, or low blood glucose levels, is one of the most common metabolic abnormalities associated with neonatal seizures. Glucose is the primary energy source for the developing brain, and neonates, particularly preterm or small-for-gestational-age infants, are at increased risk of hypoglycemia due to their limited glycogen stores and immature glucose-regulating mechanisms. Severe or prolonged hypoglycemia can cause significant neuronal damage, leading to seizures and long-term neurodevelopmental impairments. Thus, early detection and correction of hypoglycemia are essential in preventing adverse outcomes.

Similarly, electrolyte imbalances, particularly disturbances in sodium, calcium and magnesium levels, can be important contributors to neonatal seizures. Hyponatremia (low sodium levels), hypernatremia (high sodium levels), hypocalcemia (low calcium levels), and hypomagnesemia (low magnesium levels) are common biochemical abnormalities observed in neonates with seizures. These imbalances can disrupt the normal excitability of neurons, increasing the likelihood of seizure activity. For instance, hypocalcemia is frequently seen in neonates born to diabetic mothers or those with perinatal asphyxia, conditions that can alter calcium homeostasis and lead to seizures.

Perinatal asphyxia, a condition in which the newborn experiences oxygen deprivation around the time of birth, is another major cause of neonatal seizures and is often associated with metabolic acidosis. In this condition, a lack of oxygen to the brain can result in cellular injury and the accumulation of lactic acid, leading to a decrease in blood pH. This acidosis, combined with disruptions in energy metabolism, can significantly increase the risk of seizures in the affected neonate. In many cases, these seizures occur within the first 24 hours of life and may be associated with other signs of hypoxic-ischemic encephalopathy (HIE).

Given the critical role that biochemical disturbances play in the pathogenesis of neonatal seizures, it is essential to conduct a thorough evaluation of neonates presenting with seizure activity. Prompt recognition and correction of underlying biochemical abnormalities can prevent further seizure episodes and reduce the risk of long-term neurological damage. In clinical practice, a systematic approach is required to identify and manage these abnormalities. This involves the prompt measurement of blood glucose levels, serum electrolytes (sodium, potassium, calcium and magnesium) and acid-base status in neonates with suspected seizures. Appropriate treatment, such as the administration of glucose for hypoglycemia or calcium for hypocalcemia, can often result in rapid resolution of seizure activity and improved outcomes.

The assessment of biochemical abnormalities in neonates with seizures also provides important prognostic information. Neonates with seizures due to easily correctable metabolic disturbances generally have a better prognosis than those with seizures caused by more complex conditions such as structural brain abnormalities or genetic disorders. However, if these biochemical abnormalities are not recognized and treated in a timely manner, the risk of permanent brain injury increases significantly.

This study aims to assess the prevalence and types of biochemical abnormalities in neonates presenting with seizures, with a focus on identifying the most common metabolic and electrolyte disturbances associated with seizure activity. By understanding the spectrum of biochemical abnormalities in neonatal seizures, this study seeks to highlight the importance of early and comprehensive metabolic evaluation in the management of neonatal seizures. The findings of this study could contribute to improved clinical protocols for the prompt identification and treatment of biochemical causes of neonatal seizures, ultimately leading to better neonatal outcomes and reduced long-term neurological complications.

MATERIALS AND METHODS

This study was designed as a hospital-based cross-sectional observational study, conducted over a period of 12 months in the Neonatal Intensive Care Unit (NICU) of CAIMS, Karimnagar. The study

population included 76 neonates admitted to the NICU with clinical or electrographic evidence of seizures. The inclusion and exclusion criteria were as follows.

Inclusion Criteria:

- Neonates aged 0-28 days with clinical signs of seizures or electroencephalographically confirmed seizures.
- Both preterm and term neonates were eligible for inclusion.
- Neonates born in the hospital and those referred from other centers were included.
- Parents provided informed written consent for participation in the study.

Exclusion Criteria:

- Neonates with known structural brain malformations.
- Neonates with a prior diagnosis of a genetic syndrome known to cause seizures.
- Neonates with confirmed central nervous system (CNS) infections, such as meningitis or encephalitis, were excluded to focus on metabolic and biochemical causes.
- Neonates whose parents declined consent for participation.

Sample Size: A sample size of 76 was determined based on the prevalence of neonatal seizures and previous studies reporting the proportion of seizures attributable to biochemical abnormalities. A power calculation was performed, ensuring 80% power and a confidence interval of 95% to detect significant biochemical abnormalities associated with seizures.

Methods:

- **Clinical Assessment:** Upon admission, a detailed clinical history was obtained from the mother or caregiver, including antenatal and perinatal factors, birth history. The clinical features of the seizures, type (clonic, tonic, subtle, or myoclonic), and duration, were recorded.
- **Biochemical Investigations:** All neonates presenting with seizures underwent a thorough biochemical evaluation within the first 24 hours of admission, as per the study protocol. Blood samples (2-3 mL) were drawn under sterile conditions and sent to the laboratory for analysis. The following biochemical parameters were measured:
- **Blood Glucose:** Hypoglycemia was defined as blood glucose levels <40 mg/dL in term neonates and <30 mg/dL in preterm neonates.
- **Serum Electrolytes:** Sodium, potassium, calcium, and magnesium levels were measured using an automated electrolyte analyzer.
- **Hyponatremia:** Serum sodium <135 mEq/L.
- **Hypernatremia:** Serum sodium >145 mEq/L.
- **Hypocalcemia:** Total serum calcium <7 mg/dL in term neonates and <6 mg/dL in preterm neonates.
- **Hypomagnesemia:** Serum magnesium <1.5 mg/dL.
- **Acid-Base Status:** Arterial blood gas (ABG) analysis was performed to assess pH, bicarbonate (HCO_3^-), and base excess. Metabolic acidosis was defined as pH <7.35 and HCO_3^- <20 mmol/L.
- **Serum Lactate:** Elevated lactate levels were used to evaluate tissue hypoxia and metabolic acidosis.
- All biochemical values were interpreted based on standard neonatal reference ranges.

Neuroimaging and Electroencephalography (EEG): To rule out structural causes of seizures, cranial ultrasonography or magnetic resonance imaging (MRI) was performed when clinically indicated. Electroencephalography (EEG) was also conducted to confirm the presence of seizure activity and differentiate between clinical and subclinical seizures.

Additional Investigations: If necessary, further metabolic screening, including ammonia levels, lactate/pyruvate ratios and plasma amino acids, was performed in neonates with persistent seizures after correcting the identified biochemical abnormalities.

Statistical Analysis: Data were entered into Microsoft Excel and analyzed using SPSS software version 25. Continuous variables, such as blood glucose, serum electrolyte levels and lactate, were expressed as mean±standard deviation (SD) or median (interquartile range), depending on data distribution. Categorical variables, such as the presence of biochemical abnormalities, were expressed as frequencies and percentages. Chi-square tests were used to analyze categorical variables A p-value of <0.05 was considered statistically significant for all analyses.

RESULTS AND DISCUSSIONS

The study population included 76 neonates admitted to the NICU with clinical or electrographic evidence of seizures and their observation are given below.

Table 1 : Distribution of Demographic Profile among Study Population

Parameters	Frequency	Percentage
Gender		
Male	40	52.6
Female	36	47.4
Pregnancy		
Term	54	71.1
Preterm	22	28.9
Birth Weight		
Normal Birth Weight	49	64.5
Low Birth Weight	27	35.5

Table 2 : Distribution of Onset of Seizures and Type of Seizures

Parameters	Frequency	Percentage
Onset of Seizures		
First 24 Hours	18	23.7
1-3 Days	37	48.7
4-7 Day	15	19.7
After 1 week	6	7.9
Type of Seizures		
Subtle	42.0	55.3
Tonic	24	31.6
Clonic	10	13.2

Table 3 : Distribution of Biochemical Parameters among Study Population

Biochemical Parameters	Frequency	Percentage
Hypocalcaemia	19	25
Hyponatremia	9	11.8
Hypoglycemia	26	34.2
Hypomagnesemia	7	9.2

Table 4 : Distribution of Biochemical Parameters among Study Population

Type of Seizures	Type of Pregnancy		Chi-square	P-value
	Preterm	Term		
Subtle	13	29	0.269	0.874
Tonic	6	18		
Clonic	3	7		

Seizures are the most frequent neurological diseases in new-borns and they are more common in pre-term neonates than in term neonates. In this study, 76 new-borns with seizures who have been hospitalized in the neonatal intensive care unit of the CAIMS, Karimnagar and met the inclusion and exclusion criteria were included.

Neonatal seizures have no sex predilection. However, in our study, male to female ratio was 1.11:1.The study of neonatal seizures by Tekgul H *et al,* showed male to female ratio of 1.15:1[1].

In our study, 18(23.7%) had onset of seizures within the first day of life and 48.7% were within first 3 days of life of life. Kumar A *et al* too reported that 75% of the seizure episodes occurred before 115 hours of age and 57.8% developed seizures within the first 48 hours of life[2]. Similar findings were also published from the study by Gabriel[3].

In the present study we observed that, 55.3% of the patients were observed with subtle seizures, followed by tonic and clonic seizures, According to the study by T Sivaraman *et al,* subtle seizures, which accounted for roughly 61.43% of all new-born seizures in about 43 neonates, outnumbered tonic seizures (25.7%) and clonic seizures (12.86%), respectively. There were 8.2% tonic seizures, 27.2% clonic seizures and 48.4% subtle seizures in pre-term neonates[4]. In a study, subtle seizures were reported to be the commonest type contributing about 42.6%, followed by tonic in 33.9% and clonic in 15.7% of neonates[5].

In our study we have observed that, 34.2% of the patients were observed with hypoglycaemia, followed by hypocalcaemia, hyponatremia and hypomanesemia, also in the present study, we didn't find any association between type of seizures and type of pregnancy In other studies, hypoglycemia and hypocalcemia were the most common, with 39 (43.8%) and 28 (35.4%) cases, respectively[6]. According to the study by Sood *et al* overall biochemical abnormalities in 29 cases, constituting about 49.15%, were observed[7]. Compared to the Madhusudan *et al* 43.33%, Kumar *et al* discovered overall biochemical abnormalities in 62.8% of new-borns[8,9]. In study by Gayathri *et al* showed 63.4% overall abnormalities among 120 neonates[10]. Hypoglycemia was more common in pre-term infants-36.84% versus 19.61% in term infants, which is similar to our study. Whereas another study found hypocalcemia followed by hypoglycemia to be the common biochemical abnormalities. Lastly, Pre-term new-borns were more likely to have hypoglycemia in a study that supports our study[5]. Thus, these studies point to the significance of performing a biochemical work up in new-born convulsions, particularly in light of the higher prevalence of blood glucose and calcium levels. Correcting these temporary biochemical abnormalities is related to a favourable prognosis and result.

CONCLUSION

Based on the findings of our study and after discussion with other studies we can concluded that, the significant prevalence of biochemical abnormalities in neonates presenting with seizures, with hypoglycemia, and hypocalcemia being the most common contributors. The findings emphasize the importance of routine biochemical screening in the management of neonatal seizures to identify treatable causes promptly. Early detection and correction of these abnormalities, particularly in cases of early-onset seizures, can prevent further neurological damage and improve clinical outcomes. The results suggest that systematic metabolic assessment should be an integral part of neonatal seizure management protocols and further research is needed to explore long-term effects and optimize treatment strategies.

Acknowledgement: None

REFERENCES

1. Tekgul, H., K. Gauvreau, J. Soul, L. Murphy and R. Robertson et al., 2006. The current etiologic profile and neurodevelopmental outcome of seizures in term newborn infants. Pediatrics, 117: 1270-1280.
2. Kumar, A., A. Gupta and B. Talukdar, 2007. Clinico-etiological and eeg profile of neonatal seizures. Indi. J. Pediatr, 74: 33-37.
3. Ronen, G.M., S. Penney and W. Andrews, 1999. The epidemiology of clinical neonatal seizures in newfoundland: A population-based study. J. Pediatr.s, 134: 71-75.

4. Ross, A.L. and C. Lomorso, 1970. 1. Neonatal Seizures state: A study of clinical, Pathology and electrographic features in 137 full-term babies with a long term follow up. Pediatrics, 45: 404-425.
5. Das, D. and S.K. Debbarma, 2016. A study on clinico-biochemical profile of neonatal seizure. J. Neurol. Res., 6: 95-101.
6. Suganthi, V., K. Vikneshwari and G. Thivya, 2017. 1. Prevalence of hypomagnesemia in neonatal seizures in a tertiary care hospital in South India. Pediatr Rev Int J Pediatr Res, 4: 63-67.
7. Sood, A., N. Grover and R. Sharma, 2003. 1. Biochemical abnormalities in neonatal seizures. Indian Journal of Paed, 70: 221-224.
8. Kumar, A., V. Gupta, J.S. Kachhawaha and P.N. Singla, 1995. 1. Biochemical Abnormalities in neonatal seizures. Indian Pediatr, 32: 424-428.
9. Madhusudhan, K., N. Suresh, T. Babu, J. Rao and S. Kumar, 2016. Study of biochemical abnormalities in neonatal seizures with special reference to hyponatremia. Int. J. Contemp. Pediatr.s, 3: 730-734.
10. Gayatri, B., 2019. 1. A Study on Biochemical Abnormalities in Neonatal Seizures. IOSR J. Med. Dent. Sci., 18: 53-57.