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Common causes, seizure types, and outcomes of neonatal convulsions: insights from Ahmed Gassim hospital for children

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Abstract

Background: Neonatal convulsions are characterized by paroxysmal alterations in neurologic function and can occur from birth until the end of the neonatal period (1-28 days of age). Despite advancements in medical science and global health improvements, neonatal seizures remain common and are associated with significant morbidity and mortality.

Objective: This study aimed to identify the common causes of neonatal convulsions in patients admitted to Ahmed Gassim Hospital for Children between January 2022 and April 2022, and to evaluate the associations between the underlying causes, short-term outcomes, and duration of hospital admission.

Method and Design: This hospital-based study was carried out at Ahmed Gassim Hospital for Children in Khartoum State. Data were collected through a structured interview questionnaire and analyzed using the Statistical Package for the Social Sciences (SPSS).

Results: The study included 80 neonates, predominantly male (63.75%), with most being term infants (97.5%). Seizures occurred primarily within the first 5 days of life (47.5%), with recurrence in 98.75% of cases. Focal seizures (70%) were more common than generalized seizures (30%), with tonic-clonic seizures being the most frequent type (65%). Seizures were generally brief (<5 minutes in 95% of cases), and most patients (87.5%) were hospitalized for 1-3 weeks. Key diagnoses were hypoxic-ischemic encephalopathy (HIE) (38.75%) and meningitis (33.75%). Poor short-term outcomes were linked to meningitis (p=0.002), while IVH was associated with 100% mortality. Cesarean deliveries had lower rates of good outcomes (16.25%) compared to vaginal deliveries (35%). Overall, good outcomes were observed in 51.25% of cases, while 27.5% experienced complications and the mortality rate was 10%. Significant associations were found between HIE/meningitis and tonic-clonic seizures (p=0.0021) and between neonatal meningitis and poor outcomes (p=0.002).

Conclusions: This study highlights the critical role of underlying conditions like HIE and meningitis in severe neonatal seizures and their high recurrence rates. It emphasizes the importance of early diagnosis, vigilant monitoring, and targeted interventions to improve outcomes. Further research is needed to explore seizure types, underlying conditions, and outcomes to enhance treatment strategies.

Keywords: Common Causes; Seizure Types; Outcomes of Neonatal Convulsions

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1. Introduction

Neonatal convulsions are a common neurological emergency requiring urgent treatment due to their potential adverse effects on the brain. They result from sudden, paroxysmal neuron group depolarization, causing transient neurological function changes. These convulsions often indicate serious underlying conditions, necessitating targeted treatments, as repetitive episodes may lead to lasting brain damage [1]. Neonatal seizures are relatively common, occurring in 1.8–3.5 per 1,000 live births. However, they can be challenging to recognize clinically and are often difficult to distinguish from normal, poorly coordinated neonatal movements [2].

Neonatal seizures remain a common phenomenon, associated with high rates of morbidity and mortality. While neonatal seizures can be transient with favorable outcomes and no recurrence, they are also linked to neurodevelopmental disorders [3].

The majority of neonatal seizures occur within the first few days of life and are often secondary to perinatal and neonatal insults. These seizures are associated with increased mortality and a heightened risk of neurodevelopmental impairments and epilepsy in survivors. Birth asphyxia is the leading cause of neonatal seizures in term infants, often linked to maternal and obstetrical complications before and during delivery. Obstetric risk factors include nulliparity, diabetes, obesity, smoking, post-term deliveries, infections during labor, prolonged second stage, operative vaginal delivery, and shoulder dystocia. While many causes of neonatal seizures are well established, factors predicting seizures in term infants who appear vigorous at birth remain poorly understood [4].

Neonatal seizures can be categorized into clinical (subtle, clonic, tonic, and myoclonic), electrographic, or electroclinical. Electrographic seizures, identified through EEG, may present with or without observable clinical signs, whereas clinical seizures may not appear on EEG due to deep brain activity or the effects of sedation. Electroclinical seizures exhibit both clinical and electrographic characteristics. Continuous EEG monitoring is considered the gold standard for detecting neonatal seizures, which are subclinical in over 50% of cases [1, 2].

This study aimed to identify the common causes of neonatal convulsions in infants admitted to Ahmed Gasim Hospital for Children from January 2022 to April 2022 and to explore the associations between these underlying causes and short-term outcomes,

2. Methods and Materials

- **Study design**: A cross-sectional, hospital-based study was conducted in Ahmed Gasim Hospital for Children, emergency room, general words, high dependency unit, and intensive care unit. It was carried out from January to April 2022
- **Study area**: Ahmed Gasim Specialized Hospital for Children is in Khartoum State. The hospital has a total capacity of 140 beds. The intensive care unit (PICU) has 7 beds with monitors and 2 ventilators. Neonates are also admitted to this unit.
- **Study Population**: The study included all neonates admitted to Ahmed Gasim Hospital for Children with convulsions between January and April 2022, who met the study criteria. A detailed history, clinical examination, and relevant investigations were conducted for each patient.
- **Inclusion Criteria:** All neonates admitted to the emergency room, general wards, high-dependency unit, or intensive care unit of Ahmed Gasim Hospital for Children during the specified period (January to April 2022).
- **Exclusion Criteria:** Neonates were excluded if their parents or caregivers declined participation in the study.
- **Sample Size:** This study employed total coverage, including all neonates admitted to Ahmed Gasim Hospital for Children—emergency room, general wards, high-dependency unit, and intensive care unit—from January to April 2022.
- **Data Collection:** The researchers conducted data collection through an interview questionnaire specifically designed for this study. The questionnaire covered patient history, clinical examination, investigations, final diagnosis, and short-term outcomes.
- **Dependent Variables:** Sex, gestational age, weight, antenatal events, mode of delivery, and place of delivery.
- **Independent Variables:** Seizure status, types of seizures, and onset of seizures.
- **Data Analysis:** Analysis was performed using the Statistical Package for the Social Sciences (SPSS).
- **Ethical Approval:** Written consent was obtained from the hospital's administrative authority and the neonates' parents or caregivers. Furthermore, ethical approval was secured from the Sudan Medical Specialization Board (EDC) and the hospital administration. To ensure confidentiality, data were anonymized using serial numbers and used solely for research purposes.

3. Results

The study analyzed data on neonatal seizures, revealing the following distribution of seizure onset: Of the 80 patients included in the study, 38 patients (47.5%) experienced seizures within the first 5 days, 19 patients (23.7%) between 6 to 15 days, and 23 patients (28.75%) between 16 to 28 days. Among the patients, 51 (63.75%) were male and 29 (36.25%) were female, resulting in a male-to-female ratio of 1.8:1. Most patients were term infants (78, 97.5%), while 1 patient (1.2%) was preterm, and another (1.2%) was post-term [Table 1].

Regarding the type of seizures, 56 cases (70%) had focal seizures, while 24 cases (30%) had generalized seizures. Tonic-clonic seizures were present in 52 cases (65%), tonic seizures in 18 cases (22.5%), and subtle seizures in 9 cases (11%). Only 1 case (1.25%) had clonic seizures, and no cases exhibited myoclonic seizures. Most seizures (76 cases, 95%) lasted less than 5 minutes. Seizures typically started on the first day (38 cases, 47.5%), between 2 to 7 days (34 cases, 42.5%), or between 8 to 21 days (8 cases, 10%). Recurrence of seizures was common, with 79 cases (98.75%) experiencing multiple episodes. A small proportion (4 cases, 5%) had seizures lasting between 5 to 15 minutes [Table 2].

Of the deliveries, 52 cases (65%) were through normal vaginal delivery, while 28 cases (35%) were via cesarean section. Additionally, 13 mothers (16.25%) developed a fever before delivery. Most babies had normal body weight (73 cases, 91.25%), 6 (7.5%) had low birth weight, and 1 (1.25%) had a weight exceeding 4.5 kg [Table 3].

Ten cases (12.5%) had low serum calcium levels, and metabolic disorders were found in 10% of the cases, with hypoglycemia being the most common. Hypernatremia was present in 7 cases (8.7%), and 5 cases (6.25%) had low serum sodium. Hypocalcemia was not identified as a primary cause of seizures.

Seventy patients (87.5%) were admitted for 1 to 3 weeks, 9 patients (11.25%) for less than one week, and only 1 patient stayed in the hospital for more than 3 weeks [Table 4]. The most common diagnoses were hypoxic-ischemic encephalopathy (HIE) in 31 cases (38.75%) and meningitis in 27 cases (33.75%). Other causes included hypernatremia dehydration (5 cases, 6.25%), central nervous system malformations (4 cases, 5%), and hemorrhagic disease of the newborn (5 cases, 6.25%). The overall mortality rate was 10% [Table 5].

Outcomes varied: 41 cases (51.25%) were discharged in good condition, 9 cases (11.25%) were discharged against medical advice, and 22 cases (27.5%) were discharged with complications. Specifically, 16.25% of cesarean section deliveries resulted in good outcomes, with 2.5% mortality, while 35% of normal vaginal deliveries had good outcomes and 5% had mortality [Table 6].

The study found that HIE and meningitis were significantly associated with tonic-clonic seizures (p-value = 0.0021). There was no significant association between other etiologies and the type of seizures. Additionally, neonatal meningitis was linked to poor short-term outcomes (p-value = 0.002), and intraventricular hemorrhage (IVH) was associated with 100% mortality. HIE had a lower mortality rate but often resulted in neurological sequelae [Table 7].

Table 1 Represents age at onset of seizures, gender, and gestational age

Seizure Onset (Days)	Number of Patients	Percentage (%)
0-5 days	38	47.5
6-15 days	19	23.7
16-28 days	23	28.75
Gender:		
Male	51	63.75
Female	29	36.25
Gestational Age:		
Term	78	97.5
Preterm	1	1.2
Post-term	1	1.2

Table 2 Represents the type and duration of seizures

Type of Seizure	Number of Cases	Percentage (%)
Focal Seizures	56	70
Generalized Seizures	24	30
Tonic-Clonic Seizures	52	65
Tonic Seizures	18	22.5
Subtle Seizures	9	11
Clonic Seizures	1	1.25
Myoclonic Seizures	0	0
Seizure Duration:		
Less than 5 minutes	76	95
5 minutes or more	4	5

Table 3 Represents the data on delivery method and baby birth weight

Delivery Method	Number of Cases	Percentage (%)
Normal Vaginal Delivery	52	65
Cesarean Section	28	35
Baby Birth Weight		
Normal Weight	73	91.25
Low Birth Weight	6	7.5
Weight > 4.5 kg	1	1.25

Table 4 Represents the duration of hospital stay

Hospital Stay Duration	Number of Patients	Percentage (%)
1 to 3 weeks	70	87.5
Less than 1 week	9	11.25
More than 3 weeks	1	1.25

Table 5 Represents the diagnoses

Diagnosis	Number of Cases	Percentage (%)
Hypoxic-Ischemic Encephalopathy (HIE)	31	38.75
Meningitis	27	33.75
Hypernatremia Dehydration	5	6.25
Central Nervous System Malformations	4	5
Hemorrhagic Disease of the Newborn	5	6.25
Neonatal Sepsis	5	6.25
Hypoglycemia	2	2.5

Table 6 Represents the correlation between the type of delivery and short-term outcomes

Type of Delivery	Outcome	N	%	P-value
ELCS	Discharge in good condition	9	11.25%	0.132
	Discharge against medical advice	2	2.50%	
	Discharge with complication	6	7.50%	
	Passed away	2	2.50%	
EMCS	Discharge in good condition	4	5.00%	0.192
	Discharge against medical advice	0	0.00%	
	Discharge with complication	3	7.50%	
	Passed away	0	0.00%	
Normal Vaginal Delivery	Discharge in good condition	28	35.00%	0.000
	Discharge against medical advice	3	3.75%	
	Discharge with complication	7	8.75%	
	Passed away	2	2.50%	
Total		80	100%	

Table 7 Represents the correlation between diagnosis and short-term outcomes

Diagnosis	Discharge in Good Condition	%	Discharge Against Medical Advice	%	Discharge with Complication	%	Passed Away	%	P-value
Meningitis	17	21.25%	3	3.75%	5	6.25%	3	3.75%	0.002
HIE	15	18.75%	3	3.75%	1	1.25%	2	2.50%	0.082
Hemorrhagic Disease of Newborn	1	1.25%	1	1.25%	2	2.50%	1	1.25%	0.062
Neonatal Sepsis	4	5.00%	1	1.25%	0	0.00%	0	0.00%	0.128
Hypernatremic Dehydration	4	5.00%	0	0.00%	0	0.00%	0	0.00%	0.360
IVH	1	1.25%	0	0.00%	0	0.00%	1	1.25%	0.0001
CNS Malformation	2	2.50%	1	1.25%	2	2.50%	1	1.25%	0.020

4. Discussion

Neonatal seizures are a relatively common pediatric emergency, and identifying their etiology and other factors influencing outcomes is crucial. Despite advances in perinatal care, neonatal seizures continue to be associated with high rates of mortality and morbidity. Diagnosing and managing neonatal seizures present several challenges, highlighting the evolving nature of research in this field [5].

This cross-sectional study, conducted among 80 neonates at Ahmed Gasim Hospital, found that most seizures (47.75%) began within one day of birth, while 42.5% started between days 2 and 7. These results align with Leak et al., Mohamed

I et al., and Baudou et al., who reported that most seizures occurred within 0–24 hours or 1–7 days. Furthermore, 63.7% of cases were male and 36.2% female, consistent with the findings of Leak et al. (51.7% male, 48.3% female), Mohamed I et al. (65.5% male, 34.3% female), and Baudou et al. (59% male, 41% female) [6, 7,8].

4.1. Clinical Presentation and Seizure Types

In this study, tonic-clonic seizures were the most commonly observed type. In contrast, Haque et al. found that subtle seizures were the most frequent, occurring in 53.33% of patients, while focal clonic and focal tonic seizures were reported in 23.33% and 13.33% of cases, respectively. Seizure duration is a key prognostic factor, with episodes exceeding 30 minutes associated with poor outcomes, especially when unresponsive to anticonvulsant therapy [9].

4.2. Delivery Mode and Birth Weight

In our study more than half of the neonates were delivered via normal vaginal delivery, mirroring findings by Haque et al. and Al-Momen et al. who reported 83.3% and 73.8% vaginal deliveries, respectively [9, 10]. Low birth weight was associated with an increased risk of seizures, although 91.2% of neonates in this study had normal birth weight. This finding is consistent with Rumana et al., where 70% of neonates had normal birth weight [11].

4.3. Maternal and Neonatal Risk Factors

The study found no significant maternal diabetes, hypertension, or fever before delivery among the majority of mothers. However, hypothermia and low levels of public health education likely contributed to neonatal morbidity. Neonatal seizures were frequently associated with hypoxic-ischemic encephalopathy (HIE), which accounted for 38.75% of cases. These findings align with the prior study by Abdelhaie OM et al. [5]. Other causes included metabolic disturbances, intracranial infections, and meningitis (33.7% of cases), with findings consistent with studies by Pisani F, et al. and Rabindran et al. [12, 13].

4.4. Biochemical and Imaging Findings

Routine diagnostic evaluations included assessments of blood glucose, electrolytes, and imaging studies. Hypocalcemia was noted in 12.2% of cases, and MRI/CT imaging yielded positive findings in 75% of neonates. Notably, meningitis was a common cause of seizures, as reported in other studies by Aziz et al. [14].

4.5. Outcomes and Correlations

Increased morbidity and mortality were associated with neonatal encephalopathy and meningitis. Short-term outcomes were correlated with the mode of delivery and seizure etiology. The study's findings emphasize the importance of early detection and management of neonatal seizures, particularly in HIE and metabolic disturbance cases

5. Conclusion

The findings from this study provide valuable insights into the onset, types, and outcomes of neonatal seizures, with implications for clinical management. The association between HIE, meningitis, and severe seizure types, as well as the high recurrence rate, underscores the need for vigilant monitoring and targeted interventions. The study also highlights the impact of underlying conditions on neonatal outcomes and emphasizes the importance of early diagnosis and management to improve prognosis. Future research should continue to explore the links between seizure types, underlying conditions, and outcomes to develop more effective treatment strategies for neonatal seizures.

Recommendations

- Public Health Interventions: Enhance safe delivery practices, neonatal resuscitation, and infection prevention to reduce the incidence of neonatal seizures.
- Long-Term Studies: Conduct prospective studies to evaluate the long-term neurological and developmental outcomes following neonatal seizures.
- Integrated Care: Implement a comprehensive assessment and management approach involving obstetricians and pediatricians to lower incidence rates and improve outcomes.
- CSF Analysis: Ensure CSF analysis is performed for suspected cases of neonatal meningitis to confirm diagnoses and potentially reduce hospital admissions.
- Metabolic Screening: Obtain metabolic screens for suspected cases of metabolic disturbances.
- Early Recognition: Promptly identify and treat biochemical disturbances to optimize management and improve long-term outcomes.

Compliance with ethical standards

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Disclosure of conflict of interest

The authors have no conflicts of interest to declare.

Statement of informed consent

Informed consent was obtained from all individual participants included in the study.

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