e-ISSN: 0975-1556, p-ISSN:2820-2643

Available online on www.ijpcr.com

International Journal of Pharmaceutical and Clinical Research 2023; 15(4); 1529-1534

Original Research Article

The Study of Biochemical Abnormalities and its Outcome in Neonatal Seizures

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Received: 30-01-2023 / Revised: 28-02-2023 / Accepted: 30-03-2023

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Conflict of interest: Nil

Abstract

Introduction: Neonatal seizures are a typical neonatal neurological issue and may be the newborn's earliest clinical indication of CNS problems. The goal is to investigate the biochemical deviations and ascertain how newborn seizures affect neurodevelopment.

Aims and Objectives:

1. To research the biochemical deviations in newborn seizures.
2. To determine how newborn convulsions will affect neuro-development.

Methods: This is a prospective observational study conducted on 100 consecutive neonates admitted in NICU of the Department of Paediatrics, SVRR Government General Hospital, Tirupati. For each case, full history was recorded on a pretested proforma after the parents gave their informed consent in writing, and after that all cases underwent the necessary investigations. At the time of discharge, Hammersmith Neonatal Neurological examination was done and any disability if present was noted. Developmental evaluation of these infants was carried out by DASII at the age of three months after their discharge.

Results: In our study the most common etiological factor for neonatal seizure was Hypoxic-ischemic-encephalopathy (HIE) and hypocalcemia was the most common transient metabolic abnormality in this group and for outcome measurable, neurodevelopmental abnormality was observed most often with Hypoxic ischemic encephalopathy.

Conclusion: Neonatal seizures usually involve biochemical changes, either as underlying causes or as co-occurring abnormalities. For effective therapy and a positive long-term outcome, metabolic abnormalities must be identified and treated as soon as possible.

Keywords: Neonatal Seizures, Hypoxic Ischaemic Encephalopathy, Hypocalcemia, Hypoglycaemia, Metabolic Abnormalities, Infections.

Introduction

Neonatal seizure is one of the frequent neurological symptoms seen in neonates. The incidence of neonatal seizure was 0.77% in the inborn and 7.3% among the out born neonates [1]. The most common cause of neonatal seizure was hypoxic ischemic encephalopathy (HIE) followed by hypocalcemia.[1] Several other causes of these seizures were hyponatremia, hypoglycaemia, intracranial haemorrhage, infections, hypocalcaemia, metabolic disorders, structural anomalies, and hypomagnesemia. [2] In order to treat the seizure effectively and quickly and reduce avoidable morbidity, mortality, and sequelae connected with it, the aetiology of the seizure must be identified as soon as possible. [3]

Primary metabolic abnormalities are the most frequent cause, according to prior study, while non-metabolic abnormalities were seen more frequently with hypoxic ischemic encephalopathy. [4] Neonatal seizures usually involve biochemical changes, either as underlying causes or as co-occurring abnormalities. They make controlling seizures more challenging and increase the danger of future brain damage. For effective therapy and a positive long-term outcome, metabolic abnormalities must be identified and treated as soon as possible.

Neonatal seizures play a significant role in predicting outcomes. Overall, the mortality rate for infants who experience seizures has decreased in the past ten years for newborns born at full term, with the mean current fatality rate being 10% (range: 7-16%), down from 33% in the reports of past few years. Contrarily, the prevalence of negative neurodevelopmental sequelae, which normally ranges from 27 to 55 percent, is fairly steady at 46 percent. The underlying reason and the electroencephalographic activity in the background are the best indicators of how things will turn out. [5] In order to evaluate the outcome predictors in various neonatal seizure cases linked to biochemical abnormalities, the current investigation was carried out.

Materials and Methods

A Prospective observational study was conducted on 100 neonates admitted in NICU of Department of Pediatrics, SVRRGGH, S.V. Medical college, Tirupati after obtaining institutional ethical committee clearance. Neonates with congenital anomalies of central nervous System, neonates presenting with phenomena that mimic seizures in the newborn were excluded from the study. Blood samples were taken, and serum levels of sodium, potassium, and calcium were determined using an ion-selective electrode method; serum phosphorous and magnesium were determined using a spectrophotometric method; and blood glucose was determined using a glucose-oxidase method.

Thorough history of each subject was recorded on a pretested form after receiving the informed consent from the parents. Emphasis was laid on the age of occurrence of first seizure, duration of seizure, number of seizures, type of seizure, antenatal, natal and post-natal risk factors which includes maternal drug addiction/withdrawal, maternal diabetes, prolonged rupture of membranes, perinatal asphyxia, traumatic delivery, preterm, small for date, low birth weight baby, septicemia, meningitis, intracranial bleed and hyperbilirubinemia. According to Volpe 6, clinical seizures were divided into four categories: mild, clonic, tonic, and myoclonic. Although many neonates had more than one seizure type, we assigned single most prominent seizure type to a neonate in each case. We performed daily neurological examination during the admission period. For this investigation, we recorded the neonatal neurological examination that was the most aberrant. Based on published criteria, an institutional approach was implemented consistently to

control neonatal seizures.[7] We assigned each neonate to one of the following six etiologic categories: Hypoxic ischemic encephalopathy, Transient Metabolic Disturbances, Infection, Intra Cranial Bleed, Kernicterus, Meningitis. At the time of discharge, we did Hammersmith Neonatal Neurological examination and any disability if present was noted.

A multidisciplinary team consisting of a paediatrician, developmental psychologist, and physiotherapist performed follow-up at the age of three months. All newborns were formally tested using the DASII (Developmental Assessment Scale for Indian Infants) at three months old. We first calculate Motor Developmental Quotient, Mental developmental Quotient and then we record Deviation Quotients and we directly interpret the child's score in terms of his noted DQ, as on par i.e. 100 (mean score), advanced (more than100) or delayed (less than 100) when compared to normal population of his age (approx.+3 to -3 deviation values). In this study we evaluated outcome by Neurological examination and Developmental Progress. Data are presented as number or percentage as appropriate. Statistical methods applied in the present study were descriptive statistics, Chi-square test. A p value of 0.05 was considered as significant.

Results

The current study has observed that out of one hundred cases enrolled, 9 cases died and so, the outcome was measured for 91 cases. Table 1 shows that among the 46 neonates with HIE, 33 cases had biochemical abnormalities. In these 33 cases, the most common metabolic abnormality was hypocalcaemia with 10 neonates having isolated hypocalcaemia. Ten cases were found to have mixed biochemical abnormalities. There were two cases with Intracranial bleed, among which one neonate had isolated hyponatremia and another with mixed biochemical abnormality. In the eight cases with meningitis, 50% of the cases had biochemical abnormalities, and the rest did not have any. In those 4 cases with biochemical abnormalities, one case had isolated hyponatremia and 3 neonates had mixed biochemical abnormalities.

Table 1: Biochemical disturbances in neonates with seizures

Etiology (n=100)	Metabolic abnormality	Hypo glycemia	Hypocalaemia	Hyper phosphatemia	Hypo magnesemia	Hyper magnesemia	Hypo natremia	Hyper natremia
HIE (n=46)	33	8	15	3	9	3	6	2
Intracranial bleed (n=2)	2	0	0	0	1	0	2	0
Meningitis (n=8)	4	2	1	0	0	0	4	0
Transient metabolic disturbances (n=16)	16	5	11	0	3	0	4	1
Infection (n=27)	20	7	8	1	5	0	3	2
Kernicterus (n=1)	1	0	0	0	0	0	0	0

The study found that in the 27 neonates that were admitted with infections, 20 of them had biochemical disturbances. Hypocalcemia followed by hypoglycaemia were the most common

abnormalities with five neonates having isolated hypoglycaemia, 4 cases having isolated hypocalcemia, and 5 cases had mixed biochemical abnormalities. This association was found to be extremely significant with a p value of 0.001. Similarly, out of the 16 neonates with transient metabolic disturbances, hypocalcemia followed by hypoglycaemia were the most common abnormalities with 7 neonates who had mixed biochemical disturbances neonates. One neonate had kernicterus without any biochemical abnormality, and no one had hypercalcemia , hypophosphatemia and hyperglycemia.

This study observed in the 100 neonates with neonatal seizures, 58 cases had normal neurodevelopmental outcome, 33 cases had neurodevelopmental abnormalities. And it was found that in all the neonatal seizure cases who had isolated biochemical abnormalities showed a normal outcome. This was found to be statistically significant with a low p value of 0.001.

Table 2: Outcome of neonatal seizures according to etiology

Etiology	Number and percentage	Outcome		
		Normal	Developmental Abnormality	Death
HIE	46 (46%)	23	18	5
Transient metabolic Abnormalities	16(16%)	16	0	0
Infection	27 (27%)	15	10	2
I C bleed	2(2%)	0	1	1
Kernicterus	1 (1%)	0	1	0
Meningitis	8 (8%)	4	3	1
Total	100 (100%)	58	33	9

Discussion

In the current study, seizures are common in neonates with birth weight more than 2500 grams. Incidence was found to be comparatively low in the preterm babies; And this is probably due to the high mortality rate in preterm neonates because of other complications. Most of the neonates with seizures were full term 89 (89%) neonates, it is comparable to the findings of Al-Marzoki *et al* [8] (95.4%) and Yaser *et al* [9] (93.1%) in their studies. According to a study by Sahana *et al*, male neonates (63.9%) had a higher incidence of seizures than females. [10]

In our investigation, HIE was the most frequent cause of newborn seizures (46%), which is comparable to studies by Sahana *et al*. [10] and Kumar *et al*. [11] with respective prevalence rates of 57.8% and 44.4%. Infections accounted for 27% of the causes of seizures in our analysis, which is comparable to a research by Sabzehei *et al* [12], who found a 24.5% incidence of infections. However, metabolic disorders were the second most frequent cause in the study by Sahana *et al* and Kumar *et al*. Sepsis was found in 85 newborns (60%) in the Mwaniki *et al* [13] investigation, followed by neonatal encephalopathy in 30 cases (21%). Al-Marzoki [9] discovered that metabolic disorders were the second most frequent cause of birth asphyxia in 14 (15.9%) of the 42 cases (47.7%) he studied. Hypocalcemia and hypoglycemia were the most prevalent metabolic abnormalities, which is similar with the findings of the studies by Sabzehei *et al*.[12] and Fiaz *et al*.[14]

29 newborns in our study had hypocalcemia, and 17% of them had hypoglycemia. In the Sahana *et al*.[8] clinical trial, 10 (9.17%) and

7 (6.42%) newborns had hypoglycemia and hypocalcemia, respectively. In newborns with HIE, cerebral haemorrhage, infection, and metabolic abnormalities, biochemical abnormalities were seen, according to research by Kumar *et al*. [11] In the same study, perinatal asphyxia is the most frequent cause of neonatal seizures, however it is unclear how much hypoglycemia and hypocalcemia contribute to seizures in neonates who have experienced perinatal asphyxia. Additionally, Al-Marzoki [9] showed that hypoglycemia and hypocalcemia were the most prevalent metabolic disorders.

The results of the neonates with seizures in our study revealed that 31% of neonates had neurological sequelae, 9% of neonates had died, and 57% of neonates were released without sequelae. Similar results were seen in the Sahana *et al*[8] study, which showed that 49.54% of newborns had fully recovered, whereas 32.11% had neurological sequelae and 18.35% had perished. However, it was greater than the 14.7% as found in Sabzehei *et al* study. [12] The severity of the etiological variables in the neonate of our investigation may be the cause of this increased mortality. Other causes of death in our analysis included HIE and infection, which together accounted for the majority of fatalities among newborns with seizures. The mortality documented by Uria-Avellanal *et al* [15] (range: 7-16%) and the spectrum of neurodevelopmental sequelae (range: 27-55%) were comparable to the results of our investigation. Further long-term follow-up research is advised because the true relationship between etiological factors and outcomes cannot be determined during this brief time of investigation.

Conclusion

Neonatal seizures frequently involve biochemical abnormalities. Only 16% of newborns in the current study had biochemical abnormalities. Hypocalcemia and hypoglycemia are the most frequently occurring biochemical abnormalities. 75% of the newborn seizures with identifiable aetiology had biochemical abnormalities. These anomalies may significantly contribute to seizure activity, and it's possible that correcting these abnormalities will be crucial in controlling seizures. In every occurrence of newborn seizures, a biochemical workup is necessary.

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