

Metabolic and Electrolyte profile in Birth Asphyxia

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Introduction: The definition of birth asphyxia is given by the ACOG, AAP includes the existence of 3 factors: Metabolic or mixed acidemia (pH<7) which is determined by umbilical cord arterial blood samples. The major causes of neonatal seizures are Hypoxic-ischemic encephalopathy (HIE), which represents about 50% of the causes of neonatal seizures. Metabolic abnormalities, infection, intracranial hemorrhage, developmental anomalies, and other like inborn errors of metabolism are other causes of neonatal seizures. **Material and Methods:** A cross-sectional study. This is a hospital-based prospective study conducted at Nehru Hospital, BRD Medical College, Gorakhpur (UP) in the Neonatal Intensive Care Unit of the pediatric department. This study was conducted from July 2018 to July 2019. **Result:** Prevalence of Hypocalcemia was 7.6%, Prevalence of hypernatremia was 1.3%, Out of 315 patients 32 (10.2%) patients expired and 283 (89.8%) was successfully discharged. **Conclusion:** No association between Hypocalcemia and Hypomagnesemia Prevalence of hyponatremia was 6.3% and no association between hyponatremia and Hypomagnesemia. The prevalence of hypernatremia was 1.3% and there was no association between hypernatremia and Hypomagnesemia.

Keywords: Birth asphyxia, Hypocalcemia, Hypernatremia

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Introduction

Birth asphyxia is a serious clinical problem worldwide and contributes greatly to neonatal mortality and morbidity. The combination of the decrease in oxygen supply (hypoxia) and blood supply (ischemia) results in a cascade of biochemical changes inside the body, whose events lead to neuronal cell death and brain damage. Continuous asphyxia also leads to multiple organ systems dysfunction [1].

World Health Organization (WHO) defines Birth asphyxia as failure to initiate and sustain breathing in a newborn at birth [2].

Definition of birth asphyxia is given by the ACOG, AAP includes the existence of 3 factors: Metabolic or mixed acidemia (pH<7) which is determined by umbilical cord arterial blood samples; APGAR score of <3 for longer than 5 min; neurological manifestations; and multisystem organ dysfunction [3]. The major causes of neonatal seizures are Hypoxic-ischemic encephalopathy (HIE), which represents about 50% of the causes of neonatal seizures. Metabolic abnormalities, infection, intracranial hemorrhage, developmental anomalies, and other like inborn errors of metabolism are other causes of neonatal seizures [4].

The causes of seizures in preterm neonates are different from those seen in term neonates, where the HIE is the most frequent cause in term neonates, followed by cerebral malformations and metabolic disturbances. In preterm neonates, intraventricular hemorrhage and infections are the most frequent causes [5]. Hypocalcemia is defined as total serum levels less < 7mg/dl, although the exact level at which seizure occurs is debatable.

Criteria for diagnosing biochemical abnormalities:

Hypoglycemia: blood sugar < 40mg/dl

Hypocalcemia: total serum calcium <7mg/dl and ionized serum calcium < 4.4mg/dl

Hypomagnesemia: serum magnesium <1.5mg/dl

Hypermagnesemia: serum magnesium>2.5mg/dl

Hypernatremia: serum sodium >150meq/dl

Hyponatremia: serum sodium <130meq/dl

Metabolic causes of neonatal seizures with a good prognosis are hypoglycemia, hypomagnesemia, hypocalcemia.

Some hypocalcemic seizure is accompanied by hypomagnesemia, but magnesium levels are rarely investigated in resource-restricted hospitals.

87% of hypomagnesemia cases were associated with hypocalcemia implying the interrelation in pathophysiology. Among neonates with hypocalcemia, 20% had hypomagnesemia.

Material and methods

Study structure

Study Design: An observational study – Cross-sectional study

Study Centre: This is a hospital-based prospective study conducted at Nehru Hospital, BRD Medical College, Gorakhpur (UP) in the Neonatal Intensive Care Unit of the pediatric department.

Duration of Study: This study was conducted from July 2018 to July 2019.

Ethical Approval: The study is approved by the institutional ethical committee (IEC) BRD medical college Gorakhpur.

Consent: Written informed consent was taken from parents in the local language.

Case

All cases of birth asphyxia are admitted every day in the NICU which includes between the age group of birth to 72 hours.

Inclusion Criteria

- All the term neonate of birth asphyxia who ≥ 37 weeks of gestation.

Exclusion Criteria

- Preterm neonates
- Jitteriness in neonates
- Tetanic spasms in neonates
- The neonatal seizure was other than birth asphyxia.
- Newborn with congenital anomalies

Sample size: The sample size was determined using the following formula

$$N = 4pq/L^2$$

$$N = 4 \times 27 \times 73 / (5)^2 = 315$$

N = required sample size

$P = \text{Estimated prevalence of birth asphyxia } 27\%$
(Prevalence in India in the Year 2017) [42]

$Q = 100-p$

$L = \text{Margin error at } 5\%$ (Standard value of 0.05)

Methodology: A pre-structured proforma is used to record the information from the individual. After getting the consent from the parent's clinical data collected and enter in the proforma which includes age, sex, religion presenting complaints, type and duration of seizure, demographic details and examination, a maternal history risk factor for perinatal asphyxia age, weight, maternal education, preeclampsia, eclampsia, diabetes in mother, maternal infection, Multiple gestations, finding on admission are noted according to study proforma. All information is recorded in a pre-designed proforma.

Statistical Analysis: Collected data will be tabulated graphically displayed. Percentage, arithmetic mean and standard deviation to be calculated and data statistically analyzed using SPSS version 21 (statistical package for social sciences).

Interferential analysis for quantitative variables to be done using an independent 'T' test whereas analysis for qualitative data is done using the chi-square test. Statistical significance is set at 'p' < 0.05. Data will be analyzed using standard methods. Consent will be taken from the attendants before enrolling the baby in the study.

Result

Table-1: Association of hypocalcemia and birth asphyxia.

Ca level	N	Percent
Hypocalcemia	24	7.6
Normal	291	92.4
Total	315	100.0

In the present study, 24 (7.6%) patient out of 315 was found to be hypocalcemia.

Table-2: Association of calcium level and magnesium level.

		Mg level		Total
		Hypomagnesemia	Normal	
Ca level	Hypocalcemia	0	24	24
		0%	7.8%	7.6%
Ca level	Normal	8	283	291
		100.0%	92.2%	92.4%

Total	8	307	315
	100.0%	100.0%	100.0%

Applied $\div 2$ test for significance. $\div 2$ value=0.677; p-value=0.411; consider not significant.

In the present study, no patient had hypomagnesemia and hypocalcemia.

All patients of hypomagnesemia had normal calcium level, there was no association between hypomagnesemia and hypocalcemia.

Table-2: Association of Serum sodium and birth asphyxia.

Na level	N	Percent
Hyponatremia	20	6.3
Normal	291	92.4
Hypertatremia	4	1.3
Total	315	100.0

In the present study 20 out of 315 (6.3%) had hyponatremia, 4 out of 315 (1.3%) had hypertatremia and 291 out of 315 (92.4%) had normal sodium level.

Table-3: Association of a high-risk factor in mother and birth asphyxia.

H/o risk in mother	N	Percent
Yes	4	1.3
No	311	98.7
Total	315	100.0

In the present study 4 out of 315 (1.3%) patient's mothers had a significant antenatal history of risk factor.

Table-4: Association of meningitis and birth asphyxia

Meningitis	N	Percent
Yes	20	6.3
No	295	93.7
Total	315	100.0

In the present study 20 out of 315 (6.3%), patients had symptoms and lab investigations suggestive of meningitis.

Table-5: Outcome of the study.

Outcome	N	Percent
Expired	32	10.2
Discharge	283	89.8
Total	315	100.0

Out of 315 patient, 32 (10.2%) patient expired and 283 (89.8%) was successfully discharged.

Table-6: Mean Serum calcium and Serum sodium.

	Mean	SD	Median	Minimum	Maximum	Range	Count
Serum Ca	9.36	1.32	9.43	5.92	11.90	5.98	315
Serum Na	139.00	4.46	139.30	124.60	161.50	36.90	315

A mean of 2.07 with an SD of 0.39 was found for serum magnesium level

A mean of 9.36 with an SD of 1.32 was found for serum calcium level

A mean of 139 with an SD of 4.46 was found for serum sodium

Discussion

In the present study, 315 neonates with birth asphyxia were studied in 1 year. Both intramurally and extramurally delivered babies were included in this study. In a study by Asif Aziz Wani et al, a total of 100 consecutive neonates presenting with seizures from September 2013 to August 2014 were enrolled in the study. Clinical details of each seizure episode reported by the mother and subsequently observed by the resident doctors on duty were recorded.

It was found that around 54% of neonates had a biochemical abnormality alone or in association with other etiologies like hypoxic-ischemic encephalopathy (HIE), intracranial hemorrhage (ICH), meningitis, and sepsis. 31% of neonates had primary metabolic seizures. Hypocalcemia was the commonest biochemical abnormality in primary metabolic seizures and was present in 70% of neonates in this group. Hypoglycemia was the next common abnormality and was present in 41% of neonates within this group. 37 neonates (68.5%) had biochemical abnormalities superimposed on other etiologies of neonatal seizures. Metabolic abnormalities were more commonly associated with intracranial hemorrhage (53.8%) and birth asphyxia (50%). Hypoglycemia (22.7%) followed by hypocalcemia (20.5%) were the commonest biochemical abnormalities in these patients. Hyponatremia was found in 20% (n=3) cases of meningitis and 15.4% (n=2) cases of ICH [6].

Arun Kumar A.R et al conducted a study on biochemical abnormalities in neonatal seizures in a tertiary care rural teaching hospital of south India in which out of 100 neonates with seizures, 69 were outborn (referred to the hospital from outside) and 31 were inborn. Seizures occurred more frequently among term infants (78%).

One or more biochemical abnormalities were observed in 82% of neonates with seizures. Hypoglycemia (44/82=53.65 %) was the most common abnormality followed by hypocalcemia (26/82=31.7%). He concluded that Hypoglycemia and hypocalcemia were the most common disturbances present not only as primary disorders but also associated with specific etiology. Early recognition and treatment are of utmost importance to decrease morbidity and mortality [7].

In a study of biochemical abnormalities in neonatal seizures with special reference to hyponatremia by Kamatham Madhusudhan et al 120 babies admitted with seizures in NICU were enrolled Biochemical abnormalities were found in 52 babies with the most common primary abnormality being hypoglycemia mostly encountered in preterm babies and the most common secondary abnormality being hyponatremia seen mostly in term babies.

Prompt identification of the biochemical abnormalities in neonatal seizures enables specific intervention by the treating doctor resulting in better neurological outcomes [8].

Imran Gattoo et al did a study on the Clinical and etiological profile of neonatal seizures he observed that Hypoxic ischemic encephalopathy was the commonest etiology of neonatal seizures. Intracranial hemorrhage followed by Hypoxic ischemic encephalopathy was the commonest seizure etiology in preterm neonates. Majority of Hypoxic-ischemic encephalopathy patients presented with seizures in the first 72 hrs. of life.

Focal clonic and subtle seizures were the commonest seizure types encountered. 31% of neonates had primary metabolic seizures. Hypocalcemia was the commonest biochemical abnormality in primary metabolic seizures and was present in 70% of neonates in this group. Hypoglycemia was the next commonest abnormality and was present in 41% of neonates within this group [9].

In a study done by Tanveer Nawab et al on the Clinical profile of neonatal seizures with special reference to biochemical abnormalities: Out of the 110 neonates studied, birth asphyxia was the commonest cause of neonatal seizures in 66 (60%) cases, followed by neonatal sepsis and metabolic disorders. Primary metabolic abnormalities occurred in 13(11.8%) cases of neonatal seizures, most common being hypoglycemia (69.3%) followed by hypocalcemia.

Associated biochemical abnormalities were seen in 33 (30%) cases with hyponatremia 13 (39.3%) being most common followed by hypoglycemia. These were most often seen with Hypoxic-ischaemic- encephalopathy. He concluded that Biochemical abnormalities are common in neonatal seizures and often go unrecognized. These abnormalities may significantly contribute to seizure activity and hence a biochemical workup is necessary for all cases of neonatal seizures [10].

In the present study prevalence of hypocalcemia in birth asphyxia was 7.6%, a study done by Suganthi V et al [11] prevalence of hypocalcemia in birth asphyxia was 31.5%, another study done by Jain N et al the prevalence of hypocalcemia was 28% [12] and a study done by Nawab T et al [13] had 23.7% cases of hypocalcemia in birth asphyxia. In all these three studies the prevalence of hypocalcemia was higher than the present study. None patients had hypocalcemia with hypomagnesemia was found while a study done by Suganthi V et al [11] had 7.9% cases of hypocalcemia associated with hypomagnesemia and another study done by Saha D et al had 3.33% cases had hypocalcemia with hypomagnesemia [14].

In the present study 20 out of 315 (6.3%) had hyponatremia, 4 out of 315 (1.3%) had hypernatremia while a previous study had 15% cases of hyponatremia and 5.8% of hypernatremia, and another study done by Kumar et al had 11.1% hyponatremia [15,16]. The value of the present study was lower than these two studies.

None of the patients had hyponatremia with hypomagnesemia; there was no association of hyponatremia and hypomagnesemia. In the present study 4 out of 315 (1.3%) patient's mother had a significant antenatal history of high-risk factor, a study done by Aziz A et al [6] mothers with antenatal risk factor was 13% while a previous study done indicated 4% mothers had a history of high-risk factor which value was higher than the present study [15].

The mean value of serum calcium was 9.36 mg/dl in the present study while a study done by Saha D et al mean serum calcium was 7.37 ± 0.1 mg/dl which value was lower than the present study [14]. The mean value of serum sodium was 139 mEq/L found in the present study, a study was done by Basu P et al (2010) mean serum sodium was 122.1 ± 6.0 mEq/L which value was lower than the present study [17].

Conclusion

From the study, it was concluded that the Prevalence of Hypocalcemia was 7.6% No association was found between Hypocalcemia and Hypomagnesemia Prevalence of hyponatremia was 6.3%, and no association between hyponatremia and Hypomagnesemia. The prevalence of hypernatremia was 1.3% and there was no association between hypernatremia and Hypomagnesemia.

What does the study add to the existing knowledge

There have not been a lot of studies regarding the prevalence of metabolic and electrolyte profile with age gender, complications risk factor, and other electrolytes in birth asphyxia. In previous studies' role of understanding the metabolic and electrolyte profile of birth asphyxia, there should be more studies regarding metabolic and electrolyte profile in birth asphyxia.

Author's contribution

Dr. Abhishek Kumar Singh: Manuscript preparation

Dr. Bhoopendra Sharma: Manuscript preparation

Dr. Anita Mehta: Data analysis

Dr. Karm Chand Gandhi: Concept, study design

Dr. Harish Chandra Tiwari: Manuscript review

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