

STUDY OF ELECTROLYTE LEVELS IN THE CORD BLOOD OF BIRTH ASPHYXIATED NEONATES AND ITS CORRELATION WITH THE SEVERITY OF ASPHYXIA

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ABSTRACT

Background: Perinatal asphyxia contributes significantly to neonatal morbidity and mortality in developing countries owing to its potential of causing permanent brain damage and even death of the fetus. Though there are more and more studies for understanding the mechanisms leading to birth asphyxia, studies for early determination of tissue damages due to birth asphyxia are still lacking. **Objective:** An observational hospital-based cross-sectional study for finding any correlation between the levels of cord blood electrolytes (sodium, potassium, calcium) in birth asphyxiated neonates in the Department of Pediatrics and Neonatology, RIMS, Ranchi. **Method:** In this observational study, cord blood samples of 89 inborn birth asphyxiated term neonates with birth weight 2.5-4 kg, were evaluated over a period of 12 months from June 2019 to May 2020. Inclusion criteria were term, inborn neonates, appropriate for gestational age with birth asphyxia as per WHO definition- "failure to initiate and sustain breathing at birth" and based on apgar score as an apgar score of <7 at one minute of life⁵ and whose attendants had given a duly signed informed consent. A detailed clinical examination was carried out as soon as the neonates were admitted. Gestational age, birth weight, relevant perinatal history, findings on physical examination were recorded on a pre-designed proforma. **RESULTS:** Among the 89 cases that were studied, 49 were male (55.1%) and 40 were female (44.9%). 50 cases were born by vaginal delivery (56.2%) while 39 cases were born by caesarean section (43.8%). Among the cases, 5.6% developed no HIE, 50.6% developed HIE I, 33.7% HIE II and 10.1% HIE III. Comparison of cord blood electrolytes among the cases showed that the values of sodium and calcium decreased with the severity of HIE staging. Again, the potassium levels increased to some extent as the severity of asphyxia increased, but significant correlation of potassium levels within the groups was missing. **CONCLUSION:** Our study compared the cord blood electrolyte levels among the cases and showed that the levels of sodium and calcium decreased with the severity of HIE and potassium levels increased to some extent. Because estimation of umbilical cord blood values of electrolytes can be routinely done in the existing medical facilities in our country, their values can be used as a valuable indicator of the severity of tissue hypoxia. Limitation to the study was a small sample size owing to the few cases of birth asphyxiated neonates born in our hospital. Hence, further studies are needed with larger sample sizes for a better correlation.

KEYWORDS: Birth asphyxia, Cord blood, HIE, sodium, potassium, calcium.

INTRODUCTION

Perinatal asphyxia is, unquestionably, a significant neonatal problem contributing to neonatal morbidity and mortality. In India, 8.4% of inborn babies have a one minute Apgar score less than 7 and 1.4% suffer from hypoxic ischemic encephalopathy (HIE).^[1] Globally, hypoxia of the newborn (birth asphyxia) or the fetus

("fresh stillbirth") is estimated to account for 23% of the 4 million neonatal deaths and 26% of the 3.2 million stillbirths each year.^[2] Asphyxia causes multi-organ damage^[3] and hypoxic-ischemic encephalopathy (HIE) is a major outcome of this hypoxia leading to neuromotor disabilities in later life.^[4] Severity of encephalopathy can be ascertained using the Sarnat clinical stages of

HIE.^[3] Only a third of deliveries in India are institutional and many asphyxiated babies are brought late to hospitals. The signs of asphyxial injury are nonspecific and overlap with other illnesses. Hence in the absence of perinatal records, it is difficult to retrospectively diagnose perinatal asphyxia. Though there are extensive studies for understanding the mechanisms leading to birth asphyxia, studies for early determination of tissue damages due to birth asphyxia are still lacking.

When a neonate suffers asphyxia, series of clinical^[5] and biochemical,^[6] alterations occur which can adversely affect the outcome. Further the degree of these imbalances may vary according to the severity of birth asphyxia. Sodium, potassium and calcium are the major electrolytes in human body, and any deviation from their normal levels in blood might cause convulsions, shock and other metabolic abnormalities.^[7] Hyperkalemia is associated with cardiac dysfunction and death. Calcium is an important second messenger in our body and also helps carrying out muscle function and acts as cofactor for several enzymatic activities. Hypocalcaemia^[8] is associated with jitteriness, cardiac dysfunction and seizure. Hyponatremia and hypocalcaemia are also significant risk factors for perinatal brain injury.

Hence this study is being conducted to find out any correlation between the electrolyte status (sodium, potassium, calcium) in cord blood with the severity of asphyxia, so that problems can be anticipated early and appropriate measures taken and neonatal morbidity and mortality can be reduced.

MATERIALS AND METHODS

This cross-sectional observational study was performed in the the Department of Pediatrics and Neonatology, Rajendra Institute of Medical Sciences, Ranchi on 89 birth asphyxiated neonates born at RIMS from June 2019 to May 2020 [sample size was calculated based on last 1 year's(2017-2018) incidence of birth asphyxiated inborn term babies admitted in the department of Paediatrics and Neonatology, RIMS, Ranchi].

Inclusion criteria included inborn term newborns appropriate for gestational age (those babies falling between 10th to 90th percentile of weight for their gestational age i.e. weight between 2.5 to 4 kg) with Birth asphyxia as per WHO definition- "failure to initiate and sustain breathing at birth" and based on Apgar score as "an Apgar score of <7 at 5 min of life even after

receiving resuscitation" according to Neonatal Resuscitation Program (NRP) guidelines were included in the study. Informed consent was duly signed by the parents before enrolling into the study. All the cases registered were evaluated for detailed history, clinically examined thoroughly and investigated for cord blood electrolytes (sodium, potassium, calcium).

The study excluded preterm and IUGR babies, babies with suspected IEM and gross congenital malformations. Those born to mothers with epilepsy, diabetes, dyselecrolytemia, treated with drugs like diuretics, general anesthesia, phenobarbitone, pethidine, magnesium sulphate, antihypertensive or drugs likely to cause depression and electrolyte disturbance in newborn, were also excluded.

For cord blood analysis, the cord was double clamped immediately after delivery at a minimum length of 10 cm with the placenta in situ and cord blood sample was collected and sent for analysis of serum electrolytes. The data obtained was analyzed with appropriate statistical tests and methods to determine the significance and power of study.

RESULTS

Over a period of 1 year from May 2019 to June 2020, 89 neonates admitted in the NICU, RIMS, Ranchi, were evaluated for HIE and their cord blood samples studied. Among the cases, 49 were male (55.1%) and 40 were female (44.9%). The mean age of the cases studied was 53.46 ± 7.58 hours. 50 cases were born by vaginal delivery (56.2%) while 39 cases were born by caesarean section (43.8%). The mean birth weight of the cases was 2.72 ± 0.31 kg and the mean gestational age 38.40 ± 1.35 completed weeks. The mean APGAR at 1 minute was 3.90 ± 1.05 and at 5 minutes was 5.84 ± 1.40 . Among the cases, 5.6% developed no HIE, 50.6% developed HIE I, 33.7% HIE II and 10.1 % HIE III. 78 (87.60%) cases were discharged while 6 (6.70%) cases left against medical advice and 5 (5.60%) cases succumbed to the illness.

The mean values of serum electrolytes obtained from the study in various groups of HIE are depicted in table no.1, which showed a statistically significant correlation as well, with p values of <0.05 for sodium, <0.05 for potassium and <0.001 for calcium (as shown in table no.2).

Table 1: Comparison Of Mean Serum Electrolyte Levels In Different Grades Of HIE.

	Mean sodium level	Mean potassium level	Mean calcium level
No HIE	134.24 ± 3.74	3.92±0.35	1.05±0.09
HIE 1	133.69 ± 9.02	4.77±1.30	0.90±0.16
HIE2	128.57 ± 8.04	5.48±1.38	0.77±0.16
HIE 3	125.56 ± 9.84	5.27±1.46	0.56±0.29
Mean	131.17 ± 8.99	5.01±1.36	0.83±0.21

Table 2: Correlation Coefficient Of Serum Sodium, Potassium And Calcium Levels With Severity Of HIE Staging.

	Correlation coefficient	P value
Serum sodium	-0.326	<0.05
Serum potassium	0.266	<0.05
Serum calcium	-0.554	<0.001

This table shows that there is significant negative correlation of serum sodium (P<0.05) and serum calcium (P<0.001) with the severity of birth asphyxia; and significant positive correlation of serum potassium with the severity of birth asphyxia at P value <0.05.

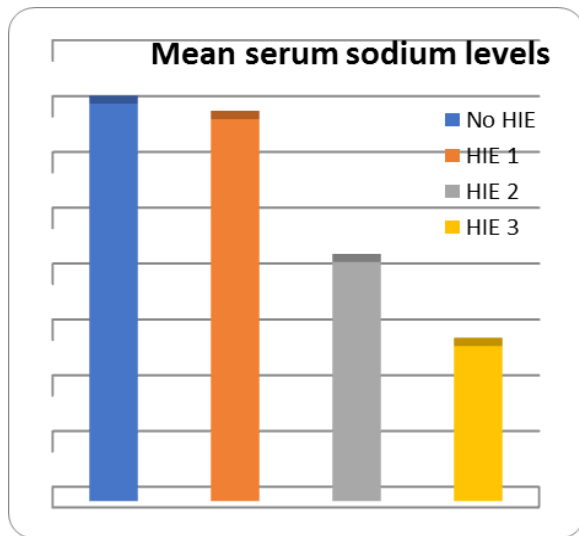


Fig. 1: Mean Serum Sodium Levels In Relation To Various Grades Of HIE Staging.

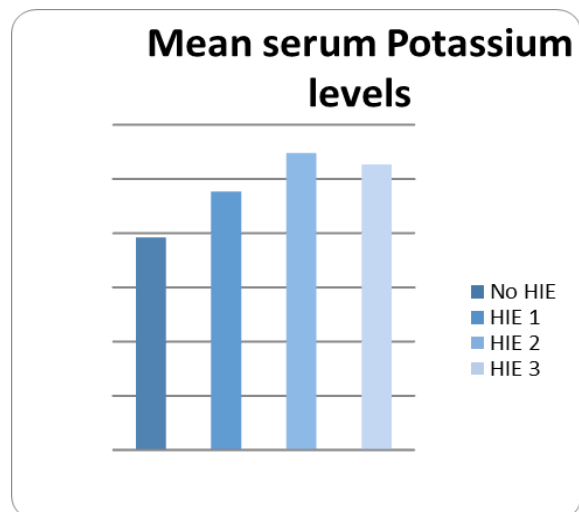


Fig 2: mean serum potassium levels in relation to various grades of HIE staging.

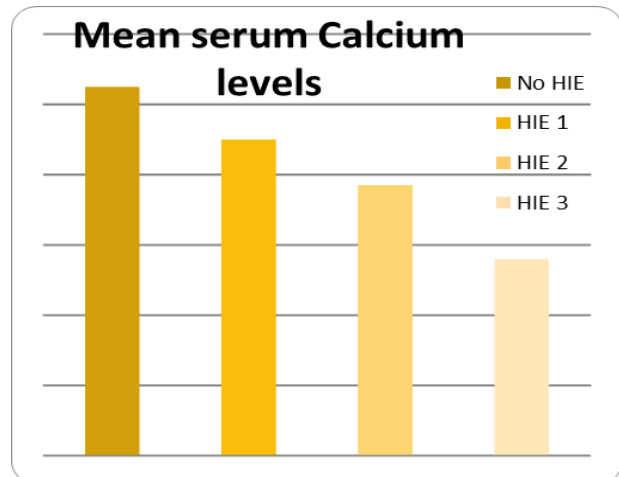


Fig. 3: Mean Serum Calcium Levels In Relation To Various Grades Of HIE Staging.

DISCUSSION

The present study revealed significant negative correlation between serum levels of sodium and calcium with increasing severity of HIE. Though serum potassium levels were slightly on the higher range in moderate to severely asphyxiated neonates as compared to mildly asphyxiated neonates, the values did not show any significant correlation between the HIE 2 and HIE 3 groups. There was no statistically significant electrolyte or metabolic difference when gender, gestational age, and birth weight of the neonates were compared. The results of the present study were in concordance with many other studies while few studies showed no significant results.

In our study, the mean serum sodium level was 131.17±8.99 mmol/l in the study population. Our study revealed that with elevation in the severity of HIE, serum sodium levels diminished and the difference was statistically significant between babies with HIE I, HIE II and HIE III. Jayaprakash et al,^[9] Thakur et al,^[7] and Bhat et al,^[10] also found similar results with the present investigation. While Prithviraj et al^[11] found no such correlation.

In our research we found the mean serum potassium level to be 5.01±1.36 mmol/l. Thakur et al^[7] and Bhat et al,^[10] found that there was a rising trend in the level of serum potassium with severity of HIE staging and the difference was statistically significant between the different groups. Jayaprakash et al,^[9] also showed varying levels of serum potassium in different grades of HIE but there was no linear correlation between the

different groups. Present study also shows that there is increasing value of serum potassium in moderate to severe birth asphyxia stages as compared to mildly asphyxiated babies but this difference does not hold any linear correlation between the different grades of HIE.

In our present study, the mean serum calcium level in our cases to be 0.83 ± 0.21 mmol/l. Jayaprakash et al,^[9] Rai et al,^[12] Prithviraj et al,^[11] found statistically significant changes in serum calcium levels in different stages of HIE. Thakur et al,^[7] did not find significant hypocalcaemia with increasing severity of HIE but there was hypocalcaemia associated with birth asphyxia. In our study too, we found similar statistically significant changes of serum calcium in association with birth asphyxia and the serum calcium levels showed gradually decreasing trend as the HIE grades progressed.

Rai et al,^[12] and Bhat et al,^[10] in their research on effect of birth asphyxia on serum calcium in 2015 found a significant negative correlation between them ($P < 0.01$). Thakur et al,^[7] and Bhat et al,^[10] found significant negative correlation between serum sodium and birth asphyxia in both studies ($P < 0.001$) and significant positive correlation between serum potassium and grades of HIE. But there was no significant correlation between serum calcium and HIE grades in the research by Thakur et al,^[7] ($P < 0.077$). In our present study, we find a significant negative correlation between serum sodium and HIE grades ($P < 0.05$), a significant positive correlation between serum potassium and HIE ($P < 0.05$) although the levels are not significant within the groups of HIE II and HIE III, and a very strong significant correlation between serum calcium and HIE severity.

Thus in our study, we have found umbilical cord blood sodium, potassium and calcium estimation to be a good, simple screening test for the early assessment of perinatal asphyxia. Furthermore, there is a correlation between the degree of hyponatremia and hypocalcaemia and the severity of the encephalopathy, indicating the degree of injury at an early stage when other quantitative methods frequently cannot be carried out.

CONCLUSION

Hypoxic ischemic encephalopathy may cause permanent damage to brain tissues that may lead to neonatal death or later manifest as developmental delay or cerebral palsy. As birth asphyxia is a very significant factor for neonatal morbidity and mortality, we require more and more predictors to detect the neonates at high risk of damage at the earliest. Electrolyte levels of cord blood of asphyxiated neonates can help significantly in this regard and help in reducing the mortality and morbidity in neonatal intensive care units worldwide. This study had a small sample size owing to a less number of birth asphyxia cases in our hospital. Hence workup of a larger population is required to further affirm the findings and utilise them in clinical practice.

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