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Study of serum sodium, serum calcium and blood glucose level in neonates with birth asphyxia

[1] Dr. G Joag, [2] Dr. R Langade, [3] Dr. CD Aundhakar, [*4] Dr. Harshada Tatiya, [5] Dr. Raghav Kakar
[1, 2] Associate Professor, Department of Pediatrics, KIMS, Karad, Maharashtra, India
[3] Head of Department, Department of Pediatrics, Krishna Institute of Medical Sciences (KIMS), Karad, Maharashtra, India
[4, 5] Resident, Department of Pediatrics, KIMS, Karad, Maharashtra, India

Abstract
Objective: To study levels of serum sodium, serum calcium and blood glucose in Neonates who were revived from Birth Asphyxia.
Method: 70 neonates were enrolled. 35 were term (asphyxiated) neonates with Apgar score of ≤7 at 5 minutes and 35 term non asphyxiated neonates. Venous blood sample for estimation of serum sodium, serum calcium and blood glucose was collected within 1 hour of admission.
Result: In this study the mean levels of serum sodium, serum calcium and blood glucose were found to be lower in asphyxiated neonates than non-asphyxiated neonates which had positive co relation with the severity of birth asphyxia.
Conclusion: Neonates with perinatal asphyxia have more significant lower levels of the studied parameters which requires medical intervention. Close clinical evaluation and biochemical monitoring is needed to early identify, properly manage, prevent adverse neurodevelopmental outcome and improve long term prognosis of neonates with asphyxia.

Keywords: birth asphyxia, serum sodium, serum calcium, blood glucose, Apgar score

1. Introduction

WHO has defined Birth Asphyxia as failure to initiate and sustain normal breathing at birth [4] and account for one million deaths each year world-wide, Birth Asphyxia is one of the 5 leading causes of perinatal death. Globally, 23 % of neonatal deaths [1] and 10 % of all deaths in children less than 5 years of age [2, 3] are estimated to occur as a result of birth asphyxia. Perinatal asphyxia is one of the most common primary cause of mortality (28.8%) and morbidity among neonates in India and is the commonest cause of stillbirths (45.1%). An Apgar score of <7 at 1 min and at 5 min is seen in 8.4% and 2.45% cases respectively in India [7].

In adults, the brain is about 2% of body weight and receives about 15% of the cardiac output. In term babies, it is 10% of body weight and uses energy not only to maintain electrical activity but also for growth. Lack of oxygen availability gives rise to depletion of NAD^+ tissue stores, decrease of ATP formation, weakening of the electron transport pump and anaerobic metabolism and acidosis, leading necessarily to death if oxygenation is not promptly re-established. The regional impact of the insult is related to (i) the severity or the extent of the insult; (ii) the metabolic imbalance during the re-oxygenation period, and (iii) the developmental stage of the affected region. Severe asphyxia has been linked to cerebral palsy, mental retardation and epilepsy, while mild-severe asphyxia has been associated with attention deficits and hyperactivity in children and adolescents [5]. Half of the children seen in the NICU follow-up clinic with abnormal neurologic examinations had birth asphyxia [6].

Birth Asphyxia leads to various metabolic disturbances like hyponatremia, hypocalcemia, hypoglycaemia which can lead to convulsion, shock and death if medical treatment is not provided.

Only a third of deliveries in India are institutional [10] and many asphyxiated babies are brought late to hospitals. The signs of asphyxial injury are nonspecific and overlap with other illnesses. In the absence of perinatal records, it is difficult to retrospectively diagnose perinatal asphyxia. A variety of markers have been examined to identify perinatal hypoxia. There are many studies for understanding mechanisms leading to birth asphyxia, but studies to find out any correlation between the sodium, calcium, glucose levels in birth asphyxia are important. Early identification and prevention of the adverse effects of these biochemical abnormalities in the newborns can be done leading to reduction in the morbidity & mortality. By preventing these adverse effects we can also improve the future outcome of the newborns. In literature there are few studies simultaneously done on serum sodium, calcium and glucose in birth asphyxia.

2. Material and Methods

This hospital based case control study was conducted on neonates admitted to Neonatal Intensive Care Unit, Tertiary Care Centre from July 2016 to June 2017. 70 neonates were enrolled. 35 were term (asphyxiated) neonates with Apgar score of ≤7 at 5 minutes and 35 term non asphyxiated neonates. The study was approved by the Institutional Ethical Committee and informed consent was obtained from parents of each subject before their enrolment in the study. All the neonates included in the study were full term admitted to NICU. Neonates with congenital malformation, suspected metabolic disorders, neonates born to mother with Diabetes

Mellitus, hypertension or mother receiving general anaesthesia were excluded Also neonates of mothers receiving phenobarbitone, magnesium sulphate, pethidine and drugs likely to cause depression in neonates were excluded from the study. Neonates included in the study did not receive any medication except vitamin K prior to collection of blood samples.

Data was recorded regarding maternal history, birth events, APGAR score, weight and sex of the neonate. Thorough clinical & neurological examination were done of all neonates included in the study. Asphyxiated neonates were monitored for hypotonia, seizures and other signs in the post neonatal period in NICU. All asphyxiated neonates (as per WHO definition) with clinical features of HIE (Hypoxic Ischaemic Encephalopathy) were staged by Sarnat & Sarnat staging. On the basis of Apgar score at 5 minutes the asphyxiated babies are grouped as mild (score of 6 to 7), moderate (score of 4 to 5), severe (score of 3 or less). Out of the 70 neonates, 40 were born via Normal vaginal delivery, 28 were born via LSCS and 2 were Instrument delivery.

Blood sample of every neonate was sent on admission for estimating the levels of Serum Sodium (Fully automated, Ion Selective Electrode method), Serum Calcium (Fully automated, Arsenazo method) and Blood glucose levels. Normal ranges used for the purpose of study were: Serum Sodium (133-146mEq/L), Serum Calcium (7.1 – 11.6mEq/L), Blood glucose >45mg/dL.

3. Statistical Analysis

Data is analysed by unpaired and paired‘t’ test, Karl Pearson co-relational coefficient and chi square test.

4. Result

Table 1: Number of subjects in each group

	Asphyxiated	Non Asphyxiated
Males	18 (52%)	20 (57%)
Females	17 (48%)	15 (43%)
Total	35 (100%)	35 (100%)

Table 2: Number of subject as per clinical grades of asphyxia

Grades	Asphyxiated
Mild	15 (42%)
Moderate	13 (38%)
Severe	07 (20%)
Total	35 (100%)

Table 3: Distribution of Asphyxiated neonates according to HIE clinical staging

No	06
I	06
II	16
III	07
Total	35

Table 4: Mean Values in Both the Groups

	Mean ± Standard deviation	
	Asphyxiated	Non Asphyxiated
Serum Sodium (mEq/L)	133.1 ± 3.8	137.3 ± 1.84
Serum Calcium(mg/dL)	8.32 ± 0.92	9.24 ± 0.13
Blood glucose(mg/dL)	54.4 ± 10.91	76 ± 15.5

4.1 Serum Sodium

Table 5: Serum Sodium among asphyxiated & non asphyxiated cases

	Total number	Mean (mEq/L)	Standard deviation	T
Asphyxiated	35	133.11	3.8	4.088
Non asphyxiated	35	137.33	1.84	P < 0.001

Table 6: Serum Sodium with severity of birth asphyxia

	Total number	Mean	Standard deviation	P
Mild	15	135.86	2.79	< 0.001
Moderate	13	132.07	3.41	
Severe	7	129.71	2.79	

Table 7: Serum Sodium with different clinical stages of HIE

	Total number	Mean	Standard deviation	P
0	06	135.17	1.17	0.008
1	06	136.17	2.32	
2	16	132.56	4.37	
3	07	130.00	1.63	

In this study serum sodium was lower among asphyxiated neonates as compared to non-asphyxiated neonates and difference between 2 groups was statistically significant. Lower sodium levels are seen among asphyxiated neonates and are directly proportional to severity of birth asphyxia and HIE stages.

4.2 Serum Calcium

Table 8: Serum Calcium among asphyxiated & non asphyxiated cases

	Total number	Mean (mg/dL)	Standard deviation	T
Asphyxiated	35	8.32	0.92	4.073
Non asphyxiated	35	9.24	0.13	P < 0.001

Table 9: Serum Calcium with severity of birth asphyxia

	Total number	Mean	Standard deviation	P
Mild	15	8.82	0.56	0.02
Moderate	13	8.07	1.03	
Severe	7	7.80	0.88	

Table 10: Serum total Calcium with different clinical stages of HIE

	Total number	Mean	Standard deviation	P
0	06	9.01	0.40	0.049
1	06	8.78	0.70	
2	16	7.98	1.08	
3	07	8.07	0.54	

In this study serum calcium was lower among asphyxiated neonates as compared to non-asphyxiated neonates and difference between 2 groups was statistically significant. Lower calcium levels are seen among asphyxiated neonates and are directly proportional to severity of birth asphyxia and HIE stages.

4.3 Blood Glucose

Table 11: Blood Glucose among asphyxiated & non asphyxiated cases

	Total number	Mean (mg/dL)	Standard deviation	P
Asphyxiated	35	55.4	10.67	< 0.001
Non asphyxiated	35	78	13.5	

Table 12: Blood Glucose with severity of birth asphyxia

	Total number	Mean	Standard deviation	P
Mild	15	59.71	11.47	< 0.05
Moderate	13	53.69	6.97	
Severe	7	46.8	4.58	

In this study blood glucose levels were lower among asphyxiated neonates as compared to non-asphyxiated neonates and difference between 2 groups was statistically significant. Lower glucose levels are seen among asphyxiated neonates and are directly proportional to severity of birth asphyxia and HIE stages.

5. Discussion

Birth Asphyxia is a common neonatal problem. Hypoxic Ischaemic brain injury is the most important consequence of birth asphyxia. Sodium, calcium, glucose are major biochemicals in human body and deviation from normal levels may be a risk factor for brain injury in already asphyxiated neonate. So knowledge of these abnormalities is very important for a paediatrician and valuable to modify entire outcome of the neonate. This study was an attempt to determine the relation and importance of these biochemical abnormalities in neonates with asphyxia. This study has given us a unique opportunity to co-relate with the previous studies and better understanding of the neonates with birth asphyxia.

It was found in this study that sodium and calcium levels were directly proportional to severity of birth asphyxia and showed a linear relationship. Blood glucose levels were also found to be lower in asphyxiated neonates. This was similar to study conducted by Manzke and Kruse who estimated total and ionised calcium in asphyxiated and non-asphyxiated newborns [8]. The results were in concordance with those of Pallab Basu and Herendranath Das [9].

All babies were discharged in due course of time. Out of all neonates in the study, there was 1 neonatal death, which belonged to the birth asphyxia category. The baby expired on Day 3 of life.

6. Conclusion

Based on the study conducted, neonates with perinatal asphyxia have more significant lower levels of the studied parameters which requires medical intervention soon after birth and it correlates well with the severity of birth asphyxia. Close clinical evaluation and biochemical monitoring is needed to early identify, properly manage, prevent adverse neurodevelopmental outcome and improve long term prognosis of neonates with asphyxia. Further research is needed to determine the prophylactic role of calcium in asphyxiated neonates to prevent functional derangements, related to hypocalcaemia.

7. Limitations of the Study

The main limitation of present study is small sample size and duration of study. If the study is carried forward, it may help for prognostication.

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