International Journal of Contemporary Pediatrics
Kumar SD et al. Int J Contemp Pediatr. 2018 May;5(3):1036-1039
http://www.ijpediatrics.com
pISSN 2349-3283 | eISSN 2349-3291

DOI: http://dx.doi.org/10.18203/2349-3291.ijcp20181537

Original Research Article

Electrolyte abnormalities in asphyxiated newborns

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Received: 19 February 2018
Accepted: 28 March 2018

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ABSTRACT

Background: Perinatal asphyxia is the most common cause of neonatal morbidity and mortality in worldwide. It accounts for 23% of all neonatal deaths. Electrolyte abnormalities are more common in the immediate post asphyxiated period and influence neonatal the outcome effectively. Aim of this study was to measure the serum sodium, potassium and calcium levels in immediate postnatal period of asphyxiated newborns and assess the correlation with different degree of birth asphyxia.
Methods: The serum sodium, potassium and calcium levels were measured in asphyxiated newborns in the early post-natal period. Both intramural and extramural newborns were included irrespective of their mode of delivery but according to the Apgar score. The measured electrolyte values were compared with the different severity of asphyxia.
Results: Out of 100 newborns 53 had hyponatremia, 10 had hyperkalemia and 3 had hypocalcemia. The serum sodium and potassium levels showed significant P value (<0.00) with the different degree of both asphyxia but calcium levels were not significant (p valve = 0.06). There was a negative linear correlation with sodium and calcium levels and positive correlation with the serum potassium levels.
Conclusions: Hyponatremia was significant in all stages of birth asphyxia, hyperkalemia was significant with increased severity of birth asphyxia and hypocalcemia was only weakly significant even in severe birth asphyxia.

Keywords: HIE, hypocalcemia, Hyponatremia, Hyperkalemia

INTRODUCTION

Birthasphyxia, although the correct definition is imprecise, is any insult to the fetus or new-born due to failure to breath or breathing poorly leading to decreased oxygen supply to various organs.[1] According to WHO, 4 million deaths per year occur causes related to birth asphyxia which is the largest cause of under 5 mortality (8.5%) after neonatal infections and other complications after birth.[2] Among the neonatal mortality 23% of all deaths are caused by birth asphyxia.[3] According to the WHO 2005 data, birth asphyxia is one of the leading cause of death in first week of life. It is strongly associated with 1.1 million stillbirths and development of severe sequelae such as cerebral palsy, epilepsy and intellectual disability.[4] The hypoxic ischemic sequelae depend upon the duration of insult in the perinatal period. Working definition for intramural birth asphyxia babies defined as follows, severe birth asphyxia is when the APGAR score at 1 min is 0-3. Mild and moderate birth asphyxia is when Apgar score at 1 min is 4-7.[5] About 30-50% of infants with HIE-II and III suffer from some form of mental and physical disabilities every year in our country. Fluid, electrolyte and metabolic abnormalities are the commonest derangements encountered in critically ill asphyxiated neonate. Serum sodium, potassium and calcium are major electrolytes in the body

and any deviation from their normal level leading to convulsions, shock, and major metabolic abnormalities.[6]

Syndrome of inappropriate secretion of antidiuretic hormone (SIADH) is a common problem in these neonates accounting for hyponatremia, hyperkalaemia results from ischaemic insult with eventual renal insufficiency.[7,8] The fluid and electrolyte shift can occur after birth asphyxia.[9] Calcium is an important second messenger in our body and act as a cofactor for muscle function and several enzyme activities.[10,11]

Hypocalcemia triggers seizure activity and deleterious cardio vascular sequences in asphyxiated new-borns. It is difficult to differentiate the seizure activity due to hypocalcimia and asphyxia.[8,12] Therefore, monitoring of serum calcium levels assumes the importance in birth asphyxia. Not only the serum calcium level, monitoring of serum sodium and potassium levels also required to the manage deleterious effects of birth asphyxia. This study has been done to monitor the electrolytes derangements correlating with the severity of birth asphyxia.

METHODS

This descriptive study (cross-sectional) was done at Kilpauk Medical College and Hospital, NICU and the study period was October 2012 to November 2013. The aim of the study was to assess the immediate post-natal electrolyte values in asphyxiated new-borns and their derangements in different severity of asphyxia. The inclusion criteria were all full term asphyxiated new-borns (both intramural and extramural) admitted in NICU on day 1 of life.

In exclusion criteria were babies born to mothers with abnormal electrolyte values, hypertension, diabetes, fever within 2 weeks, on antiepileptics, received general anesthesia, preterms and congenital malformations and suspected metabolic disease. A written informed consent obtained for all the enrolled subjects. The electrolytes (sodium, potassium and calcium) were measured from venous samples taken under aseptic precaution. For subjects with 5 min Apgar <7, samples were taken at 1 minute also along with effective resuscitation. The severity of asphyxia was staged by Sarnat and Sarnat staging. The serum sodium and potassium levels were measured by 'electrolyte analyser' model ROCHE 8190. Serum sodium estimation was done by ion selective electrode method. The Serum calcium levels were measured by 'end point calorimetric method' using O cresolphethelin-complexone or OCPC. In this study descriptive statistical analysis was used. Chi-square test used to find the statistical significance between the two proportions. Independent t test has been used to find the statistical significance between the means of two groups.

Table 1: Reference values.

Electrolytes	Normal values
Hyponatremia	<130meq/l
Hypernatremia	>150meq/l
Hypokalemia	<3.5meq/l
Hyperkalemia	>6 meq/l
Hypocalcemia	<7meq/dl
Hypercalcemia	>11meq/dl

To assess the linear relationship between the continuous variables correlation coefficient was computed and all the analyser were two tailed and p <0.05 was taken as significant. SPSS version 16 was used for data analysis.

RESULTS

This descriptive study includes 100 new-borns of both intramural and extramural newborns with different severity of birth asphyxia. Out of 100 study population 69 were male babies and 31 were female new-borns. The female to male ratio was 3:1. Among the 100 subjects 51% (48) were delivered by labour naturally and 3 by forceps and the remaining 49% (47) were delivered by LSCS. Most of them (47%) delivered by emergency section and only (2%) were delivered by elective section. The common indication for emergency LSCS was meconium aspiration syndrome (15%). Out of 100 new-borns 78% were intramural and 22% were extramural.

According to staging of birth asphyxia 47% fell under HIE stage 1, 37% and 16% were in HIE stage 2 and HIE stage 3 respectively. While analysing the distribution of HIE 54% of HIE stage 3 are extramural and 46% intramural. Distribution of 1-minute APGAR among cases showed 59% under the score 4-6, but the distribution in 5-min APGAR 85% fell under score 4-6.

Table 2: Mean values of electrolytes with HIE stages.

	HIE stage - I, N = 47, Mean±SD	HIE stage - II, N = 37 Mean±SD	HIE stage - III, N = 16 Mean±SD	P value
Sodium	131.91±5.012	127.30±4.64	120.12±3.422	< 0.01
Potassium	4.36±0.59	4.910±0.66	6.03±0.46	<0.01
Calcium	8.538±0.82	8.46±0.76	7.90±0.98	<0.05

Present study analysis showed 53% of subjects had hyponatremia irrespective of the severity of birth asphyxia. Around 10% of subjects present with hyperkalaemia. Hypocalcaemia is less prevalent, only 3 subjects suffered with low calcium levels. This study considers the correlation of electrolyte abnormalities in different stages of birth asphyxia and also with the distribution 1-5 minutes APGAR. Statistical analysis by chi-square test revealed that Serum sodium levels were significantly lower in all subjects with HIE stage 3 with an incidence of 100%.

In stage II, 62.2% of cases had low serum sodium levels. Only 29.8% subjects of HIE-I showed Hyponatremia.

Table 3: Mean values of APGAR 1 and 5 min APGAR with electrolytes.

	Score 0-3 N = 41 Mean±SD	Score 4-7 N = 59 Mean±SD		Score 0-3 N = 15 Mean±SD	Score 4-6 N = 85 Mean±SD	
Sodium	1.25±6.93	1.30±4.71	0.000	1.19±3.3	1.29±5.4	0.000
Potassium	5.29±0.81	4.51±0.69	0.000	6.05±0.47	4.62±0.68	0.000
Calcium	8.30±0.92	8.48±0.79	0.22	7.94±0.94	8.49±0.82	0.28

Almost a gross total of, 53% of subjects had significant Hyponatremia in our study which was statistically significant with a mean sodium value of 128.32mEq/L. 56.2%of subjects from HIE-III showed significant. Simultaneous data of serum potassium showed 2.7% of subjects from stage II had high serum potassium levels. None of the cases belonging to stage I showed early onset hyperkalemia.

Only 3% of subjects have hypocalcemia, in HIE stage 3 newborns 12.5% suffer with hypocalcemia. But in stage 2, only 2.7% have the same. Student t test has been used to find out the correlation of 1 min and 5 min APGAR with the electrolytes. The data showed both sodium and potassium had significant results with the P value <0.00. But the calcium levels were insignificant with the p value of <0.22 and <0.28 respectively.

DISCUSSION

Perinatal asphyxia is a formidable neonatal problem and contributes significantly to neonatal mortality and morbidity. Hypoxic ischemic encephalopathy is the major consequence of perinatal asphyxia. The important three (sodium, potassium and calcium) abnormalities will be the major risk factor for brain injury in an already asphyxiated one. Careful correction of the above electrolyte abnormalities will surely improve the outcome of new-borns. This study interprets the association of electrolyte abnormalities with the different severity of asphyxia.

Out of the 100 asphyxiated new-borns the mean value of sodium is 128.32±6.25 mEq/L and was the least in neonates with HIE stage 3 is 120.12±3.42mEq/L. Similar to this observation the mean value of potassium was 4.83±0.83 and the value in HIE STAGE 3 was 6.0312. Finally, the serum electrolyte calcium's mean value is 8.4±0.85 mEq/L. According to the Pearson correlation plotted between the electrolytes and HIE stages showed there is a negative correlation with the HIE stages and sodium level. It interprets that when the severity of HIE stages increasing the sodium level tends to fall. The P value is statistically significant (P <0.01). But the Pearson correlation for potassium levels showed positive correlation with the different HIE stages comparatively negative correlation with the sodium levels. This study found hyperkalaemia is directly proportionate to severity of HIE stages with significant p value (P value <0.01). Similar to sodium, calcium levels also presented with negative correlation with the HIE stages. Neonates in HIE stage 3 have significantly low levels of calcium (P value <0.05).

Coming to the APGAR scores and variables, the 1 minute and 5 minutes APGAR showed similar results with the electrolytes. Our statistical analysis found 1-minute APGAR can be reliable, but 5 minutes APGAR has stronger correlation with the variables. Also, the Pearson correlation showed a positive linear correlation between 1 minute, 5 minutes APGAR and serum sodium levels. The p value is significant (<0.01). The measured variables of serum potassium levels showed a negative linear correlation with APGAR scoring. The P value is also significant (<0.01). The calcium levels showed a weakly positive linear correlation with the P value of (<0.05).

Basu P et al had studied assessed the electrolyte abnormalities in 50 controls as well as in 50 asphyxiated babies of variable severity. The results were same as in the present study. This study showed significant hypocalcaemia in the case group. But in the present study only 3% had documented hypocalcaemia which was also not significant. But the correlation with severity of asphyxia was significant.[9] Jajoo et al, studied the calcium levels in 35 asphyxiated new-borns at birth, 6, 24 and 5th day of life. They observed significant low calcium levels at birth and other periods also.[10]

Gupta et al had studied the relation between the electrolyte abnormality and acute renal failure in asphyxiated new-borns. They had included preterm babies also in the account. This study also concluded that increased electrolyte derangement with increased severity of HIE stages. The subjects with hyponatremia were very much prone for ARF. But one variation from the present study is they measured ionized calcium levels which were significant.[13]

Lackmann et al, measured potassium levels in 98 asphyxiated new-borns and none of them showed significant hyperkalaemia in the initial 144 hours of life.[14] Masood N et al, investigated electrolyte derangements in 150 new-borns. Those 150 were divided in to 3 groups as each 50 and group 1 and 2 included HIE stage 2 and HIE stage 3 respectively. Group 3 was control group. This study also concluded the same result in the present study.[15]

CONCLUSION

Hyponatremia is statistically significant in all stages of birth asphyxia and had a strong negative linear correlation. Hypocalcaemia is not statistically significant, but it had a weak linear negative correlation in all the stages of perinatal asphyxia.

Hyperkalaemia is statistically significant only in HIE stage 3 and showed a positive linear correlation with the increased severity of birth asphyxia.

The early identification and time-based intervention of electrolyte abnormality in the early post asphyxiated period will significantly reduce the morbidity and mortality.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

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Cite this article as: Kumar SD, Thenmozhi M, Kumar. Electrolyte abnormalities in asphyxiated newborns. Int J Contemp Pediatr 2018;5:1036-9.