

Correlation of Serum Electrolyte Changes with Severity of Birth Asphyxia in Newborns

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Abstract

Background: To compare the changes in serum electrolytes in asphyxiated newborns of different severity with control group.

Methods: In this case control study 150 cases were enrolled and divided into three groups of 50 cases each. Group one included asphyxiated patients with Sarnat stage II, group two included asphyxiated patients with Sarnat stage III and group three included control group with no birth asphyxia. Cases and controls were full term babies weighing 2.5kg or more. Cases included newborns with APGAR score less than 7 at 5 min of birth. Controls included newborns with APGAR score 7 or more at 5 min after the birth. Neonates with congenital anomalies, serum creatinine >1.5mg/dl, suspected metabolic diseases or infants of mothers with hypertension, diabetes mellitus, toxemia of pregnancy, mothers who received general anesthesia or drugs that cause CNS depression in newborn, mothers with history of febrile illness upto two weeks before delivery and mothers with abnormal serum electrolytes status pre and immediately post delivery were not included. Cord Blood samples of all three groups were taken within 5 minutes of birth for estimation of serum electrolyte levels (Na⁺, Ca⁺⁺, K⁺). Mean values of serum electrolytes were compared by ANNOVA test and p < 0.05 was taken as significant.

Results: Mean serum sodium levels were found decreased in cases of group I and II as compared to the control group (133.76±4.98 & 132.96±6.01 mEq/L Vs 139.64±2.36 mEq/L respectively p<0.05). Mean serum calcium levels were also found significantly reduced in cases of group I and II as compared to the control group (8.68±0.70 & 8.54±0.92 mg/dl Vs 9.55±0.43 mg/dl respectively p<0.05) while mean serum potassium levels were found higher in group I & II cases versus controls (4.8±0.62 & 4.63 ±0.35 mEq/L Vs 4.42 ±0.41 mEq/L respectively p<0.05).

Conclusions: Hyponatremia and hypocalcaemia showed linear correlation with severity of birth asphyxia, while serum potassium levels remained within high normal range.

Key Words: Sarnat stage, serum electrolytes, birth asphyxia.

Introduction

Birth asphyxia is an important cause of metabolic derangements and acute neurologic injury in newborns. The term "asphyxia" is derived from a Greek word meaning "stopping of the pulse". Birth asphyxia is defined as metabolic or mixed acidemia (pH < 7.0) with persistence of an APGAR score of 0 to 3 at >5 min of birth along with hypotonia, seizures, coma or hypoxic ischemic encephalopathy and systemic impairment in immediate neonatal period.¹ Worldwide incidence of birth asphyxia is 2-9/1000 live full term births. In Pakistan this incidence is much higher due to poor availability and quality of health care.² It is estimated that around 23% neonatal deaths are due to birth asphyxia. It is also responsible for a large proportion of still births.³

According to the World Health Organization (WHO), around four million newborns develop birth asphyxia annually, and out of these 1.2 million die and almost the same number develop severe sequelae such as developmental delay, cerebral palsy and epilepsy.⁴ The grave morbidity associated with it, in the form of permanent neurological deficit like cerebral palsy and mental retardation, is up to 25%.⁵ The severity of Hypoxic-Ischemic Encephalopathy (HIE) symptoms reflects the timing and duration of the insult.⁶ Birth Asphyxia can be categorized into three stages of hypoxic ischemic encephalopathy according to Sarnat staging.^{7,8} The Sarnat Grading Scale of HIE is a scoring system used to grade the severity of an HIE injury. Metabolic derangements have been seen in asphyxiated newborns along with multisystem involvement.^{9,10,11} The electrolyte imbalance manifests in the form of hyponatremia and hypocalcaemia which have significant linear correlation with severity of birth asphyxia.^{12, 13}

Patients and Methods

This case control study was conducted in Benazir Bhutto hospital Rawalpindi from April to October

2012. Total of 150 cases were enrolled and divided into three groups of 50 cases each. Group one included asphyxiated patients with Sarnat stage II, group two included asphyxiated patients with Sarnat stage III and group three included control group with no birth asphyxia. Study was started after approval by ethical committee of Rawalpindi Medical College Rawalpindi. Both cases and controls were full term babies weighing 2.5kg or more. Cases included newborns with APGAR score less than 7 at 5 min of birth. Controls included newborns with APGAR score 7 or more at 5 min after the birth. Both genders were included. Neonates with congenital anomalies, serum creatinine >1.5mg/dl, suspected metabolic diseases or infants of mothers with hypertension, diabetes mellitus, toxemia of pregnancy, mothers who received general anesthesia or drugs that cause CNS depression in newborn, mothers with history of febrile illness upto two weeks before delivery and mothers with abnormal serum electrolytes status pre and immediately post delivery were not included in the study. Cord Blood samples of all three groups were taken within 5 minutes of birth and serum electrolyte levels (Na⁺, Ca⁺⁺, K⁺) were estimated. Data was processed on SPSS 15. Mean values of serum electrolytes were compared by ANNOVA test and p < 0.05 was taken as significant.

Results

The total number of cases included in the study were 150 from both genders (Table 1).The mean serum sodium level in group I cases was 133.76 ±4.98 (range 128 - 145) mEq/L and in group II cases was 132.96 ± 6.01 (range 124 - 142) mEq/L. In controls, the mean serum sodium level was 139.64 ± 2.36 (range 135 - 144) mEq/L (Table 2). Serum sodium level was compared in three groups by applying ANNOVA test and the difference was found to be statistically significant (p < 0.05). The mean serum calcium level in group I cases was 8.68 ± 0.70 (range 8.80 - 10.20) mg/dl and in group II cases was 8.54 ± 0.92 (range 7.20 - 10.00) mg/dl. In controls, the mean serum calcium level was 9.55 ± 0.43 (range 9.00 - 10.20) mg/dl. Serum calcium levels were compared in three groups by applying ANNOVA test and the difference was found to be statistically significant (p < 0.05). The mean serum potassium level in group I cases was 4.82 ± 0.62(range 3.80 - 6.40) mEq/L and in group II cases was 4.63 ± 0.35 (range 3.90 - 5.40) mEq/L. In controls, the mean serum potassium level was 4.42 ± 0.41 (range 3.80 - 5.00) mEq/L. Serum potassium levels were compared in three groups by applying ANNOVA test and the difference was found to be statistically significant (p < 0.05).

Table 1. Distribution of patients by gender

	Gender of Newborn		Total
	Male	Female	
	No. (%)	No. (%)	
Group I (case)	27 (54)	23 (46)	50
Group II (case)	26 (52)	24 (48)	50
Group III (control)	29 (58)	21	50

Table 2 . Mean values of electrolytes in cases and controls

Parameters	Group I (n=50) Mean ± SD	Group II (n=50) Mean ± SD	Controls (n=50) Mean ± SD	p-value
Sodium	133.76±4.98	132.96±6.01	139.64±2.3	0.00
Potassium	4.82±0.62	4.63±0.35	4.42±0.41	0.00
Calcium	133.76±4.98	132.96±6.01	139.6±2.3	0.00

Discussion

Sodium, potassium and calcium are the major electrolytes in human body, and any deviation from their normal levels in blood might cause convulsions and other metabolic abnormalities. Body should maintain optimum level of these electrolytes in blood.^{14,15} Abnormalities in these electrolyte levels may be a risk factor for the brain injury for an already asphyxiated neonate. ¹⁶ Knowledge of these abnormalities among asphyxiated newborns is very valuable to the pediatricians as it is an important variable affecting perinatal mortality. ¹⁷ Immediate aggressive treatment of these abnormalities could modify the entire outcome of the babies. ¹⁸ This study was an attempt to determine the electrolytes disturbances among patients with birth asphyxia and to compare them with controls.

The results of this study showed a lower mean of serum sodium and serum calcium levels and higher mean of serum potassium level in asphyxiated neonates as compared to controls. In literature, there are only few studies, which have focused the simultaneous measurement of serum electrolytes levels among neonates with birth asphyxia. The mean sodium level in our study in group I cases was 133.76 ± 4.98 mEq/L, and in group II cases, was 132.96 ± 6.01 mEq/L as compared to control 139.64 ± 2.36 mEq/L. These mean levels of sodium in birth asphyxia cases were found to be low as compared to those in controls. This observation was also made by Basu P et al.¹⁸ In their study significant hyponatremia was noted (p < 0.001). In another study Gupta BD et al observed that asphyxiated babies had lower mean serum sodium levels as compared to the control group(p <0.001).¹⁹ In

the current study lower mean serum sodium levels were found in group II as compared to group I. This finding may describe that fall in serum sodium concentration may be associated with severity of asphyxia.

In present study mean serum calcium level in asphyxiated neonates were low i.e. 8.68 ± 0.70 mg/dl in group I and 8.54 ± 0.92 mg/dl in group II as compared to controls i.e. 9.55 ± 0.43 (range 9.00 – 10.20) mg/dl. This shows that asphyxiated neonates have more hypocalcaemia as compared to controls. Similar results were also observed by Jain BK et al.²⁰ In study by Basu P et al mean serum calcium level was found lower ($p < 0.001$) in asphyxiated cases than controls.¹⁸ Although, serum calcium levels were lower in cases as compared to controls, but not much difference was seen in the mean serum calcium levels in I and II groups immediately after birth.

In our study, mean serum potassium levels were observed in high normal range in birth asphyxia cases i.e. 4.82 ± 0.62 mEq/L in group I and 4.63 ± 0.35 mEq/L in group II, while in controls, the mean serum potassium levels were found comparatively in lower normal range i.e. 4.42 ± 0.41 mEq/L and the comparison of all groups was statistically significant. In a study by Gupta BD et al higher serum potassium levels were also observed in asphyxiated neonates as compared to those with controls (4.35 ± 0.44 mEq/L).¹⁹ While Basu P et al observed that mean serum potassium level was higher in asphyxiated neonates as compared to controls ($p < 0.001$).¹⁸ Although, the serum potassium levels in our study were found to be increased in cases of birth asphyxia as compared to controls, but the levels remained within normal limits.

Conclusion

1. Hyponatremia and hypocalcaemia showed linear correlation with severity of birth asphyxia, while serum potassium levels remained within high normal range.
2. Electrolytes imbalance may be used as a predictor of morbidity and mortality in asphyxiated neonates and will also help in the concepts regarding immediate management of birth asphyxia patients.
3. It is required to further highlight the importance of immediate management of birth asphyxia in these patients

References

1. Birth asphyxia in neonatology (management, procedures, problems, diseases and drugs) clinical manual, edited by

- Tricia Lacy Gomella TL (ed.) Norwalle CT. Appleton and Lange 7th ed. 805, 2013.
2. Jehan I, Harris H, Salat S, Zeb A, Mobeen N. Neonatal mortality, risk factors & causes. Bull World Health Organ 2009;87:130-38.
3. Antonucci R, Porcella A, Pilloni MD. Perinatal asphyxia in the term newborn. J Pediatr Neonat Individual Med. 2014;3(2):25-28
4. Lawn JE, Wilczynska-ktende K, Cousens SN. Estimating the causes of four million deaths in the year 2000. Int J Epidemiol. 2006 Jun; 35 (3); 718-19.
5. Lawn JE, Manandhar A, Haws RA, Darmstadt GL. Reducing one million child deaths from birth asphyxia – Survey of health system gaps and priorities. Health Res Policy Syst 2007; 5(1):4.
6. Rees S, Inder T. Fetal and neonatal origins of altered brain development. Early Hum Dev. 2005;81:753-61.
7. Oztekin O, Kalay S, Tezel G, Akcakus M. Retrospective analysis for newborn infants with hypoxic-ischemic encephalopathy. Basic res. J. Med. Clin. Sci. 2012; 1(2) . 19-24.
8. Shah GS, Singh R, Das BK. Outcome of newborns with birth asphyxia. JNMA J Nepal Med Assoc 2005;44:44-46.
9. Chishty AL, Iqbal MA, Anjum A, Maqbool S. Risk factor analysis of Birth Asphyxia at the Children's Hospital, Lahore. Pak Paediatr J 2002;26:47-53.
10. Black RE, Kelley L. Reducing perinatal and neonatal mortality. Child Health Research Project. Special Report 1999;1-48.
11. Shah GS, Singh R, Das BK. Outcome of newborns with birth asphyxia. JNMA J Nepal Med Assoc 2005;44(158):44-46.
12. Moen V, Irestedt. K Hyponatremia in Birth Asphyxia— Cause or Effect? Indian J Pediatr 2010;77:1049–50.
13. Wei Z, Xia Y, Qing PF, Ting YL. Correlation of brain natriuretic peptide with hyponatremia in newborn infants with hypoxic ischemic encephalopathy. World J Pediatr 2007;3:121-24.
14. Chapman IA, Stoll BJ. Nervous System Disorders. In: Behrman RE, Kliegman RM, Jenson HB, Stanton BF, editors. Nelson Text Book of Pediatrics. 18th ed. Philadelphia: WB Saunders Elsevier 2007:713-22.
15. Maries EN, Hoehn K eds. Fluids, electrolytes and acid base balance. Human anatomy and physiology, 9th edition. Newjersey: pearson education: 2012:991-02.
16. Seyal T, Hanif A. Factors Related to Adverse Outcome in Asphyxiated Babies. Ann King Edward Med Uni 2009;15:80-84.
17. Chawla D, Agarwal R, Deorari AK, Paul VK. Fluid and electrolyte management in term and preterm neonates. Indian J Pediatr. 2008;75(3):255-59.
18. Basu P, Som S, Das H, Choudhuri N. Electrolyte Status in Birth Asphyxia. Indian J Pediatr 2010;77:259-62.
19. Gupta BD, Sharma P, Bagla J, Parakh M. Renal failure in asphyxiated neonates. Indian Paediatrics 2005;42:928-34.
20. Jain BK, Singh B, Singh H, Narang APS. Serum ionized calcium in birth asphyxia. Indian Journal of Clinical Biochemistry 2000;15:36-39.