Original Article

A Study on Electrolyte Imbalance in Asphyxiated Neonates

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Abstract

In less developed country like Bangladesh, perinatal asphyxia remains a major cause of death and disability. Disorders of electrolytes are one of the common derangements encountered in critically ill asphyxiated neonates. It may remain unrecognized leading to morbidity and mortality irrespective of the primary problem. Syndrome of inappropriate secretion of ADH (SIADH) causes hyponatraemia in perinatal asphyxia. Metabolic acidosis may further exaggerate hyponatraemia. Where as in hypernatraemia there is an absolute or relative deficit of water in relation to body sodium. Hyponatraemia and hypernatraemia may aggravate the neurological morbidity in asphyxiated infants. Metabolic acidosis may causes hyperkalamia. On the other hand respiratory acidosis may cause hypochloraemia and renal tubular damage in perinatal asphyxia may further cause loss of potassium leading to hypokalaemia. This study has been conducted to find out the pattern of electrolyte abnormalities in asphyxiated neonates. In the study out of 133 asphyxiated babies 40 (30.1%) were hyponatremic. Hypokalaemia observed in 8 (6.0%) asphyxiated babies. Hyperkalaemia was found in 28 (21.1%) asphyxiated neonates in this study. Immediate measurements of serum electrolyte followed by appropriate fluid and electrolytes therapy can reduce the overall morbidity and mortality in asphyxiated neonates.

Introduction

Perinatal asphyxia is an insult to the fetus or newborn due to lack of oxygen or lack of perfusion to various organs. Immediate morbidity and mortality of perinatal asphyxia is due to multiorgan dysfunction resulting from hypoxic-ischaemic insult. Fluid, electrolytes and metabolic abnormalities are the commonest derangements encountered in critically ill asphyxiated neonates. Out of 130 million newborn infants born each year globally, about 4 million die in the neonatal period[1]. In least developed countries perinatal asphyxia remains a major cause of death and disability[2]. Bangladesh is a developing countries where about 85% of the deliveries are taking place at home without any proper supervision[3]. A high proportion of mother in rural area never seeks or get any antenatal care (ANC)[4]. Every year approximately 3.8 million babies are born, of whom approximately 15,000 die in the first 28 days of life[4,5]. In other words one new born dies in every 3.5 minutes. As antenatal care is unsatisfactory so the risk of asphyxia is present in every pregnancy[6]. And neonatal mortality contributes 74% of the infant mortality[7]. Perinatal asphyxia is the second major cause of neonatal mortality in our country. Perinatal asphyxia is the commonest illness associated with abnormal electrolytes among sick neonates[8]. In neonate, specific symptoms of electrolyte abnormalities often merge with features of underlying HIE, and inappropriate use of fluid and electrolytes in such situation perpetuates morbidity and mortality[9]. A variety of metabolic problems are present in asphyxiated infants including hyponatremia, hypoglycemia, hypocalcemia and hypomagnesemia[10].

To the best of our knowledge, a few studies have been conducted in this context in Bangladesh. There is little information on this topic in our literature despite the fact that birth asphyxia is a leading cause of neonatal mortality. With this vision the present study has been conducted to find out pattern of electrolyte abnormalities in asphyxiated neonates.

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Objectives

General Objectives:

- The study was carried out with a view to evaluate electrolyte status in asphyxiated babies admitted into paediatric department, Rajshahi Medical College Hospital.

Specific Objectives:

- To estimate serum sodium, potassium, and calcium level in different grading of HIE of perinatal asphyxia.
- To compare the serum sodium, potassium and calcium level in different grading of HIE of perinatal asphyxia.
- To compare the serum electrolyte status of asphyxiated babies with that of healthy newborns as control group.

Material And Method

Methodology:

Study design:

Cross sectional comparative study.

Place of study:

Department of paediatrics and department of gynecology and obstetrics in Rajshahi Medical College Hospital

Period of study:

From January 2010 to December 2010.

Study population:

Asphyxiated babies admitted into paediatrics and gynecology wards of Rajshahi Medical College Hospital will constitute the study population for the present study.

Sample size: 133

Inclusion criteria:

Live born babies with perinatal asphyxia those have:

1) Delay to establish first breath within sixty seconds.
2) Delayed cry over 90 seconds.
3) Heart Rate <100 beats/minute at birth.
4) Bluish colorations of whole body over first 60-90 seconds.
5) If the newborn remains hypotonic or floppy over hours.
6) APGAR score <7 at 5 min.
7) Early neonatal seizures.

Exclusion criteria:

1) Baby of diabetic mother.
2) Septicemic babies.
3) Babies with inborn error of metabolism.
4) Baby having lethal congenital deformity.

Control: In this study 133 newborns (without asphyxia) were taken as control to compare with asphyxiated newborns.

Data collection procedure: The cases were selected as purposive sampling methods.

Clinically detected cases of perinatal asphyxia were selected from inpatient department of pediatric and obstetrics ward according to inclusion criteria. After taking verbal consent a detailed history from the mother or other caregiver who attending the baby was recorded according to a predesigned data collection sheet. With all aseptic precaution small amount (2.0 ml) of venous blood was collected after taking informed consent from the person attending the baby. EasyLyte PLUS auto analyzer was used for detection of sodium, potassium and chloride level.

Data analysis: The data were coded and entered into the computer by using SPSS software program (statistical package for the social sciences) version 12. Finally selected statistical tests like chi-square, t-test and ANOVA test were done to test the significance of the result.

Result

Table 1: comparison of serum sodium levels between cases and controls.

Serum sodium	Case		Control		Total	
	N	%	N	%	N	%
Hyponatremia (<130mml/L)	40	30.1	0	0	40	15.0
Normal S. sodium 134-146 mmol/L	93	69.9	133	100.0	226	85.0
Total	133	100	133	100	266	100

x^2=47.08 df=1 p=0.000

Regarding serum sodium level 93 (69.9%) asphyxiated neonates had normal serum sodium.40 (30.1) had hyponatremia and non hyponatremia. No neonate in the control group showed abnormal sodium level.

Table 2: comparison of serum potassium levels between cases and controls.

Serum potassium level	Case		Control		Total	
	N	%	N	%	N	%
Hypokalemia (<3.5mmol/L)	8	6	12	9	20	7.5
Normal potassium level (3.3 -5.5 mmol/L)	97	72.9	121	91.0	218	82.0
>6mmol/L	28	21.1	0	0	28	10.5
Total	133	100 .0	133	100.0	266	100.0

x^2=31.442 df=2 p=0.000

The study showed 97 (72.9%) asphyxiated neonates had normal serum potassium, 28 (21.1) had hyperkalemia and 8 (7%) hypokalemia. Among the 133 control 121 (91.1%) had normal potasium level, ≥ 12 (9%) had hypokalemia. None of the control group had hyperkalemia.

Table 3: Distribution of babies by degree of asphyxia and serum sodium level.

S. Sodium level	Grading of asphyxiated baby						Total patients	
	Mild		Moderate		Severe			
	N	%	N	%	N	%	N	%
Hyponatremia (<130 mmol/L)	12	25.5	11	19.0	17	60.7	40	30.1
Normal Sodium level (134-146 mmol/L)	35	74.5	47	81.0	11	39.3	93	69.9
Total	47	100.0	58	100.0	28	100.0	133	100.0

$x^2 = 16.364$ df=2 p=0.000

The study revealed that out of 133 neonate 40 (30.1%) where hyponatremic among them 17 (60.7%) where severely, 11 (19.0%) where moderately 12 (25.5%) were mildly asphyxiated.

Table 4: Distribution of babies by degree of asphyxia and serum Potassium level.

S. Potassium level	Asphyxiated baby						Total patients	
	Mild		Moderate		Severe			
	N	%	N	%	N	%	N	%
Hypokalemia (S.K.<3.5 mmol/L)	4	8.5	2	3.4	2	7.1	8	6.0
S.K. Normal (3.5-5.5 mmol/L)	36	76.6	44	75.9	17	60.7	97	72.9
Hyperkalemia (S.K. >6 mmol/L)	7	14.9	12	20.7	9	32.1	28	21.1
Total	47	100.0	58	100.0	28	100.0	133	100.0

$x^2 = 4.395$ df=4 p=0.355

Out of 133 asphyxiated babies 8 (6.0%) develop hypokalemia. 97 (72.9%) babies S. Potassium level were normal. 28 (21.1%) were Hyperkalemic.

Table 5: Distribution of asphyxiated baby by serum Potassium level and outcome.

S. Potassium level	Outcome of baby				Total	
	Survived		Died			
	N	%	N	%	N	%
Hypokalemia (<3.5)	4	4.8	4	8.0	8	6.0
Normal (3.5-5.5)	62	74.7	35	70.0	57	72.9
(>6) Hyperkalemia	17	20.5	11	22.0	28	21.1
Total	83	100.0	50	100.0	133	100.0

$x^2 = 0.653$ df=2 p=0.721

The study showed that 50 neonates were died among them 11 (22.0%) were Hyperkalaemic 35 (70.0%) neonates were normokalaemic and 4 (8.0%) were hypokalaemic.

Table 6: Distribution of asphyxiated baby by serum Sodium level and outcome.

S. Sodium level	Outcome of baby				Total	
	Survived		Died			
	N	%	N	%	N	%
Hyponatraemia (<130 mmol/L)	16	19.3	24	48.0	40	13.1
Normal Sodium level (134-146 mmol/L)	67	80.7	26	52.0	93	69.9
Total	83	100.0	50	100.0	133	100.0

$x^2 = 52.36$ df=1 p=0.000

Regarding the 50 died neonates 24 (48.0%) had Hyponatraemia, 26 (52.0%) had normal sodium level.

Discussion

It was observed that babies with asphyxia had higher incidence of hyponatremia. In this study out of 133 asphyxiated babies 40 (30.1%) were hyponatremic. Hyponatremia was the predominant electrolyte abnormality in the present study. This finding is consistent with finding of Singhi[15] and prasad,[16] et al. where hyponatraemia found in 30% and 29.8% respectively. Presence of SIADH in perinatal asphyxia explain high incidence of hyponatremia in these neonates. But these findings were in contrast with findings of Hossain, et. al.[18] where hyponatremia was reported in 26.7% neonates and they also found hypernatremia in 23.8% of asphyxiated neonates which was not found in the present study. Out of 40 babies 17 (42.5%) of severely asphyxiated, 11 (27.5%) of moderately asphyxiated and 12 (30.0%) of mildly asphyxiated babies were hyponatremic. The positive association between serum sodium and grading of asphyxia was found to be statistically highly significant (P<0.001). Hypokalemia observed in 8 (6.0%) asphyxiated babies was the least common electrolyte abnormalities in this study. This finding is consistent with Hossian, et. al.[8] (8.6%). Marudhkar[17] found 43 (14.8%) cases of hypokalemia. Hypokalemia was found in 28 (21.1%) asphyxiated neonates in this study. Yuan et al found hypokalaemia in 44% of sick premature infants.

Singh, et al.[11] and Roa, et al.[19] found hyperkalemia in 5.4% and 14.4% respectively of ICU admissions, which included asphyxiated as well as other sick neonates. Out of 133 cases hyponatremia observed in 40 (30.1%) neonates whereas hypontremia was not found among the control (n=133). The finding was statistically significant (P<0.001) and consistent with findings of Basu, et al., Prasad, et al.[16]. Of the asphyxiated babies (n=133) hyperkalemia was found in 8 (6.0%) neonate and hyperkalemia was found in 28 (21.1%) neonates. There were 12 (9.0%) hypokalemic neonate in control (n=133) group. This result was significant (P<0.001) and consistent with Basu, et al.[13] and Gupta, et al.[20]. Out of 40 hyponatremic babies 24 (48.0%) died, significantly higher mortality observed in present study and consistent with prasad, et al.[16]. There was 4 (8.0%) and[11] (22.0%) death among hypokalemic and hyperkalemic neonates respectively. Rao, et al.[19] reported 3 (12.5%) mortality in hypokalamic and 10 (41.6%) mortality in hyperkalemic neonates. Impaired serum calcium level in perinatal asphyxia also affects outcome. Out of 20 asphyxiated baby 7 (1.4%) died who developed hypocalcemia.

Conclusion

From this study it can be concluded that electrolyte abnormalities are common in perinatal asphyxia, which has a great impact on mortality and morbidity. In this study it is proved that babies with perinatal asphyxia develop hyponatremia, which is associated with the severity of asphyxia. The asphyxiated babies also develop hyperkalemia and hypokalemia but to reach to definite conclusion further studies are required. If inappropriate fluid and electrolytes are given, serious morbidity can result from fluid and electrolyte imbalance. So measurement of serum electrolyte is the best way to measure the baby's electrolyte status and the adequacy or excess of electrolyte intake. Specific symptoms of electrolyte abnormality often merge with the underlying disease. Close monitoring and correction of electrolyte abnormalities are important to reduce morbidity and mortality in perinatal asphyxia.

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