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Original Research Article

A case control study to evaluate the electrolyte abnormalities in asphyxiated neonates

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ABSTRACT

Background: Neonatal asphyxia is a hypoxic condition in new-born and leads to encephalopathy as well as electrolyte disturbances and imposes significant morbidity and mortality. So, the current study was performed to assess the electrolyte abnormalities among asphyxiated neonates as compare to controls.
Methods: 50 neonates have beendistributedas2 groups, with case group with 25 cases and 25 cases in neonates group depending on the variables namely Apgar score, fetal heart rates and meconium-stained liquor after baby delivery. Serum sodium, potassium and calcium ranges has been estimated; compared between the groups. In asphyxiated neonates based on the severity the electrolytes levels were also compared.
Results: The prevalence of birth asphyxia seems to be higher among male new born (64%). The sodium and calcium ranges has been decreased among asphyxiated babies when associated with control group and it was significant 129.78±4.18 vs 140.76±9.76; 8.12±2.87 vs 10.42±3.12 mg/dl). The electrolyte disturbances were higher in HIE stage 3 of high severity as compared to HIE stage I and II.
Conclusions: Electrolyte imbalances namely hyponatremia, hyperkalemia, hypocalcemia were found to be communal in asphyxiated neonates. Thus, proper monitoring is required to prevent the morbidity and mortality among the neonates.

Keywords: Birth asphyxia, APGAR scores, Electrolyte disturbances and hyponatremia

INTRODUCTION

Birth asphyxia, is a condition where there occurs a respiratory failure during birth and globally it causes 600,000 neonatal deaths and one of frequent predictor of neonatal morbidity and mortality.[1] The birth asphyxia stands as when the Apgar score by 1 min is 0–3, the mild as well as moderate cases are when the Apgar score by 1 min is 4-7.[2] The global incidence of The incidence birth asphyxia ranges between 1-1.5% and in India the incidence is 8-9% responsible to be 28.8% neonatal demises and 45.1% of new still births.[3] The early outcome of birth asphyxia is either neonatal death or presence of hypoxic-ischemic encephalopathy (HIE). The degree of HIE reveals the severity of birth asphyxia and its HIE staging [Sarnat and Sarnat] aids in the rigorousness assessment of asphyxia.[4] Various factors associated with birth asphyxia, and the main cause is a s a result of decreased cerebral blood flow.[5]

Neonatal asphyxia also causes multi organ damage and leads to alteration in the serum electrolytes and biochemical levels.[6]Alteration in the sodium, potassium and calcium levels can lead to various complications such as convulsions, shock, and other metabolic abnormalities. In asphyxiated neonates, dilutional hyponatremia may occur due to hypersecretion of antidiuretic hormone that may lead to amplified water retention.[7] The other possible hypothesis for hyponatremia in neonates with HIE is the limited capacity of sodium reabsorption (if the

concentration of sodium reaching the renal collecting tubules rises), reabsorption does not happen proportionally besides partial resistance to aldosterone.[8] The modification of potassium from the intracellular to extracellular space in early neonatal period may lead to hyperkalemia and depends on the degree of immaturity; further premature babies are more possibly to have hyperkalemia. Acute renal failure secondary to asphyxia causes hyperkalemia by declining the elimination of potassium.[9] Normally, gestational age is directly proportional to cord plasma total calcium concentration. At the time of delivery, unexpected cessation of calcium transport through the placenta decreases the serum calcium levels, which in turn leads to augmented secretion of serum parathyroid hormone [PTH]. In birth asphyxia, PTH secretion is slowed down in response to postnatal decrease in serum calcium levels and hence hypocalcemia.[10]Because of this backdrop, the current research was carried out to assess serum electrolyte disturbances among birth asphyxia children and compare with the normal babies.

METHODS

Prospective research was performed with 50 term neonates comprising of asphyxiated (n=25) and non-asphyxiated (n=25) recruited from NICU of Al Ameen Medical college and hospital during the period between January 2022-February 2023. The asphyxiated babies were stated as cases and non-asphyxiated babies as controls respectively. The study was approved by institutional ethical committee of Al Ameen medical college and hospital.

Inclusion criteria

Patients with gestational age ≥37 weeks, Neonates admitted to NICU with perinatal asphyxia who met with the following criteria: Apgar score (<7 at 5 min of life), before stable spontaneous respiration, resuscitation accompanying >1 min of positive pressure ventilation were included in study.

Exclusion criteria

Neonates with congenital anomalies, maternal drug abuse, neonates born to mothers having metabolic disorders, alcohol and smoking habits and mothers taking antiepileptic and anti-depressant medications. The parents who did not give consent electrolytes were also excluded from the study.

All the asphyxiated newborns were resuscitated based on the guidelines of neonatal resuscitation program (NRP) and Apgar score was recorded at one- and 10 min. Afterwards, the neonates were shifted to level III nursery care. Priority was given to maintain temperature in all infants because it may affect electrolyte balance in neonates.

Documents of neonates presenting with perinatal asphyxia has been assessed by restructured proforma. Classification of mild (HIE I), moderate (HIE II), also severe (HIE III) stage was established on the amended Sarnat staging for neonatal encephalopathy.[11]

The levels serum electrolytes were analyzed by standard electrolyte analyser (Abbot Healthcare, India) as per the procedure by Ion electrode method.

Statistical analysis

The statistical package for social sciences version 24 (SPSS, IBM company, Chicago, IL, USA) has been assessed for data entry and examination. The continuous and categorical variables have been presented as mean ± standard deviation. The comparison of serum electrolytes between cases and controls has been performed by unpaired student's t test. A $p<0.05$ seems to be statistically significant.

RESULTS

In this study among the 25 asphyxiated cases 16 (64%) were males and 9 (36%) were females. In control, 18 (72%) were males and 7 (28%) were females and there was no significant changes in gender among cases and controls (p=0.76). Regarding mode of delivery, majority of the patients in cases (17, 68%) and controls (22, 72%) had non vaginal delivery and it was not significant (p=0.65). The mean period of gestation in cases was 38.13±2.45 weeks and in controls was 37.92±4.65 weeks and it was not significant (p=0.65) (Table 1).

Table 1: Demographics characteristics between cases and controls.

APGAR scores	Cases, (n=25) (%)	Controls (n=25), (%)	P value
Gender			
Male	16 (64)	18 (72)	0.76 NS
Females	9 (36)	7 (28)	
Mode of delivery			
Vaginal	8 (32)	3 (28)	0.65 NS
Non-vaginal	17 (68)	22 (72)	
Gestation period (weeks) (mean ± SD)	38.13±2.45	37.92±4.65	0.65 NS

NS-Non significant

The mean APGAR at 1, 5 and 10 min was significantly lesser in cases as associated with controls and it was significant (Table 2).

The comparison of electrolytes level between asphyxiated and normal neonates was shown in Table 3. The sodium levels were significantly lower in asphyxiated babies when associated with controls (129.78±4.18 vs 140.76±9.76 meq/L; p=0.001). Meanwhile, potassium

levels significantly greater among asphyxiated babies when compared with controls (7.12±0.32 vs 5.05±0.12 meq/L; p=0.001). Calcium levels seems to significantly lesser among asphyxiated babies when associated with controls (8.12±2.87 10.42±3.12 mg/dl; p=0.001).

According HIE stage, the hyponatremia, hyperkalemia and hypocalcemia was most prevalent in HIE stage 2 as compared to HIE stage 2 and stage 1 and it was found to be significant (p<0.05) (Table 4).

Table 2: Comparison of APGAR scores between cases and controls.

APGAR scores (Min)	Cases (n=25)	Controls (n=25)	P value
1	4.27 ±0.98	7.26±0.87	0.004*
5	5.16±0.85	8.42±0.1.45	0.005*
10	7.12±0.76	9.52±0.65	0.01*

*Significant p<0.05

Table 3: Serum electrolytes level between cases and controls.

Electrolytes	Normal range	Cases (n=25)	Controls (n=25)	P value
Sodium (meq/L)	134-146	129.78±4.18	140.76±9.76	0.001*
Potassium (meq/L)	3.0-6.0	7.12±0.32	5.05±0.12	0.001*
Calcium (mg/dl)	9.0-11.6	8.12±2.87	10.42±3.12	0.001*

Unpaired student t test * denotes significant p<0.05

Table 4: Comparison of serum electrolytes level in asphyxiated babies according to HIE stages.

Serum electrolytes	HIE stage I (Mild, n=14)	HIE stage II (Moderate, n=8)	HIE stage III (Severe, n=3)	P value
Sodium (meq/L)	133.65±5.76	129.16±6.12	125.97±4.87	0.001*
Potassium (meq/L)	4.12±0.98	5.05±0.77	5.65±0.565	0.002*
Calcium (mg/dl)	9.12±2.34	8.42±1.76	7.98±1.05	0.001*

One way ANOVA, * denotes significant p<0.05

DISCUSSION

Perinatal asphyxia is a hypoxic-ischemic insult, which primarily causes tissue damage, specifically brain tissue, followed by electrolytic imbalance. The extent of tissue damage (and severity of asphyxia) is determined with serum electrolytic status and plasma sugarvalues.[1213]

In our present study, out of 25 neonates, the incidence of asphyxia was higher in males (64%) as compared to females and it agrees with the reports of Bahatkar and Aundhakar, in which 72% were males.[12] The reason for male babies being more affected is due to the death of respiratory control neurons in brainstem which mediates the function of emergency resuscitation in male gender.[14]

In the present study, APGAR scores at 1, 5 and 10 min were significantly lesser among the asphyxiated cases when compared to the controls. Earlier studies shows that neonates having 1min APGAR scores between 0-3 display higher chance of development of severe form of asphyxia (HIE stage 2 and 3).[15]

In asphyxiated babies, the mean sodium, potassium and calcium was 129.78±4.18 meq/l, 7.12±0.32 meq/l and 8.12±2.87calcium mg/dl and it was significantly altered as associated with the controls. Likewise, research performed by Basu et al the mean value of sodium, potassium and calcium among the asphyxiated cases was 122.1±6.0 meq/l, 5.05±0.63 meq/l and calcium 6.85±0.95 mg/dl correspondingly and it was significant as compared to controls.[6]

In this study established on the Sarnat and Sarnat staging, majority of the neonates, 14 were in HIE stage 1low severity. Likewise, a research performed by Simiyu et al.[16] the 50%of neonates belongs to HIE stage 1low severity. This might be due several risk factors such as meconium aspiration, respiratory distress syndrome, sepsis neonatorum, oligohydramnios, macrosomia and fetal birth injury.

The present research revealed hyponatremia, hyperkalemia and hypocalcemia was of HIE stage 3 of high severity as compared to HIE stage II and I. Like our study, Acharya et al showed high percentage of hyponatremia and hypocalcemia in HIE II/III as associated to HIE. In another study done by Bhat et al.[17,18] There was significant elevation in the severity of HIE with hyponatremia and hyperkalemia.

The main limitation in our study is low sample size and single institutional study. Further, other parameters such as electroencephalogram and stretch reflexes were not evaluated. In addition we have not correlated maternal factors with the development of electrolyte abnormalities among the asphyxiated children.

CONCLUSION

In our study, the incidence of hyponatremia, hypocalcemia and hypoglycaemia found as higher among asphyxiated neonates as compared to controls. Based on the severity, the electrolyte disturbance was higher in neonates with HIE stage 3.

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