

Electrolyte Disturbance in Asphyxiated Neonates in Maternity Hospital in Erbil, Iraq

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Abstract

Background: Perinatal asphyxia is the worldwide most common cause of neonatal morbidity and mortality. It accounts for about 25% of all neonatal deaths. Electrolyte disturbances are the most common problem of asphyxiated neonates. This study measures the serum sodium, potassium, and calcium levels in asphyxiated neonates. **Objective:** The objective is to study serum calcium, serum potassium, and serum sodium levels in asphyxiated newborns of different severity in the early neonatal period and compare with controls. **Materials and Methods:** The serum potassium, sodium, and calcium levels of asphyxiated neonates were measured in postnatal period. Neonates were included according to the Apgar score and clinical examination. The measured electrolyte values were compared with the normal neonates. **Results:** From 50 asphyxiated neonates, 17 had hyponatremia, 6 had hyperkalemia, and 4 had hypocalcemia. The serum sodium and potassium levels showed statistically significant ($P < 0.00$) with the different degree of asphyxia, but calcium levels were not statistically significant ($P = 0.06$). There was a negative linear correlation with sodium and calcium levels but with the serum potassium levels was positive. **Conclusions:** Hyponatremia was significant in all stages of birth asphyxia, hyperkalemia was significant with increased severity of birth asphyxia, and hypocalcemia was not significant.

Keywords: Birth asphyxia, hyperkalemia, hypocalcemia, hyponatremia, hypoxic-ischemic encephalopathy, serum electrolyte

INTRODUCTION

Birth asphyxia essentially is delay in starting spontaneous respiration on delivery of a newborn.^[1] More specifically, birth asphyxia is the presence of hypoxia, hypercapnia, and acidosis leading to systemic disturbances in the newborn.^[2] As stated by the American Academy of Pediatrics and American College of Obstetrics and Gynecology, all these parameters should be existing for description of asphyxia such as extreme metabolic acidosis ($\text{pH} < 7$) in cord blood, lasting of APGAR Scores 0–3 for more than 5 min, neonatal neurological complication (e.g., convulsions, unconsciousness, and hypotonia), and multiple organ involvement (kidney, lungs, liver, and heart).^[3] According to the 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.^[4]

Fluid, electrolyte, and metabolic abnormalities are the most common disturbances which occur in critically ill asphyxiated neonate. Serum sodium, potassium, and calcium are major

electrolytes in the body and any disturbance in their normal level leading to convulsions, shock, and other metabolic abnormalities.

Calcium is an important second messenger which acts as a cofactor for many enzymatic reactions and also helps proper muscle function so they should be maintained in optimum level in blood.^[5]

Normally, hypernatremia in early neonatal period is due to excretion of water through kidney and high insensible water loss leading to contraction of extracellular fluid. Whereas in perinatal asphyxia, hyponatremia may be due to increased secretion of anti-diuretic hormone (ADH) in neonates with hypoxic-ischemic encephalopathy which leads to increased water retention causing dilutional hyponatremia.^[6]

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The other causes of hyponatremia are partial resistance to aldosterone and limited capacity of collecting tubules in sodium load reabsorption^[7,8] Hyperkalemia in the early neonatal period is due to shift of potassium from the intracellular to extracellular space which is more in premature neonates.^[9] Serum potassium consequently drops as this internal potassium load is eliminated by the kidneys.^[10] Whereas in asphyxia may be due to metabolic acidosis where more than one-half of the excess hydrogen ions are buffered in the cells and electroneutrality is maintained in part by the movement of intracellular potassium into the extracellular fluid.

Other contributing factors may be acute renal failure secondary to birth asphyxia which leads to decreased excretion of potassium and hence hyperkalemia. This study was done to assess electrolyte status in asphyxiated neonates because, to the best of our information, no study has been conducted in this issue in our area. There is little information on this subject in literature; however, birth asphyxia is a noticeable cause of neonatal mortality. With this in mind, this study has been directed to get the picture of electrolyte abnormalities in asphyxiated neonates.

The aim of this study was to evaluate the serum sodium, potassium, and calcium level in neonates with perinatal asphyxia as well as to compare the serum electrolyte status of asphyxiated neonates with that of healthy newborns as control group.

MATERIALS AND METHODS

Study design

This was a cross-sectional comparative study.

Place of study

Neonatal care unit in Maternity Hospital in Erbil, Iraq.

Period of study

Beginning from September 2018 to May 2019.

Inclusion criteria

Term newborns admitted to Neonatal Intensive Care Unit of Maternity Hospital because of birth asphyxia according to the WHO definition - "failure to initiate and sustain breathing at birth" and Apgar Score of <7 at 5 min of life even after active resuscitation as stated by the Neonatal Resuscitation Program guidelines.

Exclusion criteria

- Preterm neonates <37 weeks at delivery
- Infant of diabetic mother
- Neonates with diagnosed early-onset sepsis
- Neonates with suspected inborn error of metabolism
- Neonates with gross congenital malformations.

In accordance with inclusion criteria clinically diagnosed neonates of perinatal asphyxia were taken from neonatal care unit of Maternity Hospital in Erbil and once verbal consent taken, a detailed history from the mother or caregiver

who attended the neonate was documented as stated by a predesigned data collection sheet. Using consecutive sampling method, in aseptic condition (2.0 ml) of venous blood from each neonate was collected after permission from the person attending the neonate. Sodium, potassium, and calcium levels were measured by OPTI® CCA and OPTI CCA-TS Blood Gas and Electrolyte Analyzer. Normal level of serum sodium, potassium, and calcium was taken as 135–145 mmol/l, 3.5–5.0 mmol/l, and 1.12–1.32 mmol/l, respectively.

Statistical analysis

The Statistical Package for Social Sciences version 22 (SPSS, IBM Company, Chicago, IL, USA) was used for data entry and analysis. The Chi-square test of association was used to compare the proportions of electrolytes levels between the asphyxia cases and the comparison group. Fisher's exact test was used when the expected count of more than 20% of the cells of the table was <5. Student's *t*-test of two independent samples was used to compare the means of electrolytes of the asphyxia cases and the comparison group. $P \leq 0.05$ was considered statistically significant.

RESULTS

Electrolytes (sodium, potassium, and calcium) levels of 50 neonates with asphyxia had been assessed and then compared with the levels of 50 normal neonates (comparison group). The electrolytes parameters of asphyxia cases and the comparison group are presented in Table 1.

Table 2 shows that the mean sodium level of the comparison group (138.44 mmol/l) was significantly higher than the mean (135.40 mmol/l) of the asphyxia cases ($P < 0.001$), while the mean potassium of cases (4.43 mmol/l) was significantly ($P < 0.001$) higher than the mean of the comparison group (3.98 mmol/l). No significant difference was detected between the two groups regarding the means of calcium ($P = 0.251$).

As shown in Table 3 that the prevalence of hyponatremia among the asphyxia cases was 34% compared with 2% among the comparison group ($P < 0.001$). The prevalence of hyperkalemia among cases was 12%, while none of the

Table 1: Electrolytes parameters of asphyxia cases and the comparison group

Electrolytes (mmol/l)	Mean±SD	Median	Minimum	Maximum
Cases				
Sodium	135.40±5.11	136.00	122.00	144.00
Potassium	4.43±0.62	4.25	3.60	6.10
Calcium	1.16±0.05	1.16	1.01	1.24
Comparison group				
Sodium	138.44±2.43	139.00	133.00	143.00
Potassium	3.98±0.32	4.00	3.50	4.60
Calcium	1.17±0.04	1.18	1.01	1.25

SD: Standard deviation

Table 2: Means of the electrolytes of the two study groups

Electrolytes (mmol/l)	Mean±SD		P
	Asphyxia	Comparison	
Sodium	135.40±5.11	138.44±2.43	<0.001
Potassium	4.43±0.62	3.98±0.32	<0.001
Calcium	1.16±0.05	1.17±0.04	0.251

SD: Standard deviation

Table 3: Electrolyte levels in the two study groups

Electrolytes	Asphyxia, n (%)	Comparison, n (%)	Total, n (%)	P
Sodium				
Normal	33 (66.0)	49 (98.0)	82 (18.0)	<0.001
Hyponatremia	17 (34.0)	1 (2.0)	18 (82.0)	
Potassium				
Normal	44 (88.0)	50 (100.0)	94 (94.0)	0.027*
Hyperkalemia	6 (12.0)	0 (0.0)	6 (6.0)	
Calcium				
Normal	46 (92.0)	48 (96.0)	94 (94.0)	0.678*
Hypocalcemia	4 (8.0)	2 (4.0)	6 (6.0)	
Total	50 (100.0)	50 (100.0)	100 (100.0)	

*By Fisher's exact test

comparison groups had hyperkalemia ($P = 0.027$). The prevalence of hypocalcemia among the asphyxia cases was 8%, and that among the comparison group was 4%, but the difference was not significant ($P = 0.678$).

DISCUSSION

Neonatal asphyxia is a challenging issue that contributes significantly to neonatal mortality and morbidity. Disturbances in (sodium, potassium, and calcium) will be risk factor for brain injury, which is the major concern of neonatal asphyxia. Careful correction of electrolyte disturbances will improve the consequence of asphyxia. It was noticed that asphyxiated neonates had a significant incidence of hyponatremia.

In this study, of 50 asphyxiated neonates, 17 (34.0%) were hyponatremic which was the principal electrolyte disturbance in the study. This finding is consistent with result of Singhi^[11] and Prasad *et al.*,^[12] where hyponatremia found in 30% and 29.8%, respectively. In Basu *et al.*'s^[13] study, the mean serum sodium levels were 122.1 ± 6.0 mEq/L which is significantly lower than that of control group (138.8 ± 2.7 mEq/L). High prevalence of hyponatremia in asphyxiated neonates is caused by the syndrome of inappropriate ADH. However, our results were different from that of Hossain *et al.*,^[14] where hyponatremia was found in 26.7% neonates, and they also found hypernatremia in 23.8% of asphyxiated neonates which was not found in this study.

Concerning hyperkalemia detected in 6 (12.0%) of cases and the mean was $4.43 (+0.62)$ which is in accordance with Hossain *et al.*,^[14] (8.6%). Likewise, in the study of Vandana *et al.*, the means of sodium and potassium among cases were

136.5 ± 8.7 mEq/l and 3.78 ± 0.36 mEq/l, respectively.^[15] Lackmann *et al.* measured potassium levels in 98 asphyxiated newborns, and none of them showed significant hyperkalemia in the initial 144 h of life.^[16] Hypocalcemia observed in 4 (8%) asphyxiated neonates, compared to 2 (4%) cases in comparison group, which is statistically not significant, but proportionally, it is comparable to other studies in this issue. Basu *et al.*^[13] concluded increased hypocalcemia with increased severity of birth asphyxia. Respectively, in case-control study by Mimouni *et al.*,^[17] Jajoo *et al.*,^[18] Rai *et al.*,^[19] and Schedewie *et al.*,^[20] they established lower serum calcium level in asphyxiated newborns compared to their controls.

CONCLUSIONS

Electrolyte disturbance is one of the major concerns of perinatal asphyxia, and they are thought to be increasing mortality and morbidity. Hyponatremia is predominant abnormality of birth asphyxia which needs accurate and careful management. Hyperkalemia also significant and should be treated cautiously. However, hypocalcemia had a weak linear negative association; it is not statistically significant. Regular checking and interpreting of electrolyte level are required in birth asphyxia.

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Conflicts of interest

There are no conflicts of interest.

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