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**Original Research Article**

# Electrolyte abnormalities in patients with perinatal asphyxia

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## ABSTRACT

**Background:** Perinatal hypoxia is still a major cause of death and disability in developing countries. The infant mortality rate fell from 92 per 1000 live births in 1991 to 43 per 1000 live births in 2011. The aim of the study was to study the electrolyte abnormalities in perinatal asphyxia cases.
**Methods:** This cross-sectional descriptive study was conducted at the Department of Obstetrics and Pediatrics, Rangpur Medical College and Hospital, Rangpur, Bangladesh. The study duration was 2 years, from January 2012 to December 2013. The study was conducted with a total of 120 neonates admitted in the neonatal ward of the study hospital, among which, 60 neonates who had perinatal asphyxia were selected for the case group, and the remaining 60 were age and gender-matched control group participants.
**Results:** In 70% of cases, the mother was Primipara. Among the neonates, 61.67% were male, and 38.33% were female. Only 33% of the case neonates had received regular antenatal check-ups, while 55% had irregular check-ups, and 11.67% had no antenatal checkups. According to the grading of asphyxia, 51.67% of neonates had moderate asphyxia, 20% had mild asphyxia, and 28.33% had severe asphyxia. The comparison of mean values between the case, and control groups showed that both blood urea, and serum creatinine levels were significantly higher among the case group participants, compared to control group values. The mean serum sodium value in mild, moderate, and severe asphyxia were 135.33, 123.42, and 121.53 mmol/l respectively. Mean serum potassium values were 4.11, 4.86, and 5.51 mmol/l respectively. Mean serum creatinine 0.72, 1.00, and 1.83 mg/dl respectively. Mean blood urea levels were 36.17, 58.97, and 88.06 mg/dl respectively. A significant difference was observed between the mean values of serum electrolytes and patients' asphyxia grade.
**Conclusions:** The study findings can conclude that electrolyte abnormalities are common among perinatal asphyxia patients, and babies with perinatal asphyxia developed hyponatremia, and hyperkalemia at a higher frequency, and significant raises of serum creatinine, and blood urea was also observed, which was proportionate to the severity of asphyxia.

**Keywords:** Asphyxia, Perinatal, Electrolyte, Hyponatremia, Hyperkalemia, Neonates

## INTRODUCTION

Perinatal asphyxia is the most common preventable cause of infant brain injury, resulting in extremely high neonatal mortality, and morbidity in impoverished nations. Despite significant breakthroughs in monitoring technologies, awareness of pregnancy, and neonatal diseases, perinatal asphyxia remains a major cause of death and acquired brain damage in newborns around the world.[1] According to WHO estimates, 3% of all infants

(3.6 million) in underdeveloped countries suffer from moderate to severe birth asphyxia, with roughly 23% (84000) dying, and the same number experiencing significant sequelae.[2] Birth asphyxia causes 29% of all neonatal deaths worldwide, but only 21% in Bangladesh.[3] Perinatal asphyxia is a severe neonatal health problem in Bangladesh, especially in rural areas. Untrained personnel attend around 95% of rural births, and 65% of urban deliveries. Twelve out of every thousand newborns die within the first few hours of life.[4] Perinatal asphyxia is a common disorder in Bangladesh that necessitates admission to a newborn facility. Despite improved obstetrical care in recent years in Dhaka's urban, and periurban districts, there is an increasing tendency of admission to neonatal wards with perinatal asphyxia, which can account for up to 40% of total admissions.[5] Even now, overall hospital admission records only represent a percentage of the entire incidence rate of perinatal asphyxia. Fluid, electrolyte, and metabolic abnormalities are the most commonly seen derangements in severely ill asphyxiated infants. The syndrome of inappropriate antidiuretic hormone secretion (SIADH) is a prevalent condition in young children, causing hyponatremia, and hypocalcemia.[6] Hyperkaliemia, on the other hand, can arise in these infants when the ischemia insult causes renal insufficiency.[7] Perinatal asphyxia is the most common sickness associated with abnormal electrolytes among sick neonates admitted to Dhaka Shishu Hospital's intensive care unit, and all sorts of electrolyte abnormalities, isolated or combined, are also recorded here.[8] Specific symptoms of electrolyte abnormalities frequently blend with signs of underlying hypoxia ischemic encephalopathy, or HIE, in neonates, and the use of fluid, and electrolytes in such situations prolong morbidity and mortality.[9] Organ damage is widespread in patients with ischemia insult in neonatal asphyxia, in addition to HIE.[10] Therefore, a high index of suspicion, prompt recognition, and a thorough understanding of common electrolyte abnormalities are necessary to ensure their correction and improve neonatal outcomes. There is little information on this topic in our literature despite the fact that birth asphyxia is a leading cause of neonatal mortality. Therefore, this study was carried out to evaluate the electrolyte status in asphyxiated babies after birth to potentially identify, manage, and cut the mortality of these babies.

### *Objective*

To study the electrolyte abnormalities in perinatal asphyxia. To determine the type of electrolyte imbalances in different grades of perinatal asphyxia.

## METHODS

This cross-sectional descriptive study was conducted at the Department of Obstetrics and Pediatrics, Rangpur Medical Collage and Hospital, Rangpur, Bangladesh. The study duration was 2 years, from January 2012 to December 2013. The study was conducted with a total of 120 neonates admitted in the neonatal ward of the study hospital, among which, 60 neonates who had perinatal asphyxia were selected for the case group, and the remaining 60 were age and gender-matched control group participants. Informed consent was obtained from the legal guardians of each participant, and ethical approval regarding the study was also obtained from the ethical review committee of the study hospital. Study participants were selected through purposive sampling following the inclusion and exclusion criteria. All collected data were analyzed using the SPSS software.

### *Inclusion criteria*

*Case:* Live born babies with perinatal asphyxia, babies who had a delay to establish first breath within one minute of birth, full-term pregnancy cases with healthy baby weight, newborn remains hypotonic or floppy over hours, APGAR score <7 at 5 minutes, evidence of other organ dysfunction like: respiratory distress, poor peripheral perfusion, oliguria

*Control:* Not asphyxiated babies, birth weight between 2.5 kg to 3.5 kg.

### *Exclusion criteria*

Participants with septicemic neonates, neonates with gross congenital anomalies and baby of high-risk mothers like diabetes mellitus, heart disease, etc. are excluded.

## RESULTS

The baseline characteristics of the case participants showed that in 70% of cases, the mother was primipara. Among the neonates, 61.67% were male, and 38.33% were female. Only 33% of the case neonates had received regular antenatal check-ups, while 55% had irregular check-ups, and 11.67% had no antenatal checkups. Among the case neonates, 65% had a normal vaginal delivery, and 35% had LUCS. The place of delivery was home for 38.33% of cases, the clinic for 26.67%, and the hospital for 35%. According to the gradings of asphyxia, 51.67% of neonates had moderate asphyxia, 20% had mild asphyxia, and 28.33% had severe asphyxia

According to serum sodium levels of the case neonates, 16.7% of the 12 mild cases, 71.0% of the moderate asphyxia cases, and 70.6% of the severe asphyxia cases had hyponatremia, or serum sodium levels <130 mmol/l. The remaining participants had normal sodium levels.

According to the Serum potassium level of the case neonates, 16.7% of the 12 mild cases, 3.2% of the 31 moderate cases, and 5.9% of the 17 severe cases had hypokalemia or serum level below 3.5 mmol/l. On the other hand, none of the 12 mild cases, 16.1% of the 31 moderate cases, and 35.3% of the 17 severe cases had Hyperkalemia or serum potassium level above 6 mmol/l.

Comparing both the case, and the control group participants by serum sodium levels, it was observed that 60% of the case participants had hyponatremia, while only 10% of the control group participants had hyponatremia.

Comparing the serum potassium levels of both the case and the control group, it was observed that 6.6% of the case group had hypokalemia, as opposed to the 20% of the case group participants. 758% of the case and 78.3% of the control group participants had normal serum potassium levels, while 18.3% of the case group and only 1.6% of the control group participants had hyperkalemia or serum potassium over 6 mmol/l

Most of the asphyxiated neonates had serum creatinine 0.3-0.8 mg/dl. 21 (25%) of asphyxiated neonates had creatinine values >1.5 mg/dl. Most of the control neonates (70%) had creatinine values <0.8 mg/dl and only 01(1.6%) of neonates had creatinine values >1.5 mg/dl.

The comparison of mean values between the case, and the control group showed that both blood urea, and serum creatinine levels were significantly higher among the case group participants, compared to control group values.

The mean serum sodium value in mild, moderate, and severe asphyxia were 135.33, 123.42, and 121.53 mmol/l respectively. Mean serum potassium values were 4.11, 4.86, and 5.51 mmol/l respectively. Mean serum creatinine 0.72, 1.00, and 1.83 mg/dl respectively. Mean blood urea levels were 36.17, 58.97, and 88.06 mg/dl respectively. A significant difference was observed between the mean values of serum electrolytes and patients' asphyxia grade.

**Table 1: Distribution of case group participants based on characteristics (n=60).**

| Characteristics | N | % |
|---|---|---|
| **Parity** | | |
| Primipara | 42 | 70.00 |
| Multipara | 18 | 30.00 |
| **Babies Sex** | | |
| Male | 37 | 61.67 |
| Female | 23 | 38.33 |
| **Antenatal check-up** | | |
| Regular | 20 | 33.33 |
| Irregular | 33 | 55.00 |
| No ANC | 7 | 11.67 |
| **Place of delivery** | | |
| Home | 23 | 38.33 |
| Clinic | 16 | 26.67 |
| Hospital | 21 | 35.00 |
| **Mode of delivery** | | |
| Vaginal delivery | 39 | 65.00 |
| Lower uterine caesarean section | 21 | 35.00 |
| **Neonates in different grading of asphyxia** | | |
| Mild | 12 | 20.00 |
| Moderate | 31 | 51.67 |
| Severe | 17 | 28.33 |

**Table 2: Distribution of case neonates based on grading of asphyxia, and serum sodium level (n=60).**

| Serum. Sodium level | Grading of asphyxiated baby | | | | | | Total patients (n=60) | |
|---|---|---|---|---|---|---|---|---|
| | Mild (12) | | Moderate (31) | | Severe (17) | | | |
| | N | % | N | % | N | % | N | % |
| **Hyponatremia (<130 mmol/l)** | 02 | 16.7 | 22 | 71.0 | 12 | 70.6 | 36 | 60 |
| **Normal sodium level (134-146 mmol/l)** | 10 | 83.3 | 09 | 29.0 | 05 | 29.4 | 24 | 40 |

**Table 3: Distribution of neonates based on grading of asphyxia, and serum potassium level (n=60).**

| Serum potassium level | Grading of asphyxiated baby | | | | | | Total patients (n=60) | |
|---|---|---|---|---|---|---|---|---|
| | Mild (12) | | Moderate (31) | | Severe (17) | | | |
| | N | % | N | % | N | % | N | % |
| Hypokalemia (S.K<3.5 mmol/l) | 2 | 16.7 | 01 | 3.2 | 1 | 5.9 | 4 | 6.6 |
| S.K. Normal (3.5-06 mmol/l) | 10 | 83.3 | 25 | 80.6 | 10 | 58.8 | 45 | 75.0 |
| Hyperkalemia (S.K>6 mmol/l) | 0 | 0.0 | 5 | 16.1 | 6 | 35.3 | 11 | 18.4 |

**Table 4: Distribution of neonates based on comparison of serum sodium levels between cases, and controls (n=120).**

| Serum sodium level | Case (60) | | Control (60) | | Total patients (120) | |
|---|---|---|---|---|---|---|
| | N | % | N | % | N | % |
| Hyponatremia (<130 mmol/l) | 36 | 60.0 | 6 | 10.0 | 42 | 35 |
| Normal serum sodium (134-146 mmol/l) | 24 | 40.0 | 54 | 90.0 | 78 | 65 |
| Total | 60 | 50.0 | 60 | 50.0 | 120 | 100.0 |

**Table 5: Distribution of neonates based on comparison of serum potassium levels between cases, and controls (n=120).**

| Serum potassium level | Case (60) | | Control (60) | | Total patients (120) | |
|---|---|---|---|---|---|---|
| | N | % | N | % | N | % |
| Hypokalemia (3.5 mmol/l) | 4 | 6.6 | 12 | 20.0 | 16 | 13.3 |
| Normal Potassium (3.5-5.5 mmol/l) | 45 | 75.0 | 47 | 78.3 | 94 | 76.6 |
| Hyperkalemia (S.K>6 mmol/l) | 11 | 18.3 | 1 | 1.6 | 12 | 10.1 |
| Total | 60 | 50.0 | 60 | 50.0 | 120 | 100.0 |

**Table 6: Comparison of serum creatinine levels between case, and controls (n=120).**

| Serum creatinine (mg/dl) | Cases (n=60) (%) | Controls (n=60) (%) |
|---|---|---|
| Low S. creatinine (0.3-0.8) | 30 (50) | 36 (60) |
| Normal range (0.9-1.5) | 09 (15) | 23 (38.4) |
| High S. creatinine (>1.5) | 21 (35) | 01 (1.6) |

**Table 7: Comparison of blood urea and serum creatinine levels between case, and controls (n=120).**

| Parameter | Case (n=60) | Control (n=60) | P value |
|---|---|---|---|
| Blood urea | 62.65±31.42 SD | 37.62±07.05 SD | <0.001 |
| Serum creatinine | 1.18±0.70SD | 0.81±0.24 SD | <0.001 |

**Table 8: Mean values of serum electrolyte, and creatinine, urea in different grading of asphyxia (n=60).**

| Serum electrolyte level | Mild asphyxia (mean) | Moderate asphyxia (mean) | Severe asphyxia (mean) | P value |
|---|---|---|---|---|
| Serum sodium (mmol/l) | 135.33 | 123.42 | 121.53 | <0.001 |
| Serum potassium (mmol/l) | 4.11 | 4.86 | 5.51 | <0.002 |
| Serum creatinine (mg/dl) | 0.72 | 1.00 | 1.83 | <0.001 |
| Blood urea (mg/dl) | 36.17 | 58.97 | 88.06 | <0.001 |

## DISCUSSION

In impoverished nations such as Bangladesh, perinatal hypoxia is a leading cause of infant death and disability.[11] The most prevalent derangements in the asphyxiated neonate are fluid, electrolyte, and metabolic abnormalities. These factors, coupled with impaired renal function, may be the primary cause of morbidity and mortality in prenatal asphyxia patients. To overcome these problems, it is critical to recognize electrolyte status early and manage it properly in order to prevent infant death and morbidity. A higher frequency of asphyxia is connected with a number of risk factors, including a lack of antenatal care, parity, mode of birth, low nutritional status, antepartum hemorrhage, and maternal toxemia.[12] Patient parity can be an essential determinant, as in our study, 70% of the case group participants were primipara, whereas only 30% of asphyxiated neonates were born to multigravida mothers. These findings were also consistent with earlier research on newborn hypoxia.[1,13,14] This increased rate of asphyxiated neonates born to Primipara mothers may be attributable to the decreased expansibility of the birth canal in Primipara, as well as the lengthening of labor in such cases. Proper and consistent prenatal care can also help to reduce the occurrence of perinatal asphyxia. Only 33.3% of the 60 case participants in the current study had a regular check-up, while 11.6% of neonates received no prenatal care at all. In terms of delivery location, 23 (38.3%) of asphyxiated neonates were delivered at the hospital, 16 (26.6%) were delivered at the clinic, and 21 (35%) were delivered at home. This reflects our society's lack of antenatal check-up awareness, which delays the timely prognosis of high-risk pregnancies and contributes to the development of birth asphyxia. This study was carried out in a tertiary care hospital, and the majority of the moms were admitted after a failed home trial or were referred by other healthcare facilities. Some out-born hospital-delivered neonates were admitted to this hospital after they were unable to effectively address birth asphyxia due to a lack of resources. Out of 60 asphyxiated newborns, 39 (65%) were delivered vaginally, whereas 21 (35%) were delivered through LUCS. This also lends credence to the hypothesis that diminished expansibility of the birth canal has a significant impact on child hypoxia. Our study's case group had a high rate of vaginal deliveries, which was similar to another study.[15] This study found that male newborns outnumbered female babies, which is consistent with earlier studies.[1,16,17] Nearly one-fourth (12%) of the 60 asphyxiated babies had mild asphyxia, half (31%) had moderate asphyxia, and one-third (17%) had severe prenatal asphyxia. Gupta et al and Zulfikar et al both found a similar distribution of mild and moderate asphyxia cases.[16,17] Babies experiencing asphyxia were shown to have a greater frequency of hyponatremia. In this study, 36 (60%) of 60 asphyxiated babies were hyponatremic. In the current investigation, hyponatremia was the most common electrolyte anomaly, which was consistent with the findings of Roy et al.[18] Hypernatremia is most common in extremely preterm infants due to high transepidermal water loss, which may be exacerbated by excessive sodium administration. The current investigation excluded extremely preterm newborns. Twelve newborns were severely asphyxiated, 22 were moderately asphyxiated, and two were faintly asphyxiated. The relationship between serum sodium and asphyxia grading was shown to be statistically significant. Hyponatremia was seen in 60% of the total case patients, but only 10% of the control group participants. Hyperkalemia is a more common and potentially fatal consequence of acute renal failure. Hyperkalemia was seen in 16.1% of moderate hypoxemic individuals and 35.3% of severely hypoxemic patients. This pattern of hyperkalemia among moderate and severe case group members matched earlier research findings.[18,19] Only 1.6% of participants in the control group developed hyperkalemia, compared to 18.3% of people in the case group. Blood urea and serum creatinine were considerably higher among case study participants among the various serum electrolyte mean values. Even among case group individuals, mean serum sodium levels were significantly lower in the severe hypoxemia group, although serum potassium, serum creatinine, and blood urea levels were significantly higher in the severe hypoxemia group compared to the mild and moderate groups.

### *Limitations*

The study was conducted in a single hospital with a small sample size. So, the results may not represent the whole community. A single blood sample was collected for the detection of electrolyte abnormalities, whereas serial sample collection could give a better result, and enriched with more information.

## CONCLUSION

The study findings can conclude that electrolyte abnormalities are common among perinatal asphyxia patients, and babies with perinatal asphyxia developed hyponatremia, and hyperkalemia at a higher frequency, and significant raises of serum creatinine, and blood urea were also observed, which was proportionate to the severity of asphyxia.

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