

Original Research Article

Serum Electrolytes, Glucose, Renal Functions And Arterial Blood Gas In Perinatal Asphyxia

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ABSTRACT

Introduction: Perinatal asphyxia is a devastating clinical condition because of its potential for causing permanent damage and even death of the fetus. Perinatal asphyxia is a common neonatal problem and adds significantly to neonatal morbidity and mortality.

Aims and objective: To evaluate electrolyte status, plasma glucose, renal functions and ABG in asphyxiated neonates and to assess the relationship between their values and the severity of HIE.

Methods: The study was a prospective study conducted on 125 asphyxiated and 125 non-asphyxiated term neonates recruited from Department of Paediatrics and maternal wards of the Department of Obstetrics and Gynaecology of a tertiary care teaching hospital located 50 kilometres from Jaipur city amidst rural environment from 1st January 2016 – 31st July 2017.

Results: Among the 125 neonates in case group, there were 68 (54.4%) males and 57 (45.6%) females. Among the asphyxiated neonates serum sodium levels were significantly lower and hyponatremia had a linear correlation with the severity of birth asphyxia and different stages of HIE. Blood urea and serum creatinine levels were significantly higher in asphyxiated neonates and had a linear correlation between severity of asphyxia and different stages of HIE. pH levels were significantly lower in asphyxiated neonates and had inversely linear correlation between severity of asphyxia and different stages of HIE.

Conclusion: The umbilical cord arterial values of serum sodium, urea, creatinine and pH were found to be a good, early, simple and reliable screening test for the early diagnosis and assessment of severity of perinatal asphyxia and their values correlated well with the severity of HIE.

Keywords: Asphyxia, electrolytes, glucose, renal

INTRODUCTION:

Asphyxia in perinatal period is very common neonatal problem and adds significantly to neonatal mortality and morbidity. Globally asphyxia is estimated to account for 23% of the 4 million neonatal deaths and 26% of the 3.2 million stillbirths each year.¹Nearly one million children who survive perinatal asphyxia, live with chronic neuro-developmental illnesses including cerebral palsy, mental retardation and various learning disabilities.

Every hour, 104 children die as a result of perinatal asphyxia¹ that is, approximately 8% of the total global paediatric mortality making it a serious problem. Due to a lack of resources developing countries are more affected. Yet this is a global issue requiring urgent attention.

In India, between 2.5 lakh to 3.5 lakh infants die every year due to perinatal asphyxia, mostly within the first three days of life.² Data from National Neonatal Perinatal database (NNPD) tells that perinatal asphyxia contributes to almost 20% of neonatal mortality in India.²Estimates of the proportion of neonatal mortality attributable to birth asphyxia are limited by the lack of a consistent definition for use in community-based settings and the absence of vital registration in communities where the majority of neonatal deaths occur. Although asphyxia is associated with multiple organ injuries, especially with adverse neurological outcomes, management still focuses on supportive care. So, if the adverse effects of hypoxia on the newborn are considered, there is a need to identify infants who will be at high risk for hypoxic ischemic encephalopathy and early neonatal death as a result of perinatal hypoxia. A series of markers have been examined to identify perinatal hypoxia comprising foetal heart monitoring, Apgar scoring, umbilical cord pH,

electroencephalograms (EEG), computerised tomography (CT) and magnetic resonance imaging (MRI) scans and Doppler flow studies.

Perinatal asphyxia may result in deteriorating effects on all major body systems. Many of these complications are potentially fatal. In a term infant with birth asphyxia renal, neurologic, cardiac and lung deterioration occurs in 50%, 28%, 25% and 23% cases respectively.³

Hypoxic ischemic encephalopathy refers to the central nervous system (CNS) dysfunction associated with perinatal asphyxia. The major concern in neonates with perinatal asphyxia is hypoxic ischemic encephalopathy because in relation to other organs derangements HIE has the potential to cause dangerous long-term neurological or motor sequel among the survivor neonates.

The neurodevelopmental delay cannot be assessed with currently used diagnostic methods in patients with neonatal asphyxia or HIE.⁴⁻⁶ Neonatal asphyxia causes neurological morbidity and mortality in full term infants. Despite the increasing understanding of the mechanisms leading to and resulting from birth asphyxia, early identification of brain damage following hypoxic-ischemic events still remains the toughest problems in neonatal care.⁶⁻⁸ Though there are more and more studies for understanding mechanisms leading to birth asphyxia, studies for early determination of tissue damages due to birth asphyxia are still lacking.

Hence, this study was conducted to find out any correlation between the electrolyte status, glucose, renal functions and arterial blood gas in cord blood with the severity of asphyxia, so that problems could be anticipated early and appropriate measures are taken, so neonatal morbidity and mortality could be reduced.

MATERIAL AND METHODS:

A prospective case control study was conducted on asphyxiated term neonates recruited from Neonatal Intensive Care Unit in National Institute of Medical Sciences and Research, Jaipur from 1st January 2016 – 31st July 2017 to evaluate and correlate electrolyte status, plasma glucose, renal functions and ABG with varying severity of asphyxia (according to Hypoxic Ischemic Encephalopathy staging) taking non-asphyxiated neonates as controls. The cord blood arterial samples from the 125 neonates comprising the cases and 125 neonates comprising the controls constituted the material for the study.

The study included two groups:

The case group: It included 125 neonates fulfilling the following criteria:

Inclusion criteria

Gestational age \geq 37 weeks.

Birth weight 2.5 kg or more.

Apgar score of <7 at one minute of life.

Exclusion criteria

Metabolic diseases.

Babies with congenital malformations.

Those born to mothers having hypertension, diabetes mellitus, treated with diuretics, receiving general anesthesia, pethidine, phenobarbitone, magnesium sulphate and other drugs likely to cause depression in babies.

Mothers with history of febrile attack within 2 weeks before delivery were excluded from the study.

Congenital infections.

Neonates born to mothers on anti-epileptics.

The control group: It included 125 term apparently healthy neonates appropriate for gestational age without signs of perinatal asphyxia.

Descriptive and inferential statistical analysis has been carried out in the present study. Results on

continuous measurements are presented on Mean \pm SD (Min-Max) and results on categorical measurements are presented in Number (%). Significance is assessed at 5% level of significance. The following assumptions on data are made.

Assumptions:

1. Dependent variables should be normally distributed.
2. Samples drawn from the population should be random, Cases of the samples should be independent.

Analysis of variance (ANOVA) has been used to find the significance of study parameters between three or more groups of patients. Chi-square/Fisher Exact test has been used to find the significance of study parameters on categorical scale between two or more groups.⁹

A written ethical clearance was taken from Ethics Committee of college and written consent was taken from patient's parents.

RESULTS:

Out of total 125 neonates in case group, there were 68 (54.4%) males and 57 (45.6%) females. Among the control group of 125 neonates, there were 66 (52.8%) males and 59 (47.2%) females. Among 125 asphyxiated neonates who formed the case group all 125(100%) were term gestation, whereas all neonates who constituted the control group were also of term gestation. Among the 125 neonates in case group 120(96%) neonates weighed between 2.5-3.5 kg, 5(4%) weighed >3.5 kg. The mean weight in case group was 2.86 ± 0.35 kg. Among the control group of 125 neonates, 120(96%) neonates weighed between 2.5-3.5 kg, 5(4.0%) weighed >3.5 kg. In control group mean weight was 2.93 ± 0.33 kg. Among the 125 neonates in case group, 16 (12.8%) had MSAF and in 109 (87.2%) the amniotic fluid was clear. Among the controls

106 (84.8%) neonates had clear amniotic fluid and 19(15.2%) had MSAF. Among the 125 neonates in case group, 99(79.2%) had foetal bradycardia and 26 (20.8%) had no bradycardia. All 125(100%) neonates in control group had normal heart rate. Among the 125 neonates in case group, all the 125 (100%) neonates were in need of resuscitation with >1 minute of positive pressure ventilation before stable spontaneous respiration. All the 125 (100%) neonates in control group were not in need of any such intervention. Among the 125 neonates in case group, all 125(100%) neonates had an Apgar score of <7 at 1 min and all 125(100%) neonates in control group had an Apgar score \geq 7. Incidence of Apgar score <7 is significantly more in cases (100%) at 1 min with $p < 0.001$ thereby being helpful as an important tool for birth asphyxia diagnosis and its severity. Out of the 125 cases of neonatal asphyxia studied 7(5.6%) of the neonates had a pH of <7.0, 62(49.6%) of the neonates had arterial pH between 7.0-7.15, 35(28%) of the neonates had arterial pH between 7.15-7.2, 16(12.8%) of the neonates had arterial pH between 7.2-7.25, 5(4%) of the neonates had arterial pH between 7.25-7.30. Out of the 125 neonates in the case group all 125 (100%) had signs of respiratory distress, 51(40.8%) had poor feeding, 46(36.8%) had hypotonia, 34(27.2%) had lethargy, 34(27.2%) had seizures, and 27(21.6%) had oliguria. All 125 neonates in the control group were normal on neurological examination; none of them had any signs of respiratory distress, poor feeding, hypotonia, lethargy, seizure or oliguria. Abnormal neurological examination is significantly more in cases when compared to Controls with $p < 0.001$. Among the 125 neonates in the case group, 27(21.6%) were not in HIE, 64(51.2%) had mild HIE, 27(21.6%) had moderate HIE and 7(5.6%) had severe HIE during the course in

NICU. Out of 125 cases studied 10(8%) had a serum creatinine value of <0.6 mg/dl, 106(84.8%) of the neonates had a serum creatinine value between 0.6 – 1.2 mg/dl and 9(7.2%) of the neonates had a serum creatinine values of >1.2 mg/dl. Of the 125 controls 61(48.8%) of the neonates had a serum creatinine values of <0.6 mg/dl, remaining 64(51.2%) had a serum creatinine values between 0.6 -1.2 mg/dl.

DISCUSSION:

Perinatal asphyxia is a common neonatal problem and adds significantly to neonatal morbidity and mortality. Infants with asphyxia had lower sodium and pH in the umbilical cord arterial blood, umbilical cord arterial potassium though found to be in normal range but their values were in the higher range of normal, blood urea and creatinine were found to be in the higher in asphyxiated neonates than non-asphyxiated and the findings were statistically significant, glucose levels were found low in mild, moderate and severely asphyxiated neonates, but the values were within normal range. In a study conducted by Pradeep Meena et al¹⁰, they found a significant negative correlation coefficient of APGAR score and cord blood pH to predict the severity of birth asphyxia. This shows that as the severity of Birth Asphyxia increases, the APGAR score and pH decreases, this study supports the significant role of cord blood pH in predicting severity of perinatal asphyxia with respect to HIE staging. Umbilical cord arterial values of sodium, pH and renal functions might be used as an indicator for assessment of severity of birth asphyxia and severity of HIE in neonates. But Large amounts of oxygen radicals that are produced in the re-oxygenation period following asphyxia and it is expected that high levels of urea and creatinine are produced. Because estimation of umbilical arterial values of sodium, potassium,

urea, creatinine, pH and glucose can be routinely done in the existing medical facilities in our country, their values can be used as a valuable indicator of the severity of tissue hypoxia. B.D Gupta et al¹¹, Meena Varma et al¹², and Paraswala khushboo M et al¹³ who found that serum urea and serum creatinine values were higher in asphyxiated infants compared to non-asphyxiated infants. The results of present study for serum creatinine also match with study conducted by Jayprakash et al¹⁴ who reported that serum creatinine levels were significantly higher in asphyxiated neonates (0.72±0.18 mg/dl) compared to non-asphyxiated neonates (0.55±0.11 mg/dl). So, estimation of umbilical cord arterial serum sodium, pH and renal function is an easy and affordable test and at the same time early biochemical marker of birth asphyxia which biochemically supports the clinical diagnosis and severity grading of asphyxia by Apgar score and correlates well with the severity of HIE. The predictive factors identified in this study

should be examined for their ability in a larger sample population before these markers can be applied on routine basis in a clinical scenario in infants with perinatal asphyxia.

SUMMARY AND CONCLUSION:

Perinatal asphyxia is a common neonatal problem and adds significantly to neonatal morbidity and mortality. Infants with asphyxia had lower sodium and pH in the umbilical cord arterial blood, umbilical cord arterial potassium though found to be in normal range but their values were in the higher range of normal, blood urea and creatinine were found to be higher in asphyxiated neonates than non-asphyxiated and the findings were statistically significant, glucose levels were found low in mild, moderate and severely asphyxiated neonates. By studying all these metabolic abnormalities we concluded that all Birth asphyxiated baby should be thoroughly evaluated and early management started to reduce complications associated with these.

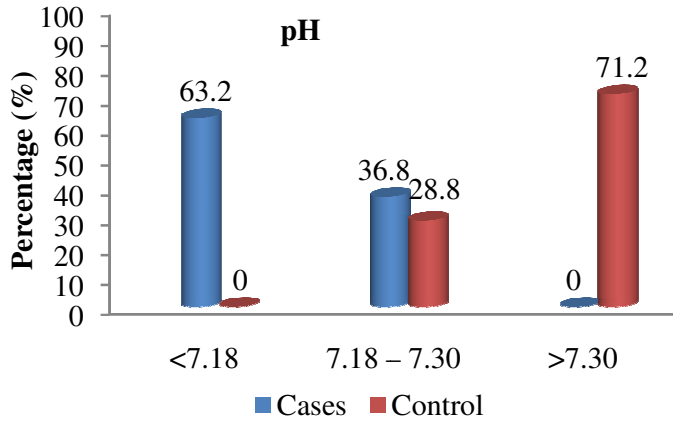
Table 1: Distribution of HIE STAGE in case group.

HIE STAGE	Number of neonates	%
Stage 0	27	21.6
Stage 1	64	51.2
Stage 2	27	21.6
Stage 3	07	05.6
Total	125	100.0

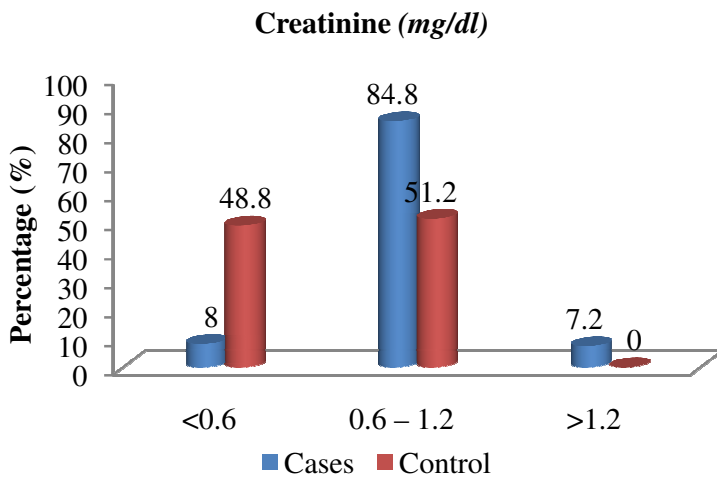
Table 2: Distribution of variables in case group.

Variables	Number of neonates (n=125)	%
Respiratory distress	125	100.0
Poor feed	51	40.8
Hypotonia	46	36.8
Lethargy	34	27.2
Seizure	34	27.2
Oliguria	27	21.6

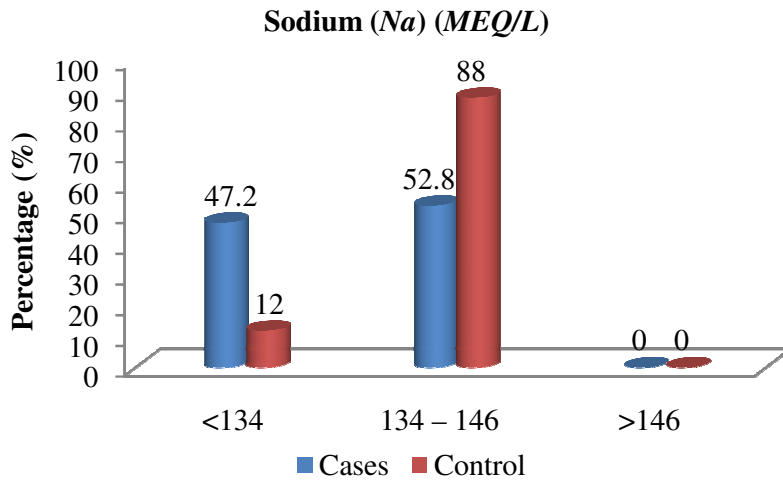
Graph-1: Shows distribution of pH values in two groups of neonates studied.



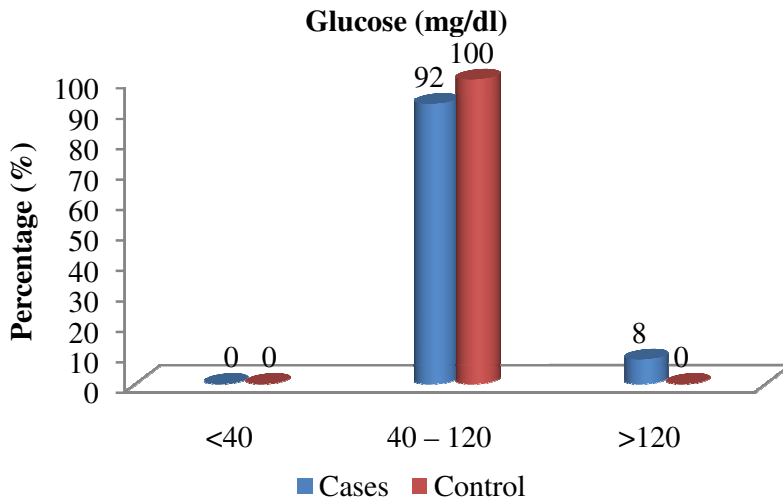
Graph-2: Shows distribution of serum Creatinine values in two groups of neonates studied.



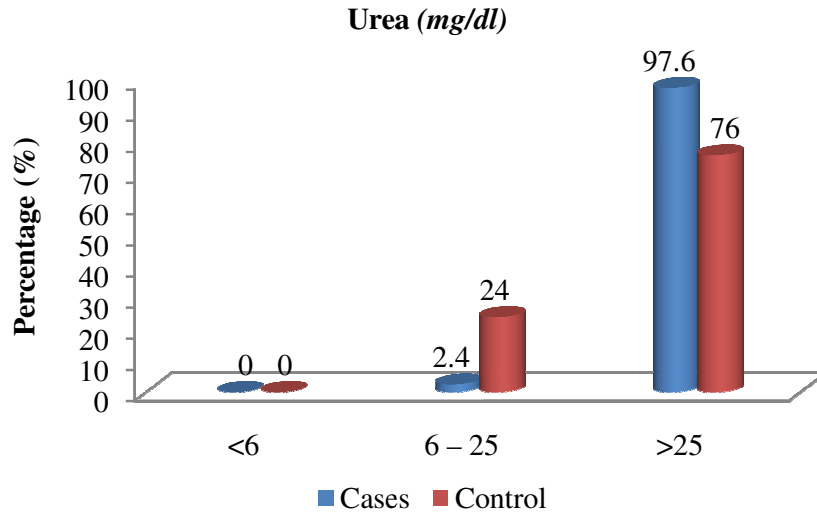
Graph-3: Shows distribution of serum sodium values in two groups of neonates studied.



Graph-4: Shows distribution of plasma glucose values in two groups of neonates studied.



Graph-5: Shows distribution of blood urea values in two groups of neonates studied.



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