

Serum Electrolyte Level and Renal Functional Status in Perinatal Asphyxia

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Perinatal asphyxia, most common cause of neonatal morbidity and mortality in developing countries accounts for 20% of perinatal deaths. This cross sectional study was done with the objective to detect renal functional abnormality and electrolyte imbalance among neonates with perinatal asphyxia and to assess severity of renal involvement with degree of asphyxia. This study was carried out in the department of Pediatrics and department of Gynae & Obstetrics in Rangpur Medical College Hospital from 2012 to 2013. Total 120 (asphyxiated -60 as case, non-asphyxiated-60 as control) were enrolled into the study. Mean serum sodium was significantly lower (125.27 ± 12.27 mEq/L vs 137.72 ± 6.44 mEq/L; $P < 0.001$) and mean potassium level higher (5.04 ± 1.02 mEq/L vs 4.39 ± 0.69 mEq/L, $P < 0.002$) in case group as compared to control. Among 60 neonates, 28 cases (46.66 %) had elevated levels of urea and 21 cases (35%) raised creatinine. Mean urea (62.65 ± 31.42) and creatinine (1.18 ± 0.7) were significantly higher (P value < 0.001) in study group in comparison with control. Mean serum sodium showed decreasing trend whereas potassium, urea and creatinine levels showed increasing trend with degree of severity of hypoxic ischemic encephalopathy. 24(40%) neonates developed ARF, of whom 08(13.33%) were in HIE -II and 16(26.6%) cases in HIE -III. No abnormalities of renal function were observed in HIE-I and control group. Therefore it was concluded that electrolyte abnormalities and impairments of renal function are common in perinatal asphyxia with an increasing risk in hypoxic ischemic encephalopathy stage -II and stage -III.

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Introduction

Perinatal asphyxia is a major cause of neonatal death and disabilities in our country.¹ About 30-50% of infants with HIE-II & III asphyxia suffer from some form of mental and physical disabilities every year in our country. Fluid, electrolyte and metabolic abnormalities are the commonest derangements encountered in critically ill asphyxiated neonate. Syndrome of inappropriate secretion of antidiuretic hormone (SIADH) is a common problem in these neonates accounting for hyponatremia.² Hyperkalaemia results from ischaemic insult with eventual renal insufficiency.³ Kidney is very sensitive to ischemic damage and is the most damaged organ in asphyxiated full term infant.⁴ Renal failure correlates well with neurological severity.⁵ Although transient renal failure is commonly observed in perinatal asphyxia, renal impairment should be suspected if serum creatinine rises or fails to show the normal post natal fall.^{6,7} Association of renal failure with perinatal asphyxia was observed in the study by Kaur et al where Acute Kidney injury (AKI) developed in 9.1% infants with moderate asphyxia and 56.0% with severe asphyxia.⁸

Methods

This cross sectional descriptive study was done in the department of Paediatrics and department of Gynae & Obstetrics in Rangpur Medical College Hospital from 2012 to 2013. Total 120 (asphyxiated -60, noasphyxiated-60) newborn were included with inclusion criteria as delayed first breath within one minute, term babies with birth weight 2.5 to 3.9 kg, presence of any one of neurological sequelae like seizure, altered reflexes, irritability, poor feeding, excessive crying, coma; evidence of other organ dysfunction like, respiratory distress, poor peripheral perfusion, oliguria. With all aseptic precautions 2 ml of venous blood was

collected & centrifuged at a rate of 3000/rpm for 10 minutes. Serum was separated and was taken in a test tube. 150µl of serum was introduced into Easylyte plus auto analyzer (ion selective electrode method) for detection of sodium, potassium and chloride level. Serum creatinine and blood urea level were estimated by biochemical analyzer (acto-1). Serum Na⁺, K⁺, Cl⁻ level were expressed in mmol/l units & serum creatinine and blood urea level in mg/dl.

Results

In this study it was revealed that out of 60 asphyxiated neonates, majority [37(61.66%)] were male [23 (38.34%)] were female. About the grading of asphyxia of neonates, it was observed that 12(20%) neonates had HIE-I, 31(51.6%) had HIE-II asphyxia and 17 (28.33%) had HIE-III asphyxia. Out of 60 neonates, 36(60%) neonates were hyponatremic (Table I), 4(6.6%) hypokalemic and 11(18.4%) hyperkalaemic (Table II). Among hyponatremic neonates 12(33.4%) had severe and 22(61.1%) HIE-II and 5(5.5%) HIE-I respectively. There was statistically significant (p<0.001) association between serum sodium level and degree of asphyxia (Table IV). Hypo and hyperkalemia was associated with the degree of asphyxia and it was statistically significant. Among the cases, 24(40.0%) babies developed ARF with serum creatinine and blood urea level significantly higher in asphyxiated babies as compared to control group (p<0.001, Table V).

Table I: Distribution of babies by grading of asphyxia and serum sodium level (n=60)

Serum. Sodium level	Grading of asphyxiated cases						Total patients	
	HIE-I (12)		HIE-II (31)		HIE-III (17)			
	N	%	N	%	N	%	N	%
Hyponatremia (<130mmol/l)	02	05.5	22	61.1	12	33.4	36	60
Normal Sodium level(134-146mmol/l)	10	41.6	09	37.5	05	20.8	24	40
Total	12	20.0	31	51.6	17	28.3	60	100

Table II: Distribution of babies by grading of asphyxia and serum potassium level (n=60)

Serum Potassium Level	Grading of asphyxiated newborn						Total patients	
	HIE- I (12)		HIE-II (31)		HIE -III (17)			
	N	%	N	%	N	%	N	%
Hypokalemia (S.Potassium<3.5mmol/l)	02	50	01	25	01	25	04	6.6
Normal S.Potassium(3.5-06mmol/l)	10	22.2	25	55.5	10	22.2	45	75
Hyperkalemia (S.Potassium>6mmol/l)	00	00	05	45.4	06	54.5	11	18.4
Total	12	20	31	51.6	17	28.6	60	100

Table III: Comparison of serum sodium level between case and control (n=120)

Serum. Sodium Level	Case (60)		Control(60)		P-value
	N	%	N	%	
Hyponatremia (<130 mmol/l)	36	60	06	10	<0.001
Normal serum sodium(134-146 mmol/l)	24	40	54	90	
Total	60	50	60	50	

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

Serum Electrolyte level	HIE-I Mean±SD	HIE-II Mean±SD	HIE-III Mean±SD	Total	p-value
Serum Sodium(mmol/L)	135.33±4.55	123.42±13.38	121.53±10.38	125.27±12.27	<0.001
Serum Potassium(mmol/L)	4.11±0.50	4.86±1.00	5.51±0.97	5.04±1.02	<0.002
Serum Creatinine(mg/dl)	0.72±0.32	1.00±0.68	1.83±0.44	1.18±0.7	<0.001
Blood Urea(mg/dl)	36.17±9.43	58.97±31.03	88.06±23.16	62.65±31.42	<0.001

Table V: Comparison of blood urea & serum creatinine level between case and control

Parameter	Case(60)	Control(60)	p value
Blood urea	62.65+ -31.42 SD	37.62+ -07.05 SD	<.001
Serum creatinine	1.18+ -0.70SD	0.81+ -0.24 SD	<.001

Table VI: Mean blood urea and serum creatinine in renal failure with grading of HIE

HIE staging	No of case	Blood Urea(mg/dl) Mean±SD	Serum creatinine(mg/dl) Mean±SD
I	12	36.17±7.05	0.72±0.32
II	23	39.47±16.12	1.00±0.14
II+ARF	08	58.06±31.03	1.53±0.68
III+ARF	16	88.6±23.16	1.83±0.55

Discussion

In this study out of 60 asphyxiated neonates, 12(20%) had HIE-I, 31(51.6%) HIE-II and 17(28.33%) had HIE-III respectively. Gupta et al in his study showed that 25% had HIE-I, 52.63% moderate and 25 % babies had severe asphyxia which were similar to the present study⁹. Zulfikar Ali et al observed 22%, 54% and 24% HIE-I, HIE-I and HIE-III respectively almost similar to the present study.¹⁰ In this study out of 60 asphyxiated babies, 36(60%) were hyponatremic, the predominant electrolyte abnormality. This finding correlates well with study findings of Banasree Roy et al which showed 56.25% developed hyponatremia in perinatal asphyxia.¹¹ Presence of SIADH in perinatal

asphyxia explains hyponatremia in these neonates. Of the asphyxiated babies (n=60), hyperkalaemia was found in 11(18.4%) neonates and hypokalaemia was found in 04(6.6%) neonates. Singh Galali et al and Roa et al found hyperkalaemia in 5.4% and 14.4% respectively of ICU admissions which included asphyxiated as well as other sick neonates.^{12,13} Hypokalaemia observed in asphyxiated babies was the least common electrolyte abnormalities in this study. This finding is consistent with the study by Hossain et al (8.6%).¹⁴ Serum creatinine level >1.5mg/dl was observed among 21(35%) neonates out of 60 asphyxiated neonates. Whereas least number 01 (1.6%) of healthy neonates in the control group had serum

creatinine level $>1.5\text{mg/dl}$ and majority 36(60%) of control neonates had serum creatinine values between 0.3-0.8 mg/dl. Chowdhary J et al showed that forty-eight (60%) neonates showed significant elevation of blood urea and 41 (51.3%) neonates had significant elevation of serum creatinine than the control group ($p < 0.001$). A rising trend in concentration of blood urea and creatinine was observed among HIE Stage II & III and difference was statistically significant. BD gupta et al showed blood urea and serum creatinine were significantly higher in asphyxiated babies compared to the control group ($p < 0.001$).⁹ Obstruction of tubular lumen and back leak mechanism contributed to increase in urea and creatinine level in asphyxiated neonates.¹¹ In this study, out of 60 asphyxiated babies, 24(40.0%) developed ARF & blood urea and serum creatinine were significantly higher in asphyxiated babies as compared to control group ($p < 0.001$). This observation closely approximates to those reported by Gupta BD et al where renal failure developed in 47.1% and Jayashree et al showed 43% of asphyxiated babies developed acute renal failure.^{9,14} Acute renal failure developed in eight cases (26%) in HIE stage II and 16 cases (94.1%) in HIE stage III but no cases of HIE-I and control group developed renal failure. Zulfikar Ali et al showed that 40% in HIE-II and 100% in HIE-III developed acute renal failure in perinatal asphyxia which was similar in HIE-III and mildly higher in contrast to this study.¹⁰

Conclusion

Electrolyte abnormalities and impairments of renal function are common in perinatal asphyxia and it showed that babies with perinatal asphyxia developed hyponatremia, hyperkalemia, and significant rising of serum creatinine and blood urea which is proportionate to the severity of asphyxia.

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