ORIGINAL ARTICLE

Association of Serum Creatinine and Electrolyte Abnormalities in Preterm Low Birth Weight Neonates

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Abstract :

Introduction: Being born prematurely is a threat to survival and the subsequent quality of life ICDDR,B Health and Science Bulletin published in March 2006 reported that prematurity and low birth weight contributes to 27.8% of neonatal deaths in rural areas of Bangladesh Premature infant are at increased risk of developing dehydration or over hydration. Therefore, high index of suspicion, prompt recognition and thorough understanding of common electrolyte abnormalities are necessary to improve neonatal outcome. The investigation of renal function in preterm neonate is complicated because of continuing renal development, rise in creatinine is transient and may not be clinically significant. Serum creatinine is most widely used marker of renal function in adults and children but its validity as a marker of GFR/ renal function is doubtful a few studies have been conducted on assessment of renal function and electrolytes in the context of prematurity in Bangladesh. But it seems to be essential for immediate management for planning appropriate fluid and electrolyte therapy and thereby for improved outcome. Information was collected who gave consent and participated in the study willingly. The sample size was 50. Duration of data collection was approximately 6 (Six) months.Patients admitted to the Holy Family Red Crescent Medical College and hospital and after meeting the inclusion and exclusion criteria a simple random sampling technique was applied for selecting the sample patients. Total 50 preterm LBW neonates fulfilling the inclusion criteria were studied during this study period. Mean creatinine level was .82 mmol/l,range was 0.40-1.90 mg/dl. Abnormal electrolytes were documented in 20(40%) preterm LBW neonates of which hyperkalemia was the predominant electrolyte abnormality found in 8(16.0%) neonates, hyponatremia was found in 7 (14.0%), hypokalemia in 3 (6.0%) and hypernatremia 2 (4.0%). In the present study 20 of preterm LBW babies have electrolyte abnormalities. Hyperkalemia was found in 8(16.0%) babies in this study from above findings it is evident that prematurity causes transient renal impairment, in preterm neonates which is inversely related to gestational age. Renal impairment should be suspected if the serum creatinine rises or fails to show normal post-natal fall. It was observed that electrolyte abnormalities are common in preterm LBW neonates and transient renal failure also occurs in a large number of preterm LBW babies. So, identification of renal failure and associated electrolyte abnormalities and proper management of fluid and electrolytes and close monitoring are important.

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Introduction :

Being born prematurely is a threat to survival and the subsequent quality of life It is encouraging that many adults who were born very preterm function well in later life[1] but a significant proportion develop disabilities and impairments[1]. Preterm is defined as gestational age less than 37 completed weeks at birth and low birth weight (LBW), as weight less than 2,500 gram[2]. According to Bangladesh demographic and health survey 2014 Under five mortality rate is 46, infant mortality is 38 and neonatal mortality rate is 28. Despite decline in mortality in children in this age group in the last few decades. Neonatal mortality rate has not changed substantially. ICDDR, B Health and Science Bulletin published in March 2006 reported that permaturity and low birth weight contributes to 27.8% of neonatal deaths in rural areas of Bangladesh[3]. In Bangladesh, preterm delivery is a common condition demanding hospital admission. Hospital admissions represent an underestimate of the true community incidence of prematurity. In a study conducted at Dhaka Shishu Hospital ICU from July 2001 through December 2003 showed that out of 92 preterm low birth weight infants admitted in ICU, 53 have some form of electrolytes abnormalities[4].

Fluid, electrolyte and metabolic abnormalities are the commonest derangements encountered in preterm infants due to their renal immaturity and relatively immature skin. They are at increased risk of developing dehydration or overhydration[5]. Clinical parameters such as altered skin turgor, dry mucous membrane, depressed anterior fontanelle are not sensitive indicators of dehydration in premature infants[6]. Premature infants require excess fluid to compensate for their larger insensible water losses and to avoid hypernatremia, hyperkalemia, hypovolumia, and hypotension. Inadequate hydration leads to hyperosmolarity and may be a risk factor for intraventricular hemorrhage.

A loss of >20% birth weight during first week of life is extreme and suggests uncompensated insensible water loss. If weight loss is <2% per day for the 4-5 days, fluid administration is probably excessive[6].

Therefore, high index of suspicion, prompt recognition and thorough understanding of common electrolyte abnormalities are necessary to improve neonatal outcome. The investigation of renal function in preterm neonate is complicated because of continuing renal development, rise in creatinine is transient and may not be clinically significant[7]. Few data are available on ARF in the neonatal period particularly with regard to preterm infants with a low gestational age. Its is also difficult to compare information because of differences in populations examined and criteria used to estimate renal function. The main causes of ARF in neonates are pre-renal mechanisms (>80% of cases). Intrinsic renal and post renal failure are much rarer condition (about 11% and 3% respectively)[8]. Most of these conditions are transient and disappear after correction of the underlying derangement or disease[9,10].

A few studies have been conducted on assessment of renal function and electrolytes in the context of permaturity in Bangladesh. But it seems to be essential for immediate management for planning appropriate fluid and electrolyte therapy and thereby for improved outcome. With this objective, the present study has been conducted to find out the association of

electrolytes abnormalities along with renal function status with morbidity and mortality of the preterm low birth weight neonates.

Methodology :

The study was conducted in Department of Paediatrics, Holy Family Red Crescent Medical College & Hospital during 1st July 2013 to 30th January, 2014. It was a cross-sectional study.

Inclusion Criteria of the study was (1) Gestational age <37 completed weeks (2) Birth weight <2500 grams and the Exclusion criteria was (1)Neonates with gross congenital abnormalities (2) Severe perinatal asphyxia (3) Sepsis (4) Maternal peripartum fever (4) Presence of signs of infection.

Information was collected who gave consent and participated in the study willingly. The sample size was 50. Duration of data collection was approximately 6 (Six) months. Patients admitted to the above-mentioned hospital and after meeting the inclusion and exclusion criteria a simple random sampling technique was applied for selecting the sample patients. All collected questionnaire was checked very carefully to identify the error in the data. Data processing work was consist of registration schedules, editing computerization, preparation of dummy table, analyzing and matching of data.

Results :

Fifty (50) preterm LBW neonates fulfilling the inclusion criteria were studied during this study period. Sex distribution of preterm LBW neonates were 25(50%) male and 25(50%) female babies and male female ratio was 1:1. There were 26 (52.0%) LBW and 24(48.0%) VLBW babies , 26(52.0%) babies had gestational age 28-33 weeks and 24 (48.0%) had gestational age 34-36 weeks . and 36(72.0%) were AGA and 14(28.0%) babies were SGA with AGA: SGA was 18:7 (Table 1).

Table 1: Distribution of preterm newborns by intrauterine growth and gestational age

Classification	No of babies	Percent (%)
AGA	36	72.0
SGA	14	28.0
Total	50	100.0

Table shows distribution of preterm newborns by intrauterine growth and gestational age. 36 (72.0%) babies were AGA and 14(28.0%) babies were SGA.

Mean creatinine level was 0.82 mmol/l, range was 0.40-1.90 mg/dl. Serum creatinine level was normal in 42(82.0%), abnormal in 8(16.0%) (Table 2).

Table-2: Serum Creatinine Level

Serum Creatinine Level	Frequency
Normal (0.4-1.0mg/dl)	42
>1 mg/dl	8
Mean	0.82 ± 0.36 SD

Table shows serum creatinine level analysis. Serum creatinine level was normal in 42(84.0%), Mean creatinine level was . 0.82 ± 0.36 SD.

Abnormal electrolytes were documented in 20(40%) out of 50 preterm LBW neonates and electrolyte status was normal in 30(60.0%) cases. Of 20 neonates who had abnormal electrolytes, hyperkalemia was the predominant electrolyte abnormality found in 8(16.0%) neonates, hyponatremia was found in 7(14.0%), hypokalemia in 3(6.0%) and hypernatremia 2(4.0%). None of them had mixed electrolyte abnormalities.

Hyperkalemia 8(16.0%) was the predominant electrolyte abnormality found in 8(16.0%) neonates, Hyponatremia was found in 7(14.0%), hypokalemia in 3(6.0%) and hypernatremia 2(4.0%). None of them had mixed electrolyte abnormalities. (Chart 1)

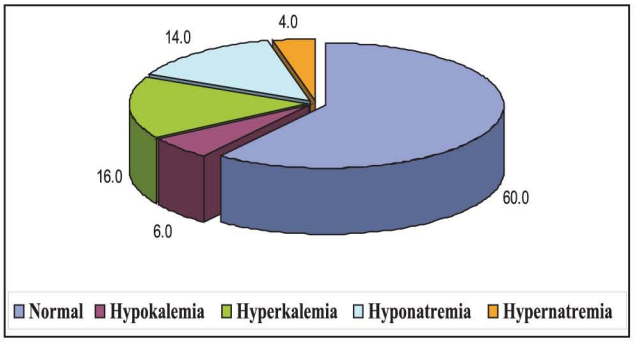

Figure-1: Type of electrolyte abnormalities

Sodium level was normal in 41(82.0%) abnormal in 9(18.0%), hyponatremia was found in 7(14.0%) an ypernatremia was found in 2(4.0%) . Mean sodium level was 137.98 mmol/l ± 5.30 SD.

Serum potassium. level was normal in 39(78.0%), abnormal in 11(22.0%), hyperkalemia was found in 8(16.0%) and hypokalemiamia was found in 3(6.0%) . Mean potassium level was 5.27 ± 1.13 SD

Discussion :

In this study, serum creatinine was determined and transient acute renal failure was defined as serum creatinine level greater than 1 mg/dl for at least 24 hours. In this study mean serum creatinine was found 0.82mg/dl on second postnatal day. Serum creatinine was more than 1 mg/dl in 8(16.0%) preterm LBW neonates. However the acute renal failure was transient in all of these cases. No infant died in this study due to renal failure. This finding consistent with N. Gordjani et al[11,12]. High serum creatinine is due to backflow of creatinine across leaky immature tubular and vascular structures.

The study found significant number 20 of preterm LBW babies have electrolyte abnormalities. Hyperkalemia (8) was the commonest abnormality detected. Hyponatremia (7), hypokalemia (3) and hypernatremia (2) were found.

Hyperkalemia was found in 8(16.0%) babies in this study. This findings are in contrast to those by Yuan et al[14] who found hyperkalemia in 44% of sick premature neonates. One fact relevant to this difference in findings might be that the present study included healthy preterm neonate, Hossain MM et al have found hyperkalemia in 58.5% (31) neonates out of 53 preterm LBW admitted in ICU. The difference revealed in this study may be due to most of the neonates are healthy and mean gestational age 33 weeks at which age nephronogenesis is almost complete although maturation is still going on. Another important is that most of the studies were conducted ICU patients, who are by definition their prematurity is not in a stable condition. We use working definition of hyperkalemia more than 6.7 mmol/l for preterm infant, but cut off value in other studies is more than 6 mmol/l[13].

In this study hyponatremia was found in 7(14.0%) babies, gestational age was between 30-32 weeks. Al-Dahhan et al[14] found negative sodium balance in 100% of neonates <30 weeks gestation, in 70% of neonates at 30-32 weeks, in 46% at 33-35 weeks and 0% greater than 36 weeks.

Hypokalemia was found in 3(6.0%) neonate with no significant abnormalities, who have gestational age 34 weeks. In a search for the causes of hypokalemia, we found the baby could

not be put to the mothers breast frequently for suckling due to maternal illness and primiparity. Inadequate feeding in early days of life may cause hypokalemia[15] which is within tolerable limits and this might be the possible explanation of hypokalemia in this healthy preterm baby. Hypernatremia was found in 2(4.0%) neonates in this study. Hossain MM et al5 have found hypernatremia in 37.5% (31) neonates out of 53 preterm LBW admitted in ICU. It may be due to excessive insensible water loss and it was responded to fluid challenge and measures taken to reduce insensible water loss.

So, from above findings it is evident that prematurity causes transient renal impairment, in preterm neonates which is inversely related to gestational age. Renal impairment should be suspected if the serum creatinine rises or fails to show normal post natal fall.

Conclusion :

From this study it was observed that electrolyte abnormalities are common in preterm LBW neonates and transient renal failure also occurs in a significant number of preterm LBW babies. So identification of renal failure and associated electrolyte abnormalities and proper management of fluid and electrolytes and close monitoring are important.

References :

01. Marlow N. Outcome following preterm birth. In: Roberton NRC. Text book of neonatology, 5th London: Churchill Livingstone; 2004. p. 63-79.

02. da Silva O.P. Prevention of low birth weight/preterm birth. In: Canadian Task Force on the Periodic Health Examination. Canadian Guide to Clinical Preventive Health Care.Ottawa: 1994. p. 38-50. Last updated 2003.

03. ICDDR, B Health and Science Bulletin, 4, No 1., March 2006. P. 23-28

04. Hossain MM, Shirin M, Mamun AA, Chowdhury NA, Hasan MQ, Afroza S.Electrolyte abnormalities in neonates admitted in intensive care unit . Bangladesh J Child Health 2004; 28: 13-17

05. Gomella TL, Cunninhum MD, Eyal F G, Zenk KE. Neonatology: Management, Procedures, On-Call Problems, Diseases, and Drugs. 4th ed. Connecticut: Appleton and Lange; 1999. p. 68-74.

06. Ambalavanan N. Fluid, Electrolyte, and Nutrition Management of the Newborn. www. eMedicine Specialties > Pediatrics > Neonatology. Last visited: May 17, 2006.

07. Manzar S, Umran KA, Awary BH, Faraidy AA. Changes in plasma creatinine in first 72 hours of life. Arch. Dis. Child. Fetal Neonatal Ed. 2001; 85: 145-148.

08. Cataldi L, Leone R, Moretti U, Mitri B, Fanos V, Ruggeri L and et al. Potential risk factors for the development of acute renal failure in preterm newborn infants: a case control study. Arch Dis Child. Fetal Neonatal Ed 2005; 90: 514-519.

09. Satolli E. Treatment of acute renal failure in newborn: the neonatological approach. Riv Ital Pediatr 1994; 20: 328-30.

10. Stapleton FB, Jones DP, Green RS. Acute renal failure in neonates: incidence, etiology and outcome. Pediatr Nephrol 1987; 1: 314-20.

11. Gallini F, Maggio L, Romagnoli C, Marrocco G, Tortorolo G. Progression of renal function in preterm neonates with gestational age 32 weeks. Pediatric Nephrology. 2000;15;1-2:119-124.

12. Gordjani N, Burghard R, Leititis JU, Brandis M. Srum creatinine and creatinine clearance in healthy neonates and prematures during the first 10 days of life. European Journal of Pediatrics 1988; 148: 2 143-5.

13. Yuan HC, Jeng MJ, Soong WJ, Chon HJ, Hwang BT. Hyperkalemia during early postnatal days in premature infants. Acta Pediatr.Taiwan 2003; 44: 208-14.

14. Al Dahhan J, Haycock GB, Chanter C, Stimmler L. Sodium homeostasis in term and preterm neonates. I Renal aspects. Arch Dis Child 1983; 58: 335-42.

15. Haycock G B, Aperia A. Salt and newborn kidney. Pediatric Nephrology 1991; 5: 65-70.