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Original Research Article

Dysnatremia and Risk Factors Leading to It in Sick Newborns Admitted in A Tertiary Care Hospital of Southern Rajasthan

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Abstract:

Introduction: Hyponatremia and hypernatremia pose intricate challenges in the clinical realm, particularly among newborns. Many sick newborns admitted have been associated with dysnatremia and its ill effects. The study aims to find out the prevalence of dysnatremia and risk factors associated with it in sick neonates.

Material and methods: A cross sectional study on all the neonates admitted in NICU of Pacific medical college and hospital, Udaipur during the study period from December 2022 to May 2023. Those neonates who did not consent were excluded. Ethical clearance was taken. Serum sodium estimation was done for sick neonates.

Result: A total of 154 sick neonates were included in the study, 147 neonates were successfully discharged and 7 (4.4%) neonates died during the hospital course. Out of 154 sick newborns enrolled, 83 (53.9%) were male while 71 (46.1%) were female. 65(42.2%) neonates had deranged serum sodium levels (dysnatremia). Hyponatremia was seen in 56(36.3%) neonates and hypernatremia was seen in 9(5.8%) neonates. Dysnatremia was significantly more frequent in preterm (p value 0.00001), LBW (p value 0.00001), Neonates with sepsis(p value 0.02), NEC (p value 0.003) and AKI (p value 0.001). Birth Asphyxia had dysnatremia but had no statistical significance (p value 0.61).

Conclusion: The neonates with prematurity, low birth weight, NEC, sepsis and acute kidney injury were more significantly dysnatremic and moreimportantly hyponatremic. Dysnatremia can be fatal if not acted upon timely as 6(83.3%) neonates who expired had dysnatremia

Keywords: Dysnatremia; Hyponatremia; Hypernatremia.

Introduction

After birth, extracellular fluid volume contracts, and this is accompanied by net negative sodium and water balance and weight loss. [1] This period is of variable duration, but by the third or fourth postnatal day, sodium and water balance have become positive, and remain so until adult life. Sodium is the principal electrolyte of extracellular fluid. The normal serum concentration in adults ranges from 130–145 mmol/l. Any deviation of serum sodium from these values is termed as dysnatremia. Hyponatremia is defined as serum sodium below 130 mmol/L and hypernatremia as serum sodium level more than 145 mmol/L.[2]

Hyponatremia and hypernatremia pose intricate challenges in the clinical realm, particularly among newborns admitted to the Neonatal Intensive Care Unit (NICU). However, the precise extent of these potentially devastating conditions remains somewhat uncertain. While the patho-physiological mechanism of hyponatremia is well-documented in adults, its impact on cerebral osmotic equilibrium and the timeframe required for brain cells to adapt to the new hypotonic environment are less understood in newborns. [3]. Many sick newborns admitted have been associated with dysnatremia and its ill effects. The study aims to find out the prevalence of dysnatremia in sick neonates admitted in our NICU and also aims to find out the risk factors that can lead to dysnatremia.

Material and method

It was a cross sectional study. The study included all the sick newborns admitted in our NICU. The study was carried out in NICU of department of paediatrics, Pacific medical college and Hospital, Udaipur. The study was carried out for a period of 6 months from December 2022 to May 2023. Newborns for whom serum sodium could not be measured during their NICU stay and those without the consent for study were excluded from the study.

The mother or caregiver of the eligible neonate provided written informed consent through the use of a consent form. A comprehensive assessment was conducted, gathering detailed information about the neonate's birth and obstetric history, gestational age at delivery, feeding practices if applicable, any reported complaints, and various risk factors associated with dysnatremia. These risk factors included prematurity, necrotizing enterocolitis, renal failure, birth asphyxia, sepsis etc. The duration of these treatments was also noted and documented on a pre-designed form. A thorough physical examination was conducted, paying special attention to signs of dehydration, edema, skin pigmentation, and ambiguous genitalia. Throughout their hospital stay, all participants were closely monitored to observe their outcomes in terms of survival and potential neurological complications. The attending physician repeated serum sodium tests during follow-up when deemed clinically necessary. Clinical indications for repeat testing included symptoms suggestive of hyponatremia, such as seizures, irritability, lethargy, and abnormal weight changes. Fluid management in the Neonatal Intensive Care Unit (NICU) adhered to a standardized protocol. The data collected was analyzed using SPSS software.

Results

A total of 154 neonates were included in the study. Out of 154 sick newborns enrolled, 83 (53.9%) were male while 71 (46.1%) were female. There were 64 (41.5%) preterm, 90 (58.5%) term neonates. Mode of delivery was normal vaginal in 102 (66.2%) and LSCS in 52 (33.7%). Out of 154 neonates, 51 (33.1%) were low birth weight, 23 (14.9%) were very low birth weight and 5 (3.2%) were extremely low birth weight.

All the 154 neonates included in the study underwent estimation of serum sodium levels. Those neonates who had deranged serum sodium were corrected according to our standard NICU protocol and repeat serum sodium was done as per the protocol.

Out of 154 sick neonates, 65(42.2%) neonates had deranged serum sodium levels (dysnatremia). Hyponatremia was seen in 56(36.3%) neonates and hypernatremia was seen in 9(5.8%) neonates. Hyponatremia was observed in 29 (56.8%) LBW out of 51 neonates admitted, 14 (60.8%) VLBW out of 23 neonates admitted and 4(80%) ELBW out of 5 neonates admitted in NICU. 9 (11.8%) out of 76 babies with weight more than 2500 grams had hyponatremia. And 6(7.8%) out of 76 babies with weight more than 2500 grams had hypernatremia. 3 (5.8%) out of 51 LBW neonates also had hypernatremia. The risk factors that lead to sick neonates and its association with dysnatremia has been summed up in table 1.

Outcome

Out of 154 neonates admitted in NICU, 147 neonates were successfully discharged and 7 (4.4%) neonates died during the hospital course. 5 out of 7 neonates who died had hyponatremia (71.4%) and 1(14.2%) neonate had hypernatremia and 1 (14.2%) neonate had no dysnatremia. The results has been summarised in table 2

Table 1: risk factor and its association with dysnatremia

Risk factor	No of neonates admitted(n)	No. of neonates with Dysnatremia	No. of neonates with Hypo-natremia	No. of neonates with Hyper-natremia	P-value
Preterm	64	45	42(93.3%)	3(6.6%)	<0.000 01
Term	90	20	14 (70%)	6(30%)	
Birth weight <2500 gms (LBW)	79	50	47(94%)	3(6%)	<0.000 01
Birth weight >2500 gms	75	15	9(60%)	6(40%)	
Sepsis present	32	19	17(89.5%)	2(10.5%)	0.02
No sepsis	122	46	39(84.8%)	7(15.2%)	
NEC present	14	11	10(90.9%)	1(9.1%)	0.003
NEC Absent	140	54	46(85.2%)	8(14.9%)	
Perinatal asphyxia present	19	7	7(100%)	0	0.61
Perinatal asphyxia absent	135	58	49(84.5%)	9(15.5%)	
AKI present	10	9	5(80%)	4(20%)	0.001
AKI absent	144	56	51(91.1%)	5(8.9%)	

Table 2: Outcome of the neonates with Dysnatremia

Outcome	No of neonates	No dysnatremia	hyponatremia	hypernatremia
Discharged successfully	147(95.5%)	88 (98.9%)	51(91.1%)	8(88.9%)
Death	7(4.5%)	1(1.1%)	5(8.9%)	1(11.1%)
	154	89	56	9

Discussion

This was a cross sectional study that was conducted over a period of 6 months in NICU of Pacific medical college and hospital, Udaipur. During the study, 154 neonates were included in the study to find out the dysnatremia among them due to conditions for which they were admitted. Out of these sick neonates, 83 (53.9%) were male while 71 (46.1%) were female.Out of 154 sick neonates, 65(42.2%) neonates had deranged serum sodium levels (dysnatremia). Hyponatremia was observed in 56(36.4%) out of 154 neonates and hypernatremia was observed in 9(5.8%) out of 154 sick neonates. In our study, hyponatremia was more common than hypernatremia in sick neonates. Similar study was conducted by Hassen F et al [4] where dysnatremia was found in 142 (37%) out of 384 sick neonate. They also observed similar findings where hyponatremia was more common than hypernatremia in sick neonates admitted in NICU. Hyponatremia in sick neonates was also observed in sick neonates by Upadhyay A. [5]

Prevalence of hypernatremia in our study was 9(5.8%) out of 154 sick neonates. Hassen et al [4] also had similar finding where prevalence of hypernatremia in sick neonates was 6.5%. We could not find studies where prevalence of hypernatremia was studied in sick neonates admitted in the NICU. However, the reported incidence in term newborns after discharge from the hospital varies from 1% [6] to 1.8% [7] to as high as 5.6% [8].

Hyponatremia and hypernatremia pose significant challenges in the clinical management of newborns admitted to the Neonatal Intensive Care Unit (NICU). However, the true extent of the potential harm caused by these conditions remains uncertain. The reported occurrence of these disorders is influenced by various factors, such as the specific criteria used to define hyponatremia and hypernatremia, the frequency of diagnostic testing, the healthcare environment, and the characteristics of the patient population. Multiple studies have highlighted the negative effects of fluctuating serum sodium levels on the neurological outcomes of preterm neonates. [9,10]. In our study, Prevalence of dysnatremia in sick neonates among neonates weighing less than 2500 grams was 32.5% which was significant as compared to the neonates weighing more than 2500 grams at birth. Hyponatremia was more common than hypernatremia. Among VLBW neonates admitted in our study, hyponatremia was observed in 14 (60.8%) out of 23 neonates. the study by hassen et al [4] had 67.2% hyponatremic VLBW neonates. Kloiber LL [11] and Moses M [12] had prevalce of hyponatremia in VLBW sick infants as 62.5% and 51% respectively. Hyponatremia in VLBW infants is attributed to the fact that they have immaturity of their kidneys which results in excessive loss of sodium in the urine. [13]

In our study, we found that preterm neonates (70.4%) had more dysnatremia as compared to term neonates (22.2%) which were significant with P value less than 0.00001. Hyponatremia was more significantly common in premature neonates. Similar findings were observed in the study by hassen et al [4) and Al-Dahhan J. [14]

Within the initial week of life, premature infants experience a physiological imbalance of sodium and water, primarily caused by the contraction of extracellular fluid. Preterm neonates possess limited capacity in their renal tubules to reabsorb sodium, leading to increased urinary losses. Additionally, there is an inadequate response to the antidiuretic hormone in the distal convoluted tubule, resulting from both deficient secretion and reduced tubular sensitivity. Moreover, the intestinal absorption of sodium is diminished in preterm newborns. Consequently, these infants are at a heightened risk of developing hyponatremia.

In our study, we found Dysnatremia among neonates with Sepsis (59.3%) as compared to those without sepsis (59.3%) that was significant with P value of 0.02. Also, Hyponatremia was more significant in neonates with sepsis as compared to those without sepsis. Hassen et al had similar finding in their study.We also found that neonates with NEC (78.6%) had more significant dysnatremia as compared to those without NEC (38.6%) with P value 0.003. Hyponatremia was more common as compared to hypernatremia in neonates with NEC. Neonatal enterocolitis causes third space losses which leads to hypervolumic hyponatremia.[15]

In our study, we observed that neonates with perinatal asphyxia had more dysnatremia but it was not significant (p value 0.61). Hyponatremia was more common in neonates with perinatal asphyxia. In neonates with perinatal asphyxia there might be hyponatremia as there is increased secretion of anti-diuretic hormone (ADH) in neonates with HIE which leads to increased water retention and hence dilutional hyponatremia. [16]

Acute kidney injury has been one important morbidity factor in neonates admitted in NICU and it leads to dysnatremia which was significant in our study (p value 0.001). Hyponatremia was more commonly associated with AKI as compared to hypernatremia. Hassen et al [4] also had the similar observation in their study.

Our study had 154 sick neonates admitted and out of those 147 (95.5%) neonates were discharged successfully and 7 (4.5%) neonates couldn't make it. 6 (85.7%) out of 7 neonates who died had dysnatremia and hyponatremia (83.3%) was associated with death more frequently than hypernatremia (16.6%) in our study.

Conclusion

Our study was a cross sectional study on sick neonates admitted to our NICU and we observed significant dysnatremia among neonates.

The neonates with prematurity, low birth weight, sepsis and acute kidney injury were more significantly dysnatremic and more importantly hyponatremic. Birth asphyxia has been an important cause of hyponatremia in our study but did not prove to be statistically significant. Dysnatremia can be fatal if not acted upon timely as 6(83.3%) neonates who expired had dysnatremia.

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