

Incidence of hypernatremic dehydration in breastfed neonates: a retrospective study in district hospital Ballari

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ABSTRACT:

Background: Neonatal Hypernatremic Dehydration (NHD) is a common occurrence in neonates. Hypernatremic dehydration is a lethal condition in neonate which adversely affects central nervous system. It presents usually around 4th postoperative day. Incidence is more common in summer season, due to raise in environmental temperature and due to inadequate water consumption by mother. Important causes of this condition include vomiting, diarrhea, inadequate breast feeding. Hypernatremia carries a high morbidity and mortality and therefore it is important to address the etiological factors to prevent complications.

AIM: To investigate the incidence of NHD, to study the clinical profile of neonates with hypernatremic dehydration and determine the outcome of these neonates after appropriate management.

Material and method: This is a retrospective study done in a District hospital. Over a three-month period i.e., April 2022 to June 2022, where all neonates admitted in Neonatal Intensive Care Unit (NICU) with serum sodium >145 mmol/l were included in the study. Initiation and frequency, technique and any problems of breastfeeding were recorded. Management of hypernatremic dehydration was done as per the standard unit protocol. Results were expressed in mean and SD in tables and compared using the Fisher's-extract test.

Results: A total of 1413 deliveries took place during the study period. Hypernatremic dehydration was reported in 119 of them, which required admission. The mean day of presentation by the neonates was day 4 of life. Moderate and severe hypernatremia were noted in 31(26.05%) and 16(13.44%) cases, 24(20%) neonates presented with seizures, and one with metabolic acidosis. More than 10% neonates had acute kidney injury (AKI) on admission. Factors that positively correlated with severe disease were primigravida mothers, latching difficulties, breast related problems, feeds less than 6 times/day, severe weight loss ($>10\%$) and decreased urine frequency (<4 /day).

Conclusion: Early diagnosis and appropriate treatment is crucial for a better prognosis. In all infants cared for in NICU, careful monitoring of electrolytes, strict input-output weight monitoring. The key to successful management of hypernatremia is careful fluid management with frequent monitoring of electrolytes. Mother should be educated about the signs and symptoms of dehydration during prenatal visits and postnatal rounds after delivery of newborn.

Key words: hypernatremic dehydration, neonates, breastfed

Introduction:

Hypernatremia, a frequently encountered electrolyte disorder, defined as serum sodium level greater than 145mmol/L and serum sodium >165 mmol/L is often regarded as severe hypernatremia. The condition represents a deficit of water in relation to total body Sodium (1). Normal neonatal feeding is based on demand or every 2hours with a minimum intake of 30 ml of breast milk /feed. It is mainly due to inadequate breastfeeding in the first week of life. Adequate breast milk intake depends on several interrelated stages such as mammogenesis, lactogenesis, let down reflex, maternal and infant breastfeeding technique (2). NHD is a potentially lethal condition and is associated with central nervous system complications such as seizures, cerebral edema, intracranial hemorrhage, cerebral venous thrombosis (3-5). Extracerebral complications include acute kidney injury (AKI), hyperglycemia or hypoglycemia, metabolic acidosis, disseminated intravascular coagulation and even death (6).

Incidence of hypernatremic dehydration varies in different geographical areas. It was previously thought to be unusual in breastfed babies. Nevertheless from 1976-1990s there were sporadic reports of hypernatremic dehydration occurring in breastfed babies. In the west,

prevalence of this condition is 1.8% (81/4280) in breastfed newborn (7). Recently, there are increasingly appearing reports of hypernatremic dehydration. Few studies have been reported from India (8,9). There is a need of increased awareness regarding this clinical entity as a result of which many cases tend to be missed or wrongly diagnosed as sepsis due to nonspecific clinical features (10). In neonates' hypernatremia should be suspected, if the weight loss is more than 10% of birth weight at the end of first week or if there are clinical findings of dehydration with hypernatremia (11).

This study was therefore undertaken at the District hospital, Ballari to study the clinical profile of neonates with hypernatremic dehydration and determine the outcome of these neonates after appropriate management.

MATERIALS AND METHODS

Our study was a retrospective analytical study that was conducted at District hospital, Ballari conducted between April to June 2022. 119 such cases were reported during study period.

Inclusion criterion:

1. All term neonates, that were on exclusive breast feeds and admitted to NICU with a serum Sodium >145mmol/L (Mild:146-155mmol/L, Moderate:156-170 ,Severe:>171mmol/L).
2. those neonates who are referred from postnatal and postoperative wards to the NICU for lethargy and poor feeding .

Exclusion criterion:

1. All preterm,
2. sick term neonates with sepsis screen positive, with birth defects, suspected neuromuscular disorders and
3. that were on mixed feeds

Neonatal data like age, sex, gestational age, birth weight, present weight, and reason for readmission, feeding pattern, number of urination and defecation were noted. Complete blood count, serum electrolytes, blood sugar, sepsis workup, blood gases, renal function of all babies at the time of admission were noted. Cerebrospinal Fluid (CSF) and were done when clinically

indicated. Maternal data like age, parity, education, weight gain during pregnancy, mode of delivery, any pre-pregnancy illness like malignancy, epilepsy, endocrine disorders, collagen vascular diseases, pregnancy related complications like hypertension, diabetes, anemia were noted. Initiation and frequency of breast feeding, let down reflex, any breast problems, water intake by mother, technique of feeding and length of hospital stay were recorded.

Breast problems were defined as inverted or cracked nipple or mastitis on physical examination. Position and technique were defined as the classical position of breast feeding. The letdown reflex was defined as milk ejection in response to suckling. All breast-feeding data was collected through a questionnaire. All the babies were examined by the pediatrician and given appropriate treatment.

In our hospital setting the fluid of choice is hypovolemic saline (0.45% of DNS). Volume restoration is an emergency in severely dehydrated infants with 0.9% Normal Saline as bolus of 20ml/kg. This should be followed by 1.5 times of 0.45% DNS calculated as per fluid deficit. After investigation if serum sodium is same or increased from previous report, we change the fluid to 1/3 (0.33%) DNS or 1/4 (0.25%) DNS. Investigations are repeated after 6 hours, if serum sodium >165mmol/L. >12 hours if serum sodium >150mmol/L.

In our hospital setting, surge in cases was seen during summer in spite of providing feeding counselling.

STATISTICAL ANALYSIS

The results were recorded, entered in excel spread sheet and then analyzed using SPSS software version 22.0. Results of the outcome variables were expressed in mean and Standard Deviation (SD), median and inter-quartile range and frequency distribution for categorical variables. Nonparametric tests chi-square and Fisher's-exact tests were applied when necessary. Subgroup analysis was applied between various factors and outcome measures. A p value<0.05 was considered significant.

table 1: Demographic characters of the study participants

S.no	Demographic characteristics	Cases [N= 119] (%)
1.	Maternal characteristics	
	a. Age in year	
	< 20 year	19(15.9%)
	20-30 year	58(48.7%)
	>30 years	42((35.2%)
	b. parity	
	Primigravida	79(66.3%)
	Multigravida	40(33.6%)
	c. Mode of delivery	
	Normal vaginal delivery	32(26.8%)
	Caesarean section	87(73.1%)
	d. any pregnancy illness	
2	Neonatal characteristics	
	a.age (days,mean+/-SD)	5
	b. gestational age (week, mean+/-SD)	38
	c. Birth weight (kg, mean+/-SD)	2.8
	d. Present weight	2.3
	e. Presenting signs and symptoms	N(%)
	Weight loss	83(62.7%)
	Lethargy	58(48.7%)
	Jaundice	72(60.5%)
	Fever	41(34.4%)
	Irritability	32(26.8%)
	Seizures	24(20.7%)
	f. serum sodium levels (mmol/l)	N (%)
	Mild (146-155)	72 (60.5%)
	Moderate (156-170)	31 (26.05%)
	Severe (>171)	16 (13.44%)

Results

A total of 1413 deliveries took place during the study period. Hypernatremic dehydration was reported in 119 of them, which required follow-up. The incidence was high in the summer season. Table 1 summarizes demographic characteristics and clinical presentation of cases enrolled were analyzed and described.

Majority of mothers were between 20 to 30 year of age, Primigravida. Majority of women had caesarean section.

The mean gestational age of neonatal cohort at birth was 38 weeks and birth weight was 2.8kg. The mean age of presentation was on day 3 of life and weight at admission was recorded to be 2.3 kg (SD 0.55). The major complaints at presentation were weight loss (69.7%), lethargy (48.7%) and jaundice (60.5). CNS signs were noted in a third of cases. Mild hypernatremia (<155mg%) was noted in 72 neonates (60.5%) with no mortality. Severe hypernatremia was present in 16 cases (13.44%) with mortality of 3 cases (18.7%). The other significant biochemical parameters were hypoglycemia 29 (24%), hypocalcemia 25 (21%) and azotemia 12(10%).

Maternal age, education, pregnancy complications and mode of delivery were not found to be significant for causing severe forms of disease or mortality [Table 2]. Infants of primigravida mothers had statistically significant hypernatremia. (p value- 0.045) Breast problems such as cracked or inverted nipples and engorgement and latching difficulties were significantly related to severe forms of hypernatremia p value- 0.015). Severe weight loss of more than 10% in neonates (p value- 0.037), breastfeeding frequency of less than six per day and decreased urine output were also positively correlated with moderate and severe hypernatremia.

No baby in our study developed CNS complications such as cerebral venous thrombosis, convulsions, or intracranial hemorrhage during the management, irrespective of the sodium levels.

Table 2: Association of risk factors with hypernatremia

s. no	Risk factors	Hypernatremia			χ^2 value	p-value
		Mild(N=72)	Moderate (N=31)	Severe(N=16)		
1.	Maternal age					
	<20y(n= 19)	14	7	4	0.68	0.953
	21-30y(n=58)	32	15	7		
	>30y(n= 42)	26	9	5		
2.	Pregnancy related complications				1.287	0.525
	Yes(n=22)	11	7	4		
	No(n=97)	61	24	12		
3.	Modeofdelivery				3.42	0.18
	Vaginaldelivery(n=32)	15	11	6		
	Caesareansection(n=87)	57	20	10		
4.	Parity				6.163	0.045*
	Primigravida(n=79)	54	16	9		
	Multigravida(n=40)	18	15	7		
5.	Breastrelatedproblems				8.29	0.015*
	Yes(n=60)	29	19	12		
	No(n=59)	43	12	4		
6.	Breastfeedingdifficulties				2.85	0.24
	Yes(n=41)	21	12	8		
	No(n=78)	51	19	8		
7.	Neonatalweightloss(%)				6.58	0.037*
	<10% (78)	46	25	7		
	>10% (41)	26	6	9		
8.	NeonatalSex				7.95	0.018*
	(male) (62)	30	21	11		
	(Female) (57)	42	10	5		
9.	Timeoffirstbreastfeed				4.73	0.09
	<30min(n=36)	20	10	6		
	>30min(n=83)	62	11	10		

Discussion

Hypernatremic dehydration is one of the most common problems encountered in the healthy term appropriate-for-gestational age neonates in the first week of life. Our study has shown this condition to be more common in neonates born to primiparous mothers (12,13). This may be because of summer season and ineffective galactopoiesis in primiparous mothers during the initial 48 hours that can lead to infrequent suckling by the baby (14), further compounding the problem because of infrequent stimulation. Ineffective feeding is primarily related to poor breast-feeding techniques, that is, incorrect positioning and latching along with lack of education about breast-feeding (15). This can sometimes be compounded by other factors such as flat nipple, sore nipple and so on, that interfere with breast-feeding (14).

Other factors associated with hypernatremic dehydration are low-birth weight babies, intra-uterine growth restriction (IUGR) babies, low maternal education, early discharge from the hospital and low socioeconomic status (14). In our study babies who are delivered by caesarean section are more likely to be fed under supervision till the time the mother is confident of handling the baby, which may reduce the risk of hypernatremic dehydration.

Weight loss is a significant marker of dehydration in the early neonatal period. Research studies have shown that a weight loss of 3% per day during the first week up to a maximum of 8-10% is acceptable (16). Babies with weight loss more than the expected should be screened for hypernatremia. Other clinical pointers towards hypernatremic dehydration are history of lethargy, poor feeding, decreased urine output, irritability, and tachycardia.

Neonatal hyperbilirubinemia is often present in neonates with hypernatremic dehydration. In our study, 20% of neonates had coexistent neonatal hyperbilirubinemia requiring phototherapy. Jaundice in these neonates is aggravated because of dehydration and decreased urine output, thereby decreased removal of bilirubin. Treatment of hyperbilirubinemia with phototherapy further adds to the dehydration because of increased insensible water loss creating a vicious cycle.

Acute kidney injury (AKI) has been reported to be the most common complication of hypernatremic dehydration, which at least in the initial stages is due to hypovolemia in these neonates (17). In our study, 15 (12.6%) patients had a history of decreased urine output, and 12(10%) babies had AKI. Thus, decreased urine output can be a reliable clue in the history that can be used for early identification of hypernatremic dehydration.

The goals of management in neonates with hypernatremic dehydration are the appropriate treatment of the condition in a protocolized manner to avoid the catastrophic consequences of the condition as well as due to its rapid correction. This is however difficult to achieve because of the presence of various factors requiring consideration, and therefore, no standard guidelines have been formulated to avoid or treat it (18).

The guiding principle in management of hypernatremic dehydration has always been to correct it slowly. It is always emphasized to correct serum sodium concentration at a rate not more than 0.5 mEq/L per hour to provide better neonatal outcomes (19-23). It should be however not be corrected too slowly as it may lead to complications such as sinus venous thrombosis and increased mortality (24,25). That neonates with a 24-h correction rate of less than 0.25mEq/L per hour were associated with significantly higher mortality as also with rapid correction (8,16,26). In our study, the average rate of correction of serum sodium concentration was approximately 6 mEq/L per day (0.25 mEq/L/hour), and it was not associated with any complications.

If managed with intravenous fluids, the main challenge is to administer a fluid with just enough sodium concentration to achieve correction albeit slowly as mentioned previously to avoid complications. This entails careful initial choice of intravenous fluids and close monitoring of serum sodium levels thereafter. The recommendations for intravenous fluids range from 1.5times the maintenance rate of 0.45% DNS fluid, but the fluid containing lower sodium concentrations should be avoided.

Quantified oral feeds allow slow correction of hypernatremia and thus should be the modality of choice if the baby is accepting orally and has no other comorbidities, as shown in a study on neonates with hypernatremia dehydration (27).

Our study elegantly brings out the safety of correction of hypernatremia with supervised and quantified oral feeding and use of intravenous fluids.

Conclusion

Hypernatremic dehydration in neonates, though rare, is common in our country especially during summer season due to high temperature conditions. It is a medical emergency with high morbidity and mortality. Early diagnosis and appropriate treatment are crucial for a better prognosis. Failure to recognize and treat can lead to severe acute morbidity and long-term sequel too. Breastfeeding should be the mode of feeding neonates, though the study brings out the association of hypernatremic dehydration due to inadequate breast feeds, breast problems being the main reason. However, it is important to take care of breast problems during antenatal check-ups. Women should be educated about the signs and symptoms of dehydration, adequacy of urine output and weight loss before discharge from the hospital. Management of hypernatremia requires strict fluid correction along with counselling and continuation of direct breast feeding.

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REFERENCES

- [1] Schwaderer AL, Schwartz GJ. Treating hypernatremic dehydration. *Pediatrics Rev.* 2005;26(4):148-51.
- [2] Koo WW, Gupta JM. Breast milk sodium. *Arch Dis Child.* 1982;57:500-2.
- [3] Boskabadi H, Maamouri G, Ebrahimi M, Ghayour-Mobarhan M, Esmaeily H, Sahebkar A, et al. Neonatal hypernatremia and dehydration in infants receiving inadequate breastfeeding. *Asia Paci J Clinical Nutrition.* 2010;19(3):301-07.
- [4] Kaplan JA, Siegler RW, Schmunk GA. Fatal hypernatremic dehydration in exclusively breast-fed newborn infants due to maternal lactation failure. *Am J Forensic Med Pathol.* 1998;19:19-22.
- [5] van Amerongen RH, Moretta AC, Gaeta TJ. Severe hypernatremic dehydration and death in a breast-fed infant. *PediatrEmerg Care.* 2001 Jun;17((3)):175-80
- [6] Unal S, Arhan E, Kara N, Uncu N, Aliefendioğlu D. Breast-feeding-associated hypernatremia: retrospective analysis of 169 term newborns. *Pediatr Int.* 2008 Feb;50((1)):29-34
- [7] Bolat F, Oflaz MB, Güven AS, Özdemir G, Alaygut D, Dogan MT, et al. What is the safe approach for neonatal hypernatremic dehydration? A retrospective study from a neonatal intensive care unit. *PediatrEmerg Care.* 2013;29(7):808-13.
- [8] Laing IA, Wong CM. Hypernatraemia in the first few days: is the incidence rising? *Arch Dis in Child Fetal Neonatal Ed.* 2002;87(3):F158-62.
- [9] Bhat SR, Lewis P, David A, Liza SM. Dehydration and hypernatremia in breast-fed term healthy neonates. *Indian J Pediatr.* 2006;73(1):39-41.
- [10] Saxena A, Kalra S, Shaw SC, Venkatnarayan K, Sood A, Tewari VV, et al. Correction of hypernatremic dehydration in neonates with supervised breast feeding: A cross-sectional observational study. *Med J Armed forces India.* 2019 [in press];<http://doi.org/10.1016/j.mjafi.2019.05.002>
- [11] Hauser GJ, Kulick AF. Electrolytes disorders in pediatric intensive care unit. *Pediatric Critical Care Medicine.* 1st ed. USA: Springer. 2007:1161-3.
- [12] Trivedi P, Patel AH. Hypernatremia in exclusively breastfed term neonates. *Indian J Child Health.* 2019;6(9):512-15.
- [13] Moritz ML, Manole MD, Bogen DL, Ayus JC. Breast feeding associated hypernatremia. Are we missing the diagnosis? *Pediatrics.* 2005;116(3):e343-47.
- [14] Munjawar N, Jaiswal A. Hypernatremia in the neonate: Neonatal hypernatremia and hypernatremic dehydration in neonates receiving exclusive breast feeding. *Indian J Crit Care Med.* 2017;21(1):30-33.
- [15] Livingstone VH, Willis CE, Abdel-Wareth LO, Thiessen P, Lockitch G. Neonatal hypernatremic dehydration associated with breast-feeding malnutrition: A retrospective survey. *CMAJ.* 2000;162(5):647-52.

- [16] Sielski L., McKee-Garrett T. 7th ed. Wolters Kluwer; New Delhi: 2016. Manual of Neonatal Care; p. 107.
- [17] Unal S., Arhan E., Kara N., Uncu N., Aliefendioğlu D. Breast-feeding-associated hypernatremia: retrospective analysis of 169 term newborns. *Pediatrics International*. 2008;50:29–34.
- [18] Bischoff A., Dornelles A., Carvalho C. Treatment of hypernatremia in breastfeeding neonates: a systematic review. *Biomedicine Hub*. 2017;2 3-3.
- [19] Oddie S. Hypernatraemic dehydration and breast feeding: a population study. *Archives of Disease in Childhood*. 2001;85:318–320.
- [20] Adrogué H., Madias N. *Hypernatremia New England Journal of Medicine*. 2000;342:1493–1499.
- [21] Kozeny G., Murdock D., Euler D. In vivo effects of acute changes in osmolality and sodium concentration on myocardial contractility. *American Heart Journal*. 1985;109:290–296.
- [22] Lien Y., Shapiro J., Chan L. Effects of hypernatremia on organic brain osmoles. *Journal of Clinical Investigation*. 1990;85:1427–1435.
- [23] Coulthard M. Will changing maintenance intravenous fluid from 0.18% to 0.45% saline do more harm than good? *Archives of Disease in Childhood*. 2008;93:335–340.
- [24] Alshayeb H., Showkat A., Babar F., Mangold T., Wall B. Severe hypernatremia correction rate mortality in hospitalized patients. *The American Journal of the Medical Sciences*. 2011;341:356–360.
- [25] Bolat F., Oflaz M., Güven A. What is the safe approach for neonatal hypernatremic dehydration? *Pediatric Emergency Care*. 2013;29:808–813.
- [26] Adrogué H., Madias N. *Hypernatremia New England Journal of Medicine*. 2000;342:1493–1499.
- [27] Erdemir A., Kahramaner Z., Cosar H. Comparison of oral and intravenous fluid therapy in newborns with hypernatremic dehydration. *The Journal of Maternal-Fetal & Neonatal Medicine*. 2014;27:491–494.