International Journal of Contemporary Pediatrics
Jayaprakash RPN et al. Int J Contemp Pediatr. 2025 Jun;12(6):929-934
http://www.ijpediatrics.com
pISSN 2349-3283 | eISSN 2349-3291

DOI: https://dx.doi.org/10.18203/2349-3291.ijcp20251471

Original Research Article

Clinical profile of hypernatremic dehydration in term neonates

Renu Prakash Nagappa Jayaprakash[1]*, Uday Kumar Seetharam Rao[1], Hareesh Sanikam[2]

[1]Department of Pediatrics, ESIC PGIMSR, Rajajinagar, Bangalore, Karnataka, India
[2]Department of Pediatrics, ESICH, Peenya, Bangalore, Karnataka, India

Received: 14 March 2025
Revised: 19 April 2025
Accepted: 02 May 2025

***Correspondence:**
Dr. Renu Prakash Nagappa Jayaprakash,
E-mail: renuprakash7@gmail.com

ABSTRACT

Background: Hypernatremic dehydration in neonates is a common situation, particularly in developing countries. Signs and symptoms of hypernatremic dehydration in neonates are subtle and non-specific. The clinical features at presentation are lethargy, poor feeding, reduced urine output, excessive weight loss, and in some cases seizures. Early breast feeding, counselling of mothers regarding breast feeding, monitoring of neonates with excessive weight loss and prompt correction of hypernatremia can prevent complications like acute kidney injury (AKI) and intraventricular haemorrhage.
Methods: The present study is a descriptive cross-sectional study conducted at department of pediatrics, ESIC-MC and PGIMSR between August 2022 to January 2024. A total of 78 neonates were enrolled.
Results: The male: female ratio was 1.2:1. Majority of neonates were born to primi gravidas and delivered through LSCS. The most common symptom was poor feeding followed by reduced urine output, lethargy and fever. Most of the neonates had mild hypernatremia and most common associated complication was AKI. None of the neonates had severe hypernatremia or seizures.
Conclusions: Early diagnosis and treatment of hypernatremic dehydration is of paramount importance to prevent morbidity and mortality. Early initiation of breast feeding and monitoring for excessive weight loss, counselling of mothers to identify at risk neonate is important in prevention and diagnosis of hypernatremic dehydration.

Keywords: Lethargy, Dehydration, Hypernatremia, Acute kidney injury

INTRODUCTION

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. Hypernatremic dehydration is defined as serum sodium concentration of >145 mEq/l.[1] In term breast fed neonates, hypernatremia most commonly develops in association with inadequate breast milk intake.[2] Hypernatremic dehydration reflects deficiency of water relative to total body solutes and is more often disorder of water than sodium homeostasis.[3]

Hypernatremia is classified based on serum sodium concentration as: mild 145-165 mEq/l, moderate 165-175 mEq/l and severe >175 mEq/l.[4]

Neonates with hypernatremic dehydration do not demonstrate overt clinical signs of intravascular depletion or dehydration until late in the course of the condition.[3]

However, it is possible to identify suspected hypernatremic dehydration by taking feeding history (poor or inadequate feeding), daily weight monitoring for excessive weight loss or decreased urine output.

Incidence: 4-30% in very low birth weight neonates and 1.38% in term neonates.[5]

Symptoms include lethargy, restlessness, excessive weight loss, irritability, decreased urine output, fever and seizures.[6]

Complications due to hypernatremic dehydration include acute kidney injury (31.3%), seizures (5.9%), intracranial haemorrhage (1.4%) and disseminated intravascular coagulation (1.4%).[6]

This study aims to identify new born who are at risk for development of hypernatremic dehydration, early symptoms, associated risk factors, complications, management of hypernatremic dehydration. As there are limited number of studies regarding hypernatremic dehydration conducted in our country, this study will aid in identifying risk factors, complications and management of neonates with hypernatremic dehydration.

METHODS

The present study is a descriptive cross-sectional study carried out among suspected cases of hypernatremic dehydration in post-natal ward and NICU at, ESIC-MC and PGIMSR between August 2022 to January 2024.

The sample size was calculated considering prevalence of hypernatremic dehydration of 3% based on pilot study data retrospectively. At 95% confidence level and absolute allowable error of 5%, the estimated sample size was n=30. 1=31. Considering 5% dropouts, the estimated sample size was 32. In the present study, 78 neonates with hypernatremic dehydration formed the study group. The sampling method used was purposive sampling technique (nonprobability sampling technique).

Inclusion criteria

Term neonates, with weight loss of more than 7% and serum sodium levels of more than 145 mEq/l were included.

Exclusion criteria

Neonates with positive septic screen and parents not willing to give consent were excluded.

Data collection

Blood samples were collected from 135 neonates suspected of hypernatremic dehydration, out of which 78 neonates who fulfilled the inclusion criteria were enrolled in the study. Detailed history, clinical findings and investigations were recorded in the predesigned structured Performa. After obtaining approval and clearance from institutional ethical committee, the neonates who fulfilled the inclusion and exclusion criteria were enrolled in the study after obtaining informed consent. Inclusion criteria were as follows, all term neonates suspected of hypernatremic dehydration (excessive weight loss, decreased urine output and serum sodium levels of more than 145 mEq/L) were included in the study. All preterm neonates and neonates whose parents did not consent were excluded.

All newborns were monitored daily for adequacy of feeding, weight loss and decreased urine output. Any term neonate with weight loss more than 7% (as per institutional protocol) was screened for hypernatremic dehydration and if found to have serum sodium level more than 145 mEq/L was recruited in the study. For study purpose hypernatremia was defined as serum sodium concentration >145 mEq/L. The neonates were treated according to institutional NICU protocol and monitored for complications. Detailed history and complete physical examination were carried out on each newborn detailed and relevant maternal history was collected. Relevant information including age, gender, weight, mode of delivery, presenting complaints and signs suggestive of hypernatremic dehydration was collected and entered in the excel sheet. Then a sterile needle of 23 G was used to puncture the site and sample (2 ml) was collected in a sterile clot activated vacutainer. The collected sample was sent to the laboratory for processing using direct ISE (ion selective electrodes) method for serum electrolytes, modified Jaffe kinetic method for serum creatinine was used.

Statistical analysis

All the data collected was compiled and entered into Microsoft excel. The qualitative variable was presented in frequency, percentage and graphs. SPSS (Statistical package for social sciences) version 21. (IBM SPASS statistics [IBM corporation: NY, USA]) was used to perform the statistical analysis-data was entered in the excel spread sheet, descriptive statistics of the explanatory and outcome variables were calculated by mean, standard deviation for quantitative variables, frequency and proportions for qualitative variables. Inferential statistics like Chi-square test was applied for qualitative variables to find the association. The level of significance set at 5%.

RESULTS

Total no. of 3172 term deliveries conducted during our study period. Among them 135 term neonates suspected of hypernatremic dehydration screened, out of which 78 neonates with hypernatremic dehydration enrolled in study that fulfilled inclusion and exclusion criteria.

Table 1: Distribution of the subjects based on gender.

Gender	N	Percent (%)
Females	35	44.9
Males	43	55.1
Total	78	100.0

Table 2: Distribution of the subjects based on parity.

Parity	N	Percent (%)
M	24	30.8
P	54	69.2
Total	78	100.0

Table 3: Distribution of the subjects based on mode of delivery.

MOD	N	Percent (%)
LSCS	62	79.5
NVD	16	20.5
Total	78	100

Majority (55.1%) of neonates were males. Most of the affected neonates had appropriate for gestational age birth weight. Out of the 78 neonates included in the study, 79.5% of the neonates were born through LSCS and 69% of the neonates were born to primigravida mothers.

Table 4: Distribution of subjects based on time of first feed.

Time of first feed	N	Percent (%)
<1 hour	25	32.1
>1 hour	53	67.9
Total	78	100.0

In this study group, most of the affected neonates (67.9%) neonates were fed after 1 hour of life and most (61.5%) neonates had weight loss between 11-15%. Most (96.2%) of the neonates were found to have mild hypernatremia. Moderate hypernatremia was noticed in 3.8%. None of the neonates had severe hypernatremia.

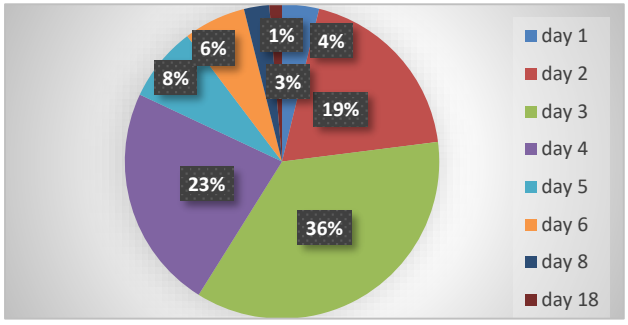

Figure 1: Distribution of the subjects based on age at presentation.

Age of presentation in majority (59%) of neonates was between day 3 and 4 of life. However, 3.8% presented as early as day 1 and 1.3% presented later on day 18.

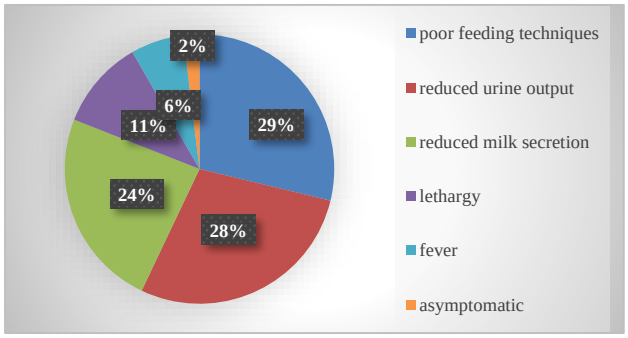

Figure 2: Distribution based on symptoms.

Majority of neonates (75.6%) predominant symptom was poor feeding followed by reduced urine output (74.3%), reduced milk secretion in the mother (62.8%), lethargy (28.2%) and fever (16.7%). However, 5.1% neonates were asymptomatic. Out of the 78 neonates affected, 30.8% had signs of dehydration. In the present study altered serum creatinine values was noted in (19.2%) suggestive of AKI. Out of the 78 neonates with hypernatremic dehydration, most (65.4%) neonates required correction with measured feeds alone

Table 5: Cross-tabulation of time of first feed and mode of delivery.

Time of first feed		MOD		Total
		LSCS	NVD	
<1 hour	Count	11	14	25
	%	14.1	17.9	32.1
>1 hour	Count	51	2	53
	%	65.4	2.6	67.9
Total	Count	75	3	78
	%	96.2	3.8	100

Chi-square value-28.41 and p=0.001.

The relationship between time of first feed and mode of delivery was statistically significant with p=0.001. The time of first feed in neonates born through LSCS was more than 1 hour.

Table 6: Cross-tabulation of weight loss and AKI.

Percentage of weight loss		AKI		Total
		N	Y	
>15%	Count	0	4	4
	%	0.0	5.1	5.1
11 to 15%	Count	40	8	48
	%	51.3	10.3	61.5
7 to10%	Count	23	3	26
	%	29.5	3.8	33.3
Total	Count	63	15	78
	%	80.8	19.2	100

Chi-square value-17.99 and p=0.001

The association between weight loss and AKI was found to be statistically significant with p=0.001%. The neonates with more percentage of weight loss had higher chances of developing AKI.

DISCUSSION

Neonatal hypernatremic dehydration is a one of the common occurrences in early neonatal period. Early diagnosis and appropriate treatment are crucial for survival and better prognosis. However, diagnosis is often difficult due to apparent wellbeing and dehydration is underestimated.

In the present study, 135 neonates clinically suspected to have hypernatremic dehydration were studied. Among

them 78 neonates had hypernatremic dehydration who were admitted to NICU at ESICMC and PGIMSR during a period of 18 months formed the study group. The 135 neonates suspected of hypernatremic dehydration screened, 57 neonates were excluded in whom serum sodium values less than 145 mEq/L and subjects who did not consent for the study. Detailed history and clinical examination were done. The 75 neonates had mild hypernatremia and 3 had moderate hypernatremia.

Out of 78 neonates enrolled, 43 (55.1%) were males, with male: female ratio being 1.2:1. This is similar to the studies conducted by Shivanagouda et al and Mahesh et al in which 55.17% and 53.3% of males were affected by hypernatremic dehydration respectively.[8] Our results differed from study conducted by Bhat et al in which females were more affected (55.2%).[6] The clinical presentation of hypernatremic dehydration is usually around ten days with a range from 3 to 21 days.

In present study, majority (n=46,59%) age of presentation was day 3- day 4 of life which was similar to studies conducted by Shivanagouda et al and Juneja et al with mean age of presentation in d3-d4 of life.[7] Typically first born neonates are affected often.[2,8] This was observation was noted in the present study in which majority (n=54, 69.2%) born to Primipara mothers compared to those born to multiparamothers 24 (30.8%). This was similar to the studies conducted by Bhat et al and Mahesh et al and Shivanagouda et al with 39 (58.2%), 23 (76.7%), 22 (75.8%) respectively. This could be attributed to poor feed establishment in primigravida mothers.[2,8] In the present study, majority (n=48,61.5%) neonates with hypernatremic dehydration had weight loss of >10%. This was similar to studies conducted by Bhat et al, Juneja et al with weight loss >10% seen in 35 (67.5%) and 12 (57.7%) respectively. This differed from the study conducted by Shivanagouda et al in which the weight loss of <10% was seen in only 13 (44.8%) of neonates.[8]

Table 7: Comparative studies showing various symptoms at time of presentation.

Presenting complaint	Present study	Nair et al[28]	Bhat et al[6]	Shivanagouda et al[8]
Poor feeding	75.6%	42.8%	58.2%	65.52%
Reduced urine output	74.3%	8.2%	43.2%	44.8%
lethargy	28.2%	26.5%	38.8%	20.6%
Fever	16.7%	34.6%	25.3%	100%

Based on clinical features at presentation in hypernatremic dehydration, various studies were conducted. All these studies show that clinical features of neonatal hypernatremic dehydration are nonspecific and may be clinically indistinguishable from occurring due to various other metabolic or infectious causes. In our study the most common presenting complaint was poor feeding (75.6%), followed by reduced urine output (74.3%), reduced secretions (62.8%), lethargy (28.2%) and fever (16.7%). The most common symptom was poor feeding except in study conducted by Shivanagouda et al in their retrospective cross sectional study hypernatremic dehydration in exclusively breast fed neonates: a clinical study where fever (100%) was the most predominant symptom and opined that fever during first few days of life can be due to dehydration.[8] In the breastfed term neonate, hypernatremia most commonly develops because of dehydration caused by inadequate breast milk intake.[9] AKI was seen in 15 neonates (19.2%). The association of AKI indifferent studies were Saxena et al were 51% n=25 and Nair et al were n=33 (67.3%) had AKI.[10] In the study conducted by Bhat et al the incidence of AKI was n=21 (31%) (67). In the present study, majority of cases had mild hypernatremia n=75, 96.2% and hence complications like AKI were less observed. Saxena et al in their cross-sectional observational study 'Correction of hypernatremic dehydration in neonates with supervised breast feeding', concluded that quantified oral feeding is effective in management of hypernatremic dehydration in neonates and not associated with dreaded CNS complications due to rapid correction.[10] In this study, majority of cases had mild hypernatremia with mean serum sodium values of 151.9 mEq/l that required correction with proper feeding. This similar to studies conducted by Shivanagouda et al (155.4 mEq/l), Nair et al (157 mEq/L) and Mahesh et al. However, in study conducted by Bhat et al mean serum sodium concentration 169 mEq/L with moderate hypernatremia.[6]

In the present study, the time of first feed being more than 1 hour was observed in 53 (67.9%) neonates. Out of 78 neonates, 51 (61.4%) required only measured feeds for correction of hypernatremia. In neonates with AKI, IV fluids were also used. Since most of the cases had mild hypernatremic dehydration, complications like AKI observed were less. No mortality, seizures/ intracranial haemorrhage was seen in any of subjects. Bhat et al in their study clinical profile and outcome of neonates with hypernatremic' dehydration-a tertiary care hospital-based study found association between inadequate breastfeeding and neonatal hypernatremic dehydration and concluded that breastfeeding should be encouraged and mothers to be counseled regarding same.[11]

Limitations

Only inborn babies born in ESICMC and PGIMSR were considered as inclusion criteria. So, study results cannot be broadly considered as a whole for the community. Breast milk sodium values were not performed in our study. Neonates could not be followed up to look for signs of neurological sequelae.

CONCLUSION

Hypernatremic dehydration is common among breast fed babies due to various reasons. Unless diagnosed early and treated properly, hypernatremic dehydration leads to complications. Hypernatremia itself or its improper treatment can cause neurological damage. Dehydration can lead to pre-renal injury which can further progress in to intrinsic renal failure, complicating the management. Most common presentation is poor feeding, lethargy, decreased urine output and fever. AKI is one of the common complications observed. Neonates born to Primi gravid mothers and through LSCS are predisposed to develop hypernatremic dehydration. Males are more predisposed for hypernatremia. Hypernatremic dehydration usually occurs around day 3 and 4 of life and varies from 3 to 21 days.

Recommendations

Early initiation of breast feeding and monitoring for excessive weight loss, counselling of mothers, training of care giver, doctors, midwives and community nurses to identify risk neonate is important in prevention and diagnosis.

ACKNOWLEDGEMENTS

Authors would like to thank Dr. Udaykumar S. and Dr. Pushpalatha, department of paediatrics, ESIC medical college and PGIMSR, Bangalore.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

REFERENCES

1. 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(1):19-22.
2. Molteni KH. Initial management of hypernatremic dehydration in the breastfed infant. Clin Pediatr (Phila). 1994;33(12):731-40.
3. Trachman H, Futterweit S, Hammer E, Siegel TW, Oates P. The role of polyois in cerebral cell volume regulation in hypernatremic states. Life Sci. 1991;49(9):677-88.
4. Christine A. Gleason, Sandra E. Avery's diseases of the newborn. 9th Ed, Elsevier. 2012;376.
5. Adrogué HJ, Madias NE. Hyponatremia. N Engl J Med. 2000;342(21):1581-9.
6. Bhat SA, Hassan ZE, Tak SA. Clinical profile and outcome of neonates with hypernatremic dehydration-a tertiary care hospital based study. Sepsis. 2019;24:35-8.
7. Das J. Hypernatremic dehydration in newborn infants: a review. Ulutas Med J. 2015;1(2):22-5.
8. Shivanagouda J, Gayathri K, Roopa BN. Hypernatremic dehydration in exclusively breast-fed neonates: A clinical study. Int J Pediatr Res. 2017;4:525-30.
9. Morton JA. The clinical usefulness of breast milk sodium in the assessment of lactogenesis. Pediatrics. 1994;93(5):802-6
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. 2020;76(4):438-42.
11. Kliegman ST, Geme JW. Nelson Textbook of Pediatrics, Edition 21. Philadelphia, PA: Elsevier. 2020.
12. Trachtman H, Futterweit S, Hammer E, Siegel TW, Oates P. The role of polyols in cerebral cell volume regulation in hypernatremic and hyponatremic states. Life Sci. 1991;49(9):677-88.
13. Garg BP, Walsh L. Clinical approach to the child with a large head. Indian J Pediatr. 2001;68:867-71.
14. Adrogué HJ, Madias NE. Hyponatremia. N Eng J Med. 2000;342(21):1581-9.
15. Morton JA. The clinical usefulness of breast milk sodium in the assessment of lactogenesis. Pediatrics. 1994;93(5):802-6.
16. Peters JM. Hypernatremia in breast-fed infants due to elevated breast milk sodium. J Am Osteopathic Assoc. 1989;89(9):1165-74.
17. Livingstone V. Breastfeeding Kinetics. Behavioral and metabolic aspects of breastfeeding. World Rev Nutr Diet. 1995;78:28-54.
18. Livingstone V. Neonatal insufficient breast milk syndrome. Med North Am. 1997;20(3):42-7.
19. Thullen JD. Management of hypernatremic dehydration due to insufficient lactation. Clin Pediatr. 1988;27(8):370-2.
20. Cooper WO, Atherton HD, Kahana M, Kotagal UR. Increased incidence of severe breastfeeding malnutrition and hypernatremia in a metropolitan area. Pediatrics. 1995;96(5):957-60.
21. Livingstone VH. Prenatal lactation assessment. J Soc Obstet Gynaecol Can. 1994;16:2351-9.
22. 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 Pacific J Clin Nutrit. 2010;19(3):301-7.

23. Swarna Rekha Bhat. Achars text book of Pediatrics 4th Ed. CRC Press. Universities Press. 2009.
24. Lipshitz F. Pediatric endocrinology. 5th Ed. Informa Health care. 2006
25. Durrani NU, Imam AA, Soni N. Hypernatremia in newborns: a practical approach to management. Biomedicine. 2022;7(2):55-69.
26. Mahesh M, Mahantesh M, Vijayasree K, Kulkarni V. Clinical profile of hypernatremic dehydration in neonates with special emphasis to acute kidney injury. Journal of Pediatric Critical Care. 2018 Sep 1;5(5):26-30.
27. Mahesh M, Mahantesh M, Vijayasree K, Kulkarni V. Clinical profile of hypernatremic dehydration in neonates with special emphasis to acute kidney injury. Journal of Pediatric Critical Care. 2018 Sep 1;5(5):26-30.
28. Nair S, Singh A, Jajoo M. Clinical profile of neonates with hypernatremic dehydration in an outborn neonatal intensive care unit. Indian pediatrics. 2018 Feb 9;55(4):301-5.

Cite this article as: Jayaprakash RPN, Rao UKS, Sanikam H. Clinical profile of hypernatremic dehydration in term neonates. Int J Contemp Pediatr 2025;12:929-34.