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Original Article

Paediatrics Section

Neonatal Hypernatremia in Exclusively Breastfed Newborns- A Case Control Study in the Postnatal Ward of a Tertiary Care Hospital

Neha Mohan Rao, Madhuri Maganthi, KS Lakshmi

ABSTRACT

Introduction: Hypernatremia, defined as a serum sodium level of more than 145 mEq/L, is a common but potentially dangerous condition in newborns. Hypernatremia in exclusively breastfed newborns is usually secondary to insufficient lactation.

Aim: To determine the clinical profile and risk factors associated with the development of hypernatremia and to assess whether neonatal hypernatremia is associated with breastfeeding problems.

Materials and Methods: This was a case control study conducted in the postnatal ward of Bangalore Baptist Hospital, Bengaluru, Karnataka, India on 64 exclusively breastfed newborns (32 cases and 32 controls), between September 2017 and June 2018. In babies with significant weight loss (more than 10% in term or more than 15% in late preterm), or symptoms suggestive of dehydration like depressed anterior fontanel, excessive cry, lethargy, poor feeding, serum sodium levels of the newborn was measured. Babies with serum sodium >150 mmol/L were in the case group and babies with sodium <145 mmol/L were in the control group. Corresponding breast milk sodium levels were measured and classified into normal or high breast milk sodium based on standard cut-offs. LATCH score of each mother-infant dyad was observed to assess breastfeeding. Maternal and neonatal risk factors were assessed and data interpreted. The data collected was then analysed using Microsoft Excel and SPSS software (version 18).

Results: On comparing breast milk sodium levels with standard normal levels, it was found that- amongst mothers with high breast milk sodium, 55.55% babies had hypernatremia, versus mothers with normal breast milk sodium, where only 20% babies had hypernatremia. This was found to be statistically significant (p=0.038) indicating an association between high breast milk sodium and hypernatremia.

Conclusion: Breastfeeding associated hypernatremia is a preventable cause of morbidity in the newborn. Mothers with high breast milk sodium are more likely to have babies with hypernatremia than mothers with normal breast milk sodium levels.

Keywords: Breastfeeding, Breast milk, Dehydration, High sodium

INTRODUCTION

Breastfeeding provides optimal nutritional, immunological and emotional nurturing for the growth and development of infants. Breastfeeding provides health advantages to both infant and mother. It is normal for the neonate to lose as much as 10% of its birth weight in the first few days of life. Neonates should start to gain weight thereafter and regain their birth weight by day 10 of life. Rapid weight loss or weight loss of >10% is a cause for concern and these babies should have their serum sodium levels monitored. High sodium levels indicate dehydration in the newborn. In addition to weight loss, hypernatremia in the newborn can also present as lethargy, poor feeding, decreased urine output with clinical signs of dehydration and rarely as seizures.

Hypernatremia may be associated with decreased fluid intake, excessive fluid loss or excessive sodium intake [1]. Several factors contribute to the development of hypernatremia in exclusively breastfed newborn babies such as caesarean delivery, primiparity, breastfeeding problems, excessive maternal body weight, delayed breastfeeding, lack of previous breastfeeding experience, and low maternal education level [2]. In addition, breast conditions associated with breastfeeding difficulties, less than four stools pink diaper and delay at initiation of first breast giving were also found to have a significant association with hypernatremia [3].

In this study, the LATCH score was used for each mother baby dyad to understand the adequacy of breastfeeding [4]. LATCH is a breastfeeding charting system that provides a systematic method for gathering information about individual breastfeeding sessions. The system assigns a numerical score, 0, 1 or 2, to five key components of breastfeeding [Table/Fig-1].

Score	0	1	2	Total
L (Latch)	Too sleepy or reluctant	Repeated attempts for sustained latch or suck. Hold nipple in mouth. Stimulate to suck.	Grasps breast. Lips flanged Rhythmic sucking	
A (Audible Swallowing)	None	A few with simulation	Spontaneous and intermittent, spontaneous and frequent	
T (Type of Nipple)	Inverted	Flat	Everts after stimulation	
C (Comfort)	Engorged severe pain	Filling red	Soft non tender	
H (Hold)	Full assist	Minimal assist	No assist	

[Table/Fig-1]: LATCH Score.

Each letter of the acronym LATCH denotes an area of assessment, which is as follows:

"L" is for how well the infant latches onto the breast,

"A" is for the amount of audible swallowing noted,

"T" is for the mother's nipple type,

"C" is for the mother's level of comfort,

"H" is for the amount of help the mother needs to hold her infant to the breast.

The system is visually represented, and with this one can assess maternal and infant variables, define areas of needed intervention and determine priorities in providing patient care and teaching.

Hypernatremia is a frequently encountered problem in postnatal ward of the study institute. It can be under-recognised since fluid shifts can underestimate the degree of dehydration [5]. In addition, neonatal hypernatremia affects growth parameters and developmental milestones of children in the first year of life [6]. This emphasises the importance of early detection and prompt treatment of the problem.

There are a few studies that have previously addressed the issue; however since it is a commonly encountered problem in the setup, there is a need for more detailed evaluation of the same.

The present study was done to determine the clinical profile and risk factors associated with the development of hypernatremia and to assess whether neonatal hypernatremia is associated with breastfeeding problems.

MATERIALS AND METHODS

This was a case control study conducted in the postnatal ward of Bangalore Baptist Hospital, Bengaluru, Karnataka, India which is a tertiary care centre for newborns. Sixty-four exclusively breastfed newborns born in the hospital, between September 2017 and June 2018 were included in the study. All exclusively breastfed newborn babies and babies with symptoms in the first two weeks of life were included. Serum sodium levels of newborns with significant weight loss (defined as more than 10% in term babies/ more than 15% in late preterm babies) or symptoms suggestive of dehydration like depressed anterior fontanel, excessive cry, lethargy, poor feeding was measured. Moderate preterms (less than 35 weeks gestation) and guardians that did not consent for the study were excluded.

Ethical committee clearance and scientific committee clearance from the institution was obtained (dated 26/09/2017). Written informed consent was taken from all patients. Details of the study were explained to the parents using information sheet. Parents were given a chance to clarify their doubts. All possible risks and expected benefits were explained to them. No care was denied if the person did not agree for the study. The privacy and confidentiality of the research participants was protected. Patient did not pay any extra cost for participation in the study.

Sample size was calculated using a confidence interval (2 sided) of 99% and a power of 90%. The ratio of sample size (Group 2/ Group 1) was 1. The final sample size obtained was 64, including 32 cases and controls each.

Latch score [4] of each mother-infant dyad was evaluated to assess adequacy of breastfeeding. Babies with serum sodium >150 mmol/L were in the case group (32 in number) and babies with sodium <145 mmol/L were in the control group (32 in number). Then, breast milk sodium levels of each of these mothers was measured and classified into normal or high breast milk sodium. Normal breast milk sodium content is 7-21 mEq/L between days 7 to 14 postpartum. Macy (in 1949) established mean (SD) Sodium content of colostrum in first five days postpartum to be 22mEq/L, transitional milk between day 5 and 10 to be 13 mEq/L, and mature milk after day 15 to be 7 mEq/L [7].

Maternal factors such as age of the mother, weight, education, parity, pregnancy complications, mode of delivery, duration of delivery, breast problems such as inverted nipple, cracked nipple or mastitis, breastfeeding technique (position), let down reflex, time of first feeding, frequency of breastfeeding and hospital stay after delivery were assessed. Pregnancy complications included maternal risk factors such as hypothyroidism, epilepsy, asthma, chronic hypertension, retroviral positive status or fever before delivery. Obstetric risk factors included Rh negative pregnancy, twins, gestational diabetes, premature rupture of

membranes, pregnancy induced hypertension, elderly gravida, breech, oligohydramnios and polyhydramnios.

Neonatal factors such as day/hours of life, birth weight, APGAR score, gestational age, sex, feeding duration, number of urinations and defecations per day were assessed. Age of the baby was taken in terms of days for analysis, with any baby between the ages of 24-48 hours being considered as two days old, 48-72 hours being considered as three-day-old and so on.

STATISTICAL ANALYSIS

Case records of both cases and controls were studied, proforma was filled and data analysis was subsequently done, using Microsoft Excel and SPSS software version 18. Chi-square test was used for categorical variables and a p-value <0.05 was considered statistically significant.

RESULTS

On comparing demographics, it was found that neither the age of the mother nor the difference in education status of the mother was associated with development of hypernatremia in the baby. Although 70% of babies in the study were born to primiparous mothers, parity of the mother and mode of delivery also had no association with development of hypernatremia in the baby [Table/Fig-2].

Maternal profile	Case group	Control group	p-value
1. Age of mother (years)	32±3.95	26.28±4.74	0.121
2. Education status of mother			0.544
Education till school (%)	1 (100%)	0 (0)	
Education till high school (%)	3 (50%)	3 (50%)	
Education till pre university (%)	2 (28.57%)	5 (71.42%)	
Graduate	22 (55%)	18 (45%)	
Post Graduate	4 (40%)	6 (60%)	
3. Parity of mother			0.784
Primiparous	23 (51.11%)	22 (48.88%)	
Multiparous	9 (47.36%)	10 (52.63%)	
Baby profile			
4. Mode of delivery			0.133
Vaginal delivery	20 (58.82%)	14 (41.17%)	
Caesarean section	12 (40%)	18 (60%)	
5. Gender of babies			0.211
No. of males	18 (58.0%)	13 (41.9%)	
No. of females	14 (42.42%)	19 (57.57%)	
6. Age of the baby (days)	3.66±1.335	3.03±1.307	0.63
7. Gestational age (weeks)	39.19±1.256	38.84±1.547	0.333
8. Birth weight (kg)	3.156±0.518	2.985±0.565	0.211

[Table/Fig-2]: Demographics of study population.

On comparing breast milk sodium levels with standard normal levels, it was found that-amongst mothers with high breast milk sodium, 55.55% had babies with hypernatremia, versus mothers with normal breast milk sodium, where only 20% had babies with hypernatremia. This was found to be statistically significant (p=0.038) indicating an association between high breast milk sodium and hypernatremia [Table/Fig-3].

Risk Factors Associated with Hypernatremia			p-value	Odd's ratio
1. Association of breast milk sodium with baby serum sodium			**0.038**	5.0
High breast milk sodium	30 (55.5%)	24 (45.5%)		
Normal breast milk sodium	2 (20%)	8 (80%)		
2. Weight gain in pregnancy (kg)	13.81±6.42	13.4±6.07	0.793	
3. Obstetric risk factors			0.313	0.6000
Present (%)	12 (42.85%)	16 (57.14%)		
Absent (%)	20 (55.55%)	16 (44.45%)		
4. Maternal risk factors			0.396	0.6160
Present	7 (41.17%)	10 (58.82%)		
Absent	25 (53.19%)	22 (46.8%)		
5. Fluid intake in mother 24 hours prior to delivery			0.428	
1 – 2 l/day	9 (39.13%)	14 (60.86%)		
3-4 l/day	14 (56%)	11 (44%)		
>5 l/day	9 (56.25%)	7 (43.75%)		
6. Requirement of resuscitation at birth			0.391	0.4667
Yes	2 (33.33%)	4 (66.66%)		
No	30 (51.72%)	28 (48.28%)		
7. APGAR- 1 minute	7.94±0.246	7.72±0.729	0.113	
8. APGAR- 5 minutes	8.97±0.177	8.91±0.296	0.309	
9. Weight loss percentage			0.211	1.8791
Significant	19 (57.57%)	14 (42.42%)		
Insignificant	13 (41.9%)	18 (58%)		
10. Time of first breastfeeding			0.114	
Within 1 hour	25 (54.34%	21 (45.65%)		
1 -2 hours	7 (50%)	7 (50%)		
>2 hours	0 (0%)	4 (100%)		
11. Frequency of breastfeeding			0.191	
<1 hour	4 (36.36%)	7 (63.63%)		
1-2 hours	28 (54.9%)	23 (45.09%)		
>2 hours	0 (0%)	2 (100%)		
12. Duration of feed in minutes	13.9±6.31	14.53±7.65	0.723	

13. Breast anomalies			0.340	
No anomalies	31 (52.6%)	28 (47.4%)		
Inverted nipple	0 (0%)	3 (100%)		
Cracked nipple	1 (50%)	1 (50%)		
14. Let down reflex			0.209	1.8889
Present	20 (57.14%)	15 (42.85%)		
Absent	12 (41.37%)	17 (58.62%)		
15. Soft breast after feeding			0.183	2.0526
Yes	24 (55.81%)	19 (44.18%)		
No	8 (38.09%)	13 (61.9%)		
16. Number of urinations per day(baby)	2.03±0.782	2.16±0.920	0.560	
17. Number of defecations per day	1.62±0.707	2±0.984	0.85	
18. LATCH Score	7.09±1.20	7.09±1.30	1.00	
19. Presenting complaints			0.45	1.4615
Excessive weight loss	19 (54.28%)	16 (45.71%)		
Others	13 (44.8%)	16 (55.17%)		
20. Icterus present at the time of symptoms			0.121	2.2549
Present	15 (62.5%)	9 (37.5%)		
Absent	17 (42.5%)	23 (57.5%)		
21. Mean breast milk sodium level	44.34±20.832	35.88±15.766	0.07	

[Table/Fig-3]: Risk factors.
Obstetric risk factors analysed included Rh negative pregnancy, twins, gestational diabetes, PROM, pregnancy induced hypertension, elderly gravida, breech, oligohydramnios and polyhydramnios; Maternal risk factors analysed were hypothyroidism, epilepsy, asthma, chronic hypertension, retroviral positive status and fever before delivery

Significant weight loss (>10% in term babies or >15% in late preterms) seemed to be more likely in the cases group than the controls group (OR 1.8791). Let down reflex and presence of a soft breast after feeding were also more likely to occur in the case group. There were higher odds of icterus being present at the time of presentation in the case group than the control group.

It was found that 48.44% babies had symptoms of dehydration, other than significant weight loss. Out of 64 babies (total), 35 babies had weight loss, 29 babies had symptoms of dehydration. These symptoms included fever (24.13%, 7 of 29 babies), excessive cry (41.3%, 12 of 29 babies), seizures (3.44%, 1 of 29 babies), decreased urine output, lethargy or hyperbilirubinemia (31.03%, 9 of 29 babies).

The secondary objectives were to assess median age of development of hypernatremia indicated by age of the baby at the time of presentation, which was 3.66±1.335 days (2.32 to 4.99 days). Percentage weight loss at presentation in the hypernatremic group was 11.02%. This was calculated by measuring weight of each baby at the time of symptoms of hypernatremia.

DISCUSSION

Maternal and neonatal profiling was done and baseline values were compared. On analysing breast milk sodium levels, it was found that amongst mothers with high breast milk sodium, 55.5% had babies with hypernatremia, in comparison with mothers with normal breast milk sodium, where only 20% had babies with hypernatremia. This was found to be statistically significant indicating a possible association between high breast milk sodium and hypernatremia. Mujawar NS and Jaiswal AN, described eight newborns with hypernatremia and concluded that breast milk sodium correlated strongly with neonatal hypernatremia in exclusively breastfed babies who did not otherwise have any risk factor [1]. Koklu E et al., also reported that the mean breast milk sodium in their study was higher than that of normal values [8], which was similar to present study. They reported that it may reflect a delay in maturation of colostrum into mature milk.

Uras N et al., also described a positive correlation between the serum sodium concentration and weight loss [9]. However, when patients were grouped into groups of >7% and <7% weight loss, no significant difference between symptoms and signs in these groups was found. Lavagno C et al., in their systematic review, found that hypernatremia was almost always (96% of 1485 cases) linked with >10% weight loss [10].

Neither let down reflex nor soft breast after feeding, as experienced by the mother, was associated with hypernatremia. Since the mean age of presentation of babies with hypernatremic dehydration in present study was 3.66±1.335 days (2.32 to 4.99 days) for case, and 3.03±1.307 days (1.723 to 4.337 days) in the control group, many mothers may not have experienced lactogenesis 2. Lactogenesis stage 2, the onset of sufficient milk production, occurs during the first 4 days of delivery. It is possible for the suckling infant to get a volume of <100 ml/day on the first day of life, while milk production rapidly increases to an average of 500 ml/day by the 4th day [7]. This may explain why mothers in index study did not experience a let-down reflex or soft breast after feeding.

In present study, 24 babies had icterus at the time of presentation (37.50%). Of these, 62.5% belonged to the case group and 37.5% belonged to the control group. The difference in the two groups was not statistically significant (p 0.121). Uras N et al., found in their study that the most common presenting complaint in babies with neonatal hypernatremia was jaundice, which was seen in 30 infants (48%) [9]. Panagoda R et al., in their study considered 46.4% infants to have jaundice secondary to dehydration [11]. Lavagno C et al., found jaundice to be present in 44% of babies in their systematic review of literature [10].

The median age of development of hypernatremia in the index study was 3.66±1.335 days (2.32 to 4.99 days). Sarin A et al., described the mean age of presentation to be later, i.e., 6 to 10 days of life [5]. This difference may also be attributed to non-establishment of lactogenesis 2.

In addition, it was found that clinical features of dehydration were present in almost half the babies, hence it is important to go by clinical assessment and not just weight loss in the first week of life. Mothers with high breast milk sodium were more likely to have babies with hypernatremia than mothers with normal breast milk sodium levels.

Limitation(s)

The cases were babies with weight loss/symptoms of hypernatremia and serum sodium >150 mmol/L. The control population also included babies which had either weight loss or symptoms of hypernatremia, with a normal biochemical value of sodium. Therefore, no healthy babies were included in the study. Breast milk sodium level of mothers of asymptomatic babies was not measured as baseline.

CONCLUSION(S)

Mothers with high breast milk sodium were more likely to have babies with hypernatremic dehydration. Significant weight loss was more likely to be present in the case group than the control group. Let down reflex and presence of a soft breast after feeding were also more likely to occur in the case group. There were higher odds of Icterus being present at the time of presentation in the case group than the control group.

Routine monitoring of weight of newborns in the first few days of life can pick up hypernatremia in asymptomatic babies. In the absence of weight loss, clinical features can be a significant clue for screening babies for hypernatremia. Further study of breast milk sodium in mothers of non-hypernatremic babies can throw light on correlation between high breast milk sodium and hypernatremia. Larger study (or with greater sample size) maybe needed to correlate high breast milk sodium levels and development of hypernatremia in babies.

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AUTHOR(S):

1. Neha Mohan Rao
2. Madhuri Maganthi
3. KS Lakshmi

PARTICULARS OF CONTRIBUTORS:

1. Resident, Department of Paediatrics, Bangalore Baptist Hospital, Bengaluru, Karnataka, India.
2. Head, Department of Paediatrics, Bangalore Baptist Hospital, Bengaluru, Karnataka, India.
3. Consultant, Department of Paediatrics, Bangalore Baptist Hospital, Bengaluru, Karnataka, India.

NAME, ADDRESS, E-MAIL ID OF THE CORRESPONDING AUTHOR:

Dr. Neha Mohan Rao,
588 7th main 17th cross Indiranagar, 2nd stage, Bangalore-560038, Karnataka, India.
E-mail: neharao89@gmail.com

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