

Original article:

Management Strategies to prevent Hypernatremic Dehydration in Exclusively Breastfed Neonates

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Abstract

Objective: A study was undertaken to assess the incidence of hypernatremic dehydration(HD) in exclusively breast fed neonates(EBFN) and to reduce its incidence by implementing an early interventional protocol

Methods: From Jan 2009 to Dec 2010, HD cases were identified. In Dec 2010 a 5 step interventional protocol educating parents and medical staff was established. It included antenatal breast feeding counselling, proper feeding techniques, identifying early signs of underfeeding in babies such as more than 10 % weight loss, less than 6 – 7 times urine and stool frequency from day 5 of birth and then introducing formula feeds for these babies and starting galactogogues for mother. Then the numbers of HD cases after this protocol implemented were noted till June 2012.

Results: We had total 14 EBFN admitted for HD, prior to protocol implementation and only two cases since then.

Conclusion: Our study strongly suggests that incidence of HD cases can be significantly reduced by this protocol.

Key words : Neonate, Exclusive breastfeeding, Hypernatremia, Dehydration, Hospital readmissions

Introduction

Dehydration is classified on the serum osmolality which is linked to serum sodium levels.(1) Hypernatremic dehydration is a type of hypertonic dehydration associated with serious complications as intracranial haemorrhage (2), venous thrombosis, gangrene(3) (4) seizures, developmental delay(5) and also high mortality (4)

It was believed to be rare in breastfed babies, but lately there have been several reports of the same in literature. (6, 7, 8, 9, 10, 11). One study reported an incidence of 2.5 per 10,000 live births. (12)

In a recent prospective 6 months study, babies were weighed daily from birth to discharge. Of 686 babies, 53 had weight loss of >10% and 19 had a high serum sodium levels.(150-160 mmol/L) (13). Another retrospective study of 51,383 newborns > 36 weeks gestation during 1995-1996 showed a

readmission of 110 infants with >12% weight loss or a serum sodium level > 150 nmol/L (11) . In Indian population, not much data available except a case report of 15 day old infant who had ARF with hypernatremia due to inadequate breast feeding. (14)

Materials and methods

We are a 244 bed tertiary care hospital situated in the suburbs of Mumbai city. The hospital averaged 58 deliveries per month during our study period from January 2009 to June 2012. Full term, exclusively breastfed babies less than 29 days old admitted for HD in our Neonatal Intensive Care Unit (NICU) were identified through the medical records department. HD was considered if a neonate was admitted in NICU with a weight loss of more than 15 %, serum sodium in excess of 150 meq/L and needing intravenous fluid correction.

Due to increased number of these cases, following 5-step interventional protocol aimed at preventing the occurrence of such dehydrations were established in December 2010 targeting medical staff and parents-

1. Antenatal education and examination of mother's breast and providing solutions for any problems, which would prevent successful latching of the baby

2. To confirm that baby is able to latch well and suck well from day-1 of neonatal life post delivery; to use 'syringe technique' or 'nipple shield' in case of flat / inverted nipple

3. To check the weight of the baby at the time of discharge (3 – 4 days average from birth) and calculate the percentage weight loss; early follow-up being advised for babies with > 10% weight loss

4. To provide verbal and written information to parents regarding frequency of urine and stool; they were advised to report back by day 5 - 6 of neonatal life, if –

a. Urine was dark yellow in colour and frequency was less than 6 to 7 times per 24 hours or

b. Orange stains on nappies even on day 5 – 6 of life or

c. Stool frequency was less than 4- 5 times in 24 hours

5. If these parents reported early or weight loss was more than 10 percent, then early intervention was done –

a. Babies were started on formula feeds

b. Lactation counselling along with galactogogues was started for the mother

Results

From January 2009 to June 2012, there were 16 recorded cases of diagnosed hypernatremic dehydration from 2410 total deliveries. All these

neonates were readmitted from day 4 to day 12 of life with history of irritable cry (14/16), yellowness of skin (10/16), reduced milk output in mother (12/16) and reduced urine and stool passage with presence of orange stain on diapers (11/16)

The percentage of weight loss in neonates was reported between 16 - 27% whereas serum sodium values ranged from 152 meq/L -188 meq/L (normal range 135 – 145 meq/L). The potassium values were within normal range. The breast-milk sodium was also recorded and they ranged from 37 meq/L to 111 meq/L. (TABLE 1)

Once the intervention protocol was established in December 2010, the cases significantly reduced to two cases from January 2011 to June 2012. (TABLE 2)

Incidental findings during the analysis of the data were:

a) There is a definitive relationship between recent weight loss of dehydrated neonates and their sodium values

(TABLE 3)

b) There was no correlation found between the day of presentation and the sodium levels in the babies (Pearson correlation of sodium value and age in days = 0.299, p value = 0.260 .

Pearson coefficient shows there is little correlation between sodium value and day of life of admission from birth. The coefficient value < 0.5 shows little correlation)

c) There is no correlation between the sodium values in the babies at presentation and their mother's breast-milk sodium levels

(Pearson correlation of sodium value and breast milk sodium = -0.210 , p value = 0.434.

Pearson coefficient shows there is little negative correlation between sodium value and B. milk sodium. The bigger p value shows very less significance for little negative correlation.)

d) There is a definitive correlation between the mother's breast-milk sodium levels and lactation failure in them

Discussion

Universally breast feeding is the safest and wholesome for newborn. (15) It is known to reduce the incidence of infections in body (16, 17, 18), Sudden infant death syndrome (19) Insulin dependent diabetes mellitus (20) Cancer (21 and allergic diseases (22).

All babies have a physiological weight loss of 6-10% in 1st 3-7 days after birth, (23, 24, 25, 26) regaining birth weight by 8-10 days of life. (27). This regain of birth weight is linked to successful lactation in mother.

There is reduced breast milk production when the breast-milk is not expressed effectively due to inappropriate latching by the neonate as in cases of cleft lip or palate, macroglossia, ankyloglossia (28) and maternal factors such as flat or inverted nipples. It's not restricted to primiparous mothers only. (29) Also a less active sleepy baby may not drain the breasts effectively leading to reduced milk production. (30)

HD in breastfed babies is due to intake of low water in breast milk and is associated with unusually high breast milk sodium(5). This is associated with secondary lactation failure in mother (31). Normal sodium concentration of colostrum for 1st 5 days- 22 +_ 12 mmol/L, transitional milk from day-5 to 10 is 13+ _ 3 mmol/L and mature milk after day-15 is 7+_ 2 mmol/L.(32) A normal drop in breast-milk sodium levels, 2 - 4 days post-delivery, is highly predictive of a successful lactation.(33).In our study all the mothers breast milk sodium was very high on day 5-10, (Table 1) when its supposed to be have dropped. Maternal sodium intake does not affect postprandial sodium concentrations in human milk. (34)

Treatment of these babies with very high sodium blood levels is crucial, as sodium levels need to reduce gradually, otherwise leading to cerebral oedema and convulsions.

As an incidental finding, we observed a co-relation between percentage of weight loss in neonates and the sodium value on readmission,(Table 3) clinical implication being that if a newborn comes in 1st 10 days of life dehydrated then these babies to be given higher sodium containing fluids intravenous even if serum electrolytes test not possible.

Recently there has been increased awareness amongst mothers to exclusively breastfeed their babies. Breast-feeding is encouraged because of obvious advantages; with breast-feeding malnutrition and HD in EBFN as the only disadvantage. Studies have shown that now there is an increasing awareness to implement changes to prevent these problems (35)(36). Certain protocols have also been made for same. (37) One case report of successful lactation following HD was found in literature (38)

However, there is no study in literature, which has shown a successful implementation of a protocol to reduce these cases. By implementing the 5-step protocol, we trained nursing staff and doctors who were involved in the mother and neonatal care. They were trained to identify and prevent the problems which would prevent the baby from successfully breastfeed after birth and watch out for early signs of babies getting reduced breast milk. These babies would then get the required early care. The successful implementation of this protocol is bore by the fact that, though the number of deliveries over the years increased in our hospital, these readmissions owing to HD have significantly reduced. Most of the mothers had a successful breast-feeding relation with their babies. Few of them were started on galactogogues by day 3 of delivery. If this did not increase the breast-

milk, then their neonates were started on formula feeds.

This study shows how the HD cases in newborns due to inadequate breast-milk can be prevented. But we could not completely avoid the secondary lactation failure in the mothers of these neonates, hence it will be worthwhile devising a way by which even secondary lactation failure can be prevented, and all mothers can exclusively breastfeed their babies until the recommended period.

Conclusion

Hence, if all the medical staff, who deals with mother and childcare, can devise their own protocols, based on the one, which we followed, the incidences of HD would reduce significantly.

Early signs of getting reduced breast milk such as weight loss more than 10%, reduced urine and stool frequency and presence of urate crystals on diaper should be the red signals, which would warrant an early follow-up by parents with their paediatrician.

Limitations of study

Babies were not followed up to see whether they needed formula feeds in long run - not documented.

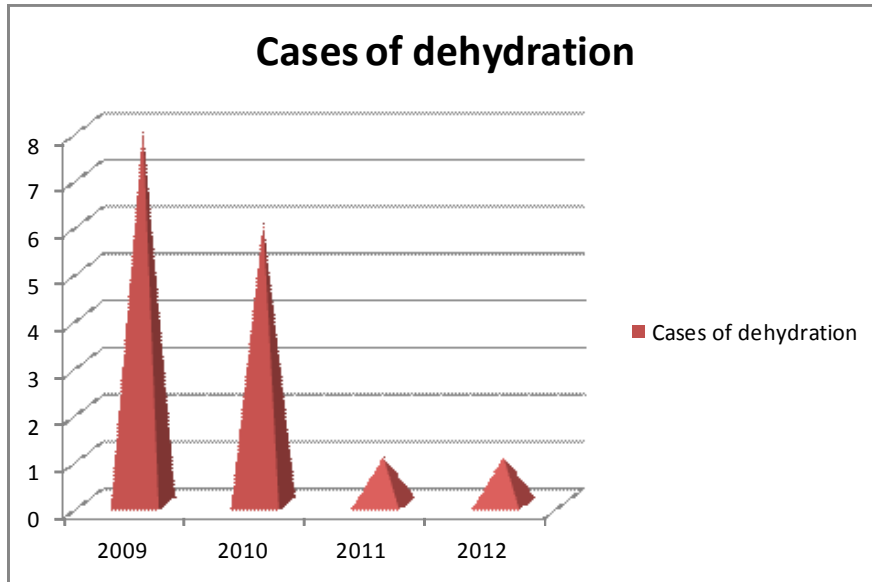
TABLE 1 :BREAST MILK SODIUM OVER YEARS

Year	Mean B. milk sodium
2009	83.29
2010	81.4
2011	73
2012	37

TABLE 2 : REDUCTION IN ADMISSION

Year	Cases of dehydration	Total Deliveries
2009	8	614
2010	6	648
2011	1	705
2012	1	443

GRAPH: 1 REDUCTION IN CASES OF DEHYDRATION



Conducted Two proportion test with the null hypothesis “the % of admissions before consultation is equal to admissions after consultation.”

Test and CI for Two Proportions

Sample X N Sample p

1 14 1262 0.011094

2 2 1148 0.001742

Difference = p (1) - p (2)

Estimate for difference: 0.00935134

95% CI for difference: (0.00308932, 0.0156134)

Test for difference = 0

(vs not = 0): Z = 2.93

P-Value = 0.003

Fisher's exact test:

P-Value = 0.005

P-value <0.05 shows that Group makes a significant difference in admission at 95% confidence level.

This shows that null hypothesis is rejected at 95% confidence level.

This means there is a significant difference in admissions before and after consultation

TABLE 3 : Correlations: sodium value, % weight loss

General Regression Analysis: sodium value versus % weight loss

Regression Equation

$$\text{sodium value} = 134.342 + 1.68054 \% \text{ weight loss}$$

Coefficients

Term	Coef	SE coef	T	P
constant	134.342	10.1849	13.1902	0.000
% Weight loss	1.681	0.5183	3.2423	0.005

Summary of Model

$$S = 10.2221 \quad R\text{-Sq} = 41.20\% \quad R\text{-Sq}(\text{adj}) = 37.29\%$$

Low p value shows that the regression is significant

Pearson correlation of sodium value and % weight loss = 0.642

P-Value = 0.005

$$\% \text{ weight loss} \quad 1.681 \quad 0.5183 \quad 3.2423 \quad \mathbf{0.005}$$

Summary of Model

$$S = 10.2221 \quad R\text{-Sq} = 41.20\% \quad R\text{-Sq}(\text{adj}) = 37.29\%$$

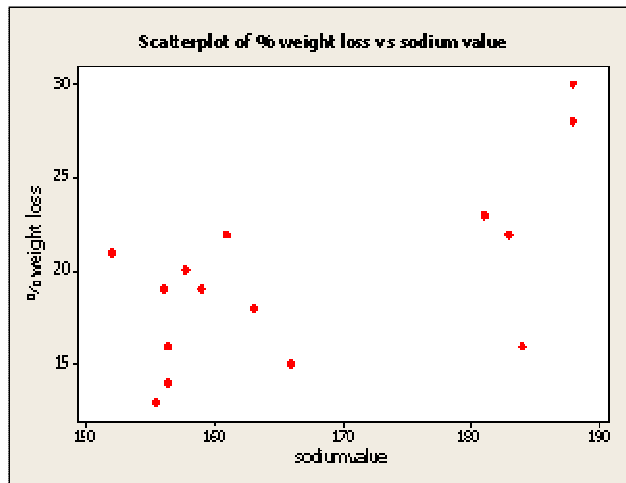
Low p value shows that the regression is significant

R-Sq =41.20, which means about 41.20% variation in percentage weight loss can be explained by sodium values at the time of admission

Pearson coefficient shows there is moderate linear correlation between sodium value and percentage weight loss.

The coefficient lies between +1 and -1 with +1 as perfect positive correlation.

Scatter plot is attached for the confirmation of above conclusion.



Abbreviations

HD- Hypernatremic Dehydration

EBFN- Exclusively Breast Fed Neonates

NICU- Neonatal Intensive Care Unit

References

1. Conley SB. Hypernatremia. *Pediatric Clinic North America* 1990; 37: 365-372
2. Korkmaz A, Yigit S, Firat M, Oran O. Cranial MRI in neonatal Hypernatremic dehydration. *Pediatr Radiol* 2000; 30:323-5
3. Roddy OF, Martin Es, Sweetenburg RL. Critical weight loss and Malnutrition in breast fed infants. *Am J Dis Child* 1981 ; 135: 597-9
4. Kaplan JA, Siegler RW, Schhunk GA. Fatal hypernatremic dehydration in exclusively breastfed newborn infants due to maternal lactation failure. *Am J Forensic Med Pathol* 1998; 19: 19-22
5. Peters JM: Hypernatremia in breast fed infants due to elevated breast milk sodium. *J am Osteopath assoc* 1989; 89: 1165-1170
6. Sofer S, Ben-Ezer D, Dagan R (1993). Early severe dehydration in young breastfed newborn infants. *Isr J Med Sci*, 29: 85-9.
7. Smith RG (1998). Severe Hypernatremic dehydration in a newborn infant. *Pediatr Child Health*, 3: 413-15
8. Pascale JA, Brittan L, Lenfestey CC, Jarrett-Pulliam C (1996). Breastfeeding, dehydration, and shorter maternity stays. *Neonatal Netw*, 15: 37-43.
9. Paul AC, ranjini K, Muthulakshmi RA, Kirubakaran C (2000). Malnutrition and hypernatremia in breastfed babies. *Ann Trop Paediatr*, 20: 179-83.
10. Harding D, Cairns P, Gupta S, Cowan F (2001). Hypernatremia: why bother weighing breast fed babies? *Arch Dis Child fetal Neonatal Ed*, 85: F145.
11. Escobar GJ, Gonzales VM, Armstrong MA, Folck BF, Xiong B, Newman T (2002). Rehospitalization for neonatal dehydration: a nested case control study. *Arch pediatr Adolesc Med*, 156: 155-61.

12. Cooper WO, Atherton HD, Kahana m Kotagal UR. Increased incidence of severe breast feeding malnutrition and hypernatremia in a metropolitan area. *Pediatrics* 1995;96(5) :957-60
13. Manganaro R, Mami C, Marrone T, Marseglia L (2001). Incidence of dehydration and hypernatremia in exclusively breastfed infants. *J Pediatr*, 139:673-5.
14. Swarna Rekha Bhat, P. Lewis, C. Dinakar Hypernatremic dehydration in a neonate- case report *Indian Pediatrics* 2001; 38:1174-1177
15. Breastfeeding and use of human milk ,Work group on breast feeding. American Academy of pediatrics (2012). *Pediatrics* 129: Number 3 March 2012.
16. Beaudry M, Dufour R, Marcoux S (1995). Relation between infant feeding and infections during 1st 6 months of life. *J Pediatr*, 126: 191-7.
17. Cochi SL, Fleming DW, Hightower AW (1986). Primary invasive *Haemophilus influenzae* type b disease: a population based assessment of risk factors. *J pediatr*, 108:887-96
18. Convert RF, Barman N, Domanico R (1995). Prior enteral nutrition with human milk protects against intestinal perforation in infants who develop necrotizing enterocolitis. *Pediatr Res*, 37:305A
19. Ford RPK, Taylor BJ, Mitchell EA (1993). Breastfeeding and risk of sudden infant death syndrome. *Int J Epidemiol*, 22:885-90.
20. Gerstein HC (1994). Cows milk exposure and type I diabetes mellitus. A critical overview of clinical literature. *Diabetes care*, 17:13-9.
21. Shu X-O, Clemens J, Zheng W (1995). Infant breastfeeding and risk of childhood leukemia and lymphoma. *Int J epidemiol*, 24:27-32
22. Saari UM, Kajosaari M (1995). Breastfeeding as prophylaxis against atopic disease: prospective follow up study until 17 years old. *Lancet*, 346:1065-69.
23. Maisels MJ, Gifford K (1983). Breastfeeding, weight loss and jaundice. *J Pediatr*, 102:117-8.
24. Maisels MJ, Gifford K, Antle CE, Leib GR (1988). Jaundice in the healthy newborn infant: a new approach to an old problem. *pediatrics*, 81:505-11
25. Marchini G, Stock S (1997). Thirst and vasopressin secretion counteract dehydration in newborn infants. *J pediatr*, 130:736-9.
26. Maisels MJ, Gifford K, Breast feeding, weight loss and jaundice. *J Pediatr* 1983; 102: 117-118
27. Robillard JE, Weismann DN, Herin P (1981). Glomerular filtration rate in prenatal lambs. *Pediatr Res*, 15:1248-55
28. Fleiss PM, Burger M, Ramkumar H, Carrington P ankyloglossia: A cause of breast feeding problems?
29. Sofer S, Ben-Ezer D, Dagan R. Isr Early Severe dehydration in young breast fed newborn infants. *J Med Sci*. 1993 Feb-Mar; 29(2-3) 85-9
30. Conley SB Hypernatremia. *Pediatr Clin North Am* 1990 ; 37:365-372
31. Verity H Livingstone, Claire E Willis, Laila O. Abdel Wareth, Paul Thiessen, Gillian Lockitch. Neonatal Hypernatremic dehydration associated with breast feeding malnutrition: a retrospective survey
32. Macy IG. Composition of Human colostrum and Milk. *Am J Dis Child* 1949; 78:589-603
33. Morton JA The clinical usefulness of breast milk sodium in assessment of lactogenesis. *Pediatrics* 1994 ; 4 (5) :802-4

34. Eremam RR, Lonnerdal B, Dewey KG. Maternal sodium intake does not affect postprandial sodium concentrations in human milk. *J Nutr* 1987; 117:1154-7
35. Neifert MR. Prevention of breastfeeding tragedies. *Pediatr Clin North Am* 2001 Apr; 48(2):273-97
36. Chilton LA. Prevention and management of hypernatremic dehydration in breastfed infants. *West J med* 1995; 163:74-76
37. Newman J. Decision tree and Post partum management for preventing dehydration in breast fed baby. *J Hum Lact*. 1996 June 12(2) 129-35
38. Thullen JD. Management of hypernatremic dehydration due to insufficient lactation. *Clin Pediatr (Phila)* 1988 Aug; 27(8) 370-2