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Hypernatremic Dehydration in Neonates

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ABSTRACT

Hypernatremic Dehydration in neonates is one of the commonest causes of admission and mortality particularly in developing countries like India. Life threatening complications including acute kidney injury (AKI), brain shrinkage, subdural capillary hemorrhage, intracranial hemorrhage and cerebral edema, venous thrombosis, gangrene and death. The aim of our study was to determine the clinical presentation, various risk factors associated with hypernatremic dehydration and outcomes. Retrospective descriptive study. The study was conducted in Department of Pediatrics, MGM Medical college and associated Chacha Nehru Balchikitsalaya and Maharaja Yashwant Rao hospital a tertiary care hospital over a period of 1 year (January 2019-2020). About 52 babies who fulfill inclusion and exclusion criteria for Hypernatremic Dehydration were enrolled. Variables recorded were risk factor for dehydration, types of feed, investigation and follow up till final outcome.: Out of 52 neonates 31(59.6%) were male and 21(40.4%) female. About 37(71.2%) were spontaneous vaginal delivered and 15(28.8%) via caesarean section. About 41(78.8%) were primiparous mothers and 11(21.2%) multiparous mothers. Mean birth weight was 2.73 kg vs Mean weight at admission was 2.22 kg, mean percentage weight loss was 18.7%. 17(32.7%) neonates were breast feed,21(40.4%) on animal milk and 14(26.9%) on mixed feeds. Decrease urine output was present in 30(57.7%) neonates followed by Diarrhea and vomiting 28(53.85%), Irritability 18(34.6%), poor feeding/lethargic 12 (23.1%) and yellowish discoloration of skin 12(23.1%). Maximum number of cases were admitted in month of May 18(34.6%) followed by April 9 (17.3%) and June 6 (11.53%). Serum creatinine values were raised in 49 babies. Mean admission values of sodium and creatinine in discharged cases were 162.923 mEq L^{-1} and 1.896 mg dL^{-1}, respectively and in babies who died they were 162.371 mEq L^{-1} and 3.4 mg dL^{-1} which was statistically significant. Mean duration of treatment was 7.50 days, 38(73.1%) neonates were discharged successfully, while in 14(26.9%) neonates who died animal milk feeding was the statistically significant risk factor responsible for poor outcome when compared with breast fed neonates. Hypernatremic dehydration with AKI was more common during season of high ambient temperature and in babies receiving animal milk feeds. Despite of correction in serum sodium, babies with persistent high creatinine values had a poor outcome. Exclusive breast feeding and taking care of ambient temperature can help in prevention of hypernatremic dehydration.

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Key Words

Hypernatremic dehydration, acute kidney injury, animal milk feeding, ambient temperature

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INTRODUCTION

Dehydration in neonates is one of the commonest causes of admission and even mortality due to its complications in neonatal intensive care unit, particularly in developing countries like India[1-2].

Depending upon the serum osmolality neonatal dehydration is classified as: Hyponatremic, normonatremic and hypernatremic dehydration. Hypernatremic dehydration (HND), defined as serum sodium concentration > 145 mmol L^{-1} (mEq L)$^{-1}$[3,4].

Hypernatremic dehydration if not treated immediately and adequately, becomes potentially lethal condition for neonates.

It may cause life threatening complications including acute kidney injury (AKI), brain shrinkage, subdural capillary hemorrhage,

intracranial hemorrhage and cerebral edema, venous thrombosis, gangrene and death[5-7].

Hypernatremic dehydration in neonates can occur due to inadequate breast feeding, consumption of animal milk with high sodium, trans-epidermal water loss or a combination of these[3,4,8,9].

Normally newborn lose as much as 7% of their birth weight on the first week of post natal life through normal diuresis and insensible water loss. Then after neonates should start gaining weight and regain their birth weight by the 10th day of their life[10].

Any weight loss >7% of birth weight is a cause for concern. The first signs of neonatal dehydration include the failure to have bowel movements or the presence of urate crystals, combined with weight loss[11].

The aim of our study was to determine the clinical presentation and various risk factors associated with hypernatremic dehydration and its outcomes.

MATERIALS AND METHODS

Type of study: Retrospective descriptive study.

Period: January 2018 to January 2019.

Cases: Neonates with hyperthermia and/or dehydration fulfilling following inclusion criteria:

- Babies with serum Na >145 mEq L^{-1}
- Euglycemia
- Normocalcemic
- No clinical and lab evidence of sepsis
- Term babies

Exclusion criteria:

- Neonates not satisfying above mentioned criterion
- Neonates who did not stay for full duration of medical treatment

Case records of 58 neonates who presented with hyperthermia and/or dehydration were reviewed. Six cases were excluded based on exclusion criteria. Investigations, management and outcomes of 52 babies were analyzed. Babies were clinically evaluated (with special note of type of feeding), investigated and managed as per the unit protocol. Serum sodium and creatinine levels at the time of admission and at final outcome were noted. Outcomes were measured as discharged or death and were correlated with degree of hypernatremia and deranged creatinine values. Statistical analysis was done using paired 't' test.

RESULTS

Important admission and outcome characteristics are shown in Table 1. Out of 52 neonates 31(59.6%) were male and 21(40.4%) were female. About 37(71.2%) were spontaneous vaginal delivered and 15(28.8%) were via caesarean section. About 41(78.8%) were primiparous mothers and 11(21.2%) were multiparous mothers. Mean birth weight was 2.73 kg and mean weight at admission was 2.22 kg, mean percentage weight loss was 18.7 % which is more then normal weight loss. About 17(32.7%) neonates were breast fed, 21(40.4%) were on animal milk and 14(26.9%) were on mixed feeds. Decrease urine output was present in 30(57.7%) neonates followed by Diarrhea and vomiting 28(53.85%), irritability 18(34.6%), poor feeding/lethargic 12 (23.1%) and yellowish discoloration of skin 12 (23.1%). As shown in Fig. 1, maximum number of cases were admitted in month of May 18(34.6%) followed by April 9 (17.3%) and June 6 (11.53%). These are the months when the environmental temperatures reach to very high levels. Serum creatinine values were raised in 49 babies. Mean admission values of sodium and creatinine in discharged cases were 162.923 mEq L^{-1} and 1.896 mg dL^{-1}, respectively and in babies who died they were 162.371 mEq L^{-1} and 3.4 mg dL^{-1}. The difference between admission values of creatinine between discharged and death cases was statistically significant. The differences between serum sodium and creatinine values at the time of admission and discharge were statistically significant in babies who survived ($p = 0.00$ for each), while in death cases only change in serum sodium from admission to time of death was statistically significant ($p = 0.001$) but that of serum creatinine was not ($p = 0.546$). It indicates that despite of correction of serum sodium, persistent elevation of creatinine (a marker of AKI) was present in cases that died, implying it to be a poor prognostic factor for outcome.

Mean duration of treatment was 7.50 days, 38(73.1%) neonates were discharged successfully, while in 14(26.9%) neonates that died animal milk feeding 10(71.4%) was statistically significant risk factor responsible for poor outcome and statistically when compared with breast fed neonates ($p = 0.001$).

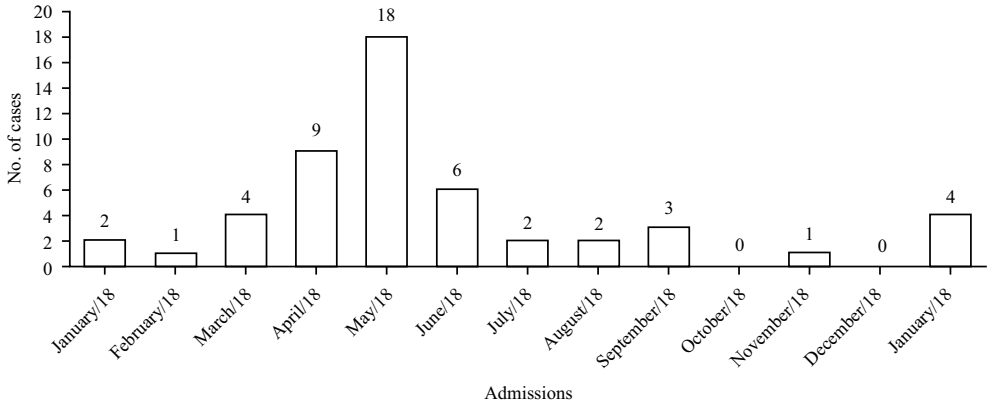

Fig. 1: Month wise distribution of cases

Table 1: Admission and outcome characteristics of cases

Total cases	52
Age at presentation	6.5 (3-16)
Sex	
Male (%)	31 (59.6%)
Female (%)	21 (40.4%)
Primiparous mothers (No., %)	41 (78.8%)
Types of delivery	
Spontaneous vaginal delivery	37(71.2%)
Caesarean section	15(28.8%)
Mean birth weight (kg)	2.73
Mean weight at admission (kg)	2.22
Mean percentage of weight loss	18.7
Type of feeds	
Exclusive breast feeding	17 (32.7%)
Animal milk feeding	21 (40.4%)
Mixed feeding:	14 (26.9%)
Clinical presentation	
Lethargic/poor feeding	12 (23.1%)
Diarrhea, vomiting	28 (53.85%)
Irritability	18 (34.6%)
Decrease urine output	30 (57.7%)
Yellowish discoloration of skin	12 (23.1%)
Sodium level (mEq L^{-1}) at admission	Mean-162.775 (range 147.5-188)
Creatinine level (mEq L^{-1}) at admission	Mean-2.301 (range 0.4-6.85)
Number of cases with raised serum creatinine	49 (94.2%)
Mean duration of stay (days)	7.50
Final outcome	
Discharge	38 (73.1%)
Death	14 (26.9%)
No. of deaths in various feeding groups	
Exclusive breast feeding	01
Animal milk feeding	10
Mixed feeding	3
Mean admission values of sodium and creatinine in discharged cases	162.923 mEq L^{-1} and 1.86 mg dL^{-1}
Mean admission value of sodium and creatinine in death cases (difference in creatinine values significant)	162.371 mEq L^{-1} and 3.4 mg dL^{-1}

DISCUSSIONS

In present study 6.5 days (3-16) was the mean age of presentation of neonates with hypernatremic dehydration, results were comparable with Lavagno *et al*.. Out of 52 neonates males 31 (59.6%) were affected more than female 21 (40.4%). In our study 37 (71.2%) were spontaneous vaginal delivered and 15 (28.8%) were via caesarean section.

Lavango found that cesarean delivery, primiparity, breast anomalies or breastfeeding problems, excessive pre-pregnancy maternal weight, delayed first breastfeeding and no prior breastfeeding experience are the maternal risk factors responsible for Neonatal Hypernatremic Dehydration[13]. Our study also suggested that babies of primiparous mothers 41 (78.8%) were at an increased risk of developing hypernatremic dehydration than multiparous 11 (21.2%), Mujawar stated that this may be because of ineffective galactopoiesis in primiparous mothers, infrequent suckling by the baby and infrequent stimulation. Ineffective feeding such as poor breast-feeding techniques, incorrect positioning and latching and lack of education about breast-feeding. This can sometimes be compounded by flat nipple, sore nipple and so on that interfere with breast-feeding[4].

Mean birth weight was 2.73 kg and mean weight at admission was 2.22 kg. Mean percentage of weight loss was 18.7% which is more than the normal weight loss similar results were found in previous study[14]. In such situation cause of weight loss should be evaluated Hypernatremia is commonly associated with excessive weight loss, hyperbilirubinemia and hypoglycemia[15,16].

Neonates with animal milk consumption 21(40.4%) were more prone for development of hypernatremic dehydration followed by breast fed infants 17(32.7%) than mixed feed 14(26.9%). Oddie *et al*.[16] found that Hypernatremic Dehydration was considered to occur in those babies who were fed with artificial feeds, powdered milk with high sodium concentration, especially when the mother failed to add enough water in the mixture[17].

Maximum number of cases were enrolled in the month of May 18(34.6%) followed by April 9(17.3%) and June 6(11.53%). These are the months when the environmental temperatures reach to very high levels.

Serum creatinine values were raised in 49 babies a marker of acute kidney injury. Decreased urine output 30(57.7%) was the most common clinical presentation in our study. Acute kidney injury (AKI) has been the most common complication of hypernatremic dehydration. Thus, decreased urine output can be a reliable clue that can be used for early identification of hypernatremic dehydration[4,18].

Diarrhea and vomiting 28(53.85%), irritability 18(34.6%), poor feeding/lethargic 12(23.1%) and yellowish discoloration of skin 12(23.1%) were the other reported clinical presentation, similar results were found in previous studies. Infants who develop hypernatremic dehydration will show signs of poor feeding including frequent, continuous and even high-pitched crying, frequent feeding (less than every 2 hr), consistently prolonged feedings (30-60 min per feed), poor skin turgor, delayed capillary refill, jaundice, low to absent wet diapers, “red brick dust” or pink urate crystals in diapers, >5% weight loss, easy fatigability during feeds, fever and irritability[13,19]. Neonatal hyperbilirubinemia treated with phototherapy further adds to the dehydration because of increased insensible water loss creating a vicious cycle.

Mean admission values of sodium and creatinine in discharged cases were 162.923 mEq L^{-1} and 1.896 mg dL^{-1}, respectively and in babies who died they were 162.371 mEq L^{-1} and 3.4 mg dL^{-1}.

The mean sodium was also around 160 mg L^{-1} in the series by Oddie in Great Britain and Trotman in Jamaica[20,21]. A sodium value above 160 mmol L^{-1} is recognized as a risk factor for complications and death[22,23]. Despite of correction of serum sodium, persistent elevation of creatinine (a marker of AKI) was present in cases that died, implying it to be a poor prognostic factor for outcome[22].

CONCLUSION

Hypernatremic dehydration with AKI was more common during season of high ambient temperature and in babies receiving animal milk feeds. Despite of correction in serum sodium, babies with persistent high creatinine values had a poor outcome. Exclusive breast feeding and taking care of ambient temperature can help in prevention of hypernatremic dehydration.

REFERENCES

1. Escobar, G.J., V.M. Gonzales, M.A. Armstrong, B.F. Folck, B. Xiong and T.B. Newman, 2002. Rehospitalization for neonatal dehydration. Arch. Pediatr. Adolesc. Med., 156: 155-0.
2. Ballot, D.E., V.A. Davies, P.A. Cooper, T. Chirwa, A. Argent and M. Mer, 2016. Retrospective cross-sectional review of survival rates in critically ill children admitted to a combined paediatric/neonatal intensive care unit in Johannesburg, South Africa, 2013-2015. BMJ Open, Vol. 6. 10.1136/bmjopen-2015-010850.
3. Späth, C., E.S. Sjöström, F. Ahlsson, J. Ågren and M. Domellöf, 2016. Sodium supply influences plasma sodium concentration and the risks of hyper- and hyponatremia in extremely preterm infants. Pediatr. Res., 81: 455-460.
4. Mujawar, N.S. and A.N. Jaiswal, 2017. Hypernatremia in the neonate: Neonatal hypernatremia and hypernatremic dehydration in neonates receiving exclusive breastfeeding. Indian J. Crit. Care Med., 21: 30-33.
5. Kaplan, J.A., R.W. Siegler and G.A. Schmunk, 1998. Fatal hypernatremic dehydration in exclusively breast-fed newborn infants due to maternal lactation failure. The Am. J. Forensic Med. Pathol., 19: 19-22.

   Moritz, M.L. and J.C. Ayus, 2005. Preventing neurological complications from dysnatremias in children. Pediatr. Nephrol., 20: 1687-1700.
6. Dogra, S., S.K. Agrawal, R. Jindal, D. Suri, J. Ahluwalia and S. Singh, 2011. Peripheral gangrene in a breast fed neonate-is hypernatremic dehydration the cause? The Indian J. Pediatr., 78: 1543-1545.
7. Peters, J.M., 1989. Hypernatremia in breast-fed infants due to elevated breast milk sodium. J. Am. Osteopath Assoc., 89: 1165-1170.
8. Bhave, G. and E.G. Neilson, 2011. Body fluid dynamics. J. Am. Soc. Nephrol., 22: 2166-2181.
9. Eidelman, A.I., R.J. Schanler, M. Johnston, S. Landers, L. Noble, K. Szucs and L. Viehmann, 2012. Breastfeeding and the use of human milk. Pediatrics, 129: e827-e841.

10. Livingstone, V.H., 1990. Problem-solving formula for failure to thrive in breast-fed infants. Can Fam Physician., 36: 1541-1545
11. Das, J.C., 2015. Hypernatremic dehydration in newborn infants: A review. Ulutas Med. J., 1: 22-25.
12. Lavagno, C., P. Camozzi, S. Renzi, S.A.G. Lava, G.D. Simonetti, M.G. Bianchetti and G.P. Milani, 2015. Breastfeeding-associated hypernatremia. J. Hum. Lactation, 32: 67-74.
13. Flaherman, V.J., E.W. Schaefer, M.W. Kuzniewicz, S.X. Li, E.M. Walsh and I.M. Paul, 2015. Early weight loss nomograms for exclusively breastfed newborns. Pediatrics, 135: e16-e23.
14. Tarcan, A., F. Tiker, N.S. Vatandas, A. Haberal and B. Gurakan, 2005. Weight loss and hypernatremia in breast-fed babies: Frequency in neonates with non-hemolytic jaundice. J. Paediatr. Child Health, 41: 484-487.
15. Yaseen, H., M. Salem and M. Darwich, 2004. Clinical presentation of hypernatremic dehydration in exclusively breast-fed neonates. The Indian J. Pediatr., 71: 1059-1062.
16. Oddie, S., S Richmond and M Coulthard, 2001. Hypernatraemic dehydration and breast feeding: A population study. Arch. Dis. Childhood, 85: 318-320.
17. Unal, S., E. Arhan, N. Kara, N. Uncu and D. Aliefendioğlu, 2008. Breast-feeding-associated hypernatremia: Retrospective analysis of 169 term newborns.
18. Caglar, M.K., I. Ozer and F.S. Altugan, 2006. Risk factors for excess weight loss and hypernatremia in exclusively breast-fed infants. Braz. J. Med. Biol. Res. Rev., 39: 536-544.
19. Oddie, S.J., V. Craven, K. Deakin, J. Westman and A. Scally, 2013. Severe neonatal hypernatraemia: A population based study. Arch. Dis. Childhood Fetal Neonatal Edition, 98: F384-F387.
20. Trotman, H., C. Lord, M. Barton and M. Antoine, 2004. Hypernatraemic dehydration in Jamaican breastfed neonates: A 12-year review in a baby-friendly hospital. Ann. Trop. Paediatrics, 24: 295-300.
21. Bolat, F., M.B. Oflaz, A.S. Güven, G. Özdemir and D. Alaygut *et al*., 2013. What is the safe approach for neonatal hypernatremic dehydration? Pediatr. Emergency Care, 29: 808-813.
22. Hsairi, M., H.B. Hamouda, B. Mahjoub, A. Bedoui and Y. Belkhir *et al*., 2006. Déshydratation hypernatrémique et allaitement maternel. J. Pédiatrie Puériculture, 19: 265-267.