



HYPERNATREMIC DEHYDRATION IN TERM NEONATES IN NEONATAL PERIOD

Pediatrics

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ABSTRACT

Objective: To assess the problem of hypernatremic dehydration in healthy exclusively breastfed term neonates in neonatal period.

Methods: Hospital based prospective study on neonates (≥ 37 week gestation and > 2 kg birth weight) admitted with dehydration ($> 10\%$ weight loss after birth and signs/symptoms of dehydration) and had hypernatremia (serum sodium > 145 mEq/L at admission) in the NICU of Balchikitsalaya, MBGH, RNT Medical college, Udaipur, Rajasthan, India over a period of 12 months from July 2015 to June 2016. Sick neonates with sepsis, birth asphyxia and congenital anomalies were excluded. Informed consent was taken. Ethical clearance for the study was taken.

Results: A total of 218 neonates with hypernatremic dehydration were enrolled. Most of the neonates 188 (86.23%) with dehydration were admitted between Day 3 to 7 after birth. Mean weight loss % after birth in neonates with hypernatremic dehydration was 15.08%. Most neonates presented with excessive cry 161 (73.8%), fever 151 (69.3%) and jaundice 122 (55.9%). Mean (SD) Sodium levels in these hypernatremic neonates was 161.44 (7.95) mEq/L.

23 (10.55%) neonates had hyperkalemia. All 218 (100%) babies had high blood urea levels and 178 (81.6%) had high creatinine levels. All 218 (100%) neonates were hyperosmolar and had metabolic acidosis at admission. 216 babies were successfully discharged and 2 babies expired during hospital stay.

Conclusion: Hypernatremic dehydration in healthy term neonates is often seen. Hypernatremic dehydration should be suspected in all the neonates with some problem in breast feeding (improper positioning, poor attachment, absent let down reflex, fissured/retracted nipples etc) to prevent neonates from its fatal complications.

KEYWORDS:

Hypernatremic dehydration; Breastfeeding; follow up

Introduction

Neonatal Hypernatremic dehydration, NHD in apparently healthy breastfed neonates by day 3-13 is described in literature [1-4]. Recent reports suggest incidence of hypernatremic dehydration is increasing [5]. Early detection of NHD is not always easy because of variable clinical presentation [4, 6]. It has been reported that environmental factors causing increased insensible losses [1], early postpartum discharge and inadequate feeding are recognized as most important causes of NHD [3]. Some authors have reported a high sodium content in breast milk [3, 7, 8] and postulated that hypernatremia could occur because of this but the evidence suggested that the most common cause of hypernatremic dehydration is low volume intake of breast milk and water losses predominantly through the skin and from the lungs [9]. Hypernatremic dehydration is a potentially lethal condition and is associated with cerebral oedema, intracranial haemorrhage, hydrocephalus, and gangrene [3]. The aim of the study is to study the problem of hypernatremic dehydration in exclusively breast fed term neonates.

Material and method

This was a hospital based prospective study on term neonates (≥ 37 weeks gestation age, > 2 kg birth weight) admitted with clinical manifestations of dehydration and weight loss of more than 10% after birth in the NICU of Balchikitsalaya, MBGH, RNT Medical college, Udaipur, Rajasthan, India. The study was conducted for period of 12 months from July 2015 to June 2016.

All healthy term (≥ 37 weeks of gestation) neonates with birth weight > 2 kg with clinical manifestations of dehydration and weight loss $> 10\%$ of birth weight with hypernatremia (> 145 mEq/L) were included in the study. Sick neonates with history of birth asphyxia, sepsis, congenital anomalies and neonates < 37 weeks of gestation and birth weight < 2 kg

and those refusing to give consent or withdrawing consent during study period were excluded.

Ethical approval was obtained from the institutional ethical committee and informed consent was taken from the parents/caregiver.

Neonates who were born in the attached PDZH, RNTMC were kept in the postnatal wards where daily pediatric rounds were taken and neonates with dehydration were admitted to NICU. These neonates were termed INBORN. Those neonates who were born elsewhere and brought to our Pediatric OPD and admitted in NICU were termed OUTBORN.

Each neonate was thoroughly examined. Weight was recorded using electronic weighing scale sensitive up to 10 grams of weight. Rectal temperature was recorded using clinical thermometer or electronic probe. Gestational age was calculated by LMP. If LMP was not available, New Ballard scoring for gestational age was used. Dehydration was labelled when suspected with its clinical signs/symptoms and on weight loss $> 10\%$ of birth weight. Status of hydration (skin turgor, fontanel, mucous membranes, urine output) were carefully evaluated. Neonates with septicemia were excluded. (Sepsis ruled out by clinical evaluation and sepsis screening)

Detailed neonatal informations were recorded (age in days, sex, birth weight, gestational age, admission weight). Details of birth were recorded (birth weight, gestational age, mode of delivery, Apgar score, feeding history). Detailed Laboratory evaluation of each neonate in the study included sepsis screen to rule out septicemia. Other investigations included blood glucose, serum electrolytes (sodium/potassium/calcium), ABG, blood urea, serum creatinine,

serum bilirubin (total, direct and indirect) blood group, urine specific gravity and urine output. X-ray chest, cranial imaging studies, CSF examinations and other investigations were performed as and when required. Each neonate was hydrated and treated as per standard protocol. Data analysis was done using Student 't' test.

Results

A total of 343 term neonates with dehydration were admitted during study period of 1 year. Out of these 218 (63.55%) term neonates had hypernatremic dehydration (serum sodium >145 mEq/L) and rest 125 (36.45%) had isonatremic dehydration. Neonates with hypernatremic dehydration were enrolled in the study. Out of 218 neonates with hypernatremic dehydration, 112(51.37%) neonates had serum sodium levels of 145-160 mEq/L, 91(41.74%) babies had 161-175 mEq/L, 12(5.50%) babies had serum sodium levels of 175-190 mEq/L and 3(1.37%) had more than 190 mEq/L of sodium levels in serum. The highest serum sodium level of 196 mEq/L was recorded in one neonate. Mean (SD) Sodium levels in these hypernatremic neonates was 161.44 (7.95) mEq/L.

Mean Age of presentation of these neonates with hypernatremic dehydration was 4.85 days. Most of the neonates 188 (86.23%) presented between 3-7 days of life with mean sodium level of 159.61 mEq/L, 30 (13.76%) presented after 7 days of life with mean sodium level of 172.86 mEq/L. Mean Birth weight of these neonates was 2644.40 grams and mean admission weight of these neonates was 2245.91 grams. Mean weight loss % after birth was 15.08%. Out of 218 hypernatremic neonates 127 (58.26%) had weight loss of 10-15% after birth with the mean sodium levels was 157.24 mEq/L and 91 (41.74%) neonates had weight loss of more than 15 % after birth with mean sodium levels of 167.28 mEq/L.

The neonates had multiple symptoms at the time of admission. Most neonates presented with excessive cry 161(73.8%), fever 151(69.3%) and jaundice 122(55.9%). Other symptoms were refusal to feed 78(35.8%), lethargy 76(34.8%), decreased frequency of micturition 40(18.3%), Breathlessness 25(11.5%) and seizures 10(4.6%).

Among study population, 13(5.9%) dehydrated neonates had hypoglycaemia (blood glucose level <40 mg/dL) and 24(11%) dehydrated neonates had hyperglycemia (>125 mg/dL) at admission. 23(10.55%) neonates had hyperkalemia at admission (serum potassium levels more than 6.5 mEq/L). All 218 (100%) babies had high blood urea levels (higher than 40 mg/dL) and mean blood urea level was 124.56 mg/dL. Highest blood urea level of 381 mg/dl was recorded in one of the neonate. 178(81.6%) had high creatinine levels (more than 1.5 mg/dL) with mean creatinine level of 2.26 mg/dL. Highest level of serum creatinine of 7.2 mg/dL was recorded in one neonate. All 218(100%) neonates were hyperosmolar with mean osmolality of 349.33 mOsm/Kg. 200(91.7%) neonates had metabolic acidosis with mean pH of 7.22. Among study population, 93(42.66%) babies had pathological hyperbilirubinemia and required phototherapy. Among study population, 216 babies were discharged and 2 babies expired during hospital stay. Mortality was 0.9%. All findings are briefed in the table 1.

	Mean	Range
Age at admission in days	4.85 days	3-20 days
Birth weight in grams	2644.40 grams	2010-3700 grams
Weight at admission in grams	2245.91 grams	1500-3100 grams
Weight loss after birth in percent	15.08%	10.34-31.82%
Blood glucose level at admission	101.94 mg/dL	27-596 mg/dL
Serum sodium level at admission	161.44 mEq/L	146-196 mEq/L
Serum potassium levels at admission	5.14 mEq/L	4.3-7.9 mEq/L
Blood urea level at admission	124.56 mg/dL	53-381 mg/dL
Serum Creatinine levels at admission	2.26 mg/dL	0.9-7.2 mg/dL
Serum osmolality at admission	349.33 mOsm/kg	298-487 mOsm/kg
Blood pH at admission	7.22	6.87-7.43
Stay at hospital in days	4.2 days	3-9 days

Table 1: Neonatal findings in hypernatremic dehydration

Discussion

A total of 343 term neonates with dehydration were admitted during study period of 1 year. Out of these 218 (63.55%) term neonates had hypernatremic dehydration (serum sodium >145 mEq/L) and were enrolled in the study according to the inclusion criteria of the study. Most of the neonates 200(93.11%) had Serum sodium levels between 145-175 mEq/L at admission, few neonates 15(6.89%) neonates had more severe hypernatremic dehydration with Serum sodium levels of more than 175 mEq/L at admission. In the present study, most of the neonates had hypernatremic dehydration which is similar to observations made in certain studies [1, 2, 6, 10] and in few case reports [11-13]. It has been well documented that women who failed to establish good breastfeeding did not experience the normal physiological decrease in breast milk sodium concentration compared with those who experienced establishing a good milk flow. It is therefore not surprising that there have been attempts to establish that the cause of Hypernatremic dehydration in breast-fed babies is unusually high sodium content of maternal breast milk [3, 7-8]. However, the most common cause of excessive weight loss and hypernatremia must be inadequate breast milk intake, since it is not possible for a poorly-fed infant to get high sodium content from a low volume of breast milk. Hypernatremia occurs primarily because of water deprivation and secondarily because of an accumulation of sodium in an attempt to maintain a proper circulating volume as renal functions in neonates are immature and the concentrating ability of kidney is poor and they keep passing diluted urine even in presence of dehydration [14].

Mean Age of presentation of these neonates with hypernatremic dehydration was 4.85 days. Most of the neonates 188 (86.23%) presented between 3-7 days of life with mean sodium level of 159.61 mEq/L, 30 (13.76%) presented after 7 days of life with mean sodium level of 172.86 mEq/L. Neonatal hypernatremic dehydration in apparently healthy neonates by day 3-13 is described in literature [1-4]. Usually, it takes 3-7 days for dehydration to manifest in healthy neonates. Out of 218 hypernatremic neonates 127 (58.26%) had weight loss of 10-15% after birth with the mean sodium levels was 157.24 mEq/L and 91 (41.74%) neonates had weight loss of more than 15 % after birth with mean sodium levels of 167.28 mEq/L. In our study, we found that as the age of presentation of the neonates increased and as the weight loss after birth increased, the mean serum sodium level also increased. This showed that severity of hypernatremia increased because of increased insensible water losses and decreased milk supply to neonates and thus leading to decreased intravascular volume. The clinical presentation of most of the hypernatremic neonates was excessive cry 161(73.8%), fever 151(69.3%) and jaundice 122(55.9%). But those who had severe hypernatremia, had more severe symptoms like decreased frequency of micturition 40(18.3%), Breathlessness 25(11.5%) and seizures 10(4.6%).

Dehydration in neonates also affects the kidney and it is reflected in the biochemical changes. All the neonates with dehydration 218(100%) had high blood urea levels and 178(81.6%) neonates had high serum creatinine levels. Also 23(10.55%) neonates had hyperkalemia at admission. Renal functions in neonates are immature and the concentrating ability of kidney is poor and they keep passing diluted urine even in presence of dehydration. In the early phase of dehydration, the renal functions are affected due to pre renal cause of low intravascular volume, but as the severity of dehydration increases, there is acute kidney injury and thus leads to severely deranged renal functions and sometimes neonates land into acute renal failure and some of them may require dialysis too [15].

All the neonates with hypernatremic dehydration 218(100%) were hyperosmolar due to hypernatremia and raised blood urea levels and low intravascular volume and in some hyperglycemia too. Davies JA [16] in his study concluded hyperosmolality as a measure of dehydration in neonatal period.

All the neonates with hypernatremic dehydration 218 (100%) had metabolic acidosis. Metabolic acidosis in neonatal dehydration has been observed and documented in literature [14].

216 babies were discharged successfully after rehydration therapy and 2 babies expired during hospital stay because of fatal complications of hypernatremia like cerebral edema, IVH and DIC. Mortality was 0.9%.

Hypernatremic dehydration is potentially lethal condition and may be associated with cerebral oedema, cerebral vessel thrombosis, intracranial haemorrhage, seizures, and disseminated intravascular coagulation prior to death [9, 17]. Dehydration in neonates can be managed effectively and successfully if correction of fluid and electrolytes is done properly. Severe dehydration in neonates may lead to CNS complications and may lead to mortality. Early discharge of the neonates with poor follow up and poorly counselled mother regarding breast feeding techniques are some important factors which leads to dehydration in neonates in first few days after birth. High index of suspicion must be present in first few days after birth to counter hazards of hypernatremic dehydration. Mothers must be given practical advices in breast feeding techniques with special emphasis on primiparous as well as mothers with caesarean section. During hospital stay, cautious and routine monitoring in first few days by trained personnel must be done. Consideration must be given to ambient environmental temperature and humidity as insensible water losses from respiratory tract and skin increases in hot and dry weather. Proper follow up on day 0, 3, 7, 14, 21, 28, counselling on breast feeding and weight recording during the follow up will help in diagnosis and management of dehydration in these neonates.

Conclusion

Hypernatremic dehydration in healthy term neonates is often seen. A total of 218 neonates with hypernatremic dehydration were admitted during the study period of 1 year. Most of the neonates (99%) with hypernatremic dehydration presented between 3-14 days of life. Severity of hypernatremia increased with increasing age of presentation and increasing weight loss after birth. Most neonates with hypernatremic dehydration presented with excessive cry (73.8%), fever (69.3%) and jaundice (55.9%). But those who had severe hypernatremia and presented late, had more severe symptoms like decreased frequency of micturition (18.3%), Breathlessness (11.5%) and seizures (4.6%). Neonates with hypernatremic dehydration had both hypoglycaemia (5.9%) and hyperglycaemia (11%). Hypernatremic dehydration in neonates was associated with altered renal function due to acute kidney injury. All the neonates had raised blood urea and 81.6% neonates had raised serum creatinine. All 218(100%) neonates were hyperosmolar. 200(91.7%) neonates had metabolic acidosis. 93(42.66%) babies had pathological hyperbilirubinemia and required phototherapy. Among study population, 216 babies were discharged and 2 babies expired during hospital stay. Mortality was 0.9%.

Hypernatremic dehydration should be suspected in all the neonates with some problem in breast feeding (improper positioning, poor attachment, absent let down reflex, fissured/retracted nipples etc). It can be diagnosed early by proper assessment of feeding and weight recording on day 0, 3, 7, 14, 21, 28 and 42.

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