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ORIGINAL ARTICLE

Retrospective evaluation of newborn cases who were followed up with the diagnosis of hypernatremic dehydration

Hipernatremik dehidratasyon tanısı ile takip edilen yenidoğan olgularımızın retrospektif değerlendirilmesi

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ABSTRACT

Aim: The aim of our study is to evaluate the demographic characteristics and epidemiological risk factors of neonatal hypernatremic dehydration and to discuss the precautions applied in our clinic in order to reduce the number of dehydration cases in the light of the literature.
Materials and Methods: Newborns who were hospitalized in our neonatal intensive care unit with the diagnosis of HD, whose serum sodium level was >147 mmol/L and born at >37 weeks were evaluated retrospectively. Babies with illnesses that would adversely affect nutritional status were excluded from the study.
Results: Mean gestational week of 54 cases included in the study was 39.19±1.07.22. The mean birth weight was 3244.06±458.46 gr. while the mean weight of hospitalization was 2880.28±514.54 gr. The percent of weight loss was found to be 8.51±3.14%. The mean age of hospitalization was 3.7±2.05 days and the mean duration of hospitalization day was 2.26±1.42 days. On admission, 11 (20.4%) patients had fever, 6 (11.1%) patients had jaundice, 3 (5.6%) patients had discomfort, 30 (55.5%) patients had more than one complaint and dehydration was detected in 4 (7.4%) patients during control admission of pediatric outpatient clinic. On physical examination, 46 (85.2%) patients had mild dehydration, 7 (13%) had moderate dehydration, and 1 (1.9%) patient had severe dehydration. The mean serum sodium value of the patients was 150.44±3.62 mmol/L, mean serum urea value was 45.5±18.13 mg/dl, and mean serum creatinine value was 0.79±0.34 mg/dl at the time of admission. The etiologies of dehydration were breast milk insufficiency in 37 (68.5%) cases, inability to breastfeed effectively due to nipple problems in 2 (3.7%) cases, and errors in breastfeeding technique in 15 (27.7%) cases. A positive correlation was found between the degree of dehydration and percent of weight loss and the serum sodium value ($p<0.001$).
Conclusion: In our study, it was found that the most common cause of hypernatremic dehydration was breast milk insufficiency. Considering other reasons, giving breastfeeding education to mothers before discharge from the hospital seems to be important in preventing hypernatremic dehydration.

Keywords: Newborn, weight loss, hypernatremia, dehydration, breast milk, education.

ÖZ

Amaç: Çalışmanın amacı neonatal HD olgularının demografik özelliklerini ve epidemiyolojik risk faktörlerini ortaya koyarak, dehidratasyon olgularının sayısını azaltmak amacıyla kliniğimizde uygulanan önlemleri literatür eşliğinde tartışmaktır.
Yöntem ve Gereçler: Yenidoğan servisimize hipernatremik dehidratasyon tanısı ile yatırılmış ve serum sodyum değeri 147 mmol/L ve üzeri olan, 37 hafta ve sonrası doğan bebekler retrospektif olarak değerlendirildi. Beslenmeyi olumsuz etkileyecek hastalığı olan bebekler çalışma dışı bırakıldı.
Bulgular: Çalışmaya alınan 54 olgunun ortalama doğum haftası 39,19±1,07 idi. Doğum ağırlıkları ortalama 3244,06±458,46 gr. iken, yatış ağırlıkları ortalama 2880,28±514,54 gr. idi. Yüzde ağırlık kaybı ise %8,51±3,14 olarak bulundu. Hastalar ortalama 3,7±2,05 günlükken yatmış ve hastanede 2,26±1,42 gün kalmışlardı. Başvuru şikayeti 11 (%20,4) hastada sadece ateş, 6 (%11,1) hastada sadece sarılık, 3 (%5,6) hastada sadece huzursuzluk, 30 (%55.5) hastada ise birden fazla başvuru şikayeti varken, 4 (%7,4) hastanın rutin kontrolünde dehidratasyon saptandı. Fizik muayenede 46 (%85,2) hastada hafif düzeyde, 7 (%13) hastada orta düzeyde, 1 (%1,9) hastada ise ağır düzeyde dehidratasyon bulguları vardı. Hastaların başvuru anındaki ortalama serum sodyum değeri 150,44±3,62 mmol/L, serum üre değeri 45,5±18,13 mg/dl, serum kreatinin değeri 0,79±0,34 mg/dl idi. 37 (%68,5) vakada anne sütü yetersizliği, 2 (%3,7) vakada meme başı sorunları nedeniyle etkin emzirememe, 15(%27,7) vakada ise emzirme tekniğindeki yanlışlıklar nedeniyle dehidratasyon gelişmişti. Dehidratasyon derecesi ve yüzde ağırlık kaybı ile serum sodyum değeri arasında pozitif korelasyon ($p<0.001$) saptandı.
Sonuç: Çalışmamızda hipernatremik dehidratasyona en sık anne sütü yetersizliğinin yol açtığı bulunmuştur. Diğer nedenler de göz önüne alınarak annelere hastaneden taburculuk öncesi emzirme eğitiminin verilmesi hipernatremik dehidratasyonu önlemede önemli görünmektedir.

Anahtar kelimeler: Yenidoğan, kilo kaybı, hipernatremi, dehidrasyon, anne sütü, eğitim.

Introduction

There is no doubt that breastfeeding is the safest and best way to feed babies (1). Breastfeeding provides social, psychological, economic, developmental and environmental benefits not only to the baby but also to the mother, family and society (2). It is accepted all over the world that breastfeeding has positive effects on

growth, development and neurological development in addition to decreasing the frequency of acute and chronic infections, immunological, inflammatory, allergic, endocrine and cancer diseases on children (2-4). Inadequate secretion of breast milk or inability to suckle causes hypernatremic dehydration (HD), especially in the first week of life (5,6). In recent years the worldwide increase in breastfeeding has led to a decrease in the incidence of HD in infants (2,7,8). Different results have been reported regarding the incidence of HD in neonates (6). In the study of Moritz et al., the incidence of hypernatremia associated with insufficient secretion of breast milk in a 5-year period was reported as 1.9%, while Ünal et al. reported the prevalence of hypernatremia as 4.1% among 169 term babies in their study which as conducted between 2002 and 2005 years (9,10). In a study of Oddie et al. in a region with 32015 live births, it was reported that eight (0.88%) of 907 cases admitted to the hospital within the first month had HD (11). The most important cause of HD is considered to be insufficient breast milk intake (12-16). The problem that causes HD is fluid deficiency in the body and the accumulation of sodium in the body to provide sufficient volume in the circulation (2). The high sodium content in breast milk at the beginning also contributes to HD. The amount of sodium in breast milk decreases with the increase of lactation and milk secretion (17). In some cases, the reason is that the baby cannot grasp the nipple and empty the milk due to nipple problems or incorrect breastfeeding techniques, despite the fact that breast milk is sufficient. During first days, the amount of breast milk is low, the mother's knowledge and skills in the breastfeeding methods are insufficient, cesarean delivery, low number of breastfeeding episodes, breastfeeding incompatibility between mother and baby, low education level of the mother, mistakes in breastfeeding technique and nipple problems are the main causes of breastfeeding insufficiency (18-21). Also, the two most common reasons for readmission to neonatal services in recent years, when early discharge practices are widely applied; are hyperbilirubinemia and dehydration (22, 23).

Hypernatremia is defined as a serum sodium value above 146 mEq/L for newborns (24,25). The serum sodium ≥150 mEq/L in neonates is a potentially life-threatening condition (26). Hypernatremic dehydration can progress with complications such as acute renal failure, disseminated intravascular coagulation, convulsions, peripheral artery thrombosis, cavernous vein thrombosis, intracranial bleeding and death in the neonatal period. Its treatment also carries serious risks such as brain edema and convulsions (27-29). Despite such important complications, detection of the problem by both mother and doctor is delayed due to the active and strong sucking reflex of hypernatremic infants during physical examination (5,30). Particularly, early discharge, not being called for early control, cesarean delivery and high sodium level in breast milk have been reported as risk factors (11,31).

The aim of our study is to evaluate the causes and related factors of HD accompanied by literature and to determine the early measures to be taken to prevent HD in our hospital and other health institutions.

Materials and Methods

The file records of newborns born 37 weeks and older who were hospitalized in our neonatal service due to HD between June 2016 and June 2020, and whose serum sodium levels 147 mEq/L and above (24,25), were retrospectively reviewed. Babies with sepsis, hypothyroidism, Down syndrome, cleft palate-lip, metabolic disease, congenital anomalies and babies born before 37 weeks were excluded from the study. A total of 54 cases were included in the study. The patient's delivery type, gender, education level of the mother, the number of children in the family, etiological factors (factors causing insufficient breast milk intake; breast milk insufficiency, nipple problems, wrong breastfeeding technique), the season in which baby was diagnosed, how many days old baby was hospitalized, diet (formula, breast milk or mix), complaints at admission (fever, jaundice, decreased sucking, restlessness, hypoactivity, decreased urine output, decreased stool), degree of dehydration, percent of birth weight loss, whether acute kidney failure has developed, duration of hospital stay were noted from file records. Acute renal failure was defined as the presence of any of the following; serum creatinine value ≥ 0.3 mg/dl (≥26.5 µmol/l) within 48 hours; or an increase of 1.5 times or more in serum creatinine compared to baseline, known or predicted to have developed within the last 7 days; or urine volume < 0.5 ml/kg/h in the last 6 hours (32).

Statistical analysis

Data were analyzed using with SPSS 16.0 computer program. Data were expressed as a percentage or as median (data range) or mean±SD depending on whether the distribution was homogeneous. Chi-square and Student's T tests were used for comparisons. Bivariate logistic regression, Pearson and Spearman correlation tests were used for correlation analysis. P values <0.05 were considered statistically significant.

Results

The mean gestational week of 54 cases included in the study was 39.19±1.07 (Table 1). Of the cases, 22 (40.7%) were female and 32 (59.3%) were male. While the mean birth weight was 3244.06±458.46 g and the mean hospitalization weight was 2880.28±514.54 g. The mean weight loss was 8.51±3.14 percent. The delivery method was spontaneous vaginal delivery in 27 (50%) patients and cesarean section in 27 (50%) patients. 34 (63%) cases were first children, 9 cases (16.7%) born in spring, 18 (33.3%) born in summer, 19 (35.2%) born in autumn, and 8 (14%) born in winter. The cases were hospitalized at a mean age of 3.7±2.05 days and stayed in the hospital for 2.26±1.42 days.

The complaints at admission were only fever in 11 (20.4%) patients, only jaundice in 6 (11.1%) patients, only restlessness in 3 (5.6%) patients, and fever, jaundice, and vomiting in 30 (55.5%) patients. It was determined that more than one of the complaints of decrease, restlessness, decrease in movements, decrease in the amount of urine, decrease in the amount of feces were present. In addition, HD was detected in 4 (7.4%) patients during routine control. On physical examination, signs of mild dehydration were found in 46 (85.2%) patients, moderate in 7 (13%) patients, and severe in 1 (1.9%) patient. In the laboratory examinations of the patients at the time of admission, the mean serum sodium value was 150.44±3.62 mmol/L. The mean serum urea and creatinine values were 45.5±18.13 mg/dl, and 0.79±0.34 mg/dl, respectivelly (Table 2). In addition, while there was no acute renal failure in 43 (79.6%) cases, acute renal failure developed in 11 (20.4%) patients. Dehydration was caused by insufficient breast milk in 37 (68.5%) cases, inability to breastfeed effectively due to nipple problems in 2 (3.7%) cases, and due to mistakes in breastfeeding technique dehydration in 15 (27.7%) cases.

Mean maternal age was 25.93±5.32 years and 18 (33.3%) mothers were primary school graduated, 15 (27.8%) mothers were secondary school graduated, 12 (22.2%) mothers were high school graduated, 8 (14.8%) mothers had a university level education, and 1 (1.9%) mother could only read and write (Table 3). In addition, 43 (79.6%) patients were fed only with breast milk, 7 (13%) with both breast milk and formula, and 4 (7.4%) with only formula.

Table 1: Demographic and laboratory data of study population.

Variable	N:50 (mean±SD)	Percentage (%)
Gestational week (week)	39.19±1.07	
Birth weight (grams)	3244.06±458.46	
Gender		
Girl	22	40.7
Boy	32	59.3
Weight of hospital admission (grams)	2880.28±54.54	
Weight loss		8.51±3.14
Type of birth		
Vaginal	27	50
Cesarean section	27	50
Order of birth		
First child	34	63
Second child	12	22
Third and over	8	15
Season of birth		
Spring	9	16.7
Summer	18	33.3
Autumn	19	35.2
Winter	8	14.8
Age at time of hospitalization (day)	3.7±2.05	
Hospitalization time (day)	2.26±1.42	

Correlation analyzes showed that there was a positive correlation between serum sodium value and degree of dehydration ($p<0.001$, $r=0.567$) and percent of weight loss ($p<0.001$, $r=0.609$) (Table 4).

Table 2: Laboratory data of the study group at the time of hospitalization.

Variable	Mean±SD
Serum sodium level (mmol/L)	150.44±3.62
Serum urea level (mg/dl)	45.5±18.3
Serum creatinine level (mg/dl)	0.79±0.34

Table 3: Distribution of demographic data of the mothers in the study group.

Variable	N:54 (Mean±SD)	
Age of mother (year)	25.93±5.32	
Education level		
Only read and write	1	1.9
Primary school	18	33.3
Secondary school	15	27.8
High school	12	22.2
University	8	4.8
Nutritional status of babies		
Breast milk	43	796
Breast milk and formula	7	13
Formula	4	74

Table 4: Correlation analysis of factors that may be associated with serum sodium level.

Variable	R value	P value*
Degree of dehydration	0.567	<0.001
Percentage of loss of birth weight	0.609	<0.001
Education level of mother	0.789	0.267
Nutritional status	0.901	0.348
Age of mother	0.861	0.437
Hospitalization time	0.683	0.079

*Analysis of Pearson correlation.

Discussion

The neonatal period is the most sensitive period of life in terms of fluid and electrolyte balance. Breast milk is undoubtedly the most ideal food for the baby. In recent years, the importance given to breast milk in the nutrition of newborns has been increasing (2). The American Academy of Pediatrics recommends that

almost every baby should be breastfed after birth (33). If breast milk is insufficient and the mother does not realize it, frequency of hypernatremia may increase.

Studies have reported that most of the cases were fed with breast milk only (21,34-36). In our study, most of the cases were tried to be fed with only breast milk, but dehydration developed because it was insufficient. The mean age of the mothers was lower in line with other studies. However, we did not find a correlation between maternal age and serum sodium value. This can indicate that the level of consciousness of young mothers has also increased.

Hypernatremic dehydration is more common in the first babies of parents, and in the study of Livingstone et al., the frequency was found to be 17% in babies of primiparous mothers (27). In our study, 34 (63%) of the cases were the first babies of their mothers. Similarly, in the study of Ünal et al. (n=169), it was reported that 74.6% of the cases with HD were the first babies of their mothers (10). In the study of Çakır et al., the first baby rate was found to be 76.4% (35). The fact is that mothers who have their first babies do not have breastfeeding experience and cannot determine the severity of the disease in their babies. This situation appears as an important factor in the development of this problem. However, in our study, we did not find a correlation between being the first baby and serum sodium level. This can show that mothers have become more conscious about baby feeding, even if it is their first baby, through pregnant education. In addition, in most studies, the male sex ratio of HD cases was found to be higher than females (21,3-36). In our study, the rate of male cases was also higher. However, the reason for this difference is unclear.

In studies, the education level of the mothers of babies with HD was found to be low. (21,34,37). However, in only one of the studies, no correlation was found between the degree of dehydration of the patient and the education level of the mother (37). The mothers of our cases had mostly primary and secondary education. In our study, no significant relationship was found between maternal education and the degree of dehydration.

There are studies supporting that HD is more common in warm seasons (34). However, there are also studies reporting that the season is not a risk factor (38). The majority of our cases were also hospitalized during the seasons when the air temperature was high. We did not find a relationship between serum sodium and seasons. We suggest that high ambient temperature will increase the body's fluid requirement and adversely affect dehydration.

In a review of many studies, it was shown that cesarean delivery is a risk factor for HD (26). The results of many studies are in the same direction as the results of the reviews (39,40). In addition, there are studies reporting that there is no difference in HD between normal birth and cesarean section (41). On the other hand, there are also publications reporting that HD patients are more often born vaginally (10,34-37). In our cases, the rate of normal and cesarean delivery was equal. On the other hand, the rate of cesarean section was low as %28 in our hospital during the year 2021. It is known that late onset of lactation and insufficient nutrition of the baby in cesarean delivery play a role in the development of hypernatremia (42). On the other hand, the fact that the rate of babies with HD who were born normally is higher than expected in some studies can be explained by the earlier discharge of mothers with normal delivery and the fact that breastfeeding practices are discharged before they are fully developed during training. In addition, this result can be explained by the fact that the insufficiency of breast milk in babies of cesarean mothers who stayed longer in the hospital was noticed earlier by healthcare professionals and additional fluid support was started early.

It has been reported that the problem usually occurs within the first 10 days of life and the duration of admission to the hospital for infants varies between 3 and 21 days. (5,11,21,43,44). In our study, the mean age at admission was 3.7±2.05 days (2-14 days) lower than the studies conducted in previous years. This decrease is a positive and pleasing finding showing that mothers' awareness of dehydration increased compared to previous years and they brought their babies to the hospital earlier. We did not find a relationship between the number of days the patient was hospitalized and the serum sodium value. We interpreted this as the reason why most of our patients were hospitalized in the first 5 days with a sodium value below 160 mEq/l.

Average length of stay in hospital has been reported to be between 1.9 and 2.6 days (21,35). Our results are consistent with these values. As the urea, creatinine, sodium levels and the degree of dehydration increase, the length of stay in the hospital also increases. However, we did not find a correlation between these values and the length of stay in our study. This result can be explained by the small number of our cases and the sodium levels being less than 160 mEq/in most of the patients.

It has been reported that parents of babies with HD are generally unaware of their baby's problem and dehydration detected during routine examination or when they apply to the hospital for another reason (45-4). In our cases, complaints were only fever in 11 (20.4%) patients, only jaundice in 6 (11.1%) patients, satiety due to insufficient breast milk and crying a lot due to this reason in 3 (5.6%) patients, whereas in 30 (11.1%) patients, the complaints were fever, jaundice, decrease in sucking, restlessness, decrease in movements, decrease in urine amount and decrease in stool amount. 4 (7.4%) patients were detected in the routine control. Similar to our results, in other studies conducted in Turkey, it was found that the most common accompanying findings were jaundice and fever, and they were the primary reasons for admission (21,35,37,38,49). However, Çakır et al. and

Unal et al. reported that the most common complaint of admission was decrease in sucking (10,36).

Pathological weight loss is usually detected on physical examination. In studies, average weight loss is reported to be between 11.5-17.1% (18,30,36,44). In our study, we found the mean weight loss was 8.51±3.14 percent, significantly lower than previous studies. This reflects the benefit of training on baby care and nutrition for pregnant and new mothers. We found a positive correlation between weight loss and serum sodium elevation. On physical examination, 46 (85.2%) patients had mild dehydration, 7 (13%) patients had moderate dehydration, and 1 (1.9%) patient had severe dehydration. In addition, we found a significant relationship between serum sodium value and the degree of dehydration ($p<0.001$). These rates show that mothers are now more conscious than before and that they apply to the hospital when the baby's dehydration is at a milder level. Of course, the contribution of facilitating access to hospitals and pediatricians cannot be denied.

In studies, the serum sodium value is reported to be between 146-207 mmol/L (21,34,37,50,51). In our study, sodium values ranged between 147-162 mmol/L. The fact that the highest limit in our patients was lower than in previous studies indicates an increase in family awareness. There was prerenal acute renal failure in 79.6% of our cases. Previous studies reported this rate as 66.7%-68.6% (10,39). The reason for dehydration was insufficient breast milk in 37 (68.5%) cases, inability to breastfeed effectively due to nipple problems in 2 (3.7%) cases, and mistakes in breastfeeding technique in 15 (27.7%) cases. Similarly, in the study of Bülbül et al., breast milk insufficiency was found in 78% of the cases, incorrect breastfeeding method in 18%, and nipple problems in 4%. These results show that mothers should be aware of breast milk insufficiency from the pregnancy period, we should teach them correct breastfeeding techniques, and we should solve the nipple problems before birth.

The most common complication detected during treatment in patients with HD is convulsion (19,47,52). This usually develops during rapid rehydration with hypotonic fluids (15,19). No seizure was observed in any of our patients during the treatment. This result can be explained both by the fact that the hospitalization sodium values of our patients are not very high (the highest sodium value is 162 mmol/L) and by giving appropriate fluid therapy.

In conclusion, hypernatremic dehydration can be prevented by educating mothers about breast milk insufficiency and proper breastfeeding techniques starting from the pregnancy period and calling them for frequent check-ups until breast milk becomes sufficient in the first 10 days and they are sure that the baby is adequately fed. Being the first baby and being born in the warmer months are risk factors. Babies with these features should be monitored more closely. It is pleasing that the awareness of mothers has increased and babies have started to be diagnosed earlier with the pregnant trainings and breastfeeding trainings that have been carried out in our country in recent years. Also, these trainings should be further expanded.

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Conflicts of Interest: None.

Ethical standard: This is a retrospective study. The authors assert that all procedures contributing to this study comply with the ethical standarts of the Turkish Council of Medical Research and with the Helsinki Declaration of 1975, as revised in 2008, and has been approved by T.C. Sağlık Bakanlığı, Konya İl Sağlık Müdürlüğü on 04.03.2021 with the number of E-86737044-806.01.03.

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