
Factors Contributing to Dehydration Fever in Neonate, A Teaching Hospital Study

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Abstract

Background: Most babies lose weight in the first few days after birth, as excess extracellular fluid is excreted. A very small number of breast-fed infants do not establish an adequate milk intake, in addition to other factors they shall continue to lose weight and develop fever.

Objective: to find out factors contributing to dehydration fever in the neonate.

Subjects and methods: The study included 34 neonates aged 1-14 days admitted to neonatal ward in Central Teaching Hospital for Children/Baghdad, over the period between 1st of June 2006 and 15th of September 2006 and were presented with fever. The control group included three apparently healthy neonates (102) for each febrile neonate in same age.

Results: The study group included 34 neonates, with mean weight loss of $17.8 \pm 5\%$. The following neonatal factors; mean weight loss, over clothing and warming of the neonate, inefficient environmental ventilation and air conditioning, activity and consciousness profile, pink diaper, delayed or decreased stool frequency (< 3 stool/day), over clothing and warming were all significantly more common in the study group. While the following maternal factors; primiparous pregnancy, caesarian section deliveries, breast milk adequacy, presence of education of technique and importance of breast feeding, breast conditions associated with breast feeding difficulties and delayed 1st breast feeding are significantly different in study group

Conclusions: In breastfed neonates, dehydration is a serious complication, and prompt initiation of breast feeding after delivery, especially caesarian section delivery and intervention if problems with breast feeding occur.

Keywords: dehydration fever, breast feeding, hyperthermia of newborn

Introduction:

The newborn infant is homeothermic, but control of body temperature can only be achieved over a narrower range of ambient conditions. The preterm infant has even greater difficulty in body temperature control, and the most immature infants behave at times as if they are poikilothermic (their body temperature tending to drift up and down with the ambient temperature). (Rutter¹)

Most babies lose weight in the days after birth. A 10% weight loss in the first 4 days is common as excess extracellular fluid is excreted. Thereafter, provided that the milk intake is adequate, a steady pattern of weight gain of approximately 25 g/day is observed (Iain²). The weight gain may be established more slowly in breast-fed infants if maternal confidence in breast-feeding is poor. A very small number of breast-fed infants do not establish an adequate milk intake, continue to lose weight and may develop hypernatremic dehydration (Van Der Heide³).

Infection is not the only cause of a raised body temperature in the newborn. Raised body temperature is also caused by a severe cerebral abnormality, either congenital (holoprosencephaly, hydranencephaly, encephalocele) or acquired (birth asphyxia) or others. Such infants have hypothalamic dysfunction leading to poor temperature control (Voora S et al⁴).

Elevations in temperature (38-39°C or 100-103°F) are occasionally noted on the 2nd-3rd day of life in infants whose clinical course has been otherwise satisfactory. This disturbance is especially likely to occur in breast-fed infants whose intake of fluid has been particularly low or in infants exposed to high environmental temperatures. The diminished sweating capacity of newborn infants is a contributing factor (Barbara^{4,5}), accordingly, in neonatal care we should provide a thermal environment which keeps body temperature in the normal range, and which does not stress the infant to produce or lose large amounts of heat, in addition to the early initiation of effective breast feeding.

Patients and methods:

This cross-sectional study was conducted in the Central Teaching Hospital for Children/ Baghdad. The study sample included thirty four newborn infants with age range of 1-14 days, admitted over the period between 1st of June 2006 and 15th of September 2006 (summer time in Iraq) and presented with fever.

Enrollment criteria of neonates included were: apparently healthy, febrile neonates with dehydration by suspicious history or examination, term neonates with gestational age > 37 weeks, known birth weight > 2 Kg, delivered for healthy mothers who had no fever or obstetric complication before or after delivery and who gave birth to a single baby via scheduled caesarean section or uncomplicated vaginal delivery. Neonates were enrolled according to the history and clinical manifestations of dehydration with weight loss $\geq 10\%$ of birth weight over the 1st two weeks of life. Dehydration was only to be related to insufficient milk intake, hot environment with no history of actual vomiting.

Each neonate included in the study had full physical examination; weighed (using a Seca scale for weight sensitive to 10gr.), the rectal route was used for body temperature measurement (fever $> 37.8^\circ\text{C}$), status of hydration (skin turgor, fontanel, mucous membranes, urine output) was carefully evaluated. Signs and symptoms of possible local or systemic infection including central nervous system dysfunction or presence of any given medications were assessed and if present, the neonates were excluded.

The control group included three apparently healthy neonates selected randomly while attending scheduled vaccination program at same age range and time for each study group dehydrated neonate.

Neonatal information included; Age in days (completed), sex, precise birth weight, body weight, activity and consciousness profile, over clothing and warming, environmental ventilation and cooling, presence of jaundice, frequency of voiding (normal ≥ 6 times a day), presence of pink colored urine and stool frequency (> 3 stool/day).

Maternal information included; maternal age, parity, significant pathological condition during pregnancy, mode of delivery, inefficient environmental ventilation and air conditioning, mode of feeding, breast milk adequacy (presence of breast engorgement, fullness and fair amount of expressed milk via milk extractors or manually), extra fluids given, mother's education, mother's education of technique and importance of breast-feeding, presence of breast conditions that are likely to be associated with feeding problems (cracked, inverted, small or flat nipples, breast engorgement), time of 1st feeding.

Laboratory tests including white cell count, differential white cell count, C-reactive protein, blood culture and serum sodium were conducted.

Daily maximum environmental temperature of Baghdad city was recorded (weather broadcasting). Newborn's condition was followed up within the next 72 hours.

Cases of abnormally high white cell counts or abnormally elevated polymorphonuclear leukocytes, positive C-reactive protein or positive blood cultures were excluded from the study group. Neonates were treated with proper feeding if possible, otherwise were given parental fluids and medications as needed.

All results were expressed in numbers and percentages, the statistical analysis was done using t-test and Chi-square and P value <0.05 was considered as significant.

Results:

Forty newborn infants with presumed dehydration fever were studied, of these; six patients were excluded from the study because they were discovered to have

infection (systemic or local) or other conditions that does not fit criteria of enrollment in the study criteria.

The study group included 34 neonates, with the age range of 1-14 days, the mean age was 3.8 ± 2.5 days, and male / female ratio was 15/19. The control group included 102 healthy neonates. Their age range of 1-14 days, the mean age was 4.6 ± 2.8 days, and male / female ratio is 55/47.

Regarding neonatal studied factors; thirty four febrile neonates between the ages of 1-13 days were studied with mean weight loss of 17.8 ± 5 (dehydrated group). The study group mean rectal temperature was $38.7 \pm 0.7^\circ\text{C}$, environmental temperature range was $41-49^\circ\text{C}$ (mean $44.4 \pm 2.3^\circ\text{C}$).

In comparison with the control group; the percentage of mean weight loss, activity and consciousness profile, over clothing and warming of the neonate, inefficient environmental ventilation and air conditioning, average no. of voiding/past 24hr, pink diaper and delayed or decreased stool frequency (< 3 stool/day), were all significantly more common in the dehydrated group. Of thirty four infants of the study group, five neonates had hypernatremia exceeding 150meq/l (151-160meq/l).

Most neonates in the study group were irritable and sucking avidly. Fewer voiding of urine in the previous 24 hours (< 6 times a day) and pink discoloration of the diaper were more frequently observed in the dehydrated group. The mean age at examination, sex distribution, birth weight and the presence of jaundice (range 5.8-15.1mg/dl) showed no significant difference. None of them needed phototherapy. The percentage of mortality in the study group was zero; Table 1 illustrates the neonatal and environmental factors that are related to dehydration fever.

Table 1: Neonatal and environmental factors of the study and control group

Neonatal Factors		Dehydrated group (N=34)	Control group (N=102)	P value
Mean age (day)		3.8 ± 2.5	4.6 ± 2.8	N.S
Sex (♂/♀)		15/19	55/47	N.S
Mean Birth weight (gr.)		3105 ± 520	3183 ± 802	N.S
Mean percentage of birth weight loss		17.8 ± 5.0	2.9 ± 2.5	0.001
Activity and consciousness Profile	Normal	12	99	0.001
	Irritable, sucking avidly	17	3	
	Convulsions	1	0	
	Lethargic	4	0	
	Unconscious	0	0	
Over clothing and warming		28	60	0.032
Inefficient ventilation and air conditioning		23 (82%)	91(89%)	0.045
Presence of jaundice (%)		20/34(58%)	40/102(39%)	N.S
Average no. of voiding/past 24hr.		0.3	3.5	0.001
Pink diaper		18(52%)	10(9%)	0.01
Delayed or decreased stool frequency		28(82%)	25(24%)	<0.001
Mean environmental temperature $^\circ\text{C}$		44.4 ± 2.3		

N.S Not significant

Regarding maternal studied factors; Primiparous pregnancy, caesarian section deliveries, breast milk adequacy, presence of education of technique and importance of breast feeding, breast conditions associated with breast feeding difficulties and delayed 1st breast feeding were significantly different in study group and in the control group. Cesarean section

deliveries were correlated with delayed first feeding time more than those who were of normal vaginal delivery (5.0 ± 1.9 hour versus 1.5 ± 0.8 hour, $P = 0.04$). Maternal ages, mode of feeding and maternal education were not significantly different from the control group. Table 2 illustrates the maternal studied factors related to dehydration fever.

Table 2: Maternal factors of study and control group

Maternal Factors		Dehydrated group (N=34)	Control group (N=102)	P value
Mean maternal age (year)		27 $\pm$ 5	29 $\pm$ 5	N.S
Parity (primiparous mother)		28(82%)	50(49%)	0.026
Mode of delivery	Cesarean section	21(61%)	22(21%)	<0.001
	Normal vaginal delivery	13(38%)	80(78%)	
Mode of feeding	Breast	27(79%)	77(75%)	N.S
	Bottle	3(8%)	7(6%)	
	Mixed	4(11%)	18(17%)	
Breast milk adequacy		14/34	69/102	0.05
Educational level	Primary Education	14(41%)	45(44%)	N.S
	Secondary Education	12(35%)	31(30%)	
	High Education	8(23%)	16(15%)	
Education of technique and importance of breast feeding		15(44%)	71(69%)	0.021
Breast conditions associated with breast feeding difficulties		6(17%)	3(2.9%)	0.025
Mean time of 1 st breast feeding(hour)		3.1 $\pm$ 2.6	2.2 $\pm$ 1.2	0.023

N.S Not significant

Discussion:

Regarding neonatal factors;

There was indifference in sex and birth weight of study and control groups.

In spite of a significant weight loss ($17.8 \pm 5.0\%$, $P = 0.001$), most of our patients were apparently well and had mild illness such as, mild to moderate signs of dehydration, jaundice or mild irritability in addition to fever as a main cause of seeking medical advice.

Regarding activity and consciousness profile; the finding of irritability and sucking avidly was the most common presentation, and the profile was significantly different from the control group.

Iraq is a known country with hot summer time and some of the local social habits in caring and handling newborn babies (wrapping newborns with heavy cloths), in addition to the role of deficient and unstable electric power supply have their bad impact on newborn's state of hydration by disrupting room ventilation and sufficient air conditioning, a finding was dissimilar to Caglar MK⁶, as he mentioned the use of overheating as a main cause of environmental factor. In cold climatic regions; the condition is more commonly related to a warmly dressed infants left in a bassinet near a radiator or stoves, traveling in well-heated automobiles, or left with bright sunlight shining directly on them through the windows of a closed room or automobile are

likely to be victims and their body temperature may reach as high as 41.4°C . (Barbara J³)

Dehydration fever in the neonatal period is far more common in hot climatic regions, and unlike the cold regions where the condition is more commonly related to leaving neonates close to fireplace or stoves (Sofer S et al⁷).

According to Maayan-Metzger⁸; in low risk full term infants, fever with no other symptoms during the first days of life (but after the first day) is related primarily to dehydration, breast feeding, caesarean section, and high birth weight. Infection is the least common explanation. The fever seen in the neonates of the present study was directly related to dehydration because there was no indication of infection and body temperature returned to normal limits in all hyperthermic babies with only the correction of water deprivation and resuming feeding (P D Mac donald⁹).

We found that infrequent micturation (<6 times a day), pink diaper discoloration (due to a high uric acid concentration in urine), and infrequent passage of stool (<3 times a day) were significantly present in the dehydrated group, a finding similar to Oddie et al¹⁰ and M. K. Caglar⁶ who also observed low urine output and decrease stool frequency in their dehydrated patients.

Regarding maternal factors;

In present study; maternal age was insignificantly different, while primiparous mothers were significantly different from the control group, a finding similar to M.K.Caglar⁶. The study showed delivery by cesarean section appears to be an important risk factor for dehydration as it is related to failure of effective breast lactation and cesarean section was also found to delay initiation of breast feeding and found that the volume of breast milk transferred to the infant was less than that transferred to infants born by normal vaginal delivery over the first 6 days of life (P D Mac donald⁹) and (Evans et al¹¹).

Therefore, primigravida mothers should receive more reassurance and practical advice in the technique of breast-feeding, and should be trained about how to correctly position the baby, appropriately attach it to the breast and observe that suckling is successful (Oddie S¹⁰ and Dewey KG¹²). These studies also showed that by day 6, only 20% of infants in the cesarean group had regained their birth weight compared with 40% in the normal vaginal group.

In present study five infants developed hyponatremia exceeding 150meq/l, in presence of inadequate breast feeding in the dehydrated group (P value 0.05), a finding similar to Laing IA², Barbara J5, Sofer S⁷.

Dewey KG¹², Mehasi AI¹³ and Korkmaz A¹⁴. It has been well demonstrated that if women fail to establish good breast-feeding then the normal physiological decrease in breast milk sodium concentration does not occur (Morton JA¹⁵). Lactogenesis stage II, the onset of sufficient milk production occurs during the first 4 days after delivery (Morton JA¹⁵, Neville MC¹⁶).

However hyponatremic dehydration in otherwise normal infants who are exclusively breast fed can be due to elevated sodium levels in breast milk (Kini N¹⁷), and since the poorly fed infant is not able to obtain a high sodium content from a low volume of breast milk, hyponatremia because of water deprivation and a secondary accumulation of sodium in an attempt to maintain circulating volume takes place (Sofer S⁷).

Our study showed significant difference in dehydrated and control group regarding mother's education of technique and importance of breast feeding with P value of 0.021, a finding similar to Newman¹⁸ who found the principal cause of insufficient breast milk intake is inappropriate positioning and latching on. So the low level of maternal knowledge in lactation and failure of early postnatal follow-up are common elements in the dehydrated group.

Breast milk adequacy, the presence of breast conditions associated with breast feeding difficulties (cracked, inverted, small or flat nipples, breast engorgement) and delay of 1st feeding were significantly different from the control group in present study, so these mothers could have been identified and additional support for breast-feeding was provided (Neifert MR¹⁹), and the clinician should elicit the infant's frequency and

duration of feeding, stooling and voiding pattern, infant hydration and evidence of jaundice (Maayan-Metzger A⁸). Also maternal breast engorgement, difficulties with milk flow and sore nipples should be watched (Cooper WO²⁰).

Significant delayed of first breast feeding in cesarean section deliveries, a finding is similar to studies of Newman¹⁸ and Manganaro R²¹, which may be attributed to postoperative painful conditions and post-anesthesia state.

So excessive weight loss occurs in exclusively breast-fed infants and can be complicated by hyponatremia and other morbidities. Fever secondary to dehydration is a useful early warning sign. These cases emphasize the importance of early and regular measurement of body weight in exclusively breast-fed infants so that prompt identification of affected cases may prevent potentially detrimental complications (PC Ng²²), and to educate the public in the proper preparation of bottle feeds when breast feeding is not possible (Mehasi AI¹³). Yet the actual impact of dehydration fever in Iraqi neonatal morbidity and mortality should be screened thoroughly according to the hot environmental conditions.

Conclusion and Recommendations:

In breastfed infants, dehydration is a serious complication. So the early detection of serious weight loss, decreased frequency of urination and stool may help for early diagnosis of dehydration related to breastfeeding failure.

Prompt initiation of breast feeding after delivery and prompt intervention if problems with breast feeding occur, in particular poor breast attachment, engorgement and nipple problems will help promote successful breast feeding (Caglar MK²³, MacDonald PD²⁴ and Zachariassen G²⁵), in addition to careful follow up of breast feeding after discharge from hospital, particularly regarding infant weighing to detect inadequate breast feeding in addition to the availability of better means of environmental air-conditioning is necessary to overcome the problem of dehydration fever.

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