Original Article

Predictors for raised body temperature in term healthy neonates during the 1st days of life: A teaching hospital study

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ABSTRACT

Background: Raised body temperature during the neonatal period is considered an alarming sign of systemic infection. However, infection is not the only cause of a raised body temperature in newborns. Elevations in temperature (>37.5°C) are occasionally noted on the 2nd–3rd day of life in infants who are otherwise healthy and asymptomatic. This disturbance is especially likely to occur in breastfed infants or in infants exposed to high environmental temperatures. **Objective:** The objective of the study was to find out the important predictors for raised body temperature in full-term infants during the 1st days of life and also the rate of neonatal sepsis among these neonates. **Study Design:** An observational study was conducted on 50 cases and 50 controls (full-term neonates aged 2–7 days) in a single, tertiary institution in East India over a period of 2 years. **Results:** Inadequate breastfeeding, weight loss, high birth weight, over clothing, inefficient environmental ventilation, and increased ambient environmental temperature were significantly more common in the study group and hence are the most significant predictors for raised body temperature during the 1st days of life. Out of the 50 babies in the study group, only four had positive sepsis screening. **Conclusion:** Raised body temperature in asymptomatic full-term breastfed babies during the initial days of life (but after the 1st day) is related primarily to dehydration along with factors such as high birth weight, inefficient environmental ventilation, and ambient environmental temperature. Infection is the least common explanation for raised temperature during that period.

Key words: Breastfeeding, Dehydration, Over clothing, Raised body temperature

Fever or raised body temperature in a neonate is always an alarming condition. Most of the time fever requires investigation to rule out sepsis and may require parenteral antibiotics to control infection. A newborn baby is homoeothermic, but his/her ability to maintain the body temperature can be easily overwhelmed by environmental conditions. Homeothermy requires a balance among heat production, skin blood flow, sweating, and respiration. Infants are prone to insult caused by extremes of temperature due to factors such as larger surface area to volume ratio, relatively small insulating body shell, and poorly developed sweat mechanism [1].

Infection is not the only cause of a raised body temperature in the newborn. Raised body temperature can also be caused by a severe cerebral abnormality, either congenital (e.g., holoprosencephaly, hydranencephaly, and encephalocele) or acquired (birth asphyxia) or others. Such infants have hypothalamic dysfunction leading to poor temperature control [2]. Fever during the neonatal period is considered an alarming sign of systemic infection which needs complete sepsis work up. Only a few studies have been carried out to identify causes in infants with raised body temperature having a low risk of serious bacterial infection, that is, normal physical examination and laboratory tests.

Raised body temperature (>37.5°C) is occasionally noted on the 2nd–3rd day of life in healthy, full-term, and asymptomatic babies having excess weight loss and having no pathological finding on physical examination. This particularly occurs in breastfed infants whose intake of milk has been particularly low or in infants exposed to high environmental temperatures. Due to diminished sweating capacity of newborn infants, the essential neonatal care should be done in a thermoneutral environment to keep their body temperature in the normal range with early initiation of effective breastfeeding [3].

The possible pathogenesis of fever may be due to high environmental temperature rather than dehydration [4]. Appleton and Foo described the phenomenon of dehydration fever in large breastfed babies on days 3–4 of life. They stated that much of the current neonatal literature makes little or no reference to dehydration fever [5]. Neonates have physiological weight loss

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in the 1st week of life due to loss of excess extracellular fluid. Term neonates normally lose 1–2% of their birth weight daily with a cumulative loss of 5–10% in the 1st week of life. Hence, serial weight measurement can be used as a guide to estimate fluid deficit/dehydration status. A very small number of breastfed infants, who do not establish an adequate milk intake, continue to lose weight and may develop hypernatremic dehydration [6].

We notice that many of the healthy full-term babies presenting with raised body temperature during the first few days of life and investigated for evidence of sepsis show no other clinical manifestation and pathological finding on physical examination. In such cases, suspicion of dehydration fever rises. Therefore, we planned this study to find out the characteristics of the important predictors for raised body temperature in full-term healthy infants during the 1st days of life and the rate of neonatal sepsis among these neonates, to avoid unnecessary hospitalization.

METHOD

This was a case–control study which was conducted over a 2-year period in a tertiary care teaching hospital in the eastern part of India. As dehydration and raised body temperature are more common during summer season, we have taken cases during that period, that is, from the month of March to June (4 months) and controls have taken during the winter season, that is, from November to February (4 months). The study included 100 full-term neonates (50 cases and 50 controls) with birth weight of > 2.5 kg, delivered from healthy mothers and with age range of 2–7 days, whose mothers were admitted in the maternity ward or who presented to our outpatient department with the complaint of fever following discharge from the hospital. Each baby included in the study population was matched with a control – a healthy full-term baby of birth weight >2.5 kg born at the same gestational age. Preterm neonates, term neonates having serious surgical or medical illness on the 1st day of life, and neonates delivered using epidural analgesia were excluded from the study.

Body temperature was not routinely measured in these newborn babies during their stay in the hospital unless they felt warm to touch to the parents/caregivers. Raised body temperature is defined as measured axillary temperature exceeding 37.5°C. Temperature was measured by digital thermometer as per guidelines by the American Academy of Pediatrics.

Weight of infants (both the study and control groups) was measured at presentation and compared with the birth weight and percentage of loss was calculated. Daily maximum ambient environmental temperature was recorded. The primary form of feeding in neonates was breastfeeding in our hospital. The policy of our hospital is to encourage breastfeeding, and no formula milk supplementation is given unless clinically indicated.

Complete sepsis screen was done in all febrile neonates. Other information regarding over clothing, ambient environmental temperature and ventilation in the room, frequency of voiding (normal ≥6 times a day), and maternal factors s as mode of delivery and parity of mother (for both case and control groups) were also collected. All results were expressed in numbers and percentages, the statistical analysis was done using SPSS 20 and t-test and Chi-square test were done and $p<0.05$ was considered as statistically significant.

RESULTS

The male/female ratio was 21:29 in the study group as compared to 28:22 in the control group. The mean age of fever onset was at 51.2±14.6 h in the study group and 56±12 h in the control group. The mean duration of fever was 2.8±1.6 h in the study group while it was 4.8±2.1 h in the control group. In 42 of the 50 babies, temperature returned to the normal range (<37.5°C) within 4 h after removal of over clothing and with correction of feeding issues. In the study group, the mean axillary temperature was 38.7±0.7°C; environmental temperature range was 40–48°C (mean 42.4±2.3°C). A peak incidence of fever was recorded during the month of March–June. Details of various neonatal and environmental factors are given in Table 1.

The study group had 13 large for gestational age (LGA) babies in comparison to 8 LGA babies in the control group. Mean percentage of weight loss is more in the study group (4.3±2.1%) as compared to the control group (2.3±1.2%), ($p<0.001$). Although serum sodium values were in the normal range in both groups, it was higher in the study group. Maternal factors are listed in Table 2.

The raised temperature in the study group may be due to delay in sufficient milk production in primipara mothers as compared to multipara mothers. Moreover, our study found cesarean section to be a significant predictor for the body weight loss rate. The body

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

Different predictors in both groups	Study group(n=50)	Control group (n=50)	p
Mean age (h)	51±14	56±12	N.S
Mean duration of fever (h)	2.8±1.6	4.8±2.1	<0.0001
Sex (♂/♀)	21/29	28/22	N.S
Mean birth weight (g)	3212±320	3020±380	0.008
Mean weight loss (%)	4.3±2.1	2.3±1.2	<0.001
Activity and general condition of the baby			
Normal	48 (96%)	14 (17.5%)	<0.001
Decreased activity/irritable	2 (4%)	34 (68%)	
Convulsion	0	5 (10%)	
Serum sodium (mmol/L)	141.4±3.6	134.2±3.1	<0.001
Positive sepsis screen	4 (8%)	42 (84%)	<0.001
Mean number of voiding in 24 h	1.2	6.4	0.001
Over clothing	40 (80%)	30 (60%)	0.03
Inefficient ventilation and air conditioning	34 (68%)	23 (46%)	0.0286
Mean environmental temperature	42.4±2.3°C	28.6±2.8°C	< 0.001

Values are expressed as mean±SD or number (%). Comparisons between the control and case groups were made using the Student's t-test (in case of normally distributed data) or Chi-square test (in case of categorical variables)

Table 2: Maternal factors in the study group and control group

Parameters	Study group	Control group	p
Mode of delivery			
Vaginal delivery	22 (44%)	33 (66%)	
Cesarean section	28 (56%)	17 (34%)	0.0294
No. of primipara mothers	28 (56%)	16 (32%)	0.0175
Mode of feeding			
Exclusive breastfeeding	39 (78%)	36 (72%)	
Bottle feeding only	3 (6%)	4 (8%)	N.S
Combined feeding	8 (16%)	10 (20%)	

N.S: Not significant

weight loss rate in the cesarean section group was higher than that in the normal vaginal delivery group. The factor responsible for this phenomenon is probably the delayed start of lactation at the breast following cesarean section. We also found that there is significant delay of first breastfeeding in cesarean section deliveries mainly due to post-operative painful conditions and post-anesthesia state.

DISCUSSION

We found the predictors of raised body temperature in newborn significantly correlated to the time of first feeding, percentage of birth weight loss, and birth weight. Our observation in the study group indicates that the main risk factor for raised body temperature after the 1st day of life is excessive weight loss. We found that the body weight loss rate in the case group was significantly higher than that in the control group. In spite of a significant weight loss, most of our patients were well in this population. This is due to inadequate breastfeeding, which may in turn be due to delivery by cesarean section and parity (primi) of mothers. These neonates in the study group were asymptomatic and the raised body temperature was not related to sepsis and only 4 neonates (8%) had positive sepsis screen. Many other studies revealed a similar association of excessive body weight loss due to dehydration, leading to newborn fever [7-11].

Additional factors such as high birth weight, inefficient environmental ventilation, and high ambient environmental temperature also influenced the body temperature of neonates in the study group. A study from North India also showed that 36.8% of newborns are likely to suffer from hyperthermia/ raised body temperature, especially in warm climates because a strong correlation between room air environmental temperature and neonatal body temperature was observed [12]. Raised body temperature seen in these neonates of the present study was directly related to dehydration because: (a) There was no symptom or sign of infection. (b) Body temperature returned to normal in all babies by correcting feeding issues and removal of over clothing. (c) High ambient environmental temperature.

Results of our study provide support for this fact that the main cause of dehydration during the 1st days of life in healthy babies may be due to difficulties in establishing breastfeeding, as it was significantly more in babies of primigravida mother and babies delivered through cesarean section. Several studies have affirmed the relationship between inadequate breastfeeding and dehydration in neonates [7-10]. The results of our study regarding some of the maternal factors such as parity (primi) and cesarean section delivery in dehydrated group were similar to the findings by Caglar *et al*. [13]. Our study agreed to the similar studies done by P D Mac Donald [14] and Evans *et al* [15]. which showed that delivery by cesarean section appears to be an important risk factor for dehydration as it is related to delay in the initiation of breastfeeding and insufficient breast milk production.

Furthermore, the results of our study are similar to the result found by the study conducted by Maayan-Metzger [16] which supported the hypothesis that the main cause of fever in low-risk asymptomatic full-term infants during the 1st days of life is dehydration resulting from difficulties in establishment of breastfeeding.

In the study group, serum sodium level is toward upper range of normal serum concentration, due to the presence of inadequate breastfeeding which is similar to the findings by Laing *et al*. [17] Hypernatremic dehydration in otherwise normal infants who are exclusively breastfed can be due to water deprivation and a secondary accumulation of sodium in an attempt to maintain circulating volume [18]. We observed a significant delay of first breastfeeding in cesarean section deliveries, a finding similar to studies of Newman and Manganaro *et al*. [10] which may be attributed to post-operative painful conditions and post-anesthesia state [19,20]. We also found that the main cause of raised body temperature is early onset sepsis in control group (84%) and these babies had features of sepsis in clinical examination.

Our study reinforces the importance of early establishment of breastfeeding, especially in primipara mothers, and helps prevent unnecessary invasive investigations in healthy, clinically well babies. Our study needs bigger sample size, longer duration of study, and multicentric trial for corroboration of our findings.

CONCLUSION

Weight loss in a full-term newborn is often ignored. We found these babies need to be given more attention and evaluation, to avoid a delay in feeding, which could cause body weight loss and dehydration. Raised body temperature in healthy full-term infants during the 1st week of life (but after the 1st day) is related primarily to dehydration (breastfeeding failure), delivery by cesarean section, high birth weight, over clothing, inefficient environmental ventilation, and increased ambient environmental temperature. Infection is the least common explanation.

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