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Research Article

Evaluation of the Etiology and Prognostic Factors of Neonatal Fever

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Abstract

Objectives: The present study aims to evaluate the etiology and prognostic factors associated with fever in febrile neonates.

Methodology: The convenient sampling method was used for recruiting febrile neonates into our study. Full-term febrile neonates who were admitted to the neonatal ward and the neonatal intensive care unit (NICU) of our medical center between 2015 - 2017 were recruited to our study. Initial data including clinical data and demographic characteristics of the patients were recorded. A researcher-made checklist was used for collecting the demographic and clinical data of the neonates. The patients were followed up during admission until diagnosis was made. Data on the clinical characteristics of the neonates were analyzed descriptively, and the results were compared between groups.

Results: A total of 250 neonates were recruited into our study. Of these, 113 (45.2%) were females and 137 (54.8%) were males. The mean age of the neonates at the time of admission was 12.29 ± 9.1 days. The final diagnosis among our study population was as follows: Proven sepsis (4.4%); suspected sepsis (44.4%); clinical sepsis (9.6%); dehydration (28.8%) and other causes (12.8%). Logistic regression analysis was also used to determine the correlation between the variables and source of fever, and the results show that serum levels of BUN, sodium, and CRP can accurately predict the etiology of fever in full-term infants.

Conclusion: Majority of the febrile neonates were admitted in summer. We observed a significant correlation between the etiology of fever and the levels of BUN, sodium and CRP.

Keywords: *Febrile Infants; Sepsis; Infection; Neonatal Fever*

Introduction

Descriptive population-based studies have indicated that approximately 1.4% of infants less than 3 months old present for fever assessment [1]. The incidence of serious bacterial infections (SBI) including urinary tract infection (UTI), meningitis, pneumonia, and sepsis in infants less than 3 months of age is estimated to be between 8 - 12.5% [2]. This rate is higher in neonates than any the other age groups, which is close to 20% [3]. Although in many febrile neonates, physical examination findings are unremarkable, in about 3% of the cases, diagnosis can be made by physical examination findings and history [4,5].

Causes of fever can be classified into four main categories: infectious, inflammatory, malignant, and other causes. The most common causes of fever are self-limiting viral infections (such as common cold and gastroenteritis) and mild bacterial infections (such as otitis media, pharyngitis, and sinusitis). The body temperature in infants with intact neurological function rarely rises above 42°C, except in cases such as malignant hyperthermia and thyrotoxicosis. The Zachariassen., *et al*.'s study conducted in 2002 investigated the characteristics of dehydration-induced fever in neonates. Of the 54 neonates admitted due to dehydration over a period of 21 months, 35 of them had a temperature between 37.6 - 39.7°C at the time of admission. The authors indicated that fever in breastfeeding neonates can be a sign of dehydration [6].

In fact, the ultimate goal of examining a febrile neonate is to identify those at risk of serious bacterial infection (SBI) and determine the need for hospitalization and initiation of empirical therapy [7]. In many cases, there are no physical clues to the diagnosis of infection in a febrile neonate. On the other hand, the response of some neonates to infection is manifested by hypothermia, so the absence of fever does not rule out the presence of infection [8]. Only half of neonates with infections have an axillary temperature above 37.8°C. Failure to diagnose bacterial infections in neonates is associated with high morbidity and mortality. For example, meningitis and bacteremia can cause sepsis, death, and neurological sequelae. Urinary tract infections can also lead to pyelonephritis which can rapidly progress to scarring of the renal parenchyma, and if not diagnosed early, can lead to renal failure [4]. In 2008, Baker and Avner reviewed the effectiveness of the predictors of SBI in febrile infants less than two months old. In this study, the febrile infants were divided to two separate groups: < 1 month and 1 - 2 months. The authors concluded that due to the absence of specific clinical signs and symptoms of infection, as well as immature nature of the infants' immune system, this classification is not reliable and that all febrile infants should be hospitalized and undergo sepsis work-up [9]. This finding indicates the necessity to evaluate the febrile infant for bacterial infection. For this reason, existing practical guidelines recommend that all infants with a rectal temperature of ≥ 38°C should be hospitalized and undergo complete sepsis work up, including complete blood count (CBC), blood culture, urine culture, and cerebrospinal fluid (CSF) culture regardless of their clinical manifestations. A chest radiograph should be taken if the infant shows symptoms and sings of respiratory distress such as nasal flaring, grunting, tachypnoea, stridor, and retractions. Also, if there are signs and symptoms of the gastrointestinal tract such as diarrhea, stool exams and cultures should be ordered [4].

Clinical diagnosis of sepsis in neonates is difficult because many of the symptoms of sepsis are nonspecific and occur in other non-infectious conditions. Although normal physical examination can rule out sepsis and SBI to some extent, in some cases, bacteremia can occur in the absence of clinical symptoms [10]. The current practice guidelines for the management of febrile infants recommend sepsis work up should include complete blood counts with differential counts, blood cultures, CSF analysis and culture, urine analysis and culture, and chest radiography [11]. Various laboratory parameters have been proposed for sepsis screening, including the acute phase reactants. However, only C-reactive protein (CRP and procalcitonin) have been studied in large studies [12,13]. According to Benitez., *et al*. two normal measurements of CRP, can rule out sepsis in the first 24 hours after birth with a prediction accuracy of 99.7% [13]. It seems that sepsis screening tests are valuable in deciding which seemingly healthy high-risk infants do not need antibiotics and when antibiotics should be discontinued [10].

Several studies have been conducted on the evaluation and identification of febrile neonates with low risk criteria for SBI. However, a comprehensive protocol has not yet been adopted and many infants present with fever are admitted without indications and undergo various tests and treatment with broad-spectrum antibiotics.

Aim of the Study

The present study aims to determine the etiology and prognostic factors associated with fever in neonates.

Material and Method

Study population

Full-term febrile neonates who were admitted to the neonatal ward and the neonatal intensive care unit (NICU) of our medical center between 2015 - 2017 were recruited to our study. The inclusion criteria included: Axillary temperature ≥ 38.5°C on the day of presentation and has lasted for more than 2 hours, confirmed by an attending physician; gestational age ≥ 37 weeks; absence of clinical signs and symptoms suggestive of infection or sepsis; and written informed consent obtained from the mother or father of the neonate. Exclusion criteria included: fever lasting less than 2 hours; fever in the first 24 hours after birth; gestational age < 37 weeks, recent antibiotic therapy before hospital admission; history of previous hospitalization for any reason; presence of congenital anomaly found on physical examination; presence of any clinical signs and symptoms suggestive of infection.

Data collection

The convenient sampling method was used for recruiting febrile neonates into our study. A researcher-made checklist was used for collecting demographic and clinical data of the neonates. Initial data recorded in our checklist included gestational age at birth, birth weight, sex, age at the time of presentation, weight on admission, percent weight loss, season, method of delivery, type of feeding, perinatal events, and body temperature on admission. Laboratory data including peripheral white blood cell count, serum levels of sodium, CRP and BUN, and urine, blood, stool, and CSF culture and chest X-ray findings were performed on all the febrile neonates during admission and the results were recorded. Relevant data related to the history and physical examination findings of the febrile neonates were also entered into our checklist. Each neonate was then followed-up until final diagnosis was established. Final diagnosis was made by the attending physician based on laboratory, paraclinical and clinical findings.

Statistical analysis

Data were analyzed using SPSS software version 21. Data on the clinical characteristics of the neonates were analyzed descriptively. Chi square test was used to compare qualitative variables between two groups. The student t-test was used to compare quantitative variables between two groups if the distribution was normal, and Mann-Whitney test was used if the distribution was skewed. Logistic regression was used for correlational analysis and odds ratio was used for estimating the association between risk factors and outcomes. P values < 0.05 were considered statistically significant.

Results

A total of 250 neonates who were admitted to the neonatal ward and NICU of our medical center between 2015 - 2017 due to fever were recruited into our study. Of these, 113 (45.2%) were females and 137 (54.8%) were males. The mean age of the neonates at the time of admission was 12.29 ± 9.1 days. Majority of the neonates (12.8%) presented on the third day of life. The mean gestational age was 38.41 ± 0.95 weeks. The mean birth weight and the mean weight on admission were 3134.35 ± 385.83g and was 3182.57 ± 476.42g, respectively. The clinical characteristics of the neonates have been presented in table 1. The majority of the neonates were admitted in the summer (83 [33.2%]) in the months of July, August, and September. About 26% (65/250) of the neonates presented with fever each during autumn and winter. The number of admissions during spring was the lowest (37 [14.8%]). Approximately, three-quarters of neonates (74% [185/250]) were exclusively breastfed, and 17.07% were fed with both formula and breast milk. Twenty-two neonates were fed with formula only. One hundred and ninety-one neonates (76.4%) were delivered by cesarean section and the remaining by NVD. A history of PROM was reported in 30% of the neonates and chorioamnionitis in 6 neonates (2.4%).

Urine culture was positive for bacterial growth in 4 (1.6%) neonates. CSF culture, blood culture and stool culture were positive for bacterial growth in 5 cases (2%), 11 cases (4.4%), and 5 cases (2%), respectively. The results of blood biochemistry tests were as follows: The

	Range	Mean ± SD
Age of the neonates (days)	2-30	12.29 ± 9.10
Gestational age (weeks)	37-41	38.41 ± 0.95
Birth weight (g)	2560-4300	3134.35 ± 385.83
Weight on admission (g)	2600-4590	3182.57 ± 476.42

Table 1A: *General and clinical characteristics.*

		N (%)
Males		137 (54.8%)
Females		113 (45.2%)
Feeding type	Exclusive breastfeeding	185 (74%)
	Formula	22 (8.8%)
	Both	43 (17.2%)
Method of delivery	Natural Vaginal Delivery (NVD)	59 (23.6%)
	Cesarean section (C/S)	191 (76.4%)
History of PROM		75 (30%)
History of Chorioamnionitis		6 (2.4%)

Table 1B: *General and clinical characteristics.*

Table 1: *General and clinical characteristics of the study population.*

mean serum BUN was 27.95 ± 26.12 (3 - 190) mg/dl and the mean serum sodium level was 142.02 ± 5.73 (123 - 168) mg/dl. The mean CRP level of the neonates was also measured as 15.28 ± 5.35 (2 - 118). Also, in CBC count, the mean WBC count for all the neonates was 10268.4 ± 4155.879 (2100 - 25300). CXR findings were remarkable in only 9 cases (3.6%). In all other cases the CXR was unremarkable or had only thymus atrophy.

Based on the results of the paraclinical investigations, as well as history and physical examination findings and the percent weight loss, the febrile neonates were classified into one of the following categories of final diagnosis: suspected sepsis-normal physical examination and paraclinical investigations and/or cases where parents did not provide informed written consent for LP: proven sepsis-cases with positive blood culture; clinical sepsis-leukocytosis and/or abnormal CRP levels; and dehydration-high levels of serum BUN or sodium. Cases with detected localized infections were classified as others. Based on this classification, the final diagnoses among our study population were as follows: Proven sepsis (11 cases, 4.4%); suspected sepsis (111 cases, 44.4%); clinical sepsis (24 cases, 9.6%); dehydration (72 cases, 28.8%); and others (32 cases, 12.8%). The other causes of fever with a local source of infection identified in our study included upper respiratory viral infections, gastroenteritis, meningitis, pneumonia, omphalitis, urinary tract infection, staphylococcal scalded skin syndrome (SSSS), and breast abscess. Thus, based on our classification, among our study population, 67 febrile neonates (26.8%) had an infectious etiology (local infection identified or had proven or clinical sepsis) and in 183 cases (73.2%), an infectious etiology was not identified. These results have been displayed in table 2.

For investigating the association between source of fever and clinical, demographic and paraclinical variables, the independent sample t-test, chi-square and Mann-Whitney tests were performed. We observed a significant difference in age of the neonates on admission,

Definitive Diagnosis		N (%)
Suspected sepsis		111 (44.4%)
Clinical sepsis		24 (9.6%)
Proven sepsis		11 (4.4%)
Dehydration		72 (28.8%)
Other diagnosis		32 (12.8%)
Source of fever	Infectious source	67 (26.8%)
	Non-infectious source	183 (73.2%)

Table 2: *Final diagnosis of fever in our study population.*

gestational age, weight and percent weight loss on admission, serum BUN, sodium, and CRP levels between the neonates with infectious etiology and those without infectious etiology (Table 3). In terms of birth weight, serum WBC count and body temperature, there was no significant difference between the febrile neonates with infectious etiology and those with non-infectious causes. Table 4 displays the association between source of fever and demographic, clinical, and paraclinical factors. Also, there was no significant difference in the sex of the neonates, season in which the cases presented, feeding type, perinatal events (PROM and chorioamnionitis), and CXR findings between infectious source and non-infectious source of fever in the neonates. Moreover, there were statistically significant difference in blood culture, stool culture, urine culture, CSF culture and method of delivery between the two groups.

Logistic regression analysis was also used to determine the correlation between the variables and source of fever. The results of this test show that serum levels of BUN, sodium and CRP can accurately predict the etiology of fever in full-term infants. Table 4 shows predictive variables of fever etiology based on logistic regression analysis.

Paraclinical investigation	Number of samples investigated (N)	Number of positive samples [N (%)]	Number of negative samples [N (%)]
CXR	250	9 (3.6%)	241 (96.4%)
U/C	250	4 (1.6%)	44 (17.6%)
S/C	250	5 (2%)	62 (24.8%)
B/C	250	11 (4.4%)	238 (95.2%)
CSF culture	250	5 (2%)	94 (37.6%)
Laboratory tests			
Test	**Number of samples**	**Mean ± SD**	
Serum BUN	250	27.95 ± 26.12 mg/dl	
Serum sodium	250	142.02 ± 5.73 mg/dl	
Serum CRP	250	15.28 ±5.35 mg/dl	
WBC count (CBC)	250	10268.4 ± 4155.879/ml	

Table 3: *Paraclinical investigations.*

Group	Variable	Infectious source	Non-infectious source	P-value
Age (days)/ mean ± standard deviation		12.54 ± 7.73	8.78 ± 8.26	0.000
Sex				
Male		101 (56.7%)	36 (50%)	0.12
Female		77 (43.3%)	36 (50%)	
Gestational age(weeks)/mean ± standard deviation		38.33 ± 0.919	38.61 ± 1.01	0.036
Birth weight (g)/mean ± standard deviation		3123.86 ± 353.39	3159.8 ± 456.95	0.506
Weight on admission (g)/mean ± standard deviation		3254.59 ± 486.91	3007.5 ± 451.3	0.000
Weight loss (%)/ mean ± standard deviation		6.86 ± 4.28	10.21 ± 2.38	0.000
Positive history of PROM		24 (13.5%)	6 (8.3%)	0.257
Positive history of chorioamnionitis		6 (3.4%)	0	0.186
Type of feeding				
Exclusive breastfeeding		179 (73.7%)	56 (78.9%)	0.502
Formula		13 (7.4%)	6 (8.5%)	
Both		33 (18.9%)	9(12.7%)	
CRP (mg/dl)/mean ± standard deviation		29.03 ± 2.18	6.24 ± 0.73	0.000
Serum WBC count/ml/mean ± standard deviation		10262.3 ± 4389.09	8283.33 ± 3542.06	0.071
Positive blood culture		11 (4.4%)	0	0.045
Positive urine culture		4 (2.2%)	0	0.033
Positive stool culture		4 (2.2%)	0	0.001
Positive CSF culture		5 (2.8%)	0	0.036
Abnormal CXR		8 (4.5%)	1 (1.4%)	0.233
Serum BUN (mg/dl)/mean ± standard deviation		19.87 ± 13.16	47.94 ± 37.31	0.000
Serum sodium (mg/dl)/mean ± standard deviation		140.6 ± 4.3	145.53 ± 7.12	0.000
Body Temperature (°C)/mean ± standard deviation		38.37 ± 0.45	38.23 ± 0.38	0.701

Table 4: *Association between source of fever and demographic, clinical, and paraclinical factors. A significant association between serum CRP, BUN, and sodium levels and source of fever was observed. Also, body fluid cultures were associated with infectious source of fever.*

Discussion

Fever in neonates is considered as a warning sign of systemic infection, and so most febrile neonates are admitted for sepsis work-up and initiation of antibiotic therapy. The immaturity of the immune system in the first few months of life highlights the importance of fever in infants. Some febrile neonates do not appear sick but may be at risk of developing a serious bacterial infection (SBI). Serious bacterial infections have been reported in 15% of febrile neonates. Undiagnosed infections such as meningitis and bacteremia can lead to death or permanent neurological sequelae [14].

According to the protocol available at our medical center, febrile infants are admitted immediately and treated with intravenous antibiotics after laboratory investigations. Febrile neonates in a good general condition, normal feeding, and normal examination and laborato-

ry investigations, are likely to have dehydration fever. Unnecessary tests and empirical antibiotic treatment in infants are associated with serious complications such as nosocomial infections and antibiotic resistance. In the present study, high risk infants, including preterm infants, as well as neonates with fever in the first 24 hours were excluded. In our study, the febrile neonates were classified into one of the following categories of diagnosis: Proven sepsis (11 cases, 4.4%), suspected sepsis (111 cases, 44.4%), clinical sepsis (24 cases, 9.6%), Dehydration (72 cases, 28.8%) and other diagnosis (32, 12.8%).

Fever in neonates can be caused by non-infectious etiologies such as excessive clothing, dehydration, and poor breastfeeding. Appleton and Foo suggested that dehydration is an important cause of fever among febrile neonates who are exclusively breastfed, and they emphasized that existing studies have not paid much attention to dehydration fever in infant [15]. In their study, Singh., *et al*. attributed fever without infectious origin to environmental factors [16].

The prevalence of positive blood culture (4.4%) in the febrile neonates in the present study is different from that of Voora., *et al*. who reported a 10% prevalence of positive culture in febrile neonates. The difference in this finding between the two studies could be due to the difference in the inclusion criteria of the two studies. In the study of Voora., *et al*. symptomatic neonates and neonates with first-day fever were included. Symptomatic neonates and fever in the first 24 hrs of life predispose infants to SBI [17]. The analysis of data in the present study revealed a significant relationship between source of fever and age of the neonate, gestational age, weight on admission, percent weight loss, sodium level, BUN level, CRP level, and positive urine culture, as well as method of delivery. Logistic regression analysis however revealed that only BUN, sodium, and CRP levels can accurately predict the etiology of fever in full-term infants.

In a study conducted by Maayan-Metzger., *et al*. on 122 febrile neonates with no clinical symptoms of sepsis, it was reported that the main risk factor for developing fever after the first 24 hrs of life was excessive weight loss. In our study, there was a significant difference in weight on admission and the percent weight loss between the febrile neonates with infectious source and those with non-infectious causes, but logistic regression analysis showed that these variables are not excellent predictors of fever etiology. This difference can be explained by the difference in the study methodology. In the study of Maayan-Metzger., *et al*. the neonates were weighed daily and weight loss of more than 3% of birth weight per day was considered abnormal. Also, in their study, breastfeeding, cesarean section and high birth weight were other risk factors for neonatal fever without infectious cause [18]. In our study, there was significant difference in the method of delivery between the two groups, such that 142 out of the 178 newborns with infection as the source of fever were born by cesarean section. Thus, in the present study, cesarean section was identified as one of the risk factors for infection-induced fever in the full-term neonates. Also, in the present study, the mean sodium levels in the febrile neonates with infectious source and non-infectious source were 140.6 ± 4.3 and 145.53 ± 7.12, respectively (P = 0.000).

Hypernatremic dehydration in breastfed infants has been described in previous studies [19,20], some of whom have been reported to have fever [21]. In our study, there was no significant relationship between body temperature and sodium level, but in the study of Maayan-Metzger., *et al*. sodium levels were higher in children with fever above 38.4°C [18]. In their study, Philip and Hewitt examined laboratory factors which predict serious bacterial infection and identified white blood cell count and neutrophil count as the most important predictors of sepsis [22]. In our study, the average white blood cell count was higher in the neonates with infection source than in the neonates without infectious source, but this difference was not significant.

Conclusion

Majority of the febrile neonates were admitted in summer. We observed a significant correlation between the etiology of fever and the levels of BUN, sodium and CRP.

Ethical Considerations

The study was approved by the ethics committee of Tehran University of Medical Sciences. The principles of the Declaration of Helsinki were observed throughout the study.

Conflicts of Interest

The authors declare that there are no conflicts of interest regarding the publication of this paper.

Bibliography

1. Greenhow TL., *et al*. "Management and Outcomes of Previously Healthy, Full-Term, Febrile Infants Ages 7 to 90 Days". *Pediatrics* (2016): 138.
2. Huppler AR., *et al*. "Performance of low-risk criteria in the evaluation of young infants with fever: review of the literature". *Pediatrics* 125.2 (2010): 228-233.
3. Schwartz S., *et al*. "A week-by-week analysis of the low-risk criteria for serious bacterial infection in febrile neonates". *Archives of Disease in Childhood* 94.4 (2009): 287-292.
4. Smitherman HF and Macias CG. Febrile infant (younger than 90 days of age): Definition of fever (2017).
5. Edwards MS., *et al*. "Group B streptococcal infections". Remington JS, Klein JO, Wilson CB, Baker CJ, eds. Infectious Diseases of the Fetus and Newborn Infant. 6th edition. Philadelphia, Pa: Elsevier Saunders (2006).
6. Zachariassen G and Juvonen P. "Neonatal dehydrering (tørstefeber) hos nyfødte børn [Neonatal dehydration (dehydration fever) in newborn infants]". *Ugeskr Laeger* 164.42 (2002): 4930-4934.
7. Kourtis AP., *et al*. "Practice Guidelines for the Management of Febrile Infants Less Than 90 Days of Age at the Ambulatory Network of a Large Pediatric Health Care System in the United States: Summary of New Evidence". *Clinical Pediatrics* 43 (2004): 11-16.
8. Escobar GJ., *et al*. "Neonatal sepsis workups in infants >/=2000 grams at birth: A population-based study". *Pediatrics* 106.2-1 (2000): 256-263.
9. Baker MD and Avner JR. "The Febrile Infant: What's New?" *Clinical Pediatric Emergency Medicine* 9.4 (2008): 213-220.
10. Polin RA and the Committee on Fetus and Newborn. "Management of Neonates with Suspected or Proven Early-Onset Bacterial Sepsis". *Pediatrics* 129.5 (2012): 1006-1015.
11. Hamilton JL and John SP. "Evaluation of Fever in Infants and Young Children". *American Family Physician* 87.4 (2013): 254-260.
12. Vouloumanou EK., *et al*. "Serum procalcitonin as a diagnostic marker for neonatal sepsis: a systematic review and meta-analysis". *Intensive Care Medicine* 37.5 (2011): 747-762.
13. Benitz WE. "Adjunct laboratory tests in the diagnosis of early-onset neonatal sepsis". *Clinics in Perinatology* 37.2 (2010): 421-438.
14. Aronson PL., *et al*. "Evaluation of the Febrile Young Infant: An Update". *Pediatric Emergency Medicine Practice* 10.2 (2013): 1-20.
15. Appleton RE and Foo CK. "Dehydration fever in the neonate: a common phenomenon". *Archives of Disease in Childhood* 64 (1989): 765-766.
16. Singh M., *et al*. "Pathogenesis of so-called "dehydration fever" in the newborn". *Indian Pediatrics* 12 (1975): 465-467.
17. Voora S., *et al*. "Fever in full-term newborns in the first four days of life". *Pediatrics* 69 (1982): 40-44.
18. Maayan-Metzger A., *et al*. "Fever in healthy asymptomatic newborns during the first days of life". *Archives of Disease in Childhood. Fetal and Neonatal Edition* 88 (2003): F312-F314.

19. Oddie S., *et al*. "Hypernatremic dehydration and breast-feeding: a population study". *Archives of Disease in Childhood* 85 (2001): 318-320.

20. Manganaro R., *et al*. "Incidence of dehydration and hypernatremia in exclusively breast-fed infants". *The Journal of Pediatrics* 139 (2001): 673-675.

21. Ng PC., *et al*. "Early onset of hypernatremic dehydration and fever in exclusively breast-fed infants". *Journal of Paediatrics and Child Health* 35 (1999): 585-587.

22. Philip AGS and Hewitt JR. "Early diagnosis of neonatal sepsis". *Pediatrics* 65.5 (1980): 1036-1041.

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