IJN
Iranian Journal of Neonatology
http://ijn.mums.ac.ir

Open Access
Original Article

Lumbar Puncture in Neonates with Sepsis

Reza Saeedi[1], Gholamali Mamori[2], Simin Maghrebi[3]*, Maryam Ziadi LotfAbadi[4]

[1] Department of Pediatrics, Associate Professor of Neonatology, Mashhad University of Medical Sciences, Mashhad, Iran
[2] Department of Pediatrics, Professor of Neonatology, Mashhad University of Medical Sciences, Mashhad, Iran
[3] Department of Pediatrics, Resident of Neonatology, Mashhad University of Medical Sciences, Mashhad, Iran
[4] Department of Health, MD-MPH,Mashhad University of Medical Sciences, Mashhad, Iran

ABSTRACT

Introduction: Infections are one of the main causes of death during childhood. Epidemiologic studies in Iran showed that the incidence of neonatal sepsis was 1.8% in 1995. Moreover, the incidence of neonatal meningitis is 0.2 to 0.4 in per 1,000 live births. The aim of this study was to determine the necessity of lumbar puncture (LP) in early neonatal sepsis.

Methods: In a retrospective study, after obtaining ethical approval, we evaluated the records of 1,100 neonates, younger than 7 days, who were admitted to the hospital between 2001 and 2007. They were suspected of sepsis and thus, LP was performed. Statistical analyses were performed by SPSS version 16. Nominal variables were compared using Chi-square or Fisher's exact test. Other parametric and non-parametric tests were used as required.

Results: In our study, 1,100 neonates, suspected of sepsis, were evaluated. Of all neonates, 28.3% and 71.7% were older and younger than 3 days, respectively. Male-to-female ratio was 1:5 in 115 neonates. Sepsis was confirmed by positive blood culture, and 21 neonates (2.1%) had positive cerebrospinal fluid (CSF), which was significantly associated with blood culture results.

Conclusion: There was a significant relationship between blood culture and CSF culture results. However, regarding the low incidence of positive CSF, LP should be performed for each case, based on clinical manifestations and clinical opinion.

Keywords: Lumbar puncture, Neonatal sepsis, Neonate

Introduction

Infections are one of the main causes of neonatal mortality. Sepsis mortality rate was reported between 11 and 24 cases in 1,000 births in India (1). Backer, in 1986, described the clinical manifestation of systemic infection as positive blood culture (2).

Neonatal sepsis is a threatening condition, and any delay in its diagnosis can lead to death. Sepsis in the first three days of life is called early-onset sepsis; on the other hand, late-onset sepsis occurs between 4 and 90 days after birth. Moreover, the incidence of neonatal meningitis is 0.2 to 0.4 in 1,000 live births (3). Meningitis might be presented as an isolated phenomenon or in association with sepsis (4). Epidemiologic studies in Iran showed that the incidence of neonatal sepsis was 1.8% in 1995 (4).

The clinical manifestations of sepsis are nonspecific in most cases, and there is no definitive or accurate test to confirm sepsis; therefore, some children might receive unnecessary antibiotic therapies. Sepsis incidence is about 1-5 in 1,000 births, but antibiotics are administered for 4.4-10.5% of the neonates (5).

Today, empirical antibiotic therapy is recommended immediately after blood sampling, based on the regional bacteriological studies. Paraclinical tests, which might be helpful in sepsis diagnosis, are tests of complete blood count (CBC), C-reactive protein (CRP), blood culture (BC), and cerebrospinal fluid (CSF) culture (4).

Early diagnosis of sepsis in suspected neonates remains a major challenge in neonatology. Although blood and CSF cultures are gold standards for infection detection, they are time-consuming and require 48 to 72 hours (6). This problem is important in developing countries due to limited resources and inadequate personnel. Any delay in confirming sepsis increases the length of hospitalization and costs, and causes

* *Corresponding author*: Simin Maghrebi, Resident of neonatology, Mashhad University of Medical Sciences, Mashhad, Iran. email:maghrebis911@mums.ac.ir .

Table 1. Patients' demographic characteristics

Characteristics		No. (%)
Age at admission	<72 h	789 (71.7)
	≥72h	311 (28.3)
Gestational age	Preterm	561 (51)
	Term	539 (49)
gender	Male	663 (60.3)
	Female	437 (39.7)
Chief complaint	Respiratory distress	601 (54.6)
	Poor feeding	418 (38)
	Agitation	2 (0.2)
	Icter	44 (4)
	Seizure	35 (3.1)
Blood culture	+	115 (10.5)
	-	895 (89.5)
CSF culture	+	21 (1.9)
	-	1079 (98.1)

trouble for the family, society, and health care services. The aim of this study was to determine the necessity of lumbar puncture (LP) in early neonatal sepsis.

Materials and Methods

This study was designed as a retrospective study in the neonatal intensive care unit (NICU) of an academic tertiary hospital. After obtaining the ethical approval, we evaluated the records of neonates younger than 7 days, who were admitted to the hospital between 2001 and 2007; they were suspected of sepsis and thus, LP was performed. Purposive sampling method was applied, and the minimum sample size was 1,000 neonates.

A suspected condition was defined as neonates presenting with poor feeding, ill appearance, lethargy, hypotony, apnea, cyanosis, respiratory distress, diarrhea, vomiting, hyperthermia, hypothermia, and skin manifestations. The exclusion criteria were as follows: 1) infants older than 7 days, 2) meningitis, and 3) no suspicion of sepsis.

Demographic characteristics such as age and gender were recorded along with paraclinical test results. Normal CSF was identified as CSF without microbiologic contamination, with normal protein (84 mg/dl) and normal glucose (more than 40 mg/dl), and less than 10 White Blood Cells (WBC). All other CSF results were considered positive for meningitis. Patients' demographic characteristics are shown in Table 1.

Statistical analysis was performed by SPSS version 16. Nominal variables were compared using Chi-square or Fisher's exact test. Other parametric and non-parametric tests were used as required.

Results

In this study, 1,100 neonates were evaluated.

Table 2. Correlations between demographic characteristics and paraclinical results of blood culture

Characteristics		Blood culture		*P*-value
		Positive No (%)	Negative No (%)	
Age at admission	<72 h	54 (6.8)	735 (93.2)	<0.000
	≥72 h	61 (19.6)	250 (80.4)	
Gestational age	Preterm	79 (14.1)	482 (85.9)	<0.000
	Term	36 (6.6)	503 (93.3)	
gender	Male	90 (13.6)	573 (86.4)	<0.000
	Female	25 (5.7)	412 (94.3)	
Chief complaint	Respiratory distress	68 (12.2)	533 (87.8)	0.085
	Poor feeding	40 (9.5)	378 (90.5)	
	Agitation	0	2 (0.2)	
	Icter	0	44 (4)	
	Seizure	0	35 (3.2)	
CSF culture	+	6 (28.5)	15 (71.4)	0.006
	-	109 (10.2)	970 (89.8)	

Of all neonates, 28.3% and 71.7% were older and younger than 3 days, respectively. Positive blood culture and CSF culture were confirmed in 115 (10.5%) and 21 neonates (1.9%), respectively. Table 2 shows the correlations between demographic characteristics and paraclinical results of blood culture.

The incidence of positive blood culture was higher in children older than 72 hours (P<0.000). Positive blood culture was associated with prematurity (P<0.000). Chief complaint had no significant effect on blood culture results (P=0.085). There was a significant relationship between blood culture and CSF culture results (P<0.000).

Table 3 shows the relationships between demographic characteristics and paraclinical results related to CSF culture.

CSF culture result was not associated with the neonate's age, chief complaint, gender, or gestational age.

Discussion

Neonatal sepsis refers to a generalized infectious syndrome, confirmed by various clinical and paraclinical tests such as blood culture. Sepsis is one of the major causes of mortality and morbidity. Despite the advances in sepsis therapeutic approaches and the significant reduction in neonatal mortality from 90% to 13-50% in recent years, its diagnosis still remains a controversial issue (7). Antibiotic administration and LP are performed in many cases without confirmed sepsis; these treatments are costly and annoying for infants and parents.

Between 2001 and 2007, 1100 neonates, suspected of sepsis, underwent LP in our tertiary hospital. Their main chief complaints were

Table 3. Relationships between demographic characteristics and paraclinical results with regard to CSF culture

Characteristics		CSF culture		*P*-value
		Positive No (%)	Negative No (%)	
Age at admission	<72 h	10 (1.3)	779 (98.7)	0.13
	≥72h	11 (3.5)	300 (96.5)	
Gestational age	Preterm	12 (2.1)	549 (97.9)	0.570
	Term	9 (1.7)	530 (98.3)	
Gender	Male	13 (2)	650 (98)	0.67
	Female	8 (1.8)	429 (98.2)	
Chief complaint	Respiratory distress	13 (2.1)	588 (97.9)	0.523
	Poor feeding	7 (1.6)	411 (98.4)	
	Agitation	0	2 (0.2)	
	Icter	0	44 (4)	
	Seizure	1 (2.8)	34 (97.1)	

respiratory distress (54.6%) and poor feeding (38%). Blood culture was positive in 10.5% of children and CSF culture was positive in 21 neonates (2.1%).

Escobar evaluated 608,014 term neonates between 1993 and 2007 in the United States. According to the obtained results, the incidence of sepsis was 0.05% in this country (350 neonates) (3). Our findings were dissimilar to his study results, since we evaluated a suspected population, including term and preterm neonates. On the other hand, this discrepancy might be due to differences in health status and health care services between developed and developing countries. Escobar also highlighted the role of clinical suspicion and neonatal and maternal features for diagnosing sepsis and reducing the percentage of unnecessary antibiotic usage (3).

Epidemiologic studies in Tehran, Iran, determined the incidence of sepsis as approximately 9% in suspected neonates (8, 9). In Afjeiee's study, only 3.5% of children underwent LP, which was negative in all cases (9). Amid's study concluded that only 3.3% of cases with neonatal sepsis had positive CSF cultures (10). These results are similar to ours and demonstrated that a small number of children with clinical manifestations of sepsis might have positive CSF.

In a study in Yazd, Iran, sepsis prevalence was estimated 3%, which is lower than the rate in Mashhad (4). This variation might be due to different inclusion and exclusion criteria of the studies; moreover, our study was performed on a larger sample size for a longer period of time.

Wiswell, in a long-term follow-up study, concluded that delay in LP examination in suspected neonates led to meningitis misdiagnosis in children with positive blood culture and could cause severe neurological consequences (11). Patrick proposed that the necessity of LP in suspected neonates depends on the hospital level (such as tertiary and academic hospitals), neonatal features, and clinical manifestations (12). This variation in results from 1995 to 2012 is due to the advances in technology and therapeutic and diagnostic methods in this time interval; it is also related to the increasing knowledge of clinical and paraclinical parameters of sepsis.

Conclusion

Our findings showed that there was an association between blood culture and CSF culture results. Despite the low incidence of positive CSF in neonates with sepsis, this test should be considered in cases with suspected manifestations, based on clinician opinion.

References

1. Nizet V, Klein J. Bacterial Sepsis and Meningitis, in Infectious Diseases of the Fetus and Newborn. Philadelphia, PA: Elsevier Saunders; 2010.
2. Ray B, Mangalore J, Harikumar C, Tuladhar A. Is lumbar puncture necessary for evaluation of early neonatal sepsis? Arch Dis Child. 2006; 91: 1033-5.
3. Escobar G, Puopolo K, Wi S, Turk B, Kuzniewicz M, Walsh E, et al. Stratification of Risk of Early-Onset Sepsis in Newborns ≥34 Weeks' Gestation. Pediatrics. 2014; 133:30-6.
4. Keyhani Z, Safarnavadeh M. Breast feeding and neonatal sepsis. RJMS. 1995; 1:239-47. (Persian)
5. Eslami Z, Borjian L. The role of C-reactive protein in diagnosis of neonatal early-onset sepsis. The Journal of Qazvin University of Medical Sciences. 2007; 11:5-8. (Persian)
6. Odetola F, Tilford J, Davis M: Variation in the use of intracranial-pressure monitoring and mortality in critically ill children with meningitis in the United States. Pediatrics 2006, 117(6):1893-1900
7. Mosaiebi Z, Dalili S, Movahedian A, Mousavi S, Banitaba S. Diagnostic value of clinical signs in neonatal sepsis. KAUMS Journal (FEYZ). 2001; 5: 54-8. (Persian)
8. Borna H, Zaeri F, Sabzi A. Evaluation of clinical and laboratory in neonates suspected for sepsis. Daneshvar. 2005. 12: 1-8. (Persian)
9. Afjeiee SA, Golnabi A, Rafiee Tabatabaei S. Determining the Frequency of Neonatal Sepsis Based on Premature Rupture of Membrane (PROM) -Scoring System at Mahdieh Hospital in Tehran. Pajoohandeh Journal. 2008; 13:159-165. (Persian)
10. Amid MH. Neonatal meningitis and sepsis incidence in children admitted in Mofid hospital between 1997-1998. Reaserch in medicine. 2002. 26: 57-63. (Persian)
11. Wiswell T, Baumgart S, Gannon C, Spitzer A. No Lumbar Puncture in the Evaluation for Early Neonatal Sepsis: Will Meningitis Be Missed? Pediatrics. 1995; 6: 803-6.

12. Patrick S, Schumacher R, Davis M. Variation in lumbar punctures for early onset neonatal sepsis: a nationally representative serial cross-sectional analysis, 2003-2009. BMC Pediatr. 2012; 12:134.