Lumbar Puncture in Neonates with Sepsis

Reza Saeedi¹, Gholamali Mamori², Simin Maghrebi³*, Maryam Ziadi LotfAbadi⁴

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
Students 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. Of all neonates, 28.3% and 71.7% were older and younger than 7 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<0.001). Positive blood culture was associated with prematurity (P<0.001). 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<0.001).

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, 1,100 neonates, suspected of sepsis, underwent LP in our tertiary hospital. Their main chief complaints were 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 microbiological 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.

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>No. (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age at admission</td>
<td>&lt;72 h 789 (71.7)</td>
</tr>
<tr>
<td>Gestational age</td>
<td>Preterm 561 (51)</td>
</tr>
<tr>
<td>gender</td>
<td>Male 663 (60.3)</td>
</tr>
<tr>
<td>Respiratory distress</td>
<td>Poor feeding 418 (38)</td>
</tr>
<tr>
<td>Blood culture</td>
<td>* 115 (10.5)</td>
</tr>
<tr>
<td>CSF culture</td>
<td>* 21 (1.9)</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Blood culture</th>
<th>Blood culture</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age at admission</td>
<td>&lt;72 h 54 (6.8)</td>
<td>≥72h 735 (93.2)</td>
</tr>
<tr>
<td>Gestational age</td>
<td>Preterm 79 (14.1)</td>
<td>Term 36 (6.6)</td>
</tr>
<tr>
<td>gender</td>
<td>Male 90 (13.6)</td>
<td>Female 25 (5.7)</td>
</tr>
<tr>
<td>Respiratory distress</td>
<td>Poor feeding 40 (9.5)</td>
<td>Agitation 0</td>
</tr>
<tr>
<td>CSF culture</td>
<td>* 6 (20.5)</td>
<td>- 109 (37.1)</td>
</tr>
</tbody>
</table>

Table 3. Correlations between demographic characteristics and paraclinical results related to CSF culture.

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<0.001). Positive blood culture was associated with prematurity (P<0.001). 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<0.001).

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.
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%).

Escober 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. Escober 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.

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

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>CSF culture</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Positive</td>
<td>Negative</td>
</tr>
<tr>
<td>Age at admission</td>
<td>&lt;72 h</td>
<td>10 (1.3)</td>
</tr>
<tr>
<td></td>
<td>≥72 h</td>
<td>11 (3.5)</td>
</tr>
<tr>
<td>Gestational age</td>
<td>Preterm</td>
<td>12 (2.1)</td>
</tr>
<tr>
<td></td>
<td>Term</td>
<td>9 (1.7)</td>
</tr>
<tr>
<td>Gender</td>
<td>Male</td>
<td>13 (2)</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>8 (1.8)</td>
</tr>
</tbody>
</table>

**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**