

Bacillus Cereus Sepsis In Preterm Neonates Caused By Central Venous Catheter: A Case Report

Li Xiaoxiao¹, Long Dianfa², Xu Hui³ and Yang Min^{4#}

1Department of Neonatology, Zaozhuang Maternal and Child Health Hospital, Zaozhuang, 277000, China

2Department of Pediatrics, Zaozhuang Maternal and Child Health Hospital, Zaozhuang, 277000, China

3Department of Clinical Laboratory, Zaozhuang Maternal and Child Health Hospital, Zaozhuang, 277000, China

4Division of Neonatology, Obstetrics and Gynecology Hospital of Fudan University, Shanghai, 200011, China

corresponding author:

Yang Min,

1Department of Neonatology, Zaozhuang Maternal and Child Health Hospital, Zaozhuang, 277000, China

E-mail address: yang2011min@126.com

Received Date: 01 Dec 2023

Accepted Date: 15 Dec 2023

Published Date: 22 Dec 2023

Citation:

Yang Min. Bacillus Cereus Sepsis In Preterm Neonates Caused By Central Venous Catheter: A Case Report. International Journal of Clinical and Medical Case Reports

1. Abstract

In recent years, Bacillus cereus infection has emerged as a main concern in the field of children's public health. This bacterium, known to be a pollutant, can be found in various settings such as hospital wards, equipment, breast milk, nutrient solution and so on. With its high pathogenicity and toxicity, Bacillus cereus infection can lead to severe and life-threatening symptoms, particularly in premature infants. This case report documents the death of a preterm infant due to Bacillus cereus sepsis, septic shock, meningitis, and pneumonia, all of which were linked to the use of a central venous catheter.

2. Keywords :

Bacillus cereus Preterm neonates Central venous catheter

3. Introduction

Bacillus cereus is a gram-positive bacillus commonly found in hospitals, and considered a "laboratory contaminant"[1]. It is an opportunistic pathogen that causes nosocomial infections, especially in immunocompromised

patients[2]. Preterm neonates, due to their immature immune system and exposure to invasive procedures are at a heightened risk. Bacillus cereus can lead to severe and potentially fatal infections in neonates[2].

4. Case presentation

A male infant born on July 11, 2019 via cesarean section, was one of twins with a gestational age of 29+4 weeks. He weighed 1.56 kg at birth, with Apgar scores of 9, 5, and 8 at 1, 5, and 10 minutes, respectively. He received treatment with ampicillin-sulbactam and cefotaxime for infection within 7 days after birth. Follow-up assessments showed normal infection indicators. Non-invasive respiratory support was provided for the first 10 days, and he exhibited stable spontaneous breathing after the removal of the ventilator. On the 5th day, peripherally inserted central catheter (PICC) was placed. On day 20, he developed redness and swelling at the PICC catheter site. This was followed by a fever (37.9°C), shallow breathing, decreased oxygen saturation, increased heart rate, reduced milk intake, fixed gaze, and poor responsiveness. Diagnostic tests revealed elevated C-reactive protein levels (35.7 mg/L), decreased white blood cell count ($3.18 \times 10^9/L$), and purulent meningitis (cerebrospinal fluid protein: 1249 mg/L, white blood cell count: $897 \times 10^6/L$, cerebrospinal fluid glucose: 1.6 mmol/L) (Table 1). These findings indicated sepsis and purulent meningitis, suggesting a PICC-related bloodstream infection. The neonate was diagnosed with hospital-acquired sepsis and immediately started on meropenem and ampicillin-sulbactam combination therapy to control the infection.

Table 1: Peripheral blood routine, blood gas, and cerebrospinal fluid biochemical results on the first day after infection

CRP	WBC	PCT	Lac	BE	Serum sodium	CSF WBC	CSF glucose	CSF protein
(mg/L)	($10^9/L$)	(ng/ml)	(mmol/L)	(mmol/L)	(mmol/L)	($10^6/L$)	(mmol/L)	(mg/L)
35.7	3.18	7.43	7.9	-15	122	897	1.6	1249

Abbreviations: CRP, C-reactive protein; WBC, white blood cell; PCT, procalcitonin; Lac, lactic acid; BE, base excess; CSF, cerebrospinal fluid.

On day 21, his body temperature spiked to 39.3°C, accompanied by convulsions, frequent episodes of apnea, and decreased heart rate. Invasive ventilator support was initiated. Blood culture from peripheral veins showed the presence of Gram-positive bacilli (Figure 1), leading to treatment with vancomycin. Subsequent cultures of PICC confirmed the presence of Bacillus cereus (Figure 2, Table 2), identified through mass spectrometry analysis with an identification score of 2.03.

International Journal of Clinical and Medical Case Reports

Table 2: Blood routine, blood culture from PICC, peripheral veins, bacterial culture from PICC catheter tip and CSF culture results on the second day after infection

CRP (mg/L)	WBC ($10^9/L$)	Blood culture from PICC	Blood culture from peripheral veins	bacterial culture from PICC catheter tip	CSF culture
138.6	4.16	positive	positive	positive	negative

Figure 1: Blood culture smear

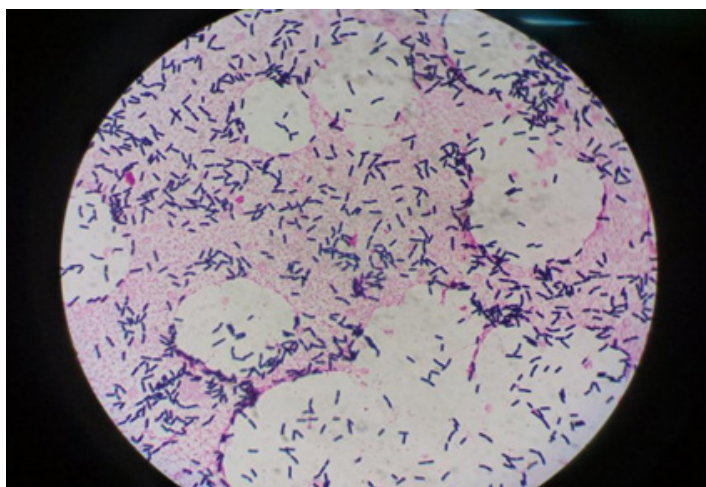
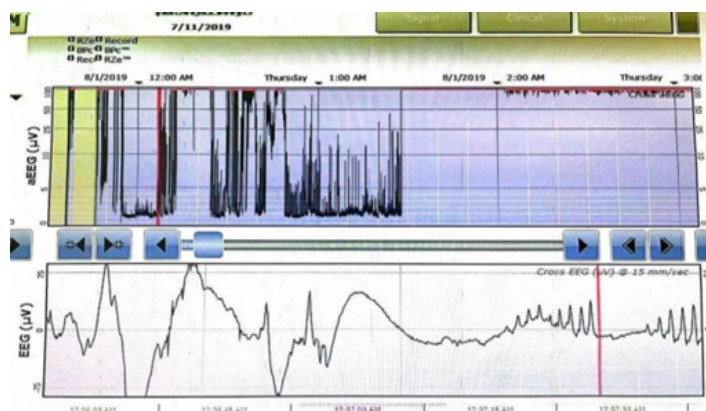


Figure 2: PICC catheter tip bacterial culture



Drug sensitivity testing indicated that both meropenem and vancomycin were effective against the identified strain. Despite ongoing treatment, the patient experienced recurring high fever and frequent seizures. Brain function examinations indicated severe brain injury with frequent burst suppression (Figure 3), and the patient died on the 23rd day. Abbreviations: CRP, C-reactive protein; WBC, white blood cell; PCT, procalcitonin; Lac, lactic acid; BE, base excess; CSF, cerebrospinal fluid.

Figure 3: Results of the electroencephalogram (EEG)



Gram staining of blood culture revealed Gram-positive slender single-ended, paired, and short round rods. After incubating the specimen at 35 degrees Celsius for 18 hours, gray, opaque colonies with beta-hemolysis were found surrounding the catheter on 5% sheep blood agar. EEG indicates burst suppression.

5. Discussion

This case highlights a common bloodstream infection associated with central venous catheters. The infection is believed to be caused by factors such as inadequate hand hygiene or contaminated intravenous nutrition. The lack of environmental sampling in the hospital setting has contributed to limited knowledge about *Bacillus cereus*. Although no hospital-wide outbreaks were reported, it is important to recognize that high-risk groups, such as preterm neonates, are susceptible to various invasive and potentially fatal infections. *Bacillus cereus* is an important but neglected human pathogen. It is a Gram-positive rod-shaped bacterium. Several toxins have been implicated in disease, such as the pore-forming toxins hemolysin BL (HBL), the nonhemolytic enterotoxin (NHE). These clinical manifestations include vomiting, gastroenteritis, endophthalmitis, respiratory tract infections, and sepsis. HBL can form pores in the plasma membrane and exert cytotoxicity on mammalian immune and non-immune cells. HBL binds to the mammalian surface receptors LITAF and CDIP1 and that both HBL and NHE induce potassium efflux and activate the NLRP3 inflammasome, leading to pyroptosis[3]. A retrospective analysis by Lotte et al. identified 69 cases of *Bacillus cereus* sepsis in preterm neonates, with a mortality rate as high as 36%[2]. As of now, six cases were identified as having positive catheter culture or blood culture from catheter, resulting in the death of three patients [4-8]. With the addition of our case, the mortality rate of *Bacillus cereus* sepsis caused by catheter-related infections in preterm neonates was reported to be as high as 60%. To mitigate the risk of catheter-related bloodstream infections, it is crucial to ensure the involvement of proficient healthcare professionals, particularly experienced nurses, in performing central venous catheterization and conducting daily maintenance procedures[9]. Strict adherence to hand hygiene practices, regular catheter evaluations, and compliance with catheter prevention and control guidelines are essential in minimizing infection occurrences[10]. Moreover, implementing additional measures,

including catheter lock therapy, routine assessment of the ongoing need for parenteral nutrition, preference for enteral nutrition support over parenteral nutrition, glucose control, and avoidance of overfeeding, can further reduce the likelihood of complications[11].

With the rising number of preterm neonates, the prevention of nosocomial infections has become a paramount concern as a global public health issue. However, in 2019, medical institutions in our city showed insufficient attention to the prevention and control of nosocomial infections, particularly in the neonatal intensive care unit (NICU). Unfortunately, there was a lack of dedicated infection control staff in the NICU, which further exacerbated the situation. It is regrettable that a comprehensive investigation into the source of the infection was not conducted at that time.

6. Conclusion

Due to its elevated pathogenicity and toxicity, *Bacillus cereus* infection can cause severe and life-threatening symptoms, especially in preterm infants. To prevent *Bacillus cereus* infection during central venous catheterization, strict infection control measures are vital. These practices should be followed in neonatal care units and primary healthcare facilities to effectively reduce the incidence of *Bacillus cereus* infection.

References

1. Bottone E J. *Bacillus cereus*, a Volatile Human Pathogen[J]. *Clinical Microbiology Reviews*, 2010,23(2):382-398.
2. Lotte R, Chevalier A, Boyer L, et al. *Bacillus cereus* Invasive Infections in Preterm Neonates: an Up-to-Date Review of the Literature[J]. *Clin Microbiol Rev*, 2022,35(2):e8821.
3. Enosi Tuipulotu D, Mathur A, Ngo C, et al. *Bacillus cereus*: Epidemiology, Virulence Factors, and Host–Pathogen Interactions[J]. *Trends in Microbiology*, 2021,29(5):458-471.
4. Glasset B, Herbin S, Granier S A, et al. *Bacillus cereus*, a serious cause of nosocomial infections: Epidemiologic and genetic survey[J]. *PloS one*, 2018,13(5):e194346.
5. Lotte R, Hérissé A, Berrouane Y, et al. Virulence Analysis of *Bacillus cereus* Isolated after Death of Preterm Neonates, Nice, France, 2013[J]. *Emerging Infectious Diseases*, 2017,23(5):845-848.
6. Campbell J R, Hulten K, Baker C J. Cluster of *Bacillus* species bacteremia cases in neonates during a hospital construction project[J]. *Infect Control Hosp Epidemiol*, 2011,32(10):1035-1038.
7. Evreux F, Delaporte B, Leret N, et al. Méningite néonatale à *Bacillus cereus*, à propos d'un cas[J]. *Archives de Pédiatrie*, 2007,14(4):365-368.
8. Heep A, Schaller C, Rittmann N, et al. Multiple brain abscesses in an extremely preterm infant: treatment surveillance with interleukin-6 in the CSF[J]. *European Journal of Pediatrics*, 2004,163(1):44-45.
9. Mobley R E, Bizzarro M J. Central line-associated bloodstream infections in the NICU: Successes and controversies in the quest for zero[J]. *Seminars in Perinatology*, 2017,41(3):166-174.
10. Timsit J, Baleine J, Bernard L, et al. Expert consensus-based clinical practice guidelines management of intravascular catheters in the intensive care unit[J]. *Annals of Intensive Care*, 2020,10(1).
11. Opilla M. Epidemiology of bloodstream infection associated with parenteral nutrition[J]. *American Journal of Infection Control*, 2008,36(10):S173-S175.