FIRST CLINICAL CASE REPORT

Postpartum bacteraemia outbreak due to *Bacillus cereus* in the delivery room

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Abstract

We report an outbreak *Bacillus cereus* causing postpartum bacteraemia in the maternity ward and delivery room. Spores transferred by the hands and gloves of the staff in the maternity ward contaminated equipment in these two areas.

Keywords: *Bacillus cereus*, bacteremia, maternity ward, sterilization
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Introduction

Bacillus cereus is a Gram-positive facultative aerobic endospore-forming rod. Humans are contaminated via the spores that remain metabolically inactive in the environment but take the form of vegetative cells when they infect the human body [1].

The pathogenicity of *B. cereus* infections depends on tissue-destructive exoenzymes such as enterotoxins, emesis-inducing toxin, haemolysins, proteases, collagenases and phospholipase C. As a result, *B. cereus* causes gastrointestinal and non-gastrointestinal infections. Moreover, a special surface structure called the S-layer of the bacillus enhances adhesion to host cells and protects from phagocytosis [2,3].

Enteric infections due to *B. cereus* are divided into two types. In the first type the contaminated food is left at room temperature, and 6 to 15 hours after consumption a large-molecular-weight protein is released that causes mainly diarrhea, cramps and nausea. In the second type, the emetic-type illness, the affected food is usually rice containing the toxin cereulide, which is stable to pH and heat and is also protease resistant. The incubation period is 30 minutes to 6 hours [3].

B. cereus as the causative agent of nosocomial bacteraemia outbreak has been reported in the neonatology hospital ward, emergency department, intensive care unit, haematology department and gastroenterology department [4]. An outbreak of bacteraemia due to contaminated linen was reported in Hong Kong in 2017 [5].

The colonies of *B. cereus* and *B. thuringiensis* of the *B. cereus* group are usually large. They present β-haemolysis, ground-glass appearance and swarming due to the motility of the bacillus [1,6,7].

Here we describe an outbreak of postpartum bacteraemia in the maternity ward due to *B. cereus*. The environmental setting of the maternity ward and the delivery room were thoroughly checked, with the operating table headrest and the portable anesthesia machine in the delivery room found to be contaminated.

Methods

Blood samples of five patients hospitalized in the maternity ward of a 750-bed university hospital who had postpartum fever were inoculated into BAC/TAlert 3D (bioMérieux, Marcy l'Étoile, France) blood aerobic culture bottles. Identification of the culpable microorganism was performed by Gram stain, catalase production, motility test and BBL Crystal Identification Systems for Gram Positive Bacteria (BD Diagnostics, Le Pont de

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Claix, France). Antibiotic susceptibility testing was performed by the disc diffusion and a gradient method (Etest, bioMérieux) [8]. Biofilm production was tested by the 96-well microtitre plate method [9].

Environmental samples were collected using Stuart transport medium swabs from the operating table headrest, surgical bed, portable anesthesia machine, anesthesia tray setup, anesthesia table, operating theatre projectors, baby bed in the delivery room and delivery room projectors. Swabs were directly inoculated onto blood agar plates, which were incubated at 37° C overnight. The following day we screened the characteristic β-haemolytic colonies of *B. cereus*.

The bioethics committee of the University General Hospital of Patras approved the study (approval 4516) and waived the need for informed consent because isolates were recovered under routine diagnostic procedures for the outbreak. The staff was informed regarding the results and the appropriate precautions.

Results

Blood cultures from all five patients revealed the presence of Gram-positive spore-forming rods, with opaque colonies surrounded of β-haemolysis onto blood agar plates and a positive motility test, catalase-positive, biofilm-producing microorganism identified as *B. cereus* by BBL GP Crystal Identification Systems (bionumber 1315000165, BD Diagnostics).

Two samples obtained from the operating table headrest and the portable anesthesia machine were positive for *B. cereus*. The isolates showed the same biotype and antimicrobial susceptibility phenotype with the clinical ones. All isolates recovered from patient and environmental samples were slime producers and were susceptible to amikacin, ampicillin/sulbactam, cefoxitin, ceftriaxone, ceftazidime, ciprofloxacin, chloramphenicol, erythromycin, gentamicin, penicillin G, sulfamethoxazole/trimethoprim, tobramycin, imipenem (MIC = 0.064 mg/L), vancomycin (MIC = 0.25 mg/L), teicoplanin (MIC = 0.50 mg/L), linezolid (MIC = 0.75 mg/L) and daptomycin (MIC = 1 mg/L).

The patients were treated successfully with ampicillin/sulbactam. The operating table headrest in the delivery room and the portable anesthesia machine were sterilized by sodium hypochlorite 5.25% to 6.15% [10,11]. After the implemented measures, cultures from the culpable surfaces were negative.

Discussion

The genus *Bacillus* includes Gram-positive rods that produce spores not altering the shape of the bacterium. It is suggested that *B. anthracis, B. thuringiensis, B. cereus, B. pseudomycoides, B. weihenstephanensis* and *B. mycoides* are varieties of the same species, known as the *B. cereus* group [7,12,13].

The identification of *Bacillus* species by the use of conventional tests depends on phenotypic characteristics such as cellular morphology; shape, position and appearance of endospores; and determination of biochemical characteristics [6]. The taxonomic relationship between many species is unclear, as there is considerable chromosomal similarity among them. As a result *B. anthracis, B. thuringiensis* and *B. cereus* are all varieties of a single species [7].

The existence, location and shape of the spores are usually determined by Gram stain or other stains for spores [6]. In our samples Gram stain sufficiently determined spore formation, location and shape.

B. cereus causes food poisoning or nongastrointestinal disease; locally ignites skin and ocular infections; systemically provokes infection of the central nervous system and the respiratory system; and may cause endocarditis and pericarditis [7,12,13].

B. cereus–induced bacteraemia is often transient, with clinical significance in immunocompromised hosts, patients with continuous intravenous infusions and neonates. It is always considered significant when isolated from blood cultures [7]. Our patients with *B. cereus* postpartum bacteraemia gave birth during the same time period in a common delivery room, and the isolates had identical phenotypic characteristics. These observations suggested that the source of the postpartum fever was the hospital environment.

Most *B. cereus* strains produce β-lactamases, and therefore the microbe is resistant to penicillins and caphalosporins [1,7,14]. Three different β-lactamases have been reported for *B. cereus*. β-Lactamases I and III are group A enzymes, whereas β-lactamase II is a heat-stable metallo-β-lactamase [15]. Resistance to erythromycin, tetracycline and carbapenems has also been reported [1,7].

Usually *B. cereus* is susceptible to erythromycin, clindamycin, aminoglycosides, ciprofloxacin, vancomycin and chloramphenicol. In daily practice, vancomycin or clindamycin are the antibiotics of choice, but resistance via the *vanA* gene has also been reported [1,7]. Our patients were treated with ampicillin/sulbactam, according to the antimicrobial susceptibility results.

In the nosocomial environment, the spores can be found in air filtration, intravenous catheters, gloves and hands of staff, endoscopy equipment and linen; further, they can survive in alcohol-based hand wash solutions [1,7]. As a result, the presence and action of an infection control committee in the hospital setting is crucial, and standard precautions are vital. Hand hygiene is important in order to eliminate the transmission via contact. Alcohol-based hand rubs do not eliminate the spores of *B. cereus*. The use of gloves should be additive to, and not a substitute for, hand hygiene. Sterilization has

sporicidal properties and is adequate to eliminate the *Bacillus* spores [12]. This can be performed by using natural or chemical methods such as pressurized steam (autoclave), dry heating, ethylene oxide gas, hydrogen peroxide gas plasma or liquid chemicals in order to both prevent and eliminate the *Bacillus* spores [11]. Among liquid chemicals, glutaraldehyde (>2.0%), 0.95% glutaraldehyde and 1.64% phenol/phenate, hydrogen peroxide (7.5%), peracetic acid (0.2%), hydrogen peroxide (1.0%) and peracetic acid (0.08%) or hydrogen peroxide (7.35%) and peracetic acid (0.23%) can be used [11].

A limitation of our study is that we did not apply molecular methods to detect virulence determinants or assess the clonal relationship of the strains; however, because all phenotypic characteristics were identical and the analysis was performed immediately, we assume that the strains were related.

Conclusion

In our case it seems that spores of *B. cereus* transferred by hands and gloves of the staff in the maternity ward contaminated the operating table headrest and the portable anesthesia machine in the delivery room, causing postpartum bacteraemia in patients that was successfully controlled.

Conflict of Interest

None declared.

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