Bacillus cereus Fasciitis: A Unique Pathogen and Clinically Challenging Sequela of Inoculation

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Abstract

Bacillus cereus is an aerobic, spore-forming, gram-positive rod. It has historically been associated with "fried rice syndrome," a foodborne diarrheal and emetic illness resulting from eating fried rice dishes that have been sitting at room temperature for hours. We report the case of a 9-year-old boy who developed culture-positive *B cereus* fasciitis of the right lower extremity after being impaled on a tree branch. This case report further elucidates and emphasizes the importance of recognizing *B cereus* as a possible cause of severe soft-tissue infection. It must be included in the differential diagnosis of gas gangrene and necrotizing fasciitis.

Bacillus cereus is an aerobic, spore-forming, gram-positive rod. It has historically been associated with "fried rice syndrome," a foodborne diarrheal and emetic illness resulting from eating fried rice dishes that have been sitting at room temperature for hours. Although this illness is a serious consequence of inoculation, an even more devastating sequela is the soft-tissue infection that the illness can cause. In the setting of penetrating trauma or postsurgical contamination, *B cereus* can mimic necrotizing fasciitis, with tissue destruction mandating urgent surgical debridement, systemic resuscitation, and antimicrobial therapy. In this article, we report the case of a 9-year-old boy who developed culture-positive *B cereus* fasciitis of the right lower extremity after being impaled on a tree branch. Institutional review board approval was obtained, and the patient and his family provided written informed consent for print and electronic publication of this case report.

Case Report

An otherwise healthy 9-year-old boy presented to the emergency department approximately 4 hours after tripping and impaling his right leg on a tree branch. On physical examination, the emergency department physician found the branch had entered approximately 3 cm distal to the fibular head on the lateral aspect of the leg. The patient was neurovascularly intact. Plain radiographs showed no air pocket, fracture, or other osseous abnormality. The wound was irrigated, and its edges loosely approximated under sterile conditions by emergency department staff. After a dressing was applied, the patient was discharged home on a 5-day course of oral cephalexin. Laboratory studies and orthopedic consultation were not obtained during this visit.

Approximately 36 hours later, the patient returned to the emergency department with fevers and increasing right lower extremity pain, swelling, and erythema surrounding the wound. Repeat radiographs did not identify any foreign object or air pocket within the soft tissues of the right leg. Computed tomography (CT) of the right lower extremity and basic laboratory studies were obtained. White blood cell (WBC) count was 17.3×10^6 cells/L (reference range, $4\text{-}11\times10^6$ cells/L), and CT showed 2 air pockets within the anterolateral soft tissues of the leg (**Figure 1**). Given these findings, empiric antibiotic therapy was initiated with vancomycin and meropenem. The orthopedic surgery department was consulted, and, after evaluation, the patient was brought to the operating room for formal irrigation and debridement of a presumed necrotizing fasciitis.

In the operating room, purulent debris and remnants of the tree branch were found in the wound; it was thoroughly irrigated and debrided. Anterior and lateral compartment fasciotomies were performed secondary to the severe swelling and soft-tissue destruction found within the compartments. The anterior and lateral musculature of the leg appeared viable. The wound was left open, and broad-spectrum antibiotics were continued.

Despite the fasciotomies and the open surgical wound, on postoperative day 2 the right leg was again significantly swollen and painful, as were the right thigh and the inguinal region. WBC count was 28×10^6 cells/L (reference range, $4\text{-}11\times10^6$ cells/L), C-reactive protein level was 116 mg/L (reference range, 0-8 mg/L), and erythrocyte sedimentation

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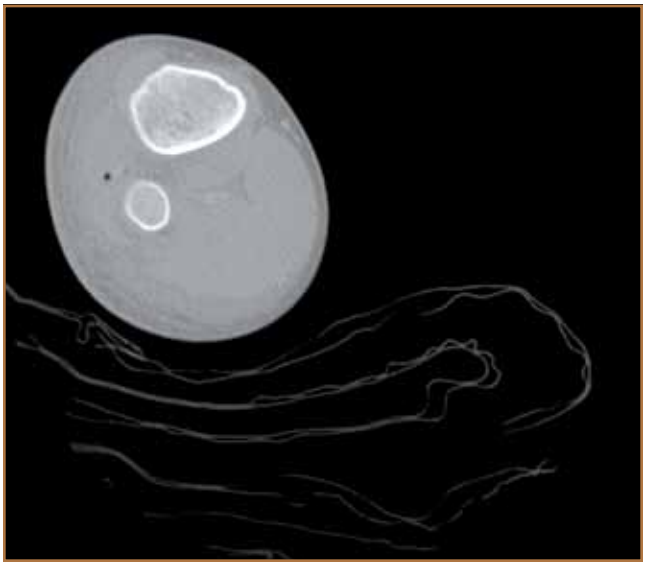

Figure 1. Computed tomography of patient's right leg shows air pocket and radiodensity representing foreign body in anterior compartment.

Figure 2. Magnetic resonance imaging of patient's right thigh shows increased signal intensity in subcutaneous tissue, along all fascial planes as well as anterior and posterior musculature.

rate was 20 mm/h (reference range, 1-12 mm/h). Magnetic resonance imaging of the right lower extremity was performed urgently and showed severe inflammation of the subcutaneous fat, fascia, and musculature throughout the extremity (**Figure 2**). The patient was returned to the operating room, where he underwent further irrigation and debridement, and fasciotomies of the superficial and deep compartments of the leg as well as of the thigh (anterior, medial, and posterior compartments) and the foot through a medial approach. The groin and the preperitoneal space were also explored, by the acute care surgical service.

Intraoperative findings included a necrotic anterior compartment of the leg; a green, fibrinous material overlying the fascial planes within the groin, thigh, and leg; and necrosis of the adipose tissue throughout the extremity. No frank purulence was noted and all other musculature was viable. The anterior compartment of the leg was debrided. Wounds were again left open, and the patient continued on broad-spectrum antibiotics at the recommendation of the pediatric infectious diseases team, which was consulted on postoperative day 1.

Microbiological and pathologic analysis was performed on the intraoperative cultures and tissue specimens. Gram stain showed wide, gram-positive rods, and *B cereus* was isolated from the aerobic cultures. The pathogen was found to be sensitive to vancomycin and meropenem, so these were continued. Pathology from the necrotic anterior compartment musculature and adipose tissue was consistent with inflammatory changes but not bacterial colonization.

Peripheral leukocytosis resolved 48 hours after the second operation. Twelve days after initial irrigation and debridement, the tissue appeared viable, and there were no signs of infection. The patient returned to the operating room, where all wounds were closed, primarily by the orthopedic and plastic surgery services.

The patient was discharged home 15 days after initial irrigation and debridement. A peripherally inserted central catheter line was used to administer intravenous (IV) vancomycin and clindamycin for another 3 weeks. The patient ambulated with crutches and underwent aggressive physical therapy for ankle dorsiflexion. He was last seen 3 months after surgery. His wounds healed well, and he had returned to full weightbearing with no activity restrictions. Only minimal weakness in foot dorsiflexion was noted.

Discussion

B cereus is found throughout the environment, particularly in soil, dust, and water. It has also been associated with bronchopneumonia, bacteremia, septicemia, meningitis, severe eye infections (keratitis, endophthalmitis, panophthalmitis), endocarditis, and osteomyelitis.[1] Case reports of severe infection often involve immunocompromised patients, IV drug users, and neonates.[1-3] The virulence of *B cereus* derives from the ability of the pathogen to produce lytic enzymes, such as phospholipases, proteases, hemolysins, and lecithinase (cereolysin).[4] In the gastrointestinal tract, these enzymes cause bowel inflammation and secretory diarrhea. In soft tissue, they trigger a necrotizing reaction.

B cereus infection can imitate gas gangrene (clostridial myonecrosis) and necrotizing fasciitis. However, these conditions have different etiologies, and only subtle clinical nuances can aid in distinguishing them. Nevertheless, they all mandate similar treatment: urgent surgical debridement, use of antibiotics, and IV fluid resuscitation.[5] Of note, some strains of *B cereus* produce β-lactamase enzymes, which make them resistant to antibiotics such as penicillins and cephalosporins. This is crucial in the clinical setting, as many of the empiric antibiotics initiated for severe soft-tissue infection are ineffective against

this pathogen. *B cereus* is typically susceptible to aminoglycosides, ciprofloxacin, and vancomycin.[2]

Gas gangrene usually presents 48 hours after localized soft-tissue trauma. Tissue crepitus, severe pain, and swelling are found on examination. Necrotic, black bullae may also develop; when incised, they release a foul odor and/or serosanguinous exudate.[6] Free air is evident on radiographs, a finding attributed to the gas-forming capabilities of *Clostridium perfringens*. This species, like *B cereus*, is a gram-positive rod found in soil and water. In addition to surgical debridement and antibiotics, hyperbaric oxygen is used to treat patients with gas gangrene, as *C perfringens* is anaerobic.[1]

Necrotizing fasciitis is an infection of subcutaneous fat, compartmental fascia, and muscle tissue. Although this infection can be postsurgical or posttraumatic, in 45% of cases the cause cannot be identified.[7] There are 2 types of necrotizing fasciitis: type 1 is caused by a polymicrobial infection involving anaerobes and aerobes, and type 2, the more severe form, involves Group A streptococcal infection.[8] Necrotizing fasciitis presents with extremity swelling, erythema, and pain.[7,9] Absence of crepitus on examination distinguishes necrotizing fasciitis from clostridial myonecrosis.[1] *B cereus* infection causes more subcutaneous fat destruction and may spare the muscle and fascia. It is this finding that may aid the clinician in distinguishing it from necrotizing fasciitis.[10]

This case report further elucidates and emphasizes the importance of recognizing *B cereus* as a possible cause of severe soft-tissue infection. It must be included in the differential diagnosis of gas gangrene and necrotizing fasciitis. Each of these conditions can have devastating consequences, and all should be treated urgently with surgical debridement and use of broad-spectrum antibiotics and IV fluids.

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This paper will be judged for the Resident Writer's Award.