Annals of Clinical Case Reports

Case Report
Published: 18 Mar, 2021

Pediatric Osteomyelitis due to *Bacillus cereus*: A Case Report

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Introduction

Non-anthracis *Bacillus* are traditionally seen as uncommon human pathogens and often dismissed as contaminants in microbiological tissue culture [1,2]. *Bacillus cereus* has found notoriety as a cause of gastroenteritis, but bone infections involving this bacterium are very rare [3]. We report a case of *B. cereus* osteomyelitis in an otherwise healthy young girl with no identifiable risk factors, the first of its kind in the literature to our knowledge.

Case Presentation

A healthy, five-year-old Caucasian female with no significant past medical history was seen in the pediatric orthopedic clinic with an 8 week history of left sided gait abnormality. She refused to heel weight-bear and had no clear history of trauma, insect bites, superficial abrasions or penetrating injury to her left foot. There was no history of fever or systemic features of infection, and no history of immunodeficiency. She had no urinary, chest, ENT (including dental) or skin evidence of infection. Her hindfoot was swollen, and was tender to palpate over the calcaneus.

Several areas of lucency and sclerosis within the calcaneus were seen on radiographs. She was admitted for further investigations. Hematological tests revealed a CRP of <3, ESR 8, and WCC of 10.6×10^9. Blood cultures showed no growth.

An MRI was performed the following day which showed increased signal within the calcaneus, talus and cuboid bones, consistent with multifocal osteomyelitis (Figure 1).

A calcaneal biopsy under general anesthesia was performed. A lateral approach was undertaken to access the calcaneus. No frank pus was seen, but the bone was friable and dark, altered interosseous blood was encountered. Multiple, non-cross-contaminated fresh tissue samples of bone fragments, tissue swabs and blood aspirate were sent to the lab for culture.

Microbiological culture revealed growth of *Bacillus cereus* in 4/4 samples, and *Staphylococcus hominus* in 2/4 samples. Histology revealed trabecular bone with absent normal marrow, having been replaced by fibrous tissue, foamy histiocytes, and lymphocytes, consistent with chronic osteomyelitis.

Following discussion with our infectious disease physicians, intravenous Vancomycin was initiated. Following initial administration in hospital, it was continued in the community for a total of 6 weeks, during which she was kept in a non-weight-bearing below knee cast. Vancomycin was chosen to provide anti-staphylococcal cover in addition to *B. cereus*, although it was less clear that this was a pathogenic organism in this patient's case. The duration was chosen due to the poor vascular supply to the calcaneus, and the poorer efficacy of vancomycin compared with beta lactam antibiotics.

A follow up MRI was obtained to confirm resolution of infection, four weeks after cessation of Vancomycin. This was consistent with resolving osteomyelitis, with reduced signal intensity in the hind foot and mid foot.

Weight bearing commenced after 6 weeks in cast. By 3 months she was running and jumping normally, without any symptoms of pain or disability. At 6 months post biopsy she continued to be symptom free with normal radiographs and was discharged from routine clinic follow-up.

Discussion

Bacillus cereus is a Gram-positive aerobic or facultatively anaerobic, spore-forming, motile, rod-shaped bacterium [4]. Its environmental reservoir includes soil, marine and fresh water, and the

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Received Date: *18 Feb 2021*
Accepted Date: *10 Mar 2021*
Published Date: *18 Mar 2021*

Citation:
Sahakian V, Taylor J, Gregg T. Pediatric Osteomyelitis due to Bacillus cereus: A Case Report. Ann Clin Case Rep. 2021; 6: 1926.

ISSN: 2474-1655

Figure 1: MRI.

intestinal tracts of invertebrates [5]. It is also one of the most common bacteria cultured from the drug associated paraphernalia of heroin addicts [6]. Having a spore form allows *B. cereus* to survive standard food cooking processes in a dormant state. Once in an active state, it produces a number of tissue destructive exo-enzymes, including an emesis-inducing toxin [7]. It is the emesis effect of *B. cereus* which gives it most notoriety, causing 'fried rice syndrome' following the consumption of cooked rice stored at room temperature after its initial preparation.

B. cereus is often regarded as an insignificant contaminant in positive clinical specimens. However, it is recognized to cause a multitude of pathologies, including fulminant sepsis, cutaneous infections, anthrax-like progressive pneumonia, severe eye infections, and meningitis [2], as well as osteomyelitis.

While uncommon, osteomyelitis due to *B. cereus* is certainly recognized, though less than 10 cases have been described in the literature [3]. All of these cases were associated with surgical or accidental trauma, IV drug use, pre-existing infection or sickle cell disease. Only two cases have been reported in children - an 11-year-old boy with a depressed skull fracture and *B. cereus* osteomyelitis of the bone fragment [8], and a 13-year-old girl with distal femoral osteomyelitis due to *S. aureus* and subsequent superimposed infection with *B. cereus* [3]. To our knowledge, this case represents the only case of *B. cereus* osteomyelitis in a child without any identifiable risk factors or history of inoculation injury, with confirmed deep infection. The patient had no other site of infection, and no definite trauma. The difficulties of history taking in a young child were illustrated in this case given the delay from symptom onset to presentation; no history of significant antecedent trauma could be recounted from the child or parents. Of note the patient was a very active child with a new trampoline; minor trauma may have had an association with this case but was below the sensitivity of the history taking to detect.

While microbiology contamination with *B. cereus* is common, we are confident our case represents a true causative effect as it was recovered from all four tissue samples, whereas *S. hominis* was only seen in two of these. Furthermore, there was a clinical and radiological resolution of infection following appropriate antibiotic treatment.

Osteomyelitis due to *B. cereus* has previously been successfully treated with gentamicin, cloxacillin, clindamycin, penicillin and vancomycin; antibiotic options typically revolve around the susceptibility profile of the isolated strain and the antibiotic resistance is variable. One study of 54 strains of *B. cereus* concluded that vancomycin may be the drug of choice for invasive infection [9].

In conclusion, while an uncommon cause of pediatric osteomyelitis, *B. cereus* should be considered in the differential diagnosis. This is particularly relevant in cases in which no response is demonstrated with traditional empiric antibiotics. Because there are no specific features to the clinical presentation or imaging, this case highlights the importance of adequate microbiological sampling prior to commencement of antibiotics.

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