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Spontaneous Clavicular Osteomyelitis Caused by Cutibacterium acnes Treated with Calcium Sulfate Beads

Essa A Alazmi[1], Gutaybah S Alqarni[1], Mohammed T Musslem[1], Ramy Samargandi[2]

Learning Point of the Article:

- Cutibacterium acnes can cause clavicular osteomyelitis even in the absence of a history of prior surgery.
- Adequate debridement is essential in managing osteomyelitis.
- Dead space filling with antibiotic-impregnated calcium sulfate beads has a potential therapeutic effect.

Abstract

Introduction: Osteomyelitis due to Cutibacterium acnes in the clavicle without a history of previous surgery is extremely rare and has been reported in one previous study. In this report, we delve into a case of clavicular osteomyelitis caused by C. acnes without the presence of hardware materials.

Case Report: We report here a case of a 32-year-old female presented with spontaneous clavicular osteomyelitis due to C. acnes that failed with medical management. The Patient was successfully treated by surgical debridement and calcium sulfate filling that impregnated with local antibiotics.

Conclusion: This case demonstrates that clavicular osteomyelitis can be caused by C. acnes even without the presence of a device. Therefore, cultures from potential bone infections that yield C. acnes should not be dismissed as contaminants. Combining clinical and laboratory criteria with emerging microbiologic tests may enhance the predictive value of C. acnes diagnostic testing in the future.

Keywords: Bone infection, clavicular infection, Cutibacterium acnes, debridement, calcium sulfate, osteomyelitis.

Introduction

Cutibacterium acnes is a slow-growing, Gram-positive bacterium commonly found in the normal skin flora of the shoulder and chest, as highlighted in orthopedic studies [1,2]. Its high prevalence in the shoulder area makes it a significant pathogen for post-operative infections, particularly in prosthetic shoulder implants and other orthopedic device-related infections of the upper limb [3, 4]. The clinical progression is slow and does not exhibit typical infection symptoms, initially presenting with shoulder pain and stiffness, and later progressing to local swelling or redness [2-4]. Several reports have been published regarding clavicular infection due to C. acnes after previous surgery and hardware implantation or due to direct colonization in asymptomatic patients [5-7]. However, osteomyelitis of the clavicle due to C. acnes in the absence of a history of surgery or hardware materials is extremely rare. To our knowledge, only one previous report has described two cases of osteomyelitis due to C. acnes not associated with implants [8]. In this report, we present a case of a female patient with spontaneous clavicular osteomyelitis secondary to C. acnes infection without a history of previous surgery in the upper limb.

Case Report

In 2018, a 32-year-old female presented due to left clavicle pain. Her history included diagnosed psoriasis in youth, no other medical or surgical history, three vaginal deliveries (G3 P3), and no allergies. The patient had no clear risk factors for developing osteomyelitis and no history of trauma. The patient presented with symptoms that were inflammatory in nature with initial swelling and night sweats without fever. Symptoms had been evolving for approximately 3 years, postpartum, affecting only the left clavicle.

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[1]College of Medicine, University of Jeddah, Jeddah, Saudi Arabia,
[2]Department of Orthopedic Surgery, College of Medicine, University of Jeddah, Jeddah, Saudi Arabia.

Address of Correspondence:
Dr. Ramy Samargandi,
Department Orthopedic Surgery, College of Medicine, University of Jeddah, Jeddah, Saudi Arabia.
E-mail: rsamargandi@uj.edu.sa

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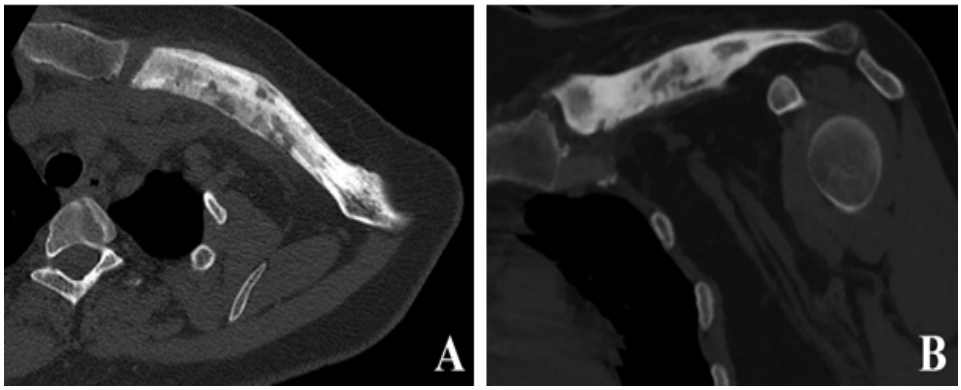

Figure 1: Axial (A) and coronal (B) computed tomography of left clavicle showing hypertrophy with areas of osteocondensation and heterogeneous lacunar zones.

A computed tomography (CT) scan revealed an abnormality in the bone structure, showing hypertrophy with areas of osteocondensation and heterogeneous lacunar zones, associated with muscle inflammation in contact (Fig. 1). The magnetic resonance imaging revealed osteitis in the medial and middle thirds of the left clavicle, with heterogeneous hypertrophic inflammatory bone remodeling (low T1 signal, high short tau inversion recovery signal), and moderate peri-lesional soft tissue infiltration without organized collection (Fig. 2). The patient underwent a biopsy for pathological examination and bacterial culture, which revealed non-specific osteitis at varying stages, from acute to chronic subacute (Fig. 3), with C. acnes detected in 4 out of 5 bacterial cultures. She was then treated with clindamycin 600 mg 3 times/day for a duration of 6 weeks. The patient showed dramatic improvement, with the pain disappearing, but has been lost to follow-up since 2018. 5 years later, in 2023, she came with a recurrence of pain in the left clavicle. A biopsy was then conducted which revealed bone tissue site of non-specific chronic osteitis lesions, absence of progressive inflammatory process, absence of element suspicious for malignancy, and Cutibacterium was found again in five out of five culture samples. The patient also underwent a 18 F-fluorodeoxyglucose positron emission tomography (PET) scan to rule out other differential diagnosis such as synovitis, acne, pustulosis, hyperostosis, and osteitis (SAPHO) syndrome, chronic recurrent multifocal osteomyelitis (CRMO). PET-CT revealed metabolic hyperactivity uptake only at the clavicle (SUVmax 3.1), confirming the unique localization and excluding other differential diagnosis (Fig. 4).

A new surgical bone biopsy, including five bacteriological samples, mycobacterial cultures, and a histopathological sample, was performed at zones of hypermetabolism identified by PET scan. The histopathological results were consistent with previous findings, while mycobacterial cultures were negative. However, all C. acnes cultures were positive 5/5. Due to the failure of non-surgical management, the patient underwent extensive surgical debridement. A sclerotic appearance without the appearance of bleeding bone was found. A horizontal anterior corticotomy for bone decompression was performed, followed by mechanical debridement with a high-speed burr and copious irrigation. The dead space was then filled with calcium sulfate Osteoset-T® (Wright Medical Technology), loaded with tobramycin and 1 g of vancomycin, and a drain was placed (Fig. 5). Postoperatively, the patient was prescribed empirical antibiotics, including piperacillin-tazobactam 4 g intravenous (IV) 3 times/day and linezolid 600 mg IV twice daily. Assessment of the culture revealed for the third time that C. acnes samples were all positive (5/5). Afterward, the patient was treated with amoxicillin 2 g 3 times/day for 3 months, and

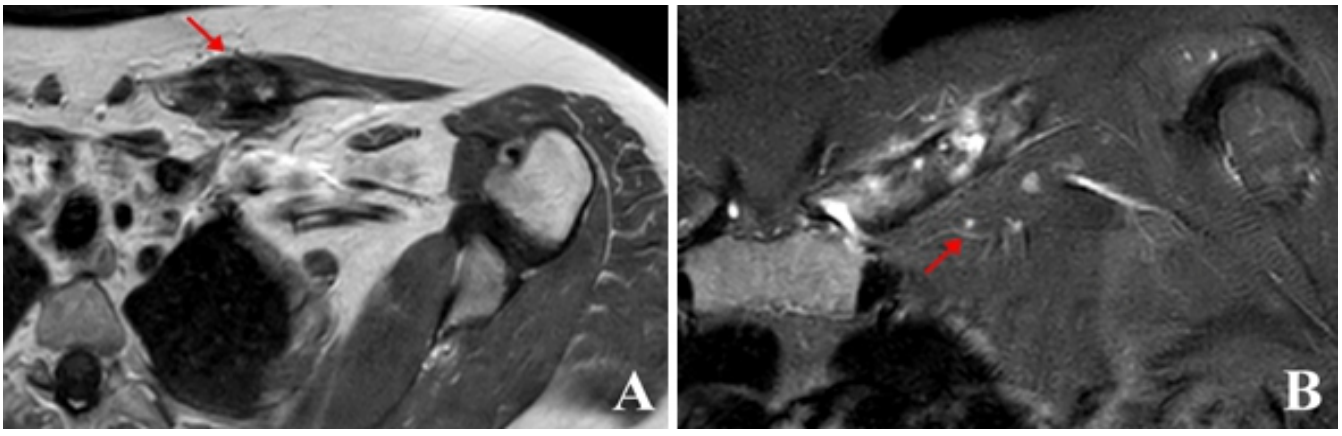

Figure 2: Magnetic resonance imaging with axial T1-weighted image (A) and coronal short tau inversion recovery (STIR) (B) of the left clavicle showing heterogeneous hypertrophic inflammatory bone remodeling (red arrow) with low signal on T1, high signal STIR.

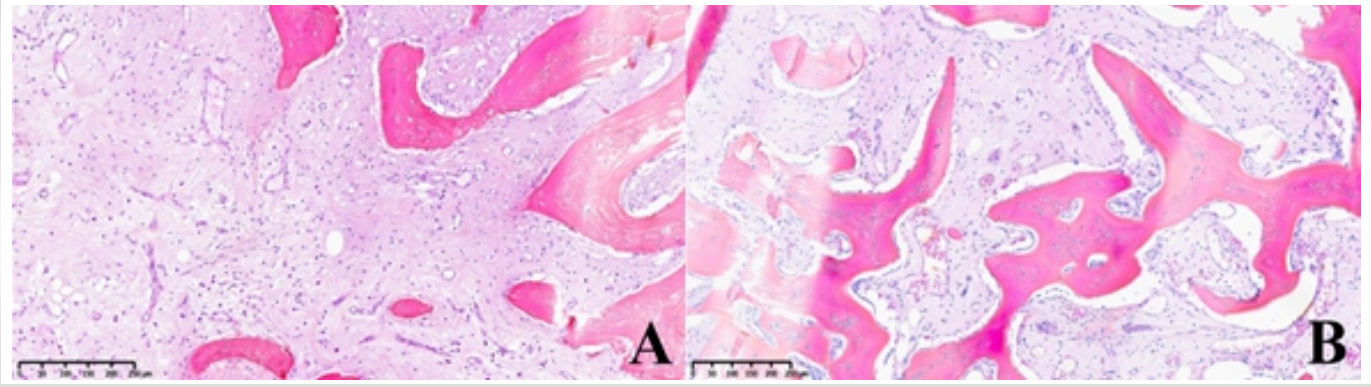

Figure 3: Histological analysis displayed similar findings in both samples (A) first sample, (B) second sample. Bone changes are observed, including neogenesis and medulla space fibrosis containing numerous capillary, lymphocytes, and plasma cells.

symptoms had completely resolved by the 5-month follow-up. The calcium sulfate beads were fully resorbed 2 months postoperatively, indicating successful integration and healing (Fig. 6).

Discussion

Diagnosing bone infections caused by low-virulence organisms, such as C. acnes, is challenging due to the lack of typical clinical signs of disease and the difficulties in confirming the diagnosis due to the possible contaminations [9]. The incidence of bone infection without the presence of an implant is believed to be much lower [6]. What is unique in this case is that the clavicular infection caused by C. acnes occurred without a history of prior surgery, underscoring the importance of considering this organism as a potential pathogen in bone infections, even in the absence of a metallic device. This finding is consistent with a previous study that reported C. acnes clavicular infection in the absence of an implant [8].

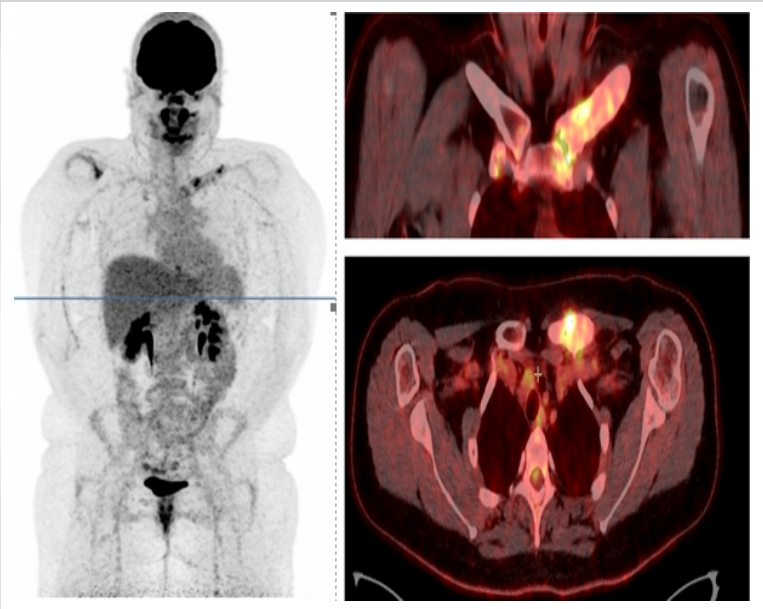

Figure 4: 18F-Positron emission tomography computed tomography showing metabolic uptake uniquely at the left clavicle (SUVmax 3.1).

Positive cultures are sometimes dismissed as "contaminants," "false-positives," or non-pathogenic Cutibacterium "growth in deep-tissue layers" [10]. In addition, certain infections can easily mimic malignancies, hence it is logical to consider malignancies as a differential diagnosis in such case. Tissue sampling and histopathological examination are essential to distinguish such lesions and to choose the right treatment. However, in our study, this organism was cultured multiple times on separate occasions.

A CT scan revealed bone structure abnormalities, showing hypertrophy with areas of osteocondensation and heterogeneous lacunar zones, along with muscle inflammation in contact. PET-CT helps in evaluating the absence of other localization to exclude SAPHO and CRMO. Furthermore, it aids in identifying zones of hypermetabolism at the lesion which helps the surgeon to meticulously debride all active zones [11]. Conditions to consider in the differential diagnosis for a patient with clavicular pain and radiographic changes include malignancy, SAPHO, condensing osteitis, Friedrich's disease, sternoclavicular hyperostosis, and CRMO [12,13]. Unlike C. acnes osteomyelitis, condensing osteitis is self-limiting and should resolve spontaneously within months. Friedrich's disease, or osteonecrosis of the medial clavicle, is another rare condition that can present with localized pain.

In this study, the patient required extensive surgical debridement and antibiotic therapy, which is necessary in clavicular infections. C. acnes is known to be difficult to eradicate, partly due to its biofilm production, which may protect against host immune responses and antimicrobial therapy [14]. Evidence suggests that management should include aggressive irrigation and debridement, removal of any hardware, and extended antibiotic treatment. This is also compatible with clavicular infection with the presence of an implant, where in a previous case study, it

Authors (year)	Age	Sex	Cultures	Antibiotic therapy	Surgical intervention	Outcome
Zaid et al. (2019) [8]	41	Female	4/5 positive C. acnes	IV Vancomycin ×6 weeks, PO Amoxicillin ×2.5 months	Surgical debridement	Symptom-free, with lesion healing on imaging
	46	Male	3/5 positive C. acnes	IV Ceftriaxone ×6 weeks	Surgical debridement	Symptom-free, with normal imaging findings
Present case	32	Female	5/5 positive C. acnes	Empiric IV Piperacillin -Tazobactam and IV Linezolid (1 week), followed by PO Amoxicillin ×3 months	Surgical debridement, Antibiotic -loaded calcium sulfate beads	Symptoms resolved by 5 -month follow -up, with lesion healing on imaging
C. acnes: Cutibacterium acnes, IV: Intravenous						

Table 1: Summary of literature-reported cases of spontaneous clavicular osteomyelitis infection caused by C. acnes.

was reported that the patient underwent implant removal revision surgery and additional IV antibiotics [5]. Similar to our case, Zaid et al. reported a case of a 41-year-old woman with right clavicular osteomyelitis caused by C. acnes, confirmed by intraoperative cultures. The initial treatment included surgical debridement and 6 weeks of IV ceftriaxone followed by oral amoxicillin. The patient developed a recurrence of the infection, requiring a second debridement and IV vancomycin followed by oral amoxicillin. At the 2-year and 3-month follow-up, she remained asymptomatic. They reported another case of a 46-year-old man with right clavicular osteomyelitis caused by C. acnes. The patient was treated with surgical debridement followed by 6 weeks of IV ceftriaxone. The patient was asymptomatic at 2-year follow-up [8]. Table 1 summarizes literature-reported cases of spontaneous clavicular osteomyelitis infection caused by C. acnes.

In the current study, the patient was successively managed by surgical debridement in conjunction with dead space filling by calcium sulfate (Osteoset-T®) and antibiotic therapy for 3-month duration. Calcium sulfate is acknowledged for its key features such as high biocompatibility, and osteoconductive properties by fast rate of resorption, stimulates osteogenesis, and reducing the local pH in the target area, which in turn leads to local bone mineralization [15]. It also has an advantage of delivering a high concentration of antibiotics and providing a scaffold for new bone formation, therefore playing a role in spontaneous bone regeneration which can be assessed radiographically [16]. In addition, it was claimed that antibiotics administered to patients infected with C. acnes retain their activity when mixed with calcium sulfate, a finding reported in a previous study by Couture et al. [17]. Previous studies have demonstrated the efficacy of calcium sulfate beads in the treatment of osteomyelitis. Ferguson et al. treated 195 patients with chronic osteomyelitis using antibiotic-loaded calcium sulfate beads, successfully resolving infections in 90.8% of cases [18]. Another study published by Zhou et al. treated 38 cases of chronic tibial osteomyelitis using local debridement combined with antibiotic-loaded calcium sulfate, achieving infection remission without recurrence in 88.4% of cases [19]. Similarly,

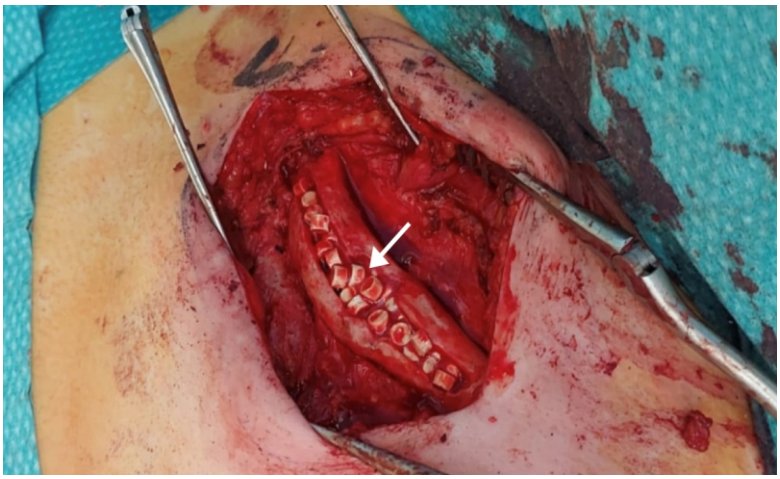

Figure 5: Intraoperative photograph after surgical debridement and bone filling with calcium sulfate (Osteoset-T®) loaded with tobramycin and vancomycin.

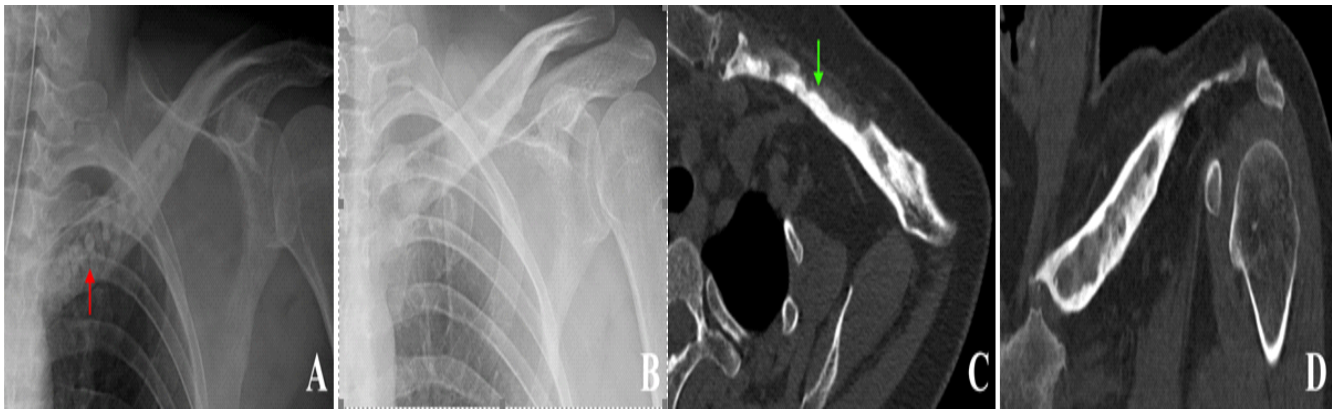

Figure 6: Post-operative X-ray and computed tomography (CT) scan images. (A) X-ray showing bone filling with calcium sulfate beads (red arrow). (B) X-ray at 2 months postoperatively showing resorption of the calcium sulfate beads. (C) CT scan at 3 months postoperatively showing anterior corticotomy of the anteromedial half of the clavicle (green arrow) in axial © and coronal (D) views.

Ferrando et al. and Badie and Arafa reported successful outcomes using antibiotic-loaded calcium sulfate beads in the treatment of chronic osteomyelitis, with infection eradication achieved in 92.3% and 76.7% of cases, respectively [20,21].

In a randomized controlled trial by McKee et al., Osteoset-T® achieved an 86% infection eradication rate in chronic osteomyelitis and infected non-unions [22]. Similarly, a retrospective review by Humm et al. reported infection eradication in 20 of 21 chronic tibial osteomyelitis cases treated with Osteoset-T® [23].

Conclusion

While most C. acnes infections occur following the placement of an orthopedic implant, the absence of previous surgery does not exclude the possibility of a C. acnes bone infection. Our case demonstrates that clavicular osteomyelitis can be caused by C. acnes even without the presence of a hardware material. Therefore, cultures from potential bone infections that yield C. acnes should not be dismissed as contaminants. Diagnosis comprises fulfilling both clinical and laboratory criteria, strengthened by the emerging microbiologic tests which may improve the diagnostic capability in the future.

Clinical Message

Clavicular osteomyelitis due to C. acnes without prior surgery is extremely rare, with only one previous study reported. Most cases involve prosthetic devices. This report presents a case of clavicular osteomyelitis caused by C. acnes without hardware, treated with surgical debridement in conjunction with calcium sulfate filling for its potential therapeutic benefits.

Declaration of patient consent: The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient has given the consent for his/ her images and other clinical information to be reported in the journal. The patient understands that his/ her names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

Conflict of interest: Nil **Source of support:** None

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