Case Report

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Septic Arthritis and Multifocal Osteomyelitis Caused by *Capnocytophaga Canimorsus*: A Case Report

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Abstract

Microbiological diagnosis of chronic osteoarticular infections remains a major challenge, particularly when the clinical presentation is atypical and the pathogen is uncommon. In this unique case, *Capnocytophaga canimorsus*, a microorganism belonging to the oral microbiota of some domestic animals, caused septic arthritis and multifocal osteomyelitis in the long bone of a 43-year-old immunocompetent man. The patient was treated with two-stage surgery and local and systemic antibiotic therapy, and had a successful recovery. *C. canimorsus* should be considered as a possible etiological agent in patients with osteoarticular pathology and a history of exposure to domestic animals.

Keywords: *Capnocytophaga*; Case report; Osteomyelitis; Septic arthritis; Osteoarticular infection

1. Introduction

Capnocytophaga canimorsus is a slow-growing, facultative anaerobe, and gram-negative rod.[1] On microscopy, the bacteria appear as medium-to-long rods with tapered or spindle-shaped ends. The phenotypic characteristics of these bacteria include positive test results for oxidase and catalase activity. Growth is often enhanced by the addition of rabbit serum and incubation in a carbon dioxide-enriched environment.[2]

This organism is part of the oral microbiota of dogs and cats,[1] but can cause human infections immunocompromised patients,[3] with case fatality rates up to 30%[4] in severe cases. *C. canimorsus* infections usually occur through a penetrating wound, skin abrasion, or contact of a skin wound with animal saliva,[3,5] although the source is unknown in approximately 10% of cases.[6] *C. canimorsus* bacteremia can lead to secondary bone infections, such as periprosthetic infection, septic arthritis, and vertebral osteomyelitis.[5]

We describe an unusual case of septic arthritis and multifocal long-bone osteomyelitis caused by *C. canimorsus*, highlighting the clinical importance of suspecting this pathogen in patients with bone and joint infection and a history of contact with dogs.

2. Case presentation

A 43-year-old man was admitted to Vall d'Hebron University Hospital, a national reference center in Barcelona, Spain, for treatment of complicated chronic osteomyelitis of the left distal femur in October 2020, which had been present for 1 year. The initial symptoms included pain and swelling of the left lower groin without fever, which later developed a fistula. He had not received antimicrobial therapy before being referred to our center. He had a history of heavy alcohol consumption (>30 g/d), and occasional cocaine and cannabis use. He lived in a rural zone of Galicia, in Northwestern Spain, and had a pet dog, but did not report any bites or scratches before the onset of his disease. He had no other medical history of note. Hematology and blood biochemistry showed leukocytosis with neutrophilia and increased levels of inflammatory markers.

Physical examination revealed swelling and suppuration of the distal medial side of the left lower leg, and limited knee movements without signs of joint effusion. Radiography and computed tomography (CT) revealed extensive chronic osteomyelitis of the left distal femur tunneling to the cortical bone and an abscess of the adjacent soft tissue with multiple fistulous tracts [Figure 1A]. The left femur showed a cortical break and peridiaphyseal distal soft tissue collection, as well as osteomyelitis of the femoral head in the form of a Brodie's abscess with invasion of the hip joint and periarticular collection [Figure 1B]. The differential diagnosis included osteomyelitis (gonococcal or staphylococcal) and a bone tumor, which can have similar symptoms and imaging findings. Therefore, microbiological and pathological confirmation of these lesions is essential.

The multidisciplinary team (Bone and Joint Infection Committee) at our center reviewed the case details, and performed a CT-guided biopsy of the femur, sending proximal and distal samples to the laboratory for microbiological and histopathological examination. The histology was unremarkable, and cultures of several tissue samples were positive for *C. canimorsus*. Joint fluid inoculated in blood culture bottles was positive after 5 days of incubation, and biopsy

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Figure 1: Radiography and CT of the legs. (A) The X-ray shows radiopaque areas in the left femur. (B) The CT scan shows diaphyseal injuries of the left femur, and the affected area extending for approximately 11.5 cm with soft tissue abscesses secondary to osteomyelitis. CT, computed tomography.

cultures showed growth from the seventh day of incubation [Figure 2A and B]. Identification was performed using mass spectrometry (MS Vitek; bioMérieux, Marcy-l'Étoile, France) and confirmed by 16S ribosomal ribonucleotide acid (rRNA) gene sequencing. In addition, 16S rRNA gene sequencing performed on bone biopsy samples detected *C. canimorsus*.

Pan-bacterial polymerase chain reaction (PCR) targeting the gene-encoding 16S rRNA was performed on both the biopsy samples and positive bacterial culture obtained during the first surgery. DNA extraction was performed using the NucliSENS easyMAG (bioMérieux, Marcy-l'Étoile, France) for bacterial culture and MagCore R HF16 Automated Nucleic Acid Extractor (RBC Bioscience, Taipei, China) for bone biopsy. A conventional PCR was performed using the primers 27 (5′-AGTTTGATCMTGGCTCAG-3′) and 787 (5′-GGACTACHAGGGTATCTAAT-3′) [7] yielding a 760-bp fragment. The 16S rRNA PCR amplicons were purified and sequenced using a 3500 XL Genetic Analyzer (Applied Biosystems, Waltham, MA). The sequences were compared with those in the GenBank database using the BLAST search tool, leading to the identification of *C. canimorsus* with a 100% identity score. The bacteria were identified 5 days after admission.

The antibiotic susceptibility of this strain was assessed using gradient agar diffusion (E-test, bioMérieux, Marcy-l'Étoile, France) according to the European Committee on Antimicrobial Susceptibility Testing recommendations, and was found to be susceptible to cefotaxime, azithromycin, clindamycin, nalidixic acid, ciprofloxacin, and cotrimoxazole.

The patient then underwent a two-stage surgery. In the first stage, surgical debridement of multifocal osteomyelitis was performed. In the hip, debridement and resection of the femoral head was performed, with subsequent placement of a preformed cement spacer with vancomycin and gentamicin (Vancogenx; Tecres, Verona, Italy). In the distal femur, debridement was performed through a bone window and the cavity was filled with calcium sulfate containing

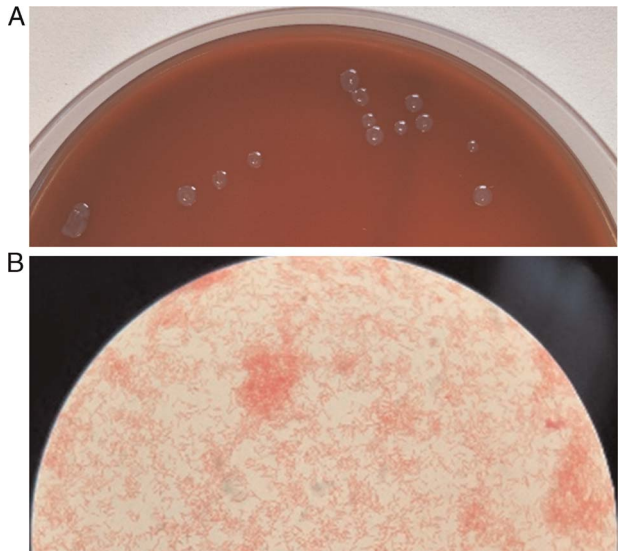

Figure 2: Blood culture and biopsy culture of joint fluid. (A) Gray-colored non-hemolytic colonies of *C. canimorsus* on Columbia 5% Sheep Blood Agar. (B) *C. canimorsus* on microscopic examination with immersion oil (100×), visualized as fine gram-negative bacilli.

vancomycin and gentamicin (Stimulan; Biocomposites Ltd., Keele, UK). The patient was treated with ceftriaxone (1 g for 1 week) and ciprofloxacin (750 mg twice a day for 3 months), based on the antimicrobial susceptibility results.

After completing the course of antibiotics, total hip replacement of the left hip was performed. After the second surgery, the patient was treated with cefuroxime 1500 mg three times per day and ciprofloxacin 750 mg twice a day for 1 week. The interoperative cultures from the second surgery were negative. The patient was followed up for 12 months after the second surgery. At his most recent assessment, he was able to walk without pain and had no signs of infection.

The patient provided written informed consent for the publication of his case details and related images.

3. Discussion

We describe a unique case of *C. canimorsus* septic arthritis and multifocal osteomyelitis. *Capnocytophaga* spp. are not a common cause of osteoarticular infections; however, they should be considered as possible agents in patients with a history of contact with domestic animals.[5]

In 1976, Bobo and Newton[1] described the first human case in a man who developed septicemia and meningitis after a dog bite. *C. canimorsus* is part of the microbiota of the oral cavity of some animals, such as healthy dogs and cats, and its transmission occurs through bites or licks from wounds, and sometimes by interaction with the animal.[3–5,8]

C. canimorsus is considered a fastidious microorganism, as it is capnophilic and facultative anaerobe, with slow growth on media with 5% sheep blood and chocolate agar, requiring at least 7 days in a 5% to 10% CO_2 environment and 37°C temperature for optimal growth conditions.[6,9] Considering that it is often routine practice to discard negative culture media within 3 to 5 days, isolation of slow-growing or fastidious bacteria can be overlooked in routine processing. If there is a high suspicion of *C. canimorsus* infection, the microbiology department should be notified in a timely manner, as the sample needs to be cultured under specific conditions for an extended incubation time.[9]

The widespread use of matrix-assisted laser desorption/ionization-time of flight MS has facilitated bacterial identification and 16S rRNA gene sequencing once a bacterial isolate has been obtained from culture. In addition, 16S rRNA is useful for the detection of slow-growing or fastidious bacteria, such as *C. canimorsus*, in sterile clinical samples,[8,9] although its use is limited owing to the complexity of the procedure. *C. canimorsus* strains described in the literature are susceptible to a wide range of antibiotics in vitro.

The goal of treating bone and joint infections is to achieve high antimicrobial activity, and good joint and bone diffusion. Beta-lactam-based regimens are usually appropriate and have intrinsic activity against *Capnocythophaga* species when combined with beta-lactamase inhibitors.[5] Thus, they are considered an appropriate choice for empiric treatment until antimicrobial susceptibility tests become available. The susceptibility of *C. canimorsus* to antibiotics can be determined using a concentration-gradient diffusion assay.

C. canimorsus infection is most commonly associated with dog or cat bites (54%), scratches (8,5%), or close contact (27%), although the source is unknown in 10% of cases.[6] In immunocompetent individuals, infections are usually asymptomatic because of the low virulence of the bacteria.[10] Pet owners and people who have occupational associations with animals, such as veterinarians, animal shelter workers, and dog breeders, are at high risk of exposure to *C. canimorsus*. Individuals with disorders in the mononuclear phagocytic system and humoral immunity are particularly susceptible to *C. canimorsus* infection.[9] Symptomatic infections can develop faster and behave more aggressively in high-risk individuals, such as those with asplenia, cirrhosis, alcohol abuse, corticosteroid therapy, and those older than 50 years.[1,3]

Clinical presentations are diverse. In one case series, the diagnoses included sepsis or septic shock (41%), fever of unknown origin (13%), meningitis (13%), cellulitis (11%), and respiratory tract infection (7%).[2] The case fatality rate can be as high as 30% for sepsis and approximately 5% for meningitis.[9] Infected patients require rapid treatment with appropriate antibiotics. Therefore, it is important to diagnose *C. canimorsus* infections as early as possible.[9]

Data on the epidemiology of *C. canimorsus* bone infections are limited. Some cases of osteomyelitis with preferential vertebral localization have been reported.[8] Other cases include osteomyelitis of the hand linked to closed-fist injury and cases of septic arthritis, mostly monoarthritis of the knee. The only case of prosthetic joint infection that we identified was a case of bilateral prosthetic knee infection in a 59-year-old patient with underlying Waldenström's disease and history of alcohol abuse.[5]

This is the case to be reported of simultaneous septic arthritis and multifocal chronic long-bone osteomyelitis due to *C. canimorsus*. The patient did not have a history of dog scratches or bites, but kept dogs as pets, and had a history of alcohol and drug use as risk factors. Aggressive two-stage surgical debridement in addition to local and systemic antibiotic therapy led to a favorable outcome.

Our findings highlight the importance of clinical awareness of *C. canimorsus* infection, including as a cause of soft tissue and bone infections, which can occur in either immunocompetent or immunocompromised patients after bites or recent exposure to dogs.

Author Contributions

All authors reviewed the clinical records, wrote the article and critically revised the manuscript for intellectual content. All authors read and approved the final version of the article.

Conflicts of Interest

None.

Data Availability Statement

The data sets generated and/or analyzed during the current study are available from the corresponding author on reasonable request.

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