Arthroplasty Today 8 (2021) 53–56

Contents lists available at ScienceDirect

Arthroplasty Today

journal homepage: http://www.arthroplastytoday.org/

Case report

Hair of the Dog? Periprosthetic Joint Infection with *Streptococcus canis*

Andrew McGuire, MD, BSc [a], Nicole Krysa, BSc, BDes, MD [b], Steve Mann, MD, MMEd, FRCS(C) [a, *]

[a] Division of Orthopaedic Surgery, Queen's University and Kingston Health Sciences Centre, Kingston, Ontario, Canada
[b] School of Medicine, Queen's University, Kingston, Ontario, Canada

ARTICLE INFO

Article history:
Received 7 October 2020
Received in revised form
17 January 2021
Accepted 21 January 2021
Available online xxx

Keywords:
Periprosthetic
Infection
Hip
Knee
Streptococcus canis
Revision

ABSTRACT

A 61-year-old man underwent elective primary total hip arthroplasty at an academic center and presented to the emergency department 2 weeks later with a periprosthetic infection. Intraoperative cultures were positive for *Streptococcus canis*. He was successfully treated with one-stage revision and 6 weeks of intravenous cefazolin. It was later determined that the patient has a pet dog who frequently licks his legs. We hypothesize that patients with pets are more likely to carry this pathogen as part of their skin microbiome, and further research is required to establish whether *S. canis* poses an infectious risk beyond that of normal group B Streptococcus skin flora and if preoperative decolonization strategies are warranted.

Introduction

The physical [1,2], emotional [3,4], and economic [5] impacts of prosthetic joint infections (PJIs) have been well documented. PJI is associated with increased rates of both morbidity [1] and mortality [2]. In addition, quality of life is negatively impacted in PJIs [3], and the prolonged immobility associated with repeated revisions results in significant psychological distress [4]. Patients with PJI also have prolonged hospital stays. Those with a surgical site infection remained in hospital for an average of 13.4 days as opposed to 4.2 days for those with an uncomplicated total hip arthroplasty ($P < .0001$) [5]. These prolonged stays are associated with increased costs, which have been found to be on average double for those with a PJI compared with for those without ($P < .0001$) [5].

Most PJIs result from surgical incision contamination with skin flora such as *Staphylococcus aureus* and coagulase-negative staphylococci [6]. *Streptococcus canis*, a group G streptococcus which was first isolated in canines, has been implicated in some human infections as well [7], and its incidence appears to be rising [8]. This case report discusses a patient who developed a deep PJI after hip arthroplasty, which was ultimately linked to close regular contact with his pet dog.

Case history

The patient provided written consent that personal data concerning the case would be submitted for publication. The patient is a 61-year-old male who had previously undergone intramedullary nailing for a remote left femoral shaft fracture at the age of 36 years, with subsequent hardware removal in 1995. He developed symptomatic left hip arthritis and was referred to an adult hip and knee arthroplasty surgeon at a tertiary center for management. Of note, the anatomy of his proximal femur and femoral shaft was slightly distorted (Fig. 1) because of the previous injury and subsequent operations, with a capacious canal and some atypical sclerosis. Despite this, it was felt the standard implants used by the consulting surgeon for primary total hip arthroplasty would be sufficient. His past medical history is significant only for controlled hypertension, obstructive sleep apnea, and gastroesophageal reflux disease. There was no indication of infection preoperatively; he was systemically well, afebrile, and had a normal leukocyte count (4.8×10^9/L). He received a hybrid total hip arthroplasty using a Stryker Trident (Mahwah, NJ) solid-back acetabular shell, Stryker Exeter (Mahwah, NJ) cemented femoral stem, with Simplex (Stryker Orthopedics, Mahwah, NJ) antibiotic (2 g tobramycin) cement (Fig. 2).

* Corresponding author. 76 Stuart Street, Victory 3, Kingston, ON, Canada K7L 2V7, Tel.: +1 613 549 6666x4899.
E-mail address: steve.mann@kingstonhsc.ca

https://doi.org/10.1016/j.artd.2021.01.010

Figure 1. Preoperative radiograph demonstrating posttraumatic femoral shaft abnormality.

Figure 2. Postoperative radiograph after index total hip arthroplasty.

The initial postoperative course was unremarkable, but upon presentation to his family physician for routine wound check and skin staple removal 2 weeks after surgery, he was noted to have cellulitis and purulent discharge and was generally feeling unwell. The patient had noticed progressive erythema and swelling around the incision over the previous 5 days. He was transferred to our center for orthopedic assessment. At the time of our assessment, the patient was feeling unwell, with a temperature of 39.1°C. There was purulent discharge from his surgical incision with roughly 5 cm of surrounding erythema and obvious subcutaneous fluctuance. His range of motion was severely limited because of pain. The serologic markers for infection were elevated, with a leukocyte count of 20.3×10^9/L, neutrophil count of 18.33×10^9/L, a C-reactive protein of 67.8 mg/L, but with a normal erythrocyte sedimentation rate of 9 mm/h. Only 1 out of 4 blood cultures were positive for *Staphylococcus epidermidis*, which was thought to be a contaminant. He remained normotensive, and his lactate was just 1.9 mm/L. Radiographs demonstrated no loosening or implant failure. A sterile bedside hip aspirate was performed, and the patient was admitted to hospital for supportive medical management and surgical intervention. Antibiotics were not administered on admission, as the patient was not thought to be septic or hemodynamically unstable, thus improving the chance of positive intraoperative cultures [9]. The initial aspirate had a total nucleated cell count of 46,000 cells/microlitre, a neutrophil count of 99%, gram positive cocci on gram stain, and was negative for crystals. According to the 2018 Periprosthetic Joint Infection criteria, the patient had an acute periprosthetic joint infection with a minor criterion score greater than 6, and operative intervention was indicated [10].

The following morning, the patient underwent irrigation and debridement of the left hip, with potential component revision depending on intraoperative findings. Preoperative antibiotics were held until cultures could be obtained. Infected hematoma was encountered immediately and clearly communicated with the joint, indicating a deep infection. Intraoperative cultures were obtained, and 2 g of IV cefazolin was then administered. Based on the extent of infection, it was decided that exchange of modular components (femoral head and polyethylene liner) would be appropriate. During removal of the liner, the acetabular cup was disengaged and subsequently converted to a cemented component for improved stability. A Stryker RimFit (Mahwah, NJ) all-poly acetabulum was used with 1 mix of Simplex (Stryker Orthopedics, Mahwah, NJ) antibiotic (2 g tobramycin) cement. A thorough synovectomy, debridement with the VERSAJET (Smith&Nephew, Largo, FL), and irrigation using sterile normal saline, dilute chlorhexidine, dilute peroxide, and castile soap was carried out. The incision was closed in a layered fashion using #1 PDS sutures for the deep layers and skin and a #0 looped PDS for the fascia lata.

Postoperatively, a peripherally insertable central catheter was inserted, and the patient was started on 2 g IV cefazolin q8h. Four out of 7 intraoperative cultures came back positive for *Beta hemolytic Streptococcus group G*, which was further defined as *Streptococcus canis*. This was sensitive to cefazolin, and therefore, he was discharged home on a 6-week course. At his 6-week follow-up, his serologic markers of infection had improved. His leukocyte count was 4.3×10^9/L, erythrocyte sedimentation rate 9 mm/h, and C-reactive protein 6.4 mg/L, and there were no concerns with his incision. Antibiotics were discontinued, his peripherally insertable central catheter was removed, and follow-up to 18 months postoperatively (time

of the writing of this case study) has revealed radiographically stable implants (Fig. 3) and excellent clinical function.

After the revision surgery, further questioning revealed that the patient had a pet dog which frequently slept in bed with him. Although the patient was adamant that he had sustained no bites or scratches and that the dog had never licked the surgical incision, the dog did frequently lick the patient's lower legs.

Discussion

Streptococcus canis are gram-positive streptococcus bacteria that were first isolated in canines. They are beta-hemolytic, aesculin-negative lactose fermenters and fall under the category of Lancefield group G. They are commonly implicated in animal infection, but their human incidence is less established. In fact, the first documented case occurred in 1996 [8]. Since that time however, the incidence of *S. canis* infection has been steadily increasing, as has our knowledge of its pathogenesis [11].

S. canis infection can present with a wide range of clinical manifestations, including invasive disease. Occasionally, beta-hemolytic streptococci can cause severe necrotizing soft-tissue infections, or may be implicated in PJIs. Fortunately, despite an increase in confirmed cases in humans, *S. canis* infections remain quite rare, with an estimated incidence of only 0.2%-1% of all gram-positive PJIs [11]. Furthermore, streptococcal infections account for only 4%-12% of PJI cases [12], as most are staphylococcal infections [13]. However, because identification at the species level is not commonly performed, the true incidence of *S. canis* in humans is likely underreported [14]. To identify the specific species, phenotypic testing or gene sequencing is usually required. There has been recent literature looking at the utility of polymerase chair reaction, specifically in the culture-negative PJI, which simultaneously tackles the issues of gene speciation, precisely directed antibiotic therapy, and the culture-negative joint infection [15], although the clinical relevance of such detailed investigation remains in question. Interestingly, in a review of 54 patients with a culture-positive *S. canis* infection, several of the patients with superficial wounds experienced clinical resolution without the aid of antibiotics, raising the question of whether these represented true "infections" or simply colonized patients [16].

Figure 3. Postoperative radiograph after irrigation and debridement and revision of acetabular component.

While the overall incidence of *S. canis* infection is low, hip and knee arthroplasty has been identified as a meaningful risk factor. A previous review found that nearly 20% of all cases of *S. canis* infection had a prosthetic joint or intraarticular hardware of some description. Otherwise, malignancy, underlying chronic joint diseases, and certain gastrointestinal diseases placed patients at the highest risk [8,16].

According to the 2019 guidelines [17], owning a pet is not a risk factor for PJI. Rare cases of human infection with *S. canis* have been associated with household contact with cats and dogs, but there does not appear to be any evidence to suggest an increase in the incidence of *S. canis* colonization from contact with household pets. Regarding preoperative screening and decolonization, current guidelines recommend a preoperative chlorohexidine wash based only on a few low-quality studies, with the rationale of little potential harm to the patient. It is known that chlorohexidine wash is sufficient to kill streptococcal bacteria, therefore making this a reasonable suggestion to include as part of regular practice. Cases such as this one suggests preoperative chlorohexidine may be particularly important in patients with household pet exposure.

As *S. canis* is such an uncommonly identified pathogen, there is little high-quality evidence available to guide treatment. According to previous guidelines, one- or two-stage revision is recommended, with IV Penicillin for 4-6 weeks as the antibiotic of choice [17]. However, compared with heavily studied pathogens such as methicillin-sensitive *S. aureus* with well-described clinical virulence and antimicrobial regimen, treatment recommendations for *S. canis* are educated generalizations at best. When prosthetic infection has been diagnosed, whether group G streptococcal infection or otherwise, standard practice has been to undergo open irrigation and debridement with potential explant. However, new literature has demonstrated successful treatment of streptococcal joint infection with the more conservative debridement, antibiotics, and implant retention technique [18]. In addition, Burkert and Watanakunakorn found that only 1 in 13 patients with group G streptococcal PJI required explant [19]. In their review, fewer than 25% of patients required operative intervention for *S. canis* septic arthritis, although the authors acknowledge that further studies are required to determine the optimal approach to these prosthetic infections [19].

This case report and review highlights several unknowns regarding *S. canis* PJI, including the prevalence of *S. canis* as part of patient normal flora, the true incidence of *S. canis* as a causative organism in PJI, and the optimal treatment algorithm. We hypothesize that patients with pets are more likely to carry this pathogen as part of their skin microbiome and also suggest that patients should be educated about wound hygiene and avoiding potential contamination from contact with household pets in the perioperative period as part of standard preoperative education.

Summary

A total hip replacement with an acute postoperative infection caused by *S. canis* was successfully treated with one-stage revision

including thorough synovectomy, debridement, and retention of the femoral component, followed by 6 weeks of intravenous cefazolin. This organism should be considered in cases of culture-negative PJI, and further research is required to establish whether *S. canis* poses an infectious risk beyond that of normal streptococcal skin flora and if preoperative decolonization strategies are warranted. We would suggest that patients should avoid household pets licking their legs in the perioperative period.

Declaration of interests

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this article.

References

[1] Boddapati V, Fu MC, Mayman DJ, Su EP, Sculco PK, McLawhorn AS. Revision total knee arthroplasty for periprosthetic joint infection is associated with increased postoperative morbidity and mortality relative to Noninfectious revisions. J Arthroplasty 2018;33(2):521.
[2] Zmistowski B, Karam JA, Durinka JB, Casper DS, Parvizi J. Periprosthetic joint infection increases the risk of one-year mortality. J Bone Joint Surg AM 2013;95(24):2177.
[3] Helwig P, Morlock J, Oberst M, et al. Periprosthetic joint infection – effect on quality of life. Int Ortho 2014;38(507):1077.
[4] Moore AJ, Blom AW, Whitehouse MR, Gooberman-Hill R. Deep prosthetic joint infection: a quality study of the impact on patients and their experiences of revision surgery. BMJ Open 2014;5(12).
[5] Poultsides LA, Ma Y, Della Valle AG, Chiu YL, Sculco TP, Memtsoudis SG. In-hospital surgical site infections after primary hip and knee arthroplasty – incidence and risk factors. J Arthroplasty 2013;28(3):385.
[6] Peel TN, Cheng AC, Buising KL, Choong PFM. Microbiological Aetiology, Epidemiology, and clinical profile of prosthetic joint infections: are current antibiotic prophylaxis guidelines effective? Antimicrob Agents Chemother 2012;56(5):2386.
[7] Taniyama D, Abe Y, Sakai T, Kikuchi T, Takahashi T. Human case of bacteremia caused by *Streptococcus canis* sequence type 9 harboring in the *scm* gene. ID Cases 2017;7:48.
[8] Galpérine T, Cazorla C, Blanchard E, Boineau F, Ragnaud JM, Neau D. *Streptococcus canis* infections in humans: retrospective study of 54 patients. J Infect 2007;55(1):23.
[9] Al-Mayahi M, Cian A, Lipsky BA, et al. Administration of antibiotic agents before intraoperative sampling in orthopedic infections alters culture results. J Infect 2015;71(5):518.
[10] Parvizi J, Tan TL, Goswami K, et al. The 2018 definition of periprosthetic hip and knee infection: an evidence-based and validated criteria. J Arthroplasty 2018;33(5):1309.
[11] Ohtaki H, Ohta H, Miyazaki T, et al. A case of sepsis caused by Streptococcus canis in a dog owner: a first case report of sepsis without dog bite in Japan. J Infect Chemother 2013;19(6):1206.
[12] Lora-Tamayo J, Senneville É, Ribera A, et al. The not-so-good prognosis of streptococcal periprosthetic joint infection managed by implant retention: the results of A large multicenter study. Arch Clin Infect Dis 2017;64:1742.
[13] Li ZL, Hou YF, Zhang BQ, et al. Identifying common pathogens in periprosthetic joint infection and testing drug-resistance rate for different antibiotics: a prospective, single center study in Beijing. Orthop Surg 2018;10(3):235.
[14] Periprosthetic joint infection; practical management guide. Daryaganj, New Delhi, India: Reference and Research Book News: Ringgold Inc; 2013.
[15] Tarabichi M, Alvand A, Shohat N, Goswami K, Parvizi J. Diagnosis of Streptococcus canis periprosthetic joint infection: the utility of next-generation sequencing. Arthroplast Today 2018;4(1):20.
[16] Bronze S, Whitby R, Schaberg R. Group G streptococcal arthritis: case report and review of the literature. Am J Med Sci 1997;313(4):239.
[17] Clinical practice guideline on the Diagnosis and Prevention of periprosthetic joint infections. Rosemont, IL: American Academy of Orthopaedic Surgeons; 2019.
[18] Lam A, Rasmussen M, Thompson O. Successful outcome for patients with streptococcal prosthetic joint infections – a retrospective population-based study. Infect Dis 2019;50(8):593.
[19] Burkert T, Watanakunakorn C. Group G Streptococcus septic arthritis and osteomyelitis: report and literature review. J Rheumatol 1991;18:904.