



# Periprosthetic Joint Infection in Bilateral Knees Caused by *Pasteurella multocida*

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**Abstract:** Periprosthetic joint infection (PJI) is a well-described complication of joint arthroplasty. *Pasteurella multocida* is a rare cause of PJI that predominantly occurs after exposure to animals, primarily cats and dogs. There are only two described cases in the literature where multiple prostheses were simultaneously infected with *P. multocida* after hematogenous dissemination. We present the third described case of the synchronous infection of multiple prosthetic joints with *P. multocida* and describe the surgical and medical approaches utilized in treating this patient.

**Keywords:** *Pasteurella multocida*; infection; polyarticular; prosthetic joint; periprosthetic joint infection

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## Introduction

PJI is an important complication after the implantation of a prosthetic joint. Roughly one million hip or knee arthroplasties are performed in the United States annually, with that number being expected to reach two million by the year 2030 [1]. Though modern rates of PJI are relatively low, the sheer volume of patients undergoing joint arthroplasty makes PJI a pressing clinical issue [2].

Treatment for PJI consists of both surgical and antimicrobial therapy. Surgical approaches include debridement with retention of the prosthetic joint, resection arthroplasty with reimplantation, resection arthroplasty without reimplantation, or amputation [3]. This is in addition to treatment with antibiotics, though the initiation of antibiotics should be delayed until specimens are collected for culture either via synovial fluid analysis, intraoperative cultures, or hardware removal.

PJIs can be described using the Tsukayama scheme, which divides infections into early (<1 month of the operation), late (>1 month from the operation), acute hematogenous infection (AHI), and positive intraoperative culture (PIC) [4]. A multicenter study to characterize the etiology of PJIs describes the most common pathogens for each of these categories. For both early and late infections, Gram-positive organisms are most common, primarily *Staphylococcus* spp. The most common Gram-negative pathogens are members of the Enterobacterales family and *Pseudomonas* spp. for both early and late infections. For AHI patients, infections again involve predominantly Gram-positive organisms, most commonly *S. aureus*. Only 22.5% of the hematogenous infections in the above study involved a Gram-negative organism, most commonly *E. coli* (12.5%). None of the 2524 cases in this study involved *P. multocida* [5].

In this case, we report a rare occurrence of polyarticular *P. multocida* PJI in bilateral knees. There are only two such cases described in the literature, to the best of our knowledge, and none since 1985 [6,7].

## Case Presentation

The patient is a 58-year-old male with a history of severe osteoarthritis status post bilateral total knee arthroplasty (TKA) who presented to clinic with worsening bilateral knee pain. His left TKA was 5 months prior and was complicated by a retinacular tear requiring incision and drainage and polyethylene exchange, which was performed 4 months after his index operation. His right TKA was performed 2 months prior to presentation. He reported some confusion and subjective fevers starting on the day of admission. He was noticed to be diaphoretic, tachycardic, afebrile, and in pain with a tense effusion of the right knee and draining wounds on the left knee. He denied trauma to the knees, recent illness, travel history, or sick contacts.

On Gram-stain, left knee synovial fluid showed few Gram-negative rods and few WBCs, and right knee showed no organisms and few WBCs. On synovial fluid cell count and differential, fluid from the left knee showed moderate blood, 100,000+ RBCs, 4+ turbidity, and 109,900 WBCs. Fluid from the right knee showed moderate blood, 100,000+ RBCs, 4+ turbidity, and 92,600 WBCs. Samples of synovial fluid were sent for culture and he was sent to the ER in anticipation of surgical intervention.

On arrival to ER, initial laboratory results showed leukocytosis to  $12.04 \times 10^9$  K/ $\mu$ L, Hgb of 7.6 g/dL, and lactate of 1.9 mmol/L. He was started on empiric piperacillin/tazobactam and vancomycin. On the day of admission, he underwent debridement and irrigation of bilateral knees with polyethylene exchange. A medial midvastus arthrotomy was performed, with tissue from the knee joints sent for aerobic, anaerobic, fungal, and AFB cultures. The polyethylene liner was removed, the joints were debrided and irrigated with 5 L normal saline with bacitracin, and new polyethylene liner was placed. Blood cultures collected on the second day of his hospitalization and were negative throughout his hospital stay. C-reactive protein (CRP) collected on the second day was 282.7.

On the second day of hospitalization, cultures from the synovial fluid collected in clinic as well as the cultures collected in the operating room grew *P. multocida*. Antibiotic coverage was switched to ampicillin/sulbactam 3 g q6h IV. He later had a PICC line placed and was transitioned to ceftriaxone 2 g IV daily and was discharged home in stable condition after a 5-day hospitalization with a plan to complete 6 total weeks of antibiotic therapy. It was also planned to place the patient on several months of oral suppressive antibiotics as he underwent debridement, antibiotics, and implant retention (DAIR) instead of the explant of hardware in both knees.

Prior to the culture results, it had been initially hypothesized that the offending pathogen was introduced during one of his prior knee revision surgeries and spread hematogenously to the other knee, invoking a hospital-associated *Pseudomonas* spp. infection as a possibility. However, when his cultures grew *P. multocida* a hospital-acquired infection was ruled out. Upon further history, it was discovered that he lived with three cats and two dogs. Though he did not recall any scratches or bites, he did report actively playing with his pets on a regular basis.

At two, four, and six weeks follow up our patient reported steady improvement, with progressively decreasing pain in both knees and improved mobility. He had small amounts of drainage from his left knee, and underwent aspiration 5 weeks after discharge which was culture-negative and with no organisms on Gram-stain. He completed his 6-week course of ceftriaxone, his PICC line was removed, and he was maintained on amoxicillin suppression for 6 additional weeks. By six weeks after discharge his CRP and ESR had normalized from 191.7 and 129 at discharge to 8.0 and 11, respectively. Surveillance labs were discontinued at that time.

## Discussion

*Pasteurella multocida* is a Gram-negative coccobacillus and is a known part of the normal microbiota of the oral, nasopharyngeal, and upper respiratory tract of animals. Zoonotic transmission to humans most commonly occurs through animal bites or scratches, though contact between animal oral or nasal secretions to surgical wounds, abrasions, or mucosal surfaces can also result in infection. In nearly all reported cases of *P. multocida* infection, prior animal contact was reported [8]. PJI due to *P. multocida* is rare, with only 44 cases reported since 1975, including this one. Of the recorded cases to date, 65% have followed a cat bite or scratch and 31% of cases have followed dog scratches, bites, or licks [9]. Hematogenous *P. multocida* PJIs such as in our patient are rare, though when they occur they can affect multiple prostheses. As mentioned above, there are only two described cases in the literature where multiple prostheses were infected with *P. multocida* after hematogenous dissemination [6,7].

The first case of polyarticular PJI infection with *P. multocida* was described by Orton et al., reporting a patient who presented with *P. multocida* septicemia, and was treated with 17 days of ampicillin after which she presented again with recurrent fever and new onset knee pain. Aspirate of the synovial fluid revealed both *P. multocida* and to a lesser extent *Pseudomonas* spp., and she was given three months of penicillin and tetracycline, yet unfortunately developed loosening of her hardware, necessitating the removal of both prostheses [6]. The patient in the second case, described by Mellors et al., developed *P. multocida* bacteremia and subsequent bilateral knee PJI. Penicillin was curative in this case, and the prostheses did not need to be removed [7]. Neither of these patients underwent any sort of surgical intervention. Our patient was able to avoid removal of the prosthesis with DAIR and 6 weeks of IV antibiotic therapy. While the concomitant *Pseudomonas* spp. infection in the first case described above may have contributed to the need for prosthesis removal, a modern approach utilizing antibiotic and surgical therapy has proven effective in saving the prostheses.

*Pasteurella multocida* is generally susceptible to a wide range of antibiotics, including penicillin, amoxicillin, third-generation or later cephalosporins, tetracyclines, co-trimoxazole, and chloramphenicol, while typically being resistant to clindamycin and erythromycin. Like other PJIs, the standard treatment approach is a combination of surgical modalities and antibiotic treatment. The surgical approach utilized depends on the timing and classification of infection, and may include hardware explant or DAIR [3]. Regardless of surgical approach, a prolonged course of antibiotics for 4-6 weeks is typical, with additional suppression if the implant is retained. Fortunately, the remission rate after DAIR for PJI caused by *P. multocida* is high. According to Honnorat et al., only 15% of cases treated with DAIR required the eventual removal of the prosthesis [9].

## Conclusions

Periprosthetic joint infections caused by *P. multocida* remain rare, but should be kept in mind by providers when patients present with the signs and symptoms of PJI in the setting of appropriate epidemiologic exposures. Due to the strong association with animal contact, a thorough history should inquire about pet ownership. Infection is most commonly caused by scratches or bites, but infection can occur even in the absence of known trauma to the skin, as in our patient. In patients with multiple prosthetic joints, there is an increased risk of polyarticular infection if the patient becomes bacteremic.

Typical treatment is similar to other PJIs, but patients with *P. multocida* PJI who are initially deemed candidates for DAIR seem to have high rates of cure without need for future removal of the prosthesis.

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## Abbreviations

PJI	Periprosthetic joint infection
AHI	Acute hematogenous infection
PIC	Positive intraoperative culture
TKA	Total knee arthroplasty
AFB	Acid fast bacillus
PICC	Peripherally inserted central catheter
DAIR	Debridement, antibiotics, and implant retention

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