Arthroplasty Today 27 (2024) 101351

Contents lists available at ScienceDirect

Arthroplasty Today

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

Case Report

Pasteurella multocida From a Cat Scratch as a Cause of Recurrent Prosthetic Joint Infection After Previously Successful Single-Stage Exchange Arthroplasty

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ARTICLE INFO

Article history:
Received 5 November 2023
Received in revised form
4 February 2024
Accepted 10 February 2024
Available online xxx

Keywords:
Prosthetic joint infection
Pasteurella multocida
Single-stage revision

ABSTRACT

We report a case of a 74-year-old female with a history of a prosthetic joint infection that was successfully treated with a single-stage exchange arthroplasty, off antibiotics, and without symptoms for 20 months. She presented 1 week after a cat scratch with acute knee pain, and aspiration grew *Pasteurella multocida*. She was successfully treated with surgical debridement and a prolonged course of antibiotics. Debate remains in the literature regarding whether recurrent infections represent a previously undetected organism or a new infection. Our report provides convincing evidence that, at least in some circumstances, the infection is new. Furthermore, this is the first case described of *P. multocida* resulting in a recurrent prosthetic joint infection after a previously successful exchange arthroplasty due to a different causative organism.

Introduction

Prosthetic joint infection (PJI) is a severe complication that occurs in 1%-2% of patients after total joint arthroplasty, with the incidence expected to increase as rates of primary total joint arthroplasty in the United States continue to rise [1,2]. The current standard of care in the United States for the treatment of PJI is two-stage exchange arthroplasty, with success rates reported at 70%-90% [3-5]. There is also evidence to suggest that single stage exchange is an effective treatment in select patient populations [6]. Unfortunately, options remain limited for patients who fail an exchange arthroplasty procedure for PJI. Outcomes of repeat two-stage procedures have been shown to have failure rates as high as 49%, and further revision exchange procedures lead to prolonged immobility and increased psychological distress for patients [7-9]. These less-than-satisfactory outcomes highlight the need for further understanding of PJI and recurrent septic failure.

Staphylococcus aureus and coagulase-negative Staphylococci are the most commonly identified organisms in PJI, while Enterococcus species and gram-negative bacilli are often isolated in polymicrobial infections [10,11]. Less commonly, infection by rare zoonotic organisms may occur. *Pasteurella multocida* is an anaerobic, gram-negative coccobacillus commonly found in the oral flora of household cats and dogs that has been reported as a rare cause of PJI [12-16]. In patients that fail two-stage exchange arthroplasty, it has been observed that the reinfecting organism differs from the organism isolated from the initial infection in 50%-80% of cases [17-19]. While reinfection with a similar organism could represent failure of eradication, reinfection with a unique organism may indicate patients with a predisposition to infection. This case report details a patient who developed an acute recurrent PJI caused by Pasteurella multocida after previous successful one-stage exchange arthroplasty due to a different original infecting organism.

Case history

The authors confirm that written informed consent has been obtained from the involved patient, and they have given approval for this information to be published in this case report.

The patient is a 74-year-old female with a past medical history of hypertension and hypothyroidism. She is nondiabetic, has never smoked cigarettes, and has a body mass index of 21 kg/m^2. She has

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https://doi.org/10.1016/j.artd.2024.101351

no known history of immunodeficiency. She underwent a primary total knee arthroplasty (TKA) performed in October of 2020 at an outside facility. She had delayed wound healing postoperatively and was treated with irrigation, debridement, and polyethylene exchange at 4 weeks postoperatively by her primary surgeon. Intraoperative cultures from that procedure grew *Serratia* and *Pseudomonas*, and she was treated with 6 weeks of appropriate intravenous (IV) antibiotics, followed by transition to suppressive oral antibiotics. One month after stopping IV antibiotics, she developed recurrent drainage from her wound. The knee was aspirated under sterile conditions in the office, and cultures grew methicillin-resistant *Staph epidermidis*. A negative-pressure dressing was placed on her wound. Laboratory analysis from that visit revealed a C-reactive protein of 88 mg/L, an erythrocyte sedimentation rate of 36 mm/hr, and a white blood cell count of 6700. She was referred to our practice and treated with a single-stage exchange procedure in March 2021. This procedure involved implant removal, rebalancing of the knee, methodical debridement, and irrigation with saline, dilute betadine, and dilute peroxide according to institutional protocol. The room was then turned over, new instruments were opened, and the leg was reprepped and draped. An additional round of irrigation was performed according to institutional protocol, followed by reimplantation with cement containing gentamycin. She was then treated with 6 weeks of culture-guided IV antibiotics. She again experienced delayed wound healing but did heal her wound by 1 month postoperatively and continued on oral antibiotics for an additional 6 months, according to protocol. She underwent a left TKA for primary osteoarthritis in November of 2021. One year later, in November 2022 (20 months from the index one-stage revision procedure), she was doing very well, with no pain or wound issues, and was off antibiotics.

She presented for an unscheduled follow-up 8 months later, in July 2023. She had developed a tooth abscess in late June and was treated with a root canal and prolonged oral antibiotics, most recently clindamycin, 10 days prior to her visit. Two weeks prior to this visit, she was scratched by her cat on her right shin, which had developed some surrounding cellulitis. She woke up with severe right knee pain 3 days prior to her visit, which prompted her to make an appointment.

At that visit, she was noted to have a large effusion and a well-healed incision; the knee was warm to the touch; and there was significant pain with palpation and any range of motion of the knee. Radiographs did not demonstrate any signs of loosening (Fig. 1). Her right knee was aspirated under sterile technique, and frank purulence was noted. Analysis showed a cell count of 29,415 nucleated cells with 95% neutrophils. She was sent to the emergency department and taken to the operating room that night for irrigation, debridement, and polyethylene exchange. Her previous aspiration cultures eventually grew *Pasteurella multocida*.

In the operating room, her prior midline parapatellar approach was used. Full-thickness medial and lateral synovectomies were performed and sent for culture. The polyethylene was removed, and the knee was extensively debrided of synovium. The knee was then irrigated with normal saline, betadine, and peroxide following institutional protocol. Clean drapes were applied, and gloves were changed. A new polyethylene of the same size was inserted. A drain was placed, the wound was sutured closed, a negative pressure dressing was placed, and she was placed in a knee immobilizer. Intraoperative aspiration also grew *P. multocida*; synovial tissue cultures were negative at postoperative day 5. Blood cultures remained negative. The patient was started on IV ceftriaxone based on infectious disease specialist recommendations, with a plan for indefinite oral antibiotic suppression.

At her 3-week postoperative visit, she was doing well clinically, and her incision was healed. At her 2-month postoperative visit, she had completed her 6-week course of IV ceftriaxone and was transitioned to oral Augmentin (US Antibiotics, Bristol, TN). She was doing well clinically, had no complaints of pain, and was participating in physical therapy. On examination, her wound was well healed without signs of infection, and her range of motion was 10-120 degrees. At her 4-month postoperative visit, she was doing well clinically, had no complaints of pain, and had completed therapy. Her knee range of motion had improved to 0-120 degrees. At her 6-month postoperative visit, she was doing very well, her pain had subsided, and she noted that she was able to go up and down ladders to decorate her home for the holidays. She has continued on oral Augmentin for indefinite suppression.

Discussion

P. multocida derives its name from the observations that it could result in sepsis and death in multiple different animal species, including humans [20]. It is a facultatively anaerobic gram-negative

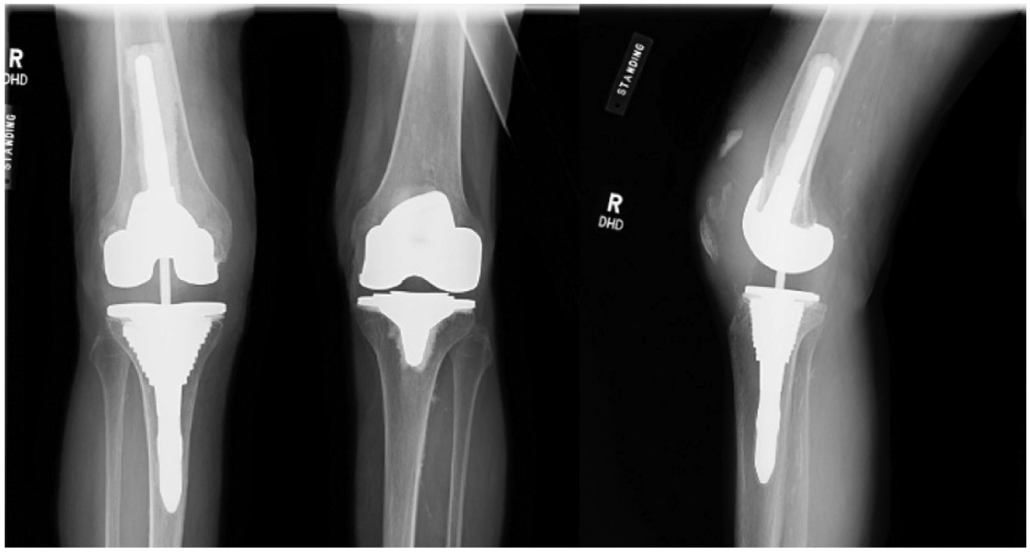

Figure 1. Preoperative radiographs at first symptomatic visit demonstrate well-positioned implants without radiographic evidence of loosening.

Table 1
Literature review of case reports of Pasteurella multocida prosthetic knee infections.

Authors	Age/sex	Animal contact	Time from primary	Time from cat scratch	Surgical intervention	Abx	Outcome - follow-up
Present case	74F	Cat scratch	3 y from primary, 2.5 y from revision	2 wks	DAIR	6 wks IV ceftriaxone followed by PO suppression	Cure -
Ranavaya [27] (2023)	75F	Cat bite, with Enterococcus sepsis treated with 14 d of Unasyn	3 y	6 wks	1 stage	6 wk IV ceftriaxone, followed by 6 mo Augmentin	Cure - 1 y
Runnstrom [28] (2018)	74M	Dog scratch	n/a	"Few" days	DAIR	6 wks Penicillin G	Cure - 1 y
Honnorat [29] (2016)	65M	Dog lick	7.6 ± 5.12 y	n/a	DAIR	Amoxicillin + Doxycycline	Cure
	63F	Cat scratch	7.6 ± 5.12 y	n/a	2 stage	Amoxicillin + Doxycycline	Cure
	65M	Dog lick	7.6 ± 5.12 y	n/a	2 stage	Amoxicillin + Doxycycline	Cure
	81F	Cat lick	7.6 ± 5.12 y	n/a	2 stage	Amoxicillin + Doxycycline	Cure
	85F	Cat and dog licks	7.6 ± 5.12 y	n/a	DAIR	Amoxicillin + Doxycycline	Cure
Ferguson [30] (2014)	67F	Dog licks	13 wks	unknown	DAIR	4 wks PO Linezolid & Ciprofloxacin, followed by 4 wks Ciprofloxacin	Cure - 6 wks
Subramanian [31] (2013)	47M	Dog licking wound	23 d	unknown	DAIR	6 wks PO Doxycycline + Clindamycin	Cure
Romano [32] (2013)	82F	Cat scratch	4 y	5 mo	DAIR	34 d Augmentin + Ciprofloxacin followed by 8 d Ciprofloxacin	Cure - 18 mo
Heydemann [33] (2010)	66M	Cat scratch	9 mo	7 d	DAIR	4 d Ampicillin/sulbactam followed by 4 wks Ceftriaxone	Cure - 18 mo
Kadakia [34] (2008)	80F	Cat scratch	9 mo	8 d	Scope I&D	2 wks IV Cefuroxime, followed by 8 wks PO Ciprofloxacin	Cure - 6 mo
Heym [13] (2006)	82F	Dog licking a toe wound	2 y	3 wks	I&D w/ retained polyethylene	11 wks PO Amoxicillin + Doxycycline	Failure, recurred 2.5 mo later treated with 2 stage exchange, Cure @ 18 mo
Zebeede [35] (2004)	41F	Cat scratch	2 y	2 wks	None	12 wks Ciprofloxacin	Cure
Stiehl [15] (2004)	63M	No contact	12 d	n/a	2 stage + medial gastric flap	Ciprofloxacin + Piperacillin/Tazobactam	Cure - 1 y
Polzhofer [36] (2004)	73F	Cat bite	6 mo	"Some" days	Scope I&D	3 wks Ampicillin/Sulbactam, followed by 3 wks Clindamycin	Cure - 1 y
Ciampolini [37] (2004)	73F	Cat scratch	14 mo	2 wks	2 stage	IV Penicillin + IV Ciprofloxacin until CRP normalized, followed by 6 wks PO Amoxicillin + PO Ciprofloxacin	Cure - 1 y
Maradona [38] (1997)	73F	Dog bite	6 mo	45 d	DAIR	3 wks IV Penicillin G followed by 3 wks PO Ciprofloxacin	Cure - 2 y
Antuna [12] (1997)	73F	Dog bite	14 mo	2 mo	1 stage	6 wks IV Ciprofloxacin followed by 4 wks IM ciprofloxacin	Cure - 2 y
Gabuzda [39] (1992)	88F	Cat bite	10 mo	"Several" days	2 stage	3 wks Ampicillin/Sulbactam followed by 3 wks penicillin	Cure
Guion [20] (1992)	45F	Dog scratch	33 mo	1 wk	2 stage	6 wks IV Cefotaxime	Cure - 2.5 y
Orton [40] (1984)[a]	74F	Cat bite	3 y	1 d	non-op initially	12 wks PO Penicillin + Tetracycline	Failure, loosened over the next 2 y, treated with bilateral resection with a knee fusion on one side pseudarthrosis + brace on the other
Mellors [41] (1985)[a]	62F	Cat scratch	n/a	4 d	None	6 wks Penicillin	Cure
Gomez [42] (1980)	64F	Cat bite	3 y	5 d	non-op initially	6 wk IV Cephalothin - 6 wk PO Cefalexin, 2nd course of IV Cephalothin after recurrence	Failure, recurred 6 wk later with implant loosening treated with resection and knee fusion
Spagnuolo [43] (1978)	72F	Cat bite	4 mo	5 d	I&D + 1 wk continuous suction-irrigation	6 wks IV Penicillin	Cure - 1 y

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Table 1 (*continued*)

Authors	Age/sex	Animal contact	Time from primary	Time from cat scratch	Surgical intervention	Abx	Outcome - follow-up
Arvan [44] (1978)	72F	Cat bite	4 mo	1 wk	I&D + 2 wk suction-irrigation with 0.25% acetic acid	3 wks IV Penicillin +1 y PO Penicillin	Cure - 21 mo
Sugarman [45] (1975)	33F	Dog lick	5 wks	n/a	Non-op initially	"months" of cloxacillin	Failure, recurred 9 mo later, treated with 14 mo of PO penicillin, eventual resection and knee fusion
Griffin [46] (1975)	64F	Cat bite	6 mo	2 d	None	Ampicillin	Cure - "some months"
Maurer [47] (1975)	55F	Dog lick	"Several" years	n/a	none	2 wks IV Penicillin	Cure

non-op, non-operative management.
[a] Indicates a reports of bilateral case.

coccobacillus that is commonly found in the oral flora of many domestic pets such as cats and dogs [21]. This bacteria is then transferred to their paws with frequent licking for grooming, which facilitates infection in humans via scratches and bites from these animals [22]. This most often presents as local wound infections and cellulitis, which may progress to local adenopathy with systemic symptoms of fever, chills, and myalgias. This may also result in tenosynovitis or osteomyelitis in the case of deeper bites where tendon and bone are more superficial such as the hand or foot [23]. Less commonly, sepsis or other severe opportunistic infections such as respiratory tract infection, endocarditis, and meningitis have been described in immunocompromised hosts [21,22,24].

The case presented in this report is the first description in which *P. multocida* was responsible for a recurrent PJI after a previous infection attributed to a different causative organism. It remains unclear if recurrent PJI is due to inadequate treatment of the initially infecting organism or if infection with a new organism can be attributed to patient-specific factors that result in a predisposition to PJI. This phenomenon was further explored by Zmistowski et al., who analyzed 92 cases of recurrent PJI and found that 63 cases (62.5%) were due to a "new" organism that was not present on cultures from the first infection [19]. In a study of 50 consecutive 2-stage exchange procedures, Haddad et al. found that 4 patients developed a recurrent PJI, with 3 (75%) being attributed to "new" organisms [25]. Similarly, Kraay et al. reported on a series of 33 patients undergoing a 2-stage exchange procedure with cementless revision implants, and of the 28 patients with a 2 year follow-up, only 2 developed a recurrent infection, both of which were caused by a "new" organism [26]. The current patient had undergone a single-stage exchange arthroplasty for a PJI caused by *Stapylococcus epidermidis* 5 months after her primary TKA. She had an excellent outcome from this and underwent a successful primary TKA on the contralateral extremity 8 months later with no further infectious symptoms until her cat scratched 20 months later. Additionally, aside from her history of previous PJI, she has no identifiable risk factors known to be associated with the development of PJI or failure of revision for infection.

Zoonotic infections make up a very small percentage of all PJIs. Since 1975, there have been only 29 cases of TKA prosthetic infections due to *P. multocida* reported in the English literature (Table 1) [12,13,15,20,27-48]. The majority (20/29, 69%) were attributed to scratch or bite from a cat or dog. Eight of the remaining patients were in close contact with cats or dogs that frequently licked their legs or wounds, and one was not known to have any direct contact with animals. Of the 19 cases that described the temporal relationship to injury, 15 (79%) of patients developed PJI symptoms of joint pain, swelling, or wound drainage in 2 weeks or less.

Earlier cases of *P. multocida* PJI were more likely to be treated nonoperatively, with 4 patients (13.7%) successfully treated with prolonged courses of antibiotics [35,41,46,47]; however, another 3 patients (10%) were initially treated nonoperatively with subsequent recurrence and loosening requiring resection and knee fusion suggesting that nonoperative management is not an effective treatment for these patients [40,42,45].

Two-stage exchange arthroplasty remains the gold standard for the treatment of PJI. In the reported cases of PJI caused by *P. multocida*, 8 patients (27%) were successfully treated with an initial 1- or 2-stage exchange arthroplasty without recurrence at follow-up. Debridement and irrigation with implant retention (DAIR) is occasionally selected as the treatment of choice in patients who may not tolerate the demands and mobility limitations of an exchange arthroplasty or have implants that are considered unresectable. Several authors have questioned the efficacy of this technique and reported high failure rates ranging from 48.2%-69%

[49-53]. Due to its acute presentation, *P. multocida* PJI appears to be amenable to treatment with irrigation and debridement (I&D) and exchange of the polyethylene. Of the reported cases, 14 patients (41%) were initially treated with I&D, with only 1 failure occurring at 2.5 months and subsequently treated with a successful 2-stage exchange procedure. Of note, that case of failure had retention of the polyethylene because a correctly sized replacement was not available [13].

Proper antibiotic management is critical for successful eradication of PJI. For all types of *P. multocida* infections, penicillins such as Penicillin V or G, Amoxicillin, and Ampicillin, as well as many later generation cephalosporins such as parenteral Ceftriaxone or oral cefuroxime and cefixime demonstrate good activity against *P. multocida*. Non-beta lactam antibiotics such as fluoroquinolone, doxycycline, or trimethoprim-sulfamethoxazole are appropriate alternatives for patients with beta-lactam intolerance [54]. Although many of the early reports utilized penicillin for treatment of PJI, most of the cases since 1990 have successfully treated *P. multocida* PJI with a third-generation cephalosporin, a beta-lactam/beta-lactamase inhibitor combination, a fluoroquinolone, or doxycycline in addition to surgical intervention. Current recommendations for antimicrobial therapy for nonstaphylococcal PJI are for 4-6 weeks of a highly bioavailable pathogen-specific antibiotic [55]. Of the 22 cases in this review that reported a duration of follow-up, 20/22 completed at least 6 weeks of antibiotic therapy. One case was treated with a DAIR procedure and completed 4 days of ampicillin/sulbactam followed by 4 weeks of ceftriaxone with no recurrence of symptoms at 18 months. The second case was the first case of *P. multocida* PJI in 1975 that was treated without surgery and only 2 weeks of IV penicillin without recurrence.

Due to its ability to rapidly spread and affinity for prosthetic joints, this raises the question of the need for prophylaxis for all animal scratches and dog bites in patients who have previously undergone total joint arthroplasty. Recent infectious disease guidelines have recommended prophylactic treatment after animal bite wounds in high-risk patients with immunocompromising comorbidities, advanced liver disease, chronic edema of the affected area, or wounds that involve deeper structures; however, no guidelines exist on whether prophylactic treatment is necessary in patients with prosthetic joints [56]. Several authors of previous cases of *P. multocida* have advocated for the use of prophylactic coverage following an animal bite [34,37,38,40,48]. Appropriate empiric treatment would not only cover *P. multocida* but also other commonly found bacteria in the oral flora of animals such as anaerobes, Streptococcus, and Staphylococcus species [54]. Similar to the practice of prescribing antibiotics before and after dental procedures, patients should be counseled to seek urgent care and consideration of prophylaxis following an animal bite or scratch.

Summary

P. multocida is an uncommon cause of PJI, often attributed to animal bites or scratches with a limited number of reported cases in the literature. To our knowledge, this is the only reported case of *P. multocida* causing a recurrent PJI after previous successful single-stage exchange arthroplasty with a different organism. Further understanding of the mechanisms of recurrent infection and predisposing patient characteristics is necessary to improve the treatment and prevention of PJI. Patients that develop *P. multocida* PJI can be successfully treated with DAIR or exchange arthroplasty along with appropriately targeted antibiotic therapy. Patients undergoing total joint arthroplasty should be counseled on the importance of reporting any significant animal-related wounds to their surgeon for consideration of empiric prophylaxis.

Conflicts of interest

J. Otero receives royalties from DePuy Synthes, is a paid consultant of DePut, Zimmer Biomet, and Onkos, and receives research support from DePuy Synthes and Zimmer Biomet. All other authors declare no potential conflicts of interest.

For full disclosure statements refer to https://doi.org/10.1016/j.artd.2024.101351.

Informed patient consent

The author(s) confirm that written informed consent has been obtained from the involved patient(s) or if appropriate from the parent, guardian, power of attorney of the involved patient(s); and, they have given approval for this information to be published in this case report (series).

CRediT authorship contribution statement

Alexander Dombrowsky: Writing – review & editing, Writing – original draft, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Josef Jolissaint:** Writing – review & editing, Writing – original draft, Project administration, Methodology, Investigation, Data curation, Conceptualization. **Jesse Otero:** Writing – review & editing, Writing – original draft, Resources, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization.

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