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Pasteurella multocida prosthetic joint infection. A case report and review of the literature

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SUMMARY

Pasteurella multocida is a Gram-negative coccobacillus that is a part of normal oral flora of animals, especially cats and dogs. It is the most common causative agent for soft tissue infections following a bite or scratch from domestic pets. Prosthetic Joint Infections (PJIs) due to *Pasteurella multocida* are rarely but increasingly reported. Since 1992, only a few cases of PJIs caused by *P. multocida* have been described. Herein we present a case of a 67-year-old immunocompetent elderly female who developed total hip arthroplasty infection due to *P. multocida* and was treated successfully with left hip washout, pseudo-tumor removal, and intravenous antibiotics and a review of the literature on prosthetic joint infections caused by *P. multocida* since 1992.

Keywords: Prosthetic join infections, *Pasteurella multocida*, debridement.

INTRODUCTION

Prosthetic joint infections (PJIs) are typically associated with aerobic bacteria such as Staphylococci, Streptococci, and Enterococci, while Gram-negative bacilli are less commonly isolated pathogens [1]. However, PJIs due to Pasteurella multocida are rarely but increasingly reported. Since 1992, only a few cases of PJIs caused by P. multocida have been described.

Pasteurella multocida is a Gram-negative coccobacillus that is a part of normal oral flora of animals, especially cats and dogs. It is frequently responsible for soft tissue infections in humans, usually following a bite or scratch from domestic pets Involvement of bones or joints is a rare complication, while infection of a prosthetic joint is even more infrequent [2, 3].

We present a case of *P. multocida* Total Hip Arthroplasty (THA) infection and a review of the literature on PJI caused by *P. multocida* over the last 22 years.

CASE PRESENTATION

A 67-year-old female presented to the emergency department with diarrhea, pain, swelling, and pronounced erythema of her left foot extending just below the knee. The patient had undergone total left hip arthroplasty (THA) 10 years prior due to degenerative hip osteoarthritis. She reported a cat bite on her left foot occurring just two days before admission. On arrival, the patient was febrile, with a temperature of up to 39°C. Her vital signs

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showed a heart rate of 110 bpm and a blood pressure of 100/82 mmHg. The left leg (lower third of the tibia) was warm, swollen, and erythematous, with a tense effusion and severely restricted range of motion due to pain.

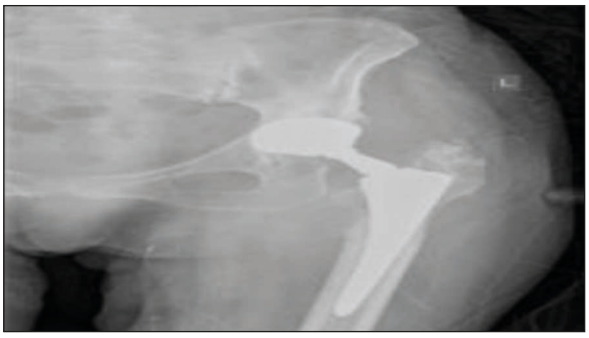

Figure 1 - AP X-Ray of the Left Hip Join: Findings compatible with Total Hip Arhtroplasty. No obvious alteration around the implant for example: no loosening signs.

The chest X-ray was normal, with no hilar lymphadenopathy observed. Standard hip radiography was satisfactory and did not show any obvious alterations around the implant (Figure 1). The patient's white blood cell count was 17.2×109/L with a neutrophilia (14.2 × 109/l), C-reactive protein (CRP) of 20mg/l (<0.5 mg/l), thrombocytopenia, elevated fibrinogen (478 mg/dl), and elevated high-sensitive troponin (1893 ng/dl), which was attributed to Type II ischemia, which further refers to a form of ischemia associated conditions that cause an imbalance between myocardial oxygen supply and demand. The patient was initially administered piperacillin - tazobactam and daptomycin intravenously (i.v). Due to persistent pain which extended above the knee the next days, the patient underwent Magnetic Resonance Imaging (MRI) (Figure 2a-e). MRI showed large encapsulated multilobular fluid collection with internal septa adjacent to the endoprosthesis of the left hip

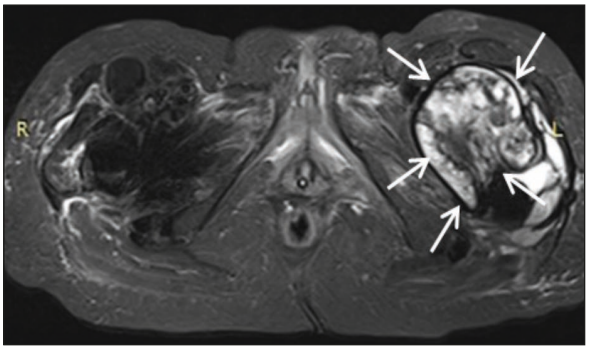

Figure 2a - Axial STIR image at the level of femoral neck. Large encapsulated multilobular fluid collection with internal septa is observed adjacent to the endoprosthesis of the left hip joint (white arrows).

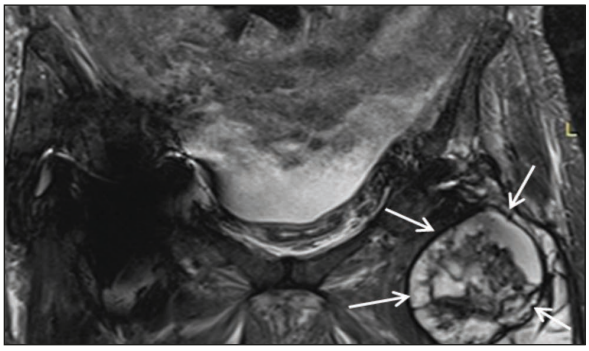

Figure 2b - Coronal STIR image at the level of pubic bone. Large encapsulated multilobular fluid collection with internal septa is depicted adjacent to the endoprosthesis of the left hip joint (white arrows).

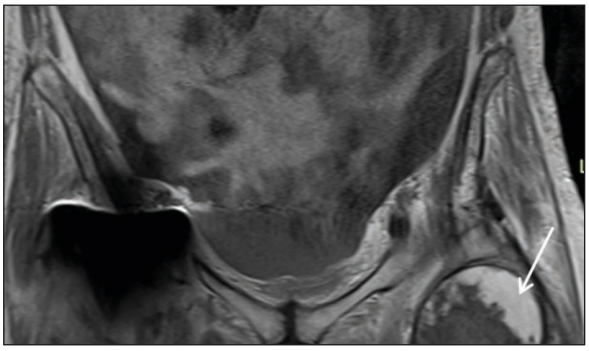

Figure 2c - Coronal T1 post Gd Fat –Suppression image at the level of pubic bone. White arrow shows the peripheral enhancement of the encapsulated collection.

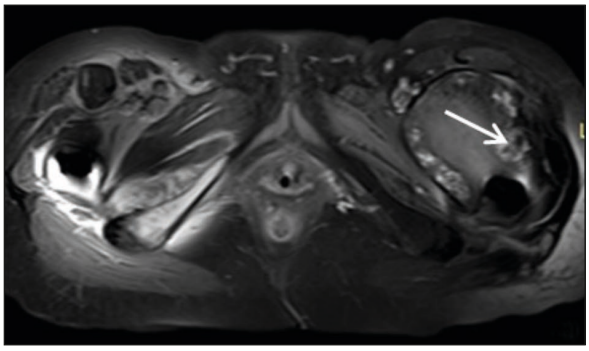

Figure 2d - Axial T1 post Gd Fat –Suppression image at the level of femoral neck. White arrow shows the peripheral enhancement of the encapsulated collection.

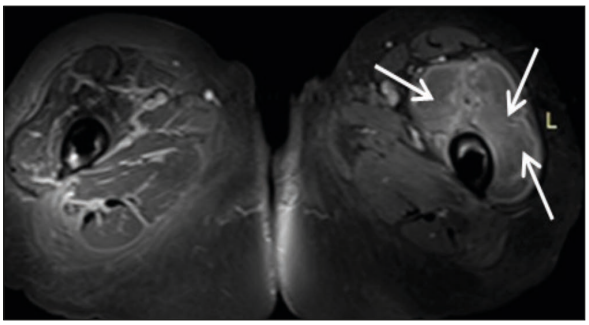

Figure 2e - Axial T1 post Gd Fat –Suppression image at the level of proximal femur. White arrow shows abscess formation in the left rectus femoris and the vastus laterali.

joint (Figure 2a-2b). This collection extended anteriorly beneath the deep fascia, causing displacement of the quadriceps muscle and protruding into the iliopsoas pouch. Its maximum outer diameter measured 12 cm.

The collection exhibited heterogeneous content, peripheral enhancement, as well as solid-enhancing wall components (Figure 2c-2d). Moreover, bilateral myositis was noted in the upper thigh muscle groups, with abscess formation in the left rectus femoris and the left vastus lateralis (Figure 2e). These findings suggested the presence of an inflammatory pseudotumor following hip arthroplasty, possibly compounded by systemic bacteremia, as evidenced by a history of cat bite. Fluid accumulation was also evident in the pelvic cavity. Of the three blood cultures that were sent to the lab, Pasteurella multocida was isolated in one. Based on these findings, the patient was scheduled for surgical treatment, which was performed within a week. She underwent a left hip washout and pseudotumor removal under general anesthesia. She continued for two weeks receiving intravenously piperacillin-tazobactam and daptomycin (in the case of coexistence of a Gram-positive organism that was not isolated) after surgery completing a total period of one month. The patient was discharged with orally antibiotic treatment (ciprofloxacin and clindamycin) for two weeks. Follow-up appointments were scheduled monthly for the first six postoperative months. The patient was asymptomatic at last follow-up.

LITERATURE REVIEW

A literature search of the case reports was performed in PubMed and in Google Scholar. The criteria were "Total Hip Arthoplasty (THA) infection due to *Pasteurella multocida*" and "Total Knee Arthroplasty (TKA) infection due to *Pasteurella multocida*". The keywords used in our search were "*Pasteurella multocida*", "Prosthetic joint infection", "THA infection due to *P. multocida*" and "TKA infection due to *P. multocida*".

Search results were limited to articles written in the English-language. There were 14 publications; 6 were found in PubMed and 8 in Google Scholar (the first one was reported in 1992 and the last one was reported in 2023) (Table 1) [3-17]. Out of the 21 cases, most were male, with an average age of 68

Table 1 - Publications of *Pasteurella multocida* prosthetic join infections.

Article	*Cases*	*Age (years) /sex*	*Immunosuppressive therapy*	*PJI*	*Time to infection after arthroplasty*	*Treatment strategy*	*Antibiotics*	*Duration of treatment*
Braithwaite BD et al. 1992 [3]	1	48, F	Insulin dependent Diabetes	THA	14 years	Revision of her total hip arthroplasty	Intravenous penicillin and flucloxacillin	4 weeks
Takwale VJ et al. 1997 [4]	1	57, F	Rheumatoid arthritis on steroids and methotrexate	THA and TKA	12 years	Total hip replacement	Intravenous flucloxacillin, benzyl penicillin and metronidazole	2 weeks
Maradona JA et al. 1997 [5]	1	73, F	Noninsulin-dependent diabetes mellitus	TKA	6 months	Surgical debridement	Intravenous penicillin G was started, 12 - 106 U	3 weeks
Stiehl JB et al. 2004 [6]	1	63, M	Healthy	TKA	7 days	Total replacement	The initial systemic antibiotic used was cefazolin, but this was changed to ciprofloxacin and piperacillin-tazobactam	8 weeks

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Article	*Cases*	*Age (years) /sex*	*Immunosuppressive therapy*	*PJI*	*Time to infection after arthroplasty*	*Treatment strategy*	*Antibiotics*	*Duration of treatment*
Metha H et al. 2004 [7]	2	84, F	Rheumatoid arthritis on steroids	THA (both sides)	10 years	One stage revision	Benzyl penicillin 1.2 g QDS and ciprofloxacin 400 mg BD intravenously for 1 w, followed by ciprofloxacin 750 mg BD orally for a further 7 weeks	8 weeks
		57, F	Rheumatoid arthritis on steroids and methotrexate	THA and TKA	7years	2-stage revision total hip arthroplasty, with a 6-week interval,	Benzyl penicillinintravenously for 4 weeks, followed by ciprofloxacin 750 mg BD orally for 8 weeks	12 weeks
Heym B et al. 2006 [8]	1	72, F	No immunocompromised	TKA	12 years	Two-step change of the TKA	Ampicillin/sulbactam 3g every 6h	
Kadakia AP et al. (2008) [9]	1	80, F	Breast carcinoma	TKA	10 years	Surgical lavage and debridement	cefuroxime	8 weeks
Heydemann JS et al. 2010 [10]	1	66, M	No immunocompromised	TKA	9 months	arthrotomy, synovectomy, replacement of the tibial interspacer	ceftriaxone	4 weeks
Romano CL et al. 2013 [11]	1	82, M	No immunocompromised	TKA	10 years	Revision of arthroplasty	Amoxicillin/clavunate and ciproflocaxin	6 weeks
Ferguson KB et al. 2014 [12]	1	67, F	No immunocompromised	TKA		Surgical lavage and debridement	Linezolid and ciprofloxacin	8 weeksa
Honnorat E et al. 2016 [13]	6	Mean age: 74	2 cases with Diabetes	5 TKA, 1THA	Mean time 7.6 years	Surgical lavage and debridement and prosthesis retention in three cases and prosthesis removal in three cases	Combination of antibiotic treatment with amoxicillin and doxycycline	8 months
Runnstrom M et al. 2018 [14]	1	74, M	No immunocompromised	TKA		Left knee irrigation, debridement and left TKA revision	Ampicillin/sulbactam 3g every 6 h, switched to penicillin G	6 weeks
Detloff BA et al. 2022 [15]	1	58, M	No immunocompromised	TKA	5 months	Debridement, antibiotics, andimplan-tretention (DAIR)	Ampicillin/sulbactam 3 g every 6 h	4 weeks
Shih CH et al. 2022 [16]	1	52, M	Liver transplantation	TKA	6 years	Antibiotics	Ampicillin/sulbactam	4 weeks
Maritati M et al. 2023 [17]	1	82, F	Breast cancer	TKA	2 years	Debridement, antibiotics, and implant retention (DAIR)	Ceftriaxone 2 g	12 weeks

Abbreviations: TKA: total knee arthroplasty, THA: total hip arthroplasty. YO: years old, M male , F: female, QDS: four times daily, BD: two times daily.

years. The majority had total knee arthroplasty. Most patients underwent surgical replacement combined with beta-lactam antibiotics (ampicillin-sulbactam, amoxicillin, piperacillin/tazobactam).

DISCUSSION

Total Hip Arthroplasty (THA) and Total Knee Arthroplasty (TKA) are highly effective procedures that significantly improve patients' quality of life

[18]. However, Prosthetic Joint Infections (PJIs) following total joint arthroplasty represent a challenging and rare complication for orthopedic surgeons. Given that hip and knee replacements are among the most frequently performed and successful surgeries worldwide, and considering the substantial proportion of the population that owns pets, PJIs present an elevated risk for patients..

The most common causative pathogen remains *Staphylococcus aureus* reported in up to 34% of cases, followed by coagulase-negative staphylococci and streptococci while Gram-negative species are rarely isolated [19-20]. *Pasteurella multocida* is a well-known opportunistic pathogen of the oral flora of dogs and cats, as well as a nasopharyngeal and respiratory flora. Since 1992, only 21cases of PJIs caused by *P. multocida* have been described, as it is well presented in Table 1. *P. multocida* is the causative pathogen of skin and soft tissue infections and, more rarely, septic arthritis, osteomyelitis, prosthetic joint infections (PJIs), peritonitis, pneumonia, endocarditis, sepsis, and meningitis, particularly in immunocompromised hosts [3, 7, 14-15]. Mehta and Mackie reported that patients with prosthetic joints, particularly if immunocompromised, should be warned that cat and dog bites and cat scratches are potential sources of infection [4, 7]. Strong clinical suspicion is needed so that they should seek urgent medical attention and even receive antibiotic chemoprophylaxis [2, 4]. Maradona et al. suggest the administration of antibiotic prophylaxis in patients who have suffered a pet bite and have a prosthetic joint or Rheumatoid Arthritis or have undergone corticosteroid therapy [5]. American Academy of Pediatrics (AAP), Infectious Diseases Society of America (IDSA) and American Academy of Family Physicians (AAFP) support the use of broad-spectrum prophylactic antibiotics for 3-5 days as soon as possible (within 12-24 hours) after a pet (dog and cat) bite under certain circumstances which apply for the majority of patients. All patients with prosthetic joint must receive antibiotic prophylaxis after a pet bite in combination with wound care, tetanus prevention [2, 4, 5, 7].

We present a case of an immunocompetent elderly female who developed a *P. multocida* infection in a total hip arthroplasty following a cat bite below her left knee. Notably, infections from licks and scratches often occur distal to the prosthetic joint without direct trauma to the joint itself [14, 17]. Patients are predominantly female, and PJIs most commonly involve a single joint, typically the knee. Over 50% of patients with PJIs have altered host defenses such as female sex, rheumatoid arthritis, obesity, kidney disease, diabetes mellitus, corticosteroid use, alcoholism, organ transplants, COPD, malignancy, multiple surgeries, abnormal intraoperative bleeding, postoperative hematoma, prolonged postoperative drainage, and advanced age [4, 5, 7, 8, 10-12, 14, 15, 17]. Our patient had only two of these risk factors: female gender and older age.

Treatment of *P. multocida* joint infections includes surgical options and antibiotic treatment. If treated with antibiotics, the treatment includes penicillins, fluoroquinolones, and second or third-generation cephalosporins. It is important to note that while most human isolates remain susceptible to beta-lactams, strains isolated from animals have demonstrated marked resistance to a variety of antibiotics [21]. Furthermore Martina Maritati et al reported the first case of a Drug-Resistant *Pasteurella multocida* Prosthetic Knee infection successfully treated with debridement, antibiotics, and implant retention [17]. Many patients still require surgical debridement or joint replacement in addition to antibiotics. Joint replacement is done in either one step or two step procedures.

In conclusion, this case underscores several important points related to the diagnosis and treatment of Pasteurella-related joint infections. It is well mentioned that is more than typical a history of animal exposure, that cat bite-related infections may appear earlier, and the decision to perform an exchange arthroplasty is multifactorial and depends on the severity of the infection. Strong clinical suspicion is essential for patients with domestic animals and prosthetic joints who present with symptoms of septic arthritis.

Authors' contribution

ML, PA and GE conceptualized the work and treated the patient, ML, CC,MA, CM, PZ, GE, PA, LL reviewed the literature and wrote the paper, MM supervised and edited the paper.

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Conflicts of interest

The authors declare that there are not any conflicts of interest.

Availability of data and materials
Available upon reasonable request.

Ethics approval
This case report was conducted in line with the Helsinki Declaration.

Consent of publication
The patient gave consent for publication

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