**Pasteurella multocida** infected total knee arthroplasty: a case report and review of the literature

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**ABSTRACT**

*Pasteurella multocida* is a rare cause of prosthetic joint infection. This infection generally follows significant animal contact, usually licks and scratches. We report a case of *P. multocida* infection that was treated with linezolid with salvage of the implant. Linezolid is generally active against Gram-positive organisms only with the exception of *Pasteurella*, which is Gram-negative. We extensively review the previous reported cases of implant infection with *P. multocida*.

**KEYWORDS**

Implant infection – Linezolid – *Pasteurella*

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Deep infection represents one of the most devastating complications of total knee arthroplasty. The rate of infection is quoted in the literature as ranging from 1% to 5%. Traditionally, Coventry’s three-stage classification (early, delayed and late) has been used although it has been updated and modified by the more recent Tsukayama’s classification into four categories, based on presentation. Treatment options for infected prosthetic joints often comprise of one or more of the following: antimicrobial therapy, arthroscopic washout, open knee debridement with or without change of polyethylene insert, one-stage or two-stage revision and arthrodesis.

The most commonly implicated organisms associated with infected prostheses include *Staphylococcus aureus* (22%), coagulase-negative staphylococci (22%), alpha and beta-haemolytic streptococci (9% and 5% respectively), enterococci (7%), aerobic Gram-negative bacilli (25%) and anaerobes (10%). Occasionally, infection may be caused by rarer organisms, particularly in the immunocompromised host. Determining the causative organism influences antibiotic therapy. We report a rare case of *Pasteurella multocida* infection of a knee implant where selection of appropriate antibiotics made a crucial impact on the overall management.

**Case History**

A 67-year-old woman presented to the orthopaedic department 13 weeks following a primary left total knee replacement for osteoarthritis. The postoperative course had been uneventful until three days prior to her presentation to the department when she reported having woken up with acute pain, swelling and erythema of her left knee. She was unable to mobilise because of the pain and was also complaining of flu-like symptoms. There was no history of trauma or any invasive therapeutic procedure in the interim period. Initial observations noted a fever of 40.1°C with an associated tachycardia of 107bpm and a blood pressure 156/82mmHg. On examination, her left knee was warm, swollen and erythematous with a tense effusion. There was a 2cm x 2cm fluctuant and pointing area on the lateral aspect of her knee. The knee was held in 5º of flexion. Any attempted passive movement was exquisitely painful.

A laboratory investigation revealed an elevated white cell count (17.2 x 10⁹/l) with a neutrophilia (14.2 x 10⁹/l) and a C-reactive protein (CRP) of 347mg/l. Under aseptic technique, 60ml of pus was aspirated from the fluctuant pointing area over the lateral aspect of the knee. However, it was felt that this was communicating with the knee joint. The initial Gram stain demonstrated numerous white cells but no organisms. Radiography of the knee was satisfactory and did not show any obvious lucencies around the implant. The patient returned to theatre the following day for an open washout and debridement along with exchange of polyethylene insert. Tissue from the infected knee was sent for bacteriological investigations. Culture from the aspirate and from the knee tissue grew *P. multocida*. As the patient was allergic to penicillin (itchy rash), she was commenced on linezolid and ciprofloxacin.
as per the sensitivities and microbiology advice of the senior author. The ciprofloxacin course was a total of eight weeks combined with linezolid for the first four weeks, as recommended by Health Protection Agency guidelines. Owing to the risk of peripheral neuropathy, linezolid should not be given for more than four weeks. The patient improved with the antibiotics and washout. Her inflammatory markers came back to normal after two weeks, and there was a significant clinical improvement in the appearance and range of motion of the knee.

On closer questioning following the culture results, the patient revealed she had a cat and three dogs as pets. She stated that her dogs frequently licked her on her legs but she denied any bites or scratches. She was discharged home on oral antibiotics and was mobilising satisfactorily at the time of discharge. She was followed up at weekly intervals in the clinic for clinical review and check of inflammatory markers to ensure that there was no flare-up or recurrence of the infection. Repeat radiography of the left knee at six weeks was satisfactory. She is still under regular follow-up and is presently completely asymptomatic, with normal white cell count and CRP.

Discussion

*P. multocida* is a facultatively anaerobic Gram-negative coccobacillus. It is a commensal in the nasopharyngeal tract of domestic pets such as cats and dogs. Bacteria are transferred to their paws by licking. Consequently, cases of *Pasteurella* infection in humans can often be attributed to bites or scratches. Infection with *Pasteurella* is more commonly associated with cat bites, probably because cats are colonised more frequently. Data suggest that 50% of cat bites and 15–20% of dog bites become infected. Infections have also been known to occur in patients without a history of bites or scratches. Although the mode of transmission in such cases is unclear, inadvertent inoculation of the pathogen followed by direct spread or indirect dissemination cannot be ruled out (eg infection of the lick or scratch wounds followed by bacteraemia). Contamination of bone allograft has also been speculated as a possible mode of acquisition.

Septic arthritis, with or without osteomyelitis, is uncommon with *Pasteurella* and infection involving prosthetic joints is very rare. In such cases, however, it is very important to definitively identify *Pasteurella* because standard therapy for prosthetic joint infection (eg flucloxacillin or vancomycin) is not appropriate for this species. *Pasteurella* is susceptible to penicillin, amoxicillin, cephalosporins, tetracyclines, co-trimoxazole and chloramphenicol. Clindamycin and erythromycin are not active. The optimal antibiotic therapy for deep seated infection with *Pasteurella* in patients allergic to beta-lactam antibiotics is uncertain. The Health Protection Agency guidelines recommend combination therapy with ciprofloxacin and linezolid in such cases. Surprisingly, linezolid, whose activity is generally limited to the Gram-positive bacteria, has been found to be effective against *Pasteurella*.

*P. multocida* is an uncommon causative organism in prosthetic joint infection and after an extensive literature search only 22 published cases (including our report) could be found (Table 1). An overwhelming majority of patients were women (18 of 21 cases where this information was available). Patients’ age ranged from 35 to 88 years.
Underlying factors included rheumatoid arthritis (8 cases), osteoarthritis (6 cases), steroids (7 cases), diabetes (2 cases) and cancer (1 case) although some of these factors are also the common indications for joint replacement. Seventeen cases involved the knee joint (one case with bilateral infection) and only five hip joint infections have been reported. Of the 22 cases of *P. multocida*, 13 required joint revision (in 4 cases, revision was undertaken after the initial conservative management failed), 8 patients were cured with antibiotics and washout with salvage of the implant, and 1 patient underwent washout with exchange of the polyethylene spacer. Most patients received either one of the beta-lactam antibiotics or ciprofloxacin. One patient was treated with clindamycin although this antibiotic is known to be inactive against *Pasteurella* in vitro.

**Conclusions**

Our report has several learning points. Correct and timely identification of this pathogen was crucial to the outcome. Although there is a lack of evidence owing to the paucity of cases, patients with a history of implant surgery who have pets at home should be advised to seek medical attention following any bite or scratch, particularly if they have a history of rheumatoid arthritis and steroid use, so that timely prophylaxis can be administered before sepsis becomes deep seated.

**Table 1** Details of reported cases of *Pasteurella multocida* prosthetic infections

| Authors          | Age/sex | Site   | Implant removal? | Antibiotics and duration | Outcome               | Animal contact |
|------------------|---------|--------|-------------------|--------------------------|-----------------------|----------------|
| Griffin, 1975    | 64 F    | TKR    | No                | AMP                      | Cure                  | Cat scratch    |
| Maurer, 1975     | 55 F    | TKR    | No                | PEN, 2 wks               | Cure                  | Lick by dog    |
| Sugarman, 1975   | 33 F    | TKR    | No                | PEN, 60 wks              | Treatment failure – revision | Lick by dog    |
| Arvan, 1978      | 72 F    | TKR    | No                | PEN, 3 wks               | Cure                  | Cat bite       |
| Spagnuolo, 1978  | 72 F    | TKR    | No                | PEN, 3 wks               | Cure                  | Cat bite       |
| Gomez-Reino, 1980| 64 F    | TKR    | No                | CLN, 6 wks               | Treatment failure – revision | Cat bite       |
| Mellors, 1984    | Not known | B/L TKR | No                | PEN                      | Cure                  | Cat scratch    |
| Orton, 1984      | 74 F    | TKR    | No                | PEN, TET, 12 wks         | Treatment failure – revision | Cat bite       |
| Gabuzda, 1992    | 88 F    | TKR    | Yes               | PRP, 3 wks, then PEN, 3 wks | Cure                  | Cat bite       |
| Guion, 1992      | 45 F    | TKR    | Yes               | CTX, 6 wks               | Cure                  | Lick by dog    |
| Braithwaite, 1992| 48 F    | THR    | Yes               | PEN, FLU, 6 wks          | Cure                  | Cat bite       |
| Antuña, 1997     | 73 F    | TKR    | Yes               | CIP, 10 wks              | Cure                  | Dog bite       |
| Takwale, 1997    | 57 F    | THR    | Yes               | PEN, 4 wks, then CIP, 8 wks | Cure                  | Cat scratch    |
| Maradona, 1997   | 73 F    | TKR    | No                | PEN, 3 wks, then CIP, 3 wks | Cure                  | Dog bite       |
| Chikwe, 2000     | 69 M    | THR    | Yes               | Not known                | Cure                  | Dog contact    |
| Stiehl, 2004     | 63 M    | TKR    | Yes               | PTZ, CIP                 | Cure                  | None           |
| Mehta, 2004      | 84 F    | THR    | Yes               | PEN, CIP, 1 wk, then CIP, 7 wks | Cure | Cat scratch |
| Mehta, 2004      | 57 F    | THR    | Yes               | PEN, 4 wks, then CIP, 8 wks | Cure | Cat scratch |
| Polzhofer, 2004  | 73 F    | TKR    | No                | CLI, 3 wks               | Cure                  | Cat bite       |
| Heydemann, 2010  | 66 M    | TKR    | No                | CTR, 4 wks               | Cure                  | Cat scratch    |

AMP = ampicillin; AMX = amoxicillin; B/L = bilateral; CFX = cefuroxime; CIP = ciprofloxacin; CLI = clindamycin; CLN = cefalotin; CTR = ceftriaxone; CTX = cefotaxime; DOX = doxycycline; FLU = flucloxacillin; PEN = penicillin; PRP = penicillinase resistant penicillin; PTZ = piperacillin/tazobactam; RIF = rifampicin; TET = tetracycline; THR = total hip replacement; TKR = total knee replacement

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Finally, we used linezolid successfully for the treatment of implant infection with Pasteurella. The activity of linezolid is generally limited to the Gram-positive spectrum and its activity against Pasteurella (which is Gram-negative) is therefore not well known even to infection specialists. Linezolid has an excellent tissue penetration and this may offer an added advantage when conservative therapy without joint replacement is planned in penicillin intolerant patients with Pasteurella sepsis.

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