Case Review

Report of a *Moraxella catarrhalis* prosthetic joint infection in an immunocompetent woman and review of the literature of haematogenous infection due to throat flora bacteria

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Introduction: *Moraxella catarrhalis* is an exclusively human commensal and mucosal pathogen. For years, this bacterium has been known to cause upper and lower respiratory tract infections, the latter of which most often occur in patients with chronic obstructive pulmonary disease. However, *M. catarrhalis* has also been described in various unusual localizations.

Case presentation: We describe the first case of a knee prosthetic infection due to *M. catarrhalis*. A 75-year-old immunocompetent woman developed a knee infection 5 months after a total knee arthroplasty. The origin of the infection was probably due to a bronchitis episode with haematogenous spread leading to an acute prosthetic infection.

Conclusion: *M. catarrhalis* should be included in the list of potential pathogens from the throat flora such as *Streptococcus pneumoniae* and *Haemophilus influenzae*. A review of the literature revealed the same clinical presentation, surgical strategy and outcome.

Keywords: bone; bronchitis; infection; joint; *Moraxella catarrhalis*; prosthesis.

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Case report

A 75-year-old woman was admitted for orthopaedic consultation at Nantes University Hospital in June 2014. She reported right knee pain for 7 days and had local signs of infection in her knee. In February 2014, suffering from severe external femorotibial osteoarthritis, a total arthroplasty of the right knee had been performed without any complications. In June 2014, she was admitted for fever and a swollen right knee. Infection of the right knee prosthesis was suspected on clinical examination (inflammation, pain and redness of the joint). Laboratory data revealed a normal blood leukocyte count (10.7×10^9 cells L^{-1}) and an elevated C-reactive protein level of

114.3 mg L^{-1} . Three sets of aerobic ($n=4$) and anaerobic ($n=2$) blood cultures remained negative despite the absence of previous or concomitant antibiotic treatment. Debridement and joint washing with a change of the mobile polyethylene component of the prosthesis were carried out, considering an early infection. The initial treatment was: vancomycin (2 g per day) for 5 days and gentamicin (200 mg per day) for 2 days. Four out of six perioperative samples were positive in culture for *Moraxella catarrhalis*. Antibiotic therapy was started, comprising a combination of ceftriaxone (2 g per day) and levofloxacin (500 mg per day) for 3 weeks and thereafter 9 weeks of levofloxacin alone (3 months treatment in total). The treatment was well tolerated, and the clinical outcome was favourable at 8 months after the knee debridement. The patient could walk again without any difficulty.

Cultures of four samples (three tissue specimens from around the prosthesis and one joint fluid) were positive

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Abbreviations: MALDI-TOF, matrix-assisted laser desorption/ionization time of flight; PJI, prosthetic joint infection.

Table 1. Clinical and microbiological characteristics of 13 cases of PJI due to oral flora bacteria, published in the literature

Reference	Species	Age	Sex	Joint	Time of onset of PJI from arthroplasty	Risk factor/underling disease	Time of onset of PJI from cause	Type of infection	Treatment		Outcome
									Surgical procedure	Antibiotic treatment after ID	
This case	<i>M. catarrhalis</i>	75	F	Knee	4 months	Productive cough	3 weeks	Acute	Deb + W + change of the mobile polyethylene Arth	Ceftriaxone + levofloxacin IV	Favourable
Leonardou <i>et al.</i> (2005)	<i>M. catarrhalis</i>	73	M	Knee	8 years	Lower respiratory symptoms, rheumatoid arthritis	5 days	Acute	Arth	Ciprofloxacin + clindamycin IV	Favourable
Ryczak <i>et al.</i> (1987)	<i>S. pneumoniae</i>	86	M	Knee	3 years	Chronic obstructive pulmonary disease	–	Acute	Arth + Deb	Penicillin G IV	Favourable
Wollner <i>et al.</i> (1989)	<i>S. pneumoniae</i>	74	F	Hip	4 years	Pleuritic pain	5 days	Acute	Deb + irrigation	Penicillin G IV	Favourable
Brian <i>et al.</i> (2004)	<i>S. pneumoniae</i>	73	M	Knee	1 years	Chronic sinusitis	–	Acute	Deb + irrigation	Vancomycin + levofloxacin	Favourable
Raad & Peacock (2004)	<i>S. pneumoniae</i>	50	F	Hip	2 years	Purulent nasal discharge and productive cough	1 week	Acute	Deb + replacement of the antibiotic-impregnated spacer	Ceftriaxone	Favourable
Bertani <i>et al.</i> (2006)	<i>S. pneumoniae</i>	82	M	Knee	2 years	Pneumonia	10 days	Acute	W + prosthesis removal	Amoxicillin + rifampicin	Favourable
Roberts <i>et al.</i> (2013)	<i>S. pneumoniae</i>	57	F	Knee	11.5 years	Congenital asplenia, autoimmune disorders	–	Chronic	Deb + resection of arthroplasty/ placement of an antibiotic cement spacer	Vancomycin + ceftriaxone	Recurrent 1 year later
Manolios <i>et al.</i> (2013)	<i>S. pneumoniae</i>	–	M	Knees	3 years	RA Failure of Anti-TNF therapy, splenectomy	–	Chronic	W	IV antibiotics	Recurrent 5 months later
Söderquist (2014)	<i>H. influenzae</i>	25	F	Hip	–	Spontaneous abortion with <i>H. influenzae</i> infection	4 days	Acute	Arth + Deb + excision of the capsule	Clindamycin IV + ciprofloxacin	Favourable
Bezwała <i>et al.</i> (2002)	<i>H. influenzae</i>	43	F	Knee	–	RA	–	Acute	Arth + Deb + drainage, irrigation	Ciprofloxacin + gentamicin	Favourable
Limbird (1985)	<i>H. influenzae</i>	63	F	Hip	6 months	Flu-like symptoms	3 weeks	Acute	Drainage/soft-tissue Deb	Ampicillin IV	Favourable
Vikram <i>et al.</i> (2001)	<i>N. meningitidis</i>	80	F	Knee	6 months	–	–	Acute	Drainage	Ceftriaxone	Favourable

ID, identification; F, female; M, male; Deb, debridement; W, wash; IV, intravenous; Arth, arthrocentesis; Favourable, healing without complication; RA, rheumatoid arthritis.

on blood and chocolate agar plates (bioMérieux) after 2 days of aerobic incubation with round, greyish, opaque and non-haemolytic colonies. Gram staining revealed Gram-negative diplococci. An accurate identification of *M. catarrhalis* (probability 99 %) was performed using MALDI-TOF mass spectrometry with a Vitek MS (bioMérieux). Sequencing of the partial 16S rRNA gene was performed, as described previously (Aubin *et al.*, 2011), to confirm the identification of this rarely encountered bacterium in such clinical specimens. The 1390 bp fragment obtained was compared with GenBank entries using the BLAST algorithm (<http://blast.ncbi.nlm.nih.gov/>) and the BIBI database (<https://umr5558-bibiserv.univ-lyon1.fr/lebibi/lebibi.cgi>). The sequence of the bacterium showed 100 % identity with the sequence of *M. catarrhalis* strain 25240 (GenBank accession no. CP008804) and the closest type strain sequence was *M. catarrhalis* ATCC 25238 (GenBank accession no. AF005185) according to the patristic distance analysis using BIBI software.

In vitro susceptibility testing was performed using the Etest diffusion method on Mueller–Hinton medium with 5 % horse blood (bioMérieux). According to *M. catarrhalis* breakpoints (French committee guidelines, <http://www.sfm-microbiologie.org>), this bacterium was considered resistant to amoxicillin (MIC, 3 µg mL⁻¹), due to β -lactamase production, most being from BRO-1 type. A search with the Nitrocefin method (Cefinase disc test CEF-F; bioMérieux) confirmed the production of a β -lactamase. The strain was susceptible to amoxicillin/clavulanic acid (MIC 0.19 µg mL⁻¹), ceftriaxone (MIC 0.38 µg mL⁻¹), and levofloxacin (MIC 0.023 µg mL⁻¹).

M. catarrhalis is a non-motile, non-sporulating, aerobic Gram-negative diplococcus. Colonies are circular, smooth, grey and non-haemolytic on blood agar under an aerobic atmosphere. Colonies can characteristically be pushed along the agar plate surface like a hockey puck. This isolate was accurately identified to the species level using MALDI-TOF mass spectrometry, an easy, quicker, cheaper and accurate tool in microbiology laboratories (Corvec *et al.*, 2012).

M. catarrhalis is an exclusively human commensal and mucosal pathogen (Aebi, 2011). Its human pathogenicity has long been debated. Over the last three decades, this bacterium was also considered as an important cause of upper respiratory tract infections, particularly in patients with chronic obstructive pulmonary disease (Murphy & Parameswaran, 2009). However, *M. catarrhalis* has been recovered from different unusual localizations such as meningitis, urinary tract infection, ophthalmic infection and endocarditis (Stefanou *et al.*, 2000). Although these examples are severe and uncommon, bacteraemia due to *M. catarrhalis* has been rarely reported, even in cases of deep infections. Nevertheless, *M. catarrhalis* bacteraemia has been associated with prosthetic vascular graft infection (Sano *et al.*, 2010).

To the best of our knowledge, this case represents the first acute haematogenous case of bone and prosthetic joint infection (PJI). Indeed, only rare cases of *M. catarrhalis* articular

infections have been described, and never on orthopaedic implants in an immunocompetent host. The only case of a prosthetic knee joint infection concerned a patient with rheumatoid arthritis treated with immunosuppressive treatment (anakinra and corticosteroids) (Leonardou *et al.*, 2005). The natural history and occurrence of prosthesis infection is determined by host factors, the nature of the host tissue in which the micro-organism grows and the virulence of the pathogen. Predisposing circumstances include: male gender, extremely advanced age, smoking, obesity, previous operation on the joint articulation, rheumatoid arthritis, corticosteroid treatment, immunosuppression, diabetes mellitus and a poor nutritional state (Tande & Patel, 2014). However, none of these factors was present in our case.

In this case, the haematogenous route was the most likely route of contamination. During anamnesis after surgery, the patient revealed some symptoms of respiratory infection (productive cough) for which she did not consult a doctor but instead used non-steroid anti-inflammatory drugs such as ibuprofen, 3 days before the hospitalization. The throat flora was probably the source of a transient bacteraemia (despite the negative blood culture), with secondary localization at the prosthesis.

The involvement of upper respiratory bacterial flora in orthopaedic devices has already been reported in the literature, particularly with *Streptococcus pneumoniae*. As revealed in Table 1, haematogenous bacteria seeding implants are more common in knee prostheses. The time of onset of PJI ranged from few days to 3 weeks from the initial cause (Ryczak *et al.*, 1987; Wollner *et al.*, 1989; Raad & Peacock, 2004; Bertani *et al.*, 2006; Roberts *et al.*, 2013; Manolios *et al.*, 2013; Söderquist, 2014; Bezwada *et al.*, 2002; Limbird, 1985; Vikram *et al.*, 2001). Ninety per cent were delayed but acute infections (6 months to more than 10 years after implantation) with a debridement and irrigation surgery strategy leading to a favourable outcome in most cases. Other bacteria belonging to the respiratory flora have been implicated in arthritis but never described in PJI, in particular *Eikenella corrodens* and *Streptococcus pyogenes* (Chang & Huang, 2005; Laatiris *et al.*, 2012).

This case illustrates the ability of *M. catarrhalis* to trigger PJI without any apparent bacteraemia in a patient with no co-morbidities and a benign productive cough. The propensity for commensal bacterium to cause unapparent bloodstream infections with septic metastasis and joint infections is of special concern for patients with or without a severely suppressed immune system. Concerning *M. catarrhalis*, the host's medical history may play a major role in the presentation and outcome of *M. catarrhalis* bacteraemia. When healthy, immunocompetent individuals are affected by *M. catarrhalis* bacteraemia, their presentations range from self-limited febrile illness to life-threatening disease (Ioannidis *et al.*, 1995).

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References

- Aebi, C. (2011). *Moraxella catarrhalis* – pathogen or commensal? *AdvExp Med Biol* **697**, 107–116.
- Aubin, G. G., Bémer, P., Guillozouic, A., Crémet, L., Touchais, S., Fraquet, N., Boutoille, D., Reynaud, A., Lepelletier, D. & Corvec, S. (2011). First report of a hip prosthetic and joint infection caused by *Lactococcus garvieae* in a woman fishmonger. *J Clin Microbiol* **49**, 2074–2076.
- Bertani, A., Drouin, C., Demortière, E., Gonzalez, J.-F., Candoni, P. & Di Schino, M. (2006). [A prosthetic joint infection caused by *Streptococcus pneumoniae*: a case report and review of the literature]. *Rev Chir Orthop Reparat Appar Mot* **92**, 610–614, (in French).
- Bezawada, H. P., Nazarian, D. G. & Booth, R. E. (2002). *Haemophilus influenzae* infection complicating a total knee arthroplasty. *Clin Orthop Relat Res* **402**, 202–205.
- Brian, S. R. & Kimbrough, R. C. III (2004). Salvage of a prosthetic knee joint infected with resistant pneumococcus. A case report. *J Bone Joint Surg Am* **86**, 2302–2304.
- Chang, C.-C. & Huang, S.-Y. (2005). *Eikenella corrodens* arthritis of the knee after a toothpick injury: report of one case. *Acta Paediatr Taiwan* **46**, 318–320.
- Corvec, S., Portillo, M. E., Pasticci, B. M., Borens, O. & Trampuz, A. (2012). Epidemiology and new developments in the diagnosis of prosthetic joint infection. *Int J Artif Organs* **35**, 923–934.
- Ioannidis, J. P., Worthington, M., Griffiths, J. K. & Snyderman, D. R. (1995). Spectrum and significance of bacteremia due to *Moraxella catarrhalis*. *Clin Infect Dis* **21**, 390–397.
- Laatiris, A., Amine, B., Ibn Yacoub, Y. & Hajjaj-Hassouni, N. (2012). Septic polyarthritis caused by group A *Streptococcus* in an immunocompetent adult: rare case. *Rheumatol Int* **32**, 2697–2700.
- Leonardou, A., Giali, S., Daoussis, D., Siambi, V., Gogos, H. & Lioussis, S.-N. C. (2005). *Moraxella catarrhalis*-induced septic arthritis of a prosthetic knee joint in a patient with rheumatoid arthritis treated with anakinra: comment on the article by Schiff et al. *Arthritis Rheum* **1337**, 1338.
- Limbird, T. J. (1985). *Haemophilus influenzae* infection of a total hip arthroplasty. *Clin Orthop Relat Res* **199**, 182–184.
- Manolios, N., Burneikis, A., Spencer, D. & Howe, G. (2013). Failure of anti-TNF therapy to reactivate previously septic prosthetic joints. *BMJ Case Rep* 2013. pii: bcr2013009827.
- Murphy, T. F. & Parameswaran, G. I. (2009). *Moraxella catarrhalis*, a human respiratory tract pathogen. *Clin Infect Dis* **49**, 124–131.
- Raad, J. & Peacock, J. E. (2004). Septic arthritis in the adult caused by *Streptococcus pneumoniae*: a report of 4 cases and review of the literature. *Semin Arthritis Rheum* **34**, 559–569.
- Roberts, A. L., Hewlett, A. L., Yu, J., Nahm, M. H., Fey, P. D. & Iwen, P. C. (2013). *Streptococcus pneumoniae* serotype 6C presenting as recurrent prosthetic knee joint infection in a patient with a history of congenital asplenia and underlying autoimmune disease: a case report and literature review. *Diagn Microbiol Infect Dis* **77**, 376–379.
- Ryczak, M., Sands, M., Brown, R. B. & Sklar, J. H. (1987). Pneumococcal arthritis in a prosthetic knee. A case report and review of the literature. *Clin Orthop Relat Res* **224**, 224–227.
- Sano, N., Matsunaga, S., Akiyama, T., Nakashima, Y., Kusaba, K., Nagasawa, Z., Koizumi, S., Goto, M. & Miyamoto, H. (2010). *Moraxella catarrhalis* bacteraemia associated with prosthetic vascular graft infection. *J Med Microbiol* **59**, 245–250.
- Söderquist, B. (2014). Prosthetic hip joint infection caused by non-encapsulated *Haemophilus influenzae*. *Scand J Infect Dis* **46**, 665–668.
- Stefanou, J., Agelopoulou, A. V., Sipsas, N. V., Smilakou, N. & Avlami, A. (2000). *Moraxella catarrhalis* endocarditis: case report and review of the literature. *Scand J Infect Dis* **32**, 217–218.
- Tande, A. J. & Patel, R. (2014). Prosthetic joint infection. *Clin Microbiol Rev* **27**, 302–345.
- Vikram, H. R., Buencamino, R. B. & Aronin, S. I. (2001). Primary meningococcal arthritis in a prosthetic knee joint. *J Infect* **42**, 279–280.
- Wollner, A., Gilon, D., Mattan, Y., Rubinow, A. & Pogrand, H. (1989). Pneumococcal infection of a prosthetic hip joint. *Int Orthop* **13**, 135–136.