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 leucocyte count (10.7 × 10⁹ 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.

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

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

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 (producing 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; Pertani 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


