Case report

A 53-year-old man with an aortic bioprosthetic valve implanted 12 months earlier presented with a 7-day history of rigors, dizziness and night sweats. He had had three previous aortic valve replacements and two episodes of aortic valve endocarditis from coagulase-negative staphylococci and *Cardiobacterium hominis*. On this occasion, he had not undergone any other surgical or dental procedures in the 12 months prior to these symptoms.

On examination, he had a temperature of 36°C, blood pressure of 90/61 mmHg, pulse of 64 beats min⁻¹, saturations 96% on ambient air and a respiratory rate of 18 min⁻¹. His heart sounds were normal except for a pansystolic murmur that was heard loudest in the aortic area. All other observations were normal. Blood tests showed a haemoglobin level of 134 g l⁻¹, white cell count of 9.7 × 10⁹ l⁻¹, platelet count of 239 × 10⁹ l⁻¹ and a C-reactive protein (CRP) level of 28 mg l⁻¹. Three sets of blood cultures within 48 h of admission grew *Kytococcus schroeteri*. The electrocardiogram showed first degree heart block. A transoesophageal echocardiogram (TOE) showed a mass attached to his aortic valve (Fig. 1). Initial treatment was 1 g vancomycin twice daily and 4 g ceftriaxone once daily, but the ceftriaxone was discontinued once the blood cultures confirmed *K. schroeteri*. After 9 days of vancomycin treatment, the patient developed a severe allergic reaction, including facial oedema and widespread rash, requiring intravenous hydrocortisone. The treatment was then changed to 600 mg linezolid twice daily (MIC 0.5 μg l⁻¹). However, after 3 days he was still pyrexial and had rigors, indicating probable treatment failure. Daptomycin, 6 mg kg⁻¹ once daily, was substituted for the linezolid and the patient’s fever settled within 24 h. The MIC of daptomycin for the *K. schroeteri* isolate was 1 μg l⁻¹, which was just on the breakpoint of sensitivity according to the guidelines of the British Society of Antimicrobial and Chemotherapy (BSAC, 2011) for staphylococci. Daptomycin trough and peak levels of 24.1 μg l⁻¹ (reference range 15–20 μg l⁻¹) and 75.7 μg l⁻¹ (reference range >50 μg l⁻¹), respectively, were achieved. After 2 weeks of intravenous therapy as an in-patient, the patient was asymptomatic and haemodynamically stable. He was discharged, and completed 6 weeks of intravenous therapy as an outpatient, receiving a dose once daily with follow-up reports made in-clinic. A repeat TOE after just 3 weeks of therapy did not show any vegetations on the aortic valve.

Three months later he was readmitted because of heart failure but with no evidence of sepsis. He had a surgically challenging but successful fifth valve replacement with another bioprosthesis. Cultures from of the valve, including subculture, did not yield any bacterial growth but 16S
rRNA-targeted PCR gave a product that matched *K. Schroeteri*. Nine months following the successful surgery, the patient remained symptom free and did not have any further episodes of endocarditis.

**Microbiology**

Growth was obtained from three sets of blood cultures on 5% horse blood agar incubated aerobically at 35°C (±1°C), producing white colonies 0.5 mm in diameter after 24 h of growth and 2 mm in diameter after 48 h of growth (Fig. 2). Cells of the isolate were large Gram-positive cocci appearing in pairs and tetrads. As there were no reactions in the API 32 Staph kit (bioMérieux) the preliminary identification was *Micrococcus*. A partial 16S rRNA gene sequence of 1191 base pairs was obtained and matched to related sequences by using a BLAST search in the GenBank database. The sequence matched the type strain of *K. Schroeteri* with 99.9% similarity (1 base difference) and was submitted to GenBank under the accession number JF288782.

Quantitative susceptibility testing was carried out using Etests strips (bioMérieux) on IsoSensitest agar (Oxoid) incubated aerobically at 35°C (±1°C) for 24 h. The isolate was recorded as being resistant to penicillin, oxacillin, erythromycin, clindamycin and ciprofloxacin and sensitive to (MIC, μg ml⁻¹): vancomycin (0.125), teicoplanin (0.032), gentamicin (1), rifampicin (0.004), linezolid (0.5), tetracycline (0.032), moxifloxacin (0.25), fusidic acid (1) and daptomycin (1).

**Discussion**

*Kytococcus* was established as a new genus separate from *Micrococcus* by Stackebrandt *et al.* (1995). *Kytococcus Schroeteri* is a Gram-positive coccus which was first described in 2002 by Becker *et al.* (2002). Cells of *Kytococcus Schroeteri* are non-encapsulated, non-motile and catalase-positive, occurring singly or in tetrads. Colonies are non-haemolytic, smooth and white but can be buttercup-yellow. Biochemically, this bacterium shows similarities with other micrococci, which may lead blood culture isolates to be dismissed as contaminants.

*Kytococcus Schroeteri* is a rare cause of prosthetic valve endocarditis (PVE) and there have been only six previous cases of *K. Schroeteri* PVE reported in the literature (Becker *et al.*, 2003; Le Brun *et al.*, 2005; Mnif *et al.*, 2006; Aepinus *et al.*, 2008; Renvoise *et al.*, 2008; Poyet *et al.*, 2010) (Table 1). In these cases there was no obvious antecedent that may have caused bacteraemia resulting in endocarditis. In two cases (Le Brun *et al.*, 2005; Mnif *et al.*, 2006), the authors postulated that the route of transmission was haematogenous. In the case reported by Aepinus *et al.* (2008) the antecedent may have been perioperative contamination during surgery for vaginal bleeding. Although species of *Kytococcus* have been isolated from skin and mucous membranes (Szczerba, 2003), attempts to cultivate the organism from the nose, throat and skin of one patient with endocarditis were unsuccessful (Le Brun *et al.*, 2005). The six previous cases of *K. Schroeteri* PVE have shown that this species is resistant to penicillins, cephalosporins and macrolides; sensitive to vancomycin, teicoplanin, rifampicin, imipenem, tetracycline, gentamicin, linezolid; and shows variable resistance to quinolones.

Daptomycin is a lipopeptide antimicrobial licensed for the treatment of complicated skin and soft tissue infections (cSSTI), right-sided endocarditis (RIE) due to *Staphylococcus aureus* and *Staphylococcus aureus* bacteraemia when associated with RIE or cSSTI. This is, to our knowledge, the first case of *K. Schroeteri* endocarditis that has been managed with daptomycin. To our knowledge, there are no published
A positive outcome was achieved in all cases in that each of the patients survived.

<table>
<thead>
<tr>
<th>Reference</th>
<th>Patient</th>
<th>Medical history</th>
<th>Valve</th>
<th>Identification of <em>K. schroeteri</em></th>
<th>Drug therapy and duration</th>
<th>Surgery</th>
</tr>
</thead>
<tbody>
<tr>
<td>Becker et al.</td>
<td>34</td>
<td>Female</td>
<td>Aortic prosthetic valve (including aortic arch prosthesis)</td>
<td>16S rRNA PCR on blood cultures</td>
<td>Vancomycin, gentamicin and rifampicin for 21 days</td>
<td>No</td>
</tr>
<tr>
<td>Le Brun et al.</td>
<td>73</td>
<td>Male</td>
<td>Aortic bioprosthetic valve</td>
<td>16S rRNA PCR on blood cultures, vegetations and valve, and by analysis of the fatty acid content</td>
<td>Vancomycin (4 g daily) (replaced by teicoplanin) and gentamicin (240 g daily) with rifampicin. After 3 weeks, changed to teicoplanin monotherapy</td>
<td>Yes – during admission</td>
</tr>
<tr>
<td>Mnif et al.</td>
<td>49</td>
<td>Female</td>
<td>Rheumatic heart disease</td>
<td>16S rRNA PCR on blood cultures</td>
<td>Vancomycin with gentamicin then pristinamycin with vancomycin for 6 weeks, and then 3 weeks of pristinamycin and rifampicin</td>
<td>No</td>
</tr>
<tr>
<td>Renvoise et al.</td>
<td>70</td>
<td>Male</td>
<td>Aortic bioprosthetic valve</td>
<td>16S rRNA PCR on blood cultures and valve</td>
<td>Vancomycin (30 mg kg⁻¹ daily) for 6 weeks, and gentamicin (3 mg kg⁻¹ daily) for 2 weeks</td>
<td>Yes – 1 month later</td>
</tr>
<tr>
<td>Aepinus et al.</td>
<td>38</td>
<td>Female</td>
<td>Type 1 diabetes mellitus</td>
<td>16S rRNA PCR on blood cultures</td>
<td>Vancomycin (2 g daily) and rifampicin (900 mg daily) for 6 weeks and gentamicin (240 mg daily) for 2 weeks, followed by levofloxacin (750 mg daily) and rifampicin (900 mg daily) for 2 months</td>
<td>No</td>
</tr>
<tr>
<td>Poyet et al.</td>
<td>72</td>
<td>Male</td>
<td>Cerebrovascular accident, coronary artery bypass surgery</td>
<td>16S rRNA PCR on blood cultures</td>
<td>Vancomycin (30 mg kg⁻¹ daily), gentamicin (3 mg kg⁻¹ daily) and rifampicin (20 mg kg⁻¹ daily) for 2 weeks followed by rifampicin and vancomycin for 4 weeks</td>
<td>No</td>
</tr>
<tr>
<td>Present case</td>
<td>53</td>
<td>Male</td>
<td>Four aortic valve replacements and two episodes of endocarditis</td>
<td>16S rRNA PCR on blood cultures and valve</td>
<td>Daptomycin (6 mg kg⁻¹ daily) for 6 weeks</td>
<td>Yes – 5 months later</td>
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in vitro daptomycin susceptibility data for *Kytococcus*. A further six strains of *K. Schroeteri* from other patients stored at the LHCAI, HPA Centre for Infections, Colindale, London, have subsequently been tested for their sensitivity to daptomycin with MICs of 0.064, 0.25 (two strains), 0.36, 0.75 and 1.0 μg l⁻¹. We suggest a tentative breakpoint of 1.0 μg l⁻¹ for sensitivity to daptomycin.

Cure of microbiological infection can be achieved if drug levels are maintained at therapeutic levels, despite the fact that the *K. Schroeteri* isolate from the present case was on the proposed breakpoint for sensitivity to daptomycin. Monitoring is recommended at the commencement of long-term therapy in these circumstances to ensure adequate dosing. In accordance with product information, monitoring of creatine phosphokinase (CPK) is advised and therapy discontinued if signs and symptoms of myopathy in conjunction with CPK elevation occur.

Daptomycin was used off-licence for left-sided PVE and for the treatment of *K. Schroeteri*. It may have a useful role in the treatment of endocarditis as an off-label prescription, especially considering this patient who required an alternative bactericidal agent when the use of conventional drugs was not tolerated. Furthermore, its once-daily dosage makes it an ideal agent for out-patient parenteral antibiotic therapy (OPAT). OPAT for endocarditis in selected patients can be safe, effective, improve patient satisfaction and reduce length of hospital stay as well as the associated costs (Chapman *et al.*, 2009). This patient was able to receive 4 weeks of intravenous therapy at home rather than as an in-patient because of the ease of administering a once-daily dose.

**Conclusions**

*K. Schroeteri* is a rare cause of PVE and may be under-recognized as a cause of PVE due to its similarity to other micrococi. This group of organisms are difficult to identify using conventional biochemical tests and require a polyphasic approach including molecular methods to identify them, otherwise they may be readily dismissed as contaminants. This is, to our knowledge, the first case of *K. Schroeteri* PVE that has been treated successfully with daptomycin, obviating the need for immediate surgery. Daptomycin can be effective in treating PVE, even when treating an organism with a susceptibility level on the breakpoint of sensitivity.

**Acknowledgements**

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**References**


