A bumpy road to the diagnosis of a *Kytococcus schroeteri* shunt infection

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We report a ventriculoperitoneal shunt infection associated with *Kytococcus schroeteri*, a Gram-positive bacterium from the family *Dermacoccaceae*. While the biochemical identification systems do not reliably identify this potential pathogen, sequence-based identification is recommended to guide the antibiotic treatment of this intrinsically meticillin-resistant species, which is susceptible to vancomycin, gentamicin and/or rifampicin.

**Introduction**

The micrococci are part of the normal skin microbiota of humans and can cause invasive infections, particularly in immunocompromised patients (Jourdain et al., 2009). The clinically relevant species described by the trivial term micrococci involve members from the genera *Micrococcus, Kocuria* and *Kytococcus*. Due to insufficient identification methods and an intrinsic resistance to several beta-lactams, infections due to kytococci are a challenge to clinical microbiologists and clinicians. *Kytococcus schroeteri* represents a species of the genus *Kytococcus* (Becker et al., 2002); we report a case study of a female infant with a *K. schroeteri* ventriculoperitoneal shunt (VPS) infection.

**Case report**

A female child of 3 years and 9 months with a VPS was admitted to the University Hospital Münster due to vomiting. She had previously been diagnosed at 2 years and 3 months with a ganglioglioma (WHO grade I) of the cervical spinal cord and underwent multiple surgery interventions, including a partial tumour resection, vertebral arch resections and duraplasties. The VPS was placed when she was 3 years old to release intracraniial pressure and achieve healing of a cerebrospinal fluid (CSF) fistula. The VPS released clindamycin and rifampicin for about 30 days after implantation (Bactiseal; Codman).

Upon admission, the infant was afebrile (37.2 °C), her blood pressure and pulse were normal and no signs of excision were observed. Blood analysis revealed 14.13 × 10⁹ leukocytes µl⁻¹ (Fig. 1), including 84.6 % granulocytes, 12.7 % lymphocytes, 2.5 % monocytes and 0.1 % of both eosinophils and basophils. The CSF examination (day 1) revealed 132 cells µl⁻¹ and a CSF total protein of 2530 mg l⁻¹. We were reluctant to remove the indwelling VPS, as the patient probably had slit ventricle syndrome. Her very narrow and rigid lateral brain ventricles raised concerns that the placement of a novel ventricular drain might be difficult or even become deleterious. Blood and CSF cultures were taken and the patient initially received meropenem (40 mg kg⁻¹, t.i.d., IV) and teicoplanin (10 mg kg⁻¹, s.i.d., IV) for 12 days. From day 10 to 19, the patient received metronidazole (30 mg kg⁻¹, q.i.d., orally) on account of *Clostridium difficile* enteritis. Cefotaxime (70 mg kg⁻¹, t.i.d., IV) was given on day 15, as the patient became febrile (Fig. 1). Glycopeptides could not be administered due to a history of an adverse reaction to vancomycin. Due to a subcutaneous induration along the shunt, the distal part of the shunt was removed on day 20, and the outlet of the proximal part was placed in the clavicular region.

Due to persistent signs of inflammation and the identification of *K. schroeteri* as the causative agent of infection, the VPS was removed and replaced by an external ventricular drain on day 28, when the subcutaneous induration along the shunt was ascending. Cefuroxime (35 mg kg⁻¹, t.i.d., IV) and gentamicin (5 mg kg⁻¹, s.i.d., IV) were given for 23 and 22 days, respectively. Subsequently, the child recovered completely from infection.

On admission, Gram-positive, catalase-positive cocci were identified in CSF cultures. A presumable finding of micrococci was reported to the clinician based on the probabilities of identification of 51.8 % for *Micrococcus*...
lylae (T index 0.98) and 47.2% for Micrococcus luteus (T index 0.93) using the ID 32 Staph system (Table 1). One aerobic blood culture out of ten became positive and yielded small and glistening colonies with yellow pigmentation (Gram-variable coccobacilli) on Columbia blood agar. The isolate was catalase positive and oxidase negative, presumably categorized as a Gram-negative rod and tested accordingly (GN identification card for VITEK 2; bioMérieux), leading to the isolate being identified as Aeromonas salmonicida. The culture of a swab taken from the shunt outlet showed growth of Gram-positive coccobacilli, which were identified as Brevibacterium sp. (API Coryne; bioMérieux). However, the turning point towards correctly identifying the causative agent was when the culture of a swab taken from the infected shunt and the surrounding tissue yielded small, slightly yellow-pigmented colonies on Columbia blood agar. As biochemical profiling for species identification gave ambiguous results, differing between API Coryne (Brevibacterium sp.) and VITEK 2 (Granulicatella sp./Facklamia sp.), 16S rRNA gene sequencing was performed, which revealed a >99% similarity to K. Schroeteri.

We suspected that the previous isolates from this patient might also be K. Schroeteri and performed 16S rRNA gene sequencing for all isolates, as previously described (Becker et al., 2002). All isolates were identified as K. Schroeteri and were shown to be clonal when arbitrarily primed PCR with prolonged ramp times was used (Ellinghaus et al., 1999). What is noteworthy is that the isolates were identified as Kytococcus sedentarius by matrix-assisted laser desorption/ionization time of flight, with an assessment score between 1.5 and 1.7, indicating an unreliable identification. According to the European Committee on Antimicrobial Susceptibility Testing breakpoints for coagulase-negative staphylococci, K. Schroeteri was susceptible (MICs in mg l−1) to gentamicin (0.75), cotrimoxazole (0.064), vancomycin (0.19), teicoplanin (0.19) and rifampicin (0.012). It was resistant to benzylpenicillin (12), cefoxitin (4), clindamycin (2) and erythromycin (4).

**Discussion**

Kytococci belong to the family Dermacoccaceae, which is part of the suborder Micrococcoineae and the order Actinomycetales (Stackebrandt et al., 1997). The species K. Schroeteri was first described in 2002 (Becker et al., 2002) and is probably a commensal of the human skin. However, K. Schroeteri can also cause severe to fatal infections. So far, K. Schroeteri has been identified as the causative agent in cases of prosthetic valve endocarditis (n=5) (Aepinus et al., 2008; Becker et al., 2003; Mnif et al., 2006; Poyet et al., 2010; Renvoise et al., 2008), pneumonia (n=3) (Hodiamont et al., 2010; Mohammedi et al., 2005), spondylodiscitis (n=1) (Jaquier et al., 2010) and VPS infection (n=1) (Jourdain et al., 2009).

In this case report, the identification of the causative agent was hampered by an abnormal Gram stain reaction, probably due to the treatment with beta-lactams or the inflamed tissue from which K. Schroeteri was isolated (Gardner, 1940; Spengler et al., 1978). The common biochemical test systems could not discriminate between different micrococci members of the families Dermatophilaceae and Micrococcaceae. Identification was either limited to the genus level (Kytococcus sp., Dermacoccus sp., Micrococcus sp. or Kocuria sp.) (Aepinus et al., 2008; Jourdain et al., 2009; Becker et al., 2003; Poyet et al., 2010; Renvoise et al., 2008) or was unreliable at the species level (M. luteus, K. sedentarius) (Mohammedi et al., 2005; Renvoise et al., 2008), or ambiguous results were obtained. Kytococci seem to be intrinsically resistant to penicillin and oxacillin (Becker et al., 2002). Therefore, the antimicrobial therapy reported in other case studies included vancomycin and gentamicin (Hodiamont et al., 2010) plus rifampicin (Becker et al., 2003; Aepinus et al., 2008; Mnif et al., 2006), or vancomycin plus gentamicin (Jourdain et al., 2009).
In this case, recovery from infection was achieved after the removal of the infected VPS. Gentamicin, and probably not cefuroxime, represented the effective antibiotic constituent, and the underlying mechanism for partial beta-lactam resistance in kytococci is still unclear.

Conclusion

We suggest that *K. Schroeteri* should be considered as a relevant pathogen if it is repeatedly identified in several independently collected specimens. Ambiguous, varying and/or inconsistent results by culture-based techniques of catalase positive, Gram-positive cocci should draw attention to members of the suborder *Micrococineae*. In contrast with other clinically relevant micrococci, kytococci are intrinsically resistant to penicillin and oxacillin.

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References


