CASE REPORT

First human case of catheter-related bloodstream infection caused by Staphylococcus schleiferi subspecies coagulans: a case report and literature review

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Abstract

Background: Staphylococcus schleiferi is a gram-positive pathogenic coccus which causes canine skin and ear infections. Only four cases of human infection caused by Staphylococcus schleiferi subspecies coagulans have been reported. Herein, we present the first case of catheter-related bloodstream infection caused by S. schleiferi subspecies coagulans.

Case presentation: A 62-year-old Japanese man was admitted to our hospital for examination of sigmoid colon tumor. During hospitalization, he had fever, shaking chills, and swelling at the peripheral venous catheter insertion site. Two sets of blood cultures were positive for S. schleiferi subspecies coagulans which was confirmed using matrix-assisted laser desorption/ionization time-of-flight mass spectrometry (MALDI-TOF MS), 16S ribosomal RNA sequencing and the coagulase test. The patient was successfully treated without relapse.

Conclusion: To our knowledge, this is the first report of catheter-related bloodstream infection caused by S. schleiferi subspecies coagulans. S. schleiferi subs. coagulans can be pathogenic in humans, and MALDI-TOF MS can contribute to accurate identification of S. schleiferi subspecies coagulans.

Keywords: Staphylococcus schleiferi subspecies coagulans, Catheter-related bloodstream infection, Matrix-assisted laser desorption/ionization time-of-flight mass spectrometry, 16S ribosomal RNA sequencing

Background

Staphylococcus schleiferi is associated with otitis externa and pyoderma in dogs [1]. It has two subspecies, S. schleiferi subsp. schleiferi and S. schleiferi subsp. coagulans that are coagulase-negative and coagulase-positive, respectively. There are multiple case reports of S. schleiferi infection including skin and soft tissue infections [2], device infections [3], urinary tract infection [4], and endocarditis [5]. A review of 28 case series of S. schleiferi infection has been reported in 2001 [6], and all isolates were coagulase-negative.

However, only four cases of human infection caused by S. schleiferi subsp. coagulans have been reported. Here, we report the first case of catheter-related bloodstream infection caused by S. schleiferi subsp. coagulans.

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Case presentation

A 62-year-old Japanese man presented to a local gastroenterology clinic with narrow stools. He had hypertension and prostatic hypertrophy. His only regular medication was amlodipine. Colonoscopy revealed a subcircumferential tumor in the sigmoid colon, and the colonoscope did not pass through the tumor. He was referred to our hospital for further examination of a sigmoid colon tumor. Bowel obstruction due to sigmoid colon cancer was suspected, and he was admitted to our hospital. Fasting and fluid administration were performed until surgical resection of the tumor.

Seven days after admission, he had a fever of 38.1℃ with shaking chills but was alert and oriented and not in acute distress. Additionally, his vital signs were as follows: pulse rate 72 beats/min, blood pressure 118/60 mmHg, respiratory rate 16 breaths/min, and oxygen saturation 98% while breathing ambient air. Physical examination revealed redness, swelling, and tenderness at the short peripheral venous catheter insertion site in his right forearm. He did not have a heart murmur, neurological abnormalities, or other abnormalities on physical examination. He denied a history of trauma, intravenous drug use, and contact with animals including dogs.

Laboratory tests showed the following results: white blood cell count 9000/µl (neutrophil 79.9%) and C-reactive protein 5.72 mg/dl. His serum creatinine and liver function tests were normal. A computed tomography scan showed no abnormal findings except for the previously known sigmoid colon tumor.

Because catheter-related bloodstream infection was suspected, a peripheral venous catheter was replaced. Piperacillin/tazobactam (4.5 g every 8 h) was initiated after two sets of blood cultures were collected. The blood cultures were collected from separate venipuncture sites by using aseptic non-touch technique. On the following day, both sets of blood cultures were positive for clusters of gram-positive cocci. Therefore, vancomycin (1 g every 12 h) was initiated additionally.

The isolate was identified using matrix-assisted laser desorption/ionization time-of-flight mass spectrometry (MALDI-TOF MS), using a MALDI Biotyper (Bruker Daltonics, Bremen, Germany, Version 4.0) as S. schleiferi subsp. coagulans (log score 1.945).

The results were confirmed using 16S ribosomal RNA sequencing. Comparison with sequences in the BLAST database (http://www.ncbi.nlm.nih.gov/BLAST) revealed that the sequence was 100% identical to that of S. schleiferi (GenBank accession number AP014944.1). The isolate was free coagulase-positive and thus, was identified as S. schleiferi subsp. coagulans. Coagulase activity was tested by using rabbit plasma (Eiken Chemical Co., Ltd., Tokyo, Japan).

Antimicrobial susceptibility testing was performed using the MicroScan WalkAway system (Beckman Coulter, Tokyo, Japan). The isolate was susceptible to all antibiotics tested including oxacillin, cefazolin, clindamycin, and vancomycin according to the Clinical and Laboratory Standards Institute M100-S29 [7]. The minimum inhibitory concentration for oxacillin was ≤ 0.25 µg/ml.

The isolate did not produce Staphylococcal enterotoxin (SE, SEA to SED) or toxic shock syndrome toxin-1 (TSST-1) as per reversed passive latex agglutination assay (Denka Co., Ltd., Tokyo, Japan).

The patient's antibiotic treatment was switched to cefazolin (1 g every 8 h) on day 5 based on the results of the antimicrobial susceptibility testing. His fever and chills improved following antibiotic treatment. Repeated blood cultures after antibiotic treatment were negative. He was treated for eight days with intravenous antibiotic therapy. The patient successfully underwent laparoscopic sigmoid colectomy without relapse of S. schleiferi bacteremia.

Discussion and conclusion

S. schleiferi was first reported as a new species in 1988 [8], and S. schleiferi subsp. coagulans can be differentiated from S. schleiferi subsp. schleiferi based on coagulase production [9]. S. schleiferi is frequently isolated from the skin and external ear of dogs [10] and is recognized as one of the pathogens causing canine otitis externa [9].

While various human cases of S. schleiferi infection have been described previously, human infection caused by S. schleiferi subsp. coagulans is rare. Only four cases of S. schleiferi subsp. coagulans infection have been reported previously including two cases of endocarditis [5, 11], a case with left ventricular assist device infection [12], and a case with bacteremia (entry site undescribed) [13] (Table 1). None of the patients died of S. schleiferi subsp. coagulans infection.

Both sets of blood cultures taken from the patient were positive for S. schleiferi subsp. coagulans and there was redness, swelling, and tenderness at the peripheral venous catheter insertion site. These clinical symptoms were resolved after withdrawal of the peripheral venous catheter. There was no other alternative explanation for bacteremia, and S. schleiferi subsp. coagulans can colonize on skin of human, especially who has contact with dogs [14]. For these reasons, we diagnosed his condition as catheter-related bloodstream infection. However, the patient denied contact with the dogs before admission. In addition, the onset of infection was a week after admission. Therefore, it is unclear how S. schleiferi subsp. coagulans colonized the patient’s skin in this case.

There are multiple reports that coagulase-negative staphylococci can produce SE alone or in combination with TSST-1 [15–17]. However, the S. schleiferi subsp.
coagulans strain did not produce SEA to SED or TSST-1 in our case. Although the possession of SE genes was reported in 86% (18/21 strains) of coagulase-positive S. schleiferi detected from dogs, the production of SEA to SED and TSST-1 has not yet been reported [18]. As S. schleiferi subsp. coagulans infection is rare in humans and there are a limited number of case reports, further studies are needed to clarify the frequency of SE/TSST-1 production in S. schleiferi subsp. coagulans infection.

Various laboratory tests were performed to identify S. schleiferi subsp. coagulans in previous reports. Two reports used Vitek system (bioMérieux Vitek Inc., Hazelwood, Missouri) [5, 12]. One report used 16S ribosomal DNA sequencing, nested PCR, and the MicroScan WalkAway system (Dade-Behring, West Sacramento, California) [5, 11, 12]. Our case is the first to use MALDI-TOF MS, 16S ribosomal RNA gene sequencing for identification of S. schleiferi subsp. coagulans. S. schleiferi subsp. coagulans could have been mistaken for Staphylococcus aureus because both are free coagulase positive [5, 19].

Accurate identification of S. schleiferi subsp. coagulans can be expected by combining MALDI-TOF MS and biochemical properties test.

Non-aureus Staphylococci, especially coagulase-negative Staphylococci are often resistant to methicillin [20], however, two previous cases and the present case were susceptible to methicillin [5, 11–13].

In summary, we present the first case of catheter-related bloodstream infection caused by S. schleiferi subsp. coagulans. The organism was identified using MALDI-TOF MS, 16S ribosomal RNA gene-sequencing analysis, and free coagulase test. Therefore, although human infection is rare, S. schleiferi subsp. coagulans can be pathogenic in humans.

**Abbreviations**

S. schleiferi: Staphylococcus schleiferi; S. schleiferi subsp. schleiferi: Staphylococcus schleiferi subspecies schleiferi; S. schleiferi subsp. coagulans: Staphylococcus schleiferi subspecies coagulans; MALDI-TOF MS: Matrix-assisted laser desorption/ionization time-of-flight mass spectrometry; SE: Staphylococcal enterotoxin; TSST-1: Toxic shock syndrome toxin-1.

**Table 1** Characteristics of cases of human infection caused by Staphylococcus schleiferi subspecies coagulans

| Infection focus                          | Age/sex | Definitive antibiotic treatment                      | Methicillin susceptibility | Outcome                         | References          |
|------------------------------------------|---------|------------------------------------------------------|----------------------------|---------------------------------|---------------------|
| Endocarditis                             | 78/M    | Benzylpenicillin, rifampin, gentamicin               | Susceptible                | Survived                        | Leung et al. [5]    |
| Endocarditis                             | 58/M    | Vancomycin, rifampin, gentamicin                    | Resistant                  | Successfully treated (died of liver failure) | Kumar et al. [12]  |
| Left ventricular assist device infection  | 55/F    | Dicloxacillin, cephalaxin                            | Susceptible                | Survived                        | Thibodeau et al. [13]|
| Bacteremia (entry site undescribed)      | 66/M    | Vancomycin                                           | Resistant                  | Survived                        | Swe et al. [14]     |
| Catheter related bloodstream infection   | 62/M    | Cefazolin, clindamycin                               | Susceptible                | Survived                        | This report         |

M male, F female

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