TURKISH JOURNAL OF EMERGENCY MEDICINE

Case Report/Case Series

Access this article online

Quick Response Code:

Website: www.turkjemergmed.com

DOI: 10.4103/2452-2473.366856

Staphylococcus schleiferi subspecies *coagulans* septic shock in an immunocompetent male following canine otitis externa

Andrew D. K. Nguyen[1,2*], Deborah Moran[3], Carole-Lynn Eland[4], Kathryn Wilks[1,4]

Departments of [1]Medicine and [3]Emergency, Sunshine Coast University Hospital, [4]Department of Microbiology, Sunshine Coast University Hospital Pathology Laboratory, Pathology Queensland, Birtinya, [2]Faculty of Medicine, University of Queensland, Brisbane, Queensland, Australia
**Corresponding author*

Abstract:

Staphylococcus schleiferi bacteremia is an underappreciated cause of septic shock in the critical care department. Although nominally a coagulase variable *Staphylococcus* and associated with otitis externa infections in canine species, it has been associated with the metastatic infection including osteomyelitis, endocarditis, nephritis, and meningitis in humans. This report records a possible zoonotic case of *S. schleiferi* subspecies *coagulans* bacteremia following canine otitis externa associated with septic shock and endovascular infection precipitating intensive care admission for vasopressor support in an immunocompetent male.

Keywords:

Bacteremia, disseminated, immunocompetent, septic shock, *Staphylococcus schleiferi*, zoonosis

Introduction

Zoonotic transmission of *Staphylococcus schleiferi* from dogs to humans is an uncommon presentation, with only sporadic cases reported since it was first described in 1988.[1,2] Less commonly still, is it implicated with sepsis, where there is a paucity of data related to its management in critical care environments around the world.[3] A lack of virulence factors typically found in *Staphylococcus aureus* such as hyaluronidase (employed in tissue penetration) and traditional isolation in canine otitis externa, has led to its presumption as an uncommon opportunistic human pathogen.[4-6] However, the coagulase variable *S. schleiferi* has been implicated in metastatic infections in immunocompromised hosts including endocarditis, osteomyelitis, and meningitis.[1,7] Therefore, recognition of this association has pertinent implications for the management of undifferentiated septic patients. Given *Staphylococcus aureus* and *S. schleiferi* subspecies (ssp.) *coagulans* can both be coagulase-positive, misidentification can occur if only coagulase testing is used to guide management in critically unwell patients.[5] This case report describes the importance of recognizing zoonotic exposure history in the prevention of *S. schleiferi* misidentification and rationalizing antibiotic management when encountering sepsis in critical care settings, including among immunocompetent patients.

Submitted: 29-09-2022
Revised: 27-10-2022
Accepted: 10-11-2022
Published: 02-01-2023

ORCID:
AD: 0000-0002-1859-6549
DM: 0000-0002-5831-4067
CLE: 0000-0002-8815-0550
KW: 0000-0001-9670-4050

Address for correspondence:
Dr. Andrew D. K. Nguyen, Department of Medicine, Infectious Diseases Unit, Sunshine Coast University Hospital, 6 Doherty Street, Birtinya, Queensland 4575, Australia.
E-mail: andrew.nguyen@uq.edu.au

How to cite this article: K. Nguyen AD, Moran D, Eland CL, Wilks K. *Staphylococcus schleiferi* subspecies *coagulans* septic shock in an immunocompetent male following canine otitis externa. Turk J Emerg Med 2023;23:184-7.

Case Report

An 84-year-old immunocompetent male presented with a 2-3 days history of right inguinal pain with associated fever, decreased appetite, and limited mobility. His history was significant for obesity, permanent atrial fibrillation on apixaban, chronic kidney disease stage IIIb, a distant repaired abdominal aortic aneurysm with an endovascular graft, and a motor vehicle accident 3 months prior resulting in a left knee hemarthrosis complicated by left lower limb cellulitis, subsequently treated and resolved. On arrival to the emergency department, he was found to be hypotensive with a blood pressure of 95/61 mmHg, borderline febrile to 37.8°C, hypoxic with an oxygen saturation of 90% on room air, and a heart rate of 75/min. His weight on admission was 114.4 kg. He remained alert and oriented throughout his presentation. Cardiovascular, inguinal, and ocular examinations were unremarkable, and there were no peripheral stigmata of infective endocarditis. Cellulitis was noted in the left lower limb, with erythema extending from his previous hemarthrosis scar, concerning for possible inoculation. Laboratory data revealed an acute on chronic renal impairment (creatinine: 111 μmol/L compared to 149 μmol/L 2 months prior (normal range: 64 - 128 μmol/L), albumin 32 g/L (35 - 50 g/L), total bilirubin 18 μmol/L which did not rise further (<20 μmol/L), creatinine kinase 72 U/L (46 - 171 U/L), aspartate aminotransferase/alanine transferase 14 (<45 U/L)/10 (<35 U/L), white cell count 8.7 × 10^9/L (3.5 - 11.0×10^9/L), neutrophil count 7.24×10^9/L (2.00-8.00×10^9/L), lymphocytes 0.66 × 10^9/L (1.00 - 4.00 × 10^9/L), pH 7.45 (7.35 - 7.45), HCO_3 22 mmol/L (22 - 32 mmol/L), and lactate 2.3 mmol/L (0.5 - 2.2 mmol/L). Coagulation profile, lymphocyte subsets, immunoglobulin subsets, and HIV serology were unremarkable. C-reactive protein was 95 mg/L initially, rising to 150 mg/L within 48 h. Within 24 h of presentation, Sequential Organ Failure Assessment (SOFA) score was 3. Early computer tomography (CT) angiography revealed no acute aortic syndrome and no vascular graft involvement. For empirical antibiotic therapy, he was commenced on intravenous (IV) flucloxacillin 2 g, gentamicin 420 mg, and vancomycin 1 g, in addition to IV crystalloid fluid resuscitation. Despite receiving three liters of fluid resuscitation, he required a metaraminol infusion to maintain a mean arterial pressure (MAP) >65 mmHg. Metaraminol infusion was chosen for shock over other vasopressors given his anticipated short duration of hemodynamic support, and the low doses (0.5 mg/h) required to maintain MAP > 65 mmHg. He was admitted to the intensive care unit for 3 days for ongoing hemodynamic monitoring. Hypoxia subsequently improved. Multiple daily blood cultures were positive, with *S. schleiferi* ssp. *coagulans* identified on associated Gram stain [Figure 1], and matrix-assisted laser desorption/ionization time-of-flight mass spectrometry. Subspecies were confirmed with urease and coagulase-positive testing. Blood cultures were repeatedly positive despite broadened antimicrobial therapy with IV piperacillin/tazobactam 4.5 g 6 h and IV vancomycin 2 g loading dose then 1 g twice daily. Once susceptibilities returned [Table 1], antimicrobials were rationalized to IV flucloxacillin.

Transthoracic and transesophageal echocardiography were unremarkable for signs of infective endocarditis. Later, CT-position emission tomography indicated moderate focal FDG uptake (SUVmax: 4.9) localizing to the proximal left iliac graft at the aortic bifurcation [Figure 2].

The patient's history was revisited, and inadvertent close exposure to his unwell pet Maltese terrier's otorrhea was noted. The canine's otitis externa preceded the patient's illness by a week and was treated with topical 23 mg/mL miconazole nitrate, 5 mg/mL prednisolone acetate, and 0.696 mg/mL polymyxin B twice daily for 10 days by the local veterinarian. The canine was known to lick the patient, and it was during the attempted application of antimicrobial treatment by the patient to his pet canine's ears, that ocular and lower limb exposure to his canine's otorrhea was noted on a background of his left knee hemarthrosis. Canine aural samples posttreatment tested positive for the *Staphylococcus intermedius* group (including *Staphylococcus pseudintermedius*) only.

Given the concern for iliac graft infection, a vascular surgical opinion was obtained. A consensus multidisciplinary team discussion concluded indefinite

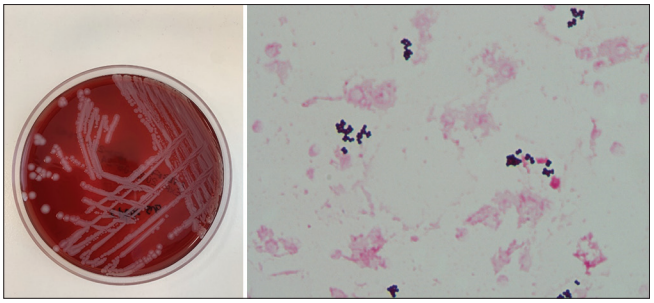

Figure 1: Blood agar plate reading of blood culture result and subsequent Gram Stain of *Staphylococcus schleiferi* subspecies *coagulans*

Table 1: Antimicrobial susceptibility profile of *Staphylococcus schleiferi* subspecies *coagulans*

Antibiotic	Susceptibility
Penicillin	Susceptibility
Flucloxacillin	Susceptibility
Cefazolin	Susceptibility
Clindamycin	Susceptibility
Co-trimoxazole	Susceptibility
Vancomycin	Susceptibility
Tetracycline	Susceptibility

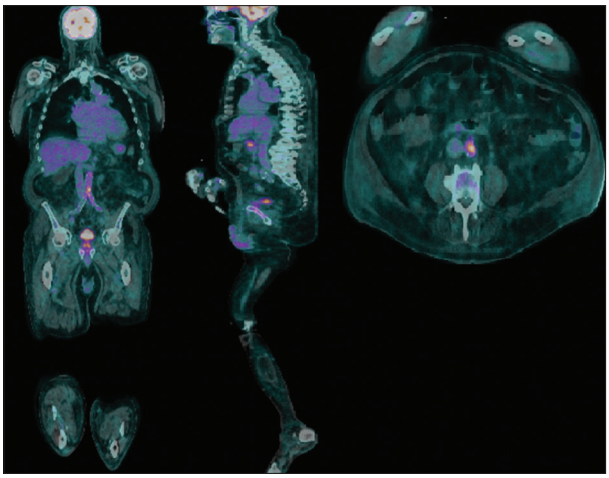

Figure 2: Coronal, sagittal, and axial CT-PET images indicating moderate FDG uptake of the left iliac vascular graft at the aortic bifurcation. FDG: Fluorodeoxyglucose, CT-PET: Computed tomography-positron emission tomography

antimicrobial suppression with oral flucloxacillin 1 g twice a day following a 6-week course of IV flucloxacillin 2 g 4 h for presumptive vascular infection given comorbidities and age. Following complications including pulmonary edema secondary to fluid resuscitation, he underwent successful diuresis with daily furosemide and was discharged with outpatient parental antimicrobial therapy and oral antimicrobial suppression as planned.

Discussion

S. schleiferi is a coagulase variable *Staphylococcus* predominantly associated with canine otitis externa. *S. schleiferi* ssp. *coagulans* is rarely found in humans but is frequently isolated from healthy dogs from the skin, as well as being associated with otitis externa.[8,9] Although canine isolates were negative in this case, swabs were taken posttreatment which may have masked growth given the known efficacy of miconazole against *Staphylococcus* species, with preceding chronology suggestive of transmission.[10] In rare human cases, it is associated with metastatic infection in immunocompromised hosts but has not been previously described to require vasopressor support or intensive care monitoring, nor endovascular involvement.[1] In this described case, the patient required vasopressor support within 24 h of presentation, reaching a SOFA score of 3. The implications are pertinent, given how underrecognized this relationship between zoonotic exposure and endovascular infection with *S. schleiferi* may be. *S. schleiferi* ssp. *coagulans* is documented to be less pathogenic than *S. schleiferi* ssp. *schleiferi*.[11,12] This is relevant, given the *S. schleiferi* ssp. *coagulans* identified in this patient, his immunocompetent status, and the severe clinical sequelae as a result of bacteremia following probable zoonotic canine transmission. Although lacking in hyaluronidase found in *Staphylococcus aureus*, pathogenicity may be related to other virulence factors including β-hemolysin, and the ability to form biofilms.[13] It is important to explore exposure history and recognize this in the critical care setting to rationalize investigations and antimicrobial therapy. Although not found in our microbiology results, *S. schleiferi* is associated with up to 57% oxacillin resistance and can have implications on an empirical antimicrobial choice until susceptibilities return.[9] This is pertinent in the acute care setting, given the impetus on rapid antimicrobial administration in sepsis. There is potential misidentification between *S. schleiferi* ssp. *coagulans* and *Staphylococcus aureus* if only coagulase testing is employed. Whereas *S. schleiferi* ssp. *coagulans* test negative with slide agglutination (clumping factor), *Staphylococcus aureus* tests positive.[14] Biochemical commercial systems, such as API Staph System (bioMérieux, Marcy l'Etoile, France), VITEK 2 (bioMérieux, Marcy l'Etoile, France), or BBL Crystal identification systems (Gram-Positive ID Kit and Rapid Gram-Positive ID Kit; Becton Dickinson), in conjunction with clumping factor and coagulase testing, can differentiate *S. schleiferi* ssp. *coagulans* from other coagulase-positive *Staphylococci* by urease production and lack of maltose/mannose production, among others.[14,15] Therefore, early recognition by treating clinicians may lead to more appropriate antimicrobial choices and improved clinical outcomes for patients.

Conclusion

In summary, we describe the first documented case of probable zoonotic transmission of *S. schleiferi* in an otherwise immunocompetent human host resulting in septic shock requiring vasopressor support in the intensive care setting. Recognizing zoonotic exposure history is important in optimizing critical care investigations and antimicrobial therapy when encountering septic patients in the critical care setting. Furthermore, appropriate identification of *S. schleiferi* ssp. *coagulans* can avoid misdiagnosis and confusion with other *Staphylococci* in the management of unwell patients.

Acknowledgments

The authors would like to acknowledge all healthcare workers and microbiology staff at Pathology Queensland who were involved in the care of this patient.

Author contributions statement

- Conceptualization: ADKN, DM, KW
- Data curation: ADK, CE, KW
- Methodology: ADKN
- Project administration: ADKN, KW
- Formal analysis: ADKN, KW
- Visualization: CE, KW
- Writing – original draft: ADKN, DM

- Writing – review and editing: ADKN, DM, KW, CE
- Supervision: KW.

Conflicts of interest
None declared.

Informed Consent
Written and signed informed consent was obtained from the patient for the publication of this case report including accompanying images.

Declaration of patient consent
The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient has given his consent for his images and other clinical information to be reported in the journal. The patient understands that his name and initial will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

Funding
None declared.

References

1. Hernández JL, Calvo J, Sota R, Agüero J, García-Palomo JD, Fariñas MC. Clinical and microbiological characteristics of 28 patients with *Staphylococcus schleiferi* infection. Eur J Clin Microbiol Infect Dis 2001;20:153-8.
2. Freney J, Brun Y, Bes M, Meugnier H, Grimont F, Grimont PAD, *et al*. *Staphylococcus lugdunensis* sp. nov. and *Staphylococcus schleiferi* sp. nov., Two Species from Human Clinical Specimens. Int J Syst Bacteriol. 1988;38:168-72.
3. Thawabi M, Jerome M, Slim J, Shamoon F, Boghossian J. Pericardial effusion and sepsis caused by Staphylococcus schleiferi. J Infect Public Health 2015;8:392-3.
4. Misic AM, Cain CL, Morris DO, Rankin SC, Beiting DP. Complete genome sequence and methylome of Staphylococcus schleiferi, an important cause of skin and ear infections in veterinary medicine. Genome Announc 2015;3:e01011-15.
5. Igimi S, Takahashi E, Mitsuoka T. Staphylococcus schleiferi subsp. coagulans sub sp. nov., isolated from the external auditory meatus of dogs with external ear otitis. Int J Syst Bacteriol 1990;40:409-11.
6. May ER, Kinyon JM, Noxon JO. Nasal carriage of Staphylococcus schleiferi from healthy dogs and dogs with otitis, pyoderma or both. Vet Microbiol 2012;160:443-8.
7. Kumar D, Cawley JJ, Irizarry-Alvarado JM, Alvarez A, Alvarez S. Case of Staphylococcus schleiferi subspecies coagulans endocarditis and metastatic infection in an immune compromised host. Transpl Infect Dis 2007;9:336-8.
8. Vandenesch F, Lebeau C, Bes M, Lina G, Lina B, Greenland T, *et al*. Clotting activity in Staphylococcus schleiferi subspecies from human patients. J Clin Microbiol 1994;32:388-92.
9. Cain CL, Morris DO, Rankin SC. Clinical characterization of Staphylococcus schleiferi infections and identification of risk factors for acquisition of oxacillin-resistant strains in dogs: 225 cases (2003-2009). J Am Vet Med Assoc 2011;239:1566-73.
10. Nenoff P, Koch D, Krüger C, Drechsel C, Mayser P. New insights on the antibacterial efficacy of miconazole in vitro. Mycoses 2017;60:552-7.
11. Yarbrough ML, Hamad Y, Burnham CA, George IA. The brief case: Bacteremia and vertebral osteomyelitis due to Staphylococcus schleiferi. J Clin Microbiol 2017;55:3157-61.
12. Kobayashi T, Ikeda M, Ohama Y, Murono K, Ikeuchi K, Kitaura S, *et al*. First human case of catheter-related blood stream infection caused by Staphylococcus schleiferi subspecies coagulans: A case report and literature review. Ann Clin Microbiol Antimicrob 2021;20:68.
13. González-Martín M, Corbera JA, Suárez-Bonnet A, Tejedor-Junco MT. Virulence factors in coagulase-positive staphylococci of veterinary interest other than Staphylococcus aureus. Vet Q 2020;40:118-31.
14. Versalovic J, Carroll KC, Funke G, Jorgensen JH, Landry ML, Warnock DW. Manual of Clinical Microbiology. 10th ed. Washington: ASM Press; 2011.
15. Zdovc I, Ocepek M, Pirs T, Krt B, Pinter L. Microbiological features of Staphylococcus schleiferi subsp. coagulans, isolated from dogs and possible misidentification with other canine coagulase-positive staphylococci. J Vet Med B Infect Dis Vet Public Health 2004;51:449-54.