

***Streptococcus pseudoporcinus* bacteremia in a patient with skin and soft tissue infection. A case report and literature review**

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SUMMARY

Streptococcus pseudoporcinus is a beta-hemolytic *Streptococcus* species arranged in short chains, which was first described in 2006. In the last years, there have been several reports of human infections by this bacterium, with five skin and soft tissue infections identified. Herein, a case of *S. pseudoporcinus* skin and soft tissue infection in a patient, who also developed bacteremia and was successfully treated with intravenous antibiotics, is reported. A 67-year-old man with a history of diffuse large B-cell lymphoma presented to the emergency department because of fever, redness, swelling, and pain in the left lower limb. He was admitted to the medical ward, diagnosed with severe non-purulent skin and soft tissue infection, and treated empirically with intra-

venous piperacillin/tazobactam at 4.5 gr thrice daily and daptomycin at 10mg/kg once daily. Blood cultures were obtained before the initiation of the antibiotics and grew *S. pseudoporcinus*. Treatment was de-escalated to ceftriaxone at a dose of 2 gr once daily. He completed two weeks of intravenous antimicrobial treatment. *S. pseudoporcinus* is an emerging pathogen associated with skin and soft tissue infections, bacteremia, and other invasive, potentially life-threatening infections. Further investigation is warranted to clarify this microorganism's pathogenesis and biological significance.

Keywords: *Streptococcus pseudoporcinus*; bacteremia; skin and soft tissue infection.

■ INTRODUCTION

Streptococcus pseudoporcinus is a Gram-positive, catalase-negative coccus arranged in short chains and characterized by a large zone of beta-hemolysis. The microorganism was first isolated from the female genitourinary tract in 2006 [1]. It was first considered to be *S. porcinus* based on phenotypic criteria; however, sequencing data differentiated it as a different, novel species, as it

was dissimilar to other *Streptococcus* species by at least 2% [1]. In the last few years, there have been several reports of human infections by this bacterium, with five cases of skin and soft tissue infections being identified so far [2-6].

Herein, we report a case of *S. pseudoporcinus* skin and soft tissue infection in a patient who also developed bacteremia and was successfully treated with intravenous antibiotics.

■ CASE REPORT

A 67-year-old man presented to the emergency department because of fever, redness, swelling, and pain in the left lower limb. The patient had

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a past medical history of diffuse large B-cell lymphoma, diagnosed three years before, that was treated with various chemotherapeutic regimens (cyclophosphamide, doxorubicin, prednisone, rituximab, and vincristine) until two years ago without adequate response, after which he was lost to follow up. Two years ago, he had a history of prosthetic joint infection after a hip arthroplasty treated with surgical debridement, implant retention, and intravenous antimicrobials. His last hospital admission was a year ago due to cellulitis of the left lower limb and bacteremia by methicillin-susceptible *Staphylococcus aureus*.

Upon admission during his current presentation, the patient had a temperature of 38.2° C, a heart rate of 100 beats per minute, a blood pressure of 120/75 mmHg, a respiratory rate of 18 breaths per minute, and an oxygen saturation of 98% while breathing ambient air. Physical examination was notable for redness, swelling, and tenderness of his entire left leg, with no clinical signs of an abscess. The heart auscultation revealed a diastolic murmur in the auscultation site of the aortic valve. Blood examinations showed an elevated white blood count of $12.3 \times 10^9/L$, a neutrophil count of $11.9 \times 10^9/L$, an elevated C-reactive protein (CRP) at 13.5 mg/dl (normal: <0.5 mg/dl), and an erythrocyte sedimentation rate (ESR) of 68 mm/1st hour. Triplex ultrasonography of the left lower limb ruled out deep venous thrombosis or the presence of a fluid collection. Two sets of blood cultures (each from a different venipuncture site) were taken before initiating antimicrobials. The patient was admitted to the medical ward, diagnosed with severe non-purulent skin and soft tissue infection, and empirically treated with intravenous piperacillin/tazobactam at 4.5 gr thrice daily and daptomycin at 10 mg/kg once daily. A computed tomography (CT) scan of the infected limb ruled out necrotizing fasciitis.

Blood cultures yielded pure growth of *S. pseudoporcinus*, identified using Vitek 2 (BioMérieux, Marcy L' Etoile, France). The matrix-assisted laser desorption/ionization-time of flight mass spectrometry (MALDI-TOF MS) (BioMérieux) further confirmed the identification. The antimicrobial susceptibility testing was performed by the E-test method, and the results were interpreted according to the Clinical and Laboratory Standards Institute (CLSI) guidelines. Table 1 shows the antimicrobial susceptibilities of the isolate. De-escalation of antimicrobials was performed with

Table 1 - Minimum inhibitory concentrations (MICs) of antimicrobials against *Streptococcus pseudoporcinus* isolated from blood cultures of the patient presented herein.

Antimicrobial agent	MIC (µg/mL)	Interpretation (S, R)
Penicillin	0.023	S
Ampicillin	0.032	S
Ceftriaxone	0.032	S
Meropenem	0.008	S
Erythromycin	8	R
Clindamycin	0.19	S
Levofloxacin	0.38	S
Linezolid	1	S
Tedizolid	0.38	S
Vancomycin	0.25	S
Daptomycin	0.032	S
Dalbavancin	0.008	S
Tetracycline	0.38	S
Chloramphenicol	3	S

S: susceptible; R: resistant; MIC: minimum inhibitory concentration.

ceftriaxone at a dose of 2 gr once daily. Due to the presence of the heart murmur on clinical examination and the sporadic association of the pathogen with infective endocarditis (IE), a transthoracic echocardiogram (TTE), was performed on the 11th day of hospitalization and showed no evidence of IE. The fever subsided on the third hospital day, and he has remained afebrile ever since. Blood cultures taken after the initiation of antimicrobials were sterile. He completed two weeks of intravenous antibiotic therapy and was discharged in an improved condition. A follow-up examination one month after discharge showed the complete resolution of the infection.

■ LITERATURE REVIEW

Pubmed was searched for all studies published until July 31, 2023, with the search term 'pseudoporcinus'. Studies published in English providing information about infections by *S. pseudoporcinus* in humans were included. The literature search retrieved 13 articles, providing information about 14 patients [2-14]. Table 2 shows the characteristics of patients with infection by *S. pseudoporcinus*, including the present case.

Table 2 - Characteristics of patients with infection by *S. pseudoporcinus* in the literature, including the patient presented herein.

Characteristics	Value
Male gender, n (%)	10 out of 14 (71.4)
Age in years, median (IQR)	52 (38.3-68.3)
Bad teeth hygiene, n (%)	2 out of 13 (15.4)
Immunosuppression, n (%)	2 out of 13 (15.4)
Pregnancy, n (%)	1 out of 13 (7.7)
Recent trauma, n (%)	1 out of 13 (7.7)
Post-surgery, n (%)	1 out of 13 (7.7)
<i>Type of infection</i>	
Bacteremia, n (%)	10 out of 15 (66.7)
Skin and soft tissue infection, (%)	6 out of 15 (40)
Infective endocarditis, n (%)	4 out of 15 (26.7)
Thoracic empyema, n (%)	1 out of 15 (6.7)
Osteomyelitis, n (%)	1 out of 15 (6.7)
Endophthalmitis, n (%)	1 out of 15 (6.7)
Maternal sepsis and chorioamnionitis, n (%)	1 out of 15 (6.7)
Spontaneous bacterial peritonitis, n (%)	1 out of 15 (6.7)
<i>Identification method*</i>	
VITEK-2, n (%)	10 out of 11 (90.9)
16s rRNA, n (%)	2 out of 11 (18.2)
MALDI-TOF MS, n (%)	2 out of 11 (18.2)
<i>Antimicrobial resistance</i>	
Penicillin, n (%)	2 out of 6 (33.3)
Quinolones, n (%)	1 out of 6 (16.7)
Cephalosporins, n (%)	1 out of 8 (12.5)
Vancomycin, n (%)	0 out of 6 (0)
<i>Clinical signs</i>	
Fever, n (%)	11 out of 13 (84.6)
Sepsis, n (%)	9 out of 12 (75)
Organ dysfunction, n (%)	5 out of 13 (38.5)
<i>Treatment**</i>	
Cephalosporins, n (%)	8 out of 13 (61.5)
Vancomycin, n (%)	4 out of 13 (30.8)
Aminopenicillin, n (%)	3 out of 13 (23.1)
Carbapenem, n (%)	2 out of 13 (15.4)
Quinolone, n (%)	2 out of 13 (15.4)
<i>Outcomes</i>	
Clinical cure, n (%)	13 out of 15 (86.7)
Mortality, n (%)	2 out of 15 (13.3)

IQR: interquartile range; MALDI-TOF MS: matrix-assisted laser desorption/ionization-time of flight mass spectrometry; rRNA: ribosomal ribonucleic acid; * more than one identification methods may have been used in some cases; ** more than one antibiotics may have been used in some cases

The median age of the patients was 52 years (range: 0 to 94), and a male predominance was noted, with male patients being 71.4%. Only two patients were immunosuppressed due to human immunodeficiency virus (HIV) infection and an underlying hematologic malignancy. The most common type of infection was bacteremia (commonly in the context of another infection, such as infective endocarditis) in 66.7%, followed by skin and soft tissue infections in 40%. Infective endocarditis was diagnosed in 4 out of 15 patients (26.7%), with the aortic valve being infected in two patients and the mitral and pulmonary valve in each of the rest. VITEK 2 was the most common method for identifying the pathogen, but 16s rRNA PCR and MALDI-TOF MS were also used to confirm the microbiological diagnosis. Patients commonly presented with fever (84.6%) and sepsis (75%). Cephalosporin resistance was low, at 12.5%; thus, these were the most commonly used antibiotics (61.5%), followed by vancomycin (30.8%) and aminopenicillins (23.1%). Mortality rate was 13.3%.

DISCUSSION

S. pseudoporcinus is a nonmotile, catalase-negative, Gram-positive coccus that produces beta-hemolytic colonies on blood agar. This bacterium has been sporadically isolated from the female genitourinary tract. According to Stoner et al., 5.4% of the non-pregnant women in their study were colonized with *S. pseudoporcinus*, and colonization was more likely to occur among black women, 30 to 40 years of age, with genital herpes, recent infection by *Trichomonas*, bacterial vaginosis, and at least two sexual partners [15]. *S. pseudoporcinus* shares similar biochemical characteristics with *S. agalactiae*, and it may give positive agglutination with group B streptococcal (GBS) antisera, leading to false identification as GBS in routine GBS screening culture [16]. *S. pseudoporcinus* is typically susceptible to β -lactam antibiotics, vancomycin, clindamycin, macrolides, and fluoroquinolones but not to tetracycline [17]. Although there are reports of resistant strains of *S. pseudoporcinus*, with resistance to β -lactam antibiotics and meropenem, susceptibility to vancomycin, daptomycin, linezolid, levofloxacin, and clindamycin seems to be retained [13].

The pathogenesis of infection by *S. pseudoporcinus* has yet to be clearly understood. Since a common

site of isolation is the woman's genitourinary tract, *S. pseudoporcinus* was thought to be associated with obstetric adverse outcomes, such as preterm delivery and chorioamnionitis [18]. Having two or more sexual partners and a recent *Trichomonas vaginalis* infection or genital herpes infection were some of the risk factors for the acquisition of *S. pseudoporcinus* [15]. Nevertheless, immunosuppression and chronic heart failure may be associated with a higher likelihood of severe illness, as suggested by the limited current literature [18]. During the last decade, several cases have been reported, revealing the diversity of the clinical importance of this bacterium. For example, there are reports of ocular infections, such as endophthalmitis after blepharoplasty or corneal perforation secondary to orbital cellulitis [5, 11]. Furthermore, invasive and even fatal infections by *S. pseudoporcinus* have been reported in patients with underlying conditions, such as in patients with liver cirrhosis, HIV, or Klippel-Trenaunay syndrome [4, 8, 13]. However, invasive infections by *S. pseudoporcinus* have also been described in immunocompetent hosts during the last years, including cases of endocarditis, pneumonia, and maternal sepsis, raising concern about the severity of the disease caused by this bacterium [6, 7, 10, 12, 18]. Herein, we present a case of a patient with skin and soft tissue infection by this microorganism. Five more cases of skin and soft tissue infection attributed to *S. pseudoporcinus* have been reported until now [2-6].

To conclude, *S. pseudoporcinus* is an emerging pathogen that was recovered on several occasions, namely skin and soft tissue infections, bacteremia, and other invasive, potentially fatal infections. Further investigation is warranted to clarify this microorganism's pathogenesis and biological significance.

Authors' contributions statement:

PI, MP, KA, SM, EP, and DPK were involved in the medical treatment of the patient. PI and MP wrote the original draft, and SM, KA, EP, and DPK critically revised the manuscript.

Conflicts of interest

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