International Journal of Pharmacy and Pharmaceutical Research (IJPPR)
Volume 32, Issue 5, May 2026 **ijppr.humanjournals.com** ISSN: 2349-7203

Shewanella putrefaciens Bacteremia in A Diabetic Male: A Clinical Challenge

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Received: 27 March 2026 Revised: 22 April 2026 Accepted: 28 April 2026

ABSTRACT

Shewanella putrefaciens, an emerging pathogen, is primarily implicated in skin and soft tissue infections. Diagnosis is challenging owing to misidentification using conventional methods, however precise diagnosis is significant due to species-specific antimicrobial resistance, S. algae being resistant to colistin. Here, we present an interesting case of a diabetic male, who presented with respiratory distress and disorientation. Blood sample showed growth of *Shewanella putrefaciens*, resistant to ceftazidime, however even after targeted therapy, patient's condition worsened. The isolate in our study was resistant to ceftazidime, in contrast to the reported studies, highlighting the need for precise diagnosis and susceptibility testing.

Keywords: Shewanella putrefaciens, resistance, emerging rare pathogen, MALDI-TOF MS, bacteremia.

INTRODUCTION:

Shewanella putrefaciens is one of the emerging pathogens implicated in human illness. The bacterium is a non-fermentative, Gram-negative bacilli (NFGNB), belonging to family *Shewanellaceae*, commonly found in marine waters [1]. *Shewanella* spp. is usually implicated in skin and soft tissue infections (SSTI), however, can infect other organ systems, leading to life-threatening sepsis [2]. The infection has been reported among patients with chronic ulcers, end-stage renal disease on dialysis, biliary duct abnormalities, malignancy and prematurity [1]. Diagnosis using conventional tests, in absence of automated or molecular identification systems is challenging. However, precise identification is pertinent as the organism exhibits species-specific antimicrobial resistance. Here, we describe a case of *S. putrefaciens* bacteremia in a 55-years-old known diabetic male, who presented with dyspnea and disoriented sensorium, and ultimately succumbed to illness, despite targeted therapy.

Case Report: A 55-years-old diabetic male, presented to emergency with complaints of shortness of breath, cough with expectoration and disorientation, without fever. Initial investigations revealed diabetic ketoacidosis, with Carbon dioxide (CO2) narcosis, leading to intubation and ventilatory support. Computed tomography of chest revealed bilateral pleural effusion and multiple cavitary lung lesions. Magnetic resonance imaging (MRI) of the brain showed acute lacunar infarct in left temporal and parietal deep white matter and cortical laminar necrosis. Empirical therapy with piperacillin-tazobactam and clindamycin was started, and laboratory investigations including blood, pleural pus and cerebrospinal fluid (CSF) culture were sent after initiation of therapy. Total leukocyte count (TLC) was elevated at 22,520 cells/µl, C-reactive protein (CRP) was 358 mg/L, and glycosylated hemoglobin (HbA1c) was 10.7%, indicative of poor glucose control. Blood sample collected in conventional blood culture bottle was incubated at 37°C aerobically, and was checked for signs of microbial growth daily. The sample exhibited turbidity on day 3 of incubation, and was inoculated onto blood and MacConkey agar, incubated overnight at 37°C aerobically, with 5% CO2. Gram-stain from the turbid sample revealed ~2-4 µm non-capsulated and non-sporing Gram-negative bacilli. After overnight incubation, blood agar plates revealed 1-2 mm in diameter, non-hemolytic, smooth, circular colonies with entire edges. MacConkey agar showed growth of non-lactose fermenting colonies with a pinkish-tan color [Figure 1]. The isolated was identified as *S. putrefaciens,* based on biochemical profile [Table 1], which was confirmed using matrix-assisted laser desorption ionization time-of-flight mass spectrometry (MALDI-TOF MS), with a discrimination score of >2. Antimicrobial susceptibility testing was performed using the Kirby-Bauer disc diffusion method. In absence of clinical and laboratory standards institute (CLSI) guidelines for *Shewanella* spp., the CLSI breakpoints for *Pseudomonas* species were used. The isolate was sensitive to piperacillin tazobactam, cefepime, imipenem, meropenem, amikacin, gentamicin, and ciprofloxacin, except ceftazidime, and thereby, clindamycin was discontinued, while piperacillin-tazobactam was continued. The patient improved and was extubated on day 8, however, the condition deteriorated after

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Volume 32, Issue 5, May 2026 ijppr.humanjournals.com ISSN: 2349-7203

3 days and endotracheal aspirate sent for microbiological analysis showed growth of *Klebsiella oxytoca*, sensitive only to carbapenems. Despite the targeted therapy with piperacillin-tazobactam and meropenem, the patient suffered sudden cardiac arrest and couldn't be revived.

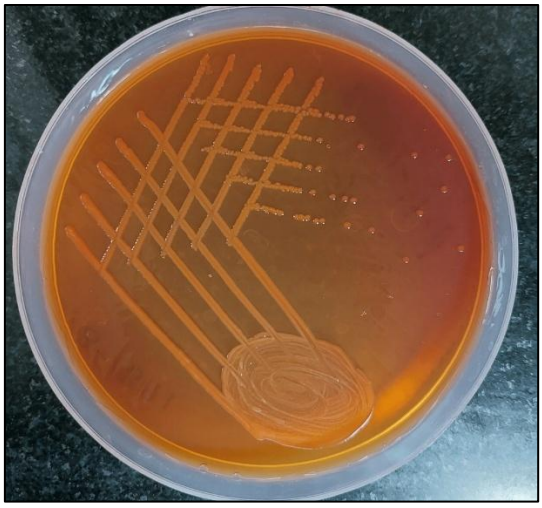

Figure 1: Colony morphology of *Shewanella putrefaciens* on MacConkey agar

Table 1: Biochemical tests performed for identification

Test	**Result**
Catalase	Positive
Oxidase	Positive
Hugh-Leifson test	Non-fermenter
Indole	Negative
Citrate utilization	Not utilized
Urease	Not produced
Triple Sugar Iron test	Production of hydrogen sulfide, with blackening of the media, without gas
Decarboxylase tests	
Lysine	Not decarboxylated
Ornithine	Decarboxylated
Arginine	Not hydrolyzed
Incubation at 42°C	No turbidity
Incubation in 6% NaCl	No growth

Discussion: The isolation of NFGNB has seen an upsurge since recent times, especially among immunocompromised, hospitalized patients and *Shewanella* is one such emerging genus [3], The bacterium isolated in 1931 from putrefied butter, was initially named as *Achromobacter putrefaciens*, later transferred to genus *Pseudomonas*, *Alteromonas*, and *Shewanella* under family *Vibrionaceae* [4]. A newer species, *S. algae* was identified subsequently in 1990, from red algae [5], following which Nozue *et al* revealed that majority of isolates identified as *S. putrefaciens* were actually *S. algae* [6]. *Shewanella* is currently included in family *Shewanellaceae,* based on 16S ribosomal ribonucleic acid (16S rRNA) analysis and includes ~30 psychrophilic species, of which three are pathogenic to humans viz. *S. algae*, *S. putrefaciens* and *S. xiamenensis*, and ~80% of human infections are caused by *S. algae* [3]. The first clinical case of *S. putrefaciens* was reported in 1964, following which several cases have been reported [1,6,7]. *S. putrefaciens* is mainly implicated in SSTI, while few cases of bacteremia have been reported. The course of bacteremia is usually benign and monomicrobial, as was noted in the present case [3]. Bacteremia usually follows presence of hepatobiliary disorder, malignancy, co-existing SSTIs, exposure to seawaters, trauma or invasive devices [2]. Secondary bacteremia has been reported in ~28% cases [8]. In the present case, culture showed pure growth of *Shewanella putrefaciens*, concordant to literature that ~40% of cases show pure monomicrobial cultures, and followed a benign course following mechanical ventilation, as described previously [3]. Our patient had no exposure to seawater, and the likely entry point remains the hospital mechanical devices. Few studies have shown association of *Shewanella* spp. with medical devices, highlighting the outbreak potential of *Shewanella* spp. in healthcare

[3]. Furthermore, our patient was diabetic, and the association of diabetes with Shewanella infection has been previously reported [7].

Mortality of ~8.6-20.3% has been noted in literature, which is ascribed partly to the underlying medical conditions [8,9]. *Shewanella* spp. are usually susceptible to fluoroquinolones, aminoglycosides, carbapenems and erythromycin, but exhibit variable susceptibility to ampicillin and are resistant to penicillin, and first and second generation cephalosporins [10]. Our isolate exhibited resistance to ceftazidime. This is in contrast to the previous literature, as authors have shown ~100% sensitivity to ceftazidime [7,9]. However, isolates of *S. algae* are resistant to colistin and polymyxin B, necessitating the precise identification to species level [2]. Few cases of multi-drug resistant *S. putrefaciens* have also been reported [3,7]. The emerging resistance has been attributed to the usage of broad spectrum antimicrobials, which exerts selective pressure on *Shewanella* spp., enabling them to adapt and develop increased resistance over time [10].

Conclusion: The present study underlines the requisite to consider *S. putrefaciens* in differential diagnosis of bacteremia in high-risk patients. The precise identification using 16S rRNA polymerase chain reaction (PCR) and MALDI-TOF MS is required for diagnosis and management, as both pathogenic species exhibit different susceptibility pattern to colistin. The isolate in our study was resistant to ceftazidime, highlighting the need for antimicrobial susceptibility testing, as *Shewanella* spp. are resistant to penicillin and exhibit variable susceptibility to ampicillin.

Acknowledgement : Nil

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How to cite this article:
Parakriti Gupta et al. Ijppr.Human, 2026; Vol. 32 (5):339-341.
Conflict of Interest Statement: All authors have nothing else to disclose.