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Case Report

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Curious Case of Shewanella Sepsis Originating from A Stercoral Ulcer

Jagani PP[1*], Jagani RP[2*], Mikhael M[2], Iqbal O[2], Yella PR[3] and Sharma A[3]

[1]Department of Pre-Medical Sciences, Richmond Gabriel University, Kingstown, Saint Vincent and the Grenadines

[2]Department of Family Medicine, Yuma Regional Medical Center, Yuma, Arizona, USA

[3]Department of Internal Medicine, Yuma Regional Medical Center, Yuma, Arizona, USA

[*]Corresponding author:

Ravi P Jagani, MD;
Yuma Regional Medical Center, Yuma, Arizona, USA

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1. Abstract

Shewanella putrefaciens is an uncommon gram-negative bacillus that is found in marine environments and soil, playing a significant role in many biogeochemical processes. However, clinically it is an opportunistic pathogen known to cause skin and soft tissue infections and intraabdominal conditions, as well as more severe diseases like chronic otitis media, intracerebral ocular infections, pneumonia, and endocarditis. We present the special case of a 77-year-old female with multiple comorbidities, including end stage renal disease (ESRD) on hemodialysis, dementia, and diet-controlled type 2 diabetes mellitus, who presented to the emergency department with lethargy, somnolence, and abdominal pain. Initial investigations revealed enterocolitis with severe anemia, prompting admission to the medical floor. Overnight, the patient was found to be septic and started on sepsis protocol with subsequent broad spectrum antibiotic coverage using piperacillin/tazobactam. Further concerns led to colonoscopy which revealed an underlying stercoral ulcer. Blood cultures were positive for Shewanella putrefaciens and antibiotic therapy with ceftriaxone was begun based on susceptibility.

Due to the possibility of septic and lethal courses in such infections, this case highlights the significance of recognizing atypical pathogens and emphasizes the importance of a timely diagnostic approach. By increasing awareness of this rare manifestation and promoting treatment with targeted therapy we can potentially improve patient outcomes.

2. Introduction

Shewanella putrefaciens, first discovered in 1931, is a pleomorphic rod-shaped, gram-negative, aerobic, and motile bacterium. It is a rare microbacterium found in the marine microflora and soil, geographically prevalent in moderate and warm climates. [1,2] It is a key spoilage agent in low temperature protein-rich foods and plays a significant role in biogeochemical processes possessing the ability to reduce various electron acceptors [3].

In clinical settings, it serves as an opportunistic human pathogen that is primarily associated with skin and soft tissue infections, along with intra-abdominal conditions like biliary tract infections and peritonitis, for which cholelithiasis, liver cirrhosis, or ESRD are predisposing factors. Additionally, it has also been associated with more severe diseases like chronic otitis media, intracerebral ocular infections, pneumonia, and endocarditis. As its effects progress, it can lead to bacteremia with the possibility of septic and lethal courses. [1, 2] In this case report, the unique case Shewanella putrefaciens from a stercoral ulcer is described in a 77-year-old woman with multiple comorbidities. Initial investigations revealed enterocolitis with severe anemia and was transferred to the medical floor where she became septic. She underwent subsequent colonoscopy demonstrating an underlying stercoral ulcer, blood cultures were taken and tested positive for Shewanella putrefaciens.

This report underscores the importance of recognizing atypical pathogens. It aims to educate clinicians on the diagnostic workup

necessary for detection and initiation of treatment, thereby improving clinical management practices and outcomes.

3. Case Presentation

We present a case of a 77-year-old female with a past medical history significant for end stage renal disease on hemodialysis, dementia, hypertension, type 2 diabetes mellitus diet-controlled, and other comorbidities who presented to the emergency department (ED) after having complaints of lethargy and somnolence that had progressively worsened over the past few days prior to presentation. She was also complaining of having abdominal pain without any other associated signs of symptoms. Approximately one week prior to this presentation, the patient was noted to have epistaxis which had resolved after nasal packing and the patient was discharged home from the ED. On physical examination, the patient was initially noted to have pale conjunctiva, displayed somnolence, and seemed ill-appearing. Remainder of the physical exam was noted to be normal. Initial vital signs in the ED were also normal. Patient underwent computed tomogram (CT) scan of abdomen and pelvis with contrast which revealed diffuse air fluid levels of mildly prominent loops of small bowel as well as seen throughout portions of the colon with associated wall thickening of the rectum with adjacent presacral fat stranding (Figure 1), findings which were concerning for underlying enterocolitis. All other imaging was noted to be within normal limits. Patient was also noted to have an acutely low hemoglobin of 5.6 g/dL (Reference range 12 - 14 g/dL) without any source of bleeding. Patient was immediately transfused with 2 units of blood and admitted to the medical floor. Overnight, patient developed a fever (101.7 F [38.7 C]) along with leukocytosis (WBC count 11.7 [4.8-10.8 K/uL]} and she was started on sepsis protocol with blood cultures sent and initiated on broad spectrum antibiotic coverage with piperacillin/tazobactam. Gastroenterology was also consulted due to sepsis secondary to enterocolitis and the patient underwent sigmoidoscopy which revealed underlying stercoral ulcer (Figure 2). Microbiology cultures from the blood started growing Shewanella putrefaciens; hence, infectious disease specialist was consulted for further guidance. With the sensitivities (Figure 3) showing susceptibility to ceftriaxone, antibiotics were re-adjusted from piperacillin/tazobactam to ceftriaxone to appropriately target the organism. Repeat blood cultures in 48 hours did not show any growth and the patient was discharged to a short term nursing facility where she was continued on intravenous ceftriaxone for a total of 14 days to finish the course of antibiotic treatment. After completion of the treatment course, the patient's symptoms had returned back to her baseline.

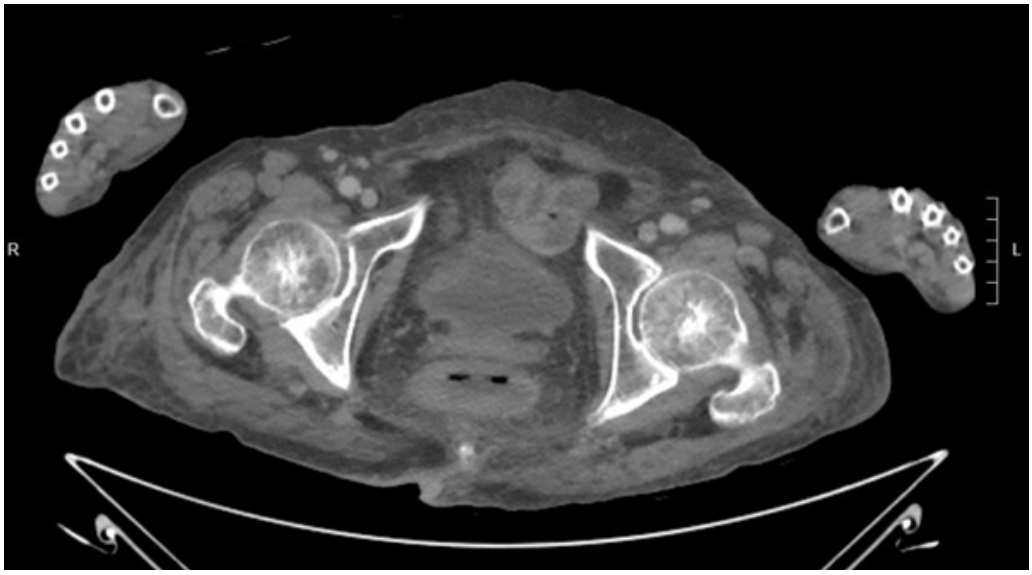

Figure 1: Wall thickening of the rectum with surrounding presacral fat stranding.

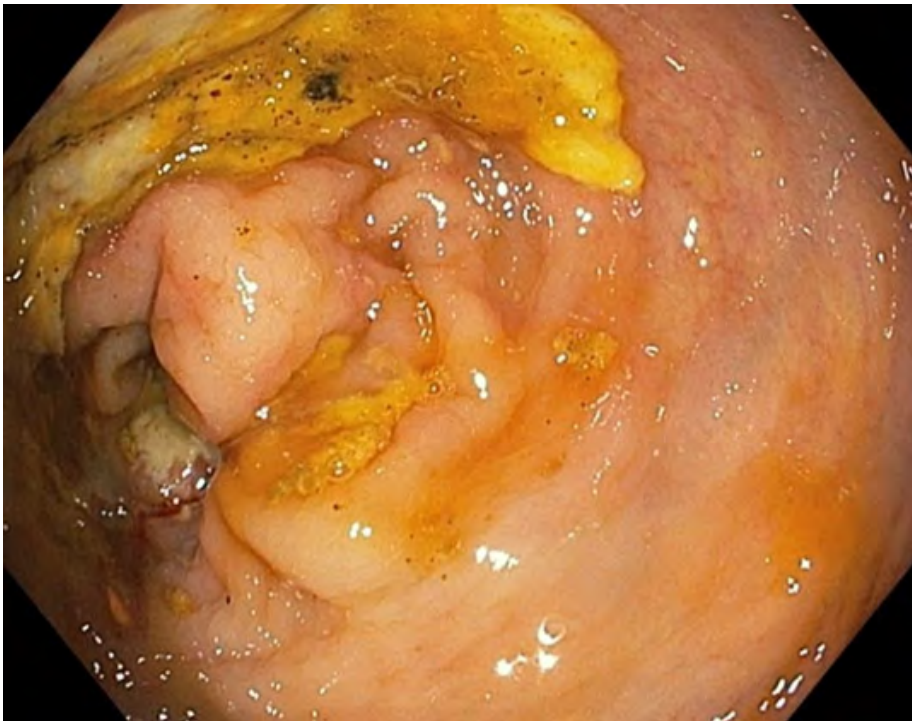

Figure 2: Ulceration approximately 4 to 5 cm in size appearing in a semi-circumferential fashion with stercoral origin.

Susceptibility

	Shewanella putrefaciens MIC	
Amikacin	<=8	Sensitive
Cefepime	<=1	Sensitive
Ceftazidime	<=2	Sensitive
Ceftriaxone	<=1	Sensitive
Ciprofloxacin	<=0.25	Sensitive
Gentamicin	<=2	Sensitive
Piperacillin + Tazobactam	8/4	Sensitive
Tobramycin	<=2	Sensitive
Trimethoprim + Sulfamethoxazole	<=0.5/9.5	Sensitive

Figure 3: Sensitivities showing different susceptibilities to *Shewanella putrefaciens*.

4. Discussion

Under the genus Shewanella, class of Gammaproteobacteria, which was established in 1985 by MacDonnell and Colewell, there are more than 70 species of [4,5] bacteria. Morphologically, they are gram-negative, motile, straight or curved rod-shaped bacteria that have positive oxidase and catalase reactions. Its species are found in broad environmental distributions such as freshwater lakes, sediments in oceans, marine microflora, and oil fields [4]. Infection is most commonly through marine-related occupational or recreational exposure [6].

Shewanella putrefaciens, was first discovered in 1931 by Derby and Hammer from isolated rotten butter. Commonly, it is found in marine environments and soil, mostly geographically prevalent in moderate and warm climates [1]. It plays an important role as the chief spoilage agent of chilled (iced), protein-rich foods that are high in pH like fish, chicken, and beef [4]. One of its main phenotypic features is its potential to decompose proteins and trimethylamine-N-oxide (TMAO) into trimethylamine, ammonia, and hydrogen sulfide (producing its classic fishy stench during food spoilage) [1].Additionally, it has the ability to reduce various electron acceptors including nitrate, thio-sulfate, sulfur, iron, manganese, and fumarate. This metabolic flexibility allows the bacteria to play a significant role in biogeochemical cycling processes [7].

Only Shewanella algae, Shewanella putrefaciens, and Shewanella xiamenensis have been linked to human diseases, with Shewanella algae being responsible for 77% of reported cases [8]. Shewanella putrefaciens is often misclassified due to its rarity. There are several distinguishing features between Shewanella algae which stand in contrast to the characteristics of Shewanella putrefaciens. This includes the capacity of Shewanella algae to form mucoid

colonies with betahemolysis on sheep blood agar, thrive at 42°C and in 6% w/v of sodium chloride (NaCl) exhibit nitrite reduction, show weak saccharolytic activity, and have the inability to ferment maltose to produce acid [9].

In clinical settings, Shewanella putrefaciens is an opportunistic human pathogen that is primarily associated with skin and soft tissue infections, along with intra-abdominal conditions like biliary tract infections and peritonitis [1]. Additionally, it has also been associated with more severe diseases like chronic otitis media which serves as an entry port for intracerebral ocular infections, pneumonia, endocarditis, arthritis, and osteomyelitis [1, 2]. Colonization in the upper and lower respiratory tracts is very rare, resulting in pneumonia which may be accompanied by respiratory failure. As its effects progress, it can lead to bacteremia, sepsis, and even death [1] In literature, it frequently shows male predominance [6] Patients who are immunocompromised and are exposed to predisposing risk factors are more prone to infections. For example, Brink et. al in 1995 found that premature infants in poor living standards are at risk. Hepatobiliary disorders such as cholelithiasis or liver cirrhosis are risk factors because the bacteria has been isolated from fats in the past and is seemingly lipophilic. End-stage renal disease (ESRD) is another risk factor as Shewanella putrefaciens has the ability to form biofilms and dialysis catheters placed in the body (ex. peritoneal or hemodialysis) can serve as potential entry ports. Chronic ulceration in the lower extremities or traumatic injury due to sea/fish water exposure are other risk factors.1 In our patient, who was vulnerable to disease due to advanced age, past medical history was significant for ESRD on hemodialysis, dementia, hypertension, type 2 diabetes mellitus dietcontrolled, and other comorbidities. Out of the predisposing risk factors mentioned, the patient had ESRD on hemodialysis, making the dialysis catheters in the body possibly serve as entry ports. Additionally, the patient had a history of hypertension and type 2 diabetes mellitus further compromising their immunity. Also, the patient complained of experiencing abdominal pain and CT abdomen findings revealed enterocolitis; aligning with the typical presentation of an intraabdominal condition.

The pathomechanisms of Shewanella putrefaciens infections are not fully understood. Current knowledge suggests that once it enters the host, it can colonize tissues, leading to local and potentially invasive infections [1]. In humans, infection typically occurs through skin contact with water, especially when the skin has wounds or ulcers. The damage and inflammation are due to the production of various virulence factors, including enzymatic activity, cytotoxin secretion, adhesion capabilities, lipopolysaccharide (LPS), and siderophores. Local enzyme production promotes necrosis of the skin and subcutaneous tissue, resulting in skin and soft tissue infections [10]. Additionally, Shewanella putrefaciens can attach to and invade human intestinal epithelial cells [1].

Diagnosis begins with clinical evaluation. The presentation of infection varies based on the site of infection and the patient's underlying health conditions. However, most commonly, Shewanella putrefaciens presents with skin and soft tissue infections, characterized by redness, swelling, pain, and sometimes necrosis [8]. Gastrointestinal symptoms such as diarrhea, abdominal pain, and vomiting are also frequent, particularly in cases of intra-abdominal infection. In a study conducted in Beijing, China from 2017 to 2019, Shewanella strains were detected in 26 subjects. The study found that all subjects (100%) experienced diarrhea, while 65.38% reported abdominal pain, and 38.46% had vomiting [11] Systemic symptoms including fever and hemodynamic instability, along with signs of sepsis can occur in more severe cases [1] In the case described, the patient exhibited lethargy, somnolence, abdominal pain, and anemia, which prompted further investigation and led to the diagnosis of enterocolitis. Notably, the patient was hemodynamically unstable with an acutely low hemoglobin of 5.6, leading to transfusion and hospitalization. Overnight, the patient developed fever, leukocytosis, and sepsis, resulting in further evaluation with colonoscopy which revealed a stercoral ulcer. The patient's gastrointestinal involvement displayed the intra-abdominal route of the disease. The systemic symptoms experienced, including lethargy, fever, hemodynamic instability, and sepsis, reflected the severe progression of the infection.

Next, further diagnosis of Shewanella infections is made by conducting routine laboratory methods such as Gram staining, oxidase, and catalase tests, along with biochemical assays. Isolated blood cultures should be acquired in the presence of fever or hemodynamic instability, which is common in individuals who are at higher risk of systemic infection [12] On nutrient agar, colonies would display light brown, round, and raised intact margins. Since most species of Shewanella tend to be non-fermentable and have the same phenotypic characteristics, they are not typically distinguished at the species level. Also, due to limited information on species in databases it is difficult to use clinical commercial analysis systems such as API 20E, API 20 NE, Vitek 2 GN card and matrix-assisted laser desorption/ionization time-of-flight mass spectrometry (MALDI-TOF MS) to do so [13] Shewanella putrefaciens and Shewanella algae both require an incubation period of 18-24 hours to allow optimal growth. Based on current knowledge, to differentiate species analysis like 16S rRNA sequencing, ribotyping, and whole-cell protein profiling can be used, beyond regular routine diagnostics. The gold standard for molecular species identification is whole-genome sequencing followed by digital DNA-DNA hybridization (dDDH) to determine specific species. This method ensures accurate identification, allowing for targeted treatment. Multilocus sequence analysis (MLSA) of protein-coding genes can be used as an even more advanced resort if further analysis is required [1]. In the described case, as the patient demonstrated

systemic symptoms and severe progression of the infection caused sepsis, microbiology samples were taken from the blood which were positive for Shewanella putrefaciens. Further differentiation testing was not needed to determine the species of Shewanella in our patient's case.

Treatment involves the use of appropriate antibiotics based on susceptibility testing in combination with local therapy. Susceptibility, or sensitivity testing involves exposing the isolated bacteria culture to various antibiotics to ascertain sensitivity and resistance by the bacteria. This testing aids in guiding clinicians towards selecting the most appropriate antibiotic therapy, thereby improving treatment outcomes and reducing the risk of antibiotic resistance development [1] Shewanella putrefaciens commonly exhibits resistance to penicillin, due to its expression of beta-lactamases, and cefazolin [1, 14] It has been reported that there have also been carbapenem-resistant strains, which is why the use of these antibiotics should be avoided. Susceptibility to many third- generation cephalosporins, piperacillin, ciprofloxacin, and gentamicin has been shown [9] Additionally susceptibility is shown to aminoglycosides, chloramphenicol, fluoroquinolones, and erythromycin. Less predictably it has shown susceptibility to ampicillin, tetracycline, trimethoprim-sulfamethoxazole. When discovered as a part of intra-abdominal infections, piperacillin-tazobactam can be used for initial therapy [14] Although, resistance has been reported with imipenem due to possible oxacillinase secretion and piperacillin-tazobactam [1, 14] In terms of empiric treatment for infections, IV treatment with fluoroquinolone or beta-lactam can be considered. Beta-lactam inhibitors should be considered when using beta-lactam due to potential beta-lactamase expression [1] Treatment courses typically last 10-14 days, depending on the severity of the infection and the patient's response to therapy. For infections involving systemic symptoms and/or leukocytosis or those involving immunocompromised patients, intravenous antibiotic therapy is recommended to be continued after discharge. In cases with localized infections, oral antibiotics may be sufficient with close follow up within 24 to 48 hours. Overall, it is crucial to monitor the patient closely and adjust the treatment plan based on clinical response and laboratory results [12]. In this case, once the patient developed fever and leukocytosis she was started on sepsis protocol and antibiotic coverage was done using piperacillin/tazobactam. The broad-spectrum antibiotics were then narrowed to ceftriaxone after sensitivity results indicated susceptibility. Once discharged, the patient continued intravenous ceftriaxone for a total of 14 days and returned with symptoms back to baseline.

The prognosis of Shewanella putrefaciens varies significantly based on its infection site and extent of spread. Additionally, poor-outcome is usually associated with patients with under-lying disease or those who are immunocompromised. In existing literature, the mortality rate associated with Shewanella infections ranges from 0 to 16% [6]. In the severe case of our patient who had advanced age and multiple pre-existing comorbidities, effects had progressed into the development of sepsis. However, the overall survival rate was increased once the course of antibiotic therapy was completed and symptoms returned back to baseline.

5. Conclusion

Shewanella putrefaciens, though rare, poses a significant challenge as a human pathogen due to its adaptability and potential severity, especially in individuals with compromised health. Our case of a stercoral ulcer in an elderly patient with multiple comorbidities highlights the unusual and severe manifestations that atypical pathogens can cause. Accurate identification, including distinguishing it from related species like Shewanella algae, is essential for effective diagnosis and treatment. Diagnosis relies on a thorough interpretation of clinical presentation, imaging studies, and microbiological analysis, underscoring the need for a multidisciplinary approach. Timely management with targeted antibiotic therapy, guided by susceptibility testing and considering resistant strains, can improve prognosis. This case underscores the importance of enhancing awareness of Shewanella putrefaciens infections and highlights the importance of prompt and accurate diagnostic and therapeutic strategies to improve patient care and outcomes.

6. Conflict of Interests

Authors declare no conflict of interests.

7. Financial Support Disclosure

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