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Primary *Shewanella algae* Bacteremia Mimicking *Vibrio* Septicemia

Shewanella algae infections are rare in humans. Previously reported cases of *S. algae* have mainly been associated with direct contact with seawater. We report a case of primary *S. algae* bacteremia occurring after the ingestion of raw seafood in a patient with liver cirrhosis that presented a fulminent course of necrotizing fasciitis.

Key Words : Shewanella algae; *Fasciitis, Necrotizing; Primary Bacteremia*

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INTRODUCTION

Shewanella algae rarely causes soft tissue and ear infections in humans (1). The skin and soft tissue infections caused by *Shewanella* spp. are commonly associated with chronic ulcers or infected burns of the lower extremities (2, 3). Skin ulcers have been reported to be colonized or infected with *Shewanella* spp., and skin ulcers are the port of entry for systemic infections (4). Only one case of primary *Shewanella* septicemia with skin and soft tissue manifestations (i.e., lower leg cellulitis) occurring after raw seafood ingestion has been described (5).

Because Korea is an endemic area for *Vibrio vulnificus* infections, primary septicemia with necrotizing fasciitis caused by this organism has been well described in patients who give a history of raw seafood ingestion and underlying hepatobiliary disease during the summer months (6). We report herein the first case of primary *S. algae* bacteremia with necrotizing fasciitis associated with raw seafood consumption which mimicked *V. vulnificus* septicemia.

CASE REPORT

A 58-yr-old man living in the southern area of Korea was admitted to the Chonnam National University Hospital complaining of painful swelling in both calves. The patient had a history of alcoholic liver cirrhosis. Two days prior to admission, the patient had eaten raw fish. He had neither history of trauma nor exposure to seawater.

On admission, both lower legs were erythematous and edematous, and hemorrhagic bullae were noted on the anterior aspect of the left lower leg. The patient's sclerae were icteric and the abdomen was distended. The patient's blood pressure was 100/40 mmHg, the temperature was 36.5℃, the pulse rate was 107 beats/min, and the respiration rate was 26/min.

Initial laboratory results were as follows: white blood cell count, 4,200/μL; hemoglobin, 8.8 g/μL; platelet count, 55,000/μL; prothrombin time, 24.9 sec with an INR of 2.22; partial thromboplastin time, 66.1 sec; total serum protein, 5.8 g/dL; albumin, 2.5 g/dL; aspartate aminotransferase, 168 U/L; alanine aminotransferase, 56 U/L; alkaline phosphatase, 56 U/L; total bilirubin, 14.9 mg/dL; blood urea nitrogen, 69.0 mg/dL; creatinine, 1.1 mg/dL; creatinine kinase, 750 U/L; lactate dehydrogenase 767 U/L; erythrocyte sedimentation rate, 43 mm/hr; and C-reactive protein, 17.4 mg/dL.

V. vulnificus septicemia was suspected based on the cutaneous manifestation of necrotizing fasciitis, the history of liver cirrhosis, and raw seafood consumption. Blood and a bulla aspirate were collected for bacteriologic cultures. The patient received 2,000 mg/day of intravenous ceftriaxone and 800 mg/day of ciprofloxacin, and fasciotomies were performed on the lower legs and dorsa of the feet. Despite treatment, erythematous swelling spread to the thigh and a second fasciotomy was performed on day 4 of hospitalization.

Cultures of blood, bulla aspirate, and tissue specimens obtained from the patient's calves yielded a gram-negative, non-

fermentative, oxidase-positive bacilli. The isolate showed mucoid colony with β-hemolysis on blood agar plate after 48 hr incubation and H_2S production on triple sugar iron agar. It was identified as *Shewanella putrefaciens* by the automatic identification systems using Vitek II (bioMerieux, Marcy-L'Etoile, France) and API 20NE (bioMerieux) with a probability of identification of 99.9%. Antimicrobial susceptibility testing with AST-N055 card (bioMerieux) showed susceptibility to all antibiotics except cefazolin. We performed a nucleic acid-based confirmatory test by using 16S rRNA gene sequencing analysis using the following primers: fD2 (5′-AGAGTTTGATCATGGCTCAG-3′) and rP2 (5′-ACGGCTACCTTGTTACGACTT-3′) (7). The isolate gene sequence showed 99% nucleotide similarities with the sequences of *S. algae* strain ATCC 51192 (Gen Bank accession no. AB205581). Therefore, the clinical isolate was ultimately identified as *S. algae*. Additional antimicrobial susceptibility test using disk diffusion method for the isolate showed susceptibility to colistin.

In spite of antibiotics and supportive care, bloody discharge from the fasciotomy sites persisted. On day 10 of hospitalization, massive hematochezia developed. Endoscopy showed esophageal and gastric varices with recent bleeding. On day 22 of hospitalization, the patient died with massive gastrointestinal bleeding and hepatic failure.

DISCUSSION

Numerous pathogenic bacteria exist in seawater and increase the risk of marine-acquired infections, including otitis media, wound infections, gastroenteritis, and miscellaneous tissue infections (8, 9). Such infections are usually associated with direct exposure to seawater or ingestion of raw or undercooked seafood. Among the marine-acquired infections, the epidemiology of *S. algae* infections is similar to infections involving marine bacteria, such as *Vibrio* and *Aeromonas*. *S. algae* can be isolated from seawater with water temperatures >13°C during the summer season (10). Primary septicemia with *Vibrio* and *Aeromonas* spp. mainly occur in patients who give a history of raw seafood ingestion and underlying hepatobiliary diseases (11). In the case presented herein, a history of raw seafood consumption in a patient with chronic liver disease and clinical manifestations of necrotizing fasciitis was consistent with *V. vulnificus* septicemia.

The most commonly described *Shewanella* infections involve the ears, skin, and soft tissues, with or without bacteremia (1, 12). Three syndromes of bacteremia with *Shewanella* spp. appear to exist as infections associated with the following clinical conditions: 1) prematurity and congenital pneumonia, 2) ulcerations of the lower extremities, and 3) an underlying disability, such as hepatobiliary disease or malignancy (13). Other atypical clinical presentations include bone and joint infections, meningitis, cerebellar abscesses, endocarditis, infected aortic aneurysms, and ocular infections. To our knowledge only 10 cases of *Shewanella* bacteremia in patients with hepatobiliary diseases have been previously reported, two in association with hepatobiliary infections, four in association with primary bacteremia without a recognizable source of infection, three in association with skin and soft tissue infections, and one in association with pneumonia (5). In total, 5 of 10 patients died of sepsis, multiorgan failure, or both. All 10 cases were reported as *S. putrefaciens* without differentiation from *S. algae*. Furthermore, as these organisms were isolated together with other bacteria in 5 cases, the pathogenic potential of *Shewanella* has been controversial. Among the 10 previously reported cases, only one patient with lower leg cellulitis had a history of raw seafood ingestion without any seawater exposure to the wound. This case of *S. algae* soft tissue infection is unique, in that it appears to be the fist reported instance of necrotizing fasciitis mimicking *V. vulnificus* septicemia, due to the ingestion of raw seafood in a patient with hepatobiliary diseases and identified the species by 16S rRNA gene sequencing analysis.

In the early 1990s, subgroup of *Shewanella* spp. was reclassified as a new species, *S. alga* on the basis of genomic and phenotypic studies (14, 15). When extensive phenotypic characterization is performed, a large number of reports of human infections allegedly reported by *S. putrefaciens* are caused by *S. algae* (16, 17). Because the automated identification systems only include *S. putrefaciens* in their databases, but not *S. algae*, they are unable to distinguish between *S. putrefaciens* and *S. algae*. However, *S. algae* occupies >80% of isolates from humans and is the more virulent species, as based on a murine pathogenicity study performed by Khashe and Janda (18). Therefore, optimal biochemical characterization to differentiate between the two species is needed. Important differential characteristics between the two species include the ability of *S. algae* to produce mucoid colonies with β-hemolysis on sheep blood agar, to grow at 42°C and in 6% NaCl, reduction of nitrite, and an inability to produce acid from maltose, all of which are in contrast to the characteristics of *S. putefaciens*. Additionally, *S. algae* is resistant to colistin, while *S. putefaciens* is susceptible. In this case, the isolate showed β-hemolysis on sheep blood agar after incubation for 48 hr and did not produce acid from maltose, findings consistent with *S. algae*. However, the isolate was susceptible to colistin and did not grow at 42°C and in 6% NaCl, findings consistent with *S. putrefaciens*. Therefore, we performed 16S rRNA gene sequencing analysis and identified the strain as *S. algae*.

The combination of a third-generation cephalosporin and tetracycline or fluoroquinolone is recommended in antimicrobial treatment of *V. vulnificus* septicemic patients (7, 19), whereas the combination of piperacillin with amikacin or gentamicin in *Shewanella* infection (13). The combination of ceftriaxone and ciprofloxacin was prescribed as empirical antibiotics for this patient because *Vibrio* septicemia was suspected based on clinical features. However, *Shewanella* spp. is usu-

ally sensitive to commonly used antibiotics that target gram-negative bacteria. Early recognition and aggressive surgical intervention is also critical to decrease mortality in necrotizing fasciitis (20).

This case highlights the notion that *S. alga*e infection should be considered in the differential diagnosis of necrotizing fasciitis in patients with a history of raw seafood ingestion, especially in geographic areas endemic with *V. vulnificus* infections.

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