Post-traumatic wound infection after diving caused by *Vibrio alginolyticus*: a case report

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Abstract

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Vibrio alginolyticus is a facultatively anaerobic, Gram-negative bacillus that is a common component of marine flora. Infections caused by *Vibrio alginolyticus* are rare and typically occur following exposure to seawater or marine animals. This report details the clinical presentation and follow-up of a 65-year-old immunocompetent male who developed a wound infection due to *Vibrio alginolyticus*. Advanced diagnostic tools, such as MALDI-TOF mass spectrometry, can enhance the identification of these bacteria. Sport clinicians need to recognise *Vibrio* infections in seawater-contaminated wounds, as infections may be serious and the therapeutic approach may differ from conventional treatments.

Introduction

Vibrio alginolyticus is a facultatively anaerobic, Gram-negative bacillus that is commonly found in marine flora. Infections caused by *V. alginolyticus* are rare and typically occur following exposure to seawater or marine animals. This report presents the clinical case and follow-up of a 65-year-old immunocompetent male with a wound infection caused by *V. alginolyticus*. Advanced diagnostic tools, such as MALDI-TOF mass spectrometry, can improve the identification of these bacteria. Doctors attending divers need to recognise *Vibrio* infections in seawater-contaminated wounds, as the therapeutic approach may differ from conventional treatments.[1]

Case report

The authors have obtained written informed consent from the patient to publish his case and related images.

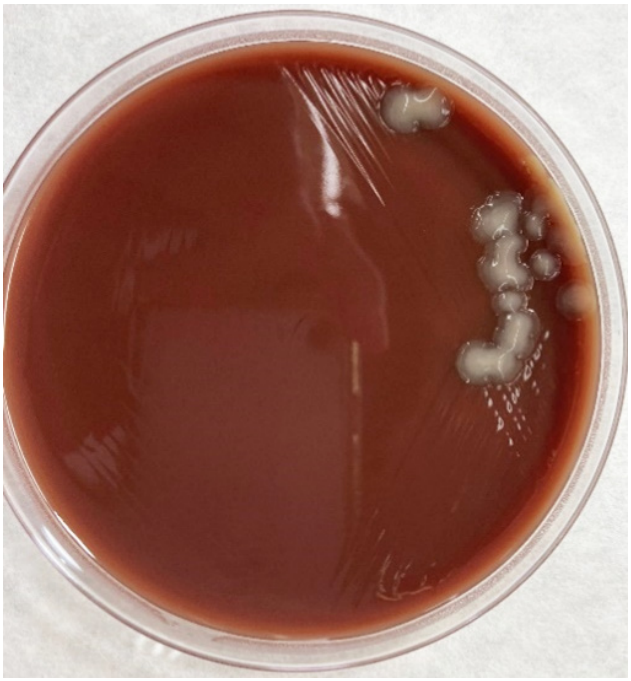
A 62-year-old healthy male was admitted to the emergency room with a 7 cm incised wound on the lateral edge of his left foot, caused by direct trauma from an scuba cylinder while diving. The wound was cleaned and sutured, and the patient was prescribed amoxicillin-clavulanic acid (875/125 mg orally, three times daily for 10 days). Five days later, the patient was hospitalised due to an infected wound dehiscence with purulent discharge (Figure 1).

Surgical cleaning and wound debridement were performed in the operating room, followed by intravenous piperacillin/tazobactam. Multiple samples were collected for culture on blood agar, chocolate agar, McConkey agar, and Columbia nalidixic acid agar incubated in a 5% CO_2 atmosphere, as well as Schaedler agar and selective anaerobic Schaedler Kanamycin-Vancomycin agar in an anaerobic environment. Few leukocytes were observed in the Gram stain, and no microorganisms were initially detected. However, after 18 hours of incubation, mucous and greyish colonies grew on the blood agar and chocolate agar plates (Figure 2), showing pleomorphic gram-negative bacilli on the Gram stain. These were identified as *V. alginolyticus* using matrix-assisted laser desorption ionization-time of flight (MALDI-TOF®, Bruker Daltonics) with a score of 2.32.

The antimicrobial susceptibility was assessed using microdilution (MicroScan®) and disc diffusion methods, interpreted according to Clinical and Laboratory Standards Institute criteria. The strain was sensitive to tetracyclines, trimethoprim-sulfamethoxazole, ciprofloxacin, meropenem, piperacillin-tazobactam, and cefotaxime. Antibiotic treatment was adjusted to doxycycline 100 mg every

Figure 1
Post-traumatic wound infection with pus leakage

Figure 2
Mucous and greyish colonies grew on the blood agar and chocolate agar plates identified as Vibrio alginolyticus



12 hours for 10 days. One month following the onset of symptoms, the patient had a well-healed scar with no evidence of infection and was able to start walking with progressive partial weight-bearing.

Discussion

V. alginolyticus is a halophilic, Gram-negative, motile, curved bacterium that belongs to the *Vibrionaceae* family. It is widespread in seawater globally.[2] Recently, global warming has led to increased marine temperatures, facilitating the spread of these pathogens to northern regions, particularly when water temperatures exceed 17°C.[3] Furthermore, *V. alginolyticus* is the most halophilic of all Vibrio species, capable of thriving in high saline concentrations. Its reservoirs include seawater and marine-origin food contaminated with seawater.

V. alginolyticus is one of the 12 Vibrio species known to cause human infections. It was first identified as a human pathogen in 1973 and has since been associated with wound and ear infections.[4] The incidence rate in the USA was only 0.048 per 100,000 people in 2011, but it increased significantly during the summer due to warmer seawater temperatures.[5] In Florida, between 1998 and 2007, *V. alginolyticus* accounted for 131 cases, nearly 20% of all vibriosis infections.[6] A recent multicenter French study reported that *V. alginolyticus* was responsible for 34% (23/67) of Vibrio-infected cases.[7]

Divers face an elevated risk of *V. alginolyticus* or *V. vulnificus* infections due to increased exposure to seawater, particularly in warm coastal areas. The risk is further compounded by the inadvertent ingestion of marine water during diving activities. Studies have quantified this exposure, revealing that occupational divers swallow an average of 9.8 mL of marine water per dive, while sport divers ingest slightly less at 9.0 mL per dive.[8] This consistent exposure to potentially contaminated water, combined with the possibility of skin abrasions or wounds during diving, creates a conducive environment for *V. vulnificus* infections, underscoring the importance of awareness and preventive measures among the diving community.

Some articles have highlighted the risk of infections caused by marine *Vibrio* species in individuals exposed to seawater, particularly in the context of diving or injuries. Tsakris et al. described a Greek diver who developed complicated suppurative otitis media caused by a marine halophilic *Vibrio* species.[9] The infection occurred after diving in seawater, highlighting the potential risk of marine bacteria in ear infections among divers. Lopes et al. presented a case of *V. alginolyticus* bacteraemia and probable sphenoiditis in a patient following a sea dive.[10] Finally, Opal and

Saxon reported an unusual intracranial infection caused by *Vibrio alginolyticus* following a head injury in salt water.[11] These cases underscore the potential for serious infections by marine *Vibrio* species among individuals exposed to seawater after traumatic injuries in aquatic environments.

Despite its relatively low virulence and inability to invade intact skin, *V. alginolyticus* possesses several virulent factors, including haemolysis, haemagglutination, and protease production.[12] These factors enable it to cause acute soft tissue infections, such as cellulitis, ulcers, abscesses, and necrotising fasciitis, through breaks in skin integrity like cuts or abrasions.

Vibrio infections typically exhibit a rapid progression, with symptoms often developing within 24 hours of exposure. These patients often experience systemic symptoms alongside the localised manifestations. Fever and chills are common, indicating the body's response to the infection. Skin infections typically exhibit severe cellulitis, intense swelling, and pain. As the infection advances, fluid-filled blisters or bullae may form, potentially becoming haemorrhagic. In severe cases, the condition can quickly progress to necrotic ulceration, gangrene, or even necrotising fasciitis, underscoring the aggressive nature of this pathogen.

The infection commonly affects the lower extremities, especially in cases of primary septicaemia. It may be localised to the site of a wound exposed to seawater or brackish water. Wound care and prompt medical attention are crucial for injuries in marine environments. The rapid progression and potential for severe complications emphasise the need for early recognition and aggressive treatment of *Vibrio* infections.

Most Vibrionaceae family members are susceptible to a wide range of antimicrobial agents. However, *V. parahaemolyticus* and *V. alginolyticus* may exhibit β-lactamase activity.[13] Common treatments for wound infections caused by *Vibrio* species include doxycycline combined with ceftazidime or a fluoroquinolone for 10–14 days. For expedition divers, several oral antibiotics are recommended to treat diving-related infections. Doxycycline is often considered the first-choice antimalarial agent for divers and can also prevent other infections such as leptospirosis and rickettsial infections. For treating impetigo and other superficial skin infections caused by *Staphylococcus aureus*, cephalexin or dicloxacillin are effective choices. Divers should always consult with a diving medical officer before using any medication and avoid diving while actively treating infections, waiting until symptoms have fully resolved before returning to diving activities.

The recently introduced MALDI-TOF diagnostic technique, which uses proteomic technology, represents a powerful tool for the rapid and accurate identification of *Vibrio* species and related bacteria.[14]

Conclusions

Vibrio species should be regarded as potential causative organisms in patients with non-healing wound infections associated with swimming or trauma in coastal areas. With marine temperatures increasing due to global warming, this consideration should be applied year-round, not just during the warmer seasons. Doctors attending divers need to be aware of and consider marine *Vibrio* species as possible causes of non-healing wound infections in this patient group.

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