

Vibrio vulnificus

William H Clevenger

268 Hidden Creek Drive

Advance, NC

27006

Clinical Laboratory Science, Junior Class

Winston-Salem State University

601 S Martin Luther King, Jr. Drive

Winston -Salem, NC

27110

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Introduction

Every summer a gram-negative bacterium makes headlines as it causes deaths in individuals who come in contact with it [1]. The bacteria is *Vibrio vulnificus*. *V. vulnificus* flourishes in warm coastal waters like the ones surrounding the southern part of the United States in the summer [2]. This bacteria can cause fever, chills, nausea and septic shock if consumed from raw seafood. [3]. The mortality rate of *V. vulnificus* has been above 50% making it the number one killer among foodborne disease agents [4]. If the bacteria comes in contact with wounds it can become severe and cause necrotizing fasciitis. Septicemia was the most reported cause of death from *V. vulnificus*. [5]. Modern medicine is available for people with *V. vulnificus* and patients can be given antibiotics orally or intravenously. Sometimes surgeries and amputations were performed after severe wound infections. One element, iron, is being further studied due to its pathogenesis in relation to *V. vulnificus* [6]. Iron-rich tissues have been found to increase the growth rate of *V. vulnificus* while more research is being conducted to understand the role of iron in *V. vulnificus*' pathogenesis. However, there are preventable measures against infections like avoiding brackish or salt water and properly preparing seafood [7]. *V. vulnificus* causes illnesses to tens of thousands of people every year just in the United States alone [8]. Though it is not as prevalent as other pathogens, *V. vulnificus* remains a threat to individuals in the summer and hurricane season.

Appearance and Biotypes

V. vulnificus is a gram-negative bacterium [4]. It is curved-shaped and is motile due to a polar flagellum it possesses. It is halophilic and anaerobic as it lives in areas without oxygen like the intestines [1]. Some genotypes do not contain the capsular polysaccharide making them less virulent. *V. vulnificus* strains have been put into three biotypes [1].

Biotype 1 has been the biotype of dominance, causing the infections to humans. Biotype 2 causes illness to eels [2]. Scientists have found strands in humans closely related to biotype 2.

Biotype 3 has been identified in Israel and only in Israel in wounds of fish farmers [9].

V. vulnificus is apart of the *Vibrio* genus [4]. It is in the Vibrionaceae family.

The Life Cycle of *V. vulnificus*

V. vulnificus comes from the oceanic waters. It combines itself to chitin through the use of a binding protein GbpA [8]. Once binded, *V. vulnificus* is consumed primarily by oysters. These oysters are consumed either undercooked or raw where it makes its way to the gastrointestinal tract of humans. Humans can also come in contact with the bacterium by exposure through wounds with contact of salty and/or brackish waters [6]. Storms, especially hurricanes can spread the bacterium to various parts of the country that normally do not see *V. vulnificus* exposures. During the warmer months, *V. vulnificus* flourishes among the organisms found in oceanic waters and spends its time in the sediment during the colder months of the year making it more prevalent in the summer.

Habitat of *V. vulnificus*

The majority of *V. vulnificus* cases have been linked to the Gulf of Mexico area [3]. The Gulf supplies oysters to the populations of the surrounding states and many other inland states during the warm summer months. However, *V. vulnificus* has been reported in other states as well. Reports have come from the far north such as the Chesapeake Bay and New England areas. Water samples were taken from the Chesapeake Bay area between the summer months and found that 80% of these samples were contaminated with *V. vulnificus*. The numbers of the bacteria ranged from 3.0×10^1 to 2.1×10^2 /ml of water. These numbers were comparable to the ones found in the Gulf of Mexico. *V. vulnificus* habitat has been primarily in the United States, but recent reports have come from other countries such as Holland, Belgium, Denmark, Germany and Sweden [2]. According to the Centers for Disease Control (CDC) and the Food and Drug Administration (FDA), 41,000 cases were reported on *V. vulnificus* every year in the United States.

Symptoms and Conditions Caused by *V. vulnificus*.

Although capable of infecting perfectly healthy individuals, *V. vulnificus* is prone to infect individuals with pre-existing liver diseases and hemochromatosis [5]. When pathogenic, through ingestion, *V. vulnificus* causes septicemia when present in the gastrointestinal tract [1,2]. The main symptoms of septicemia caused by *V. vulnificus* is fever, chills, nausea, hypotension and diarrhea. More times than not, septicemia will become fatal, in approximately 60% of cases . Another pathologic condition caused by *V. vulnificus* is

necrotizing fasciitis. Signs and symptoms of necrotizing fasciitis are localized pain around the infected area, edema and erythema. In severe cases of necrotizing fasciitis, doctors may have to perform surgical debridement and even perform amputations.

Diagnosis of *V. vulnificus*

Laboratory results of a person with *V. vulnificus* would have markers indicating severe bacterial infections like procalcitonin and lactate. Their white blood cell count would have a left shift and they would also exhibit increased creatine kinase levels with *V. vulnificus* infections [4]. Medical personnel can examine blood, stool or wounds to find the bacteria present. Cultures and gram stains should be routinely performed [7]. For cultures, thiosulfate citrate bile salts sucrose agar should be used to isolate *V. vulnificus* from other bacteria.

Doxycycline as Primary Treatment

Antibiotics are the treatment of choice for bacterial infections. Doxycycline has been regarded as the primary antibiotic treatment for *V. vulnificus* [4]. One hundred mg should be administered intravenously. Optionally, Vibramycin may be taken orally twice a day. Infection from *V. vulnificus* spreads extremely fast and can still be fatal even with the use of antibiotics. Supportive care along with doxycycline can reduce the chance of death.

Case Study

A case study on a man who could have benefitted from doxycycline follows. An

elderly man, 67, contracted *V. vulnificus* in Maryland. The patient had a cut on his leg when he ventured into the salty, warm water of the bay near his house. This is when and where he was exposed to *V. vulnificus*. Because he had a cut on his leg, the bacteria were able to enter into his bloodstream via the wound. Soon after, he began to feel intense pain around this area of his leg. He was immediately taken to the hospital where the patient received surgical debridement to repair the lesions on his leg. Eventually though, doctors were forced to amputate his leg due to the virulent bacteria. He was not given doxycycline and after four days in the hospital, the patient passed away due to the severe infection caused by *V. vulnificus*.

Iron Metabolism Linked to *V. vulnificus*

As previously mentioned, individuals with immunocompromised bodies and whom are elderly are more likely to contract *V. vulnificus*. Scientists have been able to find another link to infections of *V. vulnificus* through iron metabolism [5]. Individuals who had higher concentrations of iron in their bodies had significantly worse infections from *V. vulnificus* than those who had lower concentrations. In patients with hemochromatosis, septicemia was 100% fatal due to their iron-rich tissues. *V. vulnificus* has killed more men than women, especially men ages 50 or older [2]. A woman's menstrual cycles could play a role in keeping women's iron levels down. This correlation helps back up the the link between iron metabolism, and the severity of infections in the two sexes. Scientists were able to perform experiments on mice with the bacteria. They found that the mice injected with iron had an increased death rate of 50%.

Discussion

V. vulnificus has been overlooked by many as the primary cause of foodborne related deaths in the United States [4]. This virulent bacterium has also begun to present itself in northern European countries so the United States is no longer the only location of *V. vulnificus*. *V. vulnificus* is capable of producing rapid fatal infections after ingestion or contamination of a wound [2]. Individuals need to properly handle and cook all seafood and make sure wounds are concealed from contamination from coastal waters. Those with liver diseases and other immunocompromising diseases should stay away from coastal waters [6]. *V. vulnificus* needs to be treated immediately as over 50% of infections are fatal [7].

References

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