The Risk of Deadly *Vibrio* Infection in Gastroenterology Patients

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Although an average of only 95 *Vibrio vulnificus* infections are reported each year in the U.S., this naturally occurring marine bacterium is remarkable because of its 50% fatality rate in foodborne cases. Immunocompromised patients and those with gastroenterology diseases or disorders are at high-risk for serious infection if they consume raw or undercooked molluscan shellfish (primarily oysters) or expose open wounds or sores to seawater. While successful treatment of infections depends on prompt administration of appropriate antibiotics, a delay in seeking medical care and/or accurate diagnosis can greatly increase the risk of death. Medical professionals can help prevent infections by advising their high-risk patients to eat thoroughly cooked seafood, abstain from eating raw shellfish, and protect themselves from wound exposure. Free educational resources for medical professionals and patients are available to facilitate prevention efforts.

INTRODUCTION

Vibrio bacteria naturally occur in marine environments worldwide and are not the result of pollution. At least 12 species are human pathogens. Toxigenic *Vibrio cholerae* is probably the most well known specie worldwide, because it is endemic in regions with poor sanitation and inadequate treatment of sewage and drinking water. It can cause an acute epidemic infection known as cholera which is characterized by severe diarrhea. Without medical treatment, cholera can result in sudden dehydration and death. The Centers for Disease Control and Prevention (CDC) reported only eight cases of toxigenic *V. cholerae* illness in the United States during 2004, nine cases in 2005, and eleven in 2006; half resulted from travel in foreign countries (the Philippines, Thailand, India, Bangladesh, Morocco, and Pakistan) (1). Non-toxigenic *V. cholerae* (does not produce cholera toxin) is more common in the U.S. and causes less severe diarrhea than cholera.

Combining the annual numbers of human *Vibrio* isolates reported to CDC from 1997–2006, there were a total of 4,649 *Vibrio* cases in the United States (1). The percent of cases by specie were: 46% *V. parahaemolyticus*; 19% *V. vulnificus*; 10% non-toxigenic *V. cholerae*; 9% *V. alginolyticus*; 5% *V. fluvialis*; 2% each *V. hollisae* and *V. mimicus*; and 1% each *V. damsela* and toxigenic *V. cholerae* (serogroups O1, O75, O141). Additionally, 1% of cases were caused by other *Vibrio* species, 1% involved multiple species, and in 3% of cases, the specie was unknown (Figure 1). Since noncholera vibriosis was

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not a nationally notifiable illness until January 2007, the actual number of *Vibrio* cases from 1997 to 2006 was probably higher than the number reported.

Because mature bivalve molluscan shellfish (oysters, clams, mussels) are stationary in the marine environment and cannot move around to obtain food, they filter out nutrients from seawater. They may also filter out and accumulate *Vibrio* bacteria, which do not harm them. Oysters have been shown to accumulate *V. vulnificus* bacteria by up to 100 times the level found in seawater (2).

Vibrio infection (vibriosis) usually occurs in two primary ways: 1) consuming raw or undercooked shellfish, especially oysters, and/or 2) exposing wounds or sores to seawater or raw seafood juices. Wound infections can occur when a previously existing wound or sore is exposed to seawater during swimming, beach walking, fishing, or handling raw seafood or when a wound is obtained during a marine or seafood-related activity. Sometimes both modes of infection occur together, such as during a recreational trip to the coast when raw shellfish is consumed.

Although *V. vulnificus* does not cause the highest number of vibrioses in the United States, it is remarkable because it causes the highest mortality of all *Vibrio* species. Therefore, in this article, we will focus on *V. vulnificus* infection and how to prevent it in gastroenterology and other high-risk patients.

PREVALENCE, MORTALITY, AND SEASONALITY OF *V. VULNIFICUS* INFECTIONS

Nine hundred fifty-one *V. vulnificus* cases were reported to the CDC during 1997–2006 (95/year average). Fifty-five percent of these illnesses were of foodborne origin (raw or undercooked seafood) and 45% had a nonfoodborne cause, such as exposure to marine environment (3). However, because many illnesses may be under reported, it is estimated that actual *V. vulnificus* foodborne cases may be two times the number reported (4).

Although *V. vulnificus* infection is relatively uncommon compared to other bacterial infections, its high mortality rates are alarming. Mortality of foodborne infections is approximately 50% and as high as 67% in patients with liver disease (5, 6). Nonfoodborne or wound infection mortality has been reported to range from 17%–24% (3).

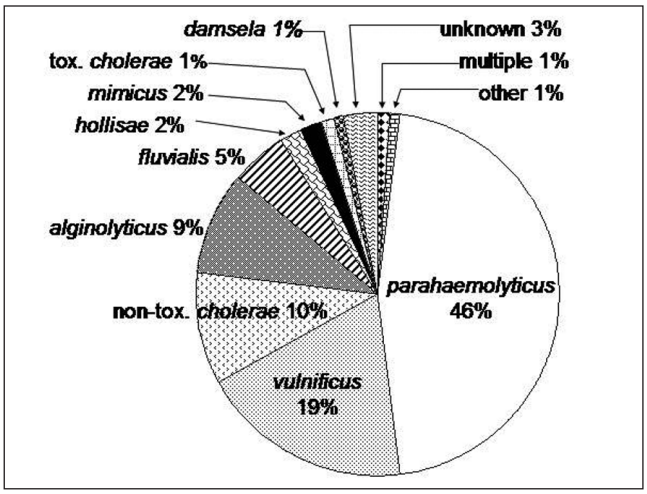

Figure 1. U.S. *Vibrio* infections by species reported to CDC, 1997–2007 (*n* = 4,649)

V. vulnificus bacteria have been detected worldwide and in all U.S. coastal waters. However, because they thrive in warm, low salinity seawater, the highest concentrations in the U.S. are found in coastal waters of the Gulf of Mexico. Consequently, Gulf coast states usually report the most cases. Of the 312 *V. vulnificus* cases reported to the CDC from 2004–2006, 63% were reported by Gulf coast states and 37% were reported by non-Gulf states (1). Infections from molluscan shellfish consumption follow a seasonal trend coinciding with warm temperatures; cases dramatically increase in April, peak in August, slowly decline during fall, and markedly drop in December. Infections still occur in winter months, but are far fewer in numbers. The seasonality of nonfoodborne *Vibrio* infections shows the same trend (3).

PATIENTS AT RISK FOR SERIOUS *V. VULNIFICUS* INFECTION

Anyone who consumes raw molluscan shellfish or is exposed to a marine environment is at risk for *V. vulnificus* infection. However, healthy patients usually don't become infected; if they do, they may experience gastroenteritis which rarely requires hospitalization or develop cellulitis from wound infections.

However, *V. vulnificus* can cause potentially fatal septicemia in patients with liver disease (including hepatitis, cirrhosis, and liver cancer). In one Florida study, people with liver disease who ate raw oysters

(continued on page 40)

A SPECIAL ARTICLE

(continued from page 38)

Table 1
Diseases/health conditions that increase risk and severity of *Vibrio vulnificus* infection (7–9)

- Liver disease (includes hepatitis, cirrhosis, liver cancer)
- Diabetes
- Stomach disorders/surgery
- Taking prescribed drugs to reduce gastric acid
- Cancer (includes lymphoma, leukemia, Hodgkin's disease)
- Chronic alcohol abuse
- Kidney disease
- Hemochromatosis (iron overload)
- AIDS/HIV
- Other immunosuppressive disorders or treatments, i.e. chemotherapy, long-term steroid use, etc.

were 80 times more likely to become ill and 200 times more likely to die compared to the illness/death rate for people without liver disease (6). The case-fatality rate was 67% for people with liver disease and 38% for those without liver disease.

Other diseases or conditions that predispose patients to *V. vulnificus* septicemia include diabetes; cancer (including lymphoma, leukemia, Hodgkin's disease); alcoholism; kidney disease; iron overload (hemochromatosis); and/or AIDS (7–9). In addition, patients who take prescribed antacids and/or have had gastric surgery are also at high-risk for serious infection (Table 1).

DIAGNOSIS AND TREATMENT

High-risk patients who develop *V. vulnificus* infection are usually treated in hospital emergency rooms because of the rapid advancement in severity of symptoms. The incubation period for consumption-related illness is usually one to seven days (10). Nausea, vomiting, abdominal cramps, diarrhea, and fever are common symptoms. Septicemia may develop, especially in patients with liver disease, and in more than 70% of these cases, patients develop bulleous skin lesions (5) sometimes filled with blood, that erode into necrotic ulcers. Wound infections may begin with redness and swelling around the site and may also produce bullae and septicemia, although this is less common than in consumption cases. Septic shock may result in quick death.

V. vulnificus may be identified from routine wound, stool, or blood cultures. However, laboratory personnel should be notified when *V. vulnificus* infection is suspected, because the bacteria are difficult to isolate without the special growth medium thiosulfate-citrate-bile salts-sucrose (TCBS) agar.

Effective treatment includes immediate administration of antibiotics. Doxycycline in conjunction with a third-generation cephalosporin such as ceftazidime is recommended (10). Aggressive supportive care may be warranted for high-risk patients. Necrotic tissue should be surgically debrided and limb amputation may be necessary (11).

EDUCATION AND PREVENTION

Since *V. vulnificus* infection has a high mortality rate in immunocompromised patients, educating them about how to avoid infection is imperative. Prevention strategies include abstaining from eating raw or undercooked oysters, clams, or mussels. Thorough cooking of shellfish kills pathogenic bacteria. To prevent wound infections, patients should avoid exposing open wounds or sores to seawater and raw seafood juices. Immediate medical treatment should be sought if patients develop symptoms of either a consumption or wound infection.

Although *V. vulnificus* bacteria exist in high concentrations in the Gulf of Mexico from April through October, these bacteria have been detected in all U.S. coastal waters, as well as in several other parts of the world. High-risk patients should be warned to not eat raw shellfish no matter where they live or travel.

Several free educational resources have been developed to help both patients and their health care providers learn about this subject. The website SafeOysters.org provides *V. vulnificus* infection information for health care professionals, consumers, fishermen, food and health educators, as well as the seafood industry. Information for consumers and fishermen is translated into Spanish and Vietnamese. Topics for medical professionals include public health impact, modes of infection, high-risk patients, prevention, symptoms, diagnosis, and treatment. A resources section lists numerous education tools.

The Interstate Shellfish Sanitation Conference (ISSC; *issc@issc.org;* 800-416-4772) has also developed several education tools that are currently available free to health care professionals. Printed publications include patient education brochures in English and

(continued on page 43)

A SPECIAL ARTICLE

(continued from page 40)

Spanish; a fact sheet for health care professionals; and published *V. vulnificus* reference materials. Free online courses for continuing education credit are also available for physicians, nurses, and dietitians, but are currently being recertified and should be operational soon (contact ISSC for access information). Table 2 summarizes various education resources on the Internet.

OYSTER INDUSTRY EFFORTS

As microbiologists and food science researchers discover new facts about *Vibrio* bacteria, the Gulf coast seafood industry uses this information to improve oyster safety. Because these bacteria cannot be removed from marine waters and increase with rising temperatures, oysters are cooled to ≤45°F as quickly as possible after they are harvested during warm weather months. Some U.S. coastal states may even restrict or prevent commercial oyster harvesting during warm weather.

Several common food processing technologies are utilized to improve safety of raw Gulf oysters after they are harvested. Technologies in current commercial use include individual quick freezing, high-pressure processing, and low-heat pasteurization (12). Oysters processed using these technologies can be marketed using the phrase, "processed to reduce *Vibrio* to non-detectable levels." However, since these oysters are still raw and could contain other pathogens, they should be thoroughly cooked before being eaten by high-risk patients.

Table 2
***Vibrio vulnificus* education resources for health care professionals**

WEBSITES

University of Georgia Marine Extension Service
www.SafeOysters.org

American Medical Association
www.ama-assn.org/ama/pub/category/13760.html

Food & Drug Administration
www.cfsan.fda.gov/~mow/chap10.html

Centers for Disease Control and Prevention
www.cdc.gov/nczved/dfbmd/disease_listing/vibriov_gi.html#

Interstate Shellfish Sanitation Conference (ISSC)
www.issc.org/Education/VibrioVulnificus.aspx

ONLINE CONTINUING EDUCATION COURSES

Sponsored by the ISSC and currently undergoing recertification. Please phone 800-416-4772 or e-mail ISSC at *issc@issc.org* for further information.

Physicians – 1 free CME, Nurses – 1 free CEU
Dietitians – 1 free CPEU

CONCLUSION

Although *V. vulnificus* consumption-related illness cases have a high mortality rate, they are fairly rare in occurrence (52 cases/year reported in U.S.). Informing high-risk gastroenterology patients about their risk of infection and encouraging them to eat thoroughly cooked oysters, clams, and mussels is an easy and economical prevention strategy. Health care providers should also document that they discussed this topic with their high-risk patients who consume raw shellfish. ■

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