

# Hyperbaric Oxygen as adjunctive therapy in *Vibrio vulnificus* septicemia and cellulitis.

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## BACKGROUND

One of the most common bacteria in tropical to subtropical seawater, *Vibrio vulnificus* is an invasive, gram-negative bacillus and recognized as a cause of fulminant primary septicemia, wound infections and gastrointestinal disorders<sup>1</sup>. In the United States, it is found predominantly along the coastlines of those states that border the Gulf of Mexico, but has also been isolated from areas in New England and the northern Pacific Coast<sup>2</sup>. *Vibrio vulnificus* infections can occur in patients with underlying liver disease, who have acquired the organism through the

gastrointestinal tract after recent consumption of raw shellfish, or through inoculation of bacterium through contamination of a wound with seawater.

**Table 1. Laboratory Values on Admission**

Variable	Value
White blood cell count (/μl)	3.3
Differential count (%)	
Granulocytes	79.8
Lymphotes	16.3
Monocytes	3.0
Esinophils	0.3
Platelets	101
Na	143
K	4.6
CL	104
CO2	25
BUN (mg/dl)	23
Glucose (mg/dl)	102
<b>Liver Function Test</b>	
Total protein (g/l)	6.3
Albumin (g/l)	3.3
Total Bilirubin (mg/dl)	0.6
ALK (U/l)	39
ALT (U/l)	65
AST (U/l)	60
GGT (U/l)	200
LDH (U/l)	605
CK (U/l)	300

## CASE REPORT

A 69 year-old male with alcoholic liver disease presented to the University of Texas' Medical Branch Hospital with a day-old fever, chills, and intense pain in his right arm. He had prepared raw fish for dinner one day prior to admission. In the next few hours, extensive erythema, multiple blisters, and bullous lesions developed over the right shoulder, forearm and right hand. He subsequently became hypotensive, with diminishing mental status. The results of laboratory studies upon his admission are shown in Table 1. *Vibrio vulnificus* infection was suspected. The patient was started with ceftazidime, levofloxacin, and doxycycline intravenously and closely followed by a surgical team. The patient continued to exhibit a spiking fever despite being administered three intravenous antibiotics. Two areas of the skin and subcutaneous tissue in the right arm and hand became progressively necrotic. An x-ray of the arm showed no subcutaneous gas

or osteomyelitis changes. *V. vulnificus* was identified from the blood culture and necrotic wounds in his arm and hand. In consideration of the positive effects of hyperbaric oxygen (HBO<sub>2</sub>) on treatment of severe infections, it was initiated on hospital day three, with a daily exposure for a total of twenty sessions. The patient's blood pressure and temperature became normal; he eventually recovered fully and his ulcers were healed completely and without the need of grafting.

## DISCUSSION

The clinical features of *Vibrio vulnificus* infections are shown in Table 2. The severity of *V. vulnificus* infections is related to both hosts and bacterial factors shown in Table 3.

<b>Table 2. Clinical features of <i>Vibrio vulnificus</i> infections</b>	
Septicemia	
	Shock
	DIC
	Endocarditis
Wound Infection	
	Necrotizing fasciitis
	Compartment syndrome
<b>Cellulitis</b>	
Gastrointestinal Illness	

<b>Table 3. Predisposition conditions and risk factors of <i>Vibrio vulnificus</i> infections</b>	
<b>Host</b>	<b>Associated Conditions</b>
Liver Cirrhosis	Consuming raw sea food
Alcohol Abuse	Contact sea water
Hemochromatosis	
Sideroblastic Anemia	
Iron overload	
Chronic renal insufficiency	
Cancer Immunodeficiency	

The invasiveness of the *V. vulnificus* is associated with the presence of the polysaccharide capsule and cytotoxin. The production of protease, lipase, cytolysin, hemolysin, hyaluronidase, mucinase, DNase, bradykinin, sulfatase, and tumor necrosis factor was implicated as contributing to the virulence of *V. vulnificus*<sup>3</sup>. The pathogenicity of *V. vulnificus* is due, in part, to its ability to cause transmural vasculitis in subcutaneous tissue. Thrombosis of the blood vessels may play an important role in the necrotizing process, which is characterized by fevers, chills, and bullous skin lesions. *V. vulnificus* septicemia is associated with a mortality greater than 50%; with septic shock the mortality approaches 100%. Patients with underlying chronic illnesses, such as cirrhosis or immunosuppression, have been noted to be at high risk for the rapid progression of this infection<sup>4</sup>. The early microbiologic diagnosis and a combined therapeutic approach, including aggressive antibiotics and hyperbaric oxygen therapy, may have contributed to the successful management of this patient.

Oxygen tensions play an important role in the outcome of infections. Hyperbaric oxygen exerts antimicrobial effects by increasing the intracellular flux of reactive oxygen species. Hyperbaric oxygen also potentiates the activity of many antimicrobial drugs by increasing the transportation or direct synergistic effects. With regard to host defenses, hyperbaric oxygen therapy augments tissue oxygen partial pressure, allowing increased bacterial killing by providing a substrate for the formation of oxygen-free radicals and augmenting respiratory burst. During the healing process, hyperbaric oxygen increases the formation of capillaries for oxygen, nutrients, and antibiotic delivery, leading to more rapid overall wound healing<sup>5,6</sup>.

## REFERENCES

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