Cholera

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Name Common Name: Cholera Etiologic agent: *Vibrio cholerae* (1)

Transmission *Vibrio cholerae* is transmitted by the fecal-oral route by infection of epithelial cells in the small intestine (1). Diarrhea from patients infected with cholera contains large amounts of viable and infectious *Vibrio cholerae* bacteria, which can infect others if ingested in the form of contaminated drinking water or food (5).

Reservoirs Infected humans are the natural reservoir for *V. cholerae* (1).

General Characteristics *V. cholerae* is a comma-shaped, gram-negative rod with a single flagellum (1). There are two common serotypes known for causing epidemic cholera: *V. cholerae* serogroup O1, the classic form of cholera and *V. cholerae* serogroup O139, which was discovered in 1992 after it emerged in epidemic proportions in India and Bangladesh (1).

Key Tests for identification The genus *Vibrio* are facultatively anaerobic, asporogenous, motile, comma-shaped, gram-negative rod bacterium (9). They are also sensitive to acidic conditions below a pH of 6, but more tolerant of alkaline conditions (1). Most members of the *Vibrio* genus are oxidase positive and nitrate-reducing (9). While 12 of the 30 species of the *Vibrio* genus are pathogenic, only *V. cholerae* is associated with epidemic cholera (1). The gold-standard test for *V. cholerae* requires only one test: the serologic confirmational test of the O1 or O139 serotype antigens. This test is confirmed by isolate agglutination with antisera raised against either the O1 or O139 antigen (9). Serotype O139 is distinguished from serotype O1 by absence of agglutination with O1 specific antiserum, agglutination with O139 specific antiserum, and the presence of a capsule.

While this is the gold standard test, alternative methods are also popular for diagnosing cases of cholera in areas with limited access to laboratory set-ups, such as after a natural disaster or in rural areas. The Crystal VC dipstick rapid
test is a simple and easy diagnostic test that can be used to alert health officials to cholera outbreaks (5). This test works as a one-step immunochromatographic test that detects cholera antigens in human fecal samples (8). The effectiveness of this kind of test is still being debated, tested, and improved upon.

Signs and Symptoms

*Vibrio cholerae* infections are characterized as an acute, diarrheal illness (5). Severe cholera symptoms are characterized by profuse watery diarrhea, vomiting, rapid heart rate, dry mucous membranes, decreased blood pressure, thirst, muscle cramps, dehydration, and loss of skin elasticity (5). In hospitalized patients, this can result in losses of up to 20 liters or more fluid per day (1). If left untreated, this severe dehydration could lead to acute renal failure, electrolyte imbalances, coma, shock, and even death within hours (5).

Virulence Mechanisms The cholera toxin is a enterotoxin (1), affecting cells in the alimentary canal, in the

AB -subunit toxin family. The toxin’s B region binds with the glycolipid GM1 receptor on the host cell surface (3). The A region of the toxin is inserted into the host, where it migrates from the endosome, to the golgi, ending in the ER (2, 4) where it permanently activates adenylate cyclase, an enzyme that plays a key regulatory role in cell signaling, and subsequently turning adenylate cyclase into a permanent “on” state. This causes excessive production of cyclic adenosine 5’-monophosphate, or cyclic AMP (1). This excess of cyclic AMP causes a cascade of cell signaling that eventually leads to the purge of chloride, bicarbonate, and water from the host cell into the intestinal lumen, thus causing dehydration, vomiting, and diarrhea. (1).

Control & Treatment The World Health Organization suggests a number of control measures to improve cholera outbreaks in susceptible communities. This includes improved access to clean water, effective sanitation of water, proper waste disposal and management, improving general hygiene standards and food practices, specific training for case management and healthcare professionals, sufficient medical supplies, and proper and timely response to cholera outbreaks (7). Cholera is a disease essentially associated with poor sanitation, and arguably the most
important step in eradicating it lies in improving community sanitation, hygiene, and access to clean water (1).

Fortunately, most infected persons will present with mild diarrhea or no symptoms at all. But approximately 5-10% of the infected persons will require treatment at a health center (5). Luckily, with treatment, the mortality rate can be reduced below 1% of all patients (7). Rehydration therapy with oral rehydration salts, intravenous fluids, and electrolytes is the gold standard rehabilitation practice for cholera patients.

Additionally antibiotic treatment for severely ill and hospitalized patients as well as zinc supplementation for children below five years of age have been demonstrated to help aid in the success of recovery from cholera infections (5).

Prevention and Vaccinations The field of prevention and vaccination against *V. cholerae* is severely lacking. There are a number of cholera vaccines available, usually in the form of whole-killed bacteria and cholera toxin B-subunit proteins in parenteral and oral vaccines. However they do not instill life long immunity, and both the CDC and WHO do not recommend the use of parenteral or oral cholera vaccines due to the incomplete protection they offer, the short duration of this protection, and the high occurrence of severe adverse reactions (5,7).

But in September 2015, a paper was published examining the effectiveness of the a new cholera treatment. This *in vitro* study generated peptides that mimicked the cholera toxin B-subunit receptor - the ganglioside receptor GM1. The presence of this peptide works as a non-competitive inhibitor by binding to cholera toxin B-subunit, and thus successfully preventing the cholera toxin from binding and infecting the human intestinal GM1 gangliosides (6).

Historical information *V. cholerae* was first isolated by the german microbiologist Robert Koch in 1883 (1).

Research suggests that the original cholera reservoir comes from the Ganges delta in India, and that cholera was spread across the world from this reservoir in mid 19th century (11). Since this time, there have been seven major pandemics killing millions of people internationally. The seventh and most current pandemic reached Africa in 1971 and the Americas in 1991 (11). It is commonly endemic in areas with poor sanitation such as parts of Africa, Asia, and Haiti, and may even
occur sporadically in developed countries due to exposure in labs or international travel (1). People who face the highest risk of cholera live in areas with poor sanitation, lack basic infrastructure and medical supplies, and have little to no access to clean water.

Global cases or outbreaks (incidence figures) The World Health Organization estimates that the global incidence rate of cholera ranges between 1.4 to 4.3 million new cases per year. The mortality rate also ranges between 28,000 to 142,000 deaths per year worldwide (11). In 2012, there were a total of 48 countries that reported cases of cholera to the WHO, with a total of 245,393 cases reported globally. The mortality rate in 2012 was reported as 3,034 deaths, or 1.2% of the total cases. Of the 48 countries that reported cholera cases, 27 were countries from the African continent, 12 from Asia, 6 countries from the Americas, 2 from Europe, and 1 from Australia (12).

Local cases (incidence figures) Cholera is not endemic to the United States, but still occurs sporadically in coastal southern states. In 2012, there were 22 reported cases of cholera infection in the United States. Of the 22 cases, seventeen cases (77%) were travel-associated - 10 of the patients traveled to Haiti, 3 to the Dominican Republic, 1 from India, 1 from Bangladesh, 1 from the Philippines, and 1 from Pakistan (10).

Of these domestic patients, 2 of the patients were treated in Texas. One of these patients reported acquiring cholera internationally, while the other had not traveled internationally and was thought to have been exposed to cholera after swimming in the Guadalupe River (10).

Work Cited


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