Cryptosporidiosis in humans

Cryptosporidiosis in Humans General Microbiology Cryptosporidiosis is a gastrointestinal disease caused by pathogens of the Cryptosporidium genus. In 1907, parasitologist Ernest Edward Tyzzer made observations on the genus and concluded that Cryptosporidium are intracellular protozoan parasites. The genus was named due to its absence of sporocytes within the oocytes, and of 16 species, C. parvum and C. hominis are the more important pathogens in humans (Tzipori 2008).

Because Cryptosporidium oocytes are resistant to commercial disinfectants and microbial drugs, several precautions are to be taken in water sources over the world. Cryptosporidiosis in immunocompetent people causes short-term diarrheal illness, while in immuno-deficient patients, such as those with AIDS, the disease causes cholera-like illness and often death (Current 1991). According to a case-control study, it was found that the largest reservoir of C. parvum is in animals, and the largest reservoir of C.

hominis is humans. C. hominis is acquired through direct or indirect contact with other infected humans. Cryptosporidiosis caused by C. hominis is highest in children ages 0-4 and can be transmitted through toilet contact even when symptoms are not present. Also, urban areas and areas with higher socioeconomic status individuals are at higher risk for C. hominis.

This species is more prevalent in urban areas due to more person-to-person contact, day care centers, nursing homes and swimming pools. C. parvum is found in livestock and is transmitted directly or indirectly to humans. This species is usually transmitted through fecal contaminated drinking water and in rural areas where there is a higher probability of animal contact.

(Lake 2007) Cryptosporidium exists in the environment as a 5-? µm-diameter oocyte containing four sporozoites (Clark 1999). The life cycle of C. parvum can be divided into six developmental events: excystation, merogony, gametony, fertilization, oocyst wall formation, and sporogony (Current 1991).

When ingested, the oocytes travel through the gut lumen to the small intestine. There, the oocytes rupture, releasing the sporozoites which then adhere to and invade the epithelial lining of the gastrointestinal tract. Cryptosporidium disrupts the microvilli that cover the host cell and encloses itself in the host cell membrane. There, the parasite establishes an intracellular niche in which the parasite and the surrounding parasitophosphorus vacuole bulge into the gut lumen and are separated from the host cell cytoplasm (Clark 1999). The parasite then replicates into eight merozoites that rupture out of the host cell and infect other host cells. The merozoites differentiate to sexually reproduce in order to regenerate oocytes which are then excreted in the feces. (Clark 1999) In both immunocompetent and immunocompromised people, diarrhea is the symptom that often leads to diagnosis since oocytes are found in stool samples.

Usually in immunocompetent people with cryptosporidiosis, the diarrhea is abundant and watery, and also usually associated with weight loss. Other symptoms include abdominal pain, nausea and vomiting, and a low-grade fever. In most healthy, well-nourished individuals, diarrhea caused by C. parvum lasts from about 3 to 12 days. In poorly nourished children, oral and intravenous rehydration is often required due to excessive fluid loss. In infants with cryptosporidiosis, malnutrition often contributes to increased

length in diarrhea, hospitalization, and even death. (Current 1991) However, in immunocompromised individuals, such as those with AIDS, the symptoms are more severe and can involve organ systems other than the gastrointestinal tract (Clark 1999).

In individuals with intestinal cryptosporidiosis, diarrhea becomes progressively worse over time and is often a cause of death due to excessive fluid loss (Current 1991). There are four clinical categories of AIDS-related cryptosporidiosis: a cholera-like illness, a chronic diarrheal illness, an intermittent diarrheal illness, and a transient diarrheal illness (Clark 1999). Other systems affected by C. parvum include respiratory cryptosporidium, gallbladder and biliary tree cryptosporidium, and pancreatic duct cryptosporidium (Current 1991). There are several suggestions to why this parasite causes diarrhea in the host. The process of intestinal absorption can be impaired or the secretion can be enhanced through the regulation of the intestinal epithelial cells that are infected by Cryptosporidium. Some studies suggest that Cryptosporidium induces programmed cell death in the biliary epithelial cells.

Other studies suggest that Cryptosporidium infection results in the release of cytoplasmic lactate dehydrogenase, which also results in cell death. (Current 1991) Cryptosporidium is resistant to antimicrobial drugs and to most common disinfectants. Studies found that about 20% of the oocytes of C. parvum within host cells do not form a thick, environmentally resistant cell wall and that the four sporozoites at this stage are surrounded by a single membrane. The oocytes that are passed into the feces have thick, environmentally resistant cell walls, and are the life cycle forms that transmit

the infection (Current 1991). As long as the thick two-layered wall remains intact in cold and moist environments, the parasite is resistant to commercial disinfectants. Some researchers believe that when Cryptosporidium establishes a niche within the host cell, the parasitophosphorus vacuole created somehow shelters the parasite from microbial drugs (Clark 1999). Although Cryptosporidium is resistant to most antimicrobial drugs, cryptosporidiosis is not usually a concern with immunocompetent individuals.

The most effective way to treat the short-tem diarrheal illness is with oral or intravenous hydration, often with parenteral nutrition (Current 1991). In individuals with AIDS, cryptosporidium is treated through partially restoring immune function with HAART. If this type of therapy is not available, there are antibiotics that have some efficacy against Cryptosporidium. These antibiotics include paromomycin and Nitazoxanide (Clark 1999). The most effective prevention of cryptosporidiosis in AIDS patients is the maintenance of the immune system through HAART therapy and the avoidance of tap water (Clark 1999). Since Cryptosporidium can be transmitted through water sources such as drinking water and swimming pools, several experiments have determined the efficacy of commercial disinfectants on the parasite.

One study demonstrates that exposure to ammonia (50% or higher) and formalin (10% or higher) for 30 minutes can kill Cryptosporidium oocytes. It was also found that freeze-drying and 30 minute exposure to temperatures of either +60 o C and -20 o C kills Cryptosporidium oocytes. Disinfectants used by hospitals and clinical laboratories were evaluated and it was found that they used lower concentrations recommended by manufacturers that

are not effective against Cryptosporidium oocytes. Therefore, a much higher concentration of disinfectants is needed to kill Cryptosporidium than what commercial disinfectant manufacturers suggest. Inadequate disinfection of hospitals, nursing homes, and day care centers could possibly contribute to the high occurrence of C. parvum in urban areas. (Current 1991)The transmission of Cryptosporidium oocytes by water has forced new precautions for drinking and recreational water disinfection.

Studies show that oocyte infectivity is abolished by exposure to 80 ppm of chlorine at 25 o C at pH 7. 0 for 2 hours, and also by exposure to ozone at 1 ppm for 10 minutes. Although water utilities attempt to maintain 1. 0 ppm of chlorine and 0.

4 ppm of ozone, C. parvum oocytes are 30 times more resistant to ozone and 14 times more resistant to chlorine dioxide than are other waterborne organisms (Current 1991). Although the risk of Cryptosporidium is lowered in areas with superior water treatment and in areas supplied by groundwater, groundwater can still be a risk for C. parvum illness (Lake 2007). Cryptosporidium is important to mammals around the world due to its prevalence in both rural and urban areas. This parasite affects both the young and old with symptoms varying depending on the immunological state of the individual. Because of its resistance to most antimicrobial drugs, the only effective treatments are rehydration in immunocompetent individuals and HAART therapy in those who have AIDS. Cryptosporidium is also unique because of its resistance to commercial disinfectants.

This characteristic has forced water utilities to be highly monitored and is lowering the risk of infection. Superior water treatment has not eliminated Cryptosporidium because there are two forms, C. parvum and C. hominis, which can be transmitted from animals to humans, and from humans to humans, respectively. Works CitedClark, Douglas P. “ New Insights into Human Cryptosporidiosis.

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