A GENERAL REVIEW ON CRYPTOSPORIDIUM PARVUM: PATHOGENESIS, DIAGNOSIS AND TREATMENT
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Introduction
Cryptosporidium parvum is one cause of severe diarrheal disease worldwide and contributed to neonatal and early infant mortality. C. parvum causes cryptosporidiosis is a zoonotic intestinal disease that affects wildlife, neonatal cattle and humans (Masheminasab et al., 2022) causing acute gastroenteritis that characterized with diarrhea and abdominal pain.

The parasite causes lung infections that can also be fatal in the immunocompromised hosts, hence Cryptosporidiosis is considered one of riskiest opportunistic infections for them (Gerace et al., 2019).

Cryptosporidium was first detected by Tyzzer in 1907 (Tzipori and Widmer, 2008). Cryptosporidium was recognized as an opportunistic pathogenic parasite in 1976 where it was thought to be a nonpathogenic parasite (Meisel et al., 1976; Nime et al., 1976).

There are more than 30 species included in the genus Cryptosporidium, only 2 species commonly infect humans, namely Cryptosporidium parvum and Cryptosporidium hominis (Ryan et al., 2014; Thomson et al., 2017).

Cparvum is responsible for most zoonotic infections in humans (Ryan et al., 2014). Cryptosporidium is intracellular protozoan parasite belong to phylum Apicomplexa (Suarez et al., 2017).

This parasite can cause many symptoms such as diarrhea depending on the host and its immune status, the infection with Cryptosporidium can spread to various organs and system of the body especially pancreatic, hepatobiliary as well as extra-intestinal such as pulmonary system and leading to chronic disease and weakness (Leitch and He, 2012).

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The infection can be a cute and self-limiting illness in immunocompetent patients, whereas in immunocompromised patients Cryptosporidiosis can become a chronic and life-threatening disease (Kurniawan et al., 2013; Elwin et al., 2012). The infection of Cryptosporidiosis occurs mainly by ingestion of contaminated food and water with oocysts, oocysts that release sporozoite which invade the intestinal epithelium cells predominantly localized to the jejunum and ileum (Baldursson and Karanis, 2011; Chippell et al., 2006).

**Life cycle**

*Cryptosporidium parvum* complete its life cycle, both sexual and asexual phases in a single host infection initiated by ingestion of food and water contaminated with feces containing oocysts, the oocysts contains four sporozoites which are released in the intestine (Paniker, 2013). Then, the parasite undergoes a sexual or schizogony reproduction leading to the production of eight merozoites within a type 1 meront, within the parasite phorous vacuole (Bouzid et al., 2013). The merozoites can propagate the infection to other sites of the intestine within invade the neighboring epithelial cells, the merozoites can undergo a sexual stage characterized by production of thin walled oocysts that auto infect the host and multiplication of merozoites (type 1 meront) and sexual stage characterized by formation of type 1 meront, which after recognition in microgametocytes and macrogametocytes to form the zygote (Tzipori and Ward, 2002).

The zygote will form four sporozoites within thin or thick walled oocysts through a process called sporogony. The thick walled are protected by resistant wall oocyst release through feces into the environment, ready to infect new individual (Bouzid et al., 2013; Jenkins et al., 2010) as figure (1):

**Figure (1): Oocysts of Cryptosporidium parvum. A. Thickwalled oocyst B. Thinwalled oocyst**

**Pathogenesis**

*Cryptosporidium* infection usually produces about of watery diarrhea in immunocompetent persons, although the infection in some persons may not lead to the symptoms (Khall et al., 2018; Shoultz et al., 2016 and Adler et al., 2017). The infection with cryptosporidiosis can be occur due to direct contact with infected animals particularly calves or drink contaminated water (Bouzid et al., 2018). Cryptosporidium infections are common in individuals no have weakened immune system such as human immunodeficiency (HIV) transplant patients and cancer (Bouzid et al., 2013; Wang et al., 2018; Florescu and Sandkovsky et al., 2016). Cryptosporidiosis caused in over 50,000 deaths every year (Shirley et al., 2012; Wang et al., 2018). Cryptosporidium is one of the most important protozoan pathogen that cause water borne outbreaks world (Bouzid et al., 2013; Adler et al., 2017 and Rehn et al., 2015). Cryptosporidium is live in the intestine of infected humans and animals in the form of oocysts, which released in the feces (Bouzid et al., 2013) after infection, Cryptosporidium alters the infection of the intestinal barrier, increasing its absorption, secretion of fluid, permeability, electrolytes, the severity, persistence and thereby and effect of the infection depend on the immunocompromised status (Kumar et al., 2018; Petry et al., 2010).

The oocyst are very resistant to chlorine, chlorine dioxide and chloramines which are commonly used in water system disinfection and remain vital in the environment for a long time (Shrivastava et al., 2017). Human can infected with Cryptosporidium by touching anything in contact with contaminated feces but the most common mode of transmission occur by ingestion of oocysts in contaminated water, food or air by inhalation of aerosolized droplets through secretions or by coughing (Petry et al., 2010; Sponseller et al., 2014).

Immunocompromised patients are more susceptible to infection than individuals with a healthy immune system. In the patients with HIV/ AIDS the disease is difficult to treat and can even result in death where the parasite often causes a
chronic prolonged form of a disease (Wang et al., 2018). In this patients this disease characterized by malabsorption and fever and can cause inflammatory disease of the biliary tree leading to sclerosing cholangitis, biliary tract obstruction, papillary stenosis and pancreatitis (Wang et al., 2018; Wang et al., 2018). For this reason, cryptosporidiosis in patients with acquired immune deficiency syndrome is considered one of the riskiest opportunistic infections (Wang et al., 2018).

**Diagnosis**

1. **Stool examination:** is usually made by identifying the presence oocysts of C. parvum to six μm in diameter in the feces of the infected individuals (Khurana and Chaudhary, 2018; Ahmed and Karanis, 2018).

The feces sample must be concentrated using the formation ether sedimentation befor to microscopic examination for detection of oocysts in feces while the oocysts of Cryptosporidium in un concentrated fecal smears can be observed by phenol auramine or acid fast (modified Ziehl-Neelson method) staining where the oocysts stain red and bright yellow, respectively (Khurana and Chaudhary, 2018; Omoruyi et al., 2014).

2. **Serodiagnosis:** for detection of Cryptosporidium antigens there are good specificity and sensitivity techniques such as the enzyme linked immunosorbent assay (ELISA) and immune chromatographic test (Agnamey et al., 2011; Hawash, 2014).

In previous studies have shown that antigen / antibody based detection techniques are in effective in the burden of cryptosporidium in the patients in blew the minimum threshold (Hawash, 2014).

3. **Molecular diagnosis:** Polymerase Chain Reaction (PCR) is also used to detect viable cysts (Paniker, 2013). PCR now accepted in most laboratories for the detection of Cryptosporidium in the feces as the gold standard (Friesen et al., 2018; Autier et al., 2018).

**Treatment**

Nitazoxanide or Paromomycin can be partially effective in few patients with AIDS, although no chemotherapeutic agent effective against cryptosporidiosis has been identified. Antiretroviral therapy can be improvement in immune status and lead to progress of cryptosporidiosis. There are other treatment methods include supportive therapy with electrolytes, fluids and nutrient replacement (Paniker, 2013).

**Conclusion**

Cryptosporidium parvum can cause lung infections that can be fatal in the immunocompromised patients hence cryptosporidiosis is considered one of riskiest opportunistic infections. There are more than 30 species included in the genus cryptosporidium, only two species commonly infect humans, are C. parvum and C. hominis. Nitazoxanide and paromomycin are effective in few patients with AIDS as well as antiretroviral therapy can be improvement in immune status.

**References**


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