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 **Giardiasis in human (*Giardia doudenalis*)**

 **Research project**

**Submitted to the department of (Biology) in partial fulfillment of the requirement for the degree of B.A in biology**

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 **SUMMARY**

Giardiasis is an common zoonotic disease for both human and animal health. There are six giardia species have been described, Giardia agilis, Giardia ardeae, Giardia psittaci, Giardia muris, and Giardia microti , which infected Amphibians, Rodent and birds , whereas the host’s for Giardia doudenalis include human, domestic and wild animals. In recent years these intestinal parasites has been identified widely in human and various other anymore and has even been recorded in contaminated environment by famous scientists **Van** **leun** **hoek** over 300 years ago. These cycles protozoa can be transmitted by person-to-person contact and consuming contaminated food and water with mature cysts as infective stage.

**Introduction**

*Giardia lamblia*(synonyms: *Giardia duodenalis*, *Giardia intestinalis*) is a unicellular, flagellated protozoan parasite resides in small intestine of host. It is responsible for gastrointestinal illness known as giardiasis are frequently causes of mortality and morbidity throughout the world.( Adam, 2001) It is very common and may infect more than third of the individuals in developing countries . The parasite causes acute or chronic diarrhea in humans especially in children and can infect other mammals,( Daly ,2010) G. lamblia live attached and colonize in small intestine on mucosal lining of duodenum and jejunum of host, its life cycle alternative between two stages resistance, dormant cyst stage and multiplying, motile trophozoite stage. (Roberts ,2009) It was discovered in 1681by Antonie van Leeuwenhoek who found the parasite in his own fecal sample when examined it microscopically . Giardia lamblia was initially named as Cercomonas intestinalis in 1859 by lambel .And in 1915 renamed as Giardia lamblia by Stiles in honor of professor A. Giard of Paris and Dr. F. Lambl of Prague(Ford ,2005). Epidemiological survey reveals that most cases from parasitic infections in children caused by Giardia lamblia infection especially in areas with low economic and poor sanitation .(Felty ,2008) The studied reported that two hundred million people in Asia, Latin American, Africa are infected each year with G. lamblia .(Thompson , 2004)The prevalence rate of G. lamblia in industrialized areas is about two to five percent (Khudier ,2011). Contaminated drinking water responsible for large community outbreaks while smaller outbreak though out the world due to contact with contaminated recreational water(Huetink ,2001)

**Classification**

According to protozoan morphology and host species in which they parasitize Giardia include more than fifty species (Lane ,2002). Now 5 species of giardia are recognized Giardia agilis ,Giardia duodenalis ,Giardia ardeae ,Giardia psittaci and Giardia muris. The only Giardia lamblia is considered to be species encountered in humans and as well as in domestic and wild mammals. According to the molecular studies there are eight genetic groups identified for groups found in man also isolated from animals like beavers and mouse (Friend ,1966)

**kingdom** : *Protista*

**Subkingdom**: *Protozoa*

**Phylum**: *Sarcoastigophora*

**Subphylum** *Masigophora*

**Class** : *Zoomastigophora*

**Order**: *Diplomonadida*

**Family**: *Hexamitidae*

**Genus** : *Giardia*

**Species** : *lamblia*

**Life cycle**

**** The parasite passes its life cycle in one host. Man acquires the infection by oral ingestion of mature cyst .Excystation of cyst occurs in the duodenum within thirty minutes ,the cytoplasm divides, thus liberate two trophozoites is illustrated (fig. 2) . Vegetative trophozoite is attach to the epithelial lining of small intestine and replicate to produce enormous numbers of parasite colonize in the duodenum and jejunum (Black ,1977). Encystation of trophozoite occur in colon to transform to cyst stage ,which is immediately infective upon pass with stool and remain survive for weeks or months.(Alsaadi ,2019) Swallowing about ten mature cysts may initiate infection in new host ,although infected host might shed one to ten billion cysts per day in their fecal material.(Kahn ,2010)

**Figure 2. Life cycle of Giardia lamblia**

**Morphology**

Life cycle of Giardia lamblia consist of two alternative trophozoite and cyst tage: Trophozoite : It is pear in shape , rounded anterior end and pointed posterior end ,it measures about 12-15 micron in length and 5-9 micron in maximum width.9 Huetink ,2001) The ventral surface has two sucking disk by which the organism adheres to mucosal surface of small intestine. The organism has two nuclei with central rounded karyosome found at anterior end , two axostyle in the mid part of the body , rod like structure across the axostyle known as median body as in fig. 2(Jump ,1994) . The organism has bilaterally symmetrical appearance. Trophozoite has eight flagella (pair of flagella situated anteriorly ,two pairs in the middle and pair of flagella in the posterior end) by which the trophozoite move from place to another (Yaeger ,1996). Cyst: It is ovoid in shape, measures about 12×6 micron in size.it has remains of flagella inside the granular cytoplasm, the organism possess two pair of nuclei either found in cluster at one end or occurs in pairs at opposite end(Adam ,2000) . The cyst has clear space between the cytoplasm and the protective cell wall as in ( fig. 1). The cyst has ability to adaptation with external environment to become survive for weeks or months (Hill ,1994)



**Figure 1.trophozoite and cyst stage of G.lamblia**

**Symptoms**

Giardiasis there may be variety of clinical symptoms . Symptoms vary depending on multiple factors such as the age of the patient, history of prior exposure, the parasite load, virulence of the parasite, and the immune response of the host(Wolf ,1992). Infection can be manifest after return from an endemic or high-risk area, as the average incubation period from infection to onset of diarrhea is 7 days, and can be as late as 28 days (Petri ,2005).The patient with giardiasis infection sometime symptomic or asymptomatic , The majority (60–80%) of infected individuals have few or no symptoms . Asymptomatic giardiasis may be epidemiologically more significant, as asymptomatic individuals are less likely to be detected or to seek treatment and therefore, are more likely to serve as carriers of the disease. Symptomatic giardiasis is characterized by the acute onset of diarrhea, abdominal pain or cramps, and flatulence. Diarrhea is the predominant symptom, occurring in 90% of symptomatic individuals , Patients pass approximately five loose or semi-formed stools per day for 2–3 days . ( Tessier,1999) . The flatulence is characterized by a sulfur odor, which produce in digestive system that is frequently emitted from the breath, stool, or both. in untreated patients these symptoms may persist for months and lead to overt malabsorption and weight loss , . In infants and children, prolonged infection may lead to impaired growth and development. And uncommon symptoms may appear like Fever, chills, severe abdominal pain, and bloody stool . Also some time we have Extraintestinal manifestations of giardiasis are rare but include maculopapular rash, urticaria, dermatitis, arthritis, and biliary tract disease.

**Diagnosis**

 *Giardia spp*. can be diagnosed by some methods, The best and golden method to manifest giardia in stool spacemens by microscopic examination . This method is performed to cyst and trophozoit stage .fecal suspension in physiological salt solution (0.85 NaCl) or fixation in sodium acetate–acetic acid–formalin (SAF) is used to prepare wet mounts in order to the observation of Giardia trophozoite in diarrhea or loose samples (Hooshyar ,2016). Wet mounts smear can be examined either unstained or iodine stained (2-5% lugol’s solution). Examination of direct wet saline preparation of a fresh stool specimen allows motile trophozoites to be seen, but in stained and SAF preparation smears the trophozoites will be non-motile. In the asymptomatic individuals and healthy carrier who do not have diarrhea, the cyst stage is more likely to be seen in a fecal sample examination. Fecal suspension in saline or lugol’s solution or in a fixative solution may be used for cyst identification .Other tests for diagnosis are Direct Fluorescent Antibody (DFA) tests, which detect intact organisms, and Enzyme Linked Immunosorbent Assays (ELISA), which detect soluble antigens in the stool, and use of multiplex real-time Polymerase Chain Reaction (PCR) assays for the detection of Giardia and other gastrointestinal protozoan pathogens, the real-time PCR showed a sensitivity of 98% and specificity of 100% [55-57]. PCR assays can detect specific genes of the parasite in stool samples.( Leung, 2019)

**Immunology**

It is well accepted that both humoral and cellular immune responses to giardial infection are generated by the host. Secreted immunoglobulin A (IgA) and IgM antibodies seem to play a role in eradicating parasites. IgA and IgG antibodies coat G. muris trophozoites in the bowel lumen of rats and mice and may reduce parasite motility and prevent adhesion to the epithelium (Farthing ,1987 ). Giardia-specific IgG and IgM antibodies have also been demonstrated in serum and may be helpful in differentiating patients with acute or recent infection from those with past or previously treated infections (Jones ,1988). Studies also indicate that, during waterborne outbreaks of diarrheal illness, the presence of serum antibody of G. lamblia, particularly IgA, may be helpful in detecting exposure to G. lamblia-contaminated water and in diagnosing giardial disease (Birkhead ,1989). . It has also been shown that, after epidemic outbreaks, patients develop some resistance to subsequent infection (Istre, 1984). However, even after repeated exposure to the organism, symptomatic infections do recur in the same individuals. Current evidence suggests that, by adulthood, a degree of resistance to this organism is present .one study found that 14% of a group of asymptomatic adults had serum antibodies to G. lamblia (67).

**Treatment**

giardiasis is a parasitic disease of great epidemiological and clinical importance because of its high prevalence and pathogenicity especially in children. unlike other infectious gastroenteritis other Giardiasis is curable. Until a few decades ago, Giardia lamblia was considered an innocent bystander in the microbial gut flora, but after the pathogenicity of the parasite was recognized, different classes of drugs have been used .( Nash,2001)Since there is no effective and safe vaccine to prevent Giardia infection; therefore, chemotherapy with synthetic drugs is now considered as the best choice for giardiasis treatment (Watkins and Eckmann, 2014). Many drugs have been evaluated in reviews and several meta-analyses .Symptomatic giardiasis should be treated to reduce the duration of symptoms, to prevent complications, and to minimize transmission of the parasite to other hosts. (Al-Awsi,2021)

First- synthetic drugs :-. Treatment of giardiasis is exclusively based on chemotherapy with antigiardial drugs, including metronidazole which is widely used drug , 250 mg orally three times daily for 5 to 7 days for adults; 5 mg/ kg/d orally in three doses for 5 to 7 days for children. and other drugs are albendazole, Quinacrine, 5-Nitroimidazoles ,nitazoxanide. Mebendazole, Tinidazole, Ornidazole, Furazolidone, Benzimidazoles, Secnidazole , Ornidazole ,and  Paromomycin is poorly systemically absorbed and may be considered if giardiasis needs to be treated in a pregnant patient in her first trimester(Juergens,2022)

Second- herbal drugs :-studies showed that the use of these synthetic drugs are associated with some limitations such as treatment-refractory cases and some drug-related side effects including nausea, mild headache, dizziness and a metallic taste in the mouth, yellowing of the skin and elevated liver enzymes. therefore, the search and discovery of new alternative anti-Giardia drugs with high effectiveness as well as minimal toxicity , . Previous reviews have demonstrated the anti-Giardia effects of some herbal extract such as *Carum copticum, Lavandula stoechas, Tanacetum parthenium, Ferula assafoetida, Allium paradoxum, Allium sativum, Artemisia annua, Allium ascalonicum, Chenopodium botrys, Ziziphora clinopodioides, Zataria multiflorahad, Eucalyptus globulus, Lippia beriandievi, Punica granatum, they also reported that the hydroalcoholic extract of Ferula assa-foetida, Chenopodium botrys*, and *Tanacetum parthenium* have the 100% in vitro efficacy against G. lamblia; while, the maximum in vivo efficacy against giardiasis was observed for the *Allium sativum* extract at the concentration of 80 mg/mL. . (Al-Awsi,2021)

**Transmission**

Transmission of giardiasis occurs through the faecal-oral route, and may be either direct (i.e., person-to-person, animal-to-animal or zoonotic) or indirect (i.e., waterborne or foodborne). Person-to-person transmission is a major source of infection and has been widely documented, particularly in day care centers, nursing homes, and other institutional settings, where personal hygiene may be poor.(Dexon ,2021) Sexual transmission of giardiasis has also been documented.(Escobedo ,2014) Reverse zoonotic transmission (zooanthroponosis) has also been proposed, especially between humans and wildlife, or companion animals. The waterborne route is probably the most widely recognized means of transmission of giardiasis, with numerous outbreaks being associated with cyst-contaminated drinking water. While foodborne transmission of giardiasis has become more widely recognized in recent years. Giardia duodenalis was 11th overall in a global ranking of foodborne parasites. The foodborne route has been associated with increasing globalization of the food trade, international travel, and changes in consumer habits , also Giardia on fresh , including leafy greens, herbs, berries, green onions, carrots, tomatoes, etc.(Dixon ,2021)

**Prevention**

Swallowed of fecal contaminated food and water is the common mode of transmission. Therefore, the best method of prevention is reducing this contamination(Al-Sabbawi,2007). Purifying or filtering drinking water using the boiling or iodine in endemic areas is important as is the washing of vegetables and fruits that may have been polluted(FengL ,2011). Children are usually infected with G. lamblia and easily spread cysts if poor sanitation is used. Proper washing of hand can help to reduce the transmission(Fletcher,2011). Hand washing carefully before eating before preparing food, , and after using of toilet can prevent many cases of Giardia occurs in day-care centers .Children infected with diarrhea should be avoid swimming pools .Avoid drinking from un treated water such as rivers , lakes and streams. Boiling the water first will destroy and kill the Giardia. Chlorination and filtration good method to remove the parasites(Erickson ,2006)

**Conclusion**

As the most spread protozoal infection, G. lamblia is important for both human and animals health .Although the wide range of effectiveness on the validity of human host, G. lamblia remains a careless as parasitic infection infect high numbers of humans . The prevalence and insistence related to control planning for eradication the parasite especially clean the source of drinking water still restricted, therefore , further future research on the mechanism of resistance to infection and strategy for good control measure should be taken to eradicate the giardiasis infection are required.

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