

Giardiasis

Giardia Enteritis,
Lambliosis,
Beaver Fever

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Etiology

Giardiasis is caused by *Giardia intestinalis*, a protozoal parasite in the family Hexamitidae (order Diplomonadida). This organism is also called *Giardia lamblia*, *Lamblia intestinalis* and *Giardia duodenalis*. The organisms isolated from humans, domestic animals and most wild animals appear to be identical; however, it is possible that *G. intestinalis* is actually a complex of several different species or subspecies. Humans are thought to be the main reservoir of infection for humans. Interspecies transmission of *G. intestinalis* has been demonstrated, and zoonotic transmission is thought to occur. However, the importance of animal reservoirs for human disease is controversial. Other species of *Giardia* are found in rodents, birds, reptiles and amphibians. These organisms are not known to be zoonotic. *Giardia muris* is seen in rodents, birds and reptiles. *Giardia agilis* occurs in amphibians.

Geographic Distribution

Giardia intestinalis occurs worldwide, and is particularly common in warm climates.

Transmission and Life Cycle

There are two stages of the parasite: cysts and trophozoites. Giardiasis is transmitted by cysts, via the fecal-oral route. The cysts can be transmitted directly between hosts, or on fomites including contaminated water and occasionally food. Among humans, anal intercourse is a means of spread. Ingested cysts release one or two trophozoites in the small intestines, where the trophozoites multiply. Many of the dividing trophozoites are carried toward the colon, and encyst along the way. The cysts are infectious when they are excreted in the feces or shortly afterward. Trophozoites may also be found in the feces, particularly diarrheic feces. *Giardia* cysts can survive for long periods in the environment under cool, moist conditions, and remain viable for several months in cold water. They have been shown to survive in water for two months at 8°C and one month at 21°C. Some cysts can survive freezing at -13°C for two weeks. *Giardia* cysts are susceptible to desiccation and direct sunlight.

Disinfection

G. intestinalis cysts and trophozoites are susceptible to 1% sodium hypochlorite, 2% glutaraldehyde or quaternary ammonium disinfectants. They can also be killed by boiling for at least one minute. The cysts are relatively resistant to chlorination, particularly if the water is cold; the amount of chlorine in drinking water is not sufficient to kill *G. intestinalis*.

Infections in Humans

Incubation Period

The incubation period in humans is 1 to 25 days; most infections become clinically apparent after 7 to 10 days.

Clinical Signs

Most human infections are asymptomatic, but some people develop mild to severe gastrointestinal signs. The usual presentation is a sudden onset of diarrhea with foul-smelling stools. The feces may have a greasy appearance, but blood is rarely seen. The diarrhea can be accompanied by abdominal cramps, bloating, flatulence, nausea and fatigue. Weight loss or dehydration can also occur. Vomiting and fever are uncommon.

The illness usually lasts for 1 to 2 weeks, but chronic infections of months to years have been reported. Chronic infections can be seen in both immunodeficient and immunocompetent individuals, and are characterized by recurrent symptoms that may lead to malabsorption syndromes, vitamin deficiencies, severe weight loss and debilitation. Urticaria has also been reported.

In addition, approximately 20-40% of patients develop disaccharide intolerance, particularly lactose intolerance, during the infection and up to six months afterward.



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Communicability

G. intestinalis can be transmitted from person to person by fecal contamination. Both symptomatic and asymptomatic individuals can excrete cysts. Cysts are shed in the feces during the entire period of infection, which may last for months. Human *Giardia* may be able to infect animals.

Diagnostic Tests

Giardiasis is often diagnosed by direct observation of the trophozoites or cysts in the feces. Either stained preparations or unstained wet mounts can be used. Repeated sampling may be necessary in cases with low levels of organisms or intermittent shedding. The flagellated trophozoite has a “tear drop” shape, with two nuclei at the anterior end and tumbling motility. The cyst is approximately 13 µm long and oval, with two to four nuclei. Immunofluorescence can also be used to visualize the organism, and an ELISA can detect *Giardia* antigens. Serology has been used in epidemiologic investigations, and PCR may be available. Culture is used only in research.

Treatment

Giardiasis can be treated with several drugs, including metronidazole, tinidazole and ornidazole. Other drugs may also be effective. Asymptomatic carriers may not need treatment. Chronic cases can be resistant to treatment, and prolonged treatment with a combination of drugs may be required. The recurrence of symptoms may be due either to resistant infections, reinfection or post-*Giardia* lactose intolerance.

Prevention

To prevent infection, untreated water from lakes, rivers, springs or shallow wells should not be drunk. In countries where the water supply may not be safe, untreated drinking water or ice should also be avoided.

Methods that can be used to treat potentially contaminated water include heating the water to a rolling boil for at least one minute; filtering the water through a filter that has an absolute pore size of at least one micron (or has been NSF rated for cyst removal) Chlorination or iodination may also destroy the cysts, but these methods are less reliable and depend on the temperature, pH and turbidity of the water.

All raw vegetables or fruits should be washed before eating, in water known to be uncontaminated.

Good hygiene, such as hand washing, can help prevent infection. It also prevents spreading giardiasis to other people. People with giardiasis should not swim in recreational water for at least two weeks after the symptoms end. Fecal exposure should be avoided during sexual activity.

Morbidity and Mortality

Giardiasis occurs most often in children and is common in day care centers. It is also prevalent in travelers, hikers and backpackers, and swimmers in contaminated water. In

addition, cases are seen in homosexual men, probably due to sexual transmission. Giardiasis is seen in approximately 2% of adults and 6-8% of children in developed countries worldwide. In developing countries, the prevalence of infection may be greater than 15% in children. Many immunocompetent people seem to have good immunity to re-infection.

Epidemics can occur due to contaminated drinking water, food or recreational waters such as ponds. Community-wide outbreaks have occasionally been associated with municipal drinking water. During epidemics in naïve populations, the morbidity rate can reach 20%.

Most infections are asymptomatic, and symptomatic cases in healthy people usually resolve spontaneously in 1 to 2 weeks. Chronic infections, lasting months or years, occur in less than 4% of patients. Chronic cases can be seen in both immunodeficient and immunocompetent individuals. In immunodeficient persons, chronic giardiasis can contribute to a decreased lifespan. In addition, approximately 20-40% of patients develop disaccharide intolerance, particularly lactose intolerance, during the infection and for up to six months afterward.

Infections in Animals

Species Affected

G. intestinalis can be found in many domestic and wild animals, including dogs, cats and ruminants. Infections are infrequent in horses and pigs. Beavers may be a source of contamination in streams.

Incubation Period

The incubation period is usually 5 to 14 days.

Clinical Signs

Most infections, particularly in adult animals, are asymptomatic. Acute, chronic or intermittent diarrhea may be seen in some puppies and kittens. The clinical signs can include diarrhea or soft stools, a poor hair coat, flatulence, and weight loss or failure to gain weight. The stools are typically light-colored and mucoid, and may contain undigested fat. Blood is rarely seen. Similar enteric signs have also been reported in other species, including calves and lambs.

Communicability

G. intestinalis cysts shed in the feces are infectious. Both symptomatic and asymptotically infected animals excrete cysts.

Diagnostic Tests

Giardiasis is usually diagnosed by microscopic examination of the feces, using either stained preparations or unstained wet mounts. Either cysts or trophozoites may be found. The flagellated trophozoite has a “tear drop” shape,

with two nuclei at the anterior end and tumbling motility. The cyst is approximately 13 µm long and oval, with 2-4 nuclei. Several samples may be needed, as shedding can be intermittent. Concentration methods (e.g. zinc sulfate fecal flotation) are often used. Immunofluorescence can also be used to visualize the organism. An enzyme linked immunosorbent assay (ELISA) can detect *Giardia* antigens in human feces, and should be effective for animals. Culture is used only in research.

Treatment

Infections may be self-limiting but the potential for zoonotic transmission should be taken into consideration. Fenbendazole, albendazole, metronidazole, tinidazole, quinacrine and furazolidone have been used in dogs or cats. Quinacrine, ipronidazole, and dimetridazole have been used in calves, and horses have been treated with metronidazole. In cats immunosuppressed by FeLV or FIV, treatment may be less effective.

Prevention

Cleaning and prompt removal of the feces can limit environmental contamination. Hard surfaces can be disinfected and should be left to dry, as the cysts are susceptible to desiccation.

Pets and livestock can be infected from unsafe water sources such as lakes, streams, springs and shallow wells. Keeping pets indoors can decrease the risk of infection. Methods used to treat potentially contaminated water include: Heating the water to a rolling boil for at least 1 minute; filtering the water through a filter that has an absolute pore size of at least 1 micron (or has been NSF rated for cyst removal). Chlorination or iodination may also destroy the cysts, but these methods are less reliable and depend on the temperature, pH and turbidity of the water.

Vaccines, available for dogs and cats, can prevent infections and the shedding of cysts. Their use is controversial.

Morbidity and Mortality

Many infections are asymptomatic. Both infection and disease occur more often in young animals. Reported prevalence rates are 20-35% in puppies, 10-15% in kittens, 17-32% in foals, 5-90% in calves, 6-80% in lambs and 7-44% in pigs. Approximately 2-10% of dogs and cats are subclinical carriers. Crowding increases the risk of transmission, and cases may be more common in kennels and catteries. Many infections are self-limiting, and giardiasis is not usually life-threatening.

Post-Mortem Lesions

Gross lesions are not usually found.

Internet Resources

- Centers for Disease Control and Prevention (CDC)
<http://www.cdc.gov/ncidod/dpd/parasites/giardiasis/default.htm>
- Material Safety Data Sheets – Canadian Laboratory Center for Disease Control
<http://www.hc-sc.gc.ca/pphb-dgsp/msds-ftss/index.html#menu>
- The Merck Manual
<http://www.merck.com/pubs/mmanual/>
- The Merck Veterinary Manual
<http://www.merckvetmanual.com/mvm/index.jsp>
- U.S. FDA Foodborne Pathogenic Microorganisms and Natural Toxins Handbook (Bad Bug Book)
<http://vm.cfsan.fda.gov/~mow/intro.html>

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