GIARDIASIS (lambliasis)

Etiology: *Giardia lamblia* (flagellate)
Epidemiology: It has worldwide distribution and is not uncommon in South Carolina. It is the most frequent protozoan intestinal disease in the US and the most common identified cause of water-borne disease associated with breakdown of water purification systems, outdoorsmanship, travel to endemic areas (Russia, India, Rocky Mountains, etc.) and day care centers.
Morphology:

**Trophozoite**: It is 12-15 μ, half pear shaped with 8 flagella and, 2 axostyles arranged in a bilateral symmetry. There are two anteriorly located large suction discs. The cytoplasm contains two nuclei and two parabasal bodies (Figure 1).
**Cyst:** Giardia cysts are 9-12 µ ellipsoidal body with smooth well-defined wall. The cytoplasm contains 4 nuclei and many structures of the trophozoite.
Life cycle: Infection occurs by ingestion of cysts, usually in contaminated water. Decystation occurs in duodenum and trophozoites (trophs) colonize the upper small intestine where they may swim freely or attach to the sub-mucosal epithelium via the ventral suction disc.
The free trophozoites encyst as they move down stream and mitosis takes place during the encystment.
The cysts are passed in the stool. Man is the primary host although beavers, pigs and monkeys are also infected and serve as reservoirs.
Pathogenicity
Common inhabitant of upper part of small intestine
Enteropathy, diarrhoea, steatorrhoea

G. lamblia cyst

*Cryptosporidium mesnili*

Life cycle

**Trophozoite**
- 6 flagellae
- 3 free anteriorly
- 1 in mouth
- 2 surrounding mouth

Blepharoplasts
Single nucleus
- Encystation

Encystation

**Cysts to environment**

2 nuclei

Thin nuclear membrane with no granules. Central karyosome

2 axonemes

Parabasal body

Blepharoplasts

2-4 N

Granules

Cytoplasm

8-12 μm

Remains of locomotory apparatus

G. lamblia trophozoites

Cyst (iodine stained)
Life cycle of Giardia lamblia. Infection occurs by the ingestion of cysts in contaminated water or food. In the small intestine, excystation releases trophozoites that multiply by longitudinal binary fission. The trophozoites remain in the lumen of the proximal small bowel where they can be Free or attached to the mucosa by a ventral sucking disk.
**Symptoms**: The early symptoms include flatulence, abdominal distension, nausea and foul-smelling bulky, explosive, often watery, diarrhea. The stool contains excessive lipids but very rarely any blood or necrotic tissue.
The more chronic stage is associated with vitamin $\text{B}_{12}$ malabsorption, disaccharidase deficiency and lactose intolerance.
Pathogenesis
The mechanisms by which *Giardia* causes diarrhea and malabsorption have not been elucidated. There is no evidence that *Giardia* produces an enterotoxin or that it invades the intestinal epithelial cells.
Electron microscopy shows that the ventral disk embeds the parasite into the epithelial microvillus layer and "footprints" of formerly adherent trophozoites are visible on the epithelial cell surface.
However, even in a heavy infection, the surface area covered and possibly damaged by the adherent trophozoites cannot account for the symptoms.
In humans, biopsy of the infected gut shows little abnormality. In a European study in which over 500 biopsy specimens from *Giardia*-infected patients were observed,
slightly over 96% had normal looking mucosa and 3.7% had mild villous shortening with a small amount of neutrophil and lymphocyte infiltration.
The lack of histologic abnormalities in the majority of symptomatic patients has also been observed in other, smaller studies.
In one study in which patients with villous shortening and inflammatory infiltration were followed with serial biopsies, these abnormalities all resolved after the infection was eradicated.
In the murine models of giardiasis, similar findings of villous atrophy and inflammatory infiltration of villous epithelium can be observed. However as with humans, the findings are subtle and inflammatory changes mild.
Giardiasis

**In conclusion**, the cause of diarrhea and malabsorption in Giardia infection is likely to be multifactorial, involving the host immune response to the pathogen as well as, yet to be identified, cytopathic substances that the parasite may secrete.
Additionally, it has been suggested that *Giardia* may cause pathology by alteration of the bile content or endogenous flora of the small intestine which in turn could affect the absorptive function of gut. These hypotheses must now be formally tested before a more complete picture emerges.
The traditional method of diagnosis is examination of stool for trophozoites or cysts (stool O&P). Both fresh and fixed stool specimens are usually examined.
Cysts are normally found but motile trophozoites can be observed in a fresh specimen of loose stool. Because the parasites are normally found in the small intestine and are shed intermittently, the sensitivity of one stool specimen is low, in the range of 50 - 70%.
However, examination of three specimens, from three different days, increases the sensitivity to 85 - 90%; specificity is close to 100%.
This assay remains the most widely used method to diagnose *Giardia* infection and is the gold standard to which other newer assays are usually compared.
It is important to note that there can be a delay between the onset of symptoms and the excretion of cysts so that a negative stool sample in someone in whom giardiasis is suspected warrants reanalysis at a later time.
Encystation occurs when the parasites transit toward the colon, and cysts are the stage found in normal (non diarrheal) feces. The cysts are hardy, can survive several months in cold water, and are responsible for transmission.
Recently, new assays have been developed based on detection of *Giardia* antigens. The direct fluorescent antibody test (DFA), uses a *Giardia*-specific antibody conjugated to a fluorophore to stain stool specimens. Because the parasites are labeled, much larger regions of the slide can be scanned more quickly and the likelihood of detecting the parasite is increased.
. On a single stool specimen the sensitivity is between 96 - 100%. Other antigen-detection tests detect soluble Giardia-specific proteins in the stool. There are two different types of soluble-antigen-detection
Covering of the epithelium by the trophozoite and flattening of the mucosal surface results in malabsorption of nutrients.
Immunology:
Some role for IgA and IgM. Increased incidence in immunodeficiency (e.g. AIDS).
Diagnosis: Diagnosis
Rapid immune-chromatographic cartridge assays also are available but should not take the place of routine ova and parasite examination\(^2\). Only molecular testing (e.g., polymerase chain reaction) can be used to identify the subtypes of *Giardia*.

Cysts in the stool and trophs in duodenal content obtained using a string device.
Symptoms, history, epidemiology. Distinct from other dysentery due to lack of mucus, and blood in the stool, lack of increased PMN leukocytes in the stool and lack of high fever.
stool can make this infection difficult to diagnose. For this reason, fecal immunoassays that are more sensitive and specific should be used[2].
collected on separate days) increase test sensitivity\textsuperscript{[1]}. The use of concentration methods and trichrome staining might not be sufficient to identify \textit{Giardia} because variability in the concentration of organisms in the
Giardia trophozoites and cysts. Credit: Waterborne Disease Prevention Branch, CDC

Because Giardia cysts can be excreted intermittently, multiple stool collections (i.e., three stool specimens
(Enterotest\textsuperscript{R}). Trophs must be distinguished from the nonpathogenic flagellate \textit{Trichomonas hominis}, an asymmetrical flagellate with an undulating membrane.
Because the cysts are infectious when passed in the stool or shortly afterward, person-to-person transmission is possible. While animals are infected with Giardia, their importance as a reservoir is unclear.

fig.(1)
Cysts of *Giardia lamblia*, stained with iron-hematoxylin (A, B) and in a wet mount (C; from a patient seen in Haiti).

Size: 8-12 µm in length. These cysts have two nuclei each (more mature ones will have four). CDC

*Giardia lamblia* cyst. Iodine stain. CDC

*Giardia* trophozoites in section of intestine (H&E). © Dr Peter Darben, Queensland University of Technology. Clinical parasitology collection. Used with permission

Protozoa Infection in Human Intestine sp. (C) © Dr Dennis Kunzelman, University of Hawaii. Used with permission
Treatment: Metronidazole is the drug of choice.