Giardia

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Giardia lamblia, the causative agent of Giardiasis is an intestinal flagellate. It holds a special place in the science of parasitic protozoology because it was the first parasitic protozoan of human seen by Antonie von Leeuwenhoek in 1681.
Epidemiology

杨欢 Occurs worldwide.
杨欢 Giardiasis accounts for 3 to 4 million deaths of children under five years of age every year, constituting one of the leading causes of death in developing countries
杨欢 Risk Factors
杨欢 – Children who attend day care centers, including diaper-aged children
杨欢 – Child care workers, Parents of infected children,
杨欢 – People who swallow water from contaminated sources, People who drink from shallow wells, Backpackers, hikers, and campers who drink unfiltered, untreated water
杨欢 – Swimmers who swallow water while swimming in lakes, rivers, ponds, and streams
Taxonomy

- **Phylum** - Metamonida,
- **Class** - Trepomonadina –
  - **Order** - Giardiida,
  - **Genus** - Giardia,
    - **Species** - Giardia lamblia

This protozoa was initially named as Cercomonas intestinalis by Lambl in 1859 and renamed Giardia lamblia by Stites in 1915, in honour of Professor A. Giard of Paris and Dr. F. lambl of Prague.
Morphology

Giardia lamblia has two forms - Trophozoite and Cyst

Trophozoite: the trophozoite of Giardia lamblia is the active, motile feeding stage that causes the pathology in small intestine. It is approximately 12 to 15 μm long and 5 to 9 μm wide. It is pear-shaped with a cytoskeleton, two nuclei, and four pairs of flagella.

- The two nuclei are similar and located at the anterior of its body, which looks like owl’s eye.
- *Giardia lamblia* has four pairs of flagella beginning at the two sets of basal bodies that are in close proximity to the midline and anteroventral to the nucleus.
Morphology of cyst

- **Cyst**: The cysts are oval measuring about 5 by 7 to 10 µm in diameter. Each cyst contains four nuclei.

- An outer filamentous layer forms a wall about 0.3-0.5 µm thick surrounding the nuclei.

- There is also an inner membranous layer containing two membranes. proteins all come together to form the cyst wall.

- The cysts of *G. lamblia* are non motile and no longer adhere to the mucosal surface and is resistant to chlorine and cold water. It is killed by heat and desiccation and removed by filtration.
The parasite passes its life cycle in single host, man.

Cysts are the infected forms. When cysts are ingested along with contaminated food and drinks, they excyst in the small intestine and liberate two trophozoites.

Trophozoites multiply by longitudinal binary fission in the lumen of the proximal small bowel where they can be free or attached to the mucosa by a ventral-sucking disk.

Encystation occurs as the parasite transit toward the colon. The cyst is the stage found most commonly in non-diarrheal feces.
Life cycle
Life cycle at a glance

- Life cycle stages: Cysts & Trophozoites
- Infective form: Cysts
- Pathogenic form: Trophozoite
- Route of infection: fecal oral
- Site of excystation: Small intestine
- Site of encystations: Large intestine
Virulence factors

1. **Cytoskeleton** mediates the mechanical adherence to the intestinal wall as well as any surface they are located and ensures survival in the host’s intestine. It generally covers the whole ventral surface, narrowing into a lateral crest. The ventral disc contains a number of key proteins used for the organism’s adherence. **Actin, myosin, and tropomyosin** are the proteins involved.

2. **Adherence** additionally depends on the pathogen’s active metabolism. It is inclined to be inhibited by temperatures below 37°C, increased oxygen levels as well as reduced cysteine concentrations.

3. **Encystation** is one mechanism of self-defense from hostile environments. During replication and colonization, some of the trophozoites encyst in the jejunum. This usually occurs after the organism has contact with biliary secretions as well as conditions such as the temperature, humidity, ionic strength and chemical disinfectants. Substances that are alkalotic or contain fatty acids also tend to cause the encystations by causing cholesterol starvation.
Pathogenesis

The pathogenesis of giardiasis has not been completely elucidated. Ingestion of one or more cysts may cause disease, in contrast to hundreds to thousands of bacteria must be consumed to produce illness.

There are several theories –

a) Direct damage: trophozoites of *G. lamblia* can induce direct damage of intestinal brush border and mucosa that results in the secretion of fluid and alteration of bile content or duodenal flora that contributes to diarrhea.

b) Apoptosis in small intestinal epithelial cells can be induced by *G. lamblia*.

c) Disruption of tight junctional zona-occludens and thereby increasing epithelial permeability across epithelial monolayers.

d) Mechanical interference with absorption: Trophozoites of *G. lamblia* by its ventral sucker attach to the intestinal mucosa and thereby mechanically interfere with absorption resulting in steatorrhea.
The spectrum of illness varies from asymptomatic carriage to severe diarrhea and malabsorption.

**Acute giardiasis** develops after an incubation period of 1 to 14 days (average of 7 days) and usually lasts 1 to 3 weeks. Symptoms include diarrhea, abdominal pain, bloating, nausea, and vomiting.

**In chronic giardiasis** the symptoms are recurrent and malabsorption and debilitation may occur. Infection with *G. lamblia* was independently associated with a risk of stunted growth.

- About 40% of those who are diagnosed with giardiasis demonstrate disaccharide intolerance during detectable infection and up to 6 months after the infection can no longer be detected.
- Lactose (i.e., milk sugar) intolerance is most frequently observed. Some individuals (less than 4%) remain symptomatic more than 2 weeks; chronic infections lead to a malabsorption syndrome and severe weight loss. Chronic cases of giardiasis are frequently refractile to drug treatment.
Laboratory Diagnosis

✓ Principle:

– Giardiasis is diagnosed by the identification of cysts or trophozoites in the feces, using direct mounts as well as concentration procedures.
– Repeated sampling may be necessary.
– In addition, samples of duodenal fluid (e.g., Enterotest) or duodenal biopsy may demonstrate trophozoites.
– Alternate methods for detection include
  • antigen detection tests by enzyme immunoassays
  • detection of parasites by immunofluorescence
  • detection of nucleic acid by PCR.

All methods are available in commercial kits.
1. **Microscopy of stool**: 3 warm stool samples should be examined from different days.

2. **String test**: The organism can be detected from duodenal content by string test.

3. **Detection of antigen**: ELISA or an immunofluorescence assay. Sensitivity of 90 to 99 percent and a specificity of 95 to 100 percent.

4. **Direct fluorescent antibody (DFA) assay**: Highly sensitive and specific method and is considered the gold standard by many laboratories.

5. **Enzyme immunoassay (EIA)**: Sensitive and useful for screening large numbers of specimens.

6. **Rapid immunochromatographic cartridge assays (ICT)**: May be used with preserved specimens and are quick and easy to perform.

6. **PCR**: May be used where facilities are available but practically not used for diagnostic purpose.

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**Treatment**

- Metronidazole is the drug of choice 750 mg t.i.d., 5-10 days or 50 mg/kg, single dose for adults, cure rate 90%.

- Nitazoxanide has provided some encouraging results in the management of giardiasis.
Prevention

✔ Practicing sanitary awareness is the most effective tool in prevention.

✔ Washing hands with hot, soapy water before handling foods and eating, after using the toilet or changing a child, staying away from unprocessed foods, such as non-pasteurized milk, and washing, peeling or cooking raw foods and vegetables that could have potentially been fertilized by manure could decrease spread via a fecal-oral route.

✔ Only drinking water from a filtration system also prevents waterborne transmission.
Summary

1) *Giardia lamblia* is an intestinal flagellate, the first human parasite seen by microscope by Antony Von Leeuwenhoek in 1961. It is pear shaped with paired structures.

2) *G. lamblia* has two stages in its life cycle, cysts and trophozoites of which cysts are the infective stage and trophozoites are the pathogenic stage and both the stages found in the stool of patient with giardiasis. It is transmitted by fecal oral route.

3) *G. lamblia* causes giardiasis which is manifested by fatty diarrhoea and malabsorption, the exact mechanism of pathogenesis is not established. It is proposed to be caused by direct mechanical interference of absorption or direct damage of jejunum by trophozoite.

4) Diagnosis of giardiasis is based on identification of cysts or trophozoites of *G. lamblia* by repeated microscopic examination of stool and also by detection of antigen from stool. Direct fluorescent antibody test, EIA and PCR are also helpful.

5) Giardiasis can be effectively treated by metronidazole.
Study Questions

1. What is the historical significance of *G. lamblia* in parasitology? Why it is so named?
2. What is the mortality and morbidity of giardiasis? What is its clinical significance?
3. Describe peculiarities of morphology of *Giardia lamblia*.
4. Write about the laboratory diagnosis of giardiasis? Which test is most sensitive?
5. Write short notes on ‘string test’.
6. Write about the pathogenesis of giardiasis.
7. How can you treat giardiasis?