Lecture Title: Giardia lamblia

Synonyms:

Giardia lamblia (G. lamblia), Giardia doudenalis, Giardia intestinalis **Objectives:**

The main objectives of the lecture are:

- 1. Biology of Giardia parasite
- 2. Epidemiology and transmission of infection by G. lamblia
- 3. Pathogenesis and clinical picture of giardiasis
- 4. Laboratory diagnose and treatment of infection by G. lamblia
- 5. Control of infection by G.lamblia.

Biology

Habitat

G. *lamblia is an intestinal flagellate protozoan lives in the duodenum and upper jejunum; and is* the **only** protozoan parasite found in the <u>lumen</u> of the human small intestine.

Infective stage (form):

Is the mature cyst

The infective dose is >=10 mature cysts

Historical background:

- *Giardia* was originally observed by van Leeuwenhoek in 1681, in his own diarrheal stool.
- Described by Vilem Dusan Lambl in 1859 and by Alfred Giard in 1895.

Morphology:

A. Cyst:

- **O** The cyst stage has smooth-wall, oval, measures $8-12 \mu m$ by $7-10 \mu m$.
- When the cyst matures, nuclear division happens.
- Cyst is surrounded by hyaline cyst wall.
- Mature cyst contains 4 nuclei and then the cyst releases 2 trophozoites upon excystation.
- Once the host is infected, trophozoites may appear in the duodenum within minutes.
- Excystation occurs within 5 minutes of exposure of the cysts to an environment with a pH between 1.3 and 2.7.



G. lamblia cyst.(1)

- B. Trophozoite:
 - **O** It is teardrop-shaped (or tennis racket), measures 9-21 by 5-15 μ m.
 - The trophozoite has a convex dorsal surface and a flat ventral surface that contains the ventral disk.
 - The trophozoite has long axostyles, 4 pairs of flagella, directed posteriorly, that aid the parasite in moving.
 - Two symmetric nuclei with prominent karyosomes produce the characteristic face like image that appears on stained preparations.





Giardia intestinalis cyst. Note red-stained nuclei (trichrome stain, ×1000). (2)



Giardia lamblia trophozoite under microscope. (3)

Life cycle

- Mature cyst (the infective stage) is found on surfaces; in soil, food and water that have been contaminated with feces from infected individuals.
- Trophozoites can also be found in feces (both regarded as diagnostic stages).
- *Giardia* cyst is protected by an outer shell that allows it to survive outside the body for long periods of time and makes it tolerant to chlorine disinfection. The cysts are hard and can survive several months in cold water.
- Life cycle starts upon ingestion of cysts. <u>Because the cysts are infectious when</u> <u>passed in the stool or shortly afterward, person-to-person transmission is</u> <u>possible.</u>
- Excystation occur in the small intestine releasing trophozoites (each cyst produces two trophozoites).
- Trophozoites multiply by longitudinal binary fission, remaining in the lumen of the proximal small bowel where they can be free or attached to the mucosa by a ventral sucking disk.

• Encystation (formation of cysts) occurs as the parasites pass to the colon. The cyst is the stage that is found most commonly in non-diarrheal feces.



Epidemiology:

Transmission of infection

- Worldwide, more prevalent in warm climates, especially among children.
- *Giardia intestinalis* has been isolated from the stools of beavers, dogs, cats, and primates.
- Beavers may act as reservoir host for G. intestinalis.
- *Giardia* can be picked up from:
- Surfaces (such as bathroom handles, changing tables, or toys) that contain feces (poop) from an infected person or animal.
- Drinking water or using ice made from water sources where *Giardia* may live (for example, untreated or improperly treated water from lakes, streams, or wells)
- Swallowing water while swimming or playing in water where *Giardia* may live, especially in lakes, rivers, springs, ponds, and streams



- Eating uncooked food that contains *Giardia* organisms
- Having contact with someone who is ill with giardiasis
- Traveling to countries in which giardiasis is common

Pathogenicity and clinical picture:

Pathogenicity

- The mechanisms by which *Giardia* causes diarrhea and intestinal malabsorption are probably multi-factorial.
- The proposed pathological mechanisms include: <u>damage to the epithelial</u> <u>brush border, enterotoxins, immunological reactions, altered gut motility,</u> <u>fluid hyper secretion, and loss of sacharidase enzymes.</u>
- Variant-specific surface proteins (VSSPs) of *Giardia play* an important role in virulence and infectivity of the parasite. Antigenic variation helps the parasite in evasion of host immune system.

Risk factors for infection

- Being a child.
- Male homosexuality
- Mentally illness
- Blood group A,
- Achlorhydria,
- Use of *Cannabis*
- Chronic pancreatitis
- Malnutrition and immune defects such as 1gA deficiency and hypogamma globulinemia. Patients with cystic fibrosis and living in crowded areas.

Clinical picture:

- ✓ A symptomatic
- ✓ Acute giardiasis:
- It develops after an incubation period of 1 to 14 days (average of 7 days) and usually lasts 1 to 3 weeks. Acute symptoms include:

Diarrhea, gases, greasy stools that tend to float (steatorrhea), abdominal cramps, GIT upset or nausea/vomiting, and dehydration (loss of fluids).

The symptoms of giardiasis might seem to resolve, but come back again after several days or weeks. Giardiasis may be mild and self limited or can cause weight loss and malabsorption.

✓ Giardiasis in children

Severe giardiasis might delay physical and mental growth, slow development, growth retardation and malnutrition.

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✓ Chronic Giardiasis:

Cases of giardia infection may resemble IBS usually diagnosed by finding cysts in the stool of patients. Occasionally, Giardia colonizes the gallbladder, causing biliary colic and jaundice.

Diagnosis:

Stool examination:

- The traditional basis of diagnosis is the detection of G. *intestinalis* trophozoites or cysts in the stool of infected patients via a stool ova and parasite (O&P, i.e. general stool examination) examination.
- ✓ Fresh stool can be mixed with an iodine solution or methylene blue and examined for cysts on a wet mount.
- ✓ If not immediately examined, stool should be preserved in 10% formalin, with subsequent trichrome or iron hematoxylin staining.

• Trophozoites may be seen in fresh watery stool but difficult because they disintegrate rapidly. If the stool is not fresh or is semi formed to formed, trophozoites will not be found.

- Cysts passed in soft and formed stools.
- Ideally, 3 stool samples from each patient on different days should be examined because of potential variations in fecal excretion rate of cysts.
- *G intestinalis* is identified in 50-70% of patients after a single stool examination and in more than 90% after 3 stool examinations.
- Stool concentration methods are used when there is low excretion rate of cysts.
- Cyst passage may lag behind the onset of symptoms by a week or more.
- Because many antibiotics, enemas, laxatives, and barium studies mask or cause, the disappearance of parasites from the stools, microscopic examination should be postponed for 5 days following these interventions.

Note: Trophozoites are best to be examined by permanent staining techniques (trichrome stains).

Duodenal Aspiration:

It is done by aspiration of duodenal contents and demonstration of trophozoites. It is more invasive than stool examination and, may have a lower diagnostic yield.

Immunological tests:

- Stool antigen enzyme-linked immunosorbent assays are highly sensitive.
- Direct Immunofluorescence Assay (DFA) can be used to show the parasites in stool samples.

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- Since levels of serum immunoglobulin G (IgG) remain elevated for long periods, they are not beneficial in making diagnosis of acute giardiasis. Serum anti-Giardia immunoglobulin M (IgM) can be beneficial in distinguishing between acute infections and past infections (serology is not part of routine lab examination for Dx of G. lamblia).

Treatment:

- Single dose of tinidazole 2 g, or metronidazole 400 mg 3 times daily for 10 days, or nitazoxanide 500 mg orally twice daily for 3 days.
- Paromomycin has been recommended for use in pregnancy because systemic absorption is low, but the cure rate is lower than other agents.

Prevention:

- Proper hand wash with soap and good sanitation.
- Infected individuals not allowed using swimming pools, lakes, and rivers until they are symptom-free for few weeks.
- Chlorination, sedimentation, and filtration methods should be implemented adequately to purify public water supplies. Drinking water can be boiled for at least 5 minutes. Chlorine or iodine water treatments are less effective than boiling or filtration, but they may be used as alternatives.
- Advice travelers to endemic areas to avoid eating uncooked foods that may have been grown, washed, or prepared with contaminated water.
- Breastfeeding appears to protect infants from infection. Breast milk contains detectable titers of secretory IgA, which is protective for infants.

Summary:

- **O** G. lamblia is the **only** protozoan parasite found in the lumen of the human small intestine.
- Exists in two morphological forms (cyst and trophozoite)
- Mature cyst is the infective stage which is transmitted orally
- Causes, acute gastroenteritis or chronic condition
- Most commonly diagnosed by stool smear
- **O** Treated by tinidazole or metronidazole
- Prevention is important to decrease burden of transmission of disease

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