Introduction to Parasitology
&
Protozoa (A)

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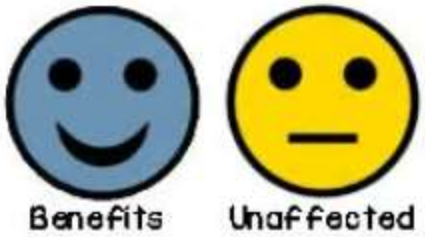
Terms used in Parasitology

- **Medical Parasitology:** is the science studying the parasites that infect the humans.
- **Parasite:** Is an organism, which is dependent on another organism (host) for its survival and causes harm to it.
- **Host:** Is a living organism that harbours the parasite.
- **Symbiosis** is a close, long-term interaction between two different species where at least one benefits

Types of symbiosis

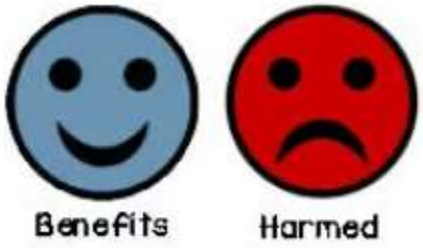
Mutualism

Both organisms benefit from the relationship



Commensalism

One organism benefits and the other is not helped or harmed



Parasitism

One organism benefits and the other is harmed

Terms used in Parasitology

- **Infective stage (I.S):** The stage by which the infection takes place.
- **Diagnostic stage (D.S):** The stage by which we can diagnose the parasitic infection (disease).
- **Habitat:** The natural site or location where the parasite lives.
- **Carrier:** A host in a state of equilibrium with parasite without or with minimal symptoms of the disease, but he is infective to others.
- **Zoonosis:** Transmission of an infection from animal to man either directly or indirectly via intermediate host.

Types of the parasites according to their in the host location

- **Ectoparasite:** A parasite that lives on the surface of

the host (infestation) (parasites on a body like lice or scabies).

- **Endoparasite:** A parasite that lives inside the body of its host (infection) either intracellular orextracellular.

Types of the parasites according to their relationship with the host

- **Obligatory parasite:** A parasite that is completely dependent upon a host.

- **Facultative parasite:** A parasite that is capable of living both freely and as a parasite.
- **Accidental (Incidental) parasite:** A parasite found in other host different from its normal host.

- **Permanent parasite:** A parasite that spends its life cycle on or in the body of its host.

- **Temporary or Intermittent parasite:** A parasite that visits its host only for a short period of time for its meal.

- **Opportunistic parasite:** A parasite that causes disease only in immunodeficient patients (AIDS, cancer patients), while in immunocompetent individuals, the parasite may exist in a latent form producing no or mild symptoms.

Types of the hosts

- **Definitive host (D.H):** It is the host which harbours the mature (adult) stage of the parasite or in which sexual reproduction of the parasite takes place.

- **Reservoir host (R.H) (source of infection):** It is an animal that harbours the mature (adult) stage of the parasite as in human. It acts also as a source of infection to man and maintains the parasite in nature.

- **Intermediate host (I.H):** It is the host which harbours the immature (larval) stage of the parasite (one or more intermediate hosts for one parasites).

- **Complete host:** which acts as both definitive and intermediate host.

Types of the hosts

- **Abberant host:** Often a "dead-end host," where a parasite is an **unusual** or **accidental host** and cannot complete its life cycle. The parasite may be unable to develop or mature, or it can cause severe, atypical symptoms in the host because it has infected the wrong location or species.

- **Vector:** An arthropod that carry the parasite to the host

Classification of Medical Parasitology

Medical Parasitology is classified into

Medical helminthology

Deals with parasitic worms

- **1-Phylum : Platyhelminthes (flat worms)**
  - **Class: Trematoda (flat worms)**
  - **Class: Cestoidea (tape worms)**
- **2-Phylum : Nemathelminthes (round worms)**
  - **Class:Nematoda**

Medical protozoology

Deals with unicellular parasites

1-Class: Rhizopoda: (move by pseudopodia) 2- Class: Ciliata (move by cilia)

3-Class: Zoomastigophora (move by flagellae)

4-Class: Sporozoa (move by gliding movement)

Classification of Phylum Protozoa

1- According to the organ of locomotion

- **1- Class Rhizopoda (Amoebae)** → Move by Pseudopodia
- **2- Class Ciliata (Ciliates)** → Move by cilia
- **3- Class Zoomastigophora (Flagellates)** → Move by flagella
- **4- Class Sporozoa (Plasmodia & Coccidia)** → Move by gliding

2- According to the habitat

1- Intestinal protozoa

- **Amoeba:**
  - *Entamoeba histolytica*
- **Ciliates:**
  - *Blantidium coli*
- **Flagellates:**
  - *Giardia lamblia*
- **Coccidia:**
  - *Cryptosporidium*

2- Blood protozoa

- **Flagellates:**
  - *Trypanosoma & Leishmania*
- **Plasmodia:**
  - Malaria
- **Coccidia:**
  - *Babesia*

3- Tissue protozoa

- **Flagellates:**
  - *Trypanosoma & Leishmania*
- **Coccidia:**
  - *Toxoplasma*

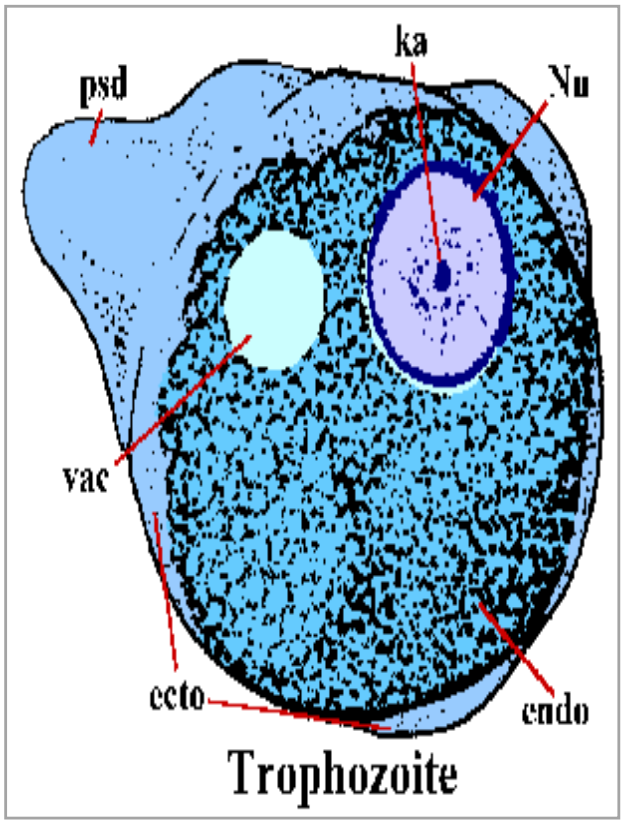
5- Urogenital protozoa

- **Flagellates:**
  - *Trichomonas vaginalis*

General characters

Protozoa are made of protoplasm that differentiated into:

- **Nucleoplasm.**
- **Cytoplasm which consists of:**
  - Outer thin hyaline ectoplasm.
  - Inner granular endoplasm.



Respiration

- **Aerobic:** For protozoa living in tissues or blood
- **Anaerobic:** For protozoa living in the intestinal lumen

Encystation:

- Formation of cysts that resist unfavourable conditions outside the body and for protection against digestive juice of the gastrointestinal tract.

Class: Rhizopoda (Amoebae)

1- Amoebae of large intestine

- *Entamoeba histolytica* (The only pathogenic)
- *Entamoeba coli.*

2- Amoeba of buccal cavity

Entamoeba gingivalis

3- Free living amoebae

Pathogenic free living amoebae

Naegleria fowleri & *Acanthamoeba*

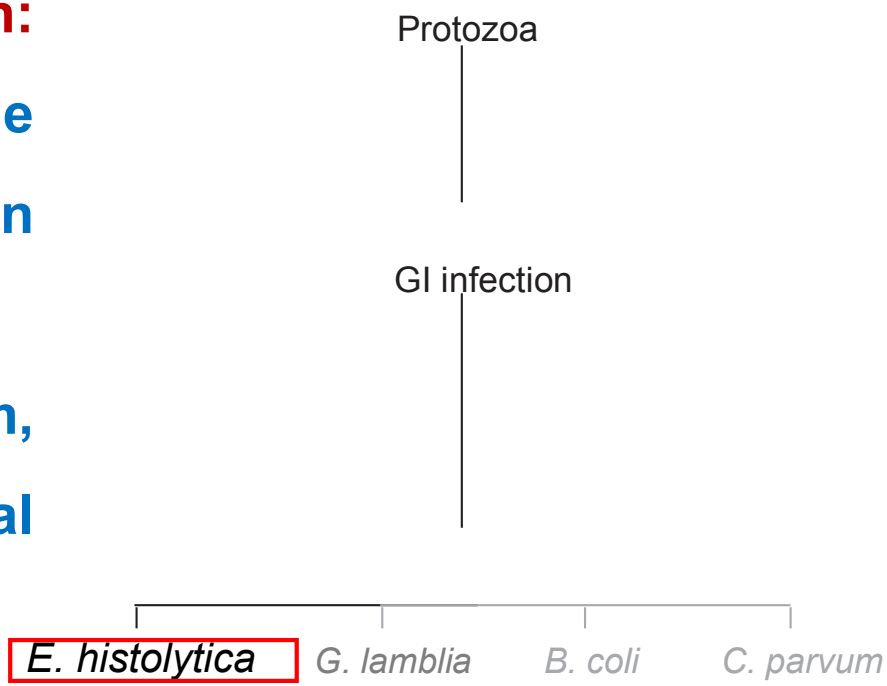
Non pathogenic free living amoebae

Coprozoic amoebae

✍**N.B.** Other species of amoebae are commensals in the large intestine such as ***E. hartmani*** & ***E. dispar*** & are morphologically similar to ***E. histolytica***. So **PCR** is required to differentiate bet. amoebae species.

Entamoeba histolytica

- **Geographical distribution:** Worldwide especially in the temperate zone and more common in areas with poor sanitary conditions.
- **Habitat:** Large intestine (caecum, colonic flexures and sigmoidorectal region).
- **D.H:** Man
- **R.H:** Dogs, pigs, rats and monkeys.
- **Disease:** Amoebiasis or amoebic dysentery



Mode of infection

1- Contaminated foods (ex. green vegetables) or drinks or hands with human stool containing mature cyst.

2- Handling food by infected food handlers as cookers and waiters.

3- Flies and cockroaches that carry the cysts from faeces to exposed food.

4- Autoinfection (faeco-oral or hand to mouth infection).

5- Homosexual transmission.

With heavy infection and lowering of host immunity

The trophozoites of *E. histolytica* invade the mucosa and submucosa of the large intestine by secreting lytic enzymes forming flask - shaped amoebic ulcers

The most common sites of amoebic ulcers are caecum, colonic flexures and sigmoidorectal regions due to decrease peristalsis & slow colonic flow at these sites that help invasion.

Clinical pictures

I) Intestinal amoebiasis

1-Asymptomatic infection

Most common and trophozoites remain in the intestinal lumen feeding on nutrients as a commensal without tissue invasion (Asymptomatic patient known as a healthy carrier and cyst passers)

2-Symptomatic infection

a) Acute amoebic dysentery

Presented with fever, abdominal pain, tenderness, tenesmus (difficult defecation) and frequent motions of loose stool containing mucus, blood and trophozoites.

b) Chronic infection

-Occurs if acute dysentery is not properly treated.
-With low grade fever, recurrent episodes of diarrhea alternates with constipation.
- Only cysts are found in stool.

3-Complications

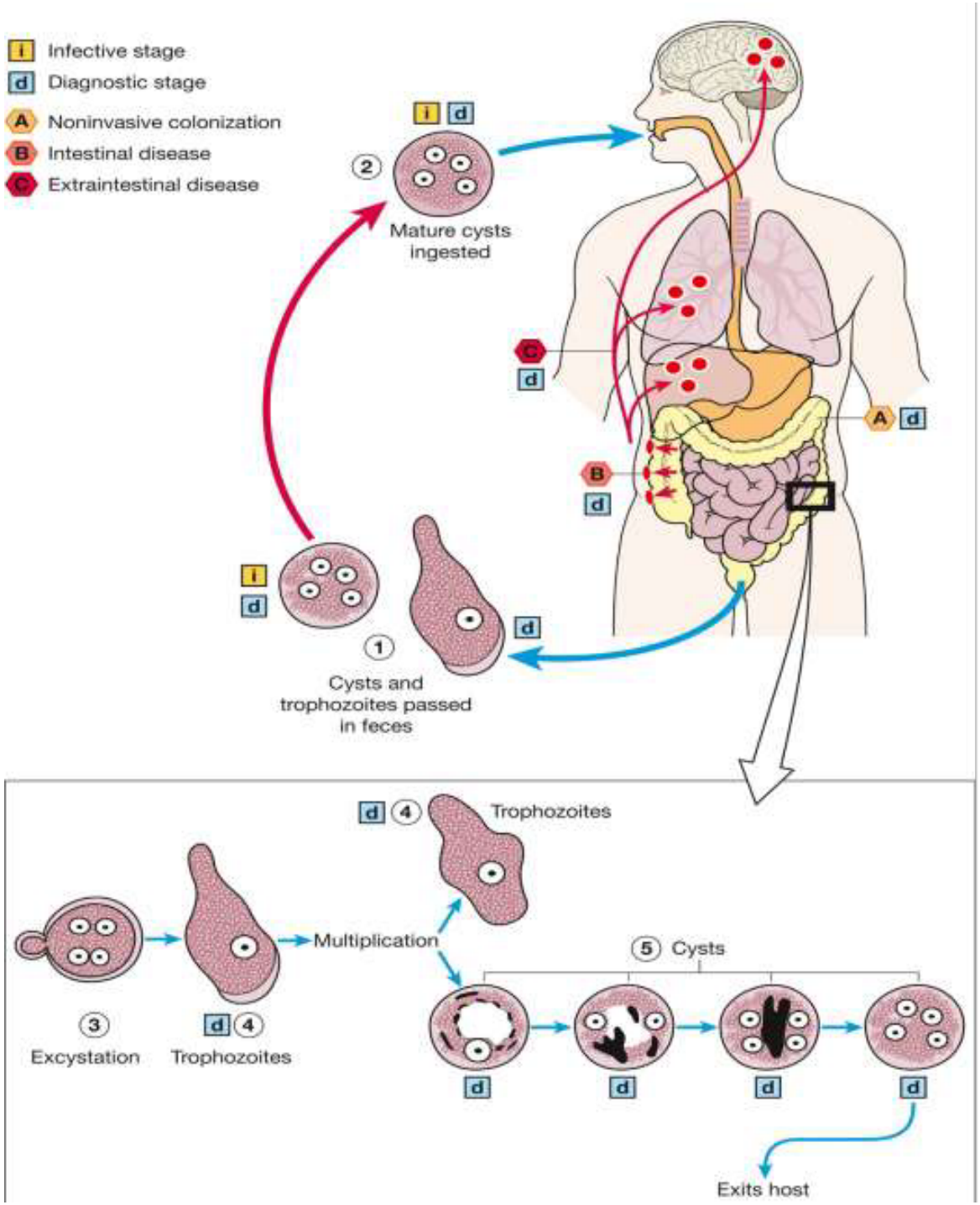
- Haemorrhage due to erosion of large blood vessels.
- Intestinal perforation ➲ peritonitis.
- Appendicitis.
- Amoeboma (Amoebic granuloma) around the ulcer ➲ stricture of affected area.

II) Extra-intestinal amoebiasis

Due to invasion of the blood vessels by the trophozoites in the intestinal ulcer ➲ reach the blood ➲to spread to different organs as:

Liver →	**-Amoebic liver abscess or diffuse amoebic hepatitis.** **-Affect commonly right lobe either due to spread via portal vein or extension from perforating ulcer in right colonic flexure.** **-CP: include fever, hepatomegaly and pain in right hypochondrium.**
Lung →	**•Lung abscess ➲ pneumonitis with chest pain, cough, fever.** **•Amoebic lung abscess usually occur in the lower part of the right lung due to direct spread from the liver lesions**
Brain →	Brain abscess ➲ encephalitis (fatal).
Skin →	Cutaneous amoebiasis (Amoebiasis cutis) due to either extension of acute amoebic colitis to the perianal region or through rupture on the abdominal wall from hepatic, colonic or appendicular lesions.

E. histolytica life cycle



Laboratory diagnosis

I)Intestinal amoebiasis

a) Direct

•**Macroscopic:** Offensive loose stool mixed with mucus and blood.

•**Microscopic:**

1-Stool examination: Reveals either trophozoites (in loose stool) or cysts (in formed stool) by direct smear, iodine stained & culture.

2-Sigmoidoscopy: To see the ulcer or the trophozoites in aspirate or biopsy of the ulcer.

3-X-ray after barium enema: to see the ulcer, deformities or stricture.

b) Indirect

-Serological tests: CFT, IHAT, IFAT, ELISA and GDPT (gel-diffusion precipitin test).

✍**N.B.** These serological tests are positive only in invasive intestinal amoebiasis but negative in asymptomatic carriers.

II)Extra- intestinal amoebiasis

According to the organ affected

a) Direct

1- X- ray:

In liver ➲ space occupying lesion.

In lung ➲pleuritis with elevation of the diaphragm

2- Ultrasonography, CT scan& MIR:

For liver abscess.

3- Aspiration of abscess content:

For liver abscess to detect trophozoites.

b) Indirect

1- Serological tests: As intestinal amoebiasis. They are positive and can persist for years.

2- Molecular by PCR.

3- Blood examination: Leucocytosis.

4- Liver function tests: Increased in amoebic liver abscess.

Treatment

1) Asymptomatic intestinal carrier

↓

Luminal amoebicides

↓

Paromomycin or

Diloxanide furoate

2) Intestinal and extra intestinal amoebiasis

↓

Tissue & luminal amoebicides

↓

Metronidazol

(Flagyl) **is the drug of choice** +

Paromomycin or

Diloxanide furoate

CLINICAL CASE

- After a camping trip to Mexico, a patient visits her doctor complaining of loose stools and abdominal cramps.
- The patient describes the stools as having flecks of blood and lots of mucus.
- The doctor orders a stool specimen in which she finds motile amoeba with ingested RBCs.
- She starts the patient on metronidazole and considers a CT scan to detect any liver abscesses.

2- According to the habitat

1- Intestinal protozoa

- **Amoeba:** *Entamoeba histolytica*
- **Ciliates:** *Blantidium coli*
- **Flagellates:** *Giardia lamblia*
- **Coccidia:** *Cryptosporidium*

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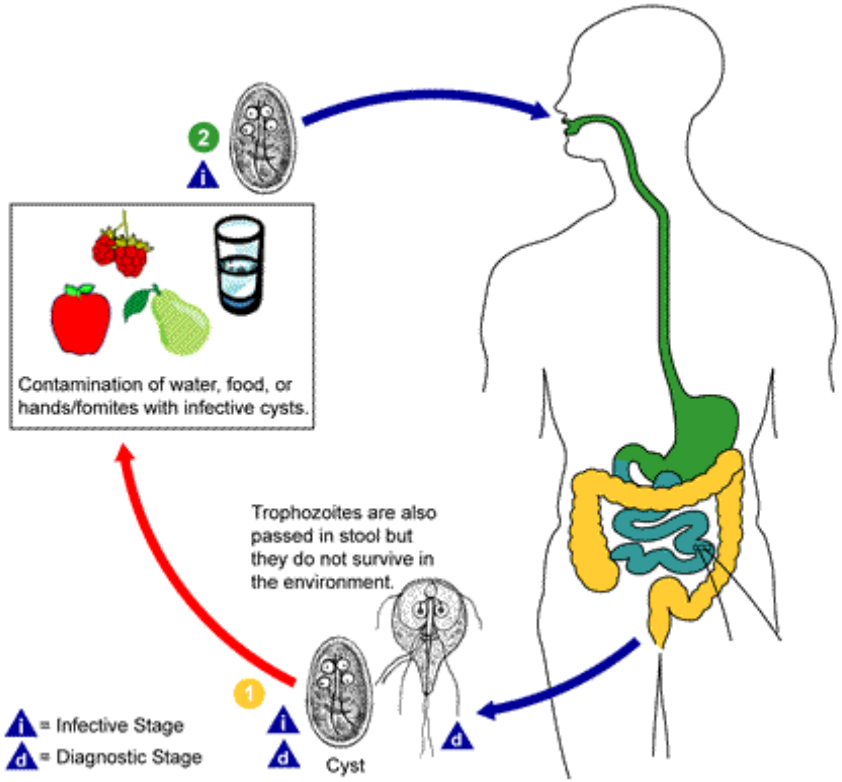
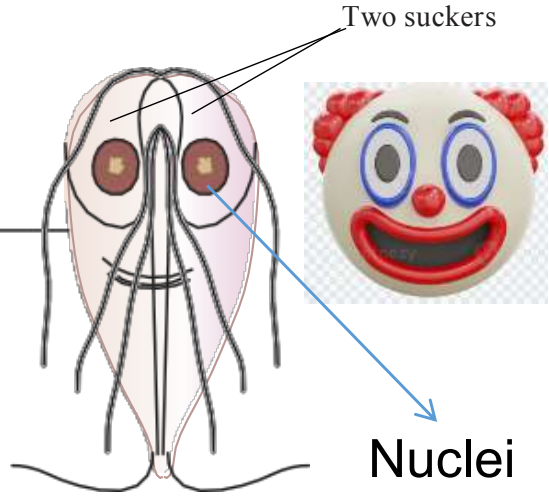
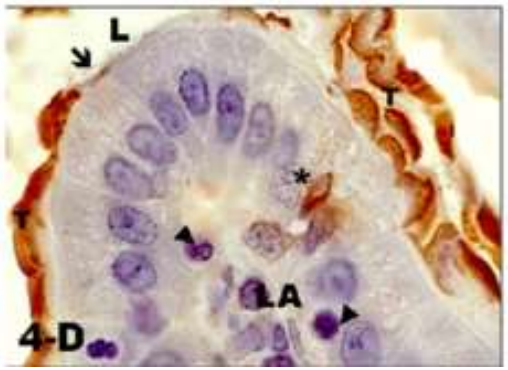
Giardia lamblia

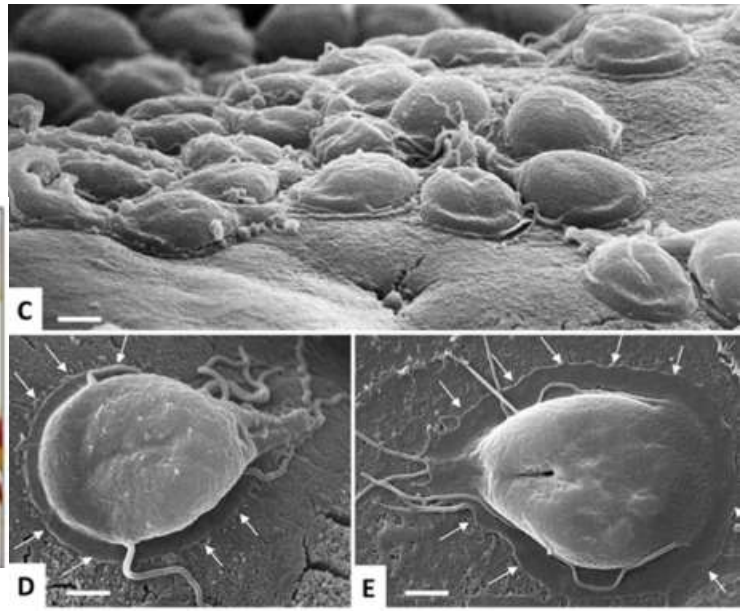




Trophozoite

Attachment to the cell surfaces Leads to malabsorption and atrophy





Giardia lamblia

Basics

- **Flagellated protozoan**
- Transmission: **fecal–oral**, **cysts** in contaminated water
→ common in **campers/hikers** ("**beaver fever**")
- Risk groups: day-care centers, travelers, oral–anal contact

Study Tip

Diarrhea caused by protozoa:

bloody → *Entamoeba histolytica*
fatty → *Giardia lamblia*
watery → *Cryptosporidium parvum*

Life Cycle

1. Ingestion of cysts
2. Excystation in **duodenum** → **trophozoites** attach to mucosa via **ventral sucking disk**
3. Do **not invade** the mucosa → **no blood**, **no eosinophilia**
4. Encystation as they move to colon → **shed in stool**

Pathophysiology

- Trophozoites **attched leads to** villous atrophy→ **fat malabsorption**
- ↓ brush-border disaccharidases → **osmotic diarrhea**

Clinical Presentation

- **Watery, foul-smelling diarrhea**
- **Steatorrhea**, bloating, flatulence
- Weight loss, fat-soluble vitamin deficiencies possible
- Can be **chronic** in patients with **IgA deficiency** or **X-linked agammaglobulinemia**

Giardia lamblia

Diagnosis

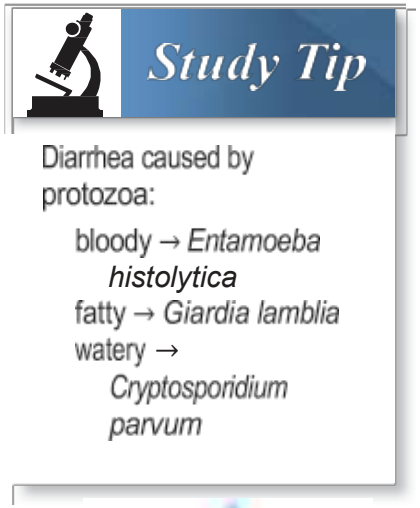
- **Trophozoites** or **cysts in stool O&P**
- Stool **antigen test** (ELISA) – most commonly used
- PCR also possible
- Duodenal biopsy: trophozoites on mucosa (rarely needed)

Treatment

- **Metronidazole** = first-line
- Alternatives: **tinidazole**, **nitazoxanide**
- Treat close contacts sometimes (high reinfection risk)

Buzzwords

- "**Camper/hiker drank untreated stream water**"
- "**Foul-smelling, greasy diarrhea**"
- "**Trophozoites with two nuclei → owl-eye appearance**"
- "**Fat malabsorption → steatorrhea**"
- "**IgA deficiency → chronic infection**"



CLINICAL CASE

A student cuts short an extended trip in a park after developing diarrhea. He explains to his doctor that the diarrhea is nonbloody but smells very bad. On further questioning, the student tells his doctor that he has been drinking water from a fresh water spring. The patient appears malnourished on physical exam. A diarrhea sample reveals 2 -nuclei motile amoeba with a tear-drop shape and 4 pairs of flagella. The student is given metronidazole.