



Entamoeba histolytica & Giardia lamblia

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Parasitology

Summer School

Lecture 2

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Entamoeba histolytica

Case study

A 27-year-old man presented with abdominal cramps, frequent bloody diarrhea, and tenesmus for 10 days. He had recently traveled to an area with poor sanitation and reported drinking untreated water. Stool examination revealed characteristic cysts and trophozoites of **Entamoeba histolytica**, with trophozoites containing ingested red blood cells. He was treated with metronidazole followed by a luminal amoebicide and advised on proper handwashing, safe drinking water, and food hygiene, leading to complete recovery.

Epidemiology and prevalence

- *E. histolytica* is worldwide in prevalence, being much more common in the tropics than elsewhere. It has been found wherever sanitation is poor, in all climatic zones
- While the majority of infected humans (80-99%) are asymptomatic, invasive amebiasis causes disabling illness in an estimated 50 million people and causes 50,000 deaths annually, mostly in the tropical belt of Asia, Africa and Latin America.
- It is the third leading parasitic cause of mortality, after malaria and schistosomiasis.

Morphology

E. histolytica occurs in two forms:

1. Trophozoite
2. Cyst.

Trophozoite

- Trophozoite is the vegetative or growing stage of the parasite. It is the only form present in tissues.
- It is irregular in shape and varies in size from 12-60 μm ; average being 20 μm . It is large and actively motile in freshly-passed dysenteric stool.
- The trophozoites divide by binary fission in every 8 hours.

Trophozoite Stage

Cytoplasm:

Outer ectoplasm: clear, transparent, refractile.

Inner endoplasm: finely granular, ground-glass appearance; contains nucleus, food vacuoles, RBCs, sometimes WBCs, and tissue debris.

Pseudopodia & Movement:

Finger-like projections formed by jerky ectoplasm movement followed by endoplasm flow. Movement is crawling/gliding (not swimming) and requires attachment to a surface.

Nucleus:

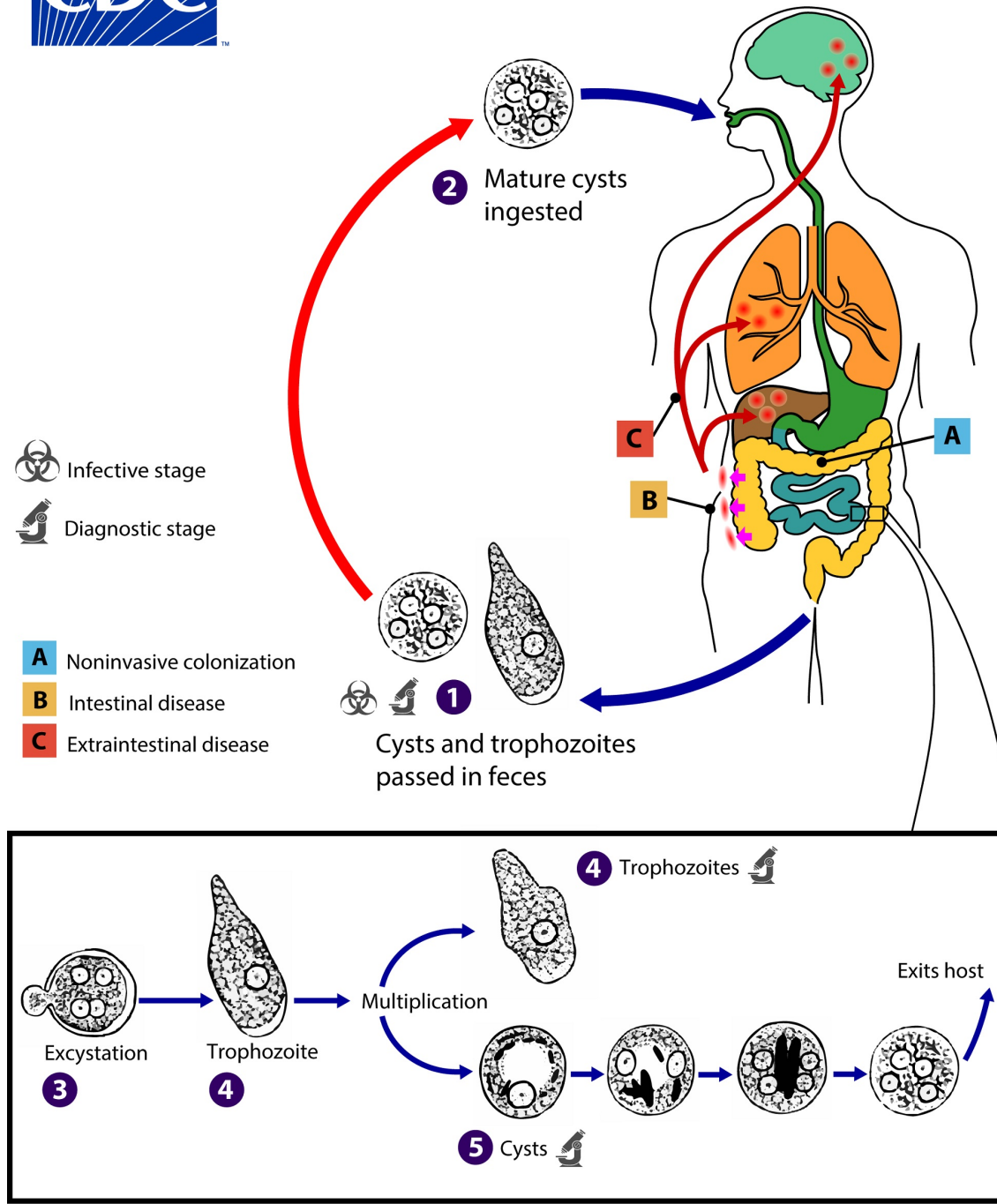
Spherical, 4–6 μm , with a central karyosome

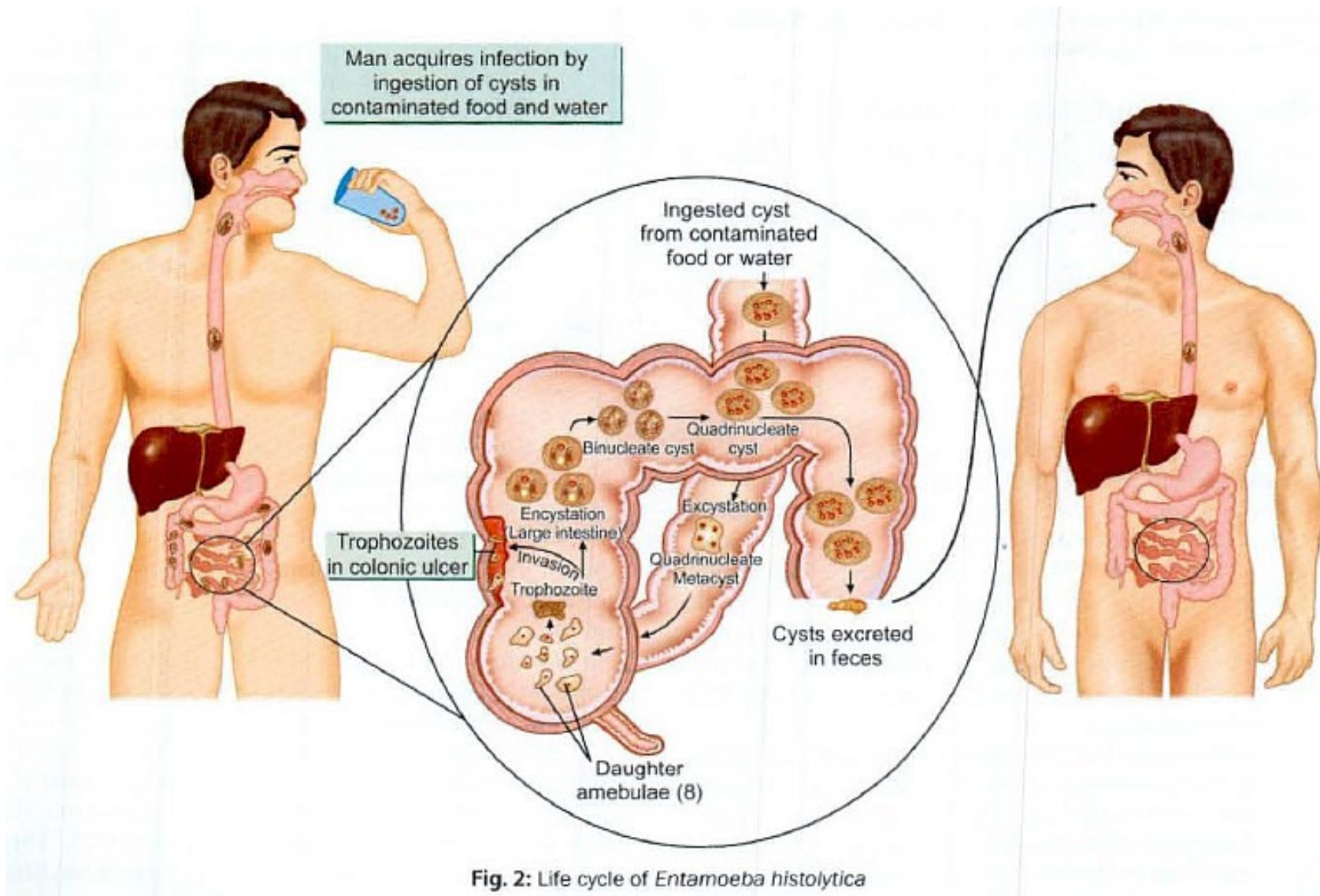
Cyst Stage

- The early cyst contains a single nucleus
- As the cyst matures, the nucleus undergoes two successive mitotic divisions to form two and then four nuclei. The mature cyst is, thus, quadrinucleate.
- The cyst wall is a highly refractile membrane, which makes it highly resistant to gastric juice and unfavourable environmental conditions.

Life cycle

- Infection occurs by ingestion of mature cysts in contaminated food or water.
- In the small intestine, cysts excyst and release trophozoites.
- Trophozoites multiply in the large intestine, may remain harmless or invade tissues (causing dysentery, liver abscess).
- Some trophozoites encyst in the colon → cysts are passed in faeces.
- Cysts survive outside the body and infect a new host.





Pathogenesis

- *E. histolytica* causes intestinal and extraintestinal
- amebiasis.
- The incubation period is highly variable. On average, it ranges from 4 days to 4 months.
- Amebiasis can present in different forms and degrees of severity, depending on the organ affected and the extent of damage caused.

Pathogenesis

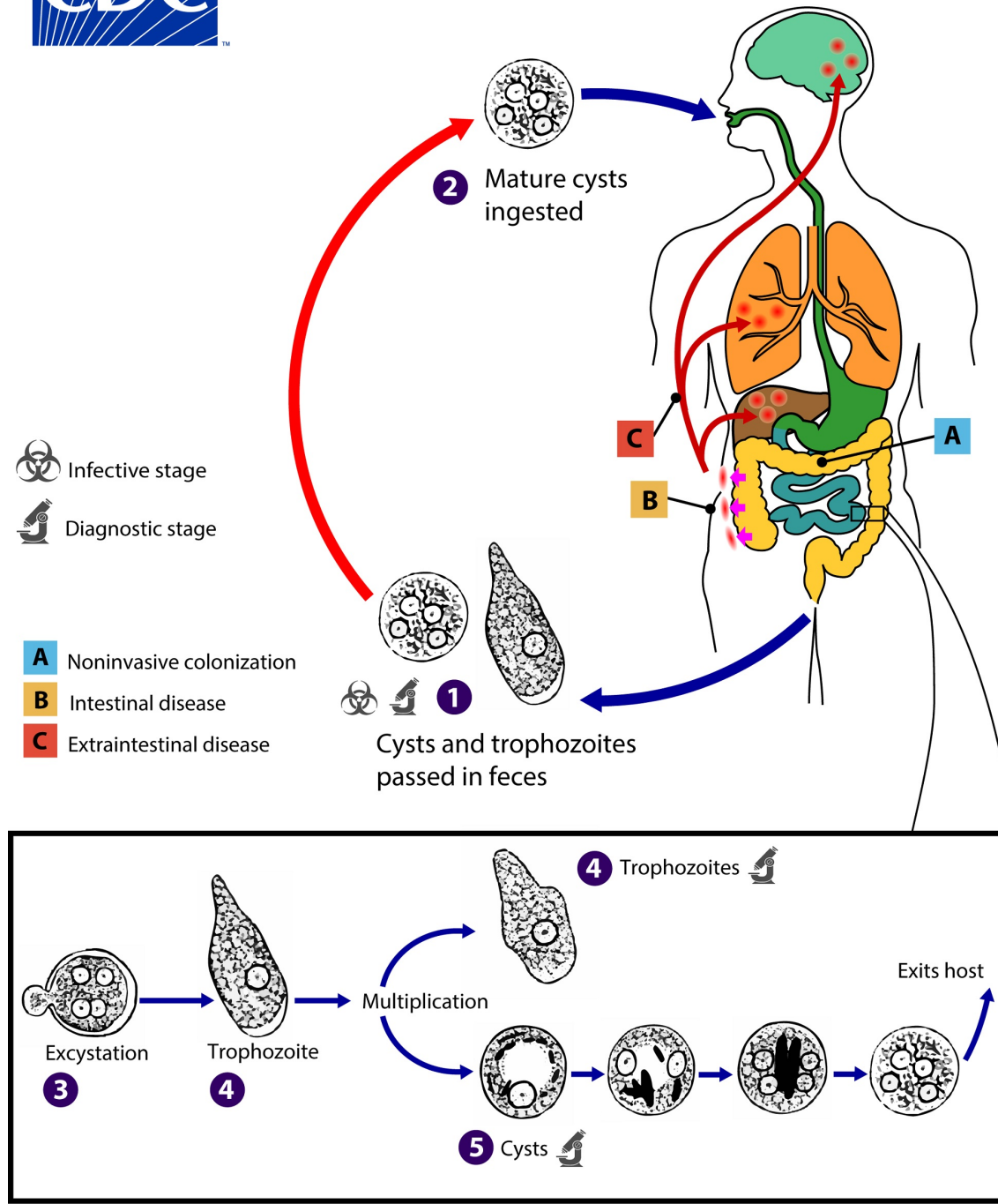
Intestinal amebiasis

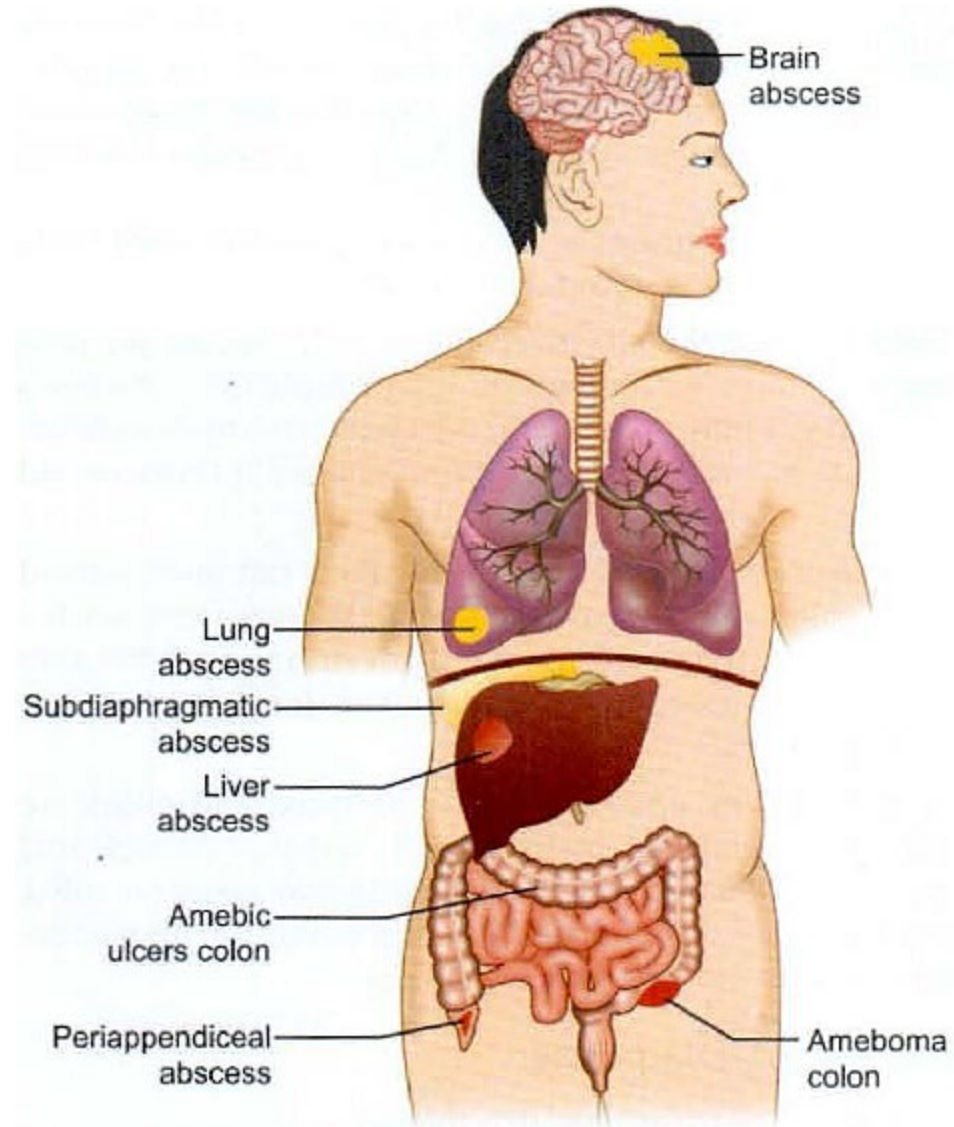
- Most infections (90%) are asymptomatic; only ~10% become invasive.
- Adherence: Amebic lectins mediate adherence to glycogen receptors of colonic mucosa
- Cytolysis: The metacystic trophozoites penetrate the columnar epithelial cells. Tissue necrosis occurs due to amebic enzymes and host inflammatory response (IL-8, TNF- α).
- The typical amebic ulcer is flask-shaped in cross section, with the mouth and neck being narrow and the base large and rounded.

Pathogenesis

Extra-intestinal amebiasis

- **Hepatic amebiasis:** is the most common extra-intestinal complication of amebiasis. Although trophozoites often reach the liver, only 5–10% of intestinal cases develop liver abscesses.
- **Pulmonary amebiasis** is rare and usually results from extension of a hepatic abscess through the diaphragm, typically affecting the lower right lung. Rarely, it occurs by direct hematogenous spread from the colon.
- **Metastatic amebiasis** occurs via hematogenous or lymphatic spread, causing abscesses in organs like the kidney, brain, spleen, and adrenals. Brain involvement is highly destructive and often fatal.





Sign and symptoms

Intestinal amebiasis

- Only about 10% to 20% of people infected with *E. histolytica* become ill. Even then, symptoms are often mild. They can include diarrhea, stomach pain, and stomach cramping. Symptoms usually develop within 2 to 4 weeks but can show up later.
- A severe form of amebiasis called amebic dysentery can cause stomach pain, bloody poop, and fever.

Sign and symptoms

Extraintestinal amebiasis

- Rarely, *E. histolytica* travels through the blood stream to the liver and forms an abscess (collection of pus). In a small number of instances, the parasite has spread to other parts of the body, including the lungs and brain.
- Liver abscess: fever, right upper quadrant pain, tender, enlarged liver
- Lung involvement: cough, chest pain, dyspnea
- Brain involvement (rare): headache, confusion, seizures

Laboratory Diagnosis

- Macroscopic appearance:
- The stool is foul-smelling, semiliquid, brownish -black in color and intermingled with blood and mucus. It does not adhere to the container.

Laboratory Diagnosis



1. Microscopic appearance:

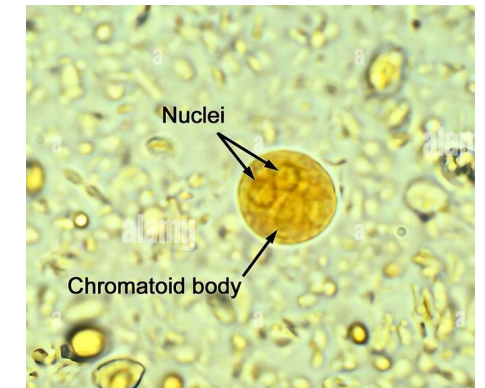
Saline preparation

- Actively motile trophozoites can be demonstrated in freshly passed stool. Presence of ingested RBCs clinches the identity of *E. histolytica*.
- Cyst has a smooth and thin cell wall



2. Iodine preparation:

- For the demonstration of cysts or dead trophozoites, iodine preparations may be required for the study of the nuclear character

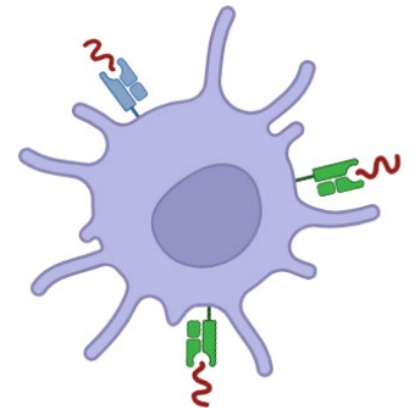
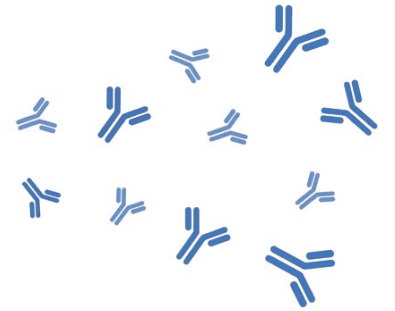


Laboratory Diagnosis

Serodiagnosis:

Serological tests become positive only in invasive amebiasis.

- Antibody detection: Amebic antibodies appear in serum only in late stages of intestinal amebiasis
- Amebic antigen detection: Amebic antigen in serum are detected only in patients with active infections and disappears after clinical cure. Antigen like Lipophosphoglycan (LPG) amebic lectin.



Treatment

Three classes of drug are used in the treatment of amebiasis:

1. **Luminal amebicides:** Diloxanide furoate, iodoquinol, paromomycin and tetracycline act in the intestinal lumen but not in tissues.
2. **Tissue amebicides:** Emetine, chloroquine, etc. are effective in systemic infection, but less effective in the intestine. Dosage of chloroquine in amebic liver abscess is 1g for 2 days followed by 5g daily for 3 weeks.
3. **Both luminal and tissue amebicides:** Metronidazole and related compounds like tinidazole and ornidazole act on both sites and are the drug of choice for treating amebic colitis and amebic liver abscess.

Giardia lamblia

Case study

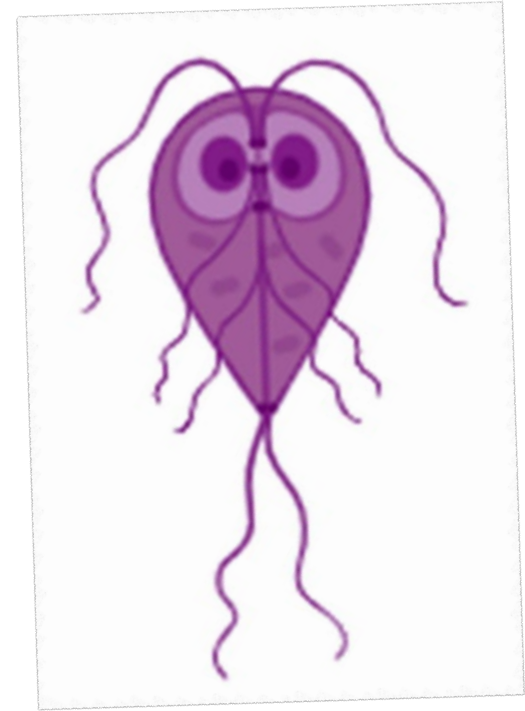
A 10-year-old boy presented with foul-smelling, greasy diarrhea, abdominal bloating, and weight loss for 2 weeks. His symptoms began after drinking untreated water during a camping trip. Stool examination revealed pear-shaped trophozoites and characteristic cysts of **Giardia lamblia**. He was treated with metronidazole and advised to drink safe water and maintain proper hand hygiene, resulting in complete recovery.

Introduction

Giardia lamblia is a flagellated protozoan parasite that infects the small intestine, causing giardiasis, a diarrheal disease.

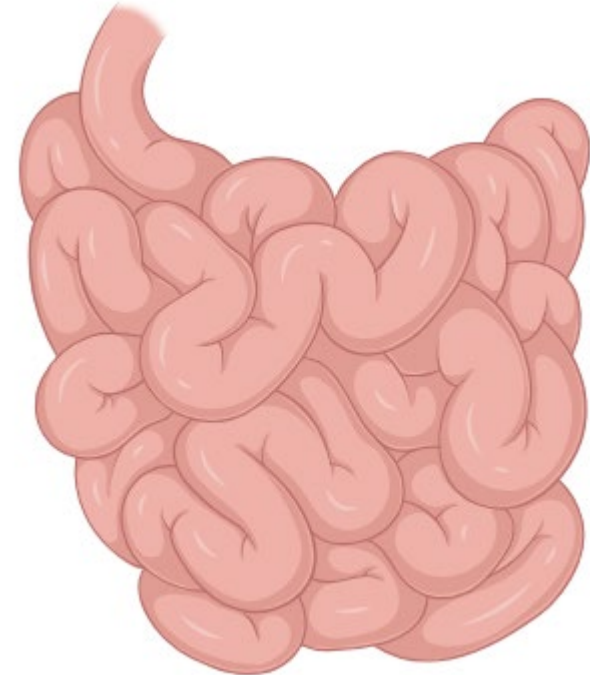
Mode of infection

It is transmitted mainly through ingestion of cysts in contaminated water, food, or by fecal–oral contact.



Habitat

G. lamblia lives in the duodenum and upper jejunum and is the only protozoan parasite found in the lumen of the human small intestine

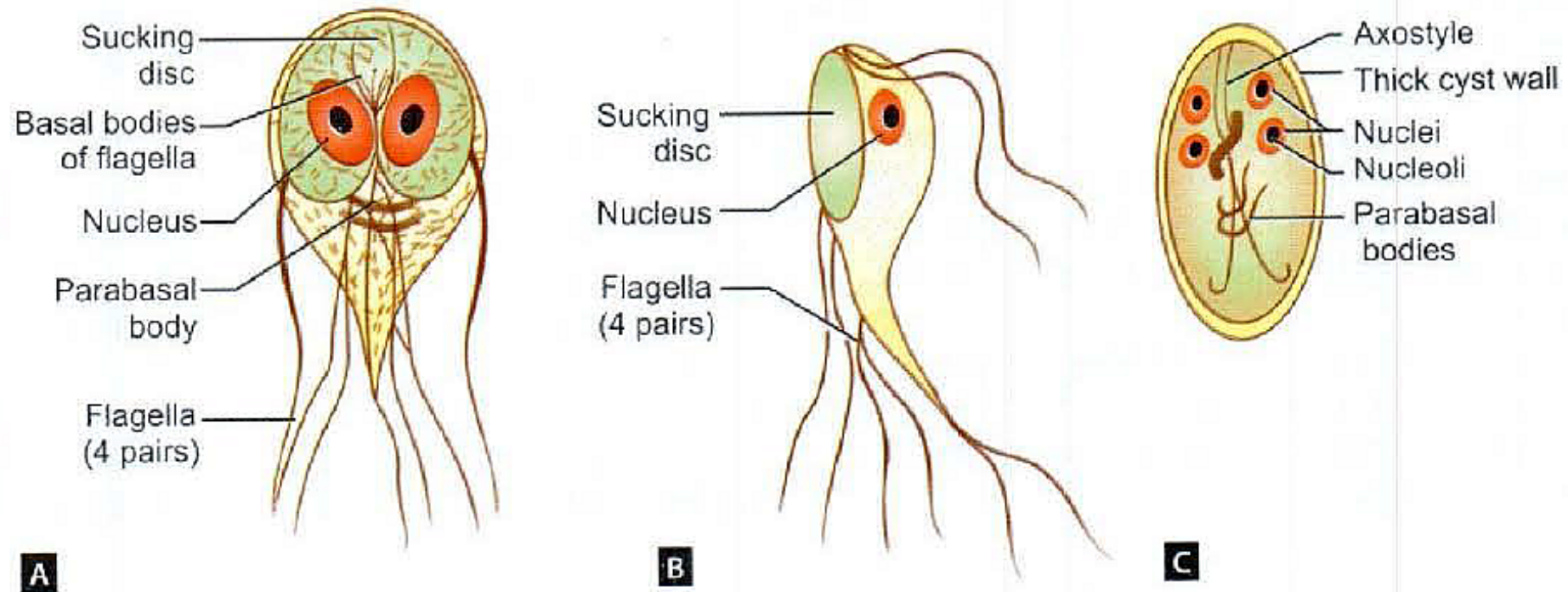


Morphology

It exists in two forms:

1. Trophozoite (or vegetative form)

2. Cyst (or cystic form).



Figs 2A to C: Trophozoite. (A) Ventral view; (B) Lateral view; and (C) Quadrinucleate cyst

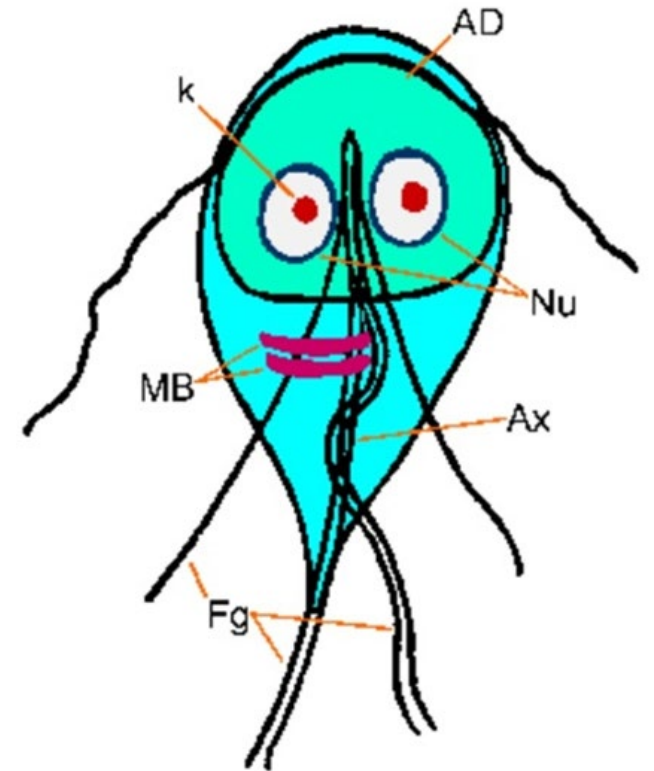
Morphology

Trophozoite

- It is in the shape of a tennis racket (heart-shaped or pyriform-shaped) and is rounded anteriorly and pointed posteriorly.
- It measures $15\text{ }\mu\text{m}$ x $9\text{ }\mu\text{m}$ wide and $4\text{ }\mu\text{m}$ thick.
- Dorsally, it is convex, and ventrally, it has a concave sucking disk, which helps in its attachment to the intestinal mucosa.

It is bilaterally symmetrical and possesses:

- One pair of nuclei
- Four pairs of flagella
- One pair of axostyles, running along the midline
- Two sausage-shaped parabasal or median bodies

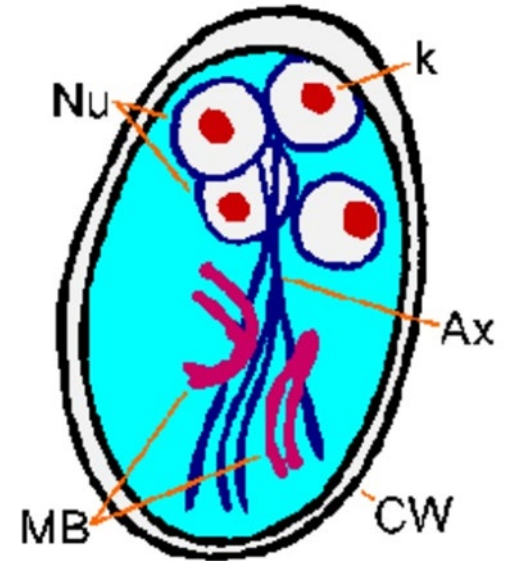


Morphology

Cyst

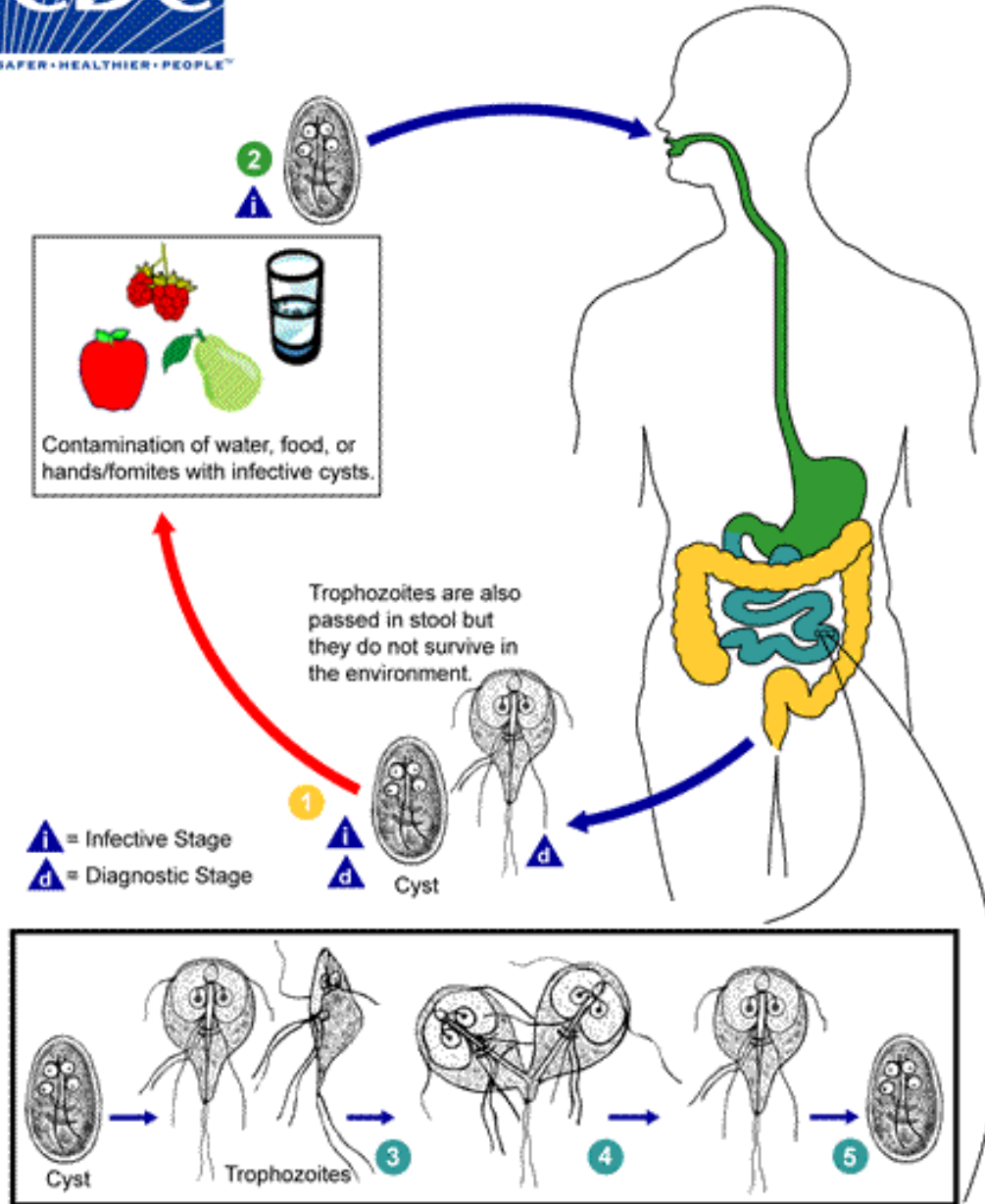
It is the infective form of the parasite.

- The cyst is small and oval, measuring $12\text{ }\mu\text{m} \times 8\text{ }\mu\text{m}$ and is surrounded by a hyaline cyst wall.
- Its internal structure includes two pairs of nuclei grouped at one end. A young cyst contains one pair of nuclei.
- The axostyle lies diagonally, forming a dividing line within the cyst wall.



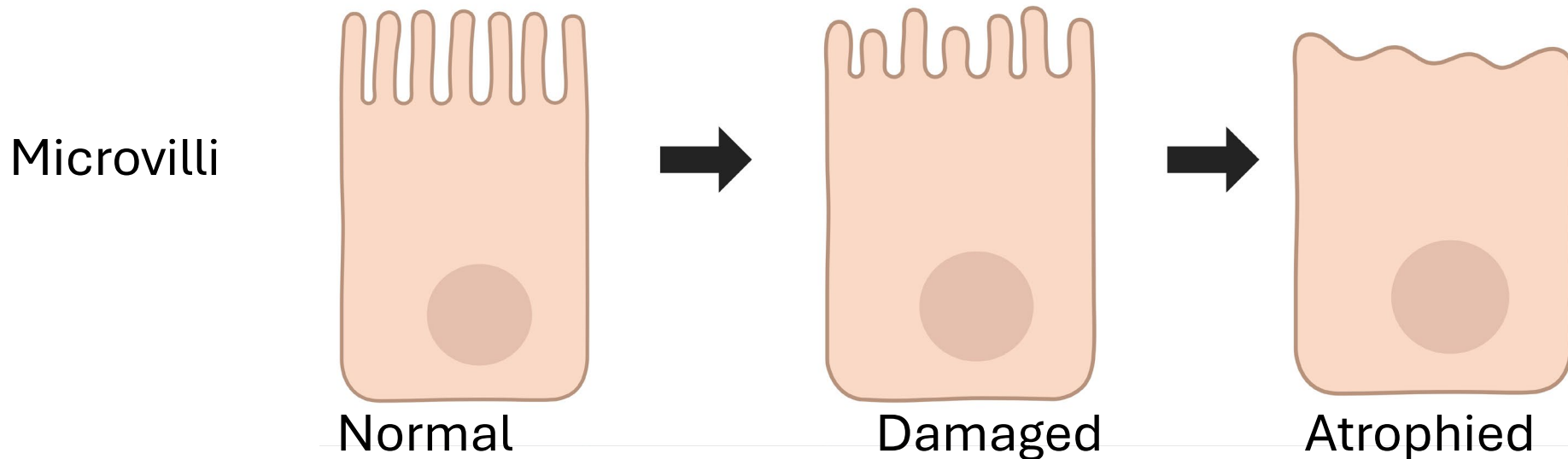
Life Cycle

- Infection starts when cysts are ingested via contaminated water, food, or hands.
- In the small intestine, cysts release trophozoites.
- Trophozoites multiply and attach to the intestinal lining, sometimes causing symptoms.
- Some trophozoites encyst and are excreted in feces, contaminating the environment.
- Cysts in the environment can infect a new host, completing the cycle.



Pathogenesis

G. lamblia is typically seen within the crypts of duodenal and jejunal mucosa. It does not invade the tissue but remains tightly adhered to the intestinal epithelium by means of the sucking disk. Sometimes it may cause the destruction of the microvilli



Sign and symptoms

- Often they are asymptomatic, but in some cases, Giardia may lead to mucus diarrhoea, fat malabsorption (**steatorrhea**), dull epigastric pain, belching and flatulence. The stool contains excess mucus and fat, but no blood
- Children may develop chronic diarrhea, malabsorption of fat, vitamin A, vitamin B12, folic acid, protein, sugars like xylose disaccharides, and weight loss.



Laboratory Diagnosis

Stool Examination

Giardiasis can be diagnosed by the identification of cysts of *Giardia lamblia* in the formed stools and the trophozoites and cysts of the parasite in diarrheal stools

- On microscopic examination, cysts and trophozoites can be found in diarrheal stools by saline and iodine wet preparations. Often, multiple specimens need to be examined



Laboratory Diagnosis

Serodiagnosis

Antigen detection: ELISA

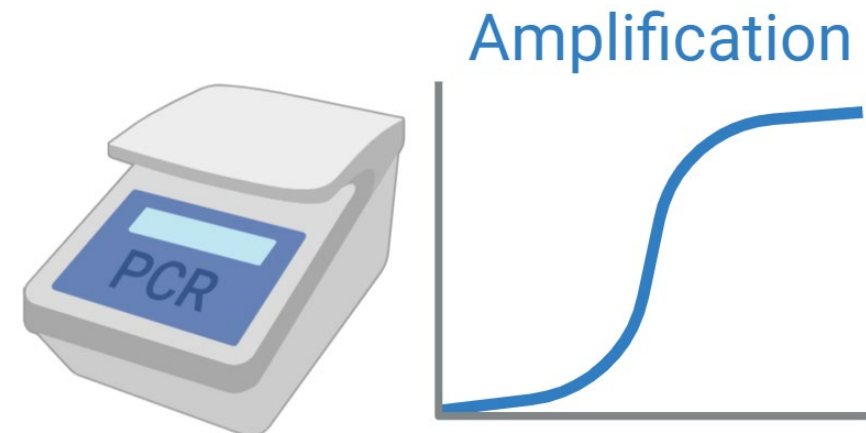
Antibody detection ELISA



Laboratory Diagnosis

Molecular Method

Deoxyribonucleic acid (DNA) probes and polymerase chain reaction (PCR) have been used to demonstrate parasitic genome in the stool specimen



Treatment

Metronidazole (250 mg, thrice daily for 5-7 days) and Tinidazole (2 g single dose) are the drugs of choice.