

Giardia and giardiasis

Trichomonas and Trichomoniasis

PROTOZOA

Protozoa are one-celled animal-like organisms

Most protozoa are too small to be seen with the naked eye (between 10–50 μm to 0.5 mm. They can be observed with a microscope.

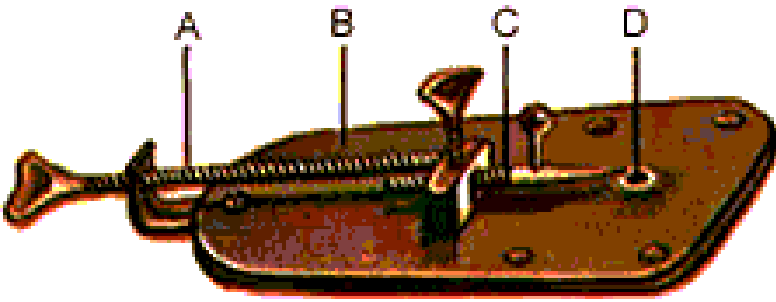
Protozoa are ubiquitous موجودة كليا throughout aqueous environments and the soil, and play an important role in their ecology.

Some protozoa can form cysts for protection against harsh conditions, allowing to survive extreme temperatures or harmful chemicals or lack of food, water, or oxygen.

For parasitic species the cyst will be important for transmission.

PROTOZOA

Because of the size of protozoan they were undetected until **Antony van Leeuwenhoek** (1632-1723) invented the first magnifying glass. He had no fortune and received no higher education or university degrees.



A Dutch tradesman van Leeuwenhoek is known as the “Father of Microbiology”. He made this first known observation of (what is most likely) *Giardia intestinalis* when examining his own feces under his microscope. Van Leeuwenhoek did not, however, make the connection between this observed creature and any pathology.

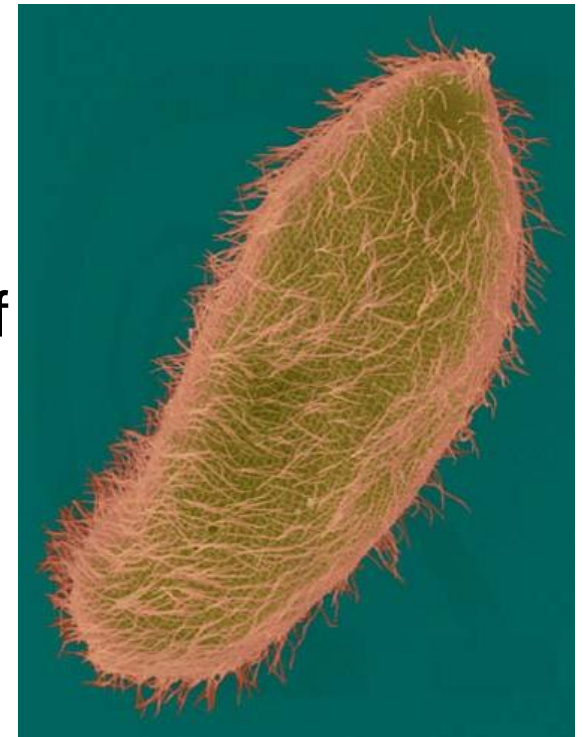


HOW PROTOZOA MOVE

FLAGELLA: a whip like extension found singly or in pairs with undulating motion which allows cells to swim through liquid media

CILIA: hair like projections shorter than flagella. Capable of rhythmical motion and act in almost synchrony creating whip-like patterns.

PSEUSOPODIA: A temporary projection of the cytoplasm. This is observed in amoebas.



Reproduction

Reproduction in protozoa may be sexual or asexual. Most common asexual reproduction is by **Binary Fission**. Other types are **multiple fission (merogony, schizogony, sporogony), budding.**



Plasmodium schizont. The nucleus divide repeatedly before cytokinesis and a large number of daughters are produced.



Paramecium dividing. Observe that the plane of fission is transverse

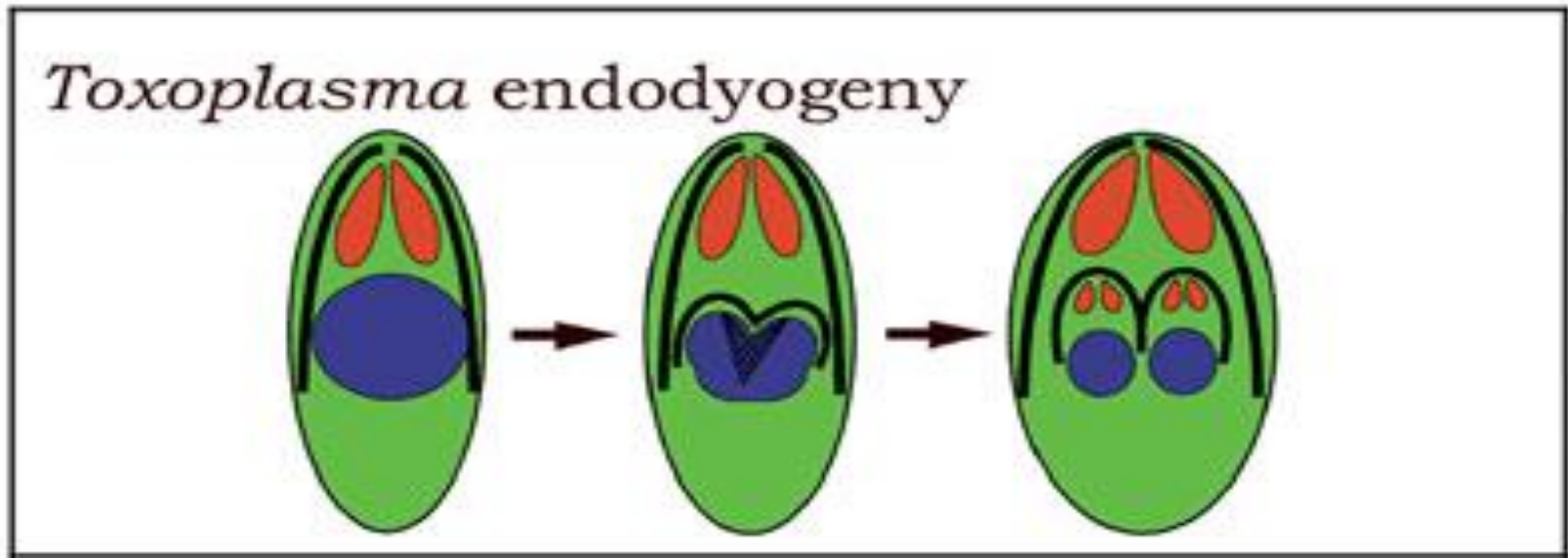


A protozoa cell dividing by binary fission with the plane of fission longitudinal

Endodyogeny

An example of internal budding in which only two daughter cells are formed.

This happens during the asexual reproduction of *Toxoplasma gondii*



The daughter cells begin forming within their cell membranes, distributed throughout the cytoplasm of the mother cell rather than at the periphery. Toxoplasma parasites divide by endodyogeny. This parasite also uses sexual reproduction during its life cycle.

GIARDIASIS

Infection with the protozoan parasite *Giardia lamblia*

- ❖ *Giardia duodenalis* most common name used. *G. intestinales* and *G. lamblia* are also used.
- ❖ *Giardia spp.* can parasitize the intestinal tract of a wide range of vertebrates, including humans.
- ❖ Disease is prevalent in children attending day care centers.
- ❖ In addition, domestic dogs and certain wild animals serve as hosts.
- ❖ Transmission of *Giardia* is predominantly by ingestion of food or water contaminated with cysts.

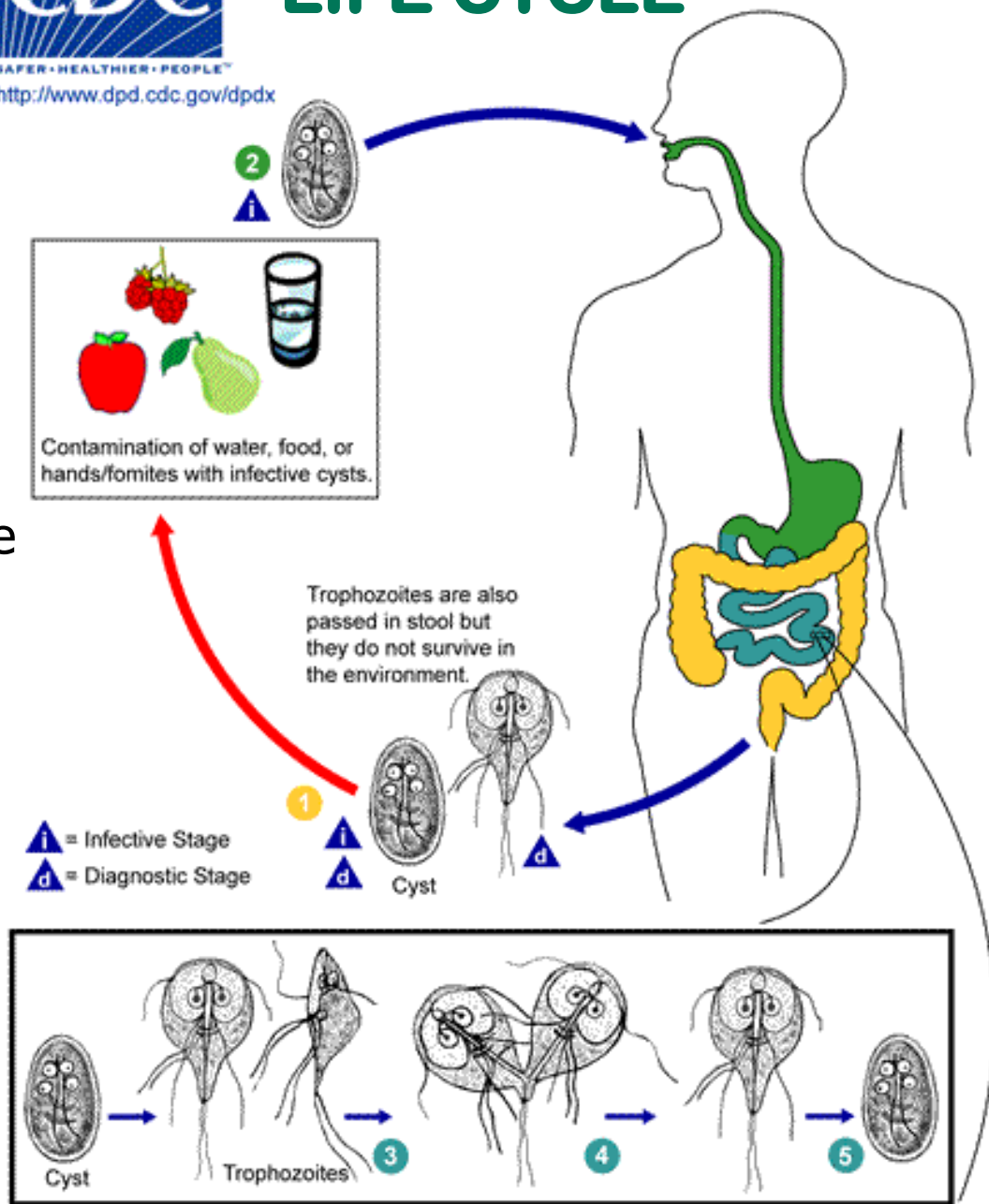


- Only one host. Simple life cycle
- Cysts are ingested in the small intestine, excystation releases trophozoites (each cyst produces two trophozoites).
- Trophozoites multiply by longitudinal binary fission, remaining in the lumen of the proximal small bowel where they can be free or attached to the mucosa by a ventral sucking disk.
- Encystation occurs as the parasites transit toward the colon.
- The cyst is the stage found most commonly in nondiarrheal feces

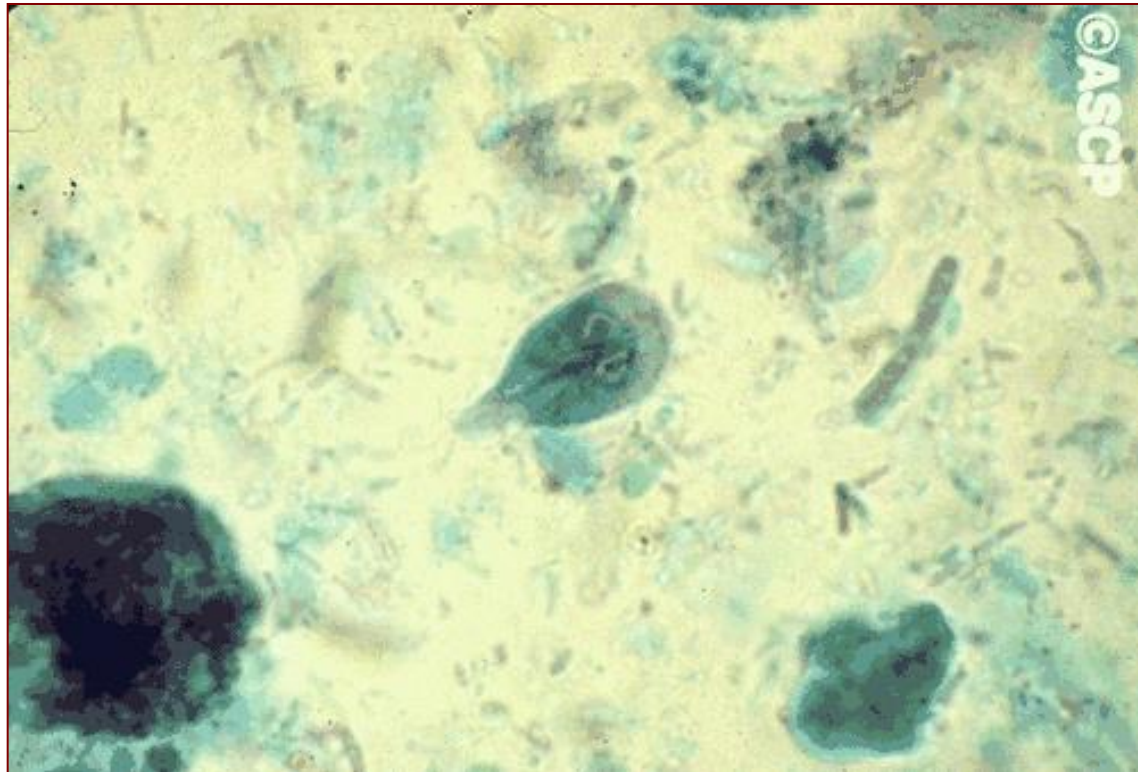


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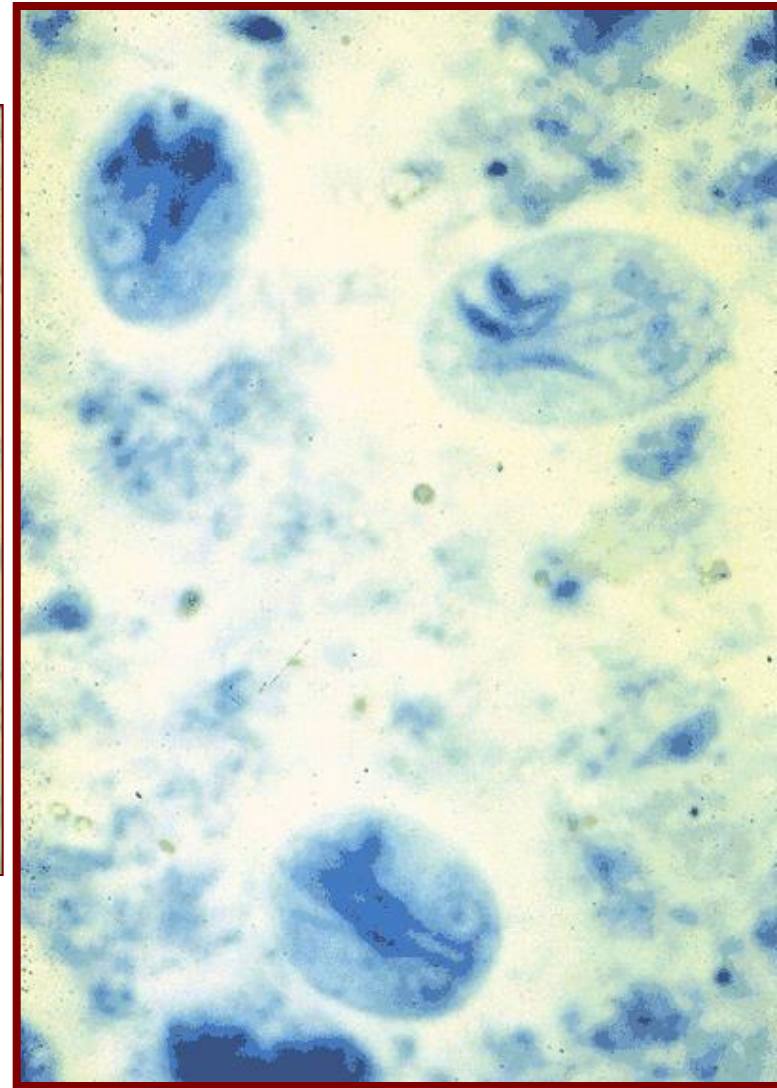
LIFE CYCLE



A Giardia trophozoite

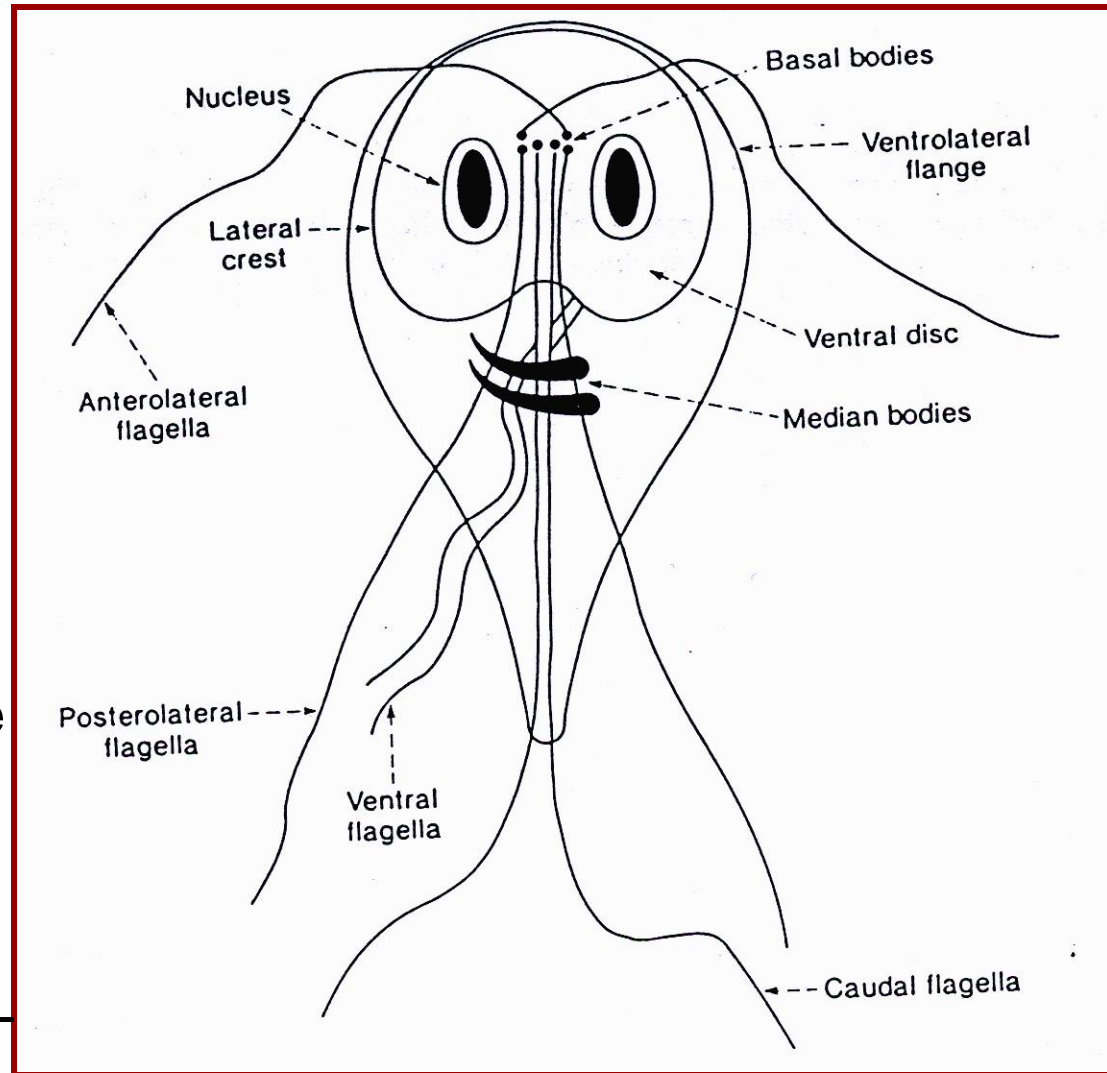


Three Giardia Cysts



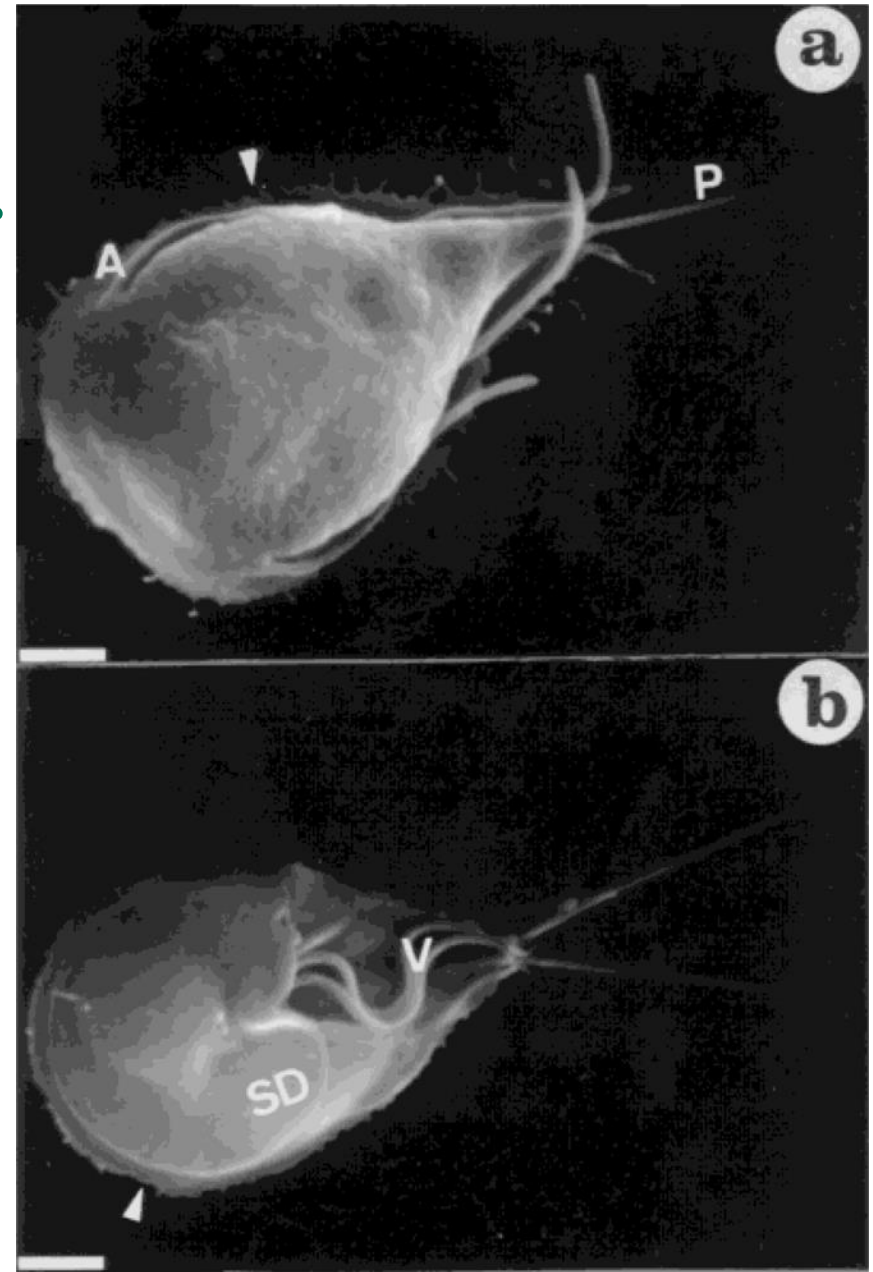
The trophozoite of *Giardia duodenalis*

- Active metabolizing, motile form, lives in the upper two-thirds of the small intestine (duodenum and jejunum)
- 12 to 15 μm long, shaped like a pear
- Two nuclei:
 - Equal DNA content
 - Both transcriptionally active
 - Both divide at the same time
- Four pairs of flagella= 8 flagella
- Ventral Adhesive Disc
- Reproduction by binary fission- asexual reproduction



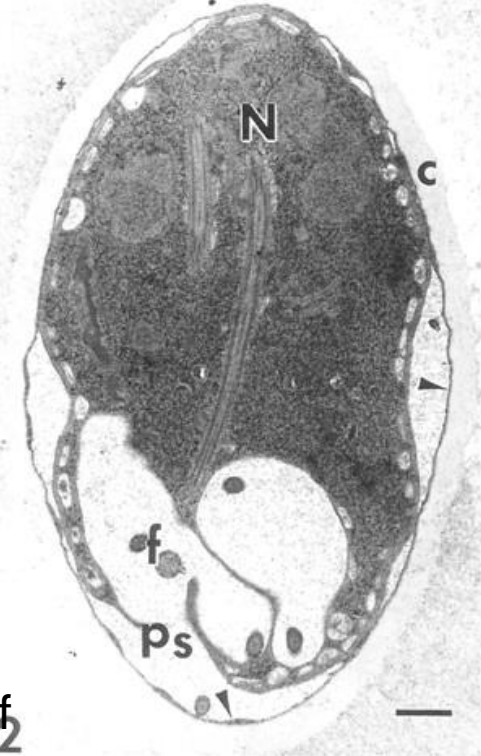
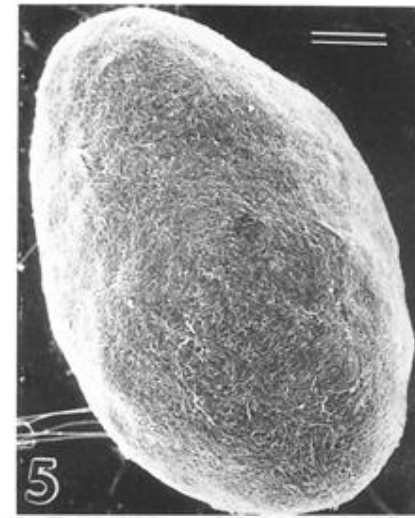
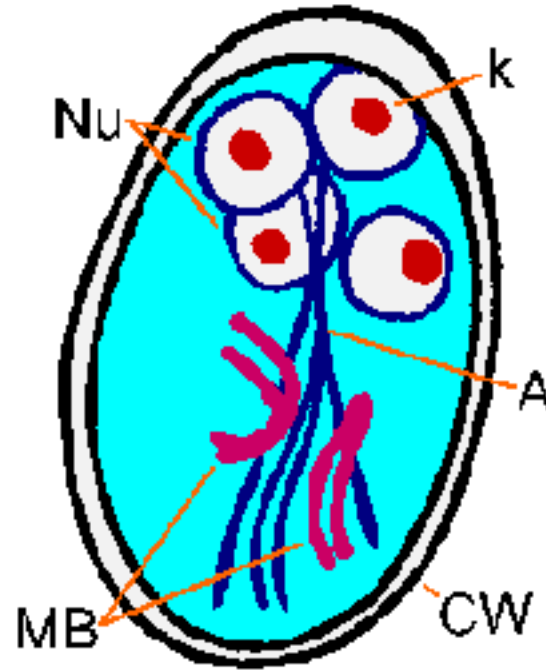
Scanning electron micrographs of trophozoites of *G. lamblia*.

Observe the typical pear-shaped body. **a:** Dorsal view of *G. lamblia*. Observe the lateral flange (arrowhead) and the caudal or posterior (P) and the anterior (A) flagella. **b:** A ventral view of the parasite. The arrowhead indicates the presence of the lateral flange, which surrounds the whole cell. The ventral flagella (V) are seen in the region of the ventral groove and the adhesive or striated disk (SD) is clearly observable. Bars: **a:** 2.7 μm and **b:** 2.0 μm .



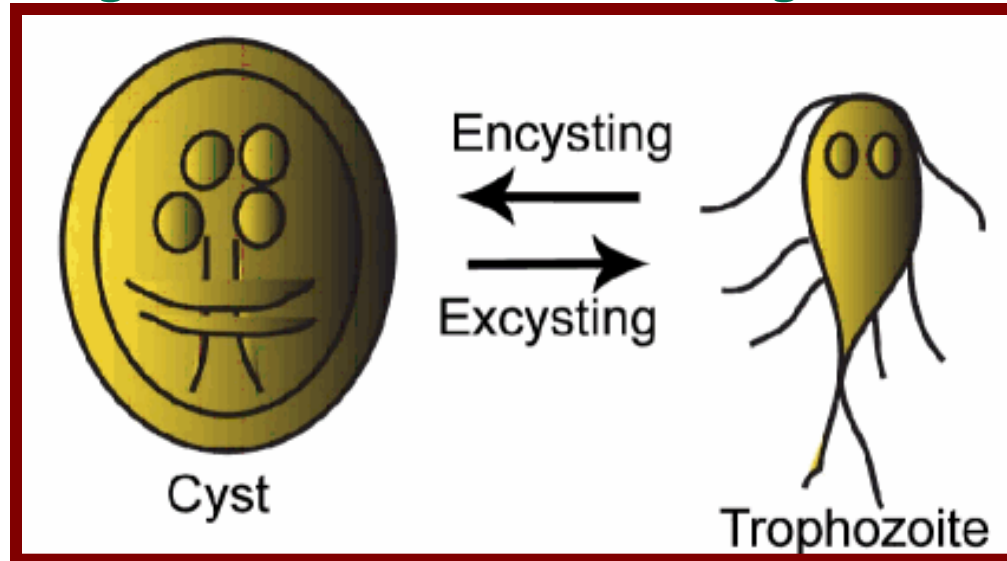
The Giardia cyst

After cyst wall formation the parasite undergoes one round of nuclear division without cytokinesis resulting in four nuclei. These four nuclei (Nu) are located at the anterior end. The flagella and adhesive disk are lost, but the axonemes (Ax) and median bodies (MB) persist. Cysts are oval shaped and measure 11-14 μm in length and 6-10 μm wide. They have a well-defined wall (CW) which is often set apart from the cytoplasm of the parasite. The cysts are passed in the feces and can survive for up to three months under appropriate temperature and moisture conditions.



SEM illustrating the filamentous nature of the cyst wall

Encystation and Excystation



Encystation

Trophozoite gradually round up and detach, lose motility and become refractile.

Encystation-specific secretory vesicles (**ESV**) are formed

In vivo occurs in the lumen of the small intestine. Trophozoites starts synthesizing cyst wall components and transport them to the outer surface.

In vitro: can be induced by: High pH and high bile salts concentration

Excystation:

Cysts pass through the stomach where they are exposed to gastric acid. In the duodenum, the gastric chyme is neutralized by bicarbonate. Excystation probably occurs in the upper small intestine. Motile trophozoites emerge in the small intestine.

In vitro: can be induced by: low pH exposure of the cyst and transfer to pH 8 and protease treatment

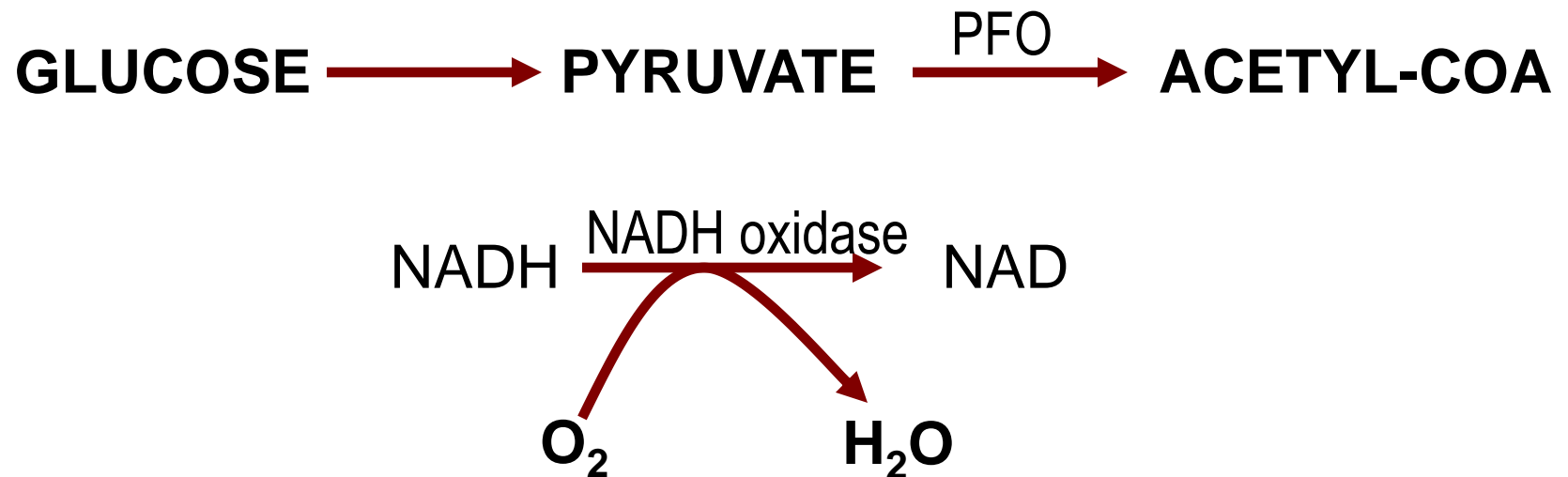
GIARDIA METABOLISM

G. Lamblia is an aerotolerant anaerobe

Parasite have no mitochondria

Tricarboxylic acid and cytochrome system is absent

Parasite uses glucose and stores glycogen



PATHOGENESIS

- Many cases of infection show no evidence of disease
- Mechanism still unknown
- Giardia colonizes the upper small intestine
- Villous blunting
- Lymphocytic infiltration
- Malabsorption
- No tissue invasion-high number of trophozoites present in the duodenal crypts

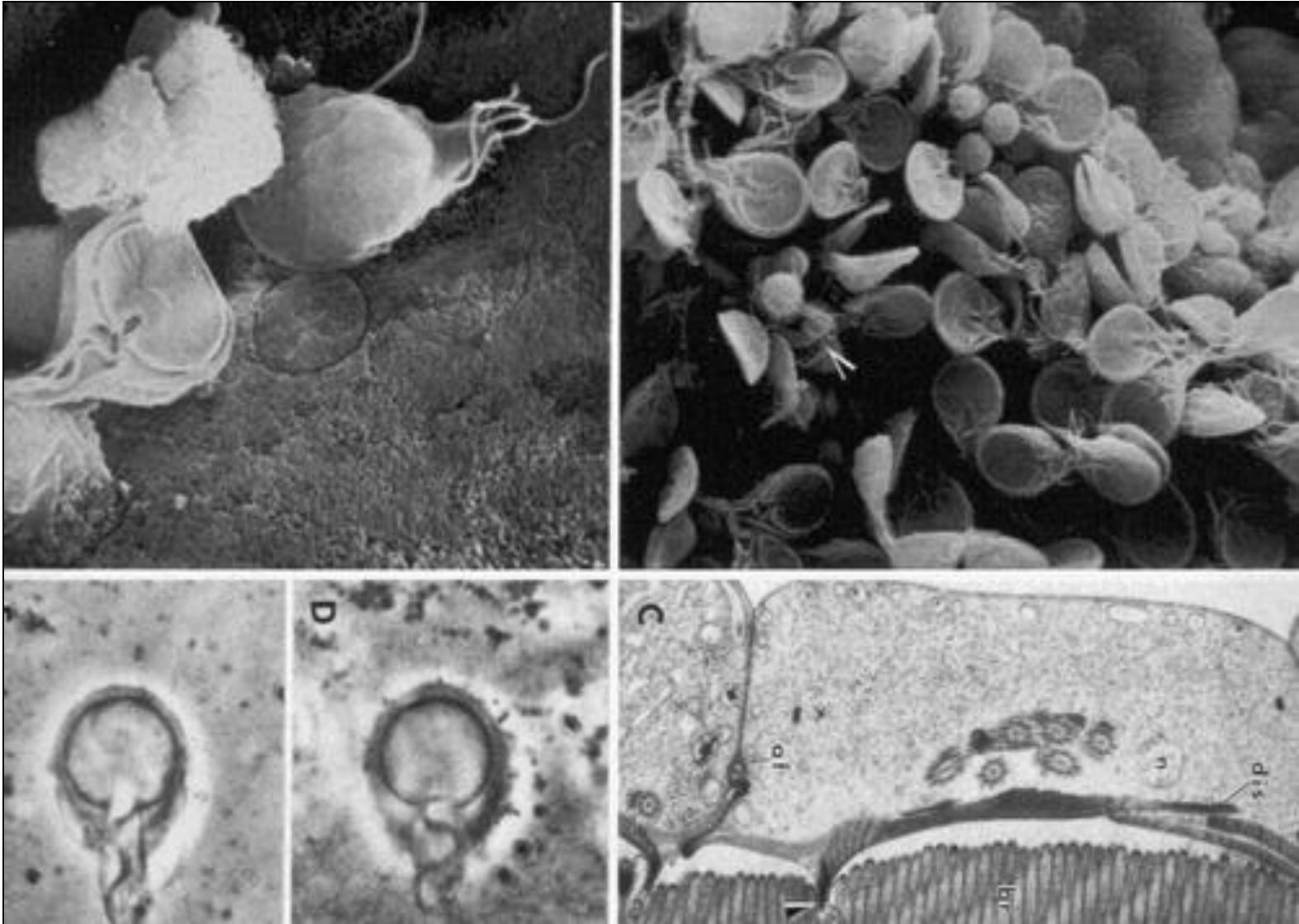


PATHOGENESIS

Possible Mechanisms

- Trophozoites released in the upper part of the SI move to the duodenum and jejunum and attach. Suction force may damage microvilli.
- Large number of parasite may interfere mechanically with digestion.
- Symptoms may result from inflammation of the mucosal cells of the small intestine.
- AIDS patients do not appear to be more susceptible to giardiasis

Adhesion of the trophozoite to the epithelial cells of the small intestine.



Note the impression left on the epithelia where a trophozoite has detached (upper left) and the interaction between the ventral disk of the parasite and the brush boarder cells of the intestines (lower right).

GIARDIASIS

CLINICAL FEATURES

Incubation period : 1-2 weeks

Majority of infected individual are asymptomatic

SYMPTOMS:

Diarrhea with loose, fool-smelling stools

Flatulence

Abdominal cramps and bloating

Nausea

anorexia

Malaise

Weight loss

Prolonged symptoms

Malabsorption



Marked spasm and irritability of the duodenum and jejunum with resultant poor filling of the duodenal C-loop and proximal and mid-jejunum. Marked thickening, edema, and spiking of mucosal folds throughout the proximal small bowel . The loops appear widely separated and the lumen appears narrow in many segments due to the combination of irritability and edema. The barium column is segmented and flocculated from spasm and increased fluid within the upper small bowel. (Courtesy of the late Dr. Richard Marshak, New York City).

GIARDIASIS

DIAGNOSIS

- Identification of cysts or trophozoites in fecal specimens
- May need to be repeated
- Detection of *Giardia* antigens in feces.
- Serodiagnosis is not useful

Imaging Diagnosis

The combination of mucosal edema, irritability, rapid transit of barium through the proximal small bowel, abnormal clumping of barium with evidence of increased secretions, narrowing of the bowel lumen, and localization of the pathological features to the duodenum and jejunum is typical of giardiasis.



**CYPRESS
DIAGNOSTICS**

The Cypress Diagnostics Giardia kit is an enzyme linked immunosorbent assay (ELISA) intended for the detection of Giardia antigen in fecal specimen.



GIARDIA TRANSMISSION

The resistant cysts is responsible for transmission.

The cysts can survive several months in cold water.

Reservoir-human and possibly other mammals

10-25 cysts sufficient. Possible sources of cysts:

- Feces for fertilizer
- Defective piping
- Flies
- Soiled hands



EPIDEMIOLOGY وبائية OF GIARDIASIS

- Worldwide distribution
- Common in areas with poor sanitary conditions
- Seasonal with peak during late summer in UK, USA and Mexico
- Prevalence: 2-5% in industrialized countries
20-30% in developing countries
- Travelers, hikers, campers are at risk. Swallowing water while swimming, drinking tap water, eating lettuce.
- Risk groups in the US: travelers, children in day cares and homosexual men

giardia

Prevent this food and waterborne disease.



Giardia (pronounced gee-ah-dee-ah) is a parasite found in the gut of humans and animals such as cattle, sheep, cats, dogs, rats and possums.

It is passed on in the faeces (poo, tūtae) of infected animals and humans.

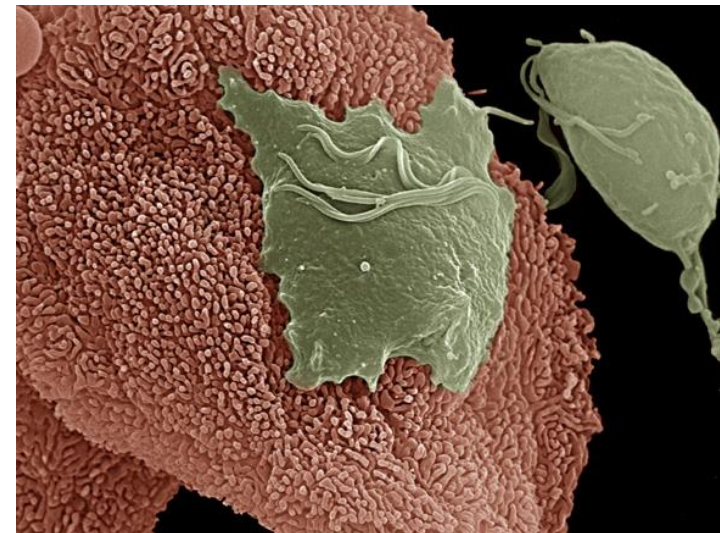
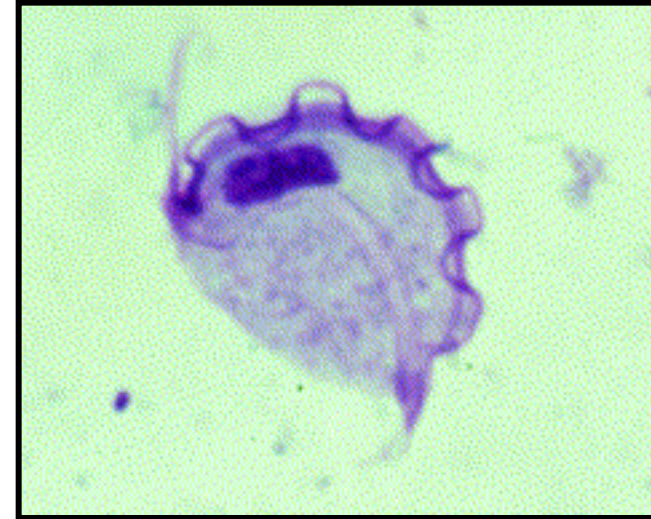
Giardia is widespread in New Zealand and the parasites can live in the environment for long periods, especially in lake, river, stream and roof water.

GIARDIASIS PREVENTION

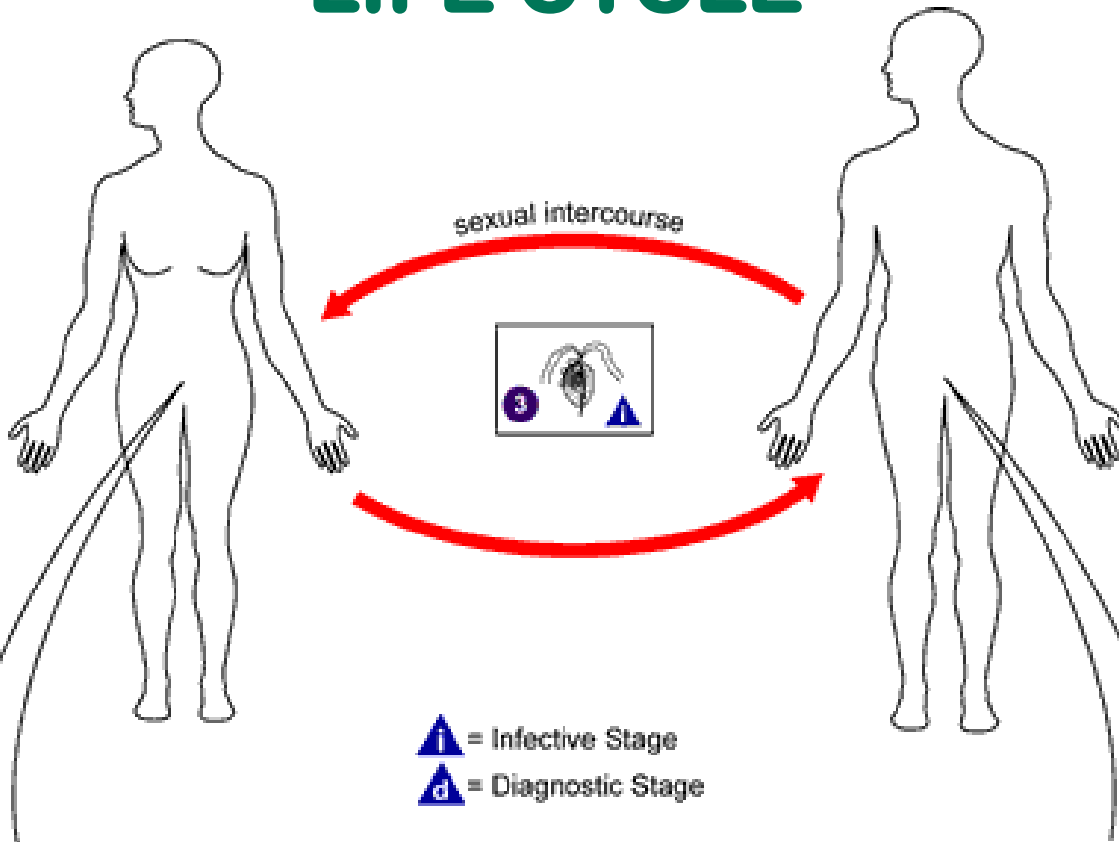
- Avoid drinking water from sources associated with outbreaks متفشى فيها المرض
- Water filtration
- Chlorination is not effective
- In day cares; wash hands and proper disposing of diapers
- Hikers المتجولون and backpackers should be warned to boil or filter water
- Swimming pools are specially vulnerable معرض للهجوم

Trichomonas vaginalis

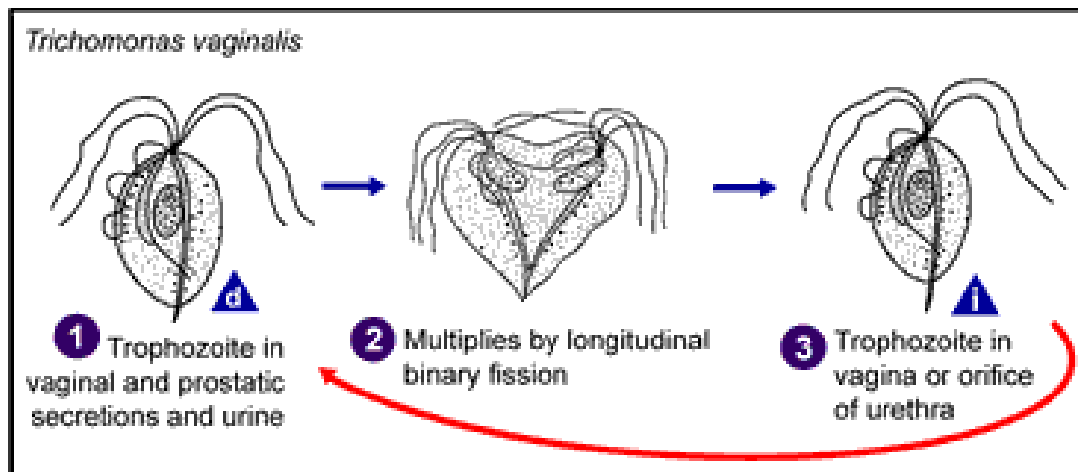
- Cause of trichomoniasis, a sexually-transmitted (rare instance of neonatal infections acquired at birth)
- Common cause of vaginitis
200 million cases/yr worldwide
3-5 million cases/yr US
- Single form - trophozoite (no cyst form)
- Found in urogenital tract (vagina & urethra in females; urethra, seminal vesicles & prostate in males)
- Extracellular - adheres to epithelia



LIFE CYCLE



Trichomonas vaginalis resides in the female lower genital tract and the male urethra and prostate, where it replicates by binary fission. The parasite does not appear to have a cyst form, and does not survive well in the external environment. *Trichomonas vaginalis* is transmitted among humans, its only known host, primarily by sexual intercourse.



A modern drawing of *Trichomonas vaginalis*, showing essentials of morphology

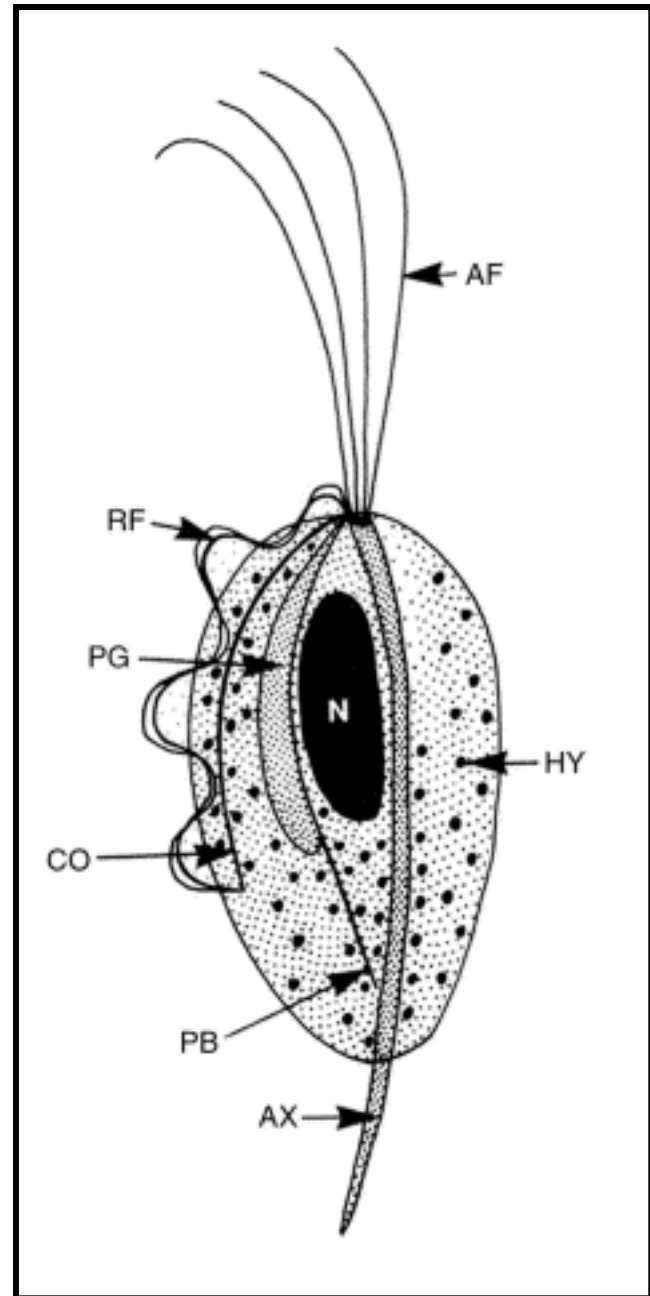
Five flagella, four anterior and fifth incorporated within the UM

Nucleus is anterior

Axostyle: commences at the nucleus and bisects the parasite

Granules: hydrogenosomes, important for metabolism

AF, anterior flagella; AX, axostyle; CO, costa; HY, hydrogenosome; N, nucleus; PB, parabasal body; PG, parabasal body and Golgi apparatus; RF, recurrent flagellum.

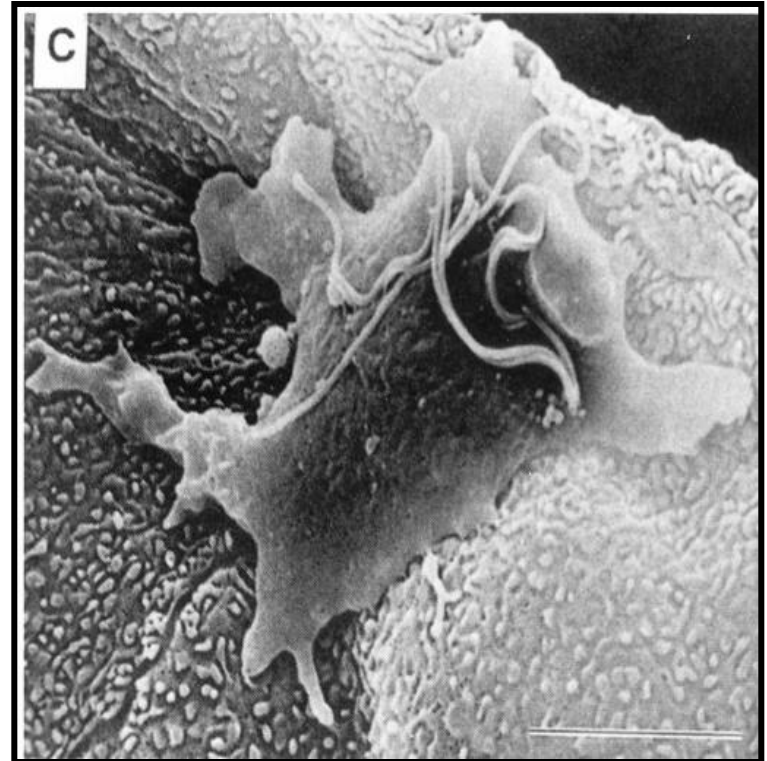
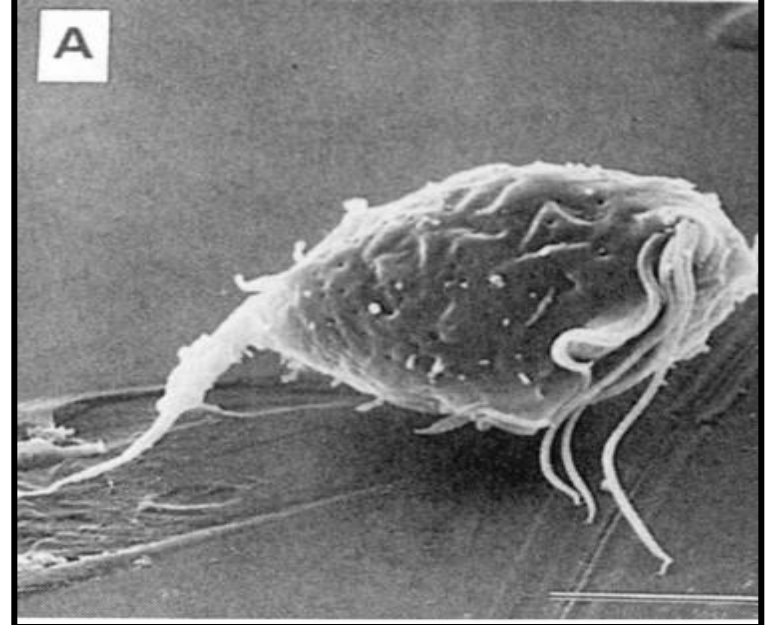


MORPHOLOGY

A: *T. vaginalis* parasite as seen in broth culture. The axostyle, undulating membrane, and flagella are clearly visible. **B:** *T. vaginalis* on the surface of a vaginal epithelial cell prior to ameboid transformation. **C:** Ameboid morphology of *T. vaginalis* as seen in cell culture. Note that the side opposite the undulating membrane adheres to the vaginal epithelial cell.

Bars, 5 μm .

Clin. Microbiol. Rev. 11:300



Trichomonas vaginalis

- Relies on host for synthesis of essential molecules (nucleotides, fatty acids, amino acids)
- Ancient eukaryote
- Facultative anaerobe
- Lacks mitochondria
- Contains hydrogenosomes (involved in carbohydrate metabolism and drug therapy)



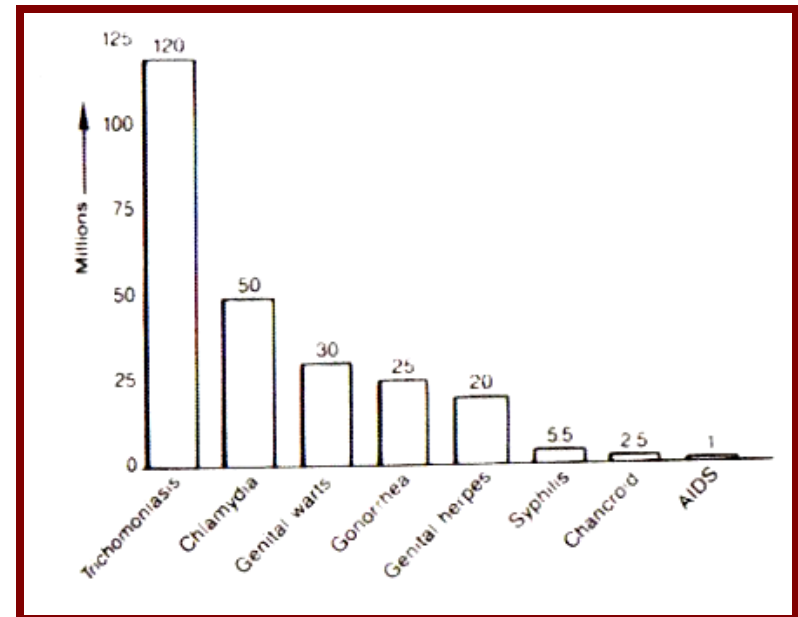
CLINICAL MANIFESTATIONS

- *T. vaginalis* infects the squamous epithelium in the genital tract
- More persistent in females
 - Acute:
 - Diffuse vulvitis
 - Yellow or green discharge
 - Hemorrhagic spots in the vaginal mucosa
 - Chronic:
 - Mild symptoms with pruritus
 - Vaginal discharge mixed with mucus
 - 25-50% women are asymptomatic
- Complications in women: 1) increased HIV transmission and infectivity; 2) greater risk of tubal infertility and atypical pelvic inflammatory disease (PID); 3) increased risk of cervical cancer; 4) association with preterm birth and premature rupture of membrane and low birth weight infants
- In men: 1) increased HIV transmission and infectivity; 2) common cause of nongonococcal urethritis and 3) a factor in male infertility as a result of decreases in both sperm motility and viability.

EPIDEMIOLOGY OF TRICHOMONIASIS

- Cosmopolitan distribution عالمي الانتشار
- More than 170 M cases worldwide with 2-3 million symptomatic infections annually in the USA
- Up to one-third of cases of *T. vaginalis* in females is asymptomatic.)
- High-risk groups are African-American, prison inmates, drug users and sex workers
- Prevalence increases with age

Global incidence of 8 STDs



DIAGNOSIS

- Clinical presentation: discharge, strawberry cervix
- Visualization of the motile parasites in vaginal secretions (45-60% sensitivity)
- Culture of parasites in special media. (InPouch). This method will identify up to 95% of infections.
- PCR-based test under development



OSOM® Trichomonas Rapid Test A rapid test for the detection of *Trichomonas Vaginalis*

Easy - to - Run - Dipstick simple, one reagent.
Accurate - 95% agreement against Composite
Reference Standard (culture and wet mount).
Unaffected by other common infections.

InPouch, Biomed Diagnostics.
A two-chambered plastic bag
culture system to improve

Giardia Entamoeba Trichomonas Common Characteristics

- Early-diverging Eukaryotes
- Facultative Anaerobes
 - Carbohydrate metabolism is anaerobic
- Lack mitochondria
- Extracellular parasites
 - Do not invade host cells
 - Adhere to plasma membrane of host cells
 - Contact-dependent cytotoxicity
 - Mechanical damage to host tissues
- Replicate and divide within the host by binary fission
- All are killed by treatment with Metronidazole, a drug that selectively kills anaerobic cells