

GIARDIASIS (lamblia)

Etiology

Giardia lamblia (a flagellate)

Epidemiology

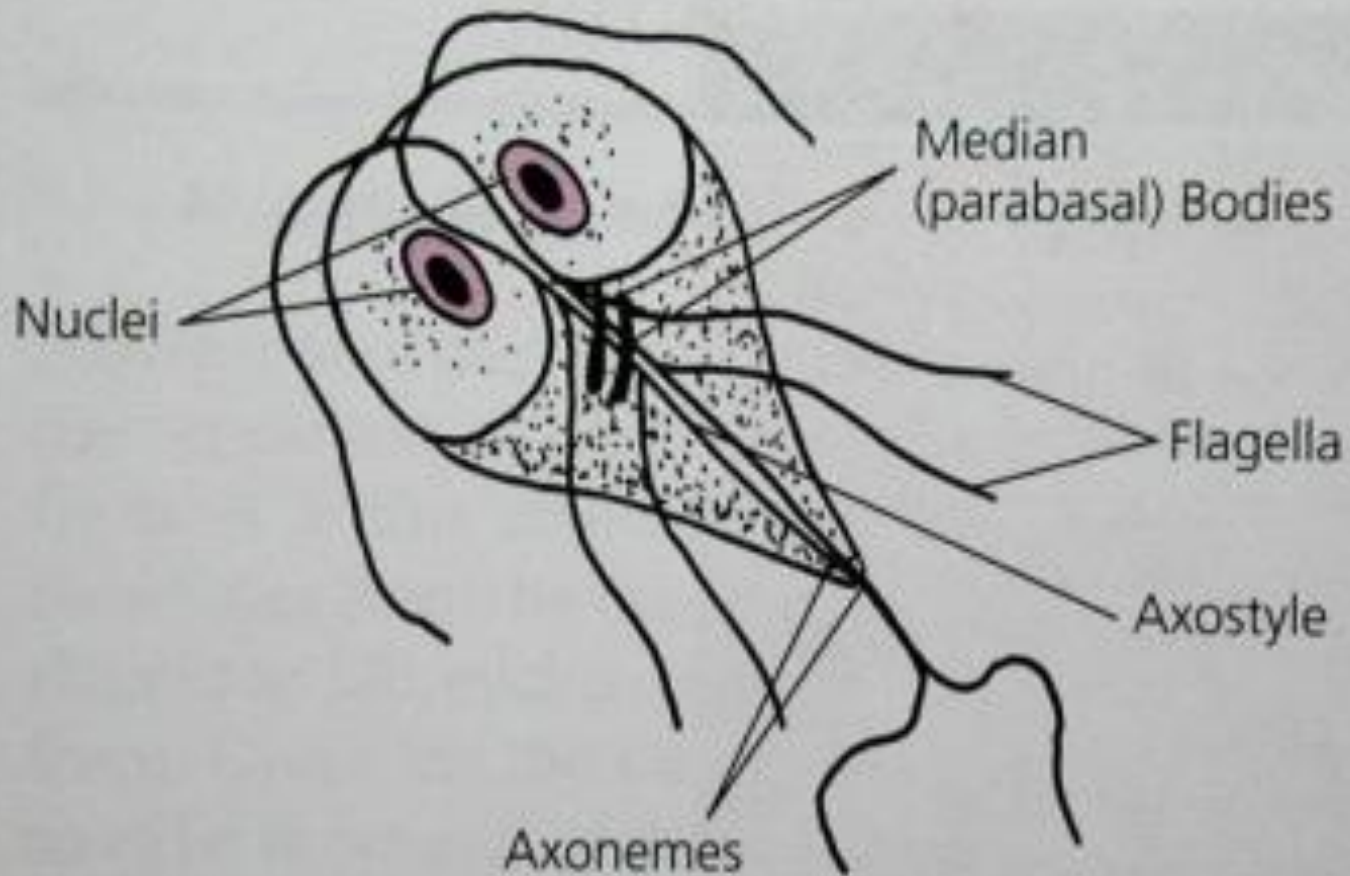
Giardia has worldwide distribution. It is the most frequent protozoan intestinal disease and the most common identified cause of water-borne disease associated with breakdown of water purification systems, drinking from contaminated streams, travel to endemic areas (Russia, India, Africa.) and day care centers

It can survive the normal amounts of chlorine used to purify community water supplies.

Young kids are three times more likely to have giardiasis than adults, which leads some experts to believe that our bodies gradually develop some form of immunity to the parasite as we grow older.

The entire family can have giardiasis, with some family members having diarrhea, some just crampy abdominal pains, and others with few or no symptoms.





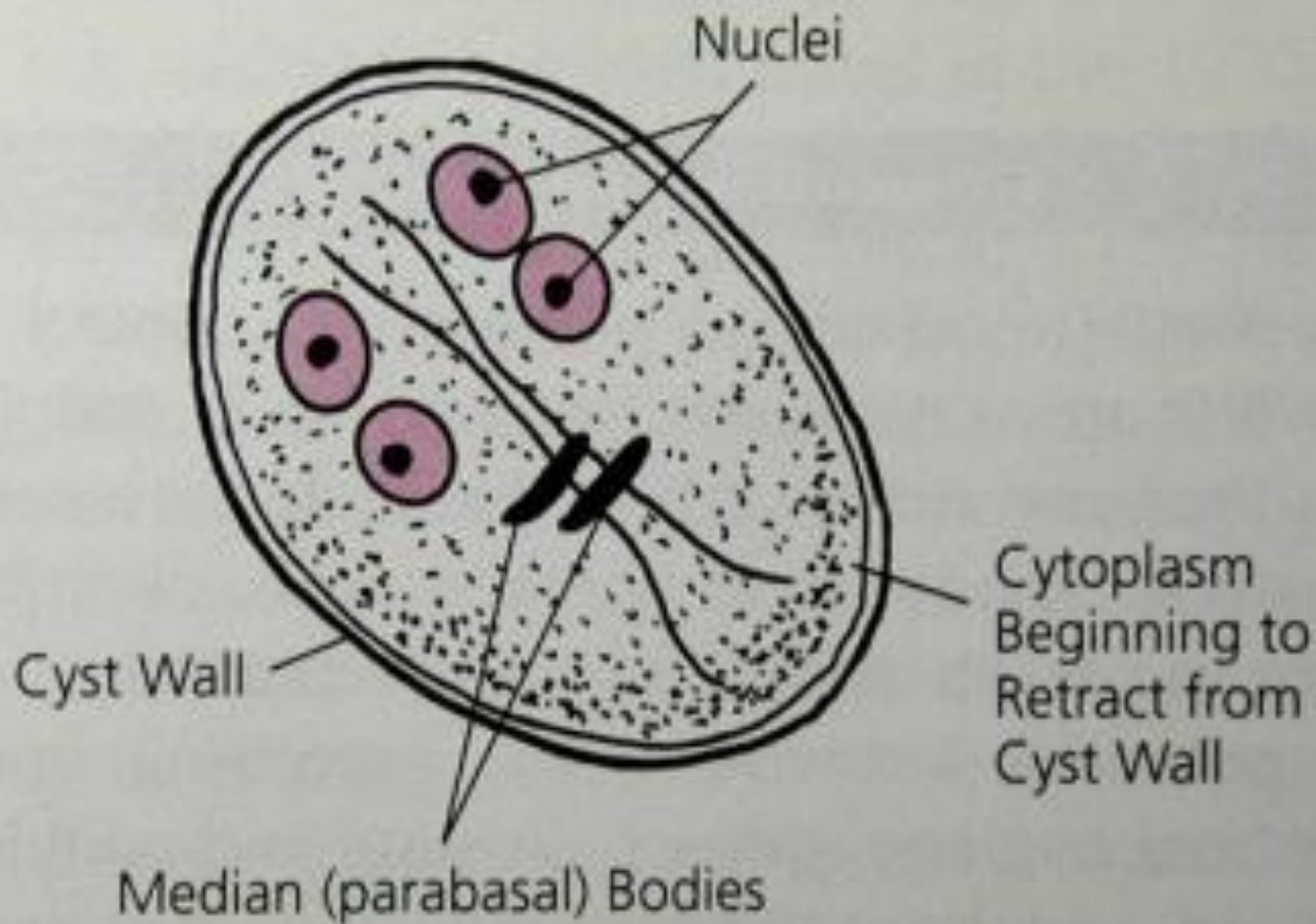
Size Range: 8 – 20 μm by 5 – 16 μm
Average Length: 10 – 15 μm

Giardia trophozoite

The *Giardia* trophozoite exhibits a characteristic pear, or tear-drop, shape with bilateral symmetry .It is typically 12-15 μm long, 5-10 μm wide, and 2-4 μm thick. Characteristic features of the trophozoite include: two nuclei (Nu) with central karyosomes (k), fibrils running the length of the parasite, and median bodies (MB).

The large karyosome and lack of peripheral chromatin gives the nuclei a halo appearance. The fibrils are called **axonemes (Ax)** and are formed from the proximal regions of the **flagella (Fg)** within the body of the trophozoite.

The **median bodies** are a pair of **curved rod-shaped** structures which lie **posterior** to the **nuclei**. At the **ultrastructural** level the **median bodies** contain an array of **microtubules**. The **function** of the median bodies is **not known**, but most believe they are somehow **involved** with the **adhesive disk** and its formation. An adhesive disk (AD), not always visible by light microscopy, occupies the ventral side of the anterior end.

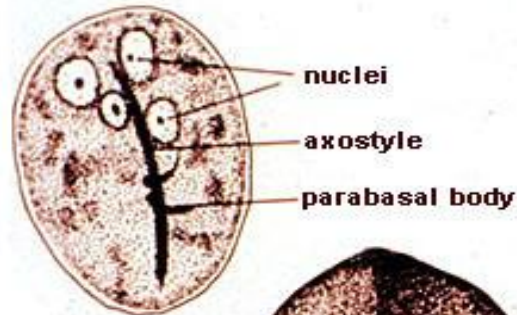


Size Range: 8 – 17 μm by 6 – 10 μm
Average Length: 10 – 12 μm

Newly formed cysts have 2 nuclei, older cysts have 4.

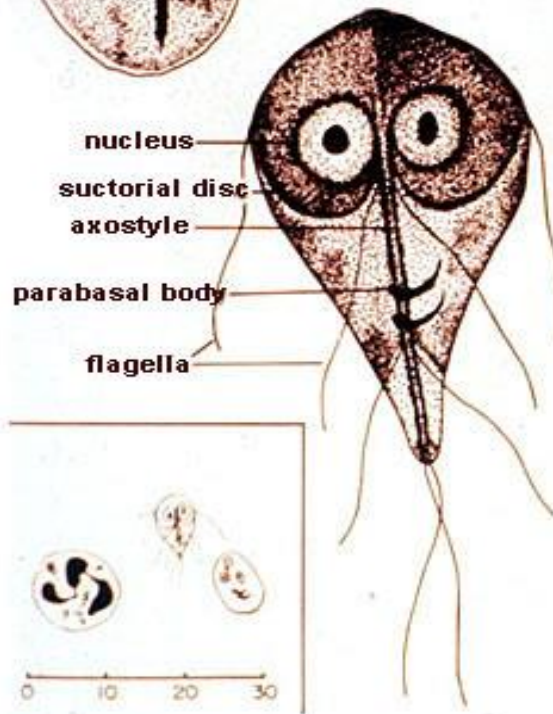
GIARDIA LAMBLIA

Diagnostic Features



Cyst

- approximately 10 u in length
- prominent axostyle
- 4 nuclei when mature
- parabasal body sometimes present



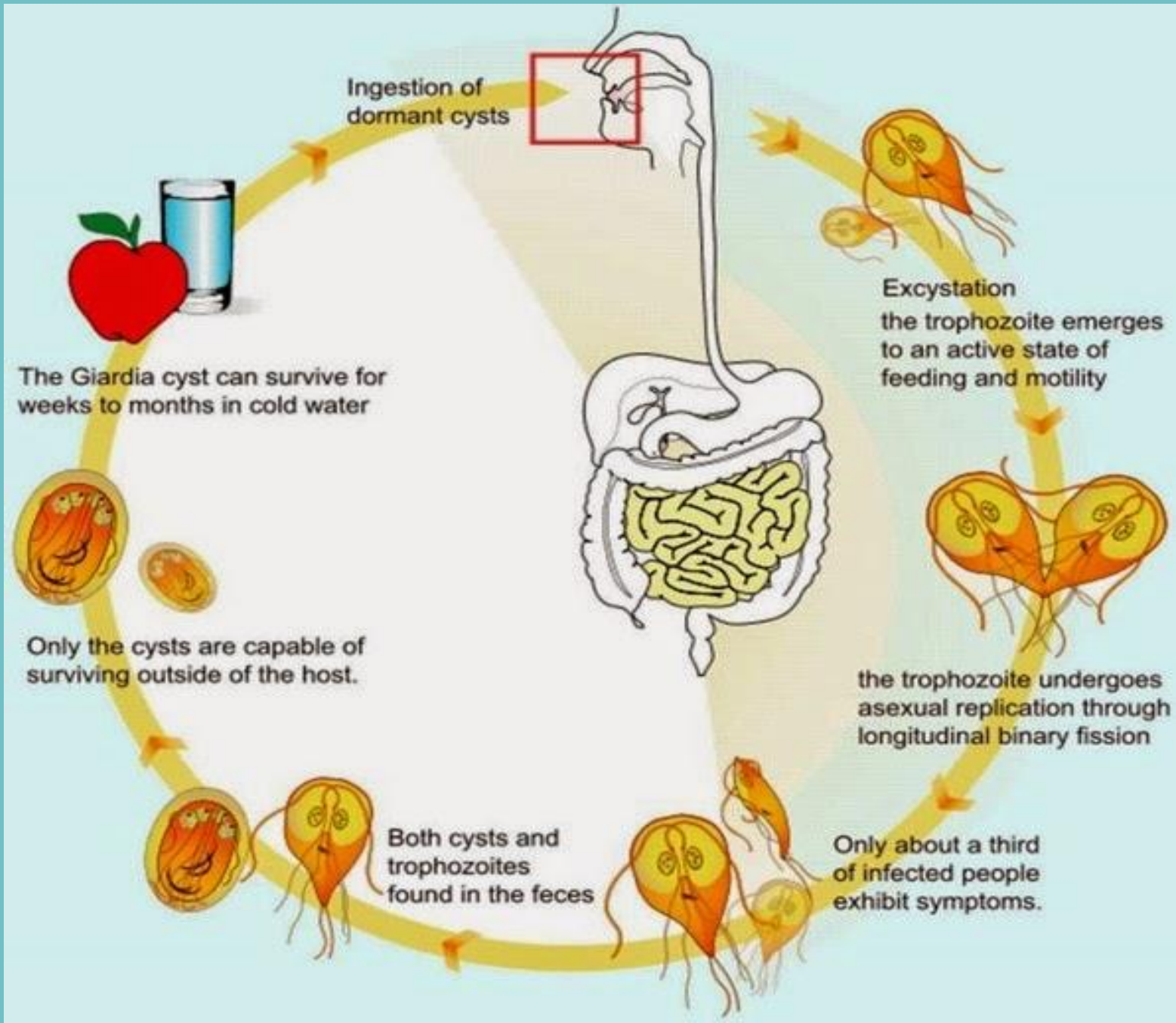
Trophozoite

- 12 u long, 8.5 u wide
- axostyle
- 2 nuclei
- parabasal body
- 4 pairs flagella
- suckorial disc
- appearance of "little old man"

Infection occurs by ingestion of cysts, usually in contaminated water.

Excystation occurs in the **duodenum** and **trophozoites** colonize the **upper small intestine** where they may **swim freely** or **attach** to the **sub-mucosal epithelium** via the **ventral suction disc**.

The free trophozoites encyst as they move down stream and mitosis takes place during the encystment. The cysts are passed in the stool. Man is the primary host although, pigs and monkeys are also infected and serve as reservoirs.



Life cycle of *Giardia lamblia*

Cysts are resistant forms and are responsible for transmission of giardiasis. Both cysts and trophozoites can be found in the feces (diagnostic stages). The **cysts** are hardy, can **survive** several months in **cold water**. Infection occurs by the ingestion of cysts in contaminated water, food, or by the fecal-oral route (hands or fomites) . 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 non-diarrheal feces .

Cysts are infectious when passed in the stool or shortly afterward, **person-to-person transmission is possible**. While animals are infected with *Giardia*, their importance as a reservoir is unclear

Symptoms

Early symptoms include flatulence, abdominal distension, **nausea** and foul-smelling bulky, explosive, often watery, diarrhea. The stool contains excessive lipids but very rarely any blood or necrotic tissue. The more chronic stage is associated with vitamin B₁₂ malabsorption, disaccharidase deficiency and malabsorption of nutrients.

Pathology:

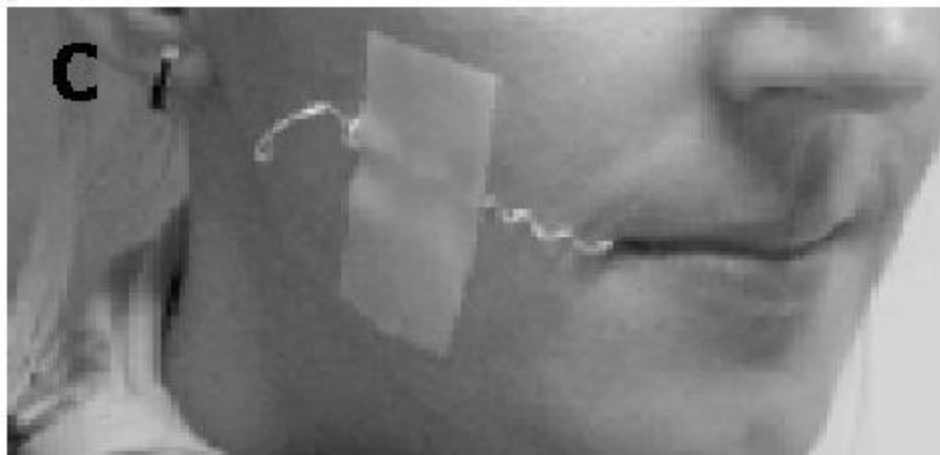
Covering of the intestinal epithelium by the trophozoite and flattening of the mucosal surface results in malabsorption of nutrients.

Immunology:

There is some role for IgA and IgM and there is increased incidence of infection in immunodeficient patients (e.g. AIDS).

Diagnosis

Symptoms, **history**, epidemiology are used in **diagnosis**. *Giardia* caused dysentery is **distinct** from other dysenteries due to lack of mucus and blood in the stool, lack of increased PMN leukocytes in the stool and lack of high fever. **Cysts** in the stool and trophozoites in the **duodenum** can be **identified microscopically** after content has been obtained using a string device (Enterotest).



Treatment:

Metronidazole is the drug of choice.

Intestinal Protozoa

Cryptosporidium parvum

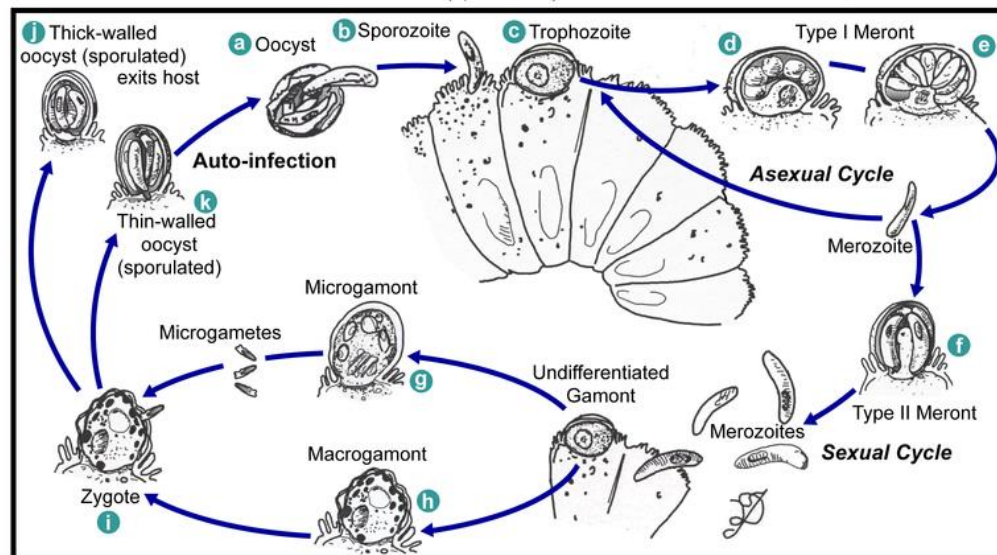
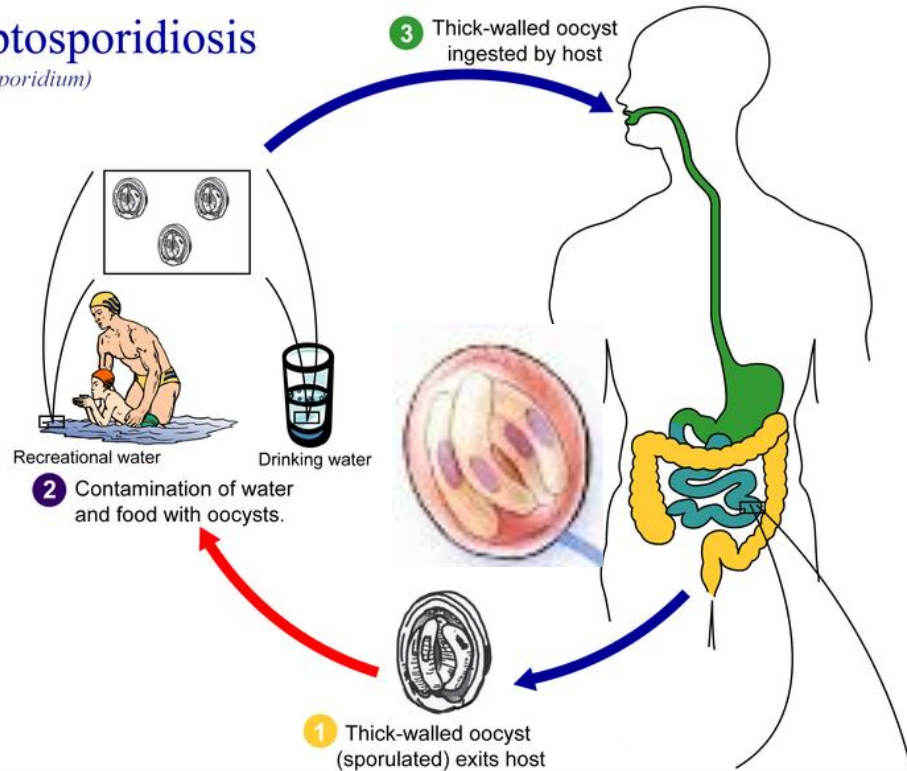
C. parvum is a small round parasite measuring 3 to 5 micrometers which is found in the gastrointestinal tract of many animals and causes epidemics of diarrhea in humans via contaminated food and water.

Humans are infected by ingestion of *C. parvum* oocysts containing four (4) sporozoites.

The sporozoites are released in the upper GI tract and attach to the gut mucosal cells where they divide to produce merozoites. The merozoites invade other mucosal cells and further multiply asexually. Some of the merozoites differentiate into male and female gametocytes and form an oocyst in which they multiply and differentiate into sporozoites. The mature oocyst is excreted with fecal material and infects other individuals

Cryptosporidiosis

(*Cryptosporidium*)



A small bolus of infection may cause mild diarrhea, whereas a larger intake of organisms may cause more pronounced symptoms including copious watery diarrhea, cramping abdominal pain, flatulence and weight loss.

Severity and duration of symptoms are related to immuno-competence. In **AIDS patients**, the organism may cause **prolonged, severe diarrhea** and the organisms may invade the **gallbladder**, biliary tract and the **lung epithelium**. There is no approved effective treatment for cryptosporidiasis, although **paromycin** is used as an investigational drug.

There are a variety of **antibody tests** for detection but many of these **detect other species** of *Cryptosporidium* than *C. parvum*. Sensitive **polymerase chain reaction** tests are available for *C. parvum* detection in environmental and animal samples.

Symptoms:

Infection with *Cryptosporidium* sp. results in a wide range of manifestations, from asymptomatic infections to severe, life-threatening illness; incubation period is an average of 7 days (but can range from 2 to 10 days). **Watery diarrhea** is the most frequent symptom, and can be accompanied by **dehydration**, weight loss, **abdominal pain**, fever, **nausea and vomiting**.

Diagnosis:

1-Microscopic:

Oocysts of *Cryptosporidium parvum*,. The oocysts are rounded, 4.2 to 5.4 μm in diameter. Sporozoites are visible inside the oocysts, indicating that sporulation has occurred.

2) Stained smears:

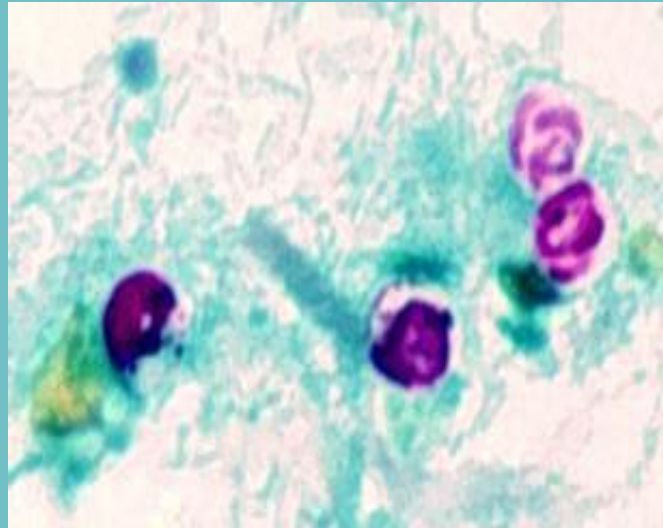
Traditional parasitology stains (e.g., Giemsa) are of limited value. They do not differentiate between oocysts and similarly-sized fecal yeasts and other debris. **Modified acid-fast staining technique** is a simple and effective method: the **oocysts** stain bright **red** against a background of **blue-green fecal debris** and **yeasts**.

Modified acid fast stain

reagents:

Reagents may be purchased commercially or prepared in the laboratory.

- a. Modified trichrome
- b. Trichrome decolorizer
- c. Carbol fuchsin solution
- d. Acid-alcohol decolorizer



Oocysts of *Cryptosporidium parvum* stained by the modified acid-fast method. Against a blue-green background, the oocysts stand out in a **bright red** stain. Sporozoites are visible inside the two oocysts to the right.

3- Enzyme immunoassays

4-Molecular methods

Isospora belli

I. belli is a rare infection of normal humans, although it is being seen in increasing numbers in AIDS patients. The infection occurs via the oro-fecal route. The infective stage of the organism is an oval oocyst (Figure 11) which, upon ingestion, follows the same course as *C. parvum*.

The disease produces symptoms similar to those of giardiasis. In normal individuals, mild infections resolve themselves with rest and diet and heavier infections can be treated with sulpha drugs. The treatment may have to be carried on for a prolonged period in AIDS patients.

The oocysts are large (25 to 30 μm) and have a typical oval shape. When excreted, they are immature and contain one sporoblast (A, B). The oocyst matures after excretion: the single sporoblast divides in two sporoblasts (C), which develop cyst walls, becoming sporocysts.



A



B



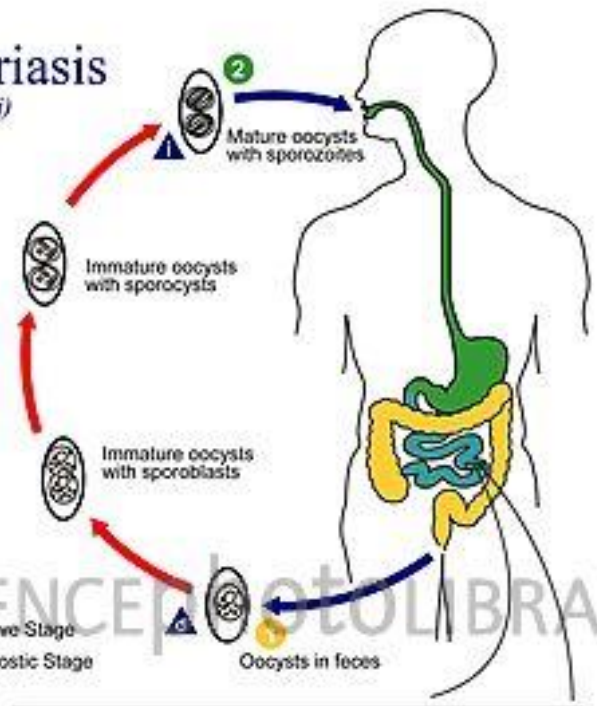
C

When excreted contain one sporoblast (A, B). after excretion: the single sporoblast divides into two sporoblasts (C)

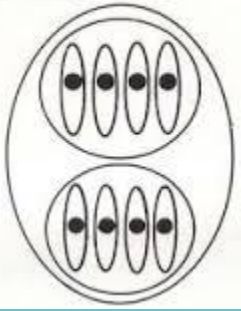
Life cycle:

At time of excretion, the **immature oocyst** contains usually **one sporoblast** (more rarely two) . In further maturation after excretion, the **sporoblast divides** in two (the oocyst now contains **two sporoblasts**); the sporoblasts secrete a **cyst wall**, thus becoming **sporocysts**; and the sporocysts divide twice to produce four sporozoites each .

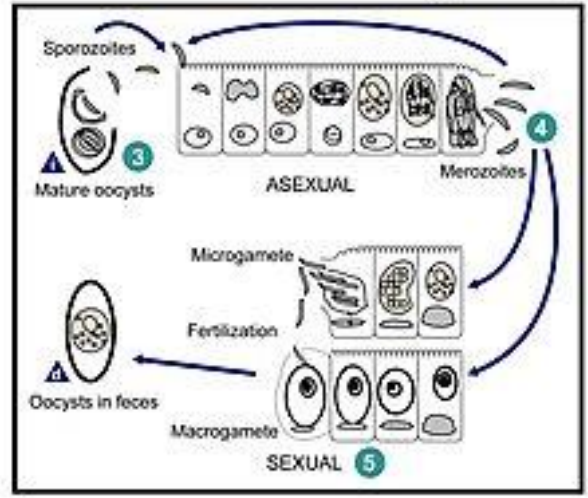
Isosporiasis (*Isospora belli*)



Sporocysts: 2
Sporozoites: 8



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Infection occurs by ingestion of oocysts containing sporocysts- : the sporocysts excyst in the small intestine and release their sporozoites, which invade the epithelial cells and form the merozoites are released, invade new epithelial cells, and continue the cycle of asexual multiplication .

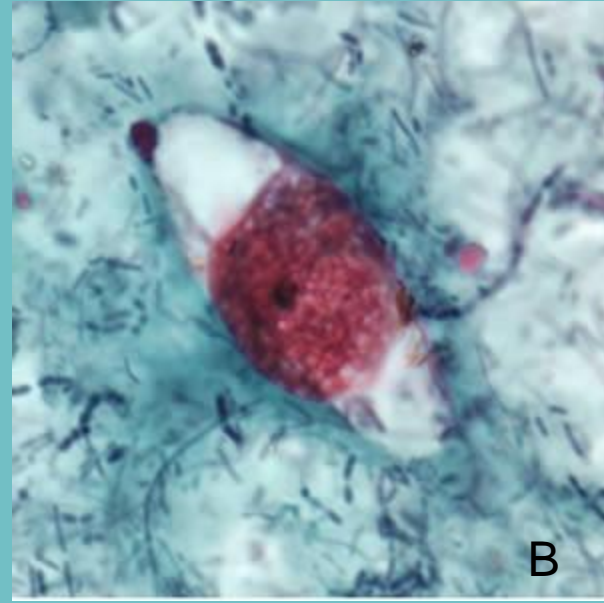
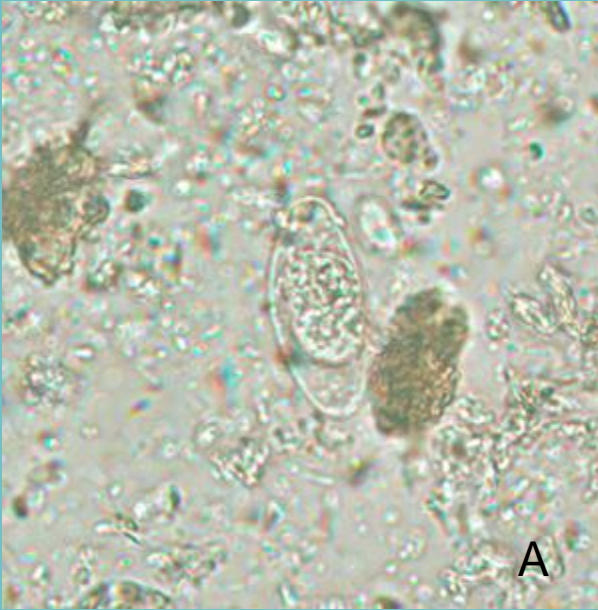
The sexual stage begins with the development of male and female gametocytes . Fertilization results in the development of oocysts that are excreted in the stool

Symptoms:

Infection causes, nonbloody diarrhea with crampy abdominal pain, which can last for weeks and result in dehydration and weight loss. In immunosuppressed patients, and in infants and children, the diarrhea can be severe.

Microscopy

The oocysts of *C. belli* are large (25 to 30 μm) and have a typical oval shape. When excreted, they are immature and contain one sporoblast. It will autofluoresce under ultraviolet (UV) microscopy.



A: Immature oocyst of *C. belli* in an unstained wet mount, showing a single sporoblast.

B: Immature oocyst of *C. belli* stained with safranin, showing a single sporoblast.

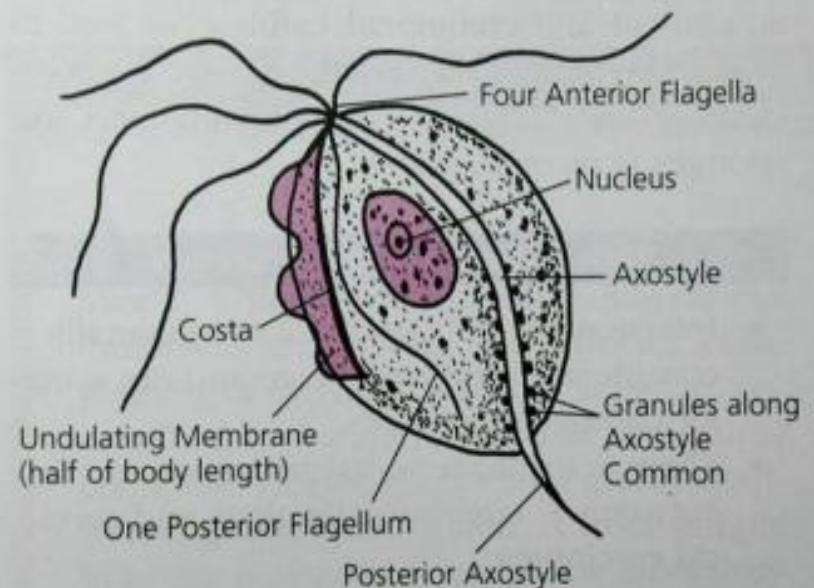
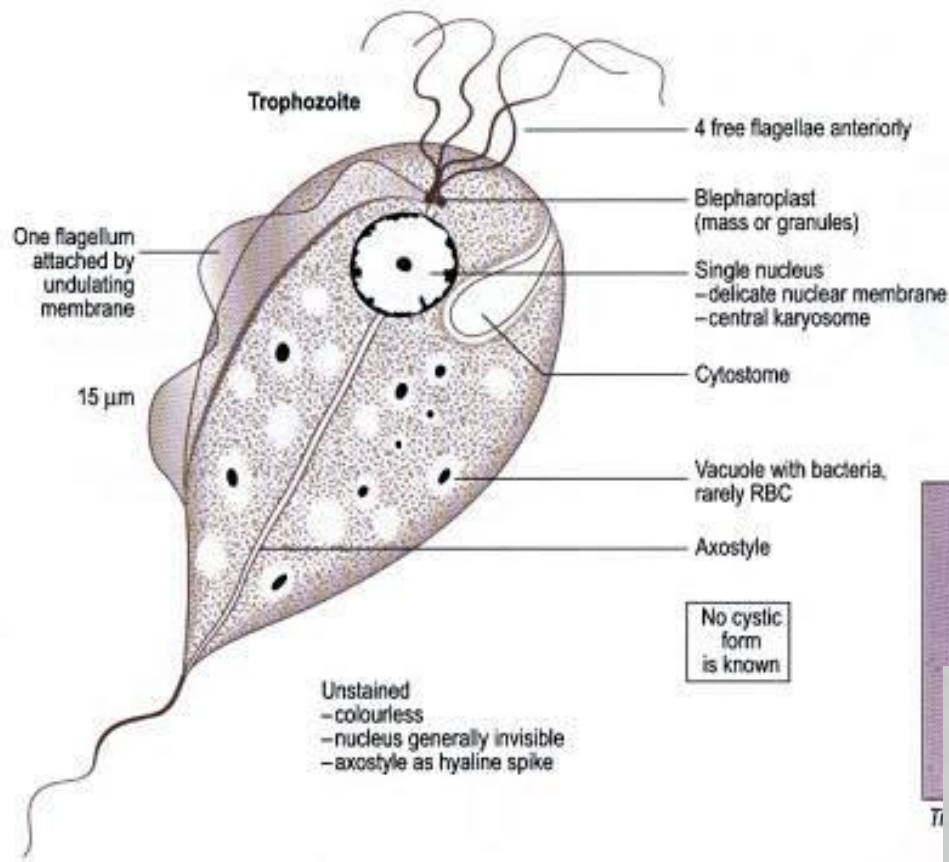
Treatment:

Trimethoprim-sulfamethoxazole
is the drug of choice.

Trichomonas vaginalis

Morphology :

A distinctive feature of the trichomonads is an axostyle (ax) which runs the length of the organism and appears to protrude from the posterior end . The axostyle is a cytoskeletal element composed of concentric rows of microtubules and is believed to function in the attachment of the parasite to epithelial cells. Trichomonads are also characterized by 4-6 flagella (fg) emerging from the anterior end.



Size Range: up to 30 μm long
 Average Length: 8 - 15 μm

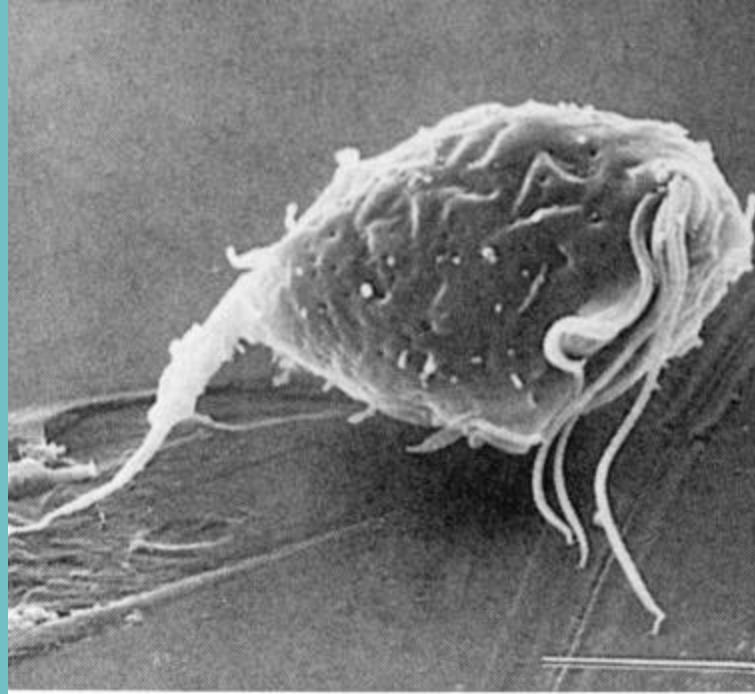


Figure 1. *T. vaginalis* parasite as seen in *broth* culture (Petrin et al., 1998).

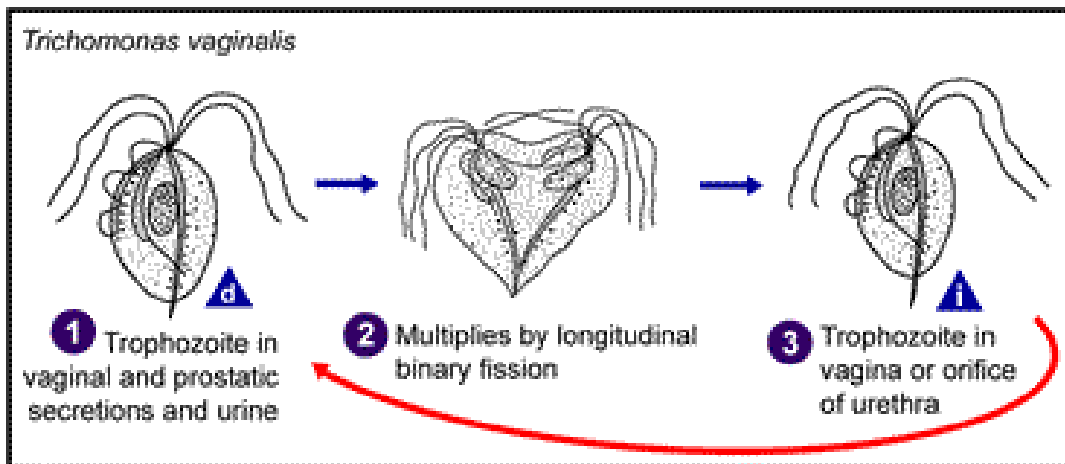
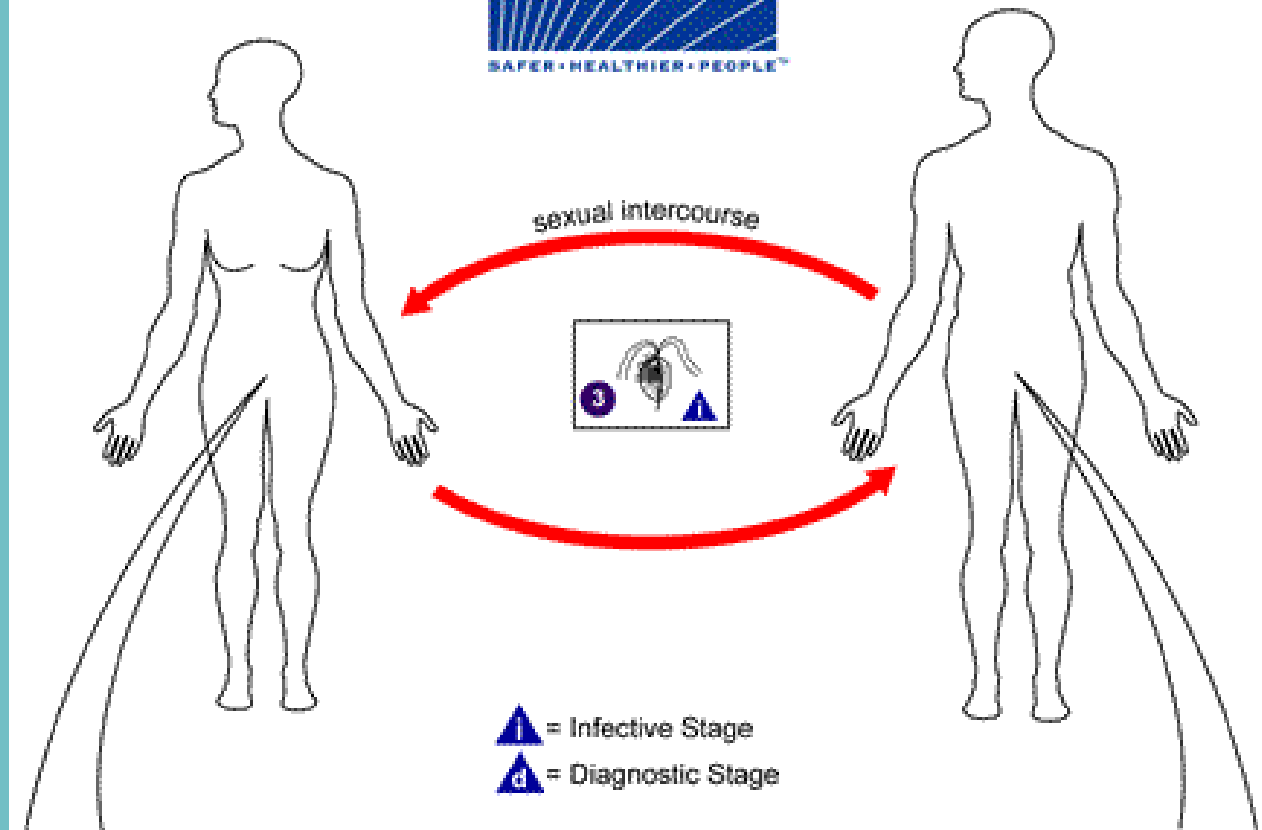
One of the flagella is attached to the body of the organism and forms a posteriorly-directed undulating membrane (um), whereas the remaining flagella are free. The combined basal bodies (bb) and the base of the undulating membrane, called the costa (cs), are often seen in stained preparations. **Less frequently** seen is the cytostomal groove (cy). A single nucleus (nu) is found at the anterior end of the parasite.

T. vaginalis trophozoite is 15 to 18 micrometers in diameter and is half pear shaped with a single nucleus, The organism does not encyst.

Life cycle

T. vaginalis colonizes the vagina of women and the urethra (sometimes prostate) of men. Infection occurs primarily via sexual contact, although non-venereal infections are possible.

Non-sexual transmission includes sharing of clothing like towels. The organism divides by binary fission which is favored high PH (pH > 5.9) There is no non-human reservoir.



Symptoms

T. vaginalis infection is rarely symptomatic in men, although it may cause mild urethritis or occasionally prostatitis. In women, it is often asymptomatic, but heavy infections in a high pH environment may cause mild to severe vaginitis with foul-smelling **yellowish**, sometimes **frothy** discharge .

Chronic infection can cause also infertility,
premature labour, premature rupture of the
placental membranes, and low birth
weight infants

Pathology:

The organism causes contact-dependent
damage to the epithelium of the infected
organ

Diagnosis

Clinical suspicion may be confirmed by finding the organism in Giemsa-stained smears of vaginal discharge or, in difficult cases, by cultivation of a swab sample in Diamond's medium. Trophs must be distinguished from the non-pathogenic flagellate *Trichomona hominis*, which is an asymmetrical flagellate with an undulating membrane.

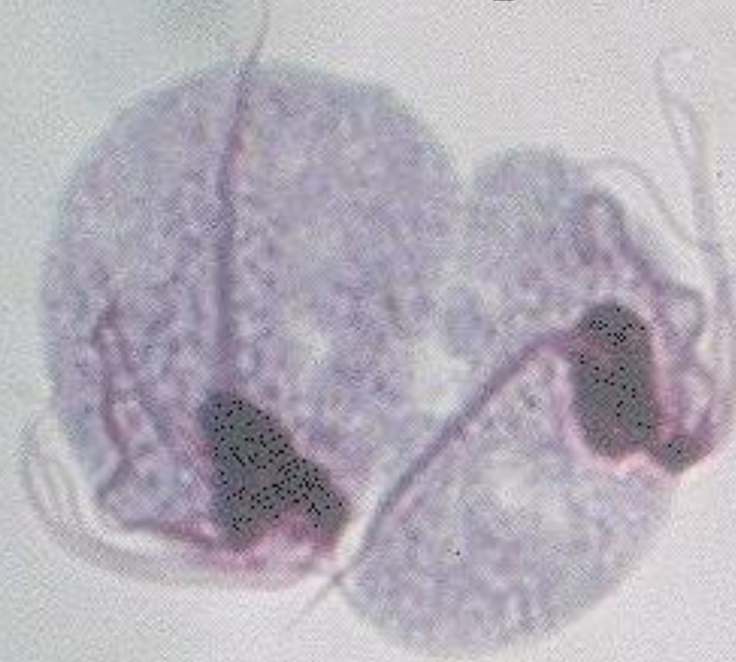
Treatment

Metronidazole (although **teratogenic**) is effective in both males and females.

Vinegar douche may be useful. Personal hygiene and the use of condoms are helpful

Teratogenic: Able to disturb the growth and development of an embryo.

Trichomonas vaginalis



(by P.W. Pappas and S.M. Wardrop)

Two trophozoites of *Trichomonas vaginalis* from culture. The flagella and single nucleus are visible

Balantidium coli

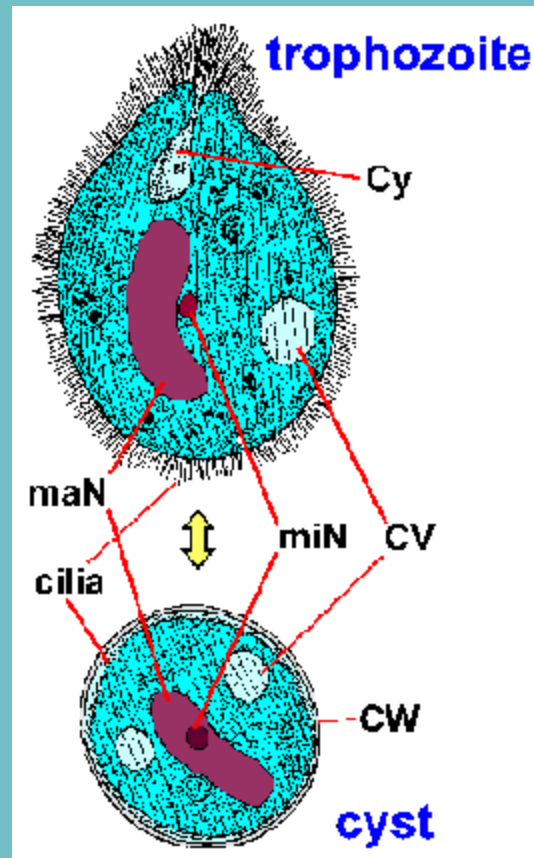
This is a parasite primarily of cows, pigs and horses. The organism is a large (100 x 60 micrometer) ciliate with a macro- and a micro-nucleus. The infection occurs mostly in farm workers and other rural dwellers by ingestion of cysts in fecal material of farm animals.

Symptoms and pathogenesis of balantidiasis are similar to those seen in entamebiasis, including intestinal epithelial erosion. However, **liver, lung and brain abscesses** are not seen.

Treatment:

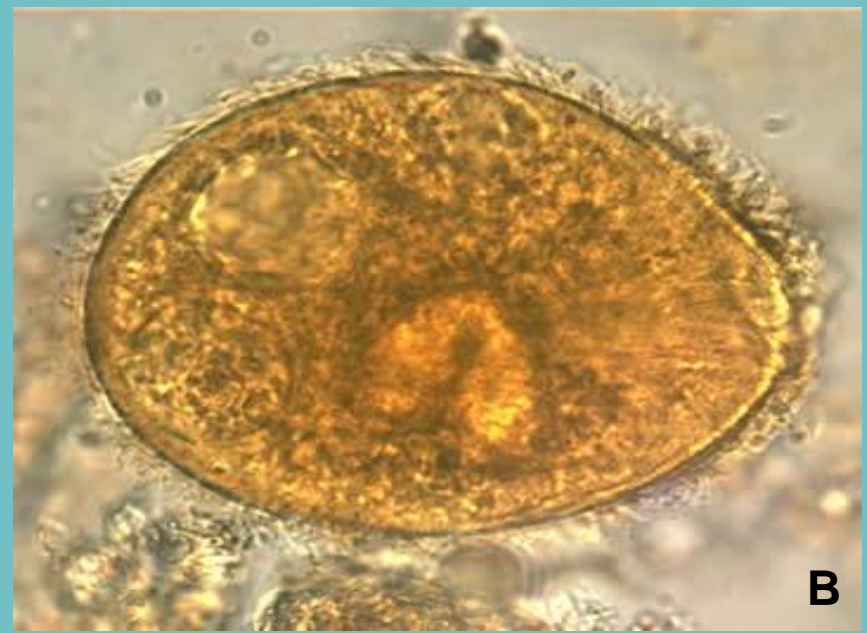
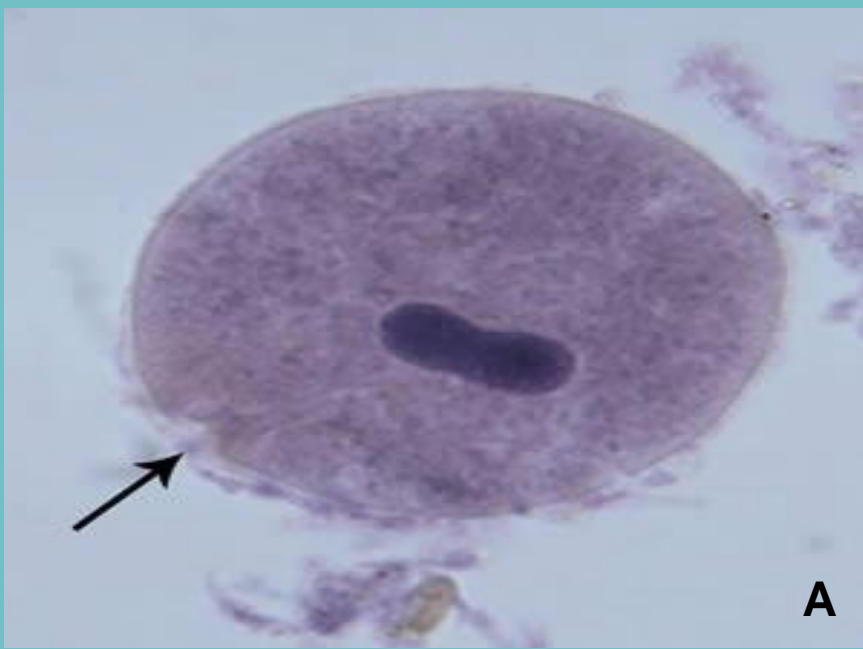
Metronidazole and iodoquinol are effective.





B. coli trophozoite

maN (macronucleus), miN (miconucleus), cv (contractile vacuole),
cy (cytosome), cw (cyst wall).



(A) *B. coli* trophozoite (hematoxylin stained smear,) Note the cytosome (black arrow) and the bean shaped macronucleus.

(B) *B. coli* trophozoite in a wet mount. Note the visible cilia on the cell surface.

Summary

Organism	Transmission	Symptoms	Diagnosis	Treatment
<i>Entameba histolytica</i>	Oro-fecal	Dysentery with blood and necrotic tissue. Chronic: abscesses	Stool: cysts with 1-4 nuclei and/or trophs.	GI: Iodoquinol or Metronidazole Abscess: Metronidazole
<i>Giardia lamblia</i>	Oro-fecal	Fowl-smelling, bulky diarrhea; blood or necrotic tissue rare.	Stool: giardia troph and/or cyst.	Iodoquinol or Metronidazole.
<i>Balantidium coli</i>	Oro-fecal zoonotic	Dysentery with blood and necrotic tissue but no abscesses.	Stool: ciliated trophs and/or cysts.	Iodoquinol or Metronidazole.
<i>Cryptosporidium parvum</i>	Oro-fecal	Diarrhea	Oocysts in stool	Paromycin (investigational)
<i>Isospora belli</i>	Oro-fecal	Giardiasis-like	Oocysts in stool	Sulpha drugs
<i>Trichomonas vaginalis</i>	Sexual	Vaginitis; occasional urethritic/proctetic	Flagellate in vaginal (or	Mebendazole; steroids

Giardia



Cyclospora



Cryptosporidium



8 - 10 micrometers

Bacteria



Virus

