

Protozoa

Subkingdom: Protozoa

Phylum: Sarcomastigophora

Class: Zoomastigophora(Flagellates)

Intestinal, Oral and Genital Flagellates

***Giardia lamblia* (intestinal flagellates)**

Giardia lamblia lives in the duodenum and upper jejunum.

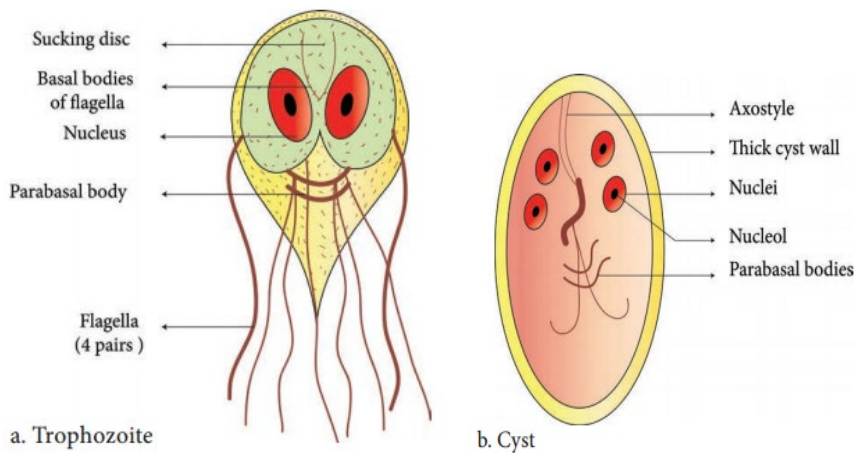
Morphology

It exists in 2 forms:

1. Trophozoite
2. Cyst

Trophozoite stage: is pyriform in shape, rounded anteriorly and pointed posteriorly. It measures $15\ \mu\text{m} \times 9\ \mu\text{m}$. Dorsally, it is convex and ventrally, it has a concave sucking disc for its attachment to the intestinal mucosa. It is bilaterally symmetrical, possesses 2 nuclei each nucleus contain centric karyosome, 4 pairs of flagella, 1 pair of axostyles running along the midline and 2 parabasal or median bodies.

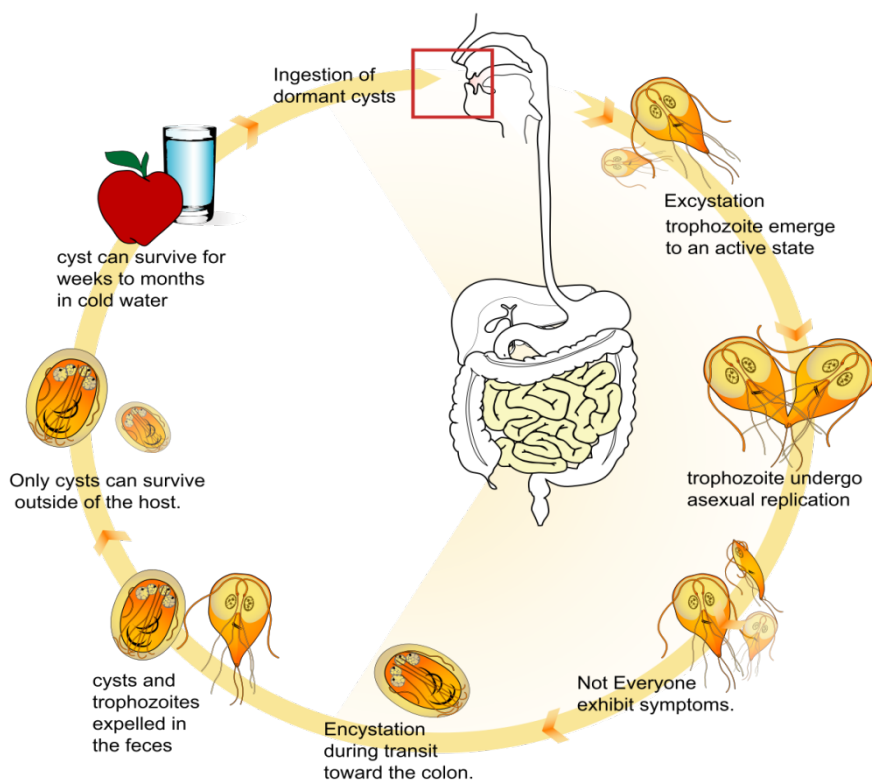
Cyst stage: is the infective form of the parasite. The cyst is oval, measuring $12\ \mu\text{m} \times 8\ \mu\text{m}$. A young cyst contains 2 nuclei. A mature cyst contains 4 nuclei. The axostyle lies diagonally. Remnants of the flagella may be seen in the cyst.



Giardia lamblia

Life Cycle

Cysts are passed out in stool of an infected human. Infective cysts are ingested. The cyst excysts to release trophozoite in the small intestine. The trophozoites multiply by binary fission. The trophozoite encysts to become cyst which is passed out in the stool. *Giardia* completes its life cycle in 1 host. Infective stage is the **mature cyst**. **Human acquires infection by ingestion of cysts in contaminated water and food.** Direct person to person transmission may also occur in children.



Pathogenesis and Clinical Features

Trophozoite does not invade the tissue, but remains adhered to intestinal epithelium by means of the sucking disc causing stunting and shortening of the villi. Patients are usually asymptomatic, but in some cases, giardiasis may cause diarrhoea, fat malabsorption (**steatorrhoea**), dull epigastric pain. The stool contains excess mucus and fat. Children may develop chronic diarrhoea, malabsorption of fat and vitamin A and weight loss.

Diagnosis

1. Microscopic examination

Detection of cysts and trophozoites in stools by direct saline, iodine wet preparations .

2. Enterotest (String test)

A useful method for obtaining duodenal specimen to detect parasites.

3. Molecular diagnosis

PCR on stool specimen.

Treatment

Metronidazole or tinidazole is the drug of choice.

Trichomonas

Genus *Trichomonas* contains three species which occur in humans:-

* *Trichomonas vaginalis*

* *Trichomonas tenax*

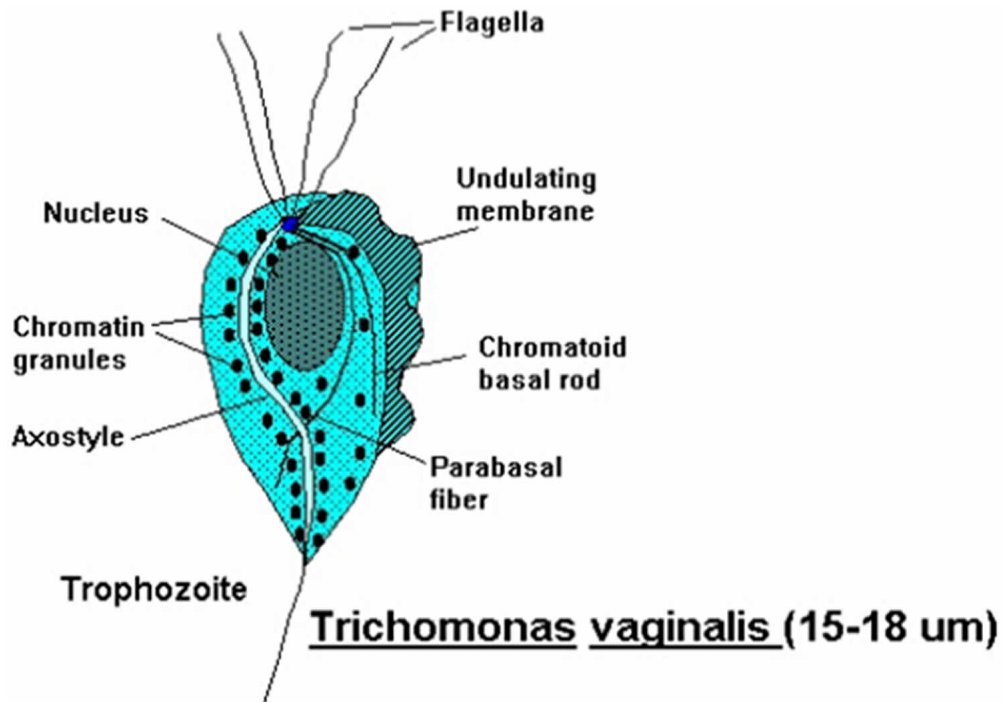
* *Trichomonas hominis*

***Trichomonas vaginalis* (Genital Flagellates)**

In human, it lives mainly in the vagina and cervix of females. In males, it occurs mainly in the anterior urethra and prostate gland.

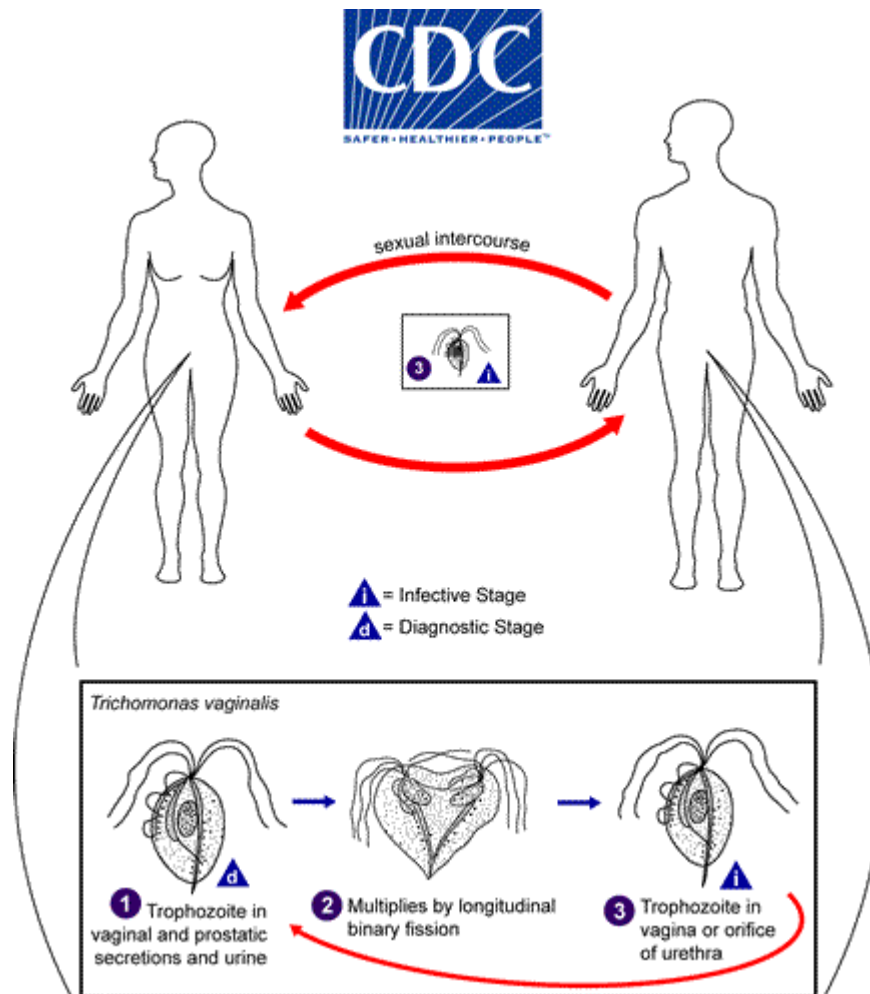
Morphology

It only exists in the trophozoite stage . Trophozoite is pear shaped or ovoid and measures 10–30 μm in length and 5–10 μm in breadth with a short undulating membrane reaching up to the middle of the body. It has 4 anterior flagella and a fifth running along the outer margin of the undulating membrane. A prominent axostyle runs throughout the length of the body and projects posteriorly.



Life Cycle

(1) Trophozoites live in the vagina and cervix, urethra and urinary bladder in females. In males, it occurs mainly in the anterior urethra, but may also be found in the prostate. (2) Trophozoites multiply by longitudinal binary fission. (3) Trophozoites in vagina or opening of urethra can be found in the vaginal and prostatic secretions and urine. Life cycle of *T. vaginalis* is completed in a human host. There is no cystic stage. The trophozoite is transmitted directly from person to person. Sexual transmission is the usual mode of infection. Fomites such as towels have been implicated in transmission.



Pathogenesis and Clinical Features

Trichomonas vaginalis infects the vagina and secretes cysteine, proteases, lactic acid and acetic acid, which disrupt the glycogen levels and lower the pH of the vaginal fluid. Trophozoite does not invade the vaginal mucosa. The infection can range from mild irritation to severe inflammation. Infection is often asymptomatic, particularly in males, although some may develop urethritis and prostatitis. In females, it may produce severe itching in the genital area with yellowish green discharge, burning sensation with urination. The incubation period is 4 days to 4 weeks.

Diagnosis

1. Microscopic examination

Vaginal or urethral discharge is examined microscopically in saline wet mount preparation for the characteristic jerky motility of the trophozoite. In males, trophozoites may be found in urine or prostatic secretions. Fixed smears can be stained with Geimsa stains.

2. Molecular diagnosis
PCR on clinical specimens.

Treatment

Metronidazole is the drug of choice.

Trichomonas tenax

It is pyriform flagellate, harmless commensal in the human mouth, living in the tartar around the teeth.

Trichomonas hominis

It is pyriform and inhabits the caecum of man feeds on enteric bacteria. It does not invade the intestinal mucosa and occasionally been found in the diarrheic stools. Its pathogenicity is yet to be established.

Phylum: Apicomplexa

Class: Sporozoa

Toxoplasma gondii

Toxoplasma gondii is an obligate intracellular coccidian parasite and it occurs in 3 forms:

1. Oocyst
2. Tachyzoite
3. Tissue cyst

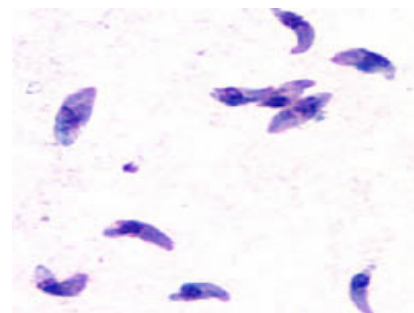
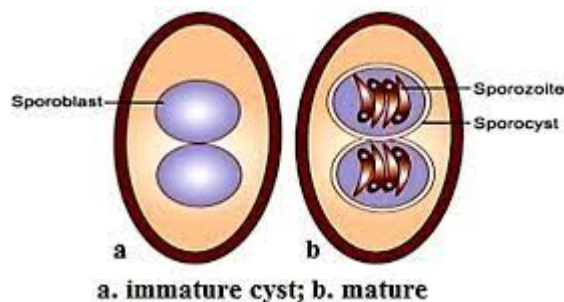
All 3 forms occur in cat which is the definitive host. Tachyzoites and tissue cysts are present in the intermediate hosts (other animals including humans). **All the 3 forms are infectious to human.**

1. Oocysts develop only in the intestine of cat. It is oval in shape and the oocysts are formed by sexual reproduction (gametogony). Cats shed millions of oocysts per day in faeces for about 2 weeks during the primary infection. The freshly passed oocysts are not infectious. They undergo sporulation in the soil with formation of 2 sporocysts, each containing 4 sporozoites. The sporulated oocyst is infective. Oocyst is very resistant to environmental conditions and can remain infective in soil

for about a year. When the infective oocyst is ingested, it releases sporozoites in the intestine, which initiates infection.

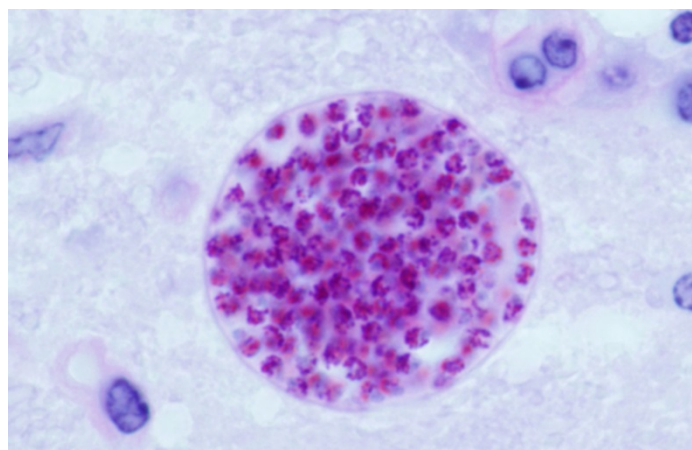
2. Tachyzoite is crescent shaped, with a pointed anterior and a rounded posterior end. The nucleus is spherical usually situated towards the central area. It can invade any nucleated cell. The rapidly proliferating tachyzoites in **acute infection**. It is **active multiplying** form seen during the acute stage of infection.

3. Tissue cyst is the dormant form of the parasite. Tissue cysts are found during **chronic stage** of the infection in the brain, eye, skeletal muscles and other organs. The **slowly multiplying** parasites within the cyst are called **bradyzoites**. The cyst is round or oval, and contains numerous bradyzoites. When raw or undercooked meat containing the cysts is ingested, infection occurs.



Oocyst

Tachyzoites

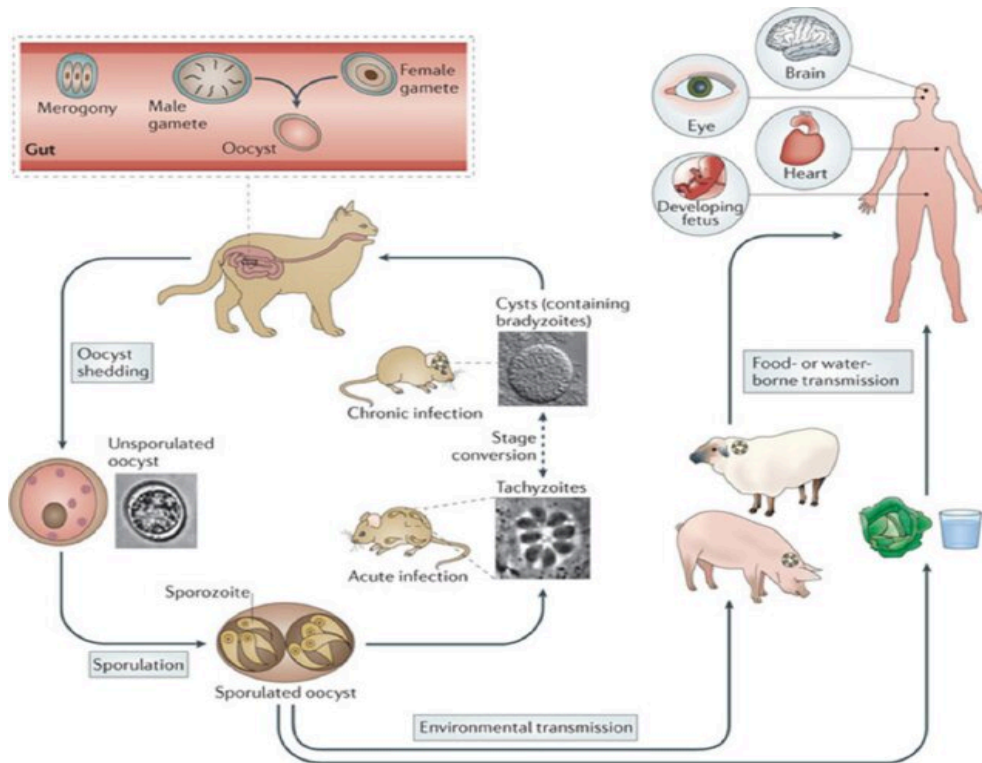


Tissue cyst

Life Cycle

Oocysts are passed out in faeces of cat, The oocysts are ingested by rodents and follow the life cycle to form tissue cysts. The definitive host (cat) ingests tissue cyst present in intermediate host, the oocysts ingested

by other intermediate hosts (e.g. sheep and pig) will follow the life cycle and become tissue cysts. Humans acquire infection when they ingest uncooked meat containing tissue cysts or ingestion of oocysts via drinking contaminated water or eating unwashed fruits and vegetables.



Toxoplasma gondii completes its life cycle in 2 hosts. Definitive host is where both sexual and asexual cycles take place. In the intermediate hosts, only asexual cycle occurs. Both sexual reproduction (gametogony) and asexual reproduction (schizogony) occur within the epithelial cells of the small intestine of the cat. **Cat** acquires infection by ingestion of tissue cysts in rats and other animals or by ingestion of oocysts passed in its faeces. The sporozoites released in the small intestine undergo asexual multiplication (schizogony) leading to formation of merozoites. Some merozoites are carried to extraintestinal tissues or organs and form tissue cysts. Some merozoites transform into male and female gametocytes and initiate sexual cycle (gametogony) with the formation of microgamete and macrogamete. A macrogamete is fertilized by motile microgamete and develops into oocyst which sporulates in the soil after being excreted in faeces of cat. An oocyst with 8 sporozoites is the infective form.

In humans, after ingestion of oocysts or tissue cyst, sporozoites from oocyst and bradyzoites from tissue cysts enter the intestinal mucosa and multiply asexually by schizogony to form tachyzoites. Tachyzoites are

carried to other extraintestinal organs via circulation to form tissue cysts. Cysts are formed in many organs particularly in muscles and brain.

Pathogenesis and Clinical Features

Toxoplasma gondii is an opportunistic parasite. Most human infections are asymptomatic. Clinical toxoplasmosis may be congenital or acquired and the manifestations depend on the immune status of the infected person.

Congenital toxoplasmosis occurs when *T. gondii* is transmitted transplacentally from mother with primary *Toxoplasma* infection to fetus. Some develop clinical manifestations of toxoplasmosis weeks, months and even years after birth. The manifestations of congenital toxoplasmosis include intracerebral calcifications, and hydrocephalus.

Acquired toxoplasmosis is mostly asymptomatic. The most common manifestations of acute acquired toxoplasmosis are cervical lymphadenopathy, fever, headache, and splenomegaly.

Diagnosis

1. Serodiagnosis (routine laboratory diagnostic method)

Diagnosis of infection with *T. gondii* can be made by detection of the presence of IgM and IgG antibodies.

2. Molecular diagnosis

PCR on blood, CSF or amniotic fluid samples.

3. Microscopic examination

Geimsa-stained impression smears of lymph nodes, bone marrow, spleen or brain may occasionally show the trophozoites. Tissue sections may show the cyst form.

Treatment

Only symptomatic cases are treated. Combination drugs of choice are pyrimethamine and sulfadiazine with folinic acid to prevent bone marrow suppression.