

Lab(1)

Introduction

Parasitology : is the study of relationships between parasites and their host , all parasitic organisms are eukaryotes .

Parasites : are living organisms, which depend on a living host for their nourishment and survival .parasites can be classified as: (**Ectoparasite** inhabit only the body surface of the host without penetrating the tissue e.g. lice, ticks ,) or (**Endoparasite** which lives within the body of the host e.g. malaria, giardia). parasites may be simple unicellular protozoa or complex multicellular metazoa.

Host : an organism, which harbors the parasite and provides nourishment and is relatively larger than the parasite .

Definitive host: the organism in which the adult or sexually mature stage of the parasite lives.

Intermediate host : the organism in which the parasite lives during a period of its development only.

Vector: a living carrier that transports a pathogenic organism from an infected to non infected host (e.g. the female *Anopheles* mosquito that transmits malaria)

Host – parasite relationships :

-**Symbiosis**: both host and parasite are dependent upon each other, none of them suffers any harm from the association .

-**Commensalism**: only the parasite derives benefit from association without causing any injury to the host .

-**parasitism**: the parasite derives benefites and the host is always harmed due to the association.

Transmission of parasites:

- 1-Food or water contamination (Round worm, *Amoeba*, *Giardia*).
- 2-Vectors (Sand fly Leishmaniasis, *Tse tse* fly Trypanosomiasis).
- 3-Sexual contact (*Trichomonas*).
- 4-Inhalation of contaminated dust or air Pinworm.
- 5-Skin penetration (Hook worms, *Schistosomes*, Strongyloides).

Parasitic damage to host:

- 1-Trauma (damage to tissues, intestine, liver, eye).
- 2-Lytic action (activity of enzymes elaborated by organism).
- 3-Tissue reponse (localized inflammation, eosinophilia).
- 4-Blood loss (heavy infection with hookworm may cause anemia).
- 5-Secondary infections (weakened host susceptible to bacterial infection).

Types of specimens which can be examined for diagnosis of parasites:

1-Natural secretions:

- stool (*Entamoeba histolytica*),
- sputum (*paragoniumuswestermani*),
- urin (*Schistosoma heamatobium*).

2-Blood: (*Plasmodium spp.*).

3-Vaginal secretions: (*Trichomonas vaginalis*).

4-Biopsy of liver or spleen: (*Leishmania donovani*).

Detection of parasites :

1-Clinical diagnosis: depends on symptoms

2-Laboratory diagnosis :

a. Microscopic examination

- wet preparation
- perception
- flotation

b. Serological exam

c. Animal inoculation

d. Intra-dermal sensitivity exam

e. Culture method

f. Tap technique

g. X-ray technique

Lab (2)

Kingdom : Protista

Subkingdom : Protozoa

Phylum : Sarcomastigophora

1-Subphylum : Sarcodina

Genus : **1-*Entamoeba histolytica*** (pathogenic ameba)

2-*Entamoeba coli* (non-pathogenic ameba)

3-*Endolimax nana* (non-pathogenic ameba)

4-*Iodamoeba butschlii* (non-pathogenic ameba)

5-*Entamoeba gingivalis* (non-pathogenic ameba)

1-*Entamoeba histolytica*

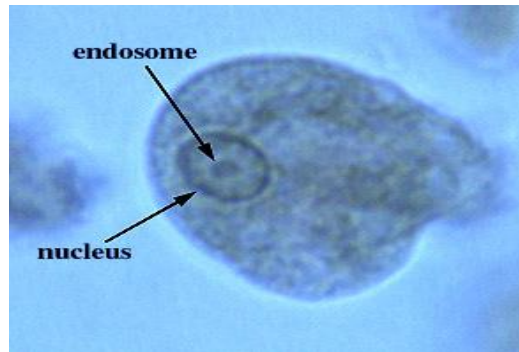
Disease name : Amebic dysentery or Amebiasis

Site of infection : Large intestine

Entamoeba histolytica : pathogenic ameba have two stages Trophozoite (vegetative and diagnostic stage) and Cyst (infective and diagnostic stage) .

Morphology of trophozoite

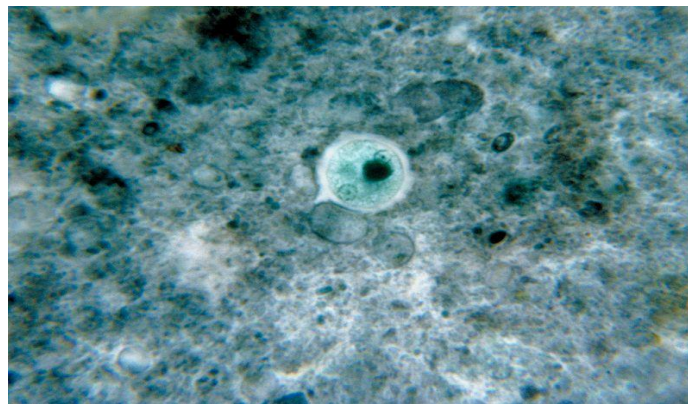
Trophozoite of *E. histolytica* is (15-30) micrometer in diameter, has a single nucleus with a small centrally placed karyosome . The nuclear chromatin is evenly distributed along the periphery of the nucleus . The fine granular endoplasm may contain ingested RBCs



Entamoeba histolytica (trophozoite)

Morphology of cyst

Cyst of *E. histolytica* is (10-15) micrometer in diameter and contain one to four nuclei . Chromatoid bodies are usually present in young cysts as elongated bars with bluntly rounded ends. Glycogen is usually diffuse, but in young cysts it is often present as a concentrated mass, staining reddish brown with iodine.



Entamoeba histolytica (cyst)

Life cycle of *Entamoeba histolytica* :

Infection occurs by ingestion of cysts on focally contaminated food or hands. The cyst is resistant to the gastric environment and passes into small intestine where it decysts. The metacyst divides into four and then eight amoebae which move to the large intestine. The majority of the organisms are passed out of the body with the feces but with chronic infection some amoeba invade the mucosal tissue forming

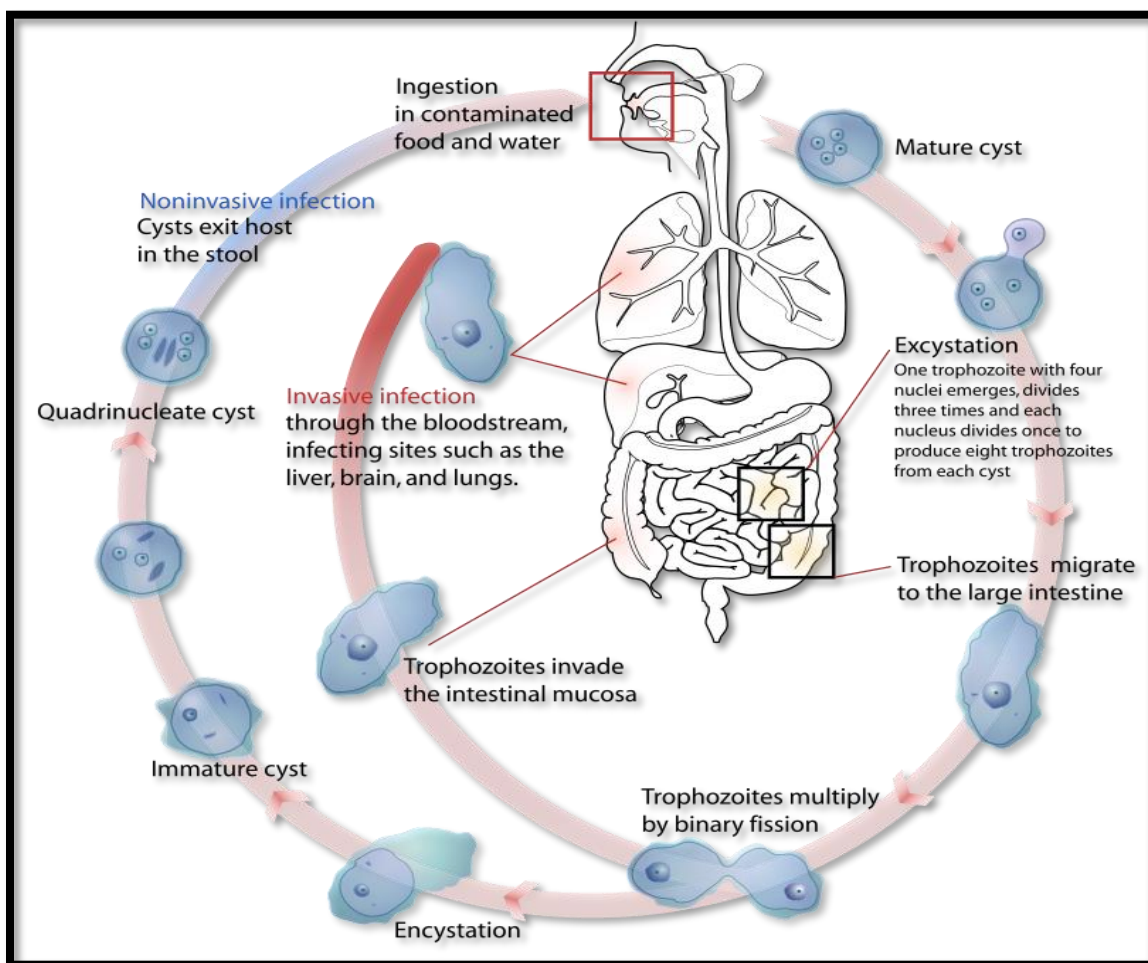
flask-shaped lesions. The organisms encyst for mitosis and are passed through with feces.(there are no intermediate or reservoir host).

Symptoms : including diarrhea with blood and mucus, fever and dehydration.

Laboratory diagnosis:

1-Laboratory diagnosis by finding the characteristic cysts in an iodine stained or formolether concentration method or a permanent stained preparation . Direct microscopy should be done by mixing a small amount of the specimen in 0.9% sodium chloride solution

2-The tests of indirect fluorescent antibody test (IFAT), or (ELISA) .



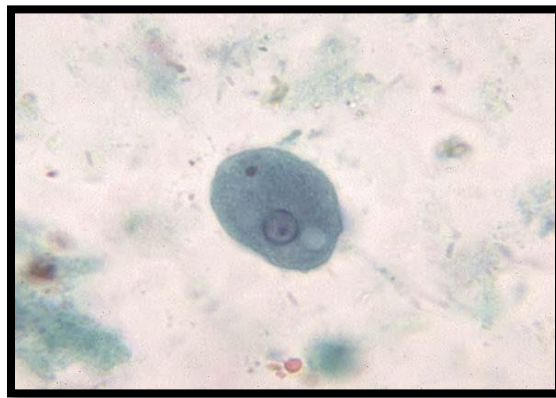
Life cycle of *Entamoeba histolytica*

2-Entamoeba coli

Entamoeba coli are non-pathogenic amoeba with world wide distribution. Its life cycle is similar to that of *E.histolytica* but it does not have an invasive stage and does not ingest red blood cells.

Morphology of trophozoite

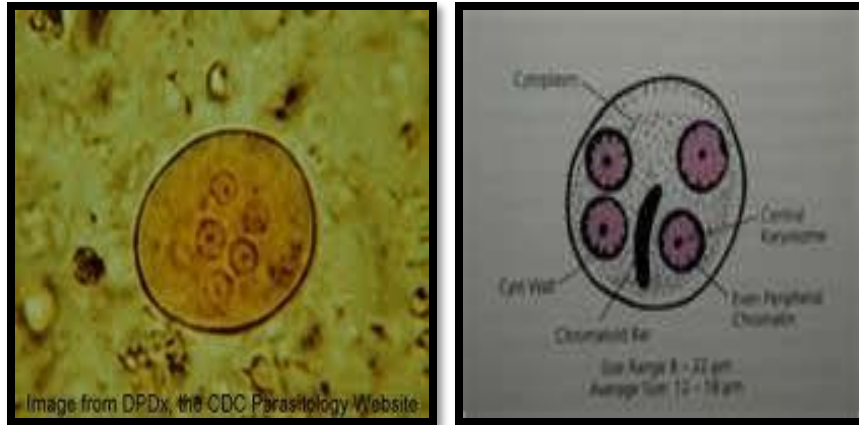
Trophozoite is larger than of *E.histolytica* ranging from (15-50) micrometer in diameter .It exhibits blunt pseudopodia with sluggish movement. A permanently stained preparation shows a nucleus with a moderately large eccentric karyosome with the chromatin clumped on the nuclear membrane. The cytoplasm appears granular containing vacuoles with ingested bacteria and other food particles.



***Entamoeba coli* (trophozoite)**

Morphology of cyst

Cyst of *E.coli* is (15-30) micrometer in diameter and contain (1-8) nuclei with irregular peripheral chromatin, karyosomes not central. Chromatoid bodies are not frequently seen but when present they are usually splinter-like with pointed ends. Glycogen is usually diffuse but in young cyst is occasionally found as a well-defined mass, which stains reddish brown with iodine.



***Entamoeba coli* (cyst)**

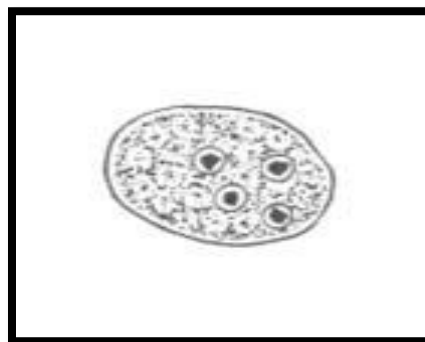
3-Endolimax nana

Morphology of trophozoite

Trophozoite of *E.nana* ranging from (6-12) micrometer in diameter. Motility is sluggish with blunt hyaline pseudopodia. In a permanently stained preparation, the nucleus exhibits a large karyosome with no peripheral chromatin on the nuclear membrane.

Morphology of cyst

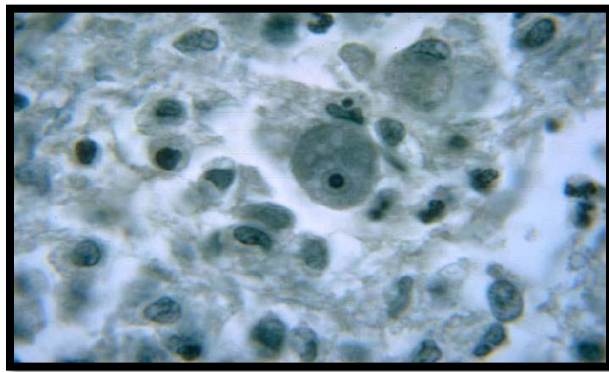
Cyst of *E.nana* is (6-9) micrometer in diameter. They can be spherical or ovoid in shape and contain (4) pinpoint nuclei, which are highlighted by the addition of iodine. Chromatoid bodies are not found and glycogen is diffuse.



4-*Iodamoeba butschlii*

Morphology of trophozoite

Trophozoite of *Iodamoeba butschlii* ranging from (8-20) micrometer in diameter, its actively motile. On a permanently stained fecal smear, a nucleus with a large karyosome is evident. Chromatoid bodies form striations around the karyosome. The cytoplasm appears granular containing vacuoles with ingested bacteria and debris.



***Iodamoeba butschlii* (trophozoite)**

Morphology of cyst

Cyst of *Iodamoeba butschlii* is (9-15) micrometer in diameter, and have one nucleus in mature cysts usually eccentrically placed. Chromatoid bodies are not present and glycogen is present as a compact well defined mass staining dark brown with iodine.



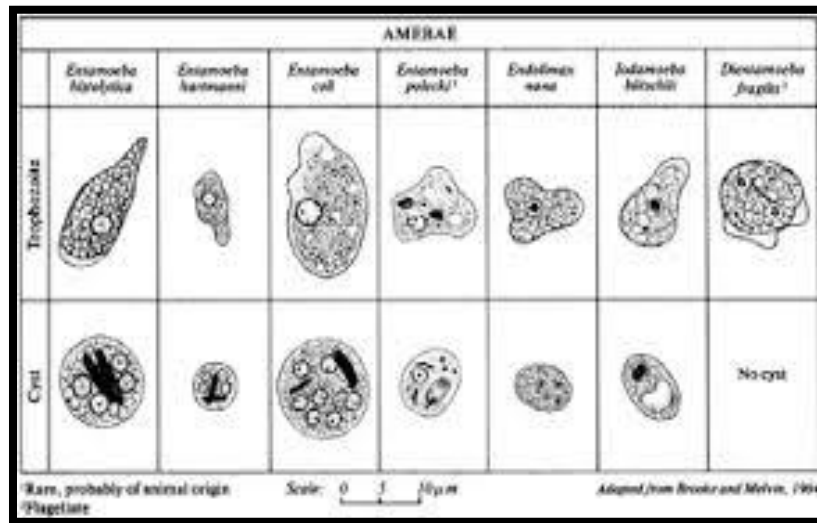
Iodamoeba butschlii (cyst)

5-Entamoeba gingivalis

Entamoeba gingivalis is found in mouth near the base of the teeth. It has only trophozoite.

Morphology of trophozoite

Trophozoite of *E. gingivalis* ranging from (5-30) micrometer in diameter, contain single small spherical nucleus, contains irregular distributed small masses of chromatin, central or eccentric karyosome. They are several food vacuoles in endoplasm contain largely dark bodies .



Types of amebae

Lab(3)

Kingdom: Protista

Subkingdom: Protozoa

Phylum: Sarcomastigophora

2-Subphylum: Ciliophora

Class: Ciliata

Order: Euciliata

Genus: *Balantidium coli*

3- Subphylum: Mastigophora (Flagellates)

Class: Zoomastigophora

Order: Diplomonadida

Genus: *Giardia lamblia* , *Trichomonas vaginalis*

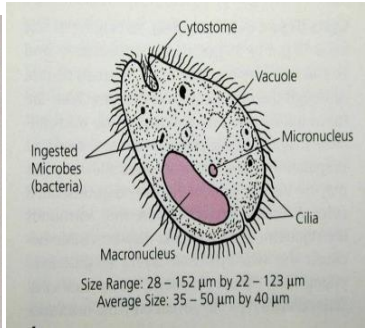
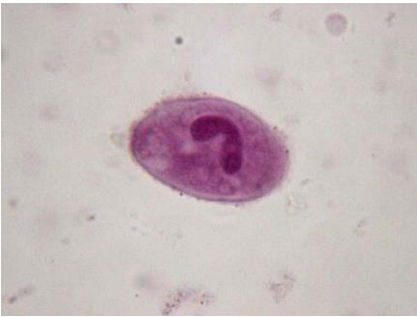
Balantidium coli

Disease name: Balantidiasis , Balantidil dysentery

Site of infection: Large intestine, cecum and terminal ileum

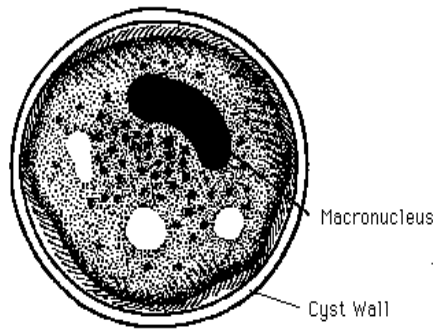
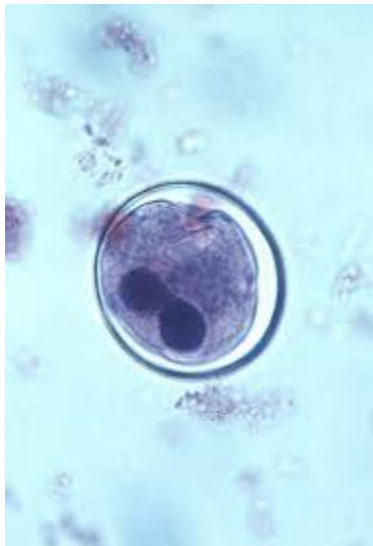
Morphology of trophozoite

They are covered in cilia and have boring or rotary motility. *Balantidium coli* is known for being the largest protozoan parasite of humans , the two nuclei are clearly visible. The macronucleus is long and kidney-shaped, and the spherical micronucleus is nestled next to it.



Cyst

Cysts are smaller than trophozoites, measuring Cysts are round and have a tough, heavy cyst wall made of one or two layers. Usually only the macronucleus and perhaps cilia and contractile vacuoles are visible in the cyst

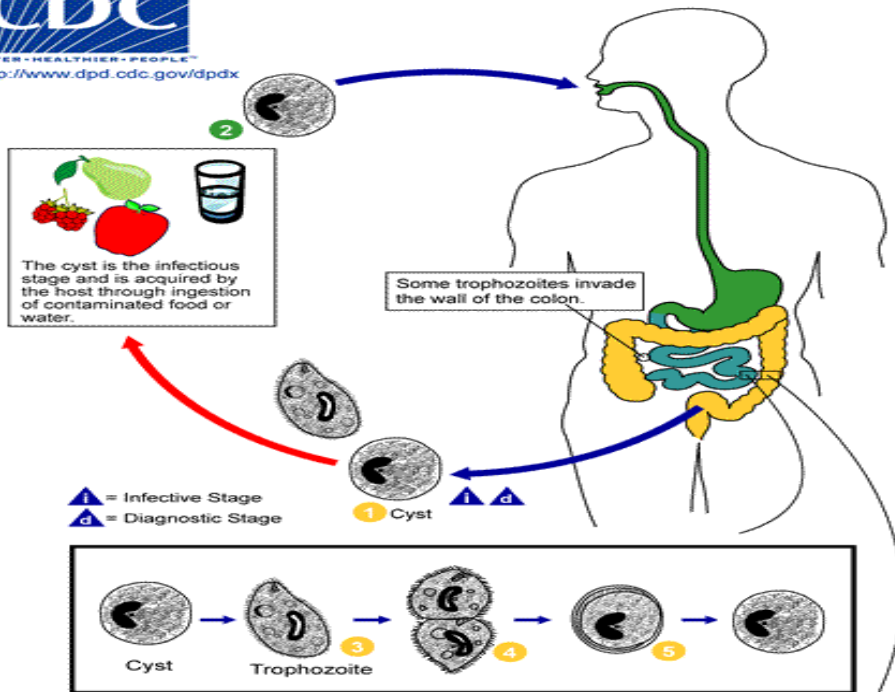


Cyst
50 x 60μ

Life cycle

Infective stage:Cyst

Diagnostic stage: Cyst,trophozoite



Symptoms:

who are infected with *B. coli* remain asymptomatic. trophozoites can invade the mucosa of the large intestine (cecum and colon) and cause ulcerations. Other bacteria in the intestine may enter the ulcer leading to secondary infections. Common symptoms chronic diarrhea, occasional dysentery (diarrhea with passage of blood or mucus), nausea, foul breath, colitis (inflammation of the colon), abdominal pain, weight loss, deep intestinal ulcerations, and possibly perforation of the intestine.

Diagnosis

Examination of stool samples, looking for trophozoites and cysts ,Trophozoites are readily identified because of their large size and the fact that *B. coli* is the only ciliate that parasitizes humans.

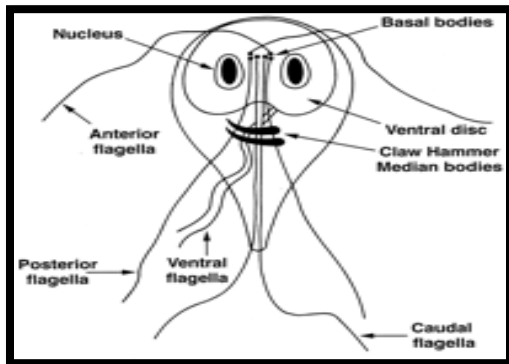
Giardia lamblia

Disease name :Giardiasis

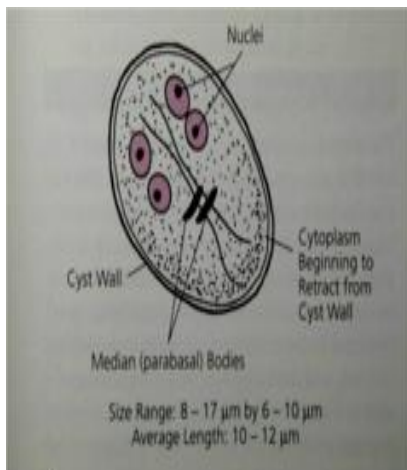
Site of infection: small intestine

Morphology:

Trophozoite: It is flattened pear shaped with two nuclei ,two slender axostyles and eight flagella (four pairs of flagella).They attach themselves to the surface of jejuna or duodenal mucosa by their disc like suckers wich are found on their ventral surface.

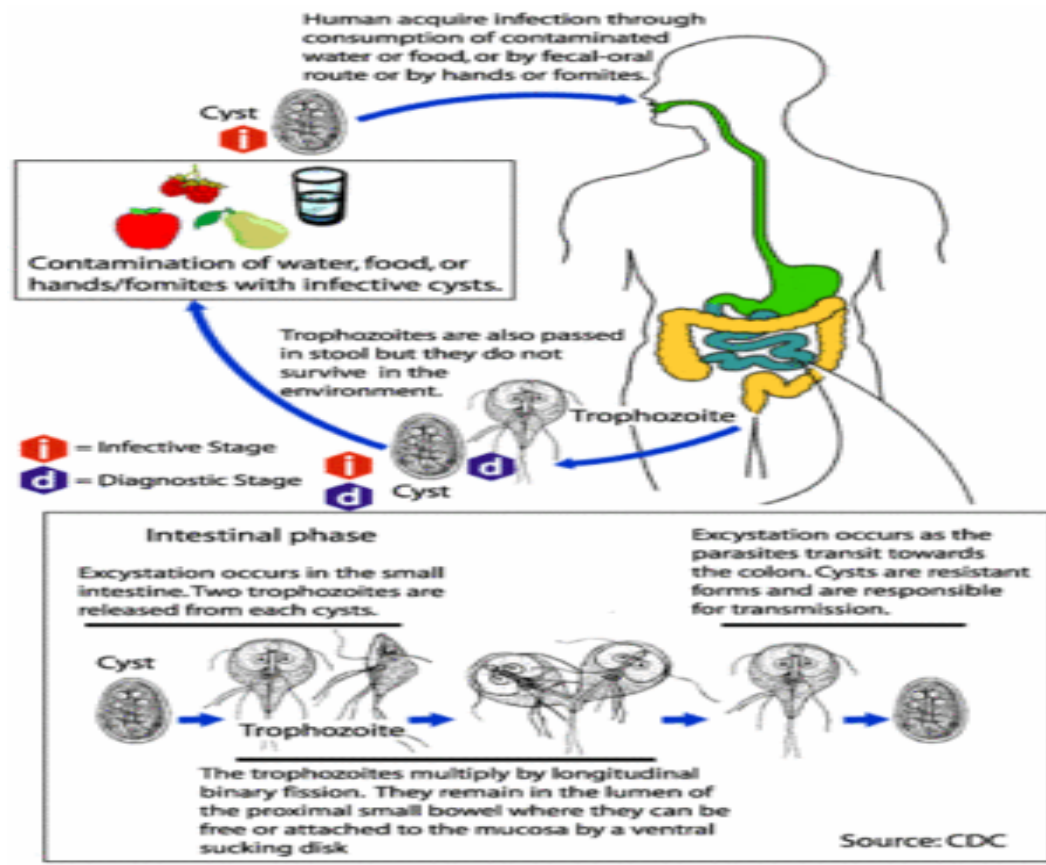


Cyst: It is ellipsoid in shape, contain four nuclei. Longitudinal fibrils consisting of the remains of axonesmesand parabasal bodies may also seen.



***Giardia lamblia* cyst stained with iodine**

life cycle



Symptoms: are abdominal pain, flatulence and watery diarrhea no blood no mucus is normally seen.

Laboratory diagnosis

1-Trophozoites and cyst are found by examination of saline wet preparation of fresh diarrheic stool.

2- duodenal or jejuna aspirate

3-Elisa to detect IgMin serum provides the evidence of current infection.

4- Biopsy from the upper intestine

3-*Trichomonas vaginalis*

It exists only in trophozoite form

Transmission is by sexual intercourse

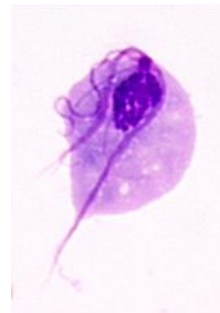
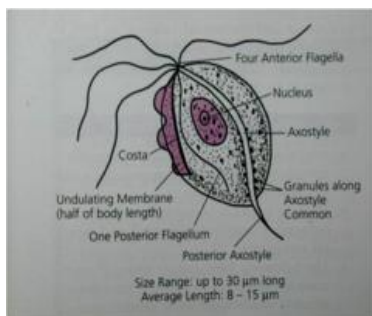
Disease name: Trichomoniasis

Site of infection: the urethra & vagina of women and the urethra & prostate gland of man

Morphology:

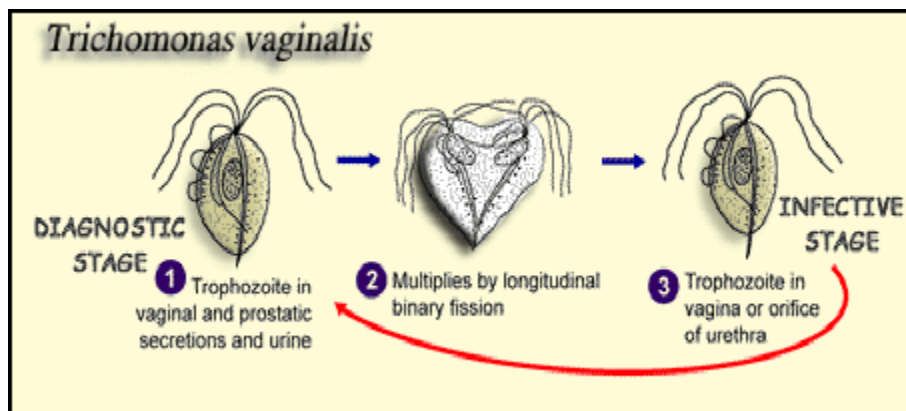
Pear shaped organism with central nucleus and four anterior flagella and

Undulating membrane extends about two-thirds of its length.



Trichomonas vaginalis trophozoite

Life cycle:



Symptoms:

Women

- A vaginal discharge is common. This is typically greenish-yellow and may be 'frothy'. The discharge usually has an unpleasant smell.

- vagina itching and uncomfortable.
- It may be sore when you pass urine.
- No symptoms occur in some women. However, they can still pass on the infection even if you have no symptoms.

Men

- Discharge from the penis is common.
- It may be sore when you pass urine.
- You may pass urine frequently (due to irritation inside the penis).
- No symptoms occur in most infected men. However, you can still pass on the infection even if you have no symptoms.

Diagnosis:

cell cultures

antigen tests (antibodies bind if the *Trichomonas* parasite is present, which causes a color change that indicates infection)

tests that look for *Trichomonas* DNA

examining samples of vaginal fluid (for women) or urethral discharge (for men) under a microscope

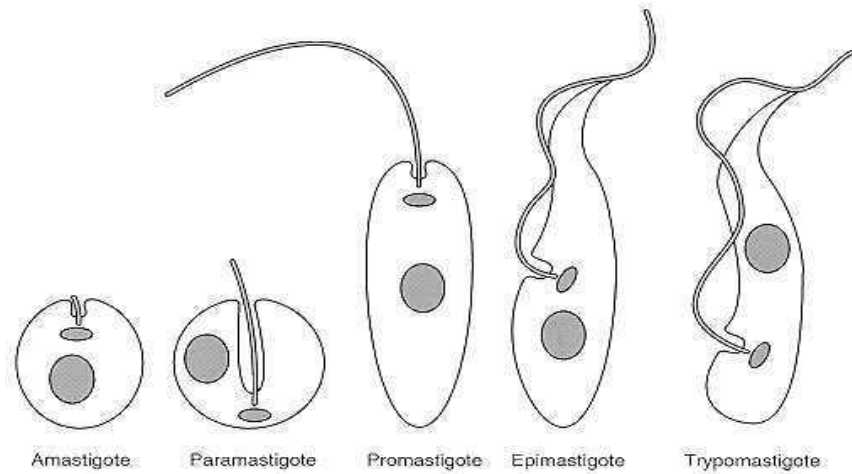
Lab (4)

Blood and Tissue flagellates: it include flagellated protozoa that contain

1-flagella 2-nuclues 3-kinetoplast

Morphology of tissue and blood flagelates

1-Amastigote 2-Promastigote 3-Epimastigote 4-Trypomastigote



Kingdom: Protista

Subkingdom: Protozoa

Phylum: Sarcomastigophora

Class: Zoomastigophora

Order: Kinetoplastida

Family: Trypanosomatidae

Genus: 1-*Leishmania* spp.

2-*Trypanosoma* spp.

Leishmania spp.

1-*Leishmania tropica*

2-*Leishmania donovani*

3-*Leishmania braziliensis*

Disease name:

- *Leishmania tropica* causes Baghdad boil (cutaneous leishmaniasis).

-*Leishmania donovani* causes kala-azar or black fever (visceral leishmaniasis).

-*Leishmania braziliensis* causes subcutaneous (mucocutaneous leishmaniasis).

Site of infection:

-*Leishmania tropica* (skin)

-*Leishmania donovani* (liver, spleen, lymph node, bone marrow)

-*Leishmania braziliensis* (mucocutaneous tissue of skin, nose, mouth)

Definitive host : human

Intermediate host (vector) : *Phlebotomus* female (sand fly)

Morphology:

Leishmania exist as flagellated extracellular Promastigotes in the sandfly vector and as a flagellar obligate intracellular Amastigotes within mononuclear phagocytes of their vertebrate hosts. The various species are not distinguishable morphologically from one another. When stained with Giemsa stain, amastigotes appear as round or oval bodies ranging from 2-3 micrometer in diameter with a well defined nucleus and kinetoplast, a rod shaped specialized mitochondrial structure. The flagellated Promastigote form is spindle shaped, measuring (10-20) micrometer in length, not including the length of the flagellum. As in the Amastigote form a nucleus and kinetoplast are clearly visible.

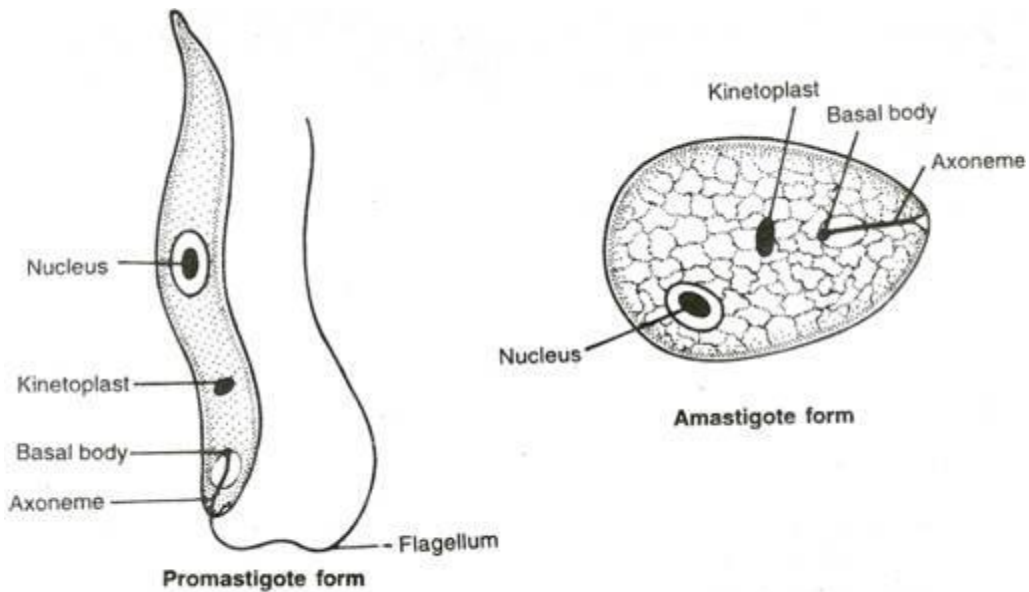
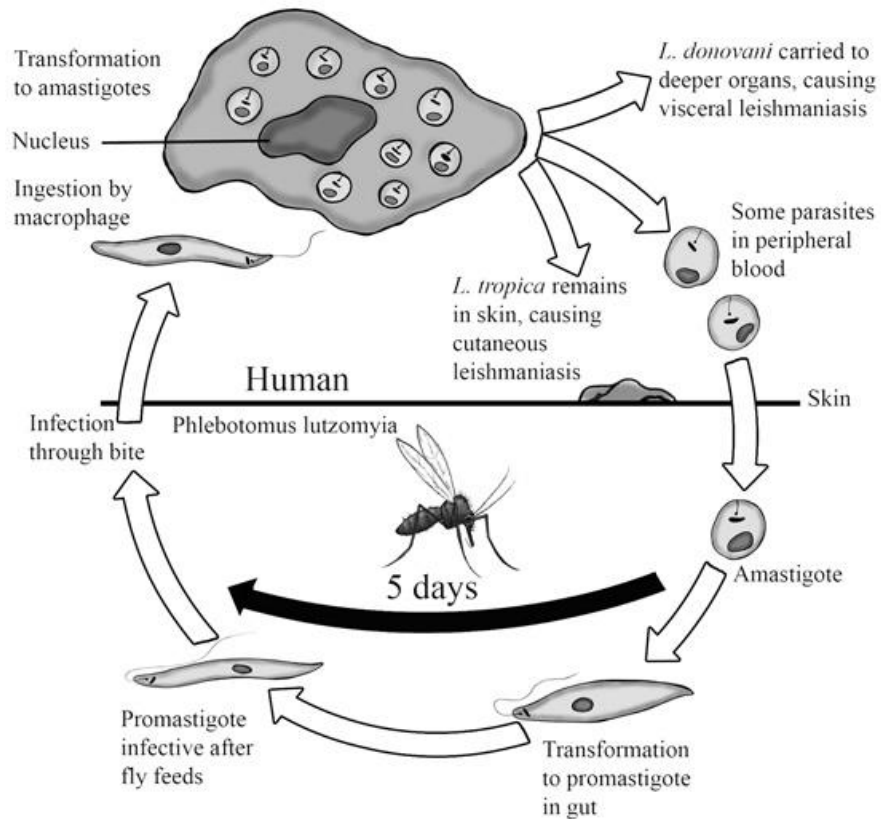


Fig. 178. Morphological forms of *Leishmania donovani*

Life cycle:

All forms of infection starts when a female sand fly (*Phlebotomus sp.*) takes a blood meal from an infected host . Small amounts of blood, lymph and macrophages infected with *Leishmania* amastigotes are ingested. Once ingested the amastigotes transform to promastigotes in the sandfly, the non-infective promastigotes divide and develop into infective metacyclic promastigotes. These are formed in the midgut of the sandfly and migrate to the proboscis. When the sandfly bites, the extracellular inoculated promastigotes at the site of the bite are Phagocytosed by macrophages. After phagocytosis, transformation to dividing amastigotes occurs within 24 hours. Reproduction at all stages of the lifecycle is believed to occur by binary fission. No sexual stage has been identified.



Diagnosis:

- 1-Direct smear of blood and lymph.
- 2-Serology.
- 3-Cuturing in N.N.N.(Nove MacNeal-Nicole).
- 4-Biopsy from liver,Spleen and bone marrow.

Lab(5)

Trypanosoma spp.

Trypanosomes are hemoflagellates and three species of the genus *Trypanosoma* are responsible for disease in humans

1-African trypanosomiasis (sleeping sickness)

There are two clinical forms of African trypanosomiasis

A – *Trypanosoma brucei gambiense* causes (Gambian trypanosomiasis chronic sleeping sickness).

B- *Trypanosoma brucei rhodesiense* causes (Rhodesians trypanosomiasis acute sleeping sickness).

Site of infection: blood ,lymph, spleen, liver, cerebrospinal fluid

Vector Tsetse genus: *Glossina* spp.

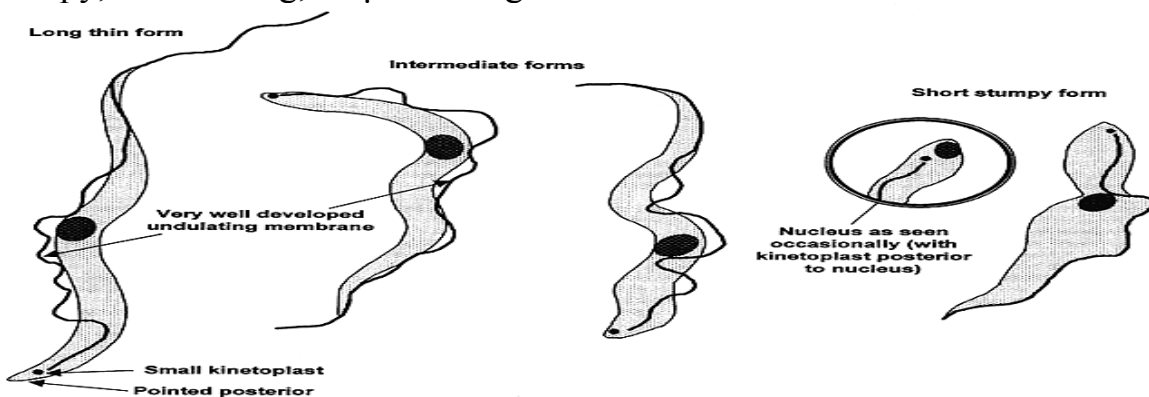
The parasite undergo several forms depending on the host

In vertebrate host (human) which is definitive host :trypomastigote

In invertebrate host (insect) which is intermediate host: trypomastigote and epimastigote

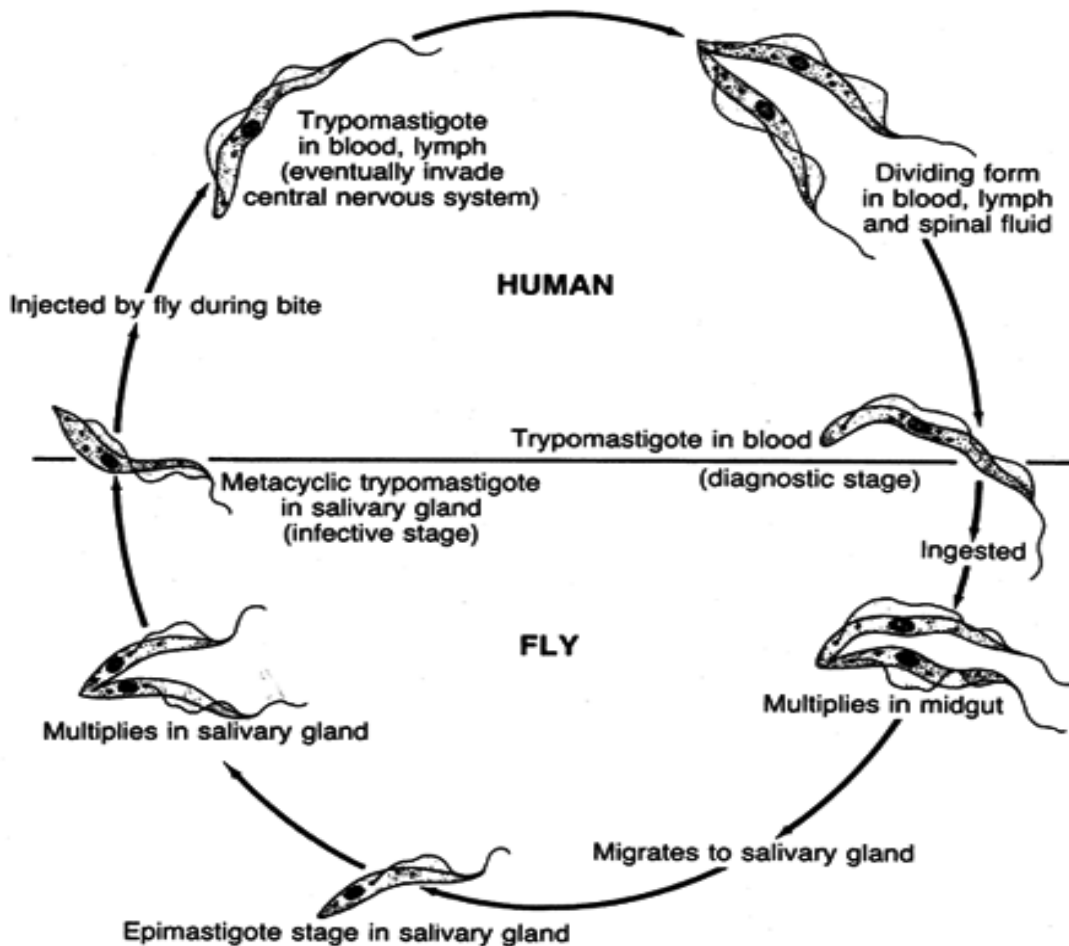
Morphology

The parasite is an elongated cell with single nucleus which usually lies near the centre of the cell, single flagellum which appears to arise from a small granule kinetoplast. two forms of trypomastigote can be seen in peripheral blood: one is long slender, 30 μm in length, and is capable of multiplying in the host, the other is stumpy, not dividing, 18 μm in length.



Life Cycle

Transmission from one vertebrate to another is carried out by blood-sucking invertebrates, usually an insect (vector). Metacyclic (infective) trypomastigotes are inoculated through the skin when a tsetse fly takes a blood meal. The parasites develop into long slender trypomastigotes which multiply at the site of inoculation where ulceration occurs. The trypanosomes continue to develop and then may invade the lymphatic tissues, the heart, various organs and in later stages, the central nervous system. Trypomastigotes are taken up by the tsetse fly (male and female) during a blood meal. The parasites develop in the midgut of the fly where they multiply. 2-3 weeks later the trypomastigotes move to the salivary glands transforming from epimastigotes into metacyclic S-shape (infective) trypomastigotes. These are known as salivarian trypanosomes as they complete their development in the salivary system (anterior portion of the vector). The tsetse fly remains infective for life i.e. about three months.



Symptoms:

The early stages of African trypanosomiasis may be asymptomatic and there is a low grade parasitaemia. This period may last for several weeks to several months. The disease may terminate untreated at this stage or go on to invade the lymph glands. Invasion of the lymph glands is usually accompanied by a high irregular fever with shivering, sweating and an increased pulse rate. Trypanosomes may invade the central nervous system giving symptoms of meningoencephalitis, confusion, apathy, excessive sleeping and incontinence.

Laboratory diagnosis of African Trypanosomiasis is by:

- Examination of blood for the parasites
- Examination of aspirates from enlarged lymph glands for the parasites
- Examination of the CSF for the parasite
- Detection of trypanosomal antibodies in the serum

2-American trypanosomiasis

Trypanosoma cruzi causes (chagas disease).

Site of infection: muscular muscle, kidneys, thyroid gland, sexual organs

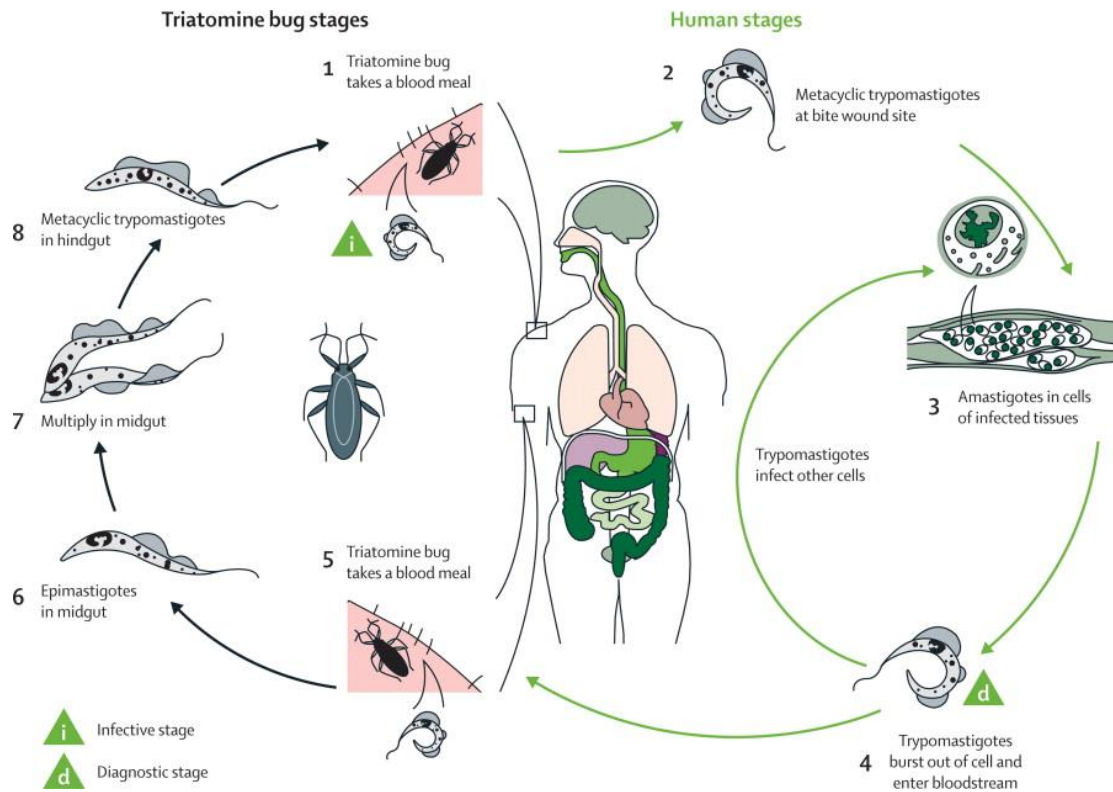
Vector Bug genus: *Tritoma*

Morphology:

Trypanosoma cruzi has a single form (monomorphic), about 20µm in length, and characteristically curved (C-shape). The kinetoplast is large, considerably larger than the *Trypanosoma brucei* species. The flagellum is medium in length.

Trypanosoma cruzi in man only occurs in the amastigote phase in muscular tissue and cells.

Lifecycle of *Trypanosoma cruzi*



Symptoms:

In an acute infection there may be fever, malaise, increased pulse rate, and enlargement of lymph glands, liver, and possibly spleen. Chronic infection include signs of cardiac muscle damage leading to heart failure.

Laboratory diagnosis of South American trypanosomiasis is by:

- Examination of blood.
- Xenodiagnosis
- Blood culture
- Serology

Lab (6)

Kingdom: Protista

Subkingdom: Protozoa

Phylum: Sarcomastigophora

Class: Ampicomplexa (sporozoa)

Order: Eucoccida

Family: Plasmodidae

Genus: *Plasmodium vivax* (benign tertian malaria).

Plasmodium malaria (quartian malaria).

Plasmodium ovale (ovale tertian malaria).

Plasmodium falsiparm (malignant tertian malaria).

Disease name: Malaria

Site of infection: Red blood cell and Liver tissue cell

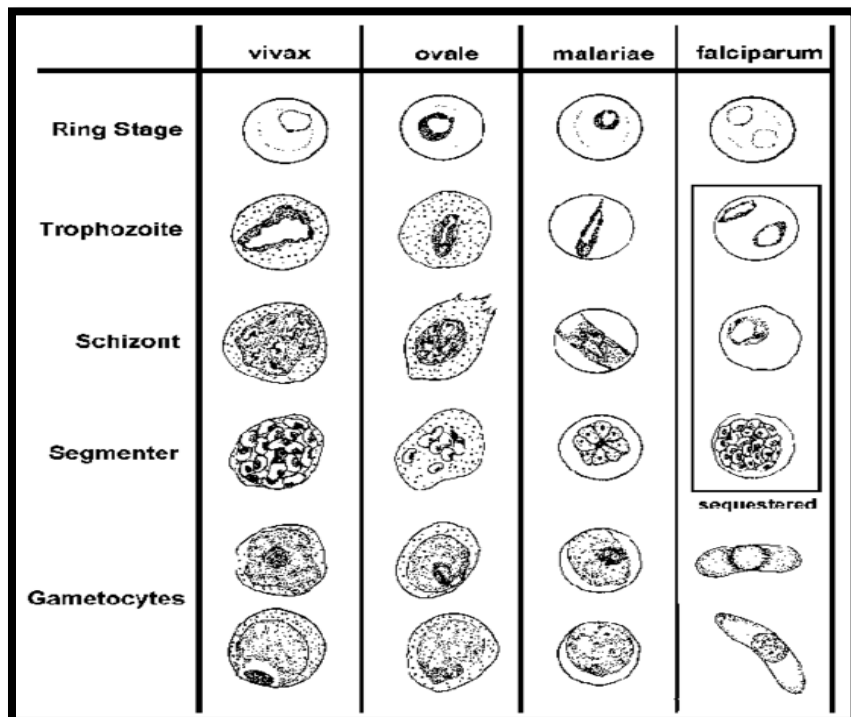
***Plasmodium* requires two hosts:**

-Definitive invertebrate host: (vector Anopheles mosquitoes female).

-Intermediate vertebrate host: (mammals, birds and lizards).

Morphology:

	<u>P.falciparum</u>	<u>P.malaria</u>	<u>P. vivax</u>	<u>P.ovalae</u>
Trophozoite	ring forms	band form	amoeboid form	compact rings in cells
Schizont	(8 – 36) merozoites.	(6–12) large merozoites	(16). merozoites	(6-12) merozoites
Microgametocyte	Larger than RBC, kidney shaped with blunt round ends	Smaller than RBC, round compact	Fills enlarged RBC, small round or oval, compact with central nucleus	Of the size of RBC round, compact
Macrogametocyte	more slender and longer than the male	Round or oval with peripheral nucleus	large round or oval with peripheral nucleus	Round or oval with peripheral nucleus



Life cycle:

sexual cycle

occurs in mosquito (9-21 days) ,fusion of micro and macrogametes are infective for mosquito→ zygote→ookinete (~24 hours) →oocyst

Asexual replication (sporogony) → sporozoites released → migrate through hemocoel→ invade salivary glands

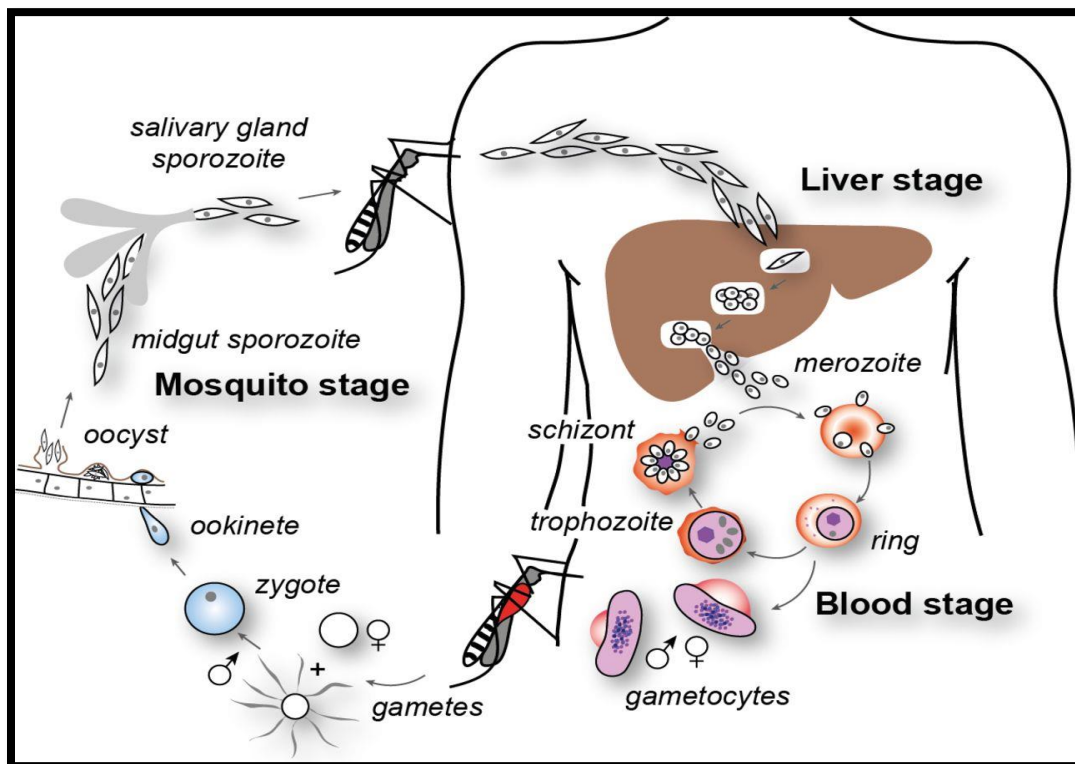
Asexual cycle

1-Exoerythrocytic schizogony (Liver stage)

Sporozoites injected during mosquito feeding→ merozoites(uninucleate asexual stages) invade liver cells .After this initial replication in the liver (exoerythrocyticschizogony) the parasites undergo asexual multiplication in the erythrocytes.

2-Erythrocytic schizogony (Blood stage)

Merozoites infect red blood cells and forms the ring stage in it and transform into trophozoites that mature into schizonts (multinucleated asexual stages) , which rupture releasing merozoites . Some parasites differentiate into asexual erythrocytic stages (gametocytes) repeated erythrocytic schizogony (48hr) in *Pf.*, *Pv.*, *Po.*and(72 hr) in *Pm.*



Symptoms:

- **Fever:** Often irregular. The regular pattern of fever does not occur until the illness has continued for a week or more.
- **Anemia:** The anemia is hemolytic in type. It is more severe in infections with *P. falciparum* because in this infection cells of all ages can be invaded.
- **Splenomegaly :** The spleen enlarges early in the acute attack of malaria.
- **Jaundice:** Mild jaundice due to hemolysis may occur in malaria.

Diagnosis:

- 1-Thin blood films stained with Giemsa stain.
- 2-Antibody test.

Lab (7)

Kingdom: Protista

Subkingdom: Protozoa

Phylum: Sarcomastigophora

Class: Ampicomplexa (sporozoa)

Order: Eucoccidia

Genus: 1-*Toxoplasma gondii*
2- *Cryptosporidium parvum*
3- *Isospora belli*

1-*Toxoplasma gondii*

Disease name : Toxoplasmosis

Site of infection: brain, eye, skeletal muscle, neural tissue

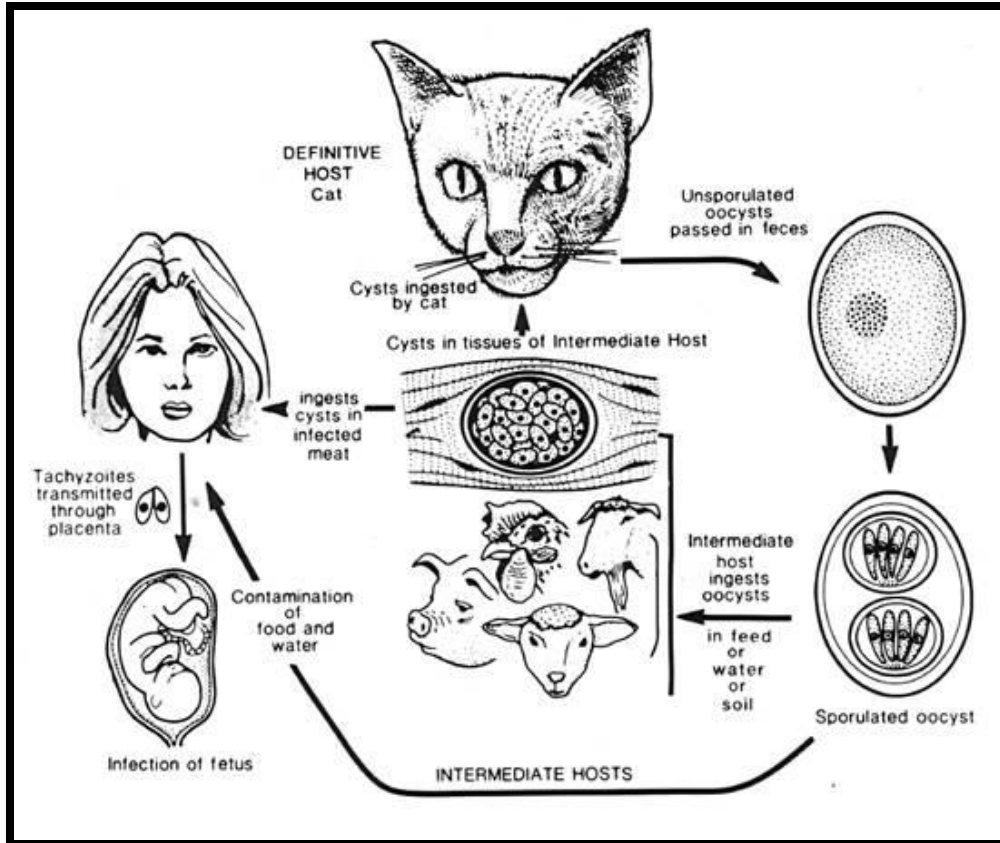
Definitive host: Cats

Morphology:

- 1-Tachyzoite: pear shaped organisms
- 2- Bradyzoites
- 3- Oocysts: contain 4sporozoites (infective stage)

Life cycle:

Infection occur by ingestion of Oocyst from contaminated hands or food, sporozoites released from oocyst in the small intestine penetrate the intestinal mucosa and find their way into macrophages where they divide very rapidly (hence the name tachyzoites) and form a cyst which may occupy the whole cell. The infected cell burst and release the tachyzoites to enter muscle and nerve cells where they are protected from the host immune system and multiply slowly (bradyzoites).these cysts are infectious to carnivores (including man).cats get infected by ingestion of cysts in flesh. Decystation occurs in the small intestine the organism penetrates the submucosal epithelial cell where they undergo mitosis,resulting micro(male) and macro(female) gametocytes.Fertilized macrogametocytes develop into Oocyst that are discharged into the gut lumen and excreted.



Symptoms

Abortion, Hydrocephalus or Microcephaly , Blindness

Laboratory Diagnosis

1.Serological Techniques

2.Isolation parasites techniques.

3.Direct identification of the parasite from peripheral blood, amniotic fluid or in tissue section.

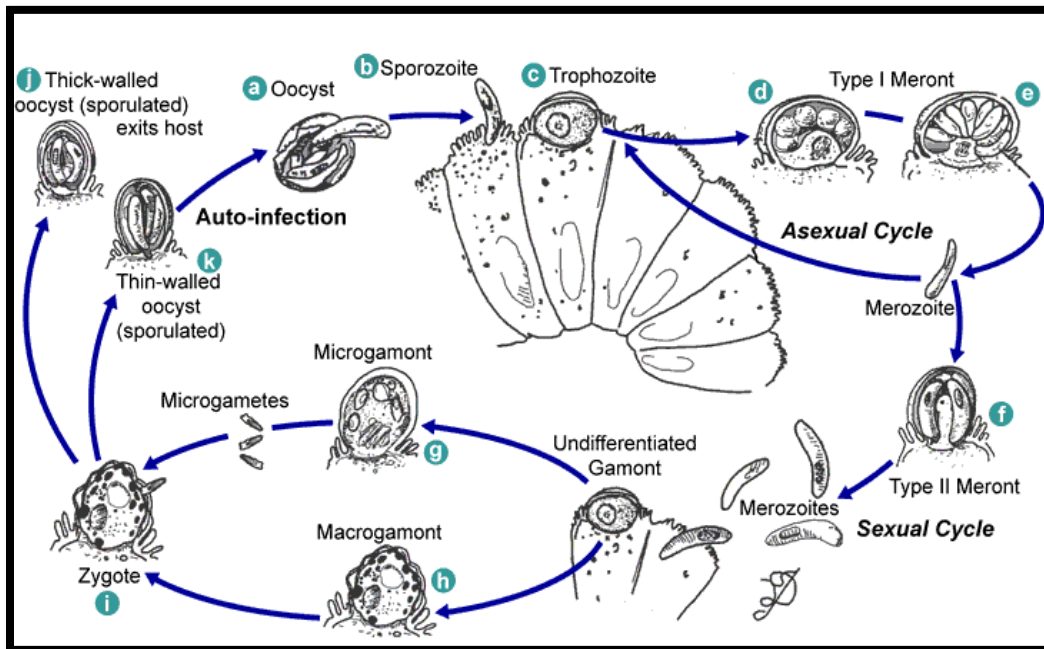
2-Cryptosporidium parvum

Disease name : Cryptosporidiosis

Site of infection : Epithelial cells of the small intestine

Infective stage :Oocyst

Life cycle



Symptoms

Persistent watery offensive diarrhea accompanied with abdominal pain, nausea, vomiting and anorexia

Diagnosis:

- Demonstration of oocyst in the stool.
- intestinal fluid or small bowel biopsy specimens
- Antigen in stool (ELISA)
- Molecular methods (PCR.)
- Serological test

3-*Isospora belli*

Disease name : Isosporiasis

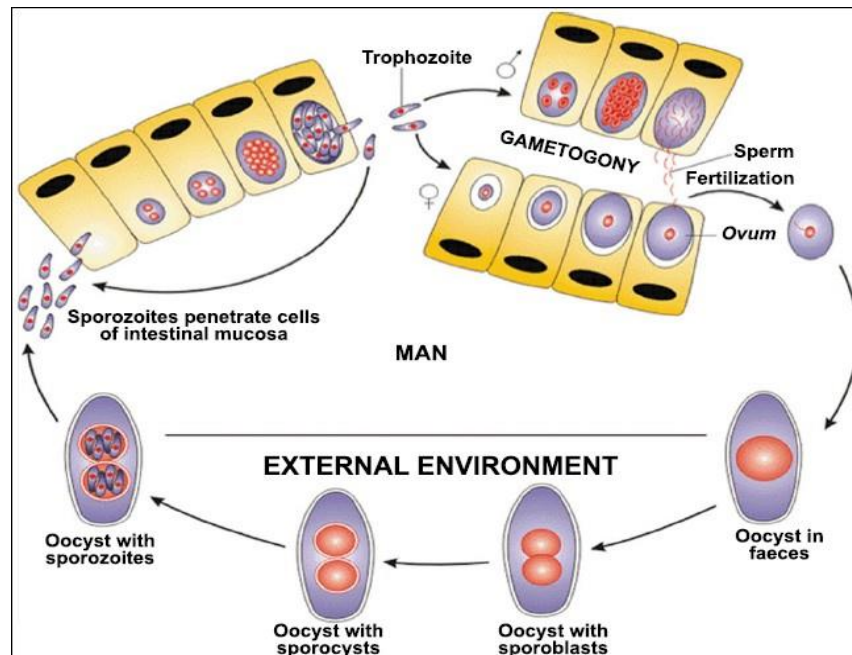
Site of infection : Epithelial cells of the small intestine .

Infective stage : Oocyst

Life Cycle

This organism can be acquired by the ingestion of sporulated oocysts found in contaminated food or water. The oocysts are thin-walled, transparent, ovoid in shape

and much larger than the oocysts of *Cryptosporidium parvum* . Oocysts of *I. belli* can survive for years in the environment.



Symptoms

In chronic infections, severe non-bloody diarrhea with cramp-like abdominal pain can last for weeks and result in fat malabsorption and weight loss. Eosinophilia may be present (atypical of other protozoa infections).

Laboratory Diagnosis :

Oocysts can be detected in stool samples .Alternatively, oocysts can be seen in a fecal smear stained by a modified Ziehl-Neelsen method, where they stain a granular red color against a green background, or by phenolauramine.

LAB 8

Kingdom: Animalia

Phylum: Platyhelminthes

Class: Trematoda

Order: Prostomata

1-Family: Opisthorchiidae

Genus: Clonorchis sinensis

2-Family: Fasciolidae

Genus: Faschiola hepatica

3-Family: Troglotrematodidae

Genus: Paragonimus westermani

The trematodes (or flukes) are leaf shaped with an outer cover called the tegument which may be smooth or spiny. There are two suckers or attachment organs, an anterior oral sucker and a posterior ventral sucker.

1- Clonorchis sinensis

Common name :chinese liver fluke

Man is the definitive hosts

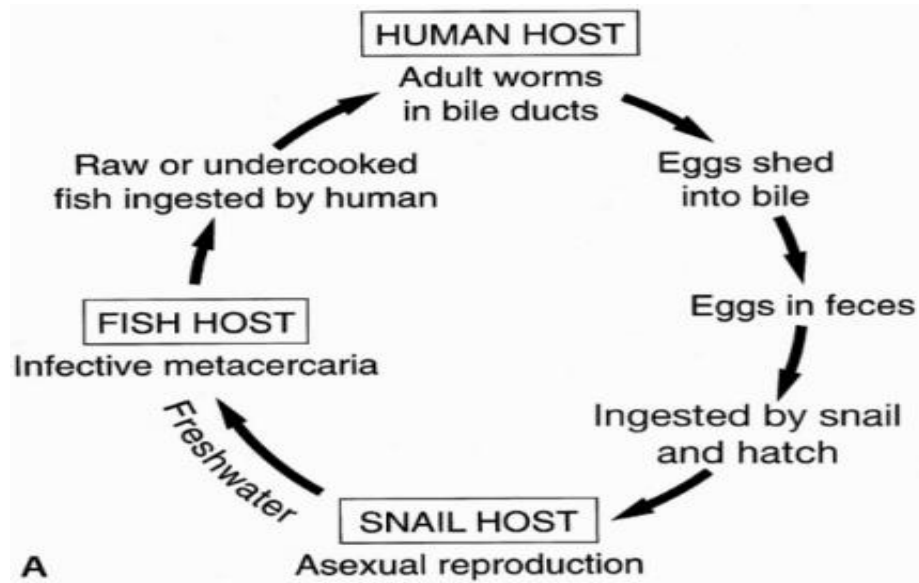
water snails and fish are the intermediate hosts.

Site of infection the biliary duct in humans who become infected by eating raw or undercooked fish. Dogs and cats are the most important reservoir hosts.

Morphology

The adult flukes measure 11–20µm by 3–4.5µm and are lanceolate in shape, translucent and brownish in color. hermaphroditic It have two suckers ,The oral sucker is larger than ventral sucker. The ova of *Clonorchis sinensis* small ovoidal or elongated with broad rounded posterior end and a convex opercular resting on shoulders (flask shaped egg),contains mature miracidium.

Life cycle



Symptoms:

The pathology is related to the number of parasites present. Light infections of up to 50 eggs or more are usually asymptomatic. A heavy infection of 500 or more eggs may cause serious illness.

Acute infections may be characterized by fever, diarrhea, epigastric pain, enlargement and tenderness of liver and sometimes jaundice. The invasion by these worms in the gall bladder may cause cholecystitis, due to flukes becoming impacted in the common bile duct.

Laboratory Diagnosis

Microscopic identification of eggs in feces following an iodine stained, formol-ether concentration method of the feces or from duodenal aspirates when there is complete obstructive jaundice

Fasciola hepatica

Common name: sheep liver fluke

The eating of unwashed watercress (freshwater plants) appears to be the source of infection,

the definitive host: The most common host is sheep (herbivorous) and some time human.

intermediate host: snails

site of infection: liver or bile ducts

Morphology

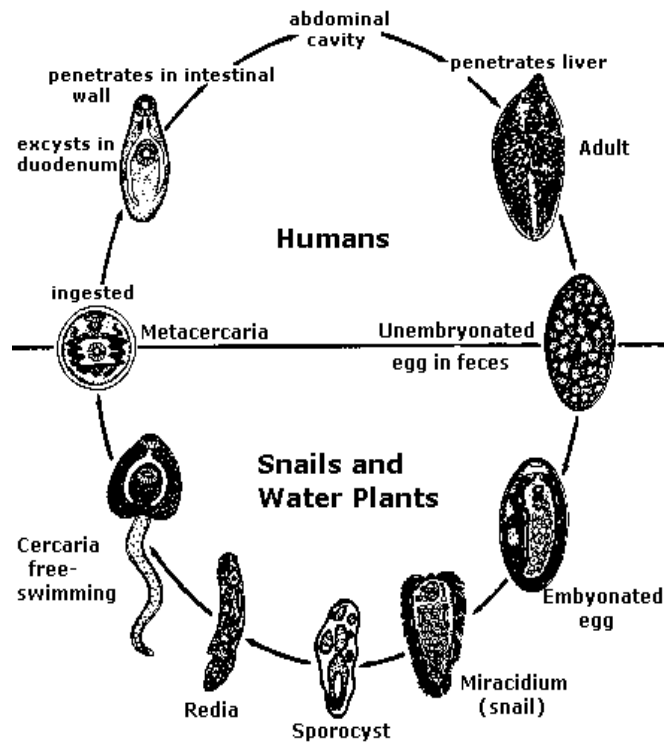
The adult flukes are large leaf-shaped parasites about 2–3cm long. There are two suckers, an anterior oral sucker surrounding the mouth and a ventral sucker on the ventral surface, oral sucker is smaller than ventral sucker

The outer tegument is covered in tiny spines which face backwards enabling them to attach themselves along with their suckers to the tissues.

Life cycle

Infective stage :metacercaria

Diagnostic stage: egg



Symptoms:

Light infections due to *Fasciola hepatica* may be asymptomatic.

However, they may produce hepatic colic with coughing and vomiting; generalized abdominal rigidity, headache and sweating, irregular fever, diarrhea and anemia.

Laboratory Diagnosis

Microscopic identification of eggs in feces (ellipsoidal ,thin shell, small indistinct operculum, unembryonated).

Serological techniques

Paragonimus westermani

Comman name: Oriental lung fluke

Site of infection: lungs and liver spleen

Morphology

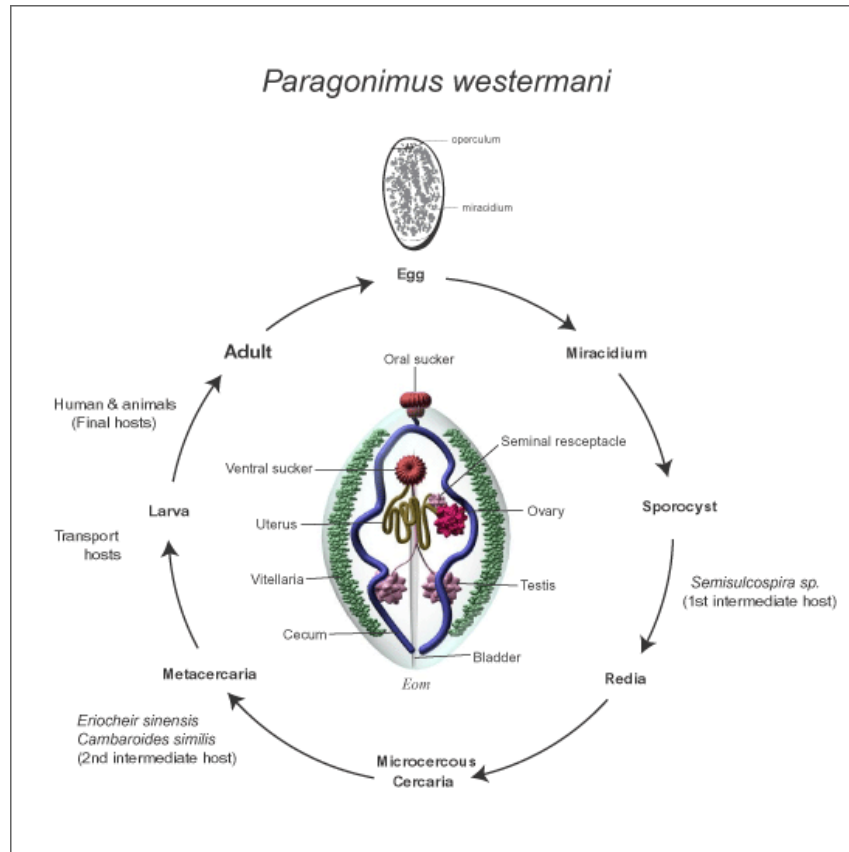
The adults are ovoid, reddish brown fluke 12µm long and are found in capsules in the lung. Oral and ventral suckers are equal in size

Life cycle

Definitive host: Human

Intermediate host 1- snail 2- crab or crayfish

Reservoir : pigs, dogs and variety of feline species



Symptoms:

As the parasites grow in the lung cyst, inflammatory reaction and fever occurs. The cyst ruptures and a cough develops resulting in an increase in sputum. The sputum is frequently blood tinged and may contain numerous dark brown eggs.

Hemoptysis may occur after paroxysms of coughing. Dyspnea and bronchitis develop with time. The disease resembles pulmonary tuberculosis. Cerebral calcification may also occur.

Laboratory Diagnosis

Diagnosis is based on finding the characteristic eggs in brown sputum. The eggs are ovoid, brownish yellow, thick shelled and operculated, unembryonated. The eggs can also be found in the feces due to swallowing sputum.

A chest x-ray may show cystic shadows and calcification.

Serological tests, in particular, the ELISA method, are useful diagnostic tests

LAB 9

Kingdom: Animalia

Phylum: Platyhelminthes

Class: Trematoda

Order: Prostomata

4-Family: Schistosomatida

Genus: 1-Schistosoma haematobium

2-Schistosoma mansoni

3-Schistosoma japonicum

The Schistosomes are blood flukes. They differ from other trematodes in that they have separate sexes. The cuticle of the male is covered with minute papillae. While the female only possesses these at the anterior and posterior end as the middle section being covered by the male body. Oral and ventral suckers are present, with the ventral one being larger serving to hold the worms in place.

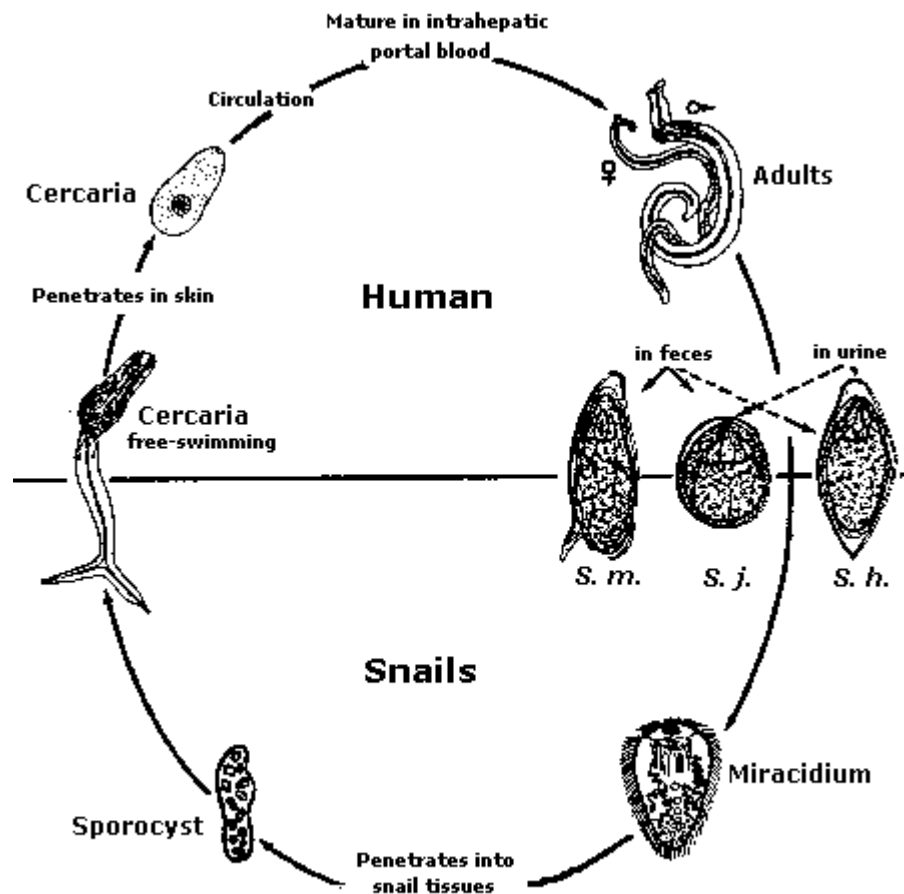
Definitive host: Human

Intermediate host: snail

Infective stage: cercaria (forked tailed)

Diagnostic stage: egg

the schistosome life cycle is very similar, with the exception that different species differ in the final location where the adult worms prefer to reside within the human body.



1-Schistosoma haematobium

Disease name: urinary schistosomiasis

Site of infection: bladder, ureters or kidneys

Morphology:

The adult males measure up to 15 millimeters in length and females up to 10µm. The male is actually flat has 5-3 testes but the sides roll up forming the canal in which the slender female resides the female has ovary in the dorsal part The ova are relatively large, They have an elongated ellipsoid shape with a prominent terminal spine.

2-Schistosoma mansoni

Disease name: Intestinal schistosomiasis

Site of infection: Large intestine (the plexus of veins draining the rectum and colon, and in branches of the portal vein in the liver

Morphology: male has 7-8 testes and female ovary in the front part The ova of *S. mansoni* are light yellowish brown, elongate and possess a lateral spine.

3-Schistosoma japonicum

Disease name: Oriental schistosomiasis

Site of infection: small intestine

Morphology

The adult worms are longer and narrower than the *S. mansoni* worms males have 6-7 testes females ovary in the center. The oval is more round with a minute lateral spine or knob (vague spine).

Symptoms

The main lesions are again due to the eggs, occurring in the intestine and liver. The eggs which are sequestered in the intestine mucosa or submucosa granulomatous reactions, resulting in the formation of pseudotubercles

Laboratory Diagnosis

Microscopy

Laboratory confirmation of infection can be made by finding the eggs in the feces after an iodine stained, formol-ether concentration method for *Schistosoma mansoni* and *Schistosoma japonicum* When eggs cannot be found in the feces, a rectal biopsy can be examined, While *Schistosoma hematobium* found in urine or feces.

Serology

Serological tests are of value in the diagnosis of schistosomiasis when eggs cannot be found. An enzyme linked immunosorbent assay (ELISA) using soluble egg antigen.

LAB 7

Phylum: Platyhelminthes

Class: Cestoda

1-Order: Cyclophyllidea

1-Family: Taeniidae

1-Taenia saginata

2- Taenia solium

3-Echinococcus granulosus

2-Family: Hymenolepidae

Genus: Hymenolepis nana

Genus: Hymenolepis diminuta

3-Family: Dipylidae

Genus: Dipylidium caninum

2-Order: Pseudophyllidae

Genus: Diphyllobothrium latum

The Main characteristics

Scolex : contains hooks and suckers

Neck

Immature segment

Mature segment

Gravid (proglottid) segment

Taenia saginata

Common name: Beef tapeworm

Disease name: taeniasis
Defenitive host: human
Intermediate host: cattle

Morphology:

The length of the adult *T. saginata* is 4-8 meters usually have 1000-2000 proglottids which may produce up to 100000 eggs per proglottid. Scolex is composed of 4 powerful suckers don't have hooks and rostellum. The mature segment contains uterus unbranched, ovary, genital pores, testes and vitelline gland. In the gravid proglottid the uterus is branched 15-20 on each side filled with eggs. Ova of *Taenia* species are spherical, yellowish brown and measure 31-34 μm in diameter. The shell is thick and radially striated. Within the shell, the oncosphere has 3 pairs of hooklets.



Site of infection: Muscle, viscera
Infective stage: cysticercus bovis
Diagnostic stage: egg

Taenia solium

Common name: Pork tapeworm
Disease name: cysticercosis
Defenitive host: human
Intermediate host: pigs
Site of infection: Brain, skin, muscle

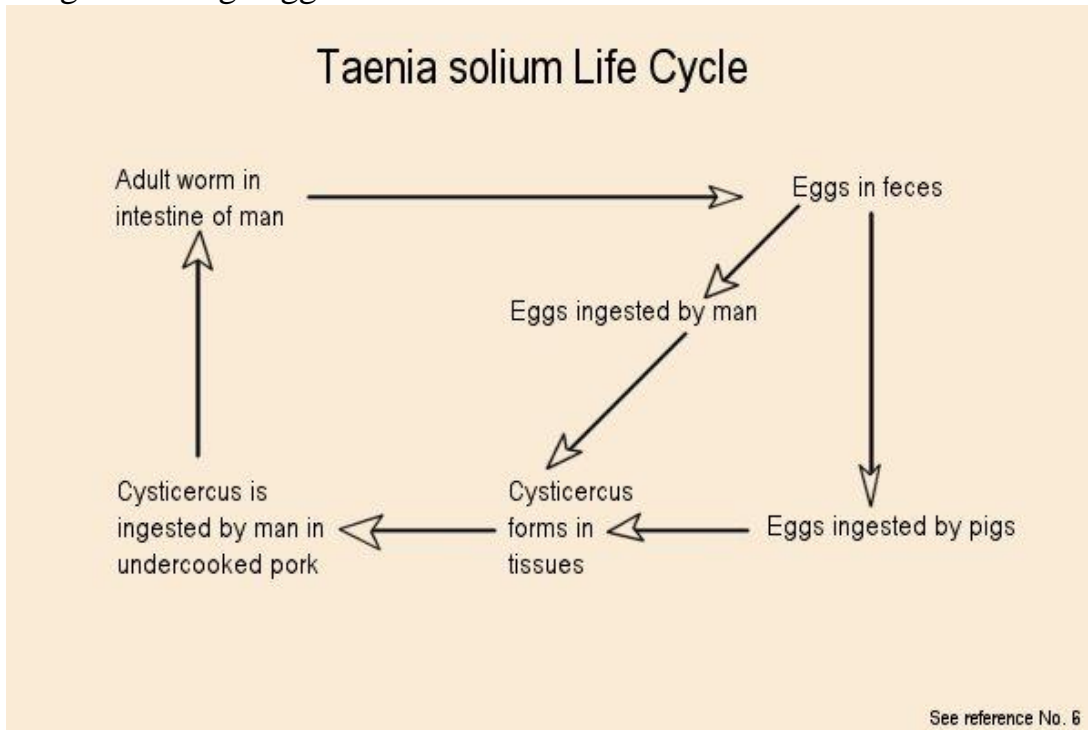
Morphology:

Length of adult worms is usually 2-7 and have an average of 1000 proglottids which may produce 50000 eggs per proglottid respectively .The proglottids can be identified by the number or uterine branches which are(7-13). It also have four suckers on its scolex and rostellum surrounded by two rows of hooks.

Life cycle:

Infective stage: cysticercus cellulose

Diagnostic stage:egg



Clinical symptoms:

Symptoms of *taenia spp.* include dizziness, abdominal pain, diarrhea, headaches, nausea and loss of appetite. There can be intestinal obstruction in humans and this can be alleviated by surgery.

Laboratory Diagnosis

Since it is difficult to diagnose using eggsEggs of *T.solium*and *T.saginata*are indistinguishableand species identification should be made from proglottidsor scolexs.alone looking at scolex or the gravid proglottids can help identify. When the uretus is injected with India ink,Its branches become visible.

3-Echinococcusgranulosus

Comman name:Hydatid cyst worm

Disease name:Hydatidiosis, echinococcosis, hydatid disease

Morphology:

Its 2-7mm in length,The adult worm contain three proglottidsscolex ,neck and body(immature,mature,gravid).Scolex have rostellum surrounded with two rows of hooks(30-36).

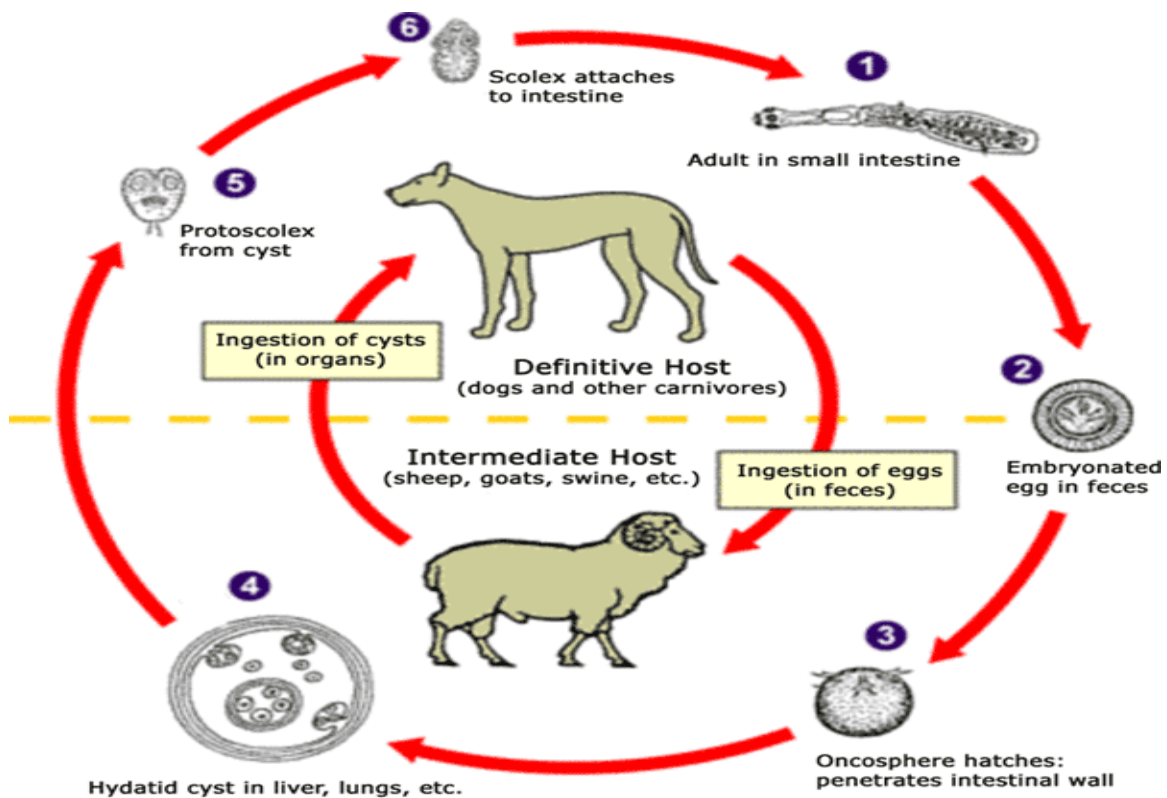
Life cycle:

Defenitive host: Dogs and canids

Intermidiate host: Human,sheep,pigs,kamel (carnivorus)

Infective stage: Embryonated egg

Diagnostic stage: Hydatid cyst



Hymenolepis nana:

Common name: Dwarf tapeworm

Morphology

Smallest tapeworm to infect humans, seldom exceeding 40mm long and 1mm wide. The scolex bears a retractable rostellum armed with a single circle 20-30 hooks. The scolex also has four suckers. The neck is long slender and the segments are wider than long.

Life cycle

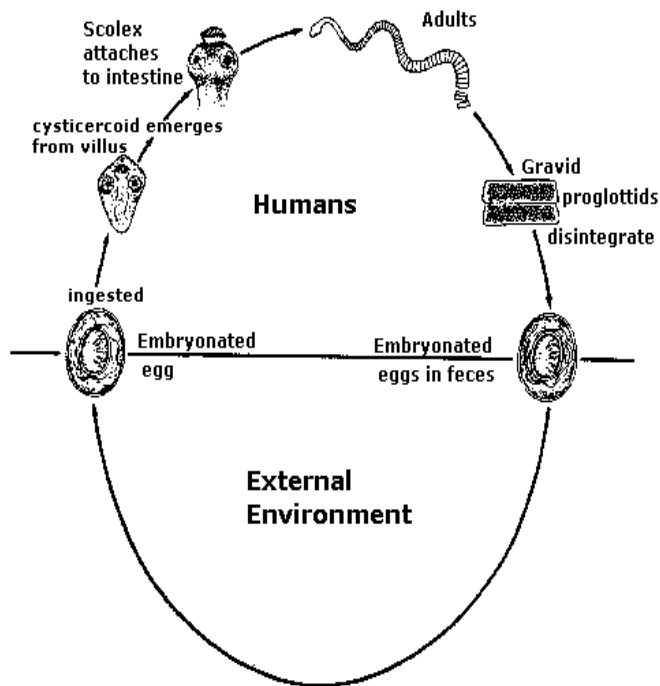
Infective stage: cysticercoid infected arthropods, embryonated egg

Diagnostic stage: Embryonated egg

No intermediate host

Definitive host: human

Site of infection: small intestine



Symptoms:

Restlessness, enteritis, anorexia, abdominal pain, vomiting, nausea and diarrhea
bloody diarrhea.

Laboratory Diagnosis Diagnosis is based on recovery and identification of the characteristic ova in a formol-ether concentrate of feces. Adult worms and proglottids are rarely seen in stool samples.

Hymenolepis diminuta

Definitive host: rats and mice and human.

Morphology

The ova are large, ovoid and yellowish with a moderately thick shell. They contain an oncosphere with six hooklets and a clear area between the oncosphere and the shell. They measure 70-85µm by 60-80µm. The adult worm is a small tapeworm 20-60cm long. It has a knob like scolex with a rostellum but no hooklets and four suckers (in contrast to *H. nana*). The rostellum can be withdrawn into a rostellum sac. The tapeworm contains about 1000 proglottids, each of which is wider than long.

Life cycle and

Site of infection : Upper small intestine

The life cycle of *H. diminuta* requires an intermediate arthropod host e.g. earwigs, larval fleas and various beetles. Human infection occurs by the accidental ingestion of an infected arthropod, which contains the cysticercoids.

Clinical Disease

The symptoms associated with *H. diminuta* infections are few if any.

Laboratory Diagnosis

Diagnosis is based on recovery and identification of the characteristic ova in a formol-ether concentrate of feces. Adult worms and proglottids are rarely seen in stool samples.

Dipylidium caninum

Common: Cucumber tapeworm, double-pore tapeworm

Morphology:

Adult is long flat worm, around 40-50cm. The body is made up of the scolex, neck and segmented section called the strobilus. The scolex has hooks for attachment. A proglottid is one set of reproductive organs, two genital pores located laterally on each segment, with two proglottids per segment.

Life cycle

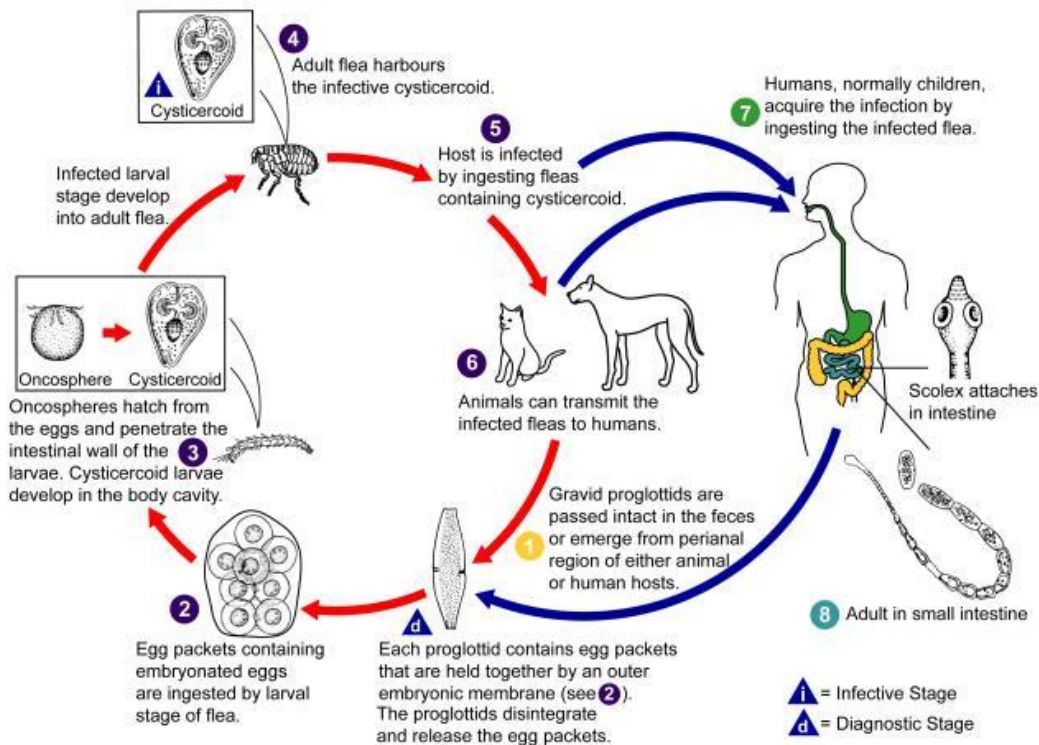
Intermediate host : Flea

Definitive host: Human pet owners especially children, canids

Infective stage: cysticercoid larvae

Defenitive stage: egg

Dipylidium caninum Infection (*Dipylidium caninum*)



Diphyllobothrium latum

Common name: broad fish tapeworm.

Site of infection: small intestine

Disease name: Diphyllobothriasis

The infection caused by *D. latum* is due to the ingestion of raw, poorly cooked or pickled fresh water fish.

Morphology

The egg is usually ovoid and has a small knob at the opercular end and is yellowish-brown in color with a smooth shell, of moderate thickness. They measure 58-75µm by 40-50µm in size. Adult worms can reach up to a length of 10 meters or more and may contain up to 3,000 proglottids. The scolex is spatulate with no rostellum or hooklets. It has two shallow grooves or bothria, which are unlike the typical four suckers seen on the *Taenia* species. The proglottids measure 3µm long and 11µm wide and have a rosette shaped central uterus..

Life Cycle

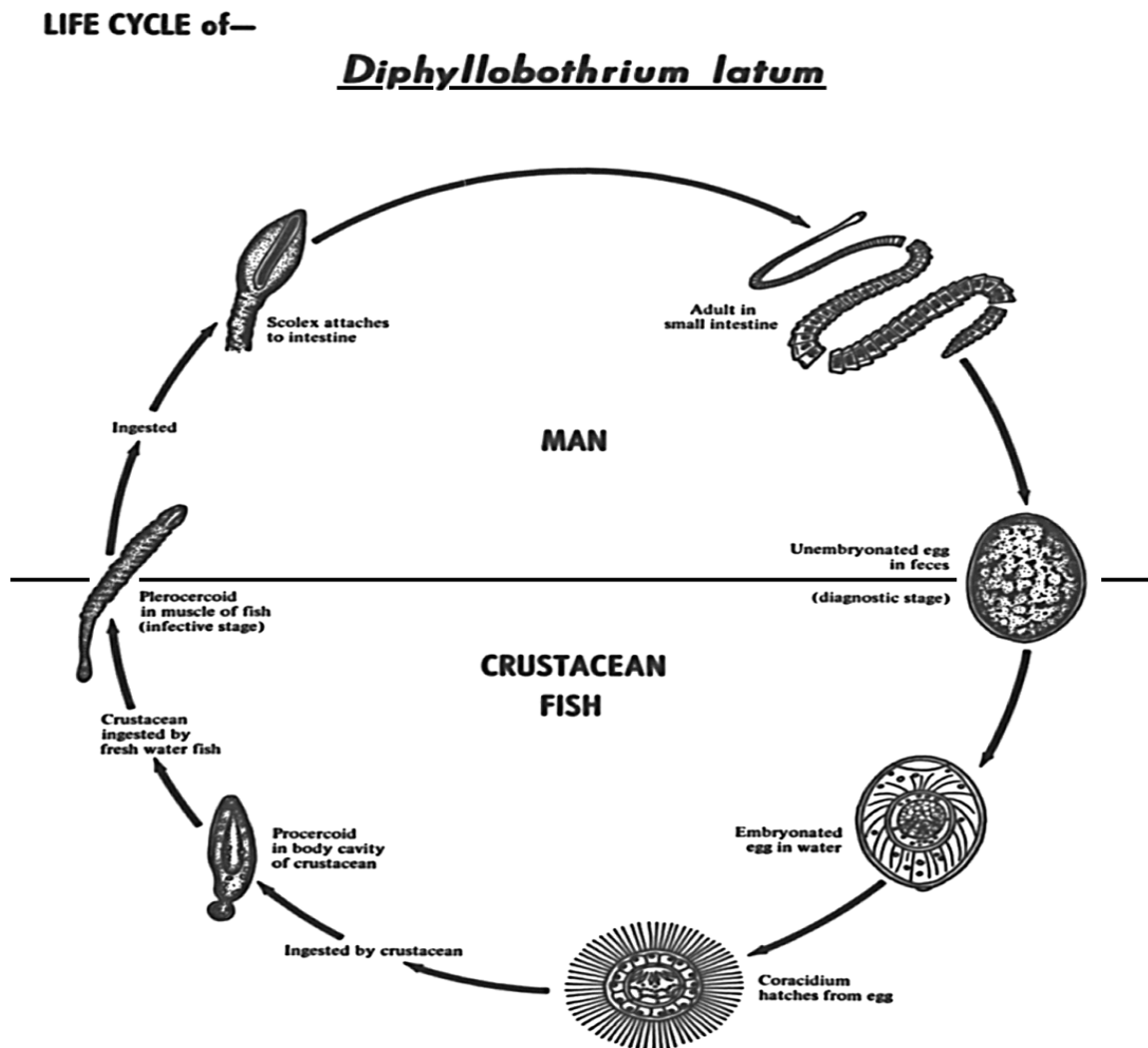
The life cycle of this tapeworm requires two intermediate hosts: Copepods (crustaceans), fish.

Definitive host: human, dog, cat and pig

Transmission to human is by eating uncooked or partly cooked fish.

Infective stage: plerocercoid larvae

Diagnostic stage: unembryonated egg



Clinical Disease

The infection may be absent or minimal with eosinophilia. There may be occasional intestinal obstruction, diarrhea, and abdominal pain. The most serious symptom is the onset of pernicious anemia. This is due to a vitamin B₁₂ deficiency.

Laboratory Diagnosis Laboratory diagnosis depends on the recovery of characteristic eggs from a formolether concentrate of feces. Proglottids may also

be seen in fecal samples usually in a chain of segments from a few centimeters to about half of a meter in length.

Phylum : Nematoda

Class: Secernentea (phasmidia)

Order: Strongylata

Family: Ancylostomatidae (hook worm)

Genus: *Ancylostoma duodenale* (Old World hookworm)

Genus: *Necator americanus* (New World hookworm)

Hook worm speices

- Site of infection: small intestine
- Definitive host: human
- No intermediate host
- Infective stage: Filariform larvae
- Diagnostic stage: egg

Ancylostoma duodenale

- Old World hookworm
- Large (male 8-11 mm, female 10-13 mm)
- buccal cavity bears two hook like teeth on the top and two triangular cutting plates on the bottom
- Disease name: Ancylostomiasis (Tunnel disease)

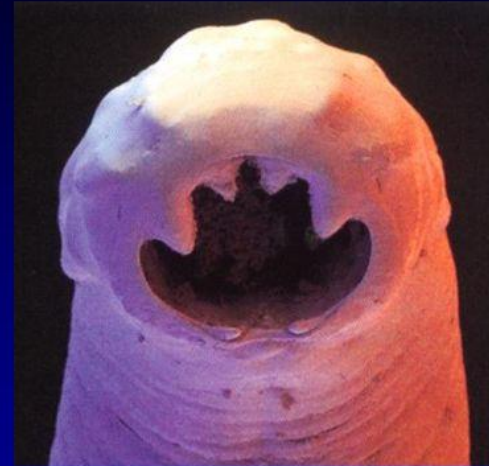
Necator americanus

- New World hookworm
- Small (male 7-9 mm, female 9-11 mm)
- The buccal cavity has four cutting plates, two on the ventral and two on the dorsal surfaces. The bursa is well developed in adult male.
- Disease name: Necatoriasis

Ancylostoma duodenale and *Necator americanus*



Necator americanus



Ancylostoma duodenale

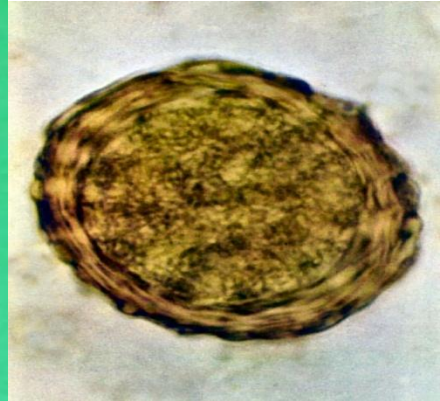
Order :Ascaridata

- Family: Ascarididae
- Genus: Ascaris lumbricoides
- :Enterobius vermicularis

Ascaris lumbricoides

- Disease name:Ascariasis
- Site of infection : small intestine
- Infective stage : embryonated egg
- Diagnostic stage : egg
- Morphology :
- The largest intestinal nematodes found in man.
- The male measures 15cm with a diameter of 3-4 μ m and has a curved tail with spicules.
- The female is 20-35cm long with a diameter of 5 μ m with a straight pointed posterior end.
- The mouth has one dorsal and two ventral lips.
- The fertilized ova are easily recognized, oval in shape with a thick wall showing an irregular bumpy surface.. The outer covering has an albuminoid coat, stained golden brown by bile stain.

Ascaris lumbricoides



Enterobius vermicularis(pinworm)

- Disease name: (Enterobiasis) causes anal itching in children.
- No intermediate host
- Site of infection : small intestine
- Humans get infected by accidentally swallowing or inhaling microscopic pinworm eggs.
- Morphology :
- Adults are white slender thin worms with pointed tail. Males are 0.2 mm thick and 2–5 mm long whereas females are 0.5 mm thick and 8–13 mm long. During sleep when body temperature is low and there is less movement the female pushes out from the anus and lays eggs on the outside skin. The eggs get stuck on skin, underwear or bedding and become infective within a few hours. Eggs survive up to three weeks on clothing, sheets or other objects. After the female has laid 11000–16000 eggs it dies

Enterobius vermicularis



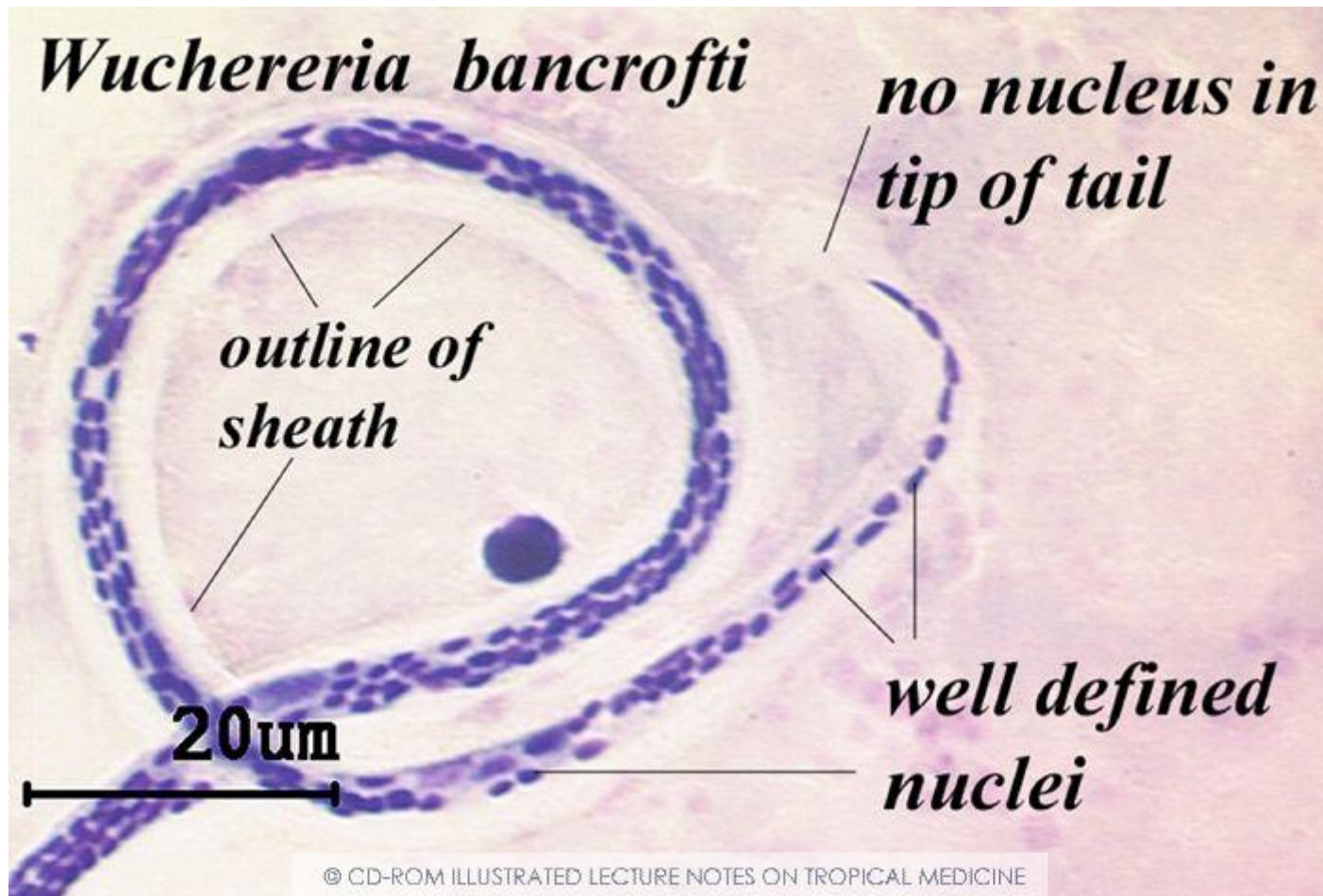
Order: Spirurata

- Family: Spirurida
- Genus: *Wuchereria bancrofti*
- :*Onchocerca volvulus*

Wuchereria bancrofti(Filaria)

- Disease name: Elephantiasis (lymphatic filariasis)
- Site of infection : Blood and lymphatic system
- Morphology : The adult worm is Sheathed , tail blunty pointed.
- Vector : Mosquito (intermediate host)
- Definitive host : Human
- Infective stage : Third stage filarial larvae)
- Diagnostic stage : Microfilariae

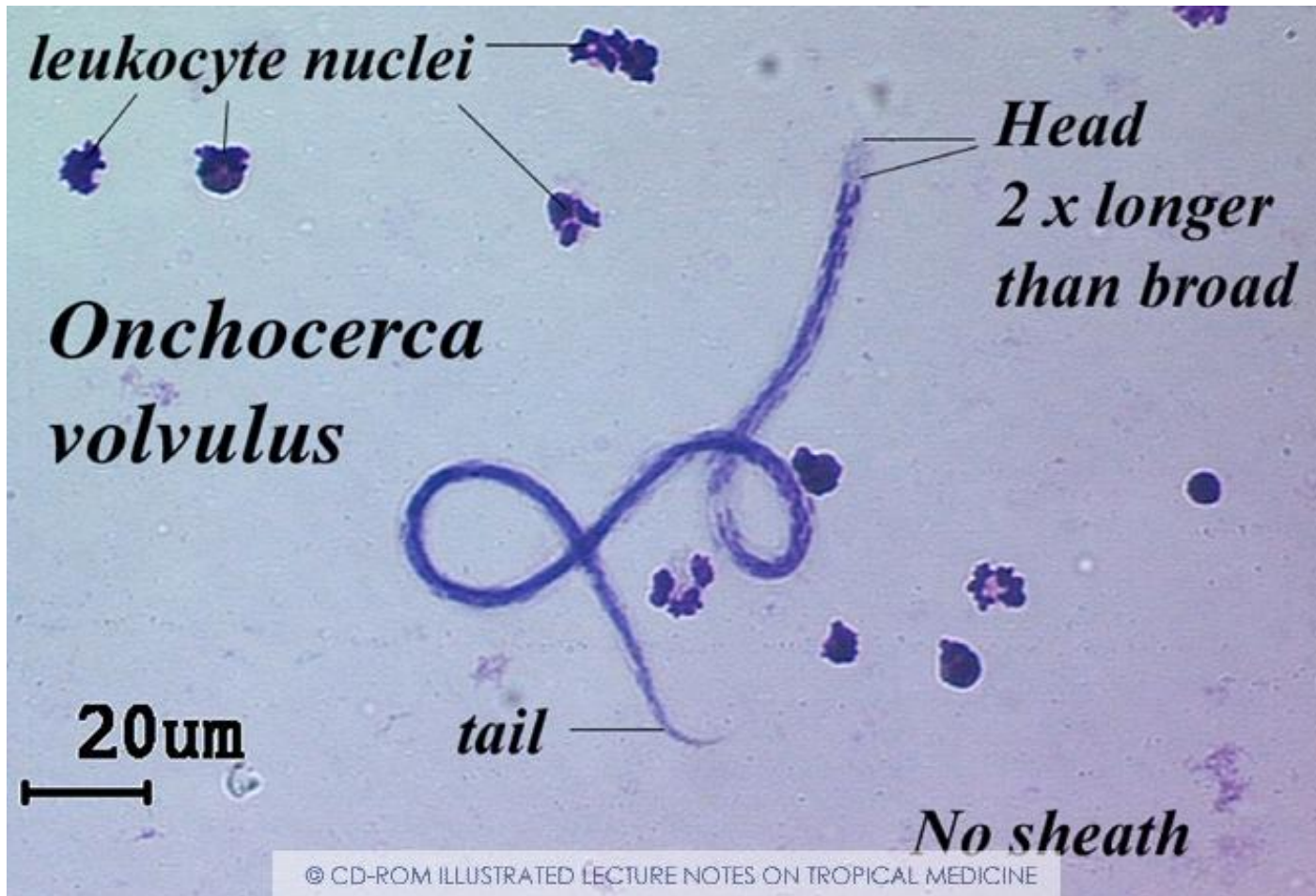
Wuchereria bancrofti



Onchocerca volvulus

- Disease name: river blindness
- Site of infection : Skin
- Morphology : The adult worm is unsheathed, tail finely pointed
- Vector :Black flies(intermediate host)
- Definitive host : Human
- Infective stage : Third stage filarial larvae)
- Diagnostic stage : Microfilariae

Onchocerca volvulus



Class: Adenophorea (Aphasmidia)

Order: Trichocephalida

Family: Trichuridae

Genus: *Trichuris trichiura*

***Trichuris trichiura* (whip worm).**

- Disease name: trichuriasis
- Site of infection: large intestine
- Definitive host : Human
- Morphology:
- The name whipworm refers to the shape of the worm , they look like whips with handles at the posterior end.
- The female have a bluntly round posterior end compared to their male with a coiled posterior end with one spicules.
- Their eggs are brown, barrel shaped, unembryonated, have bipolar plugs and a smooth shell.

Trichuris trichiura

