

PRACTICAL MEDICAL PARASITOLOGY

INTRODUCTION & DEFINITIONS

Parasitology: The science that deals with parasites and study their life cycle, disease, morphology, and laboratory diagnosis of these parasites.

Parasitism: symbiotic relationship of two different species of organisms in which one member benefits at the other members expense.

Parasite: organism that gains its nourishment, from and lives in or on another organism.

□ Types of parasites

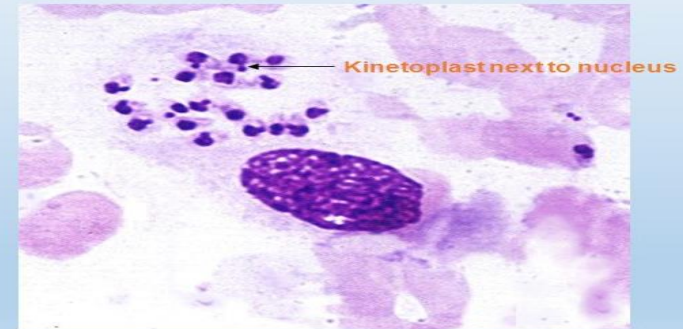
Ectoparasite: They inhabit the surface of the body of the host without penetrating into the tissues. They are important vectors transmitting the pathogenic microbes. such as ticks and lice. The infection by these parasites is called as **Infestation**, e.g., fleas or ticks.



- **Endoparasite** : They live within the body of the host some protozoa (e.g., *Leishmania*). and worms Invasion by the endoparasite is called as **infection**.



Leishmania donovani



The endoparasites are of following types

- z **Obligate parasite**: They cannot exist without a parasitic life in the host (e.g., *Plasmodium* species). : they must spend at least some of their life cycle in or on a host.
- z **Facultative parasite**: They can live a parasitic life or free-living life, when the opportunity arises (e.g., *Acanthamoeba*) they normally are free living but they can obtain their nutrients from hosts.
- z **Accidental parasite**: They infect an unusual host (e.g., *Echinococcus granulosus* infect humans accidentally), when a parasite attacks an unusual host.
- z **Aberrant parasite or wandering parasite**: They infect a host where they cannot live or develop further (e.g., *Toxocara* in humans).

- **Permanent parasite:** such as tapeworms remain in or on the host once they have invaded it.
- **Temporary parasites:** such as many biting insects feed and leave their hosts.
- **Hyperparasitism:** refers to a parasite itself having parasites.

Types of hosts;

Host is defined as an organism, which harbors the parasite and provides nourishment and shelter.

- ▶ **Definitive hosts:** they harbor a parasite while it reproduces sexually.
- ▶ **Intermediate hosts:** they harbor the parasite during some developmental stage.
- ▶ **Reservoir hosts:** are infected animals that make parasites available for transmission to other host.
- ▶ **Paratenic hosts:** a host harbors the parasite without showing any development of parasite.
- ▶ **Natural host:** the host which is naturally infected with certain species of parasite.
- ▶ **Accidentale host:** the host which usually not infected with parasites.

❖ ATTRIBUTES OF PARASITES:

- The parasites damage the host tissue by following mechanism:

1 – direct physical and chemical damage

a–Intracellular

kill the host

they multi

b– damage

inflammat

rupture pa

immunolog

c– some protozoa r

cytolytic enzymes

with host cells e.g

histolytica and *bal*

coli infection.

d– through vascular

blockage as in *falciparum*
malaria.

g– intestinal obstruction

as in *ascaris* infection.

e– mechanical pressure e.g hydatid cyst can compress the biliary tract by external pressure.

f– direct damage to the mucosal surfaces by the worms e.g. hookworms.

h– through irritant effect of large worms in the gut

2– damage by immunological mechanisms

3– introduction of neoplastic changes.

- Only two human cancers are known to be caused by parasites.
- *Clonorchis* and *opisthorchis* flukes can cause cholangiocarcinoma originating in the bile ducts.
- *Schistosoma haematobium* can initiate squamous cell bladder carcinoma.

▶ **TRANSMISSION OF PARASITES**

- ▶ It depends upon:
 - ▶ zz Source or reservoir of infection
 - ▶ zz Mode of transmission.

Sources of Infection

- ❖ **Man:** Man is the source or reservoir for a majority of parasitic infections (e.g., amoebiasis, enterobiasis, etc.) The infection transmitted from one infected man to another man is called as **anthroponoses**
- ❖ **Animal:** The infection which is transmitted from infected animals to humans is called as **zoonoses**. The infection can be transmitted to humans either directly or indirectly via vectors. (e.g., cystic echinococcosis from dogs and toxoplasmosis from cats).
- ❖ **Vectors:** Vector is an agent, usually an arthropod that transmits the infection from one infected human being to another. Vector can be biological or mechanical. An infected blood sucking insect can transmit the parasite directly into the blood during its blood meal.

- ▶ **Contaminated soil and water:** Soil polluted with human excreta containing eggs of the parasites can act as an important source of infection, e.g., hookworm, *Ascaris* species, *Strongyloides* species and *Trichuris* species. Water contaminated with human excreta containing cysts of *E. histolytica* or *Giardia lamblia*, can act as source of infection.
- ▶ **Raw or under cooked meat:** Raw beef containing the larvae of *Cysticercus bovis* and pork containing *Cysticercus cellulosae* are some of the examples where undercooked meat acts as source of infection.
- ▶ **Other sources of infection:** Fish, crab or aquatic plants, etc.

Modes of Transmission

The infective stages of various parasites may be transmitted from one host to another in the following ways:

Oral or feco-oral route: It is the most common mode of transmission of the parasites. Infection is transmitted orally by ingestion of food, water or vegetables contaminated with feces containing the infective stages of the parasite. (e.g., cysts of *E. histolytica*, and ova of *Ascaris lumbricoides*).

- ▶ **Penetration of the skin and mucous Membranes** (ingestion and inoculation are two primary routes of transmission of infection to man).
- ▶ **Sexual contact, venereal.**
- ▶ **Bite of vectors:**
- ▶ **part from this, congenital,** Mother to fetus transmission is important for few parasitic infections like *Toxoplasma gondii*,
- ▶ **Blood transfusion:**
- ▶ **Autoinfection:** Few intestinal parasites may be transmitted to the same person by contaminated hand.
- ▶ **NOTES:-**
 - ▶ **and other unusual routes are employed by the parasite is called as infection whereas clinical manifestations are given the name of disease.**
 - ▶ **The period of incubation :**is the time interval between the actual infection and the first appearance of any clinical feature. This is usually followed by prodromal period which is characterized by general feature of disease such as headache, malaise, etc. and is short in duration.

Laboratory diagnosis

- ▶ Direct demonstration of **adult parasite**
- ▶ Detection of adult worm of (*ascaris*) in the stool sample is very common. pinworms can be seen in perianal swabs and an emerging guinea worm leaves no doubt about the diagnosis.
- ▶ Microscopic examination of body fluids and excreta
- ▶ Blood: there are various ways in which blood can be examined:
- ▶ Thick and thin blood film like *plasmodium*, *leishmania*, *trypanosoma*, *babesia*.
- ▶ Wet blood film like *trypanosoma*, *microfilaria*.
- ▶ Buffy coat preparation like *trypanosoma*, *leishmania donovani*.
- ▶ Membrane filtered blood like *microfilaria*.

Stool: wet preparation

- ▶ Trophozoite in saline preparation
- ▶ Cyst and ova in iodine preparation
- ▶ Permanent stained preparation
- ▶ Concentration methods
- ▶ Urine: the principal parasitological finding in the urine is that of the eggs of *schistosoma haematobium*. *Trichomonas vaginalis*, *microfilariae* of *wuchereria bancrofti* and *onchocerca volvulus* may be detected.
- ▶ Perianal and vaginal swabs: perianal swab is the usual method for collection of *entrobius* whereas eggs of *taenia saginata* are common on perianal skin. *Trichomonas vaginalis* and rarely trphozoites of *E. histolytica* are detectable from vaginal swabs.

- **Sputum:** eggs of paragonimus, larvae of ascaris, protoscolices and brood capsules of hydatid cyst and entamoeba gangivalis. These parasite are suspected in sputum sample.
- ▶ **Duodenal aspirate and CSF:** duodenal aspirate is collected for the demonstration of trophozoites of *giardia lamblia* and eggs or larvae of *strongyloides sterocoralis* CSF is examined for trypanosomes and free living amoebae.
- ▶ **Tissues:** Examination of wet tissue specimens can sometimes yield valuable diagnostic information about the parasitic disease.
- ▶ **Culture:** methods are not developed considerably and extensively for parasites. Some parasites can be culture now like *E. histolytica*, *Leishmania* sp. *Balantidium coli*, *schistosoma*, *trichinella*, *onchocerca*.

- ▶ **Xenodiagnosis:** this method employs an intermediate host or vector, within which the parasite multiplies, to detect low level of parasitism.
- ▶ **Animal inoculation:** a few important parasitic diseases can be diagnosed by this method like *Leishmania donovani*, *Toxoplasma gondii*, *Babesia*.
- ▶ **Histopathology:** tissue cysts due to *trypanosoma cruzi* and *sarcocystis* can be easily demonstrated in stained tissue section.

- ▶ **Immunodiagnosis:** two tests are in practice: Leishmania test is a delayed type of hypersensitivity reaction which is very sensitive and specific. Casoni test indicates diagnosis of hydatid disease.
- ▶ **Radiological and scanning techniques:** some helminthes calcify in human body and produce opacities on radiological examination. These include: *Dracunculus, Loa loa, Echinococcus, Taenia solium, Paragonimus, sch. Haematobium*.
- ▶ **Molecular techniques:** various test methods used are PCR, DNA probe. Molecular tests have been developed to increase the sensitivity and specificity of diagnosis of parasitic infections by way of amplification of the parasitic antigens which may not be detectable by conventional methods.

- ▶ **Classification of parasites**
- ▶ The parasites of medical importance fall into two kingdoms:
- ▶ **1- protista:** the microscopic, single-celled, eukaryotic (having true nuclear membrane) organisms. Which resemble yeast in their size and simplicity are designated as protzoa. The shape, size, mode of reproduction and type of locomotive organella have been used to divide these into four major classes:

- ▶ **A- Rhizopodes (amoebae):** organelles of locomotion are pseudopods and the reproduction by binary fission.
- ▶ **B- Flagellates:** organelles of locomotion are flagella and reproduction by binary fission.
- ▶ **C- ciliates:** organelles of locomotions are cilia and reproductions by binary fission.
- ▶ **D- sporozoa:** without locomotion organelles and the reproductions sporogony and shizogony.

2- Animalia: Helminths are macroscopic, multicellular worms possessing well-differentiated tissues and complex organ system. These vary in length from less than one millimeter to more than a meter.

The common helminthic parasites of human being can be placed in one of the three classes on the basis of body and alimentary tract configuration, nature of the reproductive system and need for more than a single host species for the completion of life cycle:

- Trematodes
- Cestodes
- Nematodes



**Thanks For
Listening**

Entamoeba histolytica

- ▶ protozoa
- ▶ Sarcodina (pseudopoda)
- ▶ organelles of locomotion are pseudopods and the reproduction by binary fission.
- ▶ The parasitic amoeba of man:
 - 1 – pathogenic amoebas.
 - 2 – non-pathogenic amoebas.
 - 3 – free living amoebas.

Biology: Two morphological stages occur :

Trophozoite - metabolically active invasive stage, moves with pseudopodia, ingests RBC, lives in colon and is found in fresh diarrheal stool; divides by binary fission.

- trophozoite 20-30 μm
- cogwheel distribution of nuclear chromatin
- hematophagous
- unidirectional movement with pseudopodia

Cyst shape spherical or oval surrounded by thick cystic wall.

- 1 -4 nuclei
- this is the infective form resistant to stomach acid if swallowed
- survives up to 30 days; excyst to trophozoite on passing through stomach
- cyst 6-15 μm
- chromotoidal bars
- immature cyst includes uni and bi-nucleated cysts, while the mature cyst is quadri-nucleated cyst

Pathogenesis: – Digests (liquifies) human host cells (colon wall, neutrophils, liver cells)

Disease states:

- asymptomatic carrier–
- symptomatic infection
- amoebic dysentery – mucoid bloody
- amoebic – liver or lung abscess.

– Pathology:

- Flask like ulcer

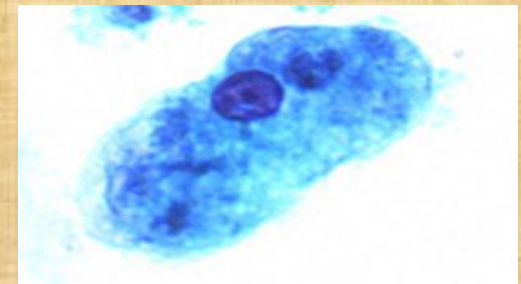
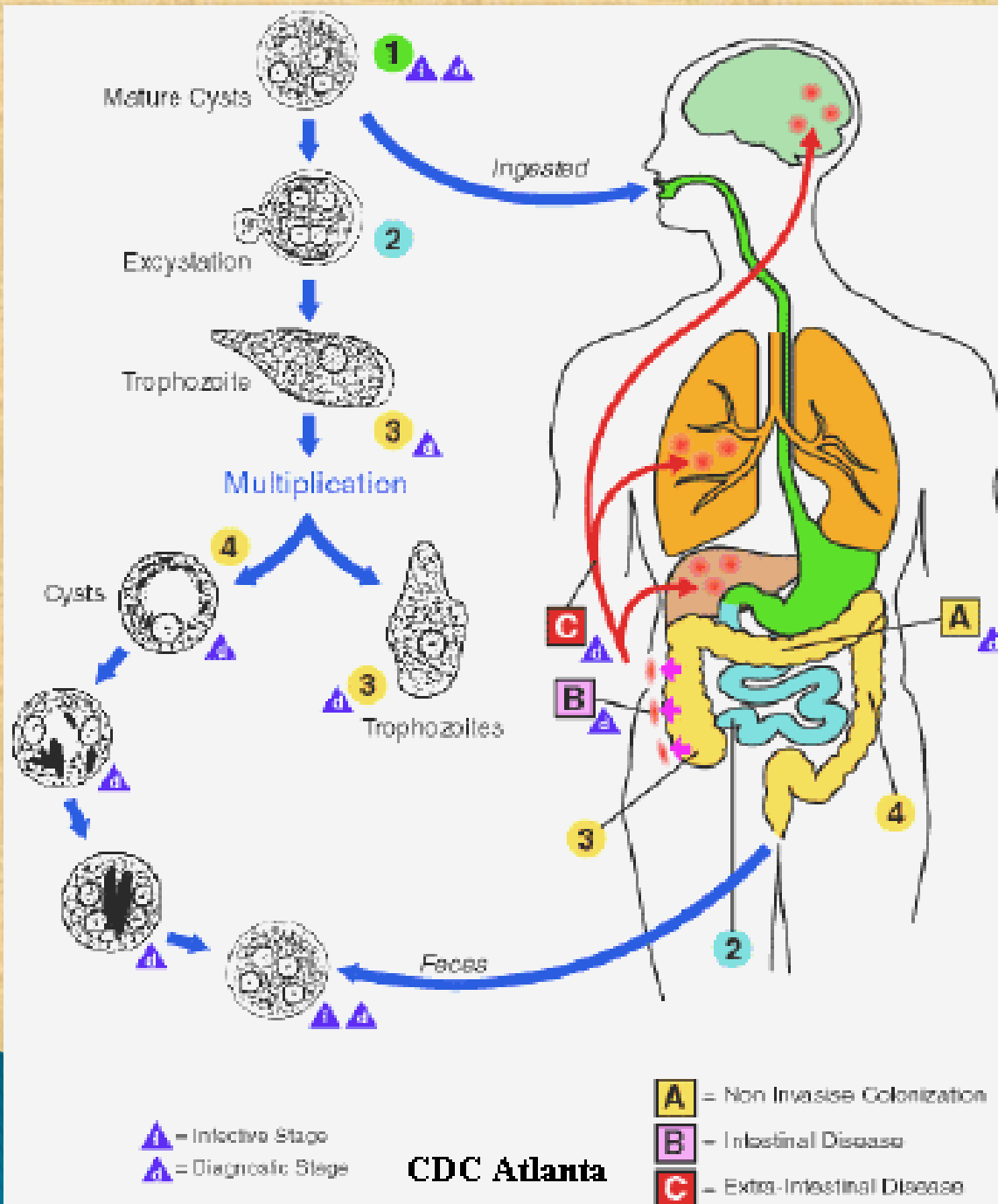
Diagnosis:

- stool examination – for trophozoites and cysts
- amoebic serology
- abscess aspirate
 - *Entamoeba dispar* a non-pathogen is indistinguishable by microscopy and is a much more common intestinal protozoan than *Entamoeba histolytica*. Antigen capture and PCR tests can distinguish *E. dispar* from *E. histolytica* in heavier infections.

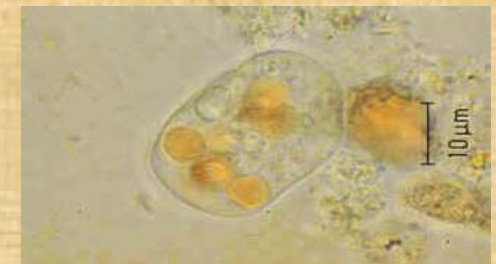
Treatment:

Invasive states (Dysentery, Liver abscess): metronidazole

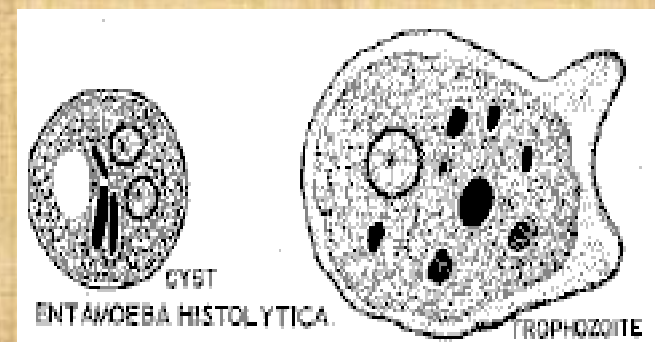
Carrier states: diiodoquine, diloxanide furoate, or paromomycin



E. histolytica trophozoite



E. histolytica trophozoite with ingested RBCs



Main points of life cycle

- ▶ Cycle cyst–trophozoite–cyst
- ▶ Host :human being
- ▶ Lodgment: large intestine
- ▶ Infective stage 4 nuclei
- ▶ Infective route: mouth
- ▶ Transmission (fecal–oral)

Entamoeba coli

- ▶ **Trophozoite**
- ▶ Size: 20–40µm
- ▶ Number of nuclei: one
- ▶ Karyosome: large, irregular shape, eccentric
- ▶ Cytoplasmic inclusion: bacteria, other debris
- ▶ Cyste
- ▶ Size range: 15–20µm
- ▶ Shape: round to spherical
- ▶ Number of nuclei: one to eight with eccentric karyosome.
- ▶ Cytoplasmic inclusions: thin chromatoid bars with pointed ends

non-pathogens:

Entamoeba dispar

Entamoeba coli

Endolimax nana














Iodamoeba butschlii

Blastocystis hominis

Trichomonas hominis

Enteromonas hominis

The characteristics important to the clinical parasitology microscopic include nuclear shape and size, chromatin distribution, the micrometer measured size of the protozoan, intracellular organelles and locomotion.

AMEBAE							
	<i>Entamoeba histolytica</i>	<i>Entamoeba hartmanni</i>	<i>Entamoeba coli</i>	<i>Entamoeba polecki</i> ¹	<i>Endolimax nana</i>	<i>Iodamoeba bütschlii</i>	<i>Dientamoeba fragilis</i> ²
Trophozoite							
Cyst							No cyst

¹Rare, probably of animal origin

²Flagellate

Scale: 0 5 10 μ m

Adapted from Brooke and Melvin, 1964