

## Medical Paracytology :

*Medical parasitology* is the science that deals with organisms living in the human body (the host) and the medical significance of this host-parasite relationship.

## ASSOCIATION BETWEEN PARASITE AND HOST

A *parasite* is a living organism, which takes its nourishment and other needs from host; the host is an organism which supports the parasite. The parasites included in medical parasitology are protozoa, helminthes, and some arthropods .

## KINDS OF HOSTS

**Definitive host** – a host that harbors a parasite in the adult stage or where the parasite undergoes a sexual method of reproduction.

- **Intermediate host** - harbors the larval stages of the parasite or an asexual cycle of development takes place. In some cases, larval development is completed in two different intermediate hosts, referred to as first and second intermediate hosts.
- **Paratenic host** – a host that serves as a temporary refuge and vehicle for reaching an obligatory host, usually the definitive host, i.e. it is not necessary for the completion of the parasites life cycle.
- **Reservoir host** – a host that makes the parasite available for the transmission to another host
- **Natural host** – a host that is naturally infected with certain species of parasite.

## symbiotic relationships

The following are the three common symbiotic relationships between two organisms:

**Mutualism** - an association in which both partners are metabolically dependent upon each other and one cannot live without the help of the other; however, none of the partners suffers any harm from the association. E.g. is the relationship between certain species of flagellated protozoa living in the gut of termites.

**Commensalism** - an association in which the commensal takes the benefit without causing injury to the host. E.g. Most of the normal floras of the humans' body can be considered as commensals.

**Parasitism** - an association where one of the partners is harmed and the other lives at the expense of the other. E.g. Worms like *Ascaris lumbricoides* reside in the gastrointestinal tract of man, and feed on important items of intestinal food causing various illnesses.

### ***EFFECT OF PARASITES ON THE HOST***

The damage which pathogenic parasites produce in the tissues of the host may be described in the following two ways;

#### **(a) Direct effects of the parasite on the host**

- Mechanical injury - e.g. Hydatid cyst causes blockage of ducts such as blood vessels producing infraction.
- Deleterious effect of toxic substances- in *Plasmodium falciparum*
- Deprivation of nutrients,

#### **(b) Indirect effects of the parasite on the host:**

Immunological reaction: Tissue damage may be caused by immunological response of the host, e.g. nephritic syndrome following Plasmodium infections., e.g. fibrosis of liver after deposition of the ova of Shistosoma

**Laboratory diagnosis** – depending on the nature of the parasitic infections, the following specimens are selected for laboratory diagnosis:

a) **Blood** – in those parasitic infections where the parasite circulates in the blood stream, ( malaria) the parasites are found inside the red blood cells .

b) **Stool** – examination of the stool it in the diagnosis of intestinal parasitic infections and also for those helminthic parasites Amoebiasis, Giardiasis, etc.

In the case of helminthic infections, the adult worms, their eggs, or larvae are found in the stool.

c) **Urine** – when the parasite localizes in the urinary tract, examination of the urine will be of help in establishing the parasitological diagnosis. For example in urinary Schistosomiasis, eggs of *Schistosoma haematobium* are found in the urine.

d) **Sputum** – examination of the sputum is useful in the following:

- In cases where the habitat of the parasite is in the respiratory tract, as In amoebic abscess of lung or in the case of amoebic liver abscess burst in into the lungs, the trophozoites of *E. histolytica* are detected in the sputum.

e) **Biopsy material** - varies with different parasitic infections. For example spleen punctures in cases of kala-azar, muscle biopsy in cases of Cysticercosis .

f) **Urethral or vaginal discharge** – for *Trichomonas vaginalis*

**Prevention and control** Preventive measures designed to break the transmission cycle are crucial to successful parasitic eradication. Such measures include:

- ☐ Reduction of the source of infection.
- ☐ Sanitary control of drinking water and food.
- ☐ Proper waste disposal .
- ☐ The use of insecticides and other chemicals used to control the vector population.
- ☐ Protective clothing that would prevent vectors from resting in the surface of the body and inoculate pathogens during their blood meal.
- ☐ Good personal hygiene.
- ☐ Avoidance of unprotected sexual practices .

## CLASSIFICATION OF MEDICAL PARASITOLOGY

Parasites of medical importance come under the kingdom called protista and animalia. Protista includes the microscopic single-celled eukaryotes known as protozoa. In contrast, helminthes are macroscopic, multicellular worms possessing well differentiated tissues and complex organs belonging to the kingdom animalia. Medical Parasitology is generally classified into:

- **Medical Protozoology** - Deals with the study of medically important protozoa.
- **Medical Helminthology** - Deals with the study of helminthes (worms) that affect man.
- **Medical Entomology** - Deals with the study of arthropods which cause or transmit disease to man.

## GENERAL CHARACTERISTICS OF MEDICALLY IMPORTANT PARASITES

Medically important protozoa, helminthes, and arthropods .

1- **PROTOZOA**: unicellular parasites , The cytoplasm consists of an outer layer of hyaline ectoplasm and an inner voluminous granular endoplasm. The ectoplasm functions in protection, locomotion, and ingestion of food, excretion, and respiration. In the cytoplasm there are different vacuoles responsible for storage of food, digestion and excretion of waste products. The nucleus also functions in reproduction and maintaining life.

**TABLE 1. CLASSIFICATION OF THE PATHOGENIC PROTOZOA:**

<b>PROTOZOA</b>	<b>ORGAN OF LOCOMOTION</b>	<b>IMPORTANT HUMAN PATHOGENS</b>
1. Rhizopoda	Pseudopodia	<i>Entamoeba histolytica</i>
2. Mastigophora (Flagellates)	Flagella	Trypanosomes, Leishmania Trichomonas , Giardia

3. Sporozoa,	None, exhibit a slight Amoeboid movement	Plasmodium.Spp
4. Ciliates	Cilia	<i>Balantidium coli</i>

## (2) HELMINTHS:

The helminthic parasites are multicellular,. The helminthes of importance to human beings are divided into three main groups with the peculiarities of the different categories described in table 2.

**TABLE 2. DIFFERENTIATING FEATURES OF HELMINTHES**  
CESTODE TREMATODE NEMATODE

	<b>CESTODE</b>	<b>TREMATODE</b>	<b>NEMATODE</b>
<b>Shape</b>	Tape like, segmente	, Leaf like Un segmented	Elongated Cylindrical
<b>Sexes</b>	Not separate (monoecious)	Not separate(monoecious) Except blood flukes which are dioecious	Separate.(diecious)
<b>"Head" End</b>	Suckers: with hooks Suckers:	no hooks	No suckers, and hooks
<b>Alimentary canal</b>	Absent	Present	Present and but incomplete complete
<b>Body cavity</b>	Absent	Absent	Present

## (3) ARTHROPODS

Arthropods, ,segmented body with jointed appendages. They have a hard exoskeleton, which helps enclose and protect the muscles and other organ .Arthropods affect the health of humans by being either direct agents for disease or agents for disease transmission.

## CLASSIFICATION OF PROTOZOA

Protozoa of medical importance are classified based on their **morphology** and **locomotive** system as described below:

**Rhizopoda(Amoebas)- *Entamoeba histolytica***

**Flagellates** – *Giarda lamblia*, *Trichomonas vaginalis*, Trypanosoma Spp,  
Leishmania Spp

**Ciliophora** - *Balantidium coli*

**Coccidian** - *Toxoplasma gondii*, **Plasmodium** species Protozoan pathogens can also be grouped according to the location in the body where they most frequently cause disease.

Type and location	Species	Disease
Intestinal tract	<u>Entamoeba histolytica</u> <u>Giardia lamblia</u> <u>Balantidium coli</u>	Ambiasis Giardiasis Balantidiasis
Urogenital tract	<i>Trichomonas vaginalis</i>	Trichomoniasis
Blood and tissue	Plasmodium species <u>Toxoplasma gondii</u> Trypanasoma species Leishmania species Naegleria species	Malaria Toxoplasmosis Trypanosomiasis Leishmaniasis Amoebic Meningoencephalitis

## AMOEBIASIS

### INTRODUCTION

Amoebas primitive unicellular microorganisms with a relatively simple life cycle which can be divided into two stages:

- Trophozoite – actively motile feeding stage.
- Cyst – quiescent, resistant, infective stage.

-Reproduction :binary fission,

-Motility by pseudopodia (“false foot”)

#### 1.1. Entamoeba histolytica

#### Morphological features

##### (a) Trophozoites

-Viable trophozoites 10-60µm in diameter.

- Motility is rapid ,progressive , and unidirectional, through pseudopods.

- The nucleus is characterized by evenly arranged chromatin on the nuclear membrane and the presence of a small, compact , centrally located karyosome.

-The cytoplasm is finely granular with few ingested bacteria or debris in vacuoles.

In the case of dysentery ,however , RBCs may be visible in the cytoplasm, and this feature is diagnostic for E. histolytica.

##### (b) Cyst

10-20µm. The immature cyst has inclusions namely; glycogen mass and chromatoidal bars..

#### Life cycle

\_Intestinal infections occur through the ingestion of a mature quadric nucleate infective **cyst**, contaminated food or drink and also by hand to mouth contact.

It is then passed unaltered through the **stomach**, as the cyst wall is resistant to gastric juice.

-In terminal ileum (with alkaline pH), excystation takes place.

-**Trophozoites** being **actively motile** invade the tissues and ultimately lodge in the Sub-mucous layer of the large bowel. grow and multiply by binary fission.

-**Trophozoites** are responsible for producing lesions in **amoebiasis**.

A certain number of trophozoites come from tissues into lumen of bowel and are first transformed into pre-cyst forms.

Pre-cysts secrete a cyst wall and become a uninucleate cyst. Eventually, mature **quadrinucleate cysts** form. These are the **infective forms**.

Both mature and immature cysts may be passed in faeces. Immature cysts can mature in external environments and become infective .

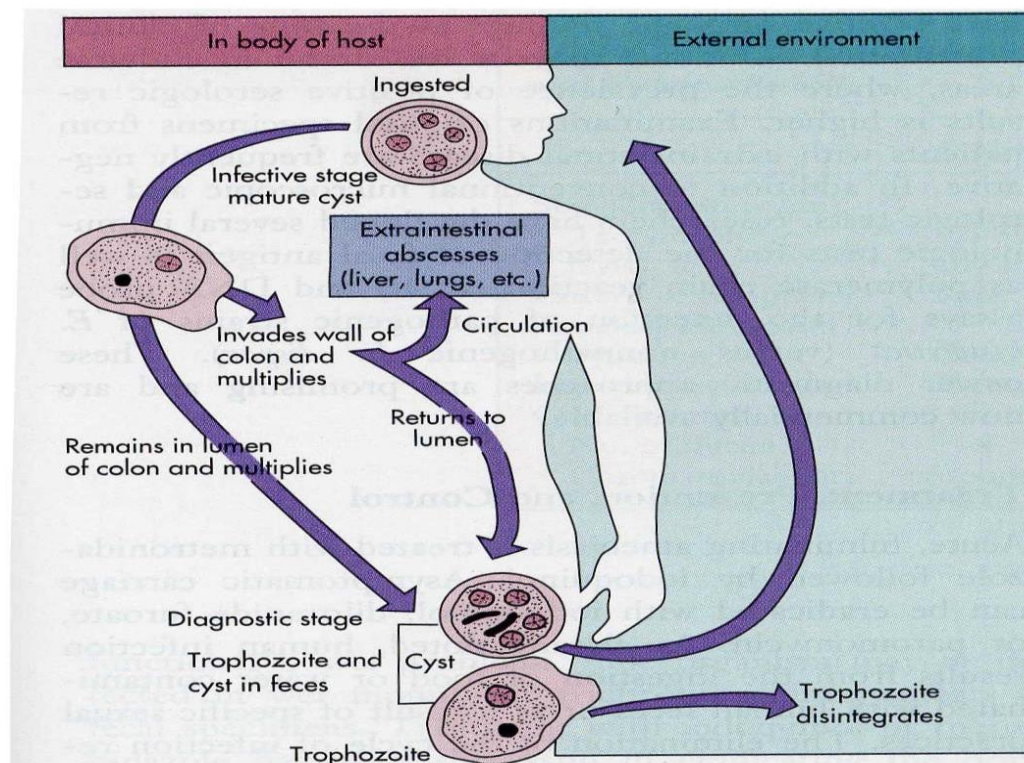


Figure-1 life cycle of *Entamoeba histolytica*

### Pathogenesis

Trophozoites divide and produce extensive local necrosis in the large intestine.

Invasion into the deeper mucosa. This can lead to secondary involvement of other organs, primarily the liver but also the lungs, brain, and heart.

## Clinical features

Intestinal amebiasis, or extra intestinal amebiasis . Diarrhea , flatulence, and cramping are complaints of symptomatic patients.

## Laboratory diagnosis

In intestinal amoebiasis:

- Examination of a fresh dysenteric fecal specimen trophozoite stage. (Motile amoebae containing red cells are diagnostic of amoebic dysentery).
- Examination of formed or semi-formed feces for cyst stage.

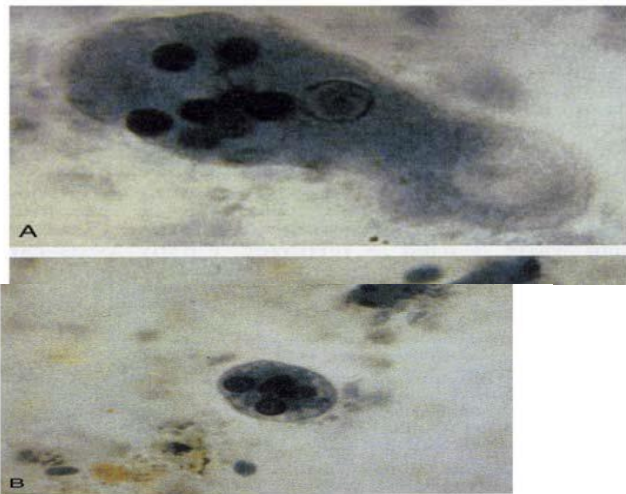


Figure 2-*E.histolytica* trophozoite (A) *E. histolytica* Cyst(B)

## Treatment

Acute, fulminating amebiasis is treated with metronidazole followed by iodoquinol .

## Prevention

Introduction of adequate sanitation measures and education about the routes of transmission .Avoid eating raw vegetables grown by sewerage irrigation .

## OTHER AMEBAE INHABITING THE ALIMENTARY CANAL

Most of these amoebae are commensal organisms that can parasitize the human gastrointestinal tract.

**Entamoeba gingivalis**- only the trophozoite stage presents, and encystation probably does not occur. E.gingivalis a commensal, living primarily on exudates from the margins of the gums, and grow best on unhealthy gums. No specific treatment is indicated. However the presence of E.gingivalis suggests a need for better oral hygiene. The infection can be prevented by proper care of the teeth and gums.

**Naegleria fowleri**- the trophozoites occur in two forms. Amoeboid forms with single pseudopodia and flagella forms with two flagella which usually appear a few

hours after flooding water or in CSF. Naegleria trophozoites in a section of spinal cord from a patient with amoebic Meningoencephalitis

## **PATHOGENIC FLAGELLATES**

### **INTRODUCTION**

Flagellates are unicellular microorganisms. Their locomotion is by flagella and reproduction is by simple binary fission. There are three groups of flagellates:

- Luminal flagellates

Giardia lamblia

- Hemoflagellates

Trypanosoma species.

Leishmania species.

- Genital flagellates

Trichomonas vaginalis

### **Luminal flagellates**

Giardia lamblia

Important features– the life cycle consists of two stages, the trophozoite and cyst. It is bilaterally symmetrical, pear-shaped with two nuclei (large central karyosome), four pairs of flagella, and a suction disc with which it attaches to the intestinal wall. The oval cyst is thick-walled with four nucleus and several internal fibers. Transmission is by ingestion of the infective cyst.

### **Pathogenesis**

Infection with G.lamblia is initiated by ingestion of cysts. Gastric acid stimulates excystation, with the release of trophozoites in duodenum and jejunum. The trophozoites can attach to the intestinal villi by the ventral sucking discs without penetration of the mucosa lining, but they only feed on the mucous secretions. In symptomatic patients, however, mucosa-lining irritation may cause increased mucous secretion and dehydration .

### **Clinical features**

#### **Clinical disease: Giardiasis**

Symptomatic giardiasis ranges from mild diarrhea to severe malabsorption syndrome. Usually, the onset of the disease is sudden and consists of foul smelling, watery diarrhea, abdominal cramps, flatulence. Blood & pus are rarely present in stool specimens.

**Laboratory diagnosis** Examination of diarrheal stool- trophozoite or cyst, or both may be recovered in wet preparation.

### **Treatment**

For asymptomatic carriers and diseased patients the drug of choice is quinacrine hydrochloride or metronidazole.



**Trichomonas vaginalis trichomoniasis.-**

Important features- it is a pear-shaped organism with a central nucleus and four anterior flagella; and undulating membrane extends about two-thirds of its length. It exists only as a trophozoite form. Transmission is by sexual intercourse. The trophozoite is found in the urethra & vagina of women and the urethra & prostate gland of men.

***Trichomanas tenax***– was first recovered from the mouth ,specifically in tartar from the teeth. There is no known cyst stage. The trophozoite has a pyriform shape and is smaller and more slender than that of *T.hominis*. Diagnosis is based on the recovery of the organism from the teeth, gums, or tonsillar crypts, and no therapy is indicated.

**References:**

1-Essentials of Medical Parasitology .2014, 1<sup>st</sup> edition.

2- Paniker's Textbook of Medical Parasitology.2018, 8<sup>th</sup> edition.