Introduction To Parasitology

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❖Medical Parasitology:

It is the science which deals with the parasites that infect man.

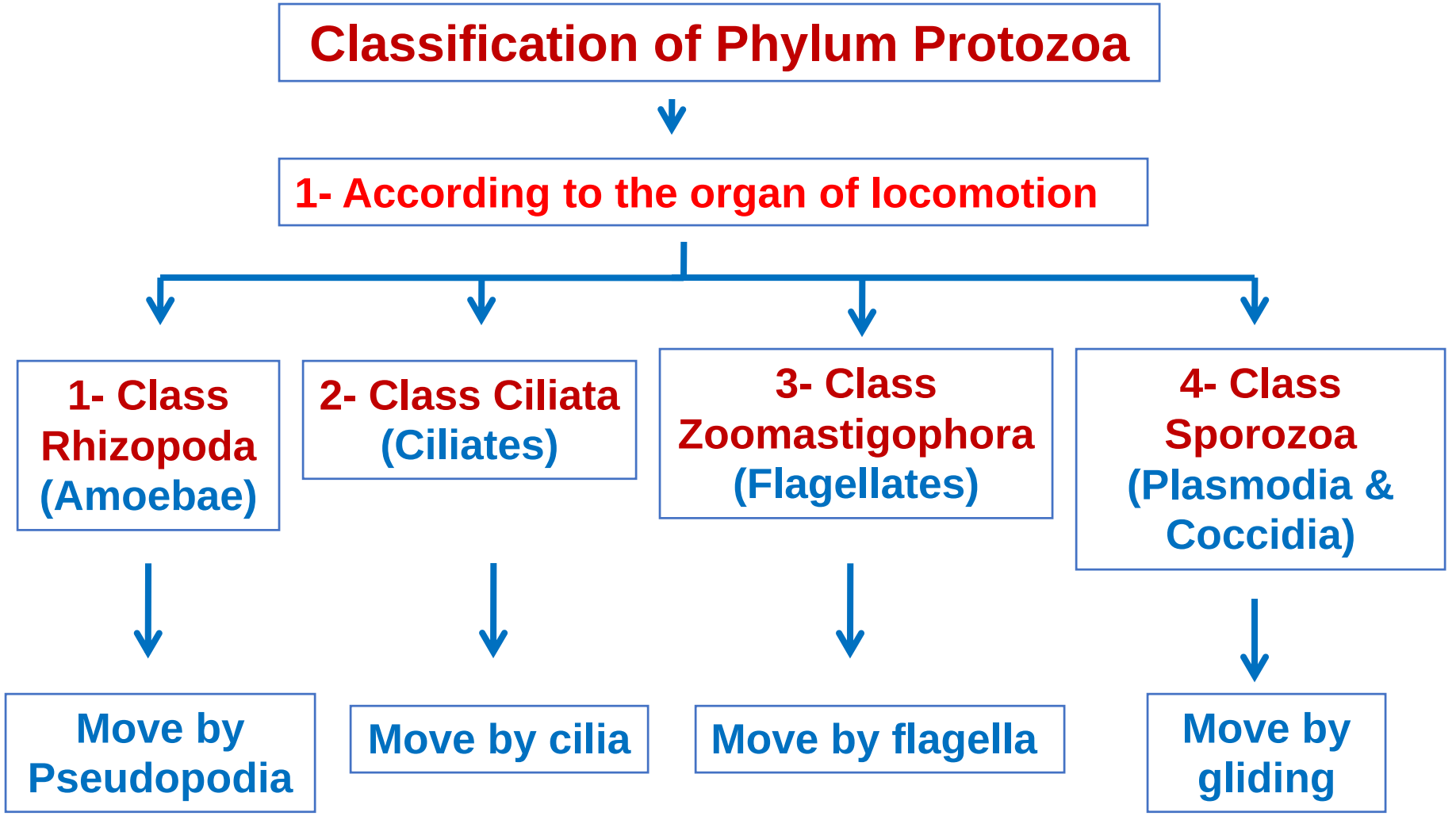
❖Parasite:

Is an organism, which lives on or within another organism (host) for survival.

❖Host:

Is a living organism that harbours the parasite.

- *Parasitic kingdom include three phyla*
- 1- Protozoa. 2- Helminths. 3- Arthropods.
- **I- Protozoa:**
- Is a phylum of the animal kingdom consisting of unicellular parasites, divided into 4 classes according to the organ of locomotion**:**
- **1- Class sarcodina:** Parasites that move by means of pseudopodia example *Entamoeba histolytica.*
- **2-Class mastigophora** : Parasites that move by means of flagella example *Giardia lamblia*
- **3- Class ciliates** : parasites that move by means of cilia example *Balantidium coli .*
- **4- Class Sporozoa** : parasites have both sexual and asexual reproductive organs, all these parasites are intracellular and they have no organ of locomotion example Plasmodium parasites causing malaria.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Move by Pseudopodia
Move by cilia
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Move by gliding

- **II- Helminths:**
- They are metazoan (Multicellular parasite) wormlike parasite, divided into 3 classes:
- **1.Class Nematoda (Roundworms) :**
- **a-** Intestinal nematodes, e.g, *Ascaris lumbricoides* .
- **b-** Tissue nematodes, e.g, *Wuchereria bancrofti* .
- **2- Class Cestoda (Tapeworms) :**
- They are flattened and segmented worms e.g: *Taenia saginata* .
- **3- Class Trematoda (Flukes):**
- They are flattened leaf- shaped worms e.g: *Schistosoma heamatobium.*

- **III- Arthropods** :

- These parasites having exoskeleton and jointed legs, divided into 2 classes:
- **1- Class Insecta** :e.g. Mosquitoes, lice and fleas .
- **2- Class Arachnida** :e.g. Ticks and mites .

Types of parasite

1- Ectoparasite: A parasite that lives on the surface of the host (infestation).

Ex : Lice (القمل)

2- Endoparasite: A parasite that lives inside the body of its host (infection).

Entamoeba Histolytica

3- Obligatory parasite: A parasite that is completely dependent upon a host for its survival.

4- Facultative parasite: A parasite that is capable of living both freely and as a parasite.

5- Permanent parasite: A parasite that spends its life cycle on or in the body of its host.

6- Temporary or Intermittent parasite: A parasite that visits its host only for a short period of time for its meal.

7- Opportunistic parasite: A parasite that causes disease **only in immunodeficient patients** (AIDS, cancer patients),while in **immunocompetent** individuals, the parasite may exist in a latent form producing no or mild symptoms.

8- Coprozoic or spurious parasite: An organism that passes through the human intestine without causing any disease and is detected in the stool after ingestion.

Types of hosts

- **1- Definitive host (D.H): It is the host which harbours the mature adult stage of the parasite or in which sexual reproduction of the parasite takes place.**
- Ex : man in case of Taenia

- **2- Reservoir host (R.H): The host which harbours the parasite and considered the source of human infection as Dog in case of kala – azar ((الحمى السوداء which is caused by the parasite (Leishmaniadonovani) .. It acts also as a source of infection to man and maintains the parasite in nature.**

Types of hosts

- **3- Intermediate host (I.H): It is the host which harbours larval stage (immature or non-sexually reproducing forms of the parasites).**
- **Ex : Snail in case of Bilharzia .**
- قوقع

4 Accidental host: The host which harbours the parasite which is not normally found .

- **Ex : the Toxo cara (dog nematode))) الديدان الخيطيةin man**

❖**The relationship between the organism and its host occurs in the following forms:-**

1- Commensalism: **It is a relationship between two living organisms where one gets benefit (commensal), while the other (host) is not harmed. (Entamoeba coli)**

2- Parasitism: **It is a relationship between two living organisms where one gets benefit (parasite), while the other (host) is harmed.**

3- Mutualism: It is a beneficial relationship between two living organisms where both drive a benefit and can successfully live apart.

4- Symbiosis: It is a close and long term beneficial relationship between two living organisms where both drive a benefit and cannot live apart.

❖Modes of transmission of parasitic infection:-

1- Direct contact through the skin.

2- Penetration of the skin.

3- Ingestion of contaminated food or drinking water containing the infective stage of the parasite.

4- Inhalation of dust carrying the infective stage of parasite.

5- Congenital from mother to foetus (transplacental) or may by transmammary (mother`s milk).

6- **Sexual contact**.

7- **Autoinfection** (either external or internal).

8- **Vectors**, through bite or feces of infected vector or by swallowing the vector.

9- **Blood transfusion** or through contaminated syringes.

10- **Organ transplantation**.

Terms used in parasitology

- **Habitat:** The natural site where the parasite lives.

- **Carrier:** A host in a state of equilibrium with parasite without or with minimal symptoms of the disease, but he is infective to others.

- **Zoonosis:** Transmission of an infection from animal to man either directly or indirectly via intermediate host e.g. viruses transmitted by arthropod vectors (arbovirus).

- **Infective stage (I.S): The stage by which the infection takes place.**
- **Diagnostic stage (D.S): The stage by which we can diagnose the parasitic infection (disease).**

- **Endemicity:** Steady or relativity moderate level of parasitic infection among population who has a certain degree of resistance and the parasite is common and well known to them.

- **Epidemicity:** Fulminating outbreak of a parasitic disease from a new parasite not common to the population who has little resistance.

Pathogenesis of parasitic infection

❖ **Occurs through the following:-**

1) Mechanical: The parasite may obstruct normal passage like intestine or bile tract.

2) Traumatic :-

✓**External due to invasion of the skin.**

✓**Internal by attachment to intestinal mucosa by buccal capsule producing ulcers.**

3) Toxin production: Circulation of parasitic products (toxins and waste products).

4)Tissue damage and necrosis: Due to enzymes secreted by parasites.

5) Cellular destruction: As RBCs or RES damage.

6) Immune stimulation: Parasitic antigens produce humoral /or cellular immune response ➲cellular proliferation and infiltration➲ formation of fibrous encapsulation around parasites (ex: hepatic granuloma in *Schistosoma mansonia*).

7) Allergic reaction due to insect bites or parasitic toxins.

- **The pathogenesis of the parasite depends on the number, size and morphology of the parasite, its activity (movement and migration), site (habitat), specific toxin and host reaction.**

Diagnosis of parasitic infection

I) Clinical diagnosis:-

Depends on the characteristic signs and symptoms

related to the parasitic infection.

II) Laboratory diagnosis:-

❖ **Direct methods** (to detect the diagnostic stage):-

Microscopical examination of the tested samples (ex:

1- stool, 2- urine, 3- blood , 4- tissue biopsy, 5- sputum & 6-aspirates.

1-Stool Examination

1- **Must collected** in clean, dry, tight fitting lid containers.

2- **Macroscopic examination:** for consistency, composition, color and presence of adult parasites such as *Enterobius vermicularis*, *Taenia* segments & *Ascaris* worm.

3- Microscopic examinations:

- **Direct saline smear or iodine smear: when helminthic eggs & protozoa cyst are in large numbers.**
- **Concentration techniques: if the parasites is scanty.**
- **Permanent stained smear : for correct identification of most protozoa.**

2- Urine examination

- The urine sample is examined macro& microscopically.
- Certain parasites can be detected in urine as ***Schistsoma haematobium*** eggs, ***Trichomonas vaginalis*** trophozoites & eggs of ***Enterobius vermicularis***.

3- Blood examination

- **Thin blood film:** to demonstrate the morphological features of the parasites.

- **Thick blood film:** to obtain large amount of blood which increase possibility of detecting light infection. Parasites detected in the blood are: Malaria, *Leishmania*, Filaria & Trypanosomes.

4-Tissue biopsy

Tissue biopsy specimens are recommended for diagnosis of a number of parasitic infections for example:

Muscle biopsy : In *Trichinella spiralis*.

Rectal biopsy : In detecting *Schistsoma* ova.

5- Sputum examination

- **Sputum is examined to detect parasites:**

✓ **living in the lung.**

✓ **migrating through the lung.**

✓**parasites which result from rupture of cysts in the lung.**

- **Parasites detected in the sputum are: Eggs of *Paragonimus*, trophozoites of *E. histolytica*, parts of ruptured hydatid cyst & migrating larvae of *Ascaris*, *Ancylostoma* &*Strongyloides*.**

6- Aspirates examination

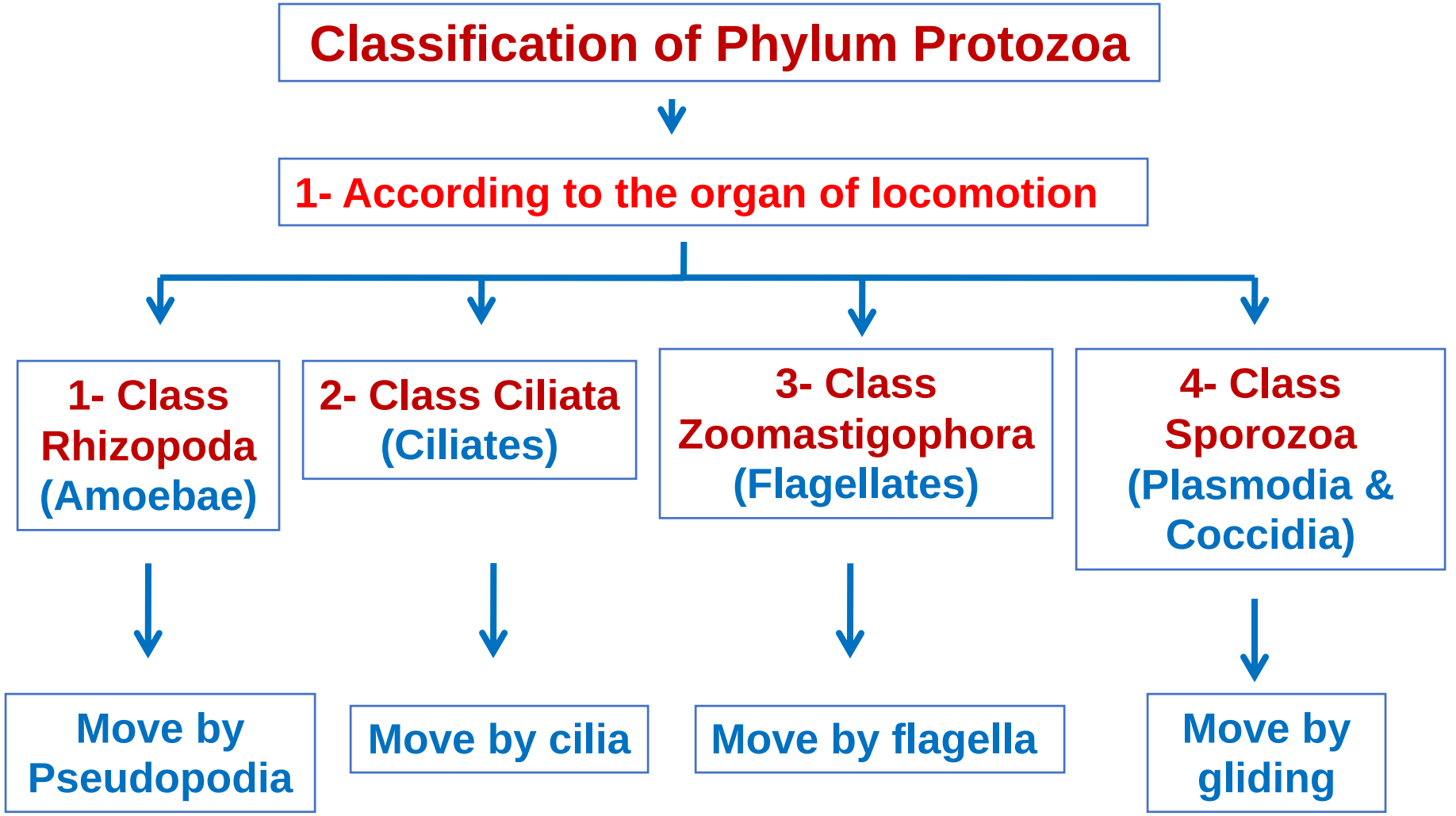
- **Cerebrospinal fluid may be used for detection of certain parasites of CNS as *Trypanosoma* spp & *Naeglaria***
- **Duodenal aspirates (Enterotest): for examination of duodenal contents.**

- **Parasites which can be present as *Giardia lamblia*, *Strongyloides larva* & *Cryptosporidium parvum*.**

Medical Protozoology

It is the study of protozoa of medical importance.

Protozoa are microscopic unicellular organisms performing all physiological functions of life.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2- According to the habitat

1- Intestinal protozoa

- **Amoeba:**
  - *Entamoeba histolytica*
- **Ciliates:**
  - *Blantidium coli*
- **Flagellates:**
  - *Giardia lamblia*
- **Coccidia:**
  - *Cryptosporidium*

2- Blood protozoa

- **Flagellates:**
  - *Trypanosoma & Leishmania*
- **Plasmodia:**
  - Malaria
- **Coccidia:**
  - *Babesia*

3- Tissue protozoa

- **Flagellates:**
  - *Trypanosoma & Leishmania*
- **Coccidia:**
  - *Toxoplasma & Sarcocystis*

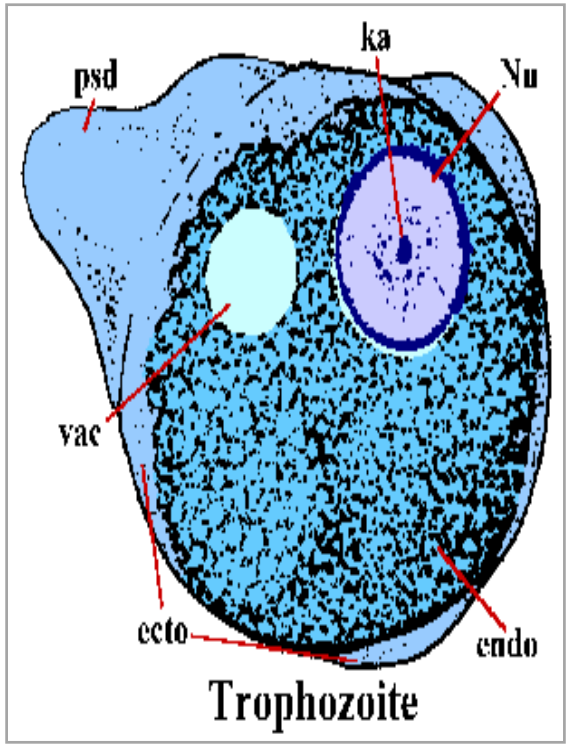
5- Urogenital protozoa

- **Flagellates:**
  - *Trichomonas vaginalis*

Morphological characters

1- Protozoa are made of protoplasm that differentiated into:

- ❖ Nucleoplasm.
- ❖Cytoplasm which consists of:
- ➢Outer thin hyaline ectoplasm.
- ➢Inner granular endoplasm.



Class: Rhizopoda (Amoebae)

1- Amoebae of large intestine

- *Entamoeba histolytica* (The only pathogenic)
- *Entamoeba coli.*

2- Amoeba of buccal cavity

Entamoeba gingivalis

3- Free living amoebae

Pathogenic free living amoebae

Naegleria fowleri & *Acanthamoeba*

Non pathogenic free living amoebae

Coprozoic amoebae

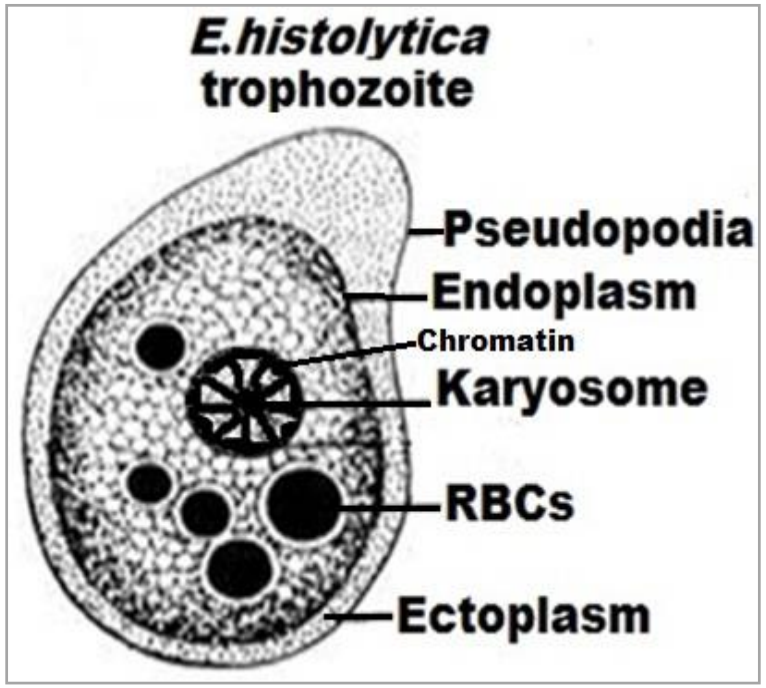
✍**N.B.** Other species of amoebae are commensals in the large intestine such as *E. hartmani* & *E. dispar* & are morphologically similar to *E. histolytica.* So PCR is required to differentiate bet. amoebae species.

Entamoeba histolytica

- **Geographical distribution:** Worldwide especially in the temperate zone and more common in areas with poor sanitary conditions.
- **Habitat:** Large intestine (caecum, colonic flexures and sigmoidorectal region).
- **D.H:** Man
- **R.H:** Dogs, pigs, rats and monkeys.
- **Disease:** Amoebiasis or amoebic dysentery

Morphological characters

1- Trophozoite stage (Vegetative form or tissue form):

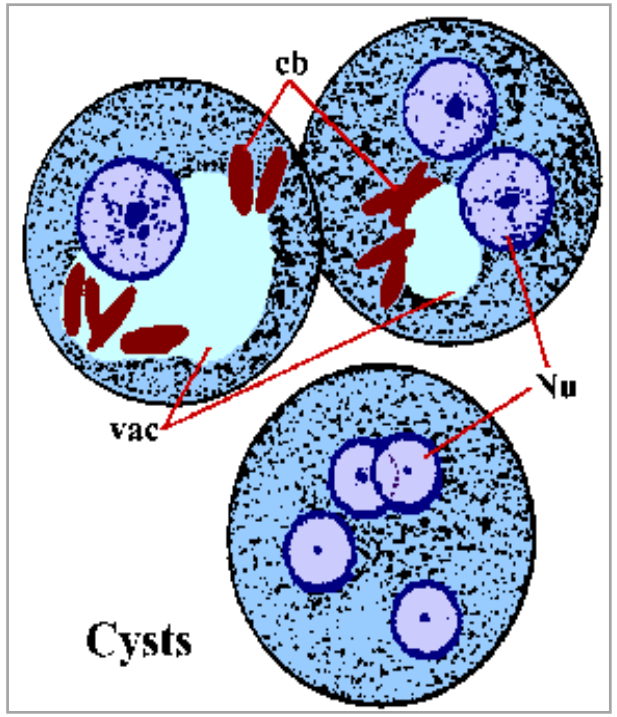


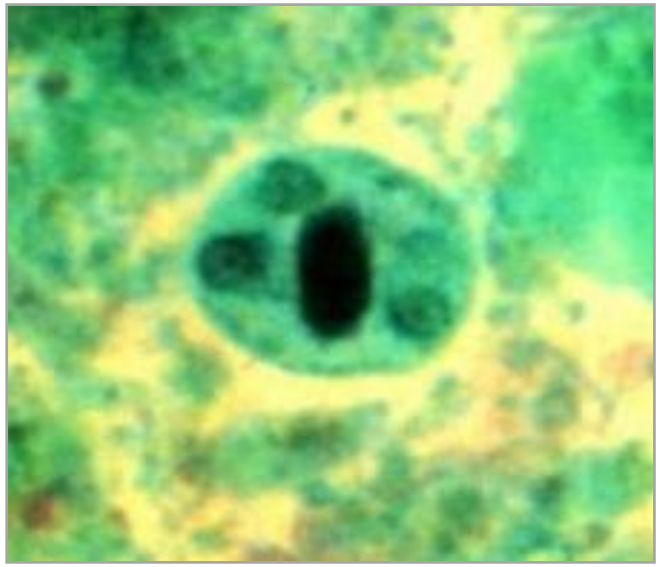
2- Cyst stage (Luminal form):

(a) Immature cyst (Uninucleate cyst and Binucleate cyst):

- ❖Uninucleate cyst (one nucleus)
- ❖Binucleate cyst (2 nucleus)

b) Mature cyst (Quadrinucleate cyst)





Mode of infection

1- Contaminated foods (ex. green vegetables) or drinks or hands with human stool containing mature cyst.

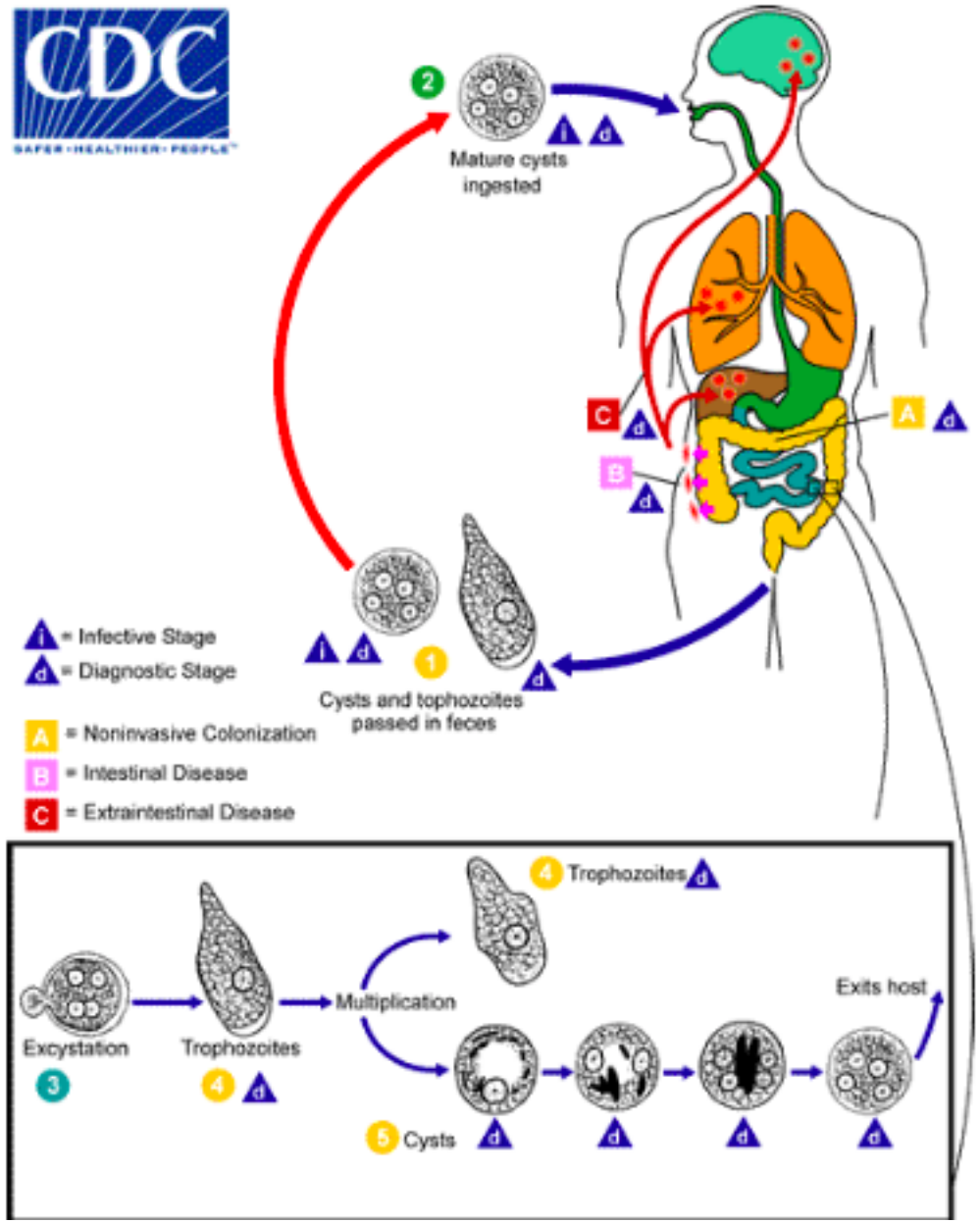
2- Handling food by infected food handlers as cookers and waiters.

3- Flies and cockroaches that carry the cysts from faeces to exposed food.

4- Autoinfection (faeco-oral or hand to mouth infection).

5- Homosexual transmission.

Life Cycle


CDC
SAFER·HEALTHIER·PEOPLE™
2
Mature cysts ingested
i d
C d
A d
B d
i = Infective Stage
d = Diagnostic Stage
A = Noninvasive Colonization
B = Intestinal Disease
C = Extraintestinal Disease
i d
1
Cysts and tophozoites passed in feces
d
4 Trophozoites d
Multiplication
Exits host
Excystation
3
Trophozoites
4 d
5 Cysts
d
d
d
d

Clinical pictures

I) Intestinal amoebiasis

1-Asymptomatic infection

Most common and trophozoites remain in the intestinal lumen feeding on nutrients as a commensal without tissue invasion (Asymptomatic patient known as a healthy carrier and cyst passers)

2-Symptomatic infection

a) Acute amoebic dysentery

Presented with fever, abdominal pain, tenderness, tenesmus (difficult defecation) and frequent motions of loose stool containing mucus, blood and trophozoites.

b) Chronic infection

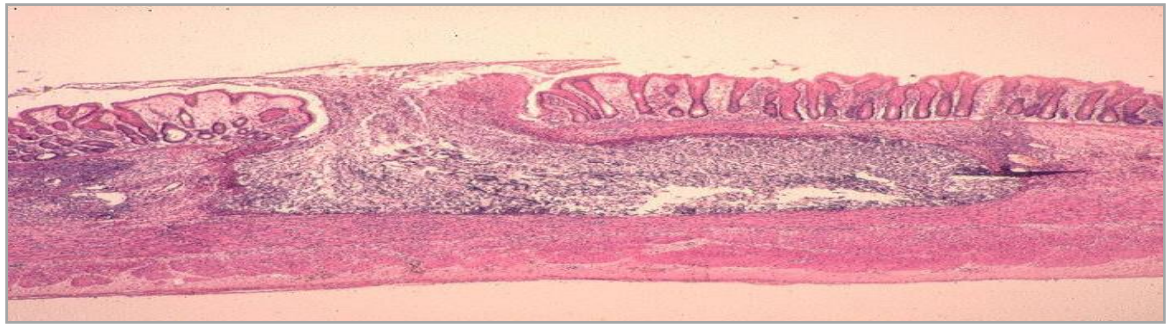
-Occurs if acute dysentery is not properly treated.
-With low grade fever, recurrent episodes of diarrhea alternates with constipation.
- Only cysts are found in stool.

3-Complications

- Haemorrhage due to erosion of large blood vessels.
- Intestinal perforation ➲ peritonitis.
- Appendicitis.
- Amoeboma (Amoebic granuloma) around the ulcer ➲ stricture of affected area.

With heavy infection and lowering of host immunity

- The trophozoites of *E. histolytica* invade the mucosa and submucosa of the large intestine by secreting lytic enzymes ➲ amoebic ulcers
- The ulcer is flask- shaped with deeply undermined edges containing cytolyzed cells, mucus and trophozoites.



- The most common sites of amoebic ulcers are caecum, colonic flexures and sigmoidorectal regions due to decrease peristalsis & slow colonic flow at these sites that help invasion.

II) Extra-intestinal amoebiasis

Due to invasion of the blood vessels by the trophozoites in the intestinal ulcer ➲ reach the blood ➲to spread to different organs as:

→ **Liver** →

-Amoebic liver abscess or diffuse amoebic hepatitis.
-Affect commonly **right lobe** either due to spread via portal vein or extension from perforating ulcer in right colonic flexure.
-CP: include fever, hepatomegaly and pain in right hypochondrium.

→ **Lung** →

•Lung abscess ➲ pneumonitis with chest pain, cough, fever.
•Amoebic lung abscess usually occur in the **lower part of the right lung** due to direct spread from the liver lesions through the diaphragm or very rarely trophozoites may reach the lung via blood.

→ **Brain** → Brain abscess ➲ encephalitis (fatal).

→ **Skin** → **Cutaneous amoebiasis (Amoebiasis cutis) due to either extension of acute amoebic colitis to the perianal region or through rupture on the abdominal wall from hepatic, colonic or appendicular lesions.**

Laboratory diagnosis

I)Intestinal amoebiasis

a) Direct

•**Macroscopic:** Offensive loose stool mixed with mucus and blood.

•**Microscopic:**

1-Stool examination: Reveals either trophozoites (in loose stool) or cysts (in formed stool) by direct smear, iodine stained & culture.

2-Sigmoidoscopy: To see the ulcer or the trophozoites in aspirate or biopsy of the ulcer.

3-X-ray after barium enema: to see the ulcer, deformities or stricture.

b) Indirect

-Serological tests: CFT, IHAT, IFAT, ELISA and GDPT (gel-diffusion precipitin test).

✍**N.B.** These serological tests are positive only in invasive intestinal amoebiasis but negative in asymptomatic carriers.

II)Extra- intestinal amoebiasis

According to the organ affected

a) Direct

1- X- ray:

In liver ➲ space occupying lesion.

In lung ➲pleuritis with elevation of the diaphragm

2- Ultrasonography, CT scan& MIR:

For liver abscess.

3- Aspiration of abscess content:

For liver abscess to detect trophozoites.

b) Indirect

1- Serological tests: As intestinal amoebiasis. They are positive and can persist for years.

2- Molecular by PCR.

3- Blood examination: Leucocytosis.

4- Liver function tests: Increased in amoebic liver abscess.

Treatment

1) Asymptomatic intestinal carrier

↓

Luminal amoebicides

↓

Paromomycin or

Diloxanide furoate

2) Intestinal amoebiasis

↓

Tissue & luminal amoebicides

↓

Metronidazol (Flagyl) is the drug of choice +

Paromomycin or

Diloxanide furoate

3)Extra-intestinal amoebiasis

↓

Tissue & luminal amoebicides

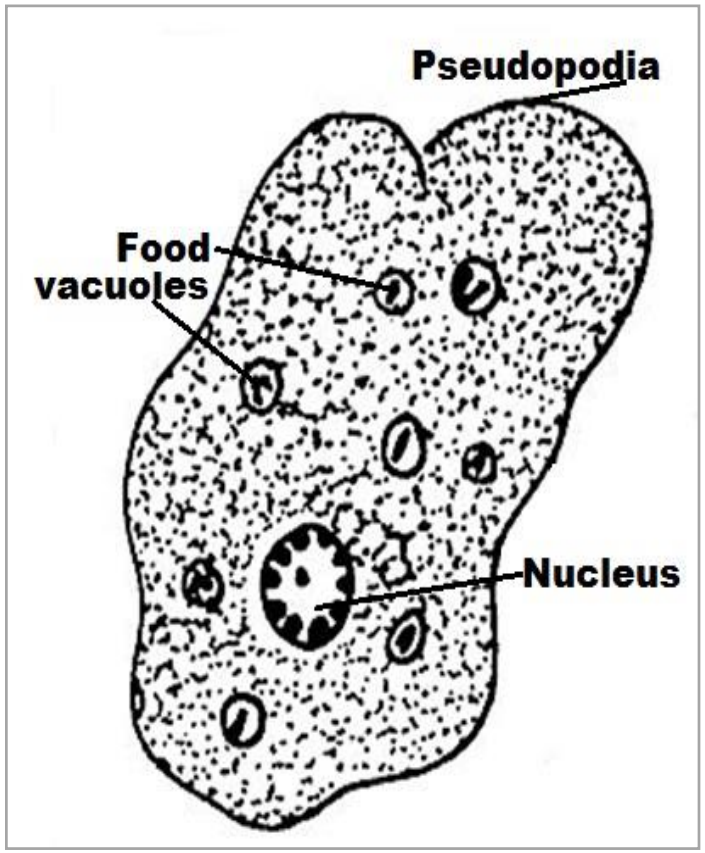
↓

Metronidazol (Flagyl) +

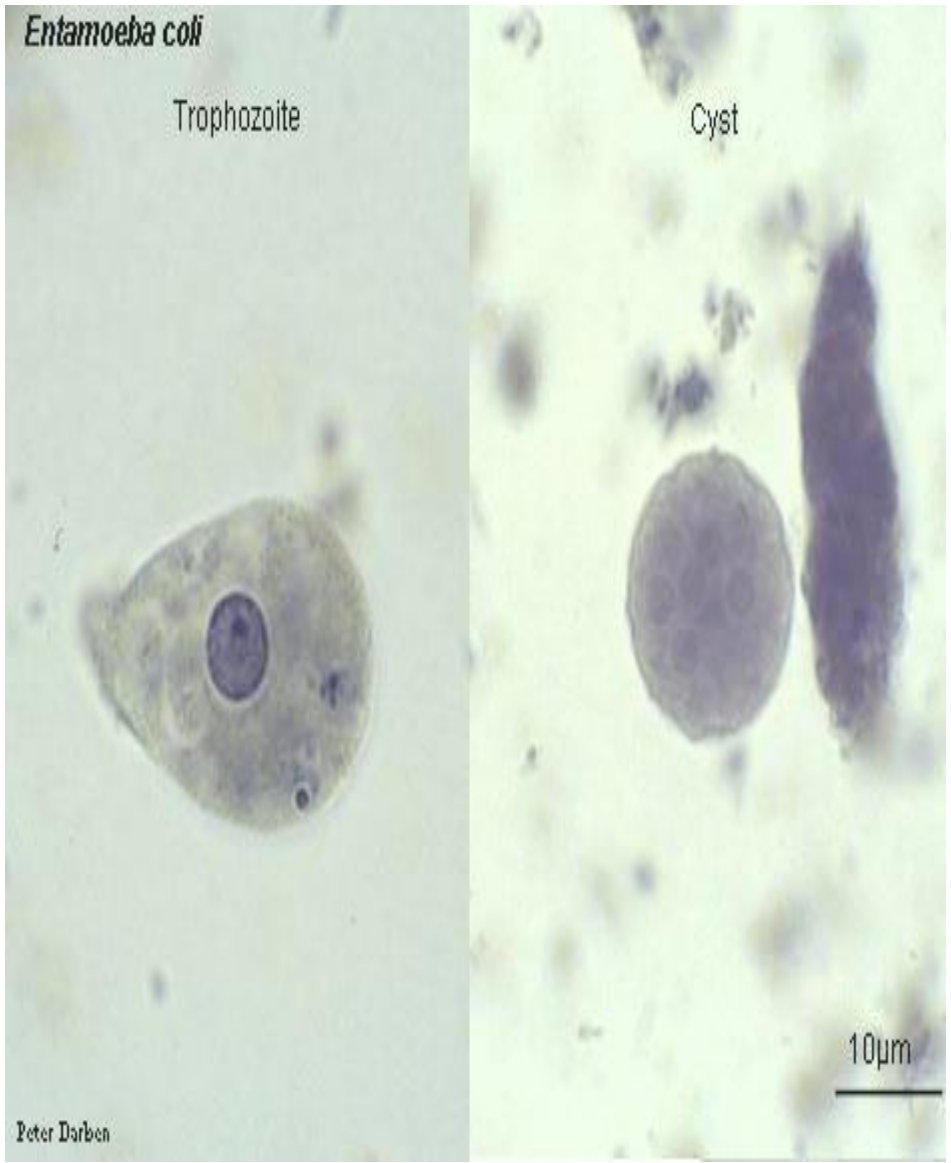
Paromomycin or

Diloxanide furoate

- ***Entamoeba coli :***
- It is a parasite of the large intestine .
- Its life cycle is similar to that of *E.histolytica*.
- It is of medical importance only because it may be mistaken for *E.histolytica* .It has two stages (trophozoite& cyst). The important morphological features are :



E. Coli trophozoite



E. Coli cyst

The End