

Entamoeba histolytica

Genus *Entamoeba* was defined by Casagrandi and Barbagallo in 1895. *Entamoeba* is derived from the Greek words Entos: within and Amoeba: change. It is an acellular, anaerobic parasitic protistan found in vertebrates. There are different species of *Entamoeba*, *E. histolytica*, *E. coli*, *E. gingivalis*, *E. dispar*, *E. hartmanni*, *E. polecki*. Of these only *Entamoeba histolytica* is pathogenic to man and other vertebrates. It causes amoebiasis, amoebic dysentery and other extraintestinal lesions (liver abscess) in man. *E. gingivalis* is a harmless commensal found in large numbers in the mouth with poor oral hygiene. *E. coli* is a commensal of the lumen of the colon part of the large intestine. *E. hartmanni* is non-pathogenic and closely resembles *E. histolytica* in morphology except that it is smaller in size. *E. polecki* is a common naturally occurring parasite in monkeys and pigs, rarely found in man but if found can cause diarrhoea.

Entamoeba histolytica was first described by W.D. Lambl 1859 in the colonic autopsy of a child who died of diarrhoea. Fedor Loschin 1875 described the pathogenic nature of *Entamoeba histolytica*. He inoculated the parasite through the rectum of a dog and found that the dog had developed dysentery, thus proving the pathogenic nature of the parasite. Kartulis (1886) confirmed amoeba as a causative agent of amoebic dysentery and amoebic liver abscess. Dobell described the life cycle of the parasite in 1925.

Systematic position of Entamoeba

Phylum- Protozoa
Subphylum-Sarcodina
Superclass-Rhizopoda
Class- Lobosa
Genus-*Entamoeba*
Species-*histolytica*
Distribution

Entamoeba histolytica infection is worldwide in distribution, more common in the tropics and the sub-tropics. It is the third leading cause of death in the developing countries of the world. About 50 million people are infected by *Entamoeba histolytica* and about 40,000–100,000 deaths occur in a year.

Habit and Habitat

Entamoeba histolytica lives in the mucosa and sub-mucosa of the large intestine (caecum and sigmoidorectal region of man). *Entamoeba histolytica* exists in two forms (i) Minuta or non-pathogenic, non-invasive form (ii) Virulent or pathogenic or tissue invading form.

Minuta form is smaller in size and lives in the lumen of the large intestine whereas the virulent form lives in the mucosa and sub-mucosa of the large intestine of man.

Host: Human, apes and monkeys. Also found in pigs, dogs, cats and rats.

Reservoir: Human and monkeys. Asymptomatic human carriers act as reservoir for the spread of *Entamoeba histolytica*. As such there are no animal reservoirs.

Morphology:

Entamoeba histolytica exists in three forms:

- Trophozoite or feeding stage or free moving stage lives in the mucosa and sub-mucosa of large intestine (colon and cecum). It is the invasive form of the parasite.

- Pre-cyst: It is the transient stage, between the trophozoite and cyst, formed in the lumen of the large intestine
- Cyst: It is the non-feeding infective stage of the parasite found in the lumen of the large intestine

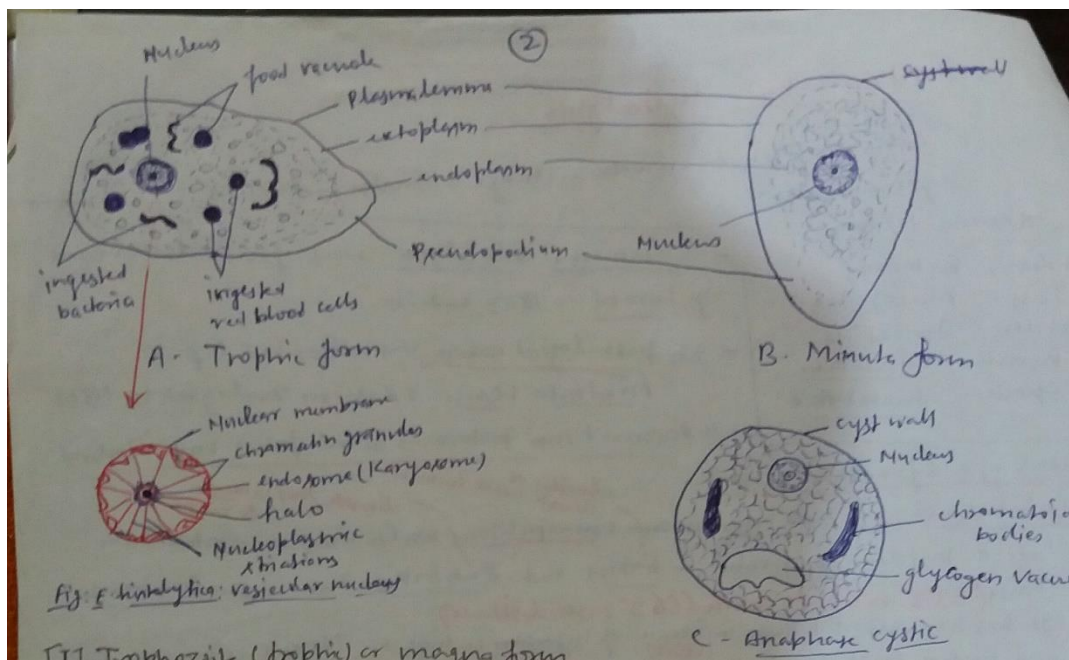
Trophozoite:

Size: Varies in size from 8 μ m- 40 μ m with an average size of about 20 μ m -25 μ m.

Shape: Not fixed, constantly changing its shape by thrusting out pseudopodia.

Cytoplasm: The cytoplasm is differentiated into a clear, thin translucent ectoplasm and a central fluid like granular endoplasm. Endoplasm contains nucleus, numerous food vacuoles, erythrocytes, granules and tissue debris. The trophozoite is an anaerobic parasite. It lacks mitochondria, golgi bodies and rough endoplasmic reticulum. Contractile vacuole which is a characteristic feature of protistansis also wanting in them.

Nucleus: Nucleus is the most distinguishing feature of *Entamoeba*. Nucleus is spherical in shape, about 3.5 μ m in size, lined externally by a thin, delicate nuclear membrane. The nuclear membrane is lined internally by a single layer of evenly distributed chromatin granules. The chromatin granules are in the form of small dots. A compact, small karyosome or endosome surrounded by a clear halo (ring) is centrally located. Nuclear striations (spoke like lines) radiate out from the endosome and extend upto the nuclear membrane.



Locomotion: The trophozoite shows slow, gliding movement in one direction. They move about with the help of pseudopodia. Pseudopodia are finger like flowing extensions of the cytoplasm which may be short and wide or long and narrow. Locomotion is brought about by the forward extension of the ectoplasm followed by the granular endoplasm which then flows into the finger like extensions. The direction of movement may change suddenly by giving out pseudopodia at some other site.

Feeding and digestion: Food consists of bacteria and other cytolysed organic substances found in the hosts intestine. Food is taken in by *Entamoeba* either by phagocytosis or by pinocytosis. A food vacuole is formed. The food vacuole contains RBC which may be in various stages of digestion. The digestion is intra-cellular within the food vacuole.

Trophozoites:

PRE CYST: Smaller in size (10-20µm) than the trophozoite but larger than cyst, round or oval with a blunt pseudopodia. It has a relatively large nucleus that retains all the characteristics of the nucleus of a trophozoite. The trophozoite extrudes food vacuoles before encystment so that the endoplasm is free from red blood cells and other ingested food particles.

CYST: Cyst exists in three forms: (i) Immature uninucleate cyst (ii) Binucleate cyst (iii) Mature quadrinucleate cyst. The trophozoite becomes completely round and is surrounded by a transparent, highly retractile double walled resistant cyst wall. The cyst wall varies greatly in size from 6-9 µm (small race) to 12-15 µm (large race). The cytoplasm is clear and hyaline (transparent/glassy). Before encystment, the parasite eliminates food vacuoles and accumulates considerable amount of food in the form of glycogen mass and black bodies called chromatoidal bodies. These chromatoidal bodies are large, smooth, oblong rods with rounded ends. They may be one to several in number. They are called chromatoidal bars or chromatoidal bodies because they stain as chromatin with haematoxylin stain. It is believed that the chromatoidal bodies contain DNA and phosphates and serve as storage for ribosomes. Cyst when formed is uninucleate but the nucleus within the cyst divides twice to form a quadrinucleate cyst. It is this mature quadrinucleate cyst (cyst containing four nuclei) which is the infective stage. Occasionally, additional division may result in aberrant form with more nuclei. Although the nucleus retains all the characteristics of the trophozoite, it is smaller in size due to successive mitotic division. The mature quadrinucleate cyst lacks chromatoidal bodies and glycogen mass as they are absorbed by the cytoplasm.

Life Cycle:

E. histolytica is a monogenetic parasite. The infection begins when the host swallows the mature quadrinucleate cyst along with the contaminated food or water. As the cyst wall is resistant to the acidic content of the stomach, the quadrinucleate cyst passes unaltered into the small intestine where excystation takes place. In the intestine, the cyst wall is digested by the action of trypsin in an alkaline medium at a temperature of 37°C. During this process, the cytoplasmic body retracts and loosens from the cyst wall. Pseudopodia are formed at various points and vigorous amoeboid movements occur within the cyst. Frequently, the pseudopodia press against the wall at certain spots as though the imprisoned organism were searching for exit. Eventually, a tetranucleate amoeba known as metacyst (amoeba with four nuclei) emerges out. Immediately on emergence, the four nuclei of the metacyst undergo division to form eight nuclei. Each nucleus gets surrounded by a bit of its own cytoplasm and leads an independent existence. Thus, eight amoebulae are formed. These are known as metacystic or metacyclic trophozoites which are actively motile. The metacystic trophozoites move down to the caecum and ileocolic region of the intestine. The young amoebulae being actively motile invade the tissues and finally lodge themselves in the mucosa and submucosa of the large intestine its final abode. They prefer this site as the organic material (food), pH and gases in this part of the large intestine are more stable and ideal for the existence of *E. histolytica* trophozoites. Here, the trophozoites grow at the expense of living tissues and multiply by simple binary fission. The trophozoites secrete histolysin which causes necrosis and destruction of the host's tissue and helps the parasite to derive nourishment from the dissolved dead tissues.

When the conditions become unfavourable for the trophozoites in the lumen of the large intestine, they start to develop a cyst wall. A pre-cyst is first formed which soon becomes a uninucleate immature cyst. The nucleus within the cyst divides to first form a binucleate cyst. The nucleus divides again for the second time to form a quadrinucleate/tetranucleate mature cyst (infective stage). The transformation of trophozoite into a mature quadrinucleate cyst is called encystation and is a means

of protection of a species from extinction. Encystation does not take place in the tissues of man: neither in the intestinal mucosa nor in the liver, lungs etc. Thus, actually the metastatic invasion of the trophozoite for all biological purposes is a dead end for the parasite.

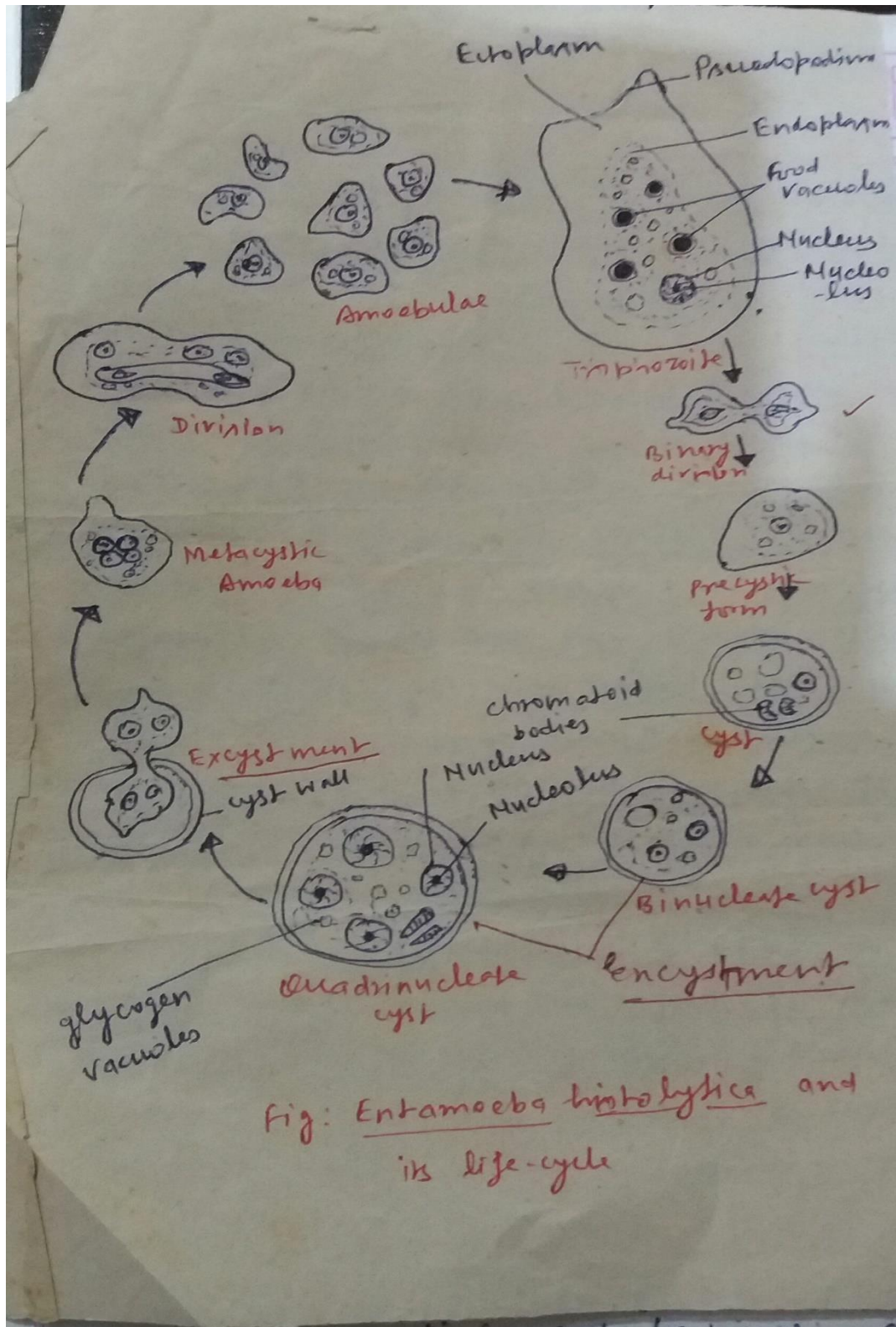


Fig: *Entamoeba histolytica* and its life-cycle

Encystation takes only a few hours and the mature quadrinucleate cyst can remain viable in the lumen of the large intestine for only two days. Mature quadrinucleate cysts are passed out along with the faeces of the host. The cysts are resistant to the environmental conditions and can live for a

few weeks to a few months depending on the temperature (thermal death occurs at 50°C). Moisture is essential for the long existence of the cyst. They can live upto 10 days in a moist stool. Trophozoites are also voided out along with the cysts in the faeces but they cannot survive outside the body of the host for more than an hour and even if they are ingested by another human being during this period they are killed in the body of the host by the acidic juices of the stomach. A very important point to note is that both excystation and encystation are not reproductive processes. Encystation and excystation can take place in the same host; another host is required only for the perpetuation of the species.

Mode of Infection: faecal-oral route Infective Stage: Mature Quadrinucleate cyst

Source of Infection: Carriers of *Entamoeba histolytica* are of two types: 1. Contact carriers: People who have never suffered from amoebic dysentery and their health remains unaffected. They are healthy carriers of *E. histolytica*. They can shed cysts for many years 2. Convalescent carriers: Persons who have recovered from acute amoebic dysentery.

Transmission:

(i) Fruits, raw vegetables and food contaminated by faeces containing quadrinucleate cyst (ii) Contaminated water (iii) Unhygienic habits (iv) Mechanical vectors like houseflies and cockroaches. Houseflies may act as carrier of the cysts from faeces to unprotected food and water. The droppings of cockroaches too have been found to contain mature cysts and thus they also serve as a source of infection. (v) Sexual transmission of *Entamoeba histolytica* has been reported in about 20-30% homosexuals.

Reference: 1. e-content MHRD