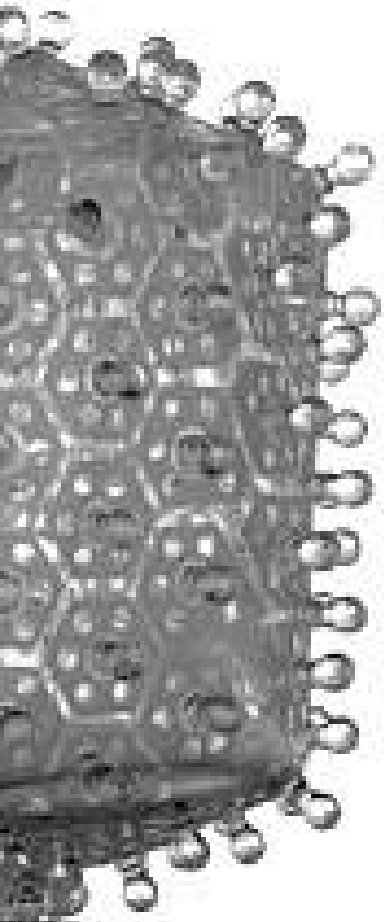

Microbiology

Lecture No:.....32.....

Dr Name:.....Hassan.....

Done by:.....Ula Isleem.....

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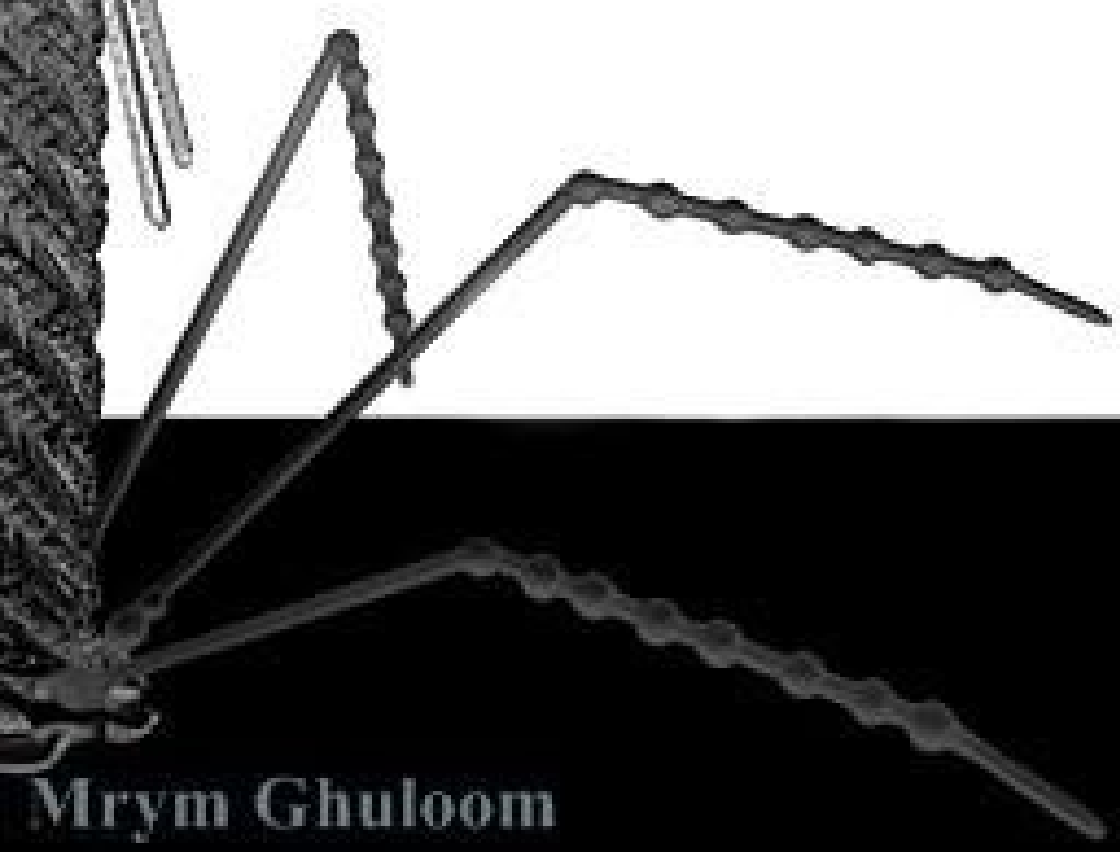


Mrym Ghuloom

Parasitology

Protozoa

Today, we will discuss a group of parasites known as **Protozoa**. They are unicellular, and range in diameter from 2-120 microns. Some of them are intracellular and the others are extracellular. We said that the vegetative from is usually referred to as a **trophozoid**. Trophozoids are rarely transmitted, and there is no way they can be transmitted without an intermediate host. As far as protozoa are concerned, you get a resistant morphological form of the parasite that can withstand living outside of the body until it is transmitted elsewhere. That is a **cyst**

Note: A cyst is the resting or dormant stage of the organism that can withstand unfavorable conditions

We can classify protozoa into 4 main groups:

1)Rhizopoda:

This classification has to do with the parasite's method of locomotion. They are organisms that move by the means of **pseudopodia** or false feet(podia means foot and pseudo means artificial). Pseudopodia are an extension of the cytoplasm

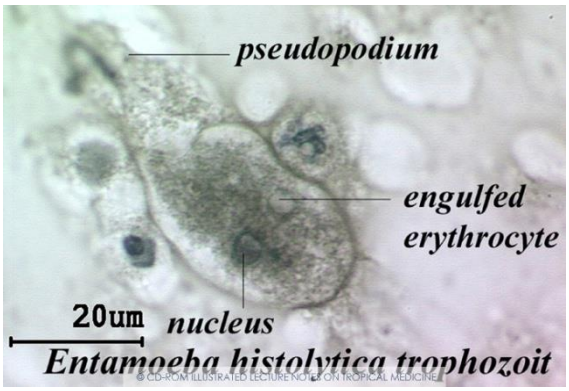
We all know Amoeba move by pseudopodia, pushing part of the cytoplasm outwards and then sucking the rest of the cytoplasm in it.

From yahoo! answers: To understand how amoeba move we have to understand the amoeba's anatomy. The cytoplasm inside the cell is capable of changing into different states. It can turn very easily from a fluid into a solid state and back again.

The fluid state of the cytoplasm is called plasmasol, the more solid state is called plasmagel. When the organism moves the plasmasol flows through the center of the cell towards the front. When the plasmasol moves to the sides it becomes solid again. This way the cell can propel itself as a whole but can also send pseudopodia in many directions.

The Rhizopoda move sideways, rhizomes is a lateral movement. The most important rhizopoda is amoeba. Amoeba is a parasite which can cause disease in human beings.

This is a member of the rhizopoda which is Entamoeba. There are many species of Entamoeba which can be present in the human being. There are about 6, but only one can be pathogenic. That one is the Entamoeba histolytica-the reason we refer to Ameoba as problematic.



Entamoeba histolytica are the trophozoids. Usually it measures about 20-25 microns in diameter. Here you can see a nucleus. The answer to a student's question the other day, is that parasites are eukaryotes. They are not prokaryotes like bacteria. They have a nucleus, nuclear membrane and all types of organelles. Here you can see the cytoplasm and the pseudopodia. This is the trophozoid. We will not go into details about the morphology, we will get to that when we discuss the gastrointestinal tract.

Where does Entamoeba histolytica live? It actually lives in the large intestine. Pathologically, it causes dysentery in the large intestine. We have two types of dysentery: a bacterial one

known as bacillary dysentery, caused by Shigella which causes bloody diarrhea and mucus and Amoebic dysentery caused by parasites.

Here, we don't have an intermediate host. The parasite spreads directly from one person to another; usually via the fecal-oral route. The Entamoeba histolytica is usually excreted in the feces of someone who has dysentery, and food which may have come in contact with the feces, is eaten by another person, who may become infected.

The trophozoid itself, can leave the body alive. However, if it remains without a host, it dries up very quickly and then dies. Even if you do eat the Entamoeba histolytica which was in the feces, it will be destroyed by the hydrochloric acid in your stomach. So, the spread IS NOT through the trophozoid, it is through the cyst. The cyst is smaller than the trophozoid, at about 15 microns in diameter. There are 4 nuclei and tough resistant layer. The cyst can last for weeks outside the body, and if they are eaten, they are resistant to the stomach acid, so they will go on to the intestine. The hydrolytic enzymes of the intestine will break down the cyst's wall and release the 4 nuclei. Each of them will become a new trophozoid. That is an example of infection by the Rhizopoda. We will discuss the Amoeba in more detail, some other time.

2) Flagellates which move by means of flagella

These are examples of Flagellates →

The one at the top is Giardia lamblia.

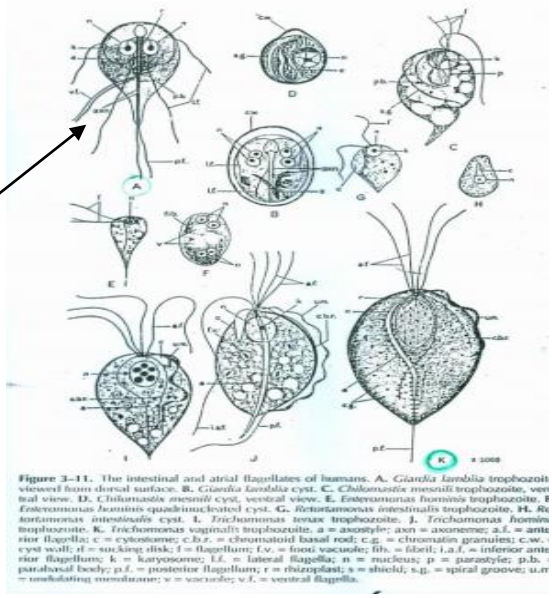


Figure 3–11. The intestinal and atrial flagellates of humans. A. *Giardia lamblia* trophozoit viewed from dorsal surface. B. *Giardia lamblia* cyst. C. *Chilomastix mesnili* trophozoite, ve tral view. D. *Chilomastix mesnili* cyst, ventral view. E. *Enteromonas hominis* trophozoite. *Enteromonas hominis* quadrinucleated cyst. G. *Retortamonas intestinalis* trophozoite. H. *R fortamonas intestinalis* cyst. I. *Trichomonas tenax* trophozoite. J. *Trichomonas homin* trophozoite. K. *Trichomonas vaginalis* trophozoite. a = anastyle; axn = axoneme; a.f. = ant rior flagella; c = cytostome; c.b.r. = chromatoid basal rod; c.g. = chromatin granules; c.w. cyst wall; rf = sucking disk; f = flagellum; f.v. = food vacuole; fib. = fibril; i.a.f. = inferior ant rior flagellum; k = karyosome; l.f. = lateral flagella; n = nucleus; p = parastyle; p.b. par.abasal body; p.f. = posterior flagellum; r = rhizoplast; s = shield; s.g. = spiral groove; u.m = undulating membrane; v = vacuole; v.f. = ventral flagella.

Written by

You don't have to remember the names, because at this point, they probably won't make sense to you, but you should notice the features of the Flagellates.

*Giardia lamblia: you can see flagella sticking out through the sides

*Trichomonas Vaginalis: transmitted through sexual contact, you can see 4 anterior flagella

And so on…..

There is a cyst for Giardia Lamblia, but Trichomonas does not need cysts since it is transmitted directly through sexual contact.

3) Ciliates are the third group and again, as the name implies, they have cilia.

Do you remember studying Paramecium in high school or in Biology? You may not have seen them move, but they are very motile. Under the microscope, it almost looks like a fast swimmer. That is because it has a lot of cilia. This is an example of a Ciliate.

Another example is the Balantidium coli:

You can see the cilia all around the surface. This parasite is more advanced than the Amoeba, for example, because it has a **mouth**

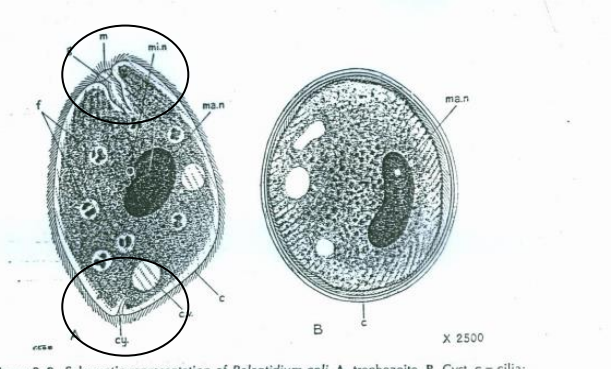


Figure 3–9. Schematic representation of *Balantidium coli*. **A.** trophozoite. **B.** Cyst. c = cilia; cy = cytopyge; c.v. = contractile vacuole; f = food vacuole; g = gullet; m = mouth; ma. n = macronucleus; mi. n = micronucleus. (Modified from Dobell and O'Connor, 1921.)

opening and an **anal opening(cytopyge)**. It takes food from one end, metabolizes it, then excretes it from the posterior end.

Next to the trophozoid, there is also a figure of the cyst, but we'll come back to that later. Just remember that the **Ciliates can have cysts.**

4)The Apicomplexans(Sporozoa): Here we are not interested in the movement. Rather, they are called apicomplexans because they have a special apparatus on the **apex** on the anterior end of the organism, which enables these organisms to go inside cells. So, in reality, these apicomplexans are going to complete their life cycle intracellularly because they are specially adapted for going inside cells. You can look up a picture of the apicomplexans and notice their specialized end apparatuses**. You do not need to know the exact structure.** Just remember that the apparatus is at the apex and helps the parasite to enter the cell.

*The apexes on Toxoplasma are not clearly demarcated.

One class of apicomplexan is the Toxoplasma gondii, but the more common, and widespread parasite is, of course, Malaria. I'm sure you've all heard that RBCs are affected by this parasite. Different stages of development of Malaria are either schizogony or sporogony(asexual and sexual) development.

How do Protozoa behave? We mentioned that some of them were intracellular and others extracellular.

For example; the same organism can have an intracellular and extracellular stage. Take the example of a trypanosome, like Leishmania. There are multiple morphologies for the same organism. There is a **promastigote**, which is another word for

a trophazoid-and is the extracellular variety of a **trypanosome,** on the other hand there is an **amastigote** which is up taken by the macrophage. The amastigote is the intracellular variety and contains a nucleus and **kinetoplast** next to each other, the nucleus being only about 4 microns in diameter. The extracellular variety is present in the intermediate host, which is in this case, a sandfly. The intercellular variety, which is the amastigote, happens to be in the human being. So, if a sandfly lands on a human being and bites them, the fly will take the amastigotes. The amastigotes will multiply in the gut of sandfly and the sand fly will transmit the promastigotes into the next person they bite. So, one morphology exists in the intermediate host, the other exists in the primary host.

*You don't have to remember all these names, just remember the concept of the intracellular and extracellular stages.

A student asks: Does this mean that the extracellular variety does not cause infection?

The professor answers that he does not know if the sandfly which takes up the extracellular variety is harmed. We are concerned with humans. As soon as the extracellular parasite enters the body, tissues will divide, induce its flagella, invades macrophages and becomes intracellular, and that's where the pathology begins. No matter how much, we talk about other hosts, humans are our main concern.

So, if the extracellular morphology of other types of parasites enters the cell, will it cause infection?

Yes, it will. As soon as it is injected, it is phagocytosed by the macrophages, but it becomes intracellular and induces

intracellular flagella in the macrophage, and becomes an amastigote, dividing in the macrophage.

What about the multiplication of these organisms?

So, we said that the best form and the ones that were significantly dividing were those that eat, excrete, move and produce disease. **Usually, the division is done by binary fission**, like Bacteria. One nucleus divides to become two, and so on, so the cell increases exponentionally, a very simple process. There are, however, exceptions like different forms of binary fission.

For example: There is a form of division known as **schizogeny.** Schizogeny is a process where the trophozoid has grown into a morphology where several nuclei appear at the same time in the organism. Like in the apicomplexia, in plasmodium. The trophozoid can produce up to 18 nuclei. They are still within the same organism, and not yet separated. After a while, 18 organisms are produced. This is not really binary fission. All of a sudden 18 new organisms are produced and released into the blood stream. Not all parasites produce 18.

There is another form of division known as **endodyogeny**. It is a peculiar binary fission. There is replication of the nucleus and other cellular components into 2, but the cells do not separate. The components all remain part of the mother cell. And each of these two cells which are still integrated into the mother cell will produce two more integrated cells, and the mother cell will get bigger and bigger, until it is completely filled with these components.

Until now, all these methods of multiplication are asexual. The cases, where we do have sexual reproduction are in the

apicomplexia. One example, is the malaria parasite. We mentioned that the malaria have a **schizont** stage, where the trophozoid produces 18 nuclei, which in turn produce 18 new organisms. But, sometimes, protozoans stop becoming schizonts. They remain one entity which becomes bigger and bigger and gives rise to gametocytes. Larger gametocytes are macrogametocytes(female/ovum variation in parasites) and smaller ones are microgametocytes (the male/sperm variation). Within the agent, we have RBCs which contain **macrogametocytes** or **microgametocytes.** They don't burst the RBC's. They stay in them and start replicating.

So, what happens after that? The mosquito(the intermediate host) lands on a human and sucks some blood, taking up RBCs which contain gametocytes. These gametocytes are released in the gut of mosquito and fuse together to form a zygote(an ookinete). The zygote will start multiplying in the mosquito to form a sporozoite. Not all protozoa have this cycle, it's mostly the apicomplexia which do. This is the difference between asexual and sexual multiplication.

Helminths:

We are finished with Protozoa. Now, we are going to talk about the other group of parasites known as Helmniths. Helminths are separated mainly into two groups:

1)Roundworms: They are cylindrical in shape, and are also known as nematohelminths or nematodes

2)Flat worms(flattened appearance): which are further divided into cestodes(tapeworms-which look like the wound up tape in a cassette) and trematodes(flukes-which look a lot like leaves, oval and pointed at one end).

Nematodes(Round worms):

*They are very small measuring about 2mm or very big and measure about 1m.

*They have a life span of 6/8 weeks to 10/15 years depending on their species.

Note: You cannot determine a life span for Protozoa since they're constantly dividing and making new cells. However, Helmniths are living creatures and only live for a certain time.

One relevant thing about nematodes is that they do have separate sexes, male and female, which distinguish them from flatworms. And of course, they do not reproduce by binary fission. They produce eggs. The production of eggs is mostly related to luminal nematodes (intestinal nematodes). The luminal nematodes inhabit the intestinal lumen and produce eggs which are excreted in the feces. Eggs come in many different sizes. →

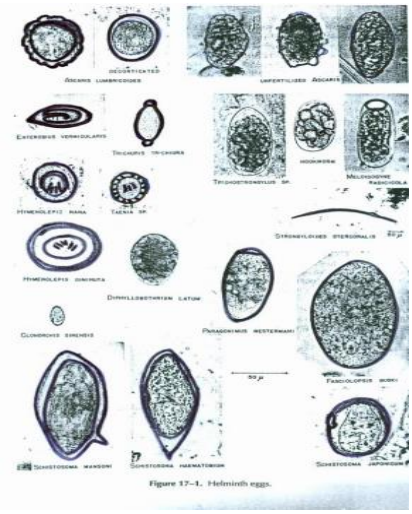


Figure 17–1. Helminth eggs.

When it comes to tissue nematodes, there's really no point in producing eggs because how are they going to leave the body? It's very difficult for them to come out. Usually, tissue nematodes are transmitted by insects (intermediate host). The insects don't eat the worms. Some of them are relatively big, like the ones that cause elephantiasis and malaria. So, what do these tissue nematodes do instead of laying eggs? They release larvae. This embryonic form of the worm is called microfilariae.

Larvae comes in the form of a very thin tube full of nuclei, about 200 microns in length. When a mosquito suck the blood it takes up these larvae, which then develop in the mosquito and the infected mosquito bites someone else, transmitting the microfilariae to them.