

Intestinal Protozoa

1- Entamoeba Histolytica

Morphology	Mode of infection	The Life Cycle	Notes
1- Trophozoite Form (Vegetative form / tissue form). 2- Cyst Form (Luminal form), small and circular, can be: a- Immature cyst , which can be either Uninucleate cyst with one nucleus, or Binucleate cyst with 2 nuclei. b- Mature cyst , (Quadri-nucleate cyst)	1- Contaminated stuff with human stool containing mature cysts. 2- Handling food through infected food handlers as cooks and waiters. 3- Flies and cockroaches. 4- Autoinfection (faeco-oral or hand to mouth infection). 5- Homosexual transmission.	1- Ingestion of the cyst (the infectious form). 2- Excystation , to produce Trophocytes. 3- The Trophocytes multiply to produce 4 cysts. 4- Cysts go to the site of infection.	- Worldwide distributed, more common in poor sanitary conditions. - Inhabit the L. intestine . - D.H: Man - R.H: Dogs, pigs, rats and monkeys. - Causes: Amoebiasis (amoebic dysentery).

2- Giardia Lamblia

Morphology	Pathogenesis	Transmission	Life Cycle	Clinical Aspects	Diagnosis	Treatment
1- Trophozoite (active) - Attaches to the lining of the small intestine and colonize it. - Responsible for the signs and symptoms of giardiasis. - Heart-shaped with 4 pairs of flagella, - 2 nuclei with central karyosome and 2 axostyles - Swaying/ dancing motion 2- Cyst (inactive) - Found in stool - Ellipsoid, thick walled and highly resistant to chlorinated water. - Mature: 4 nuclei Immature: 2 nuclei	- Usually weak pathogens. - Large numbers of parasites cause irritation, low-grade inflammation of the duodenal or jejunal mucosa, with acute or chronic diarrhea, associated with epithelial cell damage.	- Fecal-oral route with the ingestion of cysts - Personal contact with animals like beavers, oral-anal sex and man to man sex.	1- Ingestion 2- Excystation in small intestine. (cyst → 2trophozoite) 3- Trophozoite undergoes binary fission . 4- Encystation .	- Varies from asymptomatic carriage to severe diarrhea and mal-absorption. - Stools may be watery, and foul smelling and does not contain mucous or blood.	To detect Giardia antigen: 1- Immunologic enzyme-linked immunoassays (EIAs). 2- Immune-fluorescence microscopy To detect Giardia: Trichrome stain of preserved stool. <i>The cyst in non-diarrheal stool. The trophozoite in diarrheal stools.</i>	Quinacrine & Metronidazole Tinidazole Furazolidone paromomycin

3- Cryptosporidium

Morphology	Pathogenesis	Transmission	Life Cycle	Clinical Aspects	Diagnosis	Treatment
- Small spherical structures arranged along the line of epithelial cells inhabiting the surface of villi of the lower small bowel. - Acid-fast staining - Infective stage of Cryptosporidium is called Sporulated oocyst.	- Usually asymptomatic and transient. - C hominis, C parvum can infect the intestine in immune-compromised persons - Parasites of rodents, fowl (eggs/flesh of a bird), rhesus monkeys, cattle, and other herbivores. - Causes self-limited, mild gastroenteritis and diarrhea.	- Contact with contaminated water and food. - Exposure to infected animals or to water contaminated by feces of infected animals.	- Completes its life cycle within a host, including its asexual and sexual reproductive cycles. - They are immediately infectious. 1- Ingestion or inhalation of Sporulated oocysts. 2- Excystation. 3- Sporozoites are released and parasitize epithelial cells of the gastrointestinal tract or other tissues such as the respiratory tract.	- Immuno-competent patients: asymptomatic infection or self-limited watery diarrhea - Immune-compromised patients: chronic, severe, non-bloody diarrhea with nausea, vomiting, abdominal pain, and anorexia resulting in weight loss and death	- Detection of oocysts in fresh stool samples: Acid fast stain. - Stool antigen detection: Direct fluorescent antibody or EIA tests.	Nitazoxanide

4- Cyclospora

Life cycle	Clinical Aspects	Diagnosis	Treatment
- Similar to the Cryptosporidium and appears to involve only a single host. - Main difference is that Cyclospora oocysts are not immediately infectious when freshly passed in stools, so person to person transmission is uncommon.	Causes altered mucosal architecture with shortening of intestinal villi due to diffused edema and infiltration of inflammatory cells which leads to diarrhea, anorexia, fatigue, and weight loss .	Examining stools for oocysts which are acid-fast positive (reddish color).	Trimethoprim-sulfamethoxazole (TMP-SMZ).

5- Balantidium coli		
Morphology	Clinical Aspects	Treatment
- The largest intestinal protozoa of humans. - The trophozoite stage is a ciliated oval organism. - It rotates around a long axis motion (Rotary motility).	- It causes Balantidiasis (Balantidium dysentery). - Most infections are harmless. However, rarely, in acute outbreaks the trophozoites invade the large bowel and terminal ileum causing erosions and ulceration. - Some trophozoites invade the wall of the colon and multiply, leading to the presence of mucous and blood in the stool.	Oxytetracycline, which may be followed by Iodoquinol or Metronidazole.

-----End on Intestinal Protozoa-----

Sexually Transmitted Protozoa, Trichomonas		
General characteristics	Diagnosis	Treatment
- Flagellated protozoa with 3-5 anterior flagella.	- In most symptomatic cases, wet mount examination for motile trophozoites is enough. - There is no Cyst stage within Trichomonas, so we depend on Trophozoites for diagnosis.	- Topical and systemic Metronidazole. - Tinidazole and Ornidazole are equally effective with fewer side effects. - These drugs belong to (Nitroimidazoles) family.
<u>There are three members of the genus Trichomonas that parasitize humans:</u> 1- Trichomonas Hominis: parasitize the intestine. 2- Trichomonas Tenax: parasitize the mouth. 3- Trichomonas Vaginalis: Parasitize the Vagina in females causing low-grad inflammation limited to vulva vagina and cervix, causing vaginitis with frothy yellow or creamy discharge, while in males in parasitizes the prostate, seminal vesicle and Urethra - Trichomonas vaginalis cause trichomoniasis in humans. - It is pear- shaped with undulating membrane (which enhances motility of the parasite in a viscous fluid, such as blood) lined with a flagellum and 4 anterior flagella. - It moves with wobbling or rotating motion - Direct contact of T-vaginalis with the squamous epithelium of the genitourinary tract results in: a) Destruction of the involved epithelial cells. b) Development of a neutrophilic inflammatory reaction. c) Petechial hemorrhages (tiny pinpoint red mark). d) Pain during urination (dysuria) or sexual intercourse. - It is a sexual transmitted disease (STD) but sometimes, nonvenereal transmission can occur (non-sexual transmission) for example babies can get infected as they move through the birth.		

Blood and Tissue Protozoa

1- Hemoflagellates

- They are invasive either in **tissues or in the blood**. They produce highly **morbid**, and **lethal** diseases. They usually need **I.H (Vectors)**.
- Hemoflagellates have several morphologic forms:
 - a) **Amastigote** (rounded form): Found in intracellular Environments (Tissues)
 - b) **Epimastigote** and **Promastigote**: Found in insect hosts
 - c) **Trypomastigote**: Found in mammalian Bloodstream

a- Trypanosoma	African Trypanosoma	- Vector: tsetse fly (<i>Glossina</i> species), Which is found only in rural Africa: a) <i>Glossina palpalis</i> transmits → <i>Trypanosomiasis brucei gambiense</i>. b) <i>Glossina morsitans</i> transmits → <i>Trypanosomiasis brucei rhodesiense</i>. - Tsetse flies of both sexes transmit pathogenic African trypanosomes (if we compare it to malaria, only female anopheles mosquito can transmit the disease). A bite by the tsetse fly is often painful and can develop into a red sore (Chancroid) then parasitemia occurs and the infection invades the CNS. - Tsetse fly bites humans and inoculates parasites that are found in its saliva. - The infection leads to Insomnia at night, and Sleepiness during the day. - The African trypanosomes shows two morphologic forms: Trypomastigote and Epimastigote. - The African trypanosomes only attach to RBCs, without invading them, unlike malaria, which invades RBCs. - West African Trypanosomiasis causes slowly developing chronic disease, while East African Trypanosomiasis causes acute disease.
	American Trypanosoma	- Vector: Reduviid bugs (also called Triatomine bugs, kissing bugs). Causes zoonotic disease. - It has 3 developmental stages: 1- Epimastigote, Inhabits insects. 2- Trypomastigote, Inhabits the bloodstream. 3- Amastigotes, inhabits tissues. It is usually found in heart, liver and brain, so it's a serious infection - D.H: Humans, dogs, cats and rat. - Reduviid bug defecates near wounds while taking a blood meal, then a chagoma forms (an inflammatory nodule at the bite site of the reduviid bug).
b- Leishmania		- It is flagellated, obligate intracellular protozoa. - Life cycle requires two hosts: a) Vertebrate; mammalian host b) Invertebrate vector; female sand fly. - Infects primarily phagocytic cells and macrophages. - Transmission occurs through: 1. Bite of sand fly. 2. Transfusion blood and transplantation. 3. Mother to baby. 4. Direct contact; from man to man through nasal secretion.

Cont.	Leishmaniasis is divided into clinical syndromes according to what part of the body is affected most: 1- Cutaneous Leishmaniasis it is also called (Baghdad boil, oriental sore), caused by (L. Tropica) and (Leishmania major). <i>Leishmania major is the most common type in Jordan especially in areas near to Al Aqaba city.</i> 2- Mucocutaneous leishmaniasis is caused by (L. Braziliensis). 3- Visceral Leishmaniasis (black fever, kala-azar), caused by (L. Donovan).
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2- Plasmodium (Blood Sporozoa)

- Cause **malaria** in their hosts. The parasite always has **two hosts** in its life cycle: **Dipteran insect** host and a **vertebrate** host.
- The life cycle of Plasmodium can be divided into two distinct phases: **1- The asexual cycle** (schizogony), in vertebrate hosts e.g. humans.
2- The sexual cycle, in insect e.g. mosquitoes.
- The vector for malaria is the **female anopheline** mosquito.

Types	Mechanism of infection	Diagnosis	Treatment
<u>1- P. Malaria:</u> Causes quartan fever, recur (occur again) every 72 hours or every fourth day (at three-day intervals). Also causes classical malaria in humans <u>2. P. vivax:</u> The most frequent and widely distributed cause of malaria. Cause tertian fever, recur every 48 hours or every third day (two-day intervals). <u>3. P. Ovalle:</u> Relatively uncommon. Also causes tertian fever. → Cont. in next page	1. The vector mosquito takes a blood meal. 2. Sporozoites, in the saliva of the Mosquito, are discharged into the punctured wound. 3. Within an hour, infective sporozoites are carried via the blood to the liver. 4. They penetrate hepatocytes and begin to grow, initiating the pre-erythrocytic or primary exoerythrocytic cycle. <i>The parenchyma cells of the host become infected before RBCs.</i> <i>Exoerythrocytic cycle: is the developmental stage of the malaria parasite in liver.</i> → Cont. in next page	To determine which type of plasmodium is causing the disease: 1- Thick and thin blood films, 200 - 300 oil immersion fields. 2- Blood is collected using EDTA anticoagulant. 3- Giemsa stain, Wright's stain, Fluorescent nucleic acid stains, such as acridine orange are used. Or we use antigen-antibody detection.	1- Quinolines (e.g. Chloroquine): Used for all types except for P. falciparum infections due to acquired resistance, they are treated using combination therapies. 2- Primaquine Treats Hypnozoites. 3- Artemisinin. 4- Tetracycline, doxycycline, and clindamycin

<u>4. P. Falciparum:</u> Major species associated with deadly infections throughout the world. It causes malignant fever which recurs every 48 hours but with more severe symptoms, the temperature can reach more than 42 degrees affecting the brain and cerebral cortex. <u>5. P. Knowlesi:</u> It causes malaria in monkeys and can infect human as well	5. The sporozoites become round/ oval and begin dividing repeatedly. Schizogony results in large numbers of exoerythrocytic merozoites (a small ameboid trophozoite). 6. Once these merozoites leave the liver, they invade the RBCs, this mark the end of the exoerythrocytic cycle, initiating the erythrocytic cycle (Infection of RBCs). 7. Once the RBCs and reticulocytes (immature red blood cell) have been invaded, the parasites grow and feed on hemoglobin. 8. Within the RBC, the merozoite (or young trophozoite) becomes vacuolated, ring shaped, ameboid, and uninucleate. 9. Merozoites progress into mature trophozoites. Once the nucleus begins to divide, the trophozoite is called a developing schizont (contains many merozoites, which rupture releasing merozoites into the bloodstream). 10. The excess protein and hematin present from the metabolism of hemoglobin (hemolytic anemia) combine to form malarial pigment.	These drugs are classified into the following, according to the stage of malarial growth that they target: 1. Tissue schizonticides: kill tissue schizonts. 2. Blood schizonticides: kill blood schizonts. 3. Gametocytocides: kill gametocytes. 4. Sporonticides: prevent formation of sporozoites within the mosquito, inhibiting the life cycle of malarial parasite.
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Tissue protozoa (cysts of parasites in tissues are called bradyzoites)

Toxoplasma Gondii	- It is coccidian protozoa with worldwide distribution that infects wide range of animals and birds but does not appear to cause disease in them. - The only host of which the oocyst-producing sexual stage of toxoplasma can develop are strictly the cats and their relatives. - When oocysts are ingested, they either repeat their sexual life cycle in a cat, or if ingested by a human they can establish an infection in which it can reproduce asexually, where it opens and releases sporozoites to the duodenum then invade various cells especially macrophages where they form tachyzoites which spread infection to lymph nodes and other organs. - Latent infections occur with Toxoplasma. - It produces either congenital or postnatal toxoplasmosis. Congenital infections occur in non-immune mothers during pregnancy.
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Major Points

- **E. Histolytica:** Causes Amoebiasis
- **Balantidium Coli:** Largest intestinal Protozoa, causes Balantidiasis and has a rotary motility.
- **G. Lamblia:** Swaying/ Dancing motion. Infection Varies from asymptomatic carriage to severe diarrhea and mal-absorption.
- **Cyclospora & Cryptosporidium:** Single host & Acid-Fast staining
- **Cryptosporidium:** self-limited, mild gastroenteritis and diarrhea.
- **Cyclospora:** Altered mucosal architecture, diarrhea, anorexia, fatigue, and weight loss.
- **Sexually Transmitted Protozoa:** Trichomonas.
- **African Tryp.** → Tsetse fly, causes Insomnia and sleeplessness.
- **American Tryp.** → Reduviid Bugs, forms chagoma.
- **Trichomonas Vaginalis:** Causes Trichomoniasis
- **Toxoplasma Gondii:** Causes Toxoplasmosis
- **P. Malaria:** Quartan fever and classical Malaria. **P. Vivax:** Most freq. and causes tertian fever.
- **P. Ovale:** Uncommon, causing tertian fever. **P. Knowlesi:** Malaria in monkeys.
- **P. Falciparum:** Causes major deadly infections and malignant fever.