

Parasites Lecture Outline**March 9, 12****Protozoan Parasites**

Protozoan parasites are single celled parasites can live extracellularly or intracellularly. Most are transmitted by insect vectors.

Intracellular: Plasmodium (malaria). Toxoplasma. Leishmania.

Extracellular: Entamoeba (amebic dysentery). Trypanosomes. Giardia.

II. Diseases caused by protozoan parasites.

1. Malaria- leading cause of death from infectious disease.

2 million deaths/year.

35% of world's population has been infected.

Caused by different species of Plasmodium (P. vivax, P. falciparum, P. ovale).

Parasites live in liver cells and then in red blood cells (rbcs).

Mosquito vector. Cyclic fevers of disease.

2. Sleeping sickness is also known as African trypanosomiasis caused by Trypanosoma brucei.

Extracellular. Parasites live freely in bloodstream.

Transmitted by bite of tsetse fly. Uncontrolled infection can spread to brain.

Chaga's disease. American trypanosomiasis caused by Trypanosoma cruzi.

Extra/intracellular. Vector is "kissing" bug. Animal reservoirs.

Parasite replicates in macrophages and muscle cells.

3. Leishmania. Leishmaniasis. Skin lesions or systemic disease.

Sandfly vector. Lives in macrophages.

4. Toxoplasma gondii--intracellular parasite lives in macs and other cells.

Persistent. Zoonosis from cat/mouse life cycle.

III. Immune Responses to Protozoan Parasites

1. Innate immunity. Extracellular protozoan parasites eliminated by phagocytosis and C' activation.

2. Antibody responses.

Extracellular. Opsonization, Complement activation, ADCC.

Intracellular. Neutralization to block entry of parasites into host cells.

2. T cell immunity

Against extracellular parasites. Th2 cytokines for antibody responses.

Against intracellular parasites CTLs to kill infected cells.

Th1 cytokines for activating macrophages and CTLs and DTH response.

IV. Immune evasion

1. Live Intracellular. By replicating inside host cell parasites avoid immune response. Malaria live in red blood cells which have no nucleus and when infected are not recognized by CTLs and NK cells.

Leishmania/Trypanosoma cruzi live in macrophages.

2. Antigenic variation.

A. Malaria different stages in life cycle express different antigens.

B. Trypanosomes have one surface glycoprotein that covers the parasite. This surface protein is immunodominant for antibody responses.

Gene switching: The Trypanosomes

have actual gene "cassettes" of

variant surface glycoproteins (VSGs)

which can randomly switch to different VSG.

A parasite expressing new VSG escapes antibody detection and replicates to continue infection.

Helminth Parasites

Parasitic worms. Most are larger enough to be seen with naked eye.
Most are extracellular. Intracellular worm stages are usually cyst form.

I. Nematodes are segmented roundworms.

Nematodes live in animal or human intestines but must transmit through eggs or cysts to new host.
Mostly fecal/oral transmission.

Examples:

A. *Enterobium vermicularis*. Pinworm is a very common urban parasite of humans.
Usually a disease of small children and transmitted easily by fecal oral.

B. *Ascaris lumbricoides*. These are the large round worms in small intestine.
Most common worm infection in the world.

C. Ancylostoma. These parasites are known as **Hookworms** and they are transmitted through contaminated feces. Can actually enter through skin by walking on contaminated soil.

D. Trichinella. The intracellular form makes cysts in pork meat which can be transmitted to humans when they eat undercooked pork and cause Trichinosis.

II. Cestodes are flat segmented worms.

Examples: *Taenia solium*. **Tapeworms**. Cysticercosis. Humans get from uncooked pork.
Echinococcus granulosus can cause hydatid cysts.

Echinococcus is normally a disease transmitted in a cycle between sheep and dogs.

Humans become infected after eating contaminated sheep meat but are usually dead end hosts (no transmission through feces back to sheep).

III. Trematodes are also known as flukes. Life cycle has replication stage in water snails.

Example: *Schistosoma mansoni* Blood fluke. Adult lives in mesenteric veins. Long-lived in hosts 20-40 years. Deposit millions of eggs through intestines in feces.

Also *Schistosoma hematobium* lives in renal veins eggs released into urinary tract.

IV. Immune responses

Most are extracellular and too large for phagocytosis.

For larger worms host will often develop inflammation and hypersensitivity.

Eosinophils and IgE will be activated to initiate an inflammatory response in intestine or lungs to expel worms.. These are histamine elicited reactions very similar to allergic reactions.

Acute response after previous exposure can be an IgE and Eosinophil mediated systemic inflammation which results in expulsion of worms.

Chronic exposure to antigens can cause chronic inflammation through

A. Delayed type hypersensitivity (DTH) from Th1/activated macrophages can result in granulomas.

B. Th2/B cell responses increase IgE, Mast cells, and Eosinophils which can activate inflammation.

V. Immune evasion mechanisms.

1. Large size. Immune system finds large parasites difficult to eliminate. Primary response is inflammation to initiate expulsion but often times the worms are ignored rather than causing disease (immunopathology) without actually eliminating the worm.

2. Coating with host proteins.

Schistosomes-worm takes on host blood proteins

such as blood group ags, MHC class I and II, therefore worms are seen as self.

3. Molecular mimicry.

Mimic of host structure or function.

Schistosomes has E-selectin CAM that may help in adhesion or invasion.