Parasites of Medical Importance

Parasitology
- The study of eucaryotic parasites: protozoa and helminths
- Cause 20% of all infectious diseases
- Less prevalent in industrialized countries - increasingly common in AIDS patients

Protozoa
- Single-celled, animal-like microbes; most have some form of motility
- Life cycles vary
  - Most propagate by simple asexual cell division of the active feeding cell (trophozoite)
  - Many undergo formation of a cyst
  - Others have a complex life cycle that includes asexual & sexual phases

Entamoeba histolytica
- Alternates between a large trophozoite, motile by means of pseudopods, & a smaller, non-motile cyst
- Trophozoite has a large nucleus and lacks most other organelles
- Humans are the primary hosts
- Ingested
- Carried by 10% of world population
**Entamoeba histolytica**
- Cysts are swallowed & arrive at the small intestine; alkaline pH & digestive juices stimulate cyst to release 4 trophozoites
- Trophozoites attach, multiply, actively move about & feed
- Asymptomatic in 90% of patients
- Amoeba may secrete enzymes that dissolve tissues & penetrate deeper layers of the mucosa
- Result: dysentery, abdominal pain, fever, diarrhea & weight loss

**Flagellate Diseases**

**Amoebic Brain Infections**
- Caused by *Naegleria fowleri* & *Acanthamoeba*
- Ordinarily inhabit standing water
- Primary acute meningoencephalitis is acquired through nasal contact with water or traumatic eye damage
- Infiltration of brain is usually fatal
- Several cases reported in Arizona in 2007

**Trichomonas vaginalis**
- Causes trichomoniasis
- Reservoir is human urogenital tract
- 50% of infected are asymptomatic
- Strict parasite, cannot survive long outside of host
- 3 million cases yearly, a top STI
- Female symptoms - foul-smelling, green-to-yellow discharge; vulvitis; cervicitis; urinary frequency and pain
- Male symptoms - urethritis, thin, milky discharge, occasionally prostate infection
- Treat with metronidazole

**Giardia lamblia**
- Pathogenic flagellate
- Unique symmetrical heart shape
- Cysts are small, compact, and multinucleate; can survive for 2 months in the environment
- Cysts enter duodenum, germinate, & travel to jejunum to feed & multiply
- Causes giardiasis – diarrhea, abdominal pain
- Treatment: quinacrine or metronidazole
- Agent is killed by boiling, ozone, & iodine
**Giardia lamblia**

- Trophozoite
- Cyst
- Nuclei
- Ventral depression

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**Hemoflagellates**

- Live in blood & tissues of human host
- Obligate parasites
- Cause life-threatening and debilitating zoonoses
- Spread by blood-sucking insects that serve as intermediate hosts
- Acquired in specific tropical regions
- Have complicated life cycles & undergo morphological changes

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**Trypanosoma**

- Distinguished by their infective stage, trypomastigote is an elongate, spindle-shaped cell with tapered ends, eel-like motility
- 2 types of trypanosomiasis
  - *T. brucei* - African sleeping sickness
  - *T. cruzi* - Chagas disease - endemic to Central and South America

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**Trypanosoma brucei**

- Causes African Sleeping Sickness
- Spread by tsetse flies
- Harbored by reservoir mammals
- Biting of fly inoculates skin with trypansome, which multiplies in blood & damages spleen, lymph nodes & brain
- Chronic disease symptoms are sleep disturbances, tremors, paralysis & coma
- Treatment before neurological involvement: melarsoprol, eflornithine
Trypanosoma cruzi

- Causes Chagas disease
- Reduvius bug (kissing bug) is the vector
- Infection occurs when bug feces is inoculated into a cutaneous portal
- Local lesion, fever, and swelling of lymph nodes, spleen, and liver
- Heart muscle and large intestine harbor masses of amastigotes
- Chronic inflammation occurs in the organs (especially heart and brain)
- Treatment: nifurtimox and benzonidazole

Leishmania

- Leishmaniasis is a zoonosis transmitted among mammalian hosts by female sand flies that require a blood meal to produce eggs
- Infected macrophages carry the pathogen into the skin & bloodstream, giving rise to fever, enlarged organs & anemia
- Kala azar is the most severe & potentially fatal form
- Treatments: antimony, amphotericin B

Apicomplexan parasites

- Sporozoans
- Lack locomotor organelles in the mature state
- Alternate between sexual & asexual phases & between different animal hosts
- Most form specialized infective bodies that are transmitted by arthropod vectors, food, water, or other means
  - Plasmodium
  - Toxoplasma
  - Cryptosporidium

Plasmodium

- Causes malaria
- Female Anopheles mosquito is the vector
- Obligate intracellular sporozoan
- 4 species: *P. malariae, P. vivax, P. falciparum & P. ovale*
- 300-500 M new cases each year
- 2 M deaths each year
Plasmodium

- Infective form for humans (sporozoites) enters blood with mosquito saliva, penetrate liver cells, multiply, and form hundreds of merozoites, which multiply in & lyse RBCs
- Symptoms include episodes of chills-fever-sweating, anemia, and organ enlargement
- Therapy is chloroquine, quinine or artemisinin

Toxoplasma gondii

- Obligate apicomplexan parasite with extensive distribution
- Lives naturally in cats that harbor oocysts in the GI tract
- Acquired by ingesting raw meats or substances contaminated by cat feces
- Most cases of toxoplasmosis go unnoticed except in fetus & AIDS patients which can suffer brain & heart damage
- Treatment: pyrimethamine & sulfadiazine

Cryptosporidium

- An intestinal pathogen
- Infects a variety of mammals, birds, and reptiles
- Exists in tissue and oocyst phases
- 1990s – 370,000 cases in Milwaukee, WI, due to contaminated water; filtration required for removal
- Ingestion of oocysts gives rise to sporozoites that penetrate intestinal cells
- Causes gastroenteritis, headache, sweating, vomiting, abdominal cramps, diarrhea
- AIDS patients may suffer chronic persistent diarrhea
- No effective drugs

Helminths

- Disease results from worms feeding on and migrating through tissues, accumulation of worms, and worm products
- Diagnosis based on blood cell count (eosinophilia), serological tests; eggs, larvae, or adult worms in feces; sputum, urine, blood, or tissue biopsies
- Anthelmintic drugs may suppress a helminthic metabolic process that differs from the human process, inhibit the worm's movement, prevent it from holding position, and act locally in the intestine
Blood flukes: Schistosomes

- Schistosomiasis is the 2nd most prominent parasitic disease
- Adult flukes live in humans & release eggs into water; early larva develops in freshwater snail into a 2nd stage larva
- This larva penetrates human skin & moves into the liver to mature; adults migrate to intestine or bladder & shed eggs, giving rise to chronic organ enlargement