MEDICAL PARASITOLOGY

PROTOZOANS

I. Amoeba
   A. *Entamoeba histolytica* - transmitted through ingestion of cysts in the feces.
      - Symptoms include severe dysentery with blood and mucus in the feces.
   B. *Acanthamoeba spp.* - free-living amoeba found in water.
      - Can cause keratitis and possibly encephalitis. - probably enters via mucous membrane
   C. *Balamuthia spp.* - free living amoeba found in water. - probably enter via mucous membrane
      - Can lead to encephalitis

II. Flagellates
   A. Giardiasis - transmitted through ingestion of encysted forms in the feces.
      1. *Giardia lamblia*
         - Can cause severe and persistent diarrhea that can last for weeks.
   B. Trichomoniasis - sexually transmitted, a venereal disease
      1. *Trichomonas vaginalis*
         - Can cause urinary and genital tract infections. This can cause irritation and itching. - Sometimes responsible for premature births.
   C. Hemoflagellates
      1. Trypanosomiasis
         a. African Sleeping Sickness - transmitted by the tsetse fly.
            i. *Trypanosoma gambiense*
            ii. *Trypanosoma rhodesiense*
               - Symptoms include decreased physical activity, decreased mental acuity, coma and possibly death.
Note: The trypanosomes will vary their surface antigens, thus making it difficult if not impossible to manufacture effective vaccines.

b. Chagas Disease-transmitted by the kissing bug. – Found mostly in South America
   i. *Trypanosoma cruzi*
      - Can cause loss of involuntary muscular contraction of the esophagus and stomach. – Can also cause heart damage.

2. Leishmaniasis-transmitted by the sand fly.
   a. *Leishmania donovani*
   b. *Leishmania braziliensis*
   c. *Leishmania tropica*
      - Can lead to secondary infections and symptoms such as hepatosplenomegaly, lymphadenopathy, anemia and weakness. This protozoan can attack macrophages. Skin manifestations which include crusty scabs and shallow ulcerations are possible. Dogs can act as reservoirs.

III. Ciliates

A. Ciliate Dysentery (balantidiasis)-transmitted through the ingestion of encysted forms in the feces.
   1. *Balantidium coli*
      - Only known ciliate to be pathogenic to humans. – Can lead to diarrhea, nausea and weight loss. Pigs can act as reservoirs.

IV. Sporozoa (Apicomplexans)-Special organelles at tips (apices) of cells contain enzymes used to penetrate host tissues.

A. Malaria-transmitted by the *Anopheles* mosquito.
   1. *Plasmodium vivax*
   2. *Plasmodium malariae*
3. *Plasmodium falciparum*

- *Plasmodium* enters erythrocytes and undergoes schizogony (multiple fission). Fever and chills are a result of toxic metabolites that are released as RBC’s rupture. Symptoms lead to the shedding of clothes. Resultant exposures of skin surfaces provide a favorable opportunity for mosquitoes to procure a blood meal. This enhances the transmission of the parasite back to the mosquito salivary glands for completion of the *Plasmodium* life cycle.

B. Toxoplasmosis-can be carried and transmitted by domestic cats. Can also acquire by consuming cysts in undercooked meats.

1. *Toxoplasma gondii*

   - Can cause teratogenic effects on fetus. *Toxoplasma* can also be responsible for causing convulsions, brains damage, blindness and death.

C. Pneumocystis Pneumonia-found in healthy human lungs. Disease in those that are immunocompromised.

1. *Pneumocystis carinii (jiroveci)*

   - Organism infects the alveolar spaces and forms thick-walled cysts in the lungs.

D. Cryptosporidiosis-transmitted in feces of cows, rodents, dogs and cats.

1. *Cryptosporidium spp.*

   - In healthy individuals the symptoms are mostly mild. In those that are immunocompromised one can experience severe diarrhea.

**HELMINTHS (Worms)**

I. Flatworms (Platyhelminthes)

A. Flukes (Trematodes)-flat, leaf-shaped bodies

1. Lung Fluke-encysted larvae in raw crayfish are consumed by human host.

   a. *Paragonimus westermanni*

The adult in the lungs will lay eggs. The eggs migrate up the respiratory passage to the laryngopharynx where they are swallowed and enter the intestine. The eggs are excreted in the feces and enter water. The eggs
hatch into larvae and will enter a snail for further development. The larvae will leave the snail and enter a crayfish. Humans will eat encysted larvae in uncooked crayfish. Now in the human G.I., the larvae will burrow through the intestinal wall and through the diaphragm and enter the lungs. The larvae mature into the egg laying adults. Symptoms include chronic bronchitis. Involvement of other organs including the liver and brain may cause further damage.

2. Blood Fluke (Schistosomiasis or Bilharzia)- in water, larvae burrow through the skin of the host and enter capillaries. They will work their way into the veins of the liver or urinary bladder. The larvae will mature into adults. The body defense against the eggs from the adults will cause the damage. Eggs are excreted into water with the feces or urine. The eggs hatch into larvae which invade snails for further maturation. The larvae will leave the snails and burrow into humans.

   a. *Schistosoma mansoni* (liver)- liver disease (swelling).

   b. *Schistosoma japonicum* (urinary bladder)- can cause bladder cancer.

   Note: The schistosomes can hide from host immune cells by covering themselves with host proteins.

B. Tapeworms (Cestodes)- the scolex is a special head with hooks and suckers. Segments called proglottids extend from the scolex. Each proglottid is a reproductive unit with both male and female parts (monocious).

1. Humans as Definitive Host

   a. Beef Tapeworm- the human host consumes encysted larvae in undercooked beef. The larvae mature into adults in the human intestines. Proglottids with eggs break off from the worm and exit the body in the feces. Cows grazing on pastures will consume the proglottids laden with eggs. The eggs now hatch into larvae within the cows and migrate to muscle. Humans can eat the encysted live larvae in undercooked beef and the cycle repeats. The majority of these
infestations are asymptomatic. However, symptoms can include diarrhea, hunger, weight loss, irritability and nausea.

i. *Taenia saginata*

2. Humans as Intermediate Host

   a. Hydatidosis (Cystic Hydatid Disease)-human hands contaminated with eggs in dog feces or dog saliva are swallowed. Eggs hatch into larvae. The larvae can migrate to the liver or the lungs, where they can form very large hydatid cysts. Protein metabolites made by the larvae collect in the cysts. These proteins can cause shock and perhaps death if the cysts rupture.

   i. *Echinococcus granulosus*

II. Roundworms (Aschelminthes)

A. Nematodes

1. Intestinal Nematodes

   a. Eggs Infective

   i. *Ascaris lumbricoides*-eggs are excreted in human feces and can survive long periods in the soil until ingested by a host. Eggs hatch into larvae. The larvae migrate to the lungs via the bloodstream. They are swallowed in the throat area. In the intestines the larvae mature into adults and produce eggs. Larvae remaining in the lungs can lead to inflammation and blockage. Sometimes the larvae migrate to the liver resulting in abscesses. The adult worms in the intestines can exit and appear through openings in the mouth, anus, nose etc. Peritonitis and malnutrition are possible symptoms of infestation. The worms display sexual dimorphism as the males are smaller with curled tails.

   

   *Ascaris lumbricoides*

   ii. *Enterobius vermicularis*-eggs deposited in the perianal area can contaminate hands when the area is scratched. The most common symptom is an itchy anus.
b. Larvae Infective

i. Hookworm (North American)-hookworm larvae typically gain access to the human host by burrowing in through the skin in the feet. The larvae in the bloodstream travel to the lungs. The larvae work their way up to the throat area where they are swallowed. They become adults in the small intestine. Eggs are excreted in feces. The eggs hatch into larvae in the soil. The larvae eat bacteria and other microorganisms until they come in contact with another host. The cycle is repeated. The adult worms in the intestines feed on blood and tissues. This can lead to anemia and lethargic behavior.

*Necator americanus*

ii. Trichinosis-typically acquired by eating the encysted larvae in undercooked pork and not from fecal contamination. In the intestines, the larvae are freed from the cysts and mature into adults. Adults give birth to larvae which can invade tissues. Many infestations are insignificant. Severe cases can be fatal as a result of heart failure, kidney failure and respiratory disorders.

*Trichinella spiralis*

2. Tissue Nematodes (Filaria) - The filarial worms invade subcutaneous tissues and lymphatics. Problems arise as a result of inflammation and scarring.

a. Elephantiasis-the filarial larvae are delivered by a mosquito vector. Swelling and disfiguration occurs as a result of the inflammatory response from dead or dying worms in the lymphatics. This causes obstruction and blockage.

i. *Wucheria bancrofti*

b. River Fever (River Blindness, Onchocerciasis)-the blackfly (*Simulium spp.*) acts as the vector. The adults are found in subcutaneous nodules. Dead or dying larvae can cause an itchy skin rash but can also be responsible for ocular lesions that can cause blindness.
i.  *Onchocerca volvulus*

c.  Guinea Worm (Dracunculiasis)-picked up by consuming contaminated water. Larvae in contaminated water migrate to subcutaneous tissues. Mature worms burrow to skin surface to release eggs. The resultant burning and pain drive infected individuals into the water for relief. Eggs now in the water become larval forms. The cycle now repeats.

i.  *Dracunculus medinensis*

d.  Dog “Heartworm”-larvae are transmitted by a mosquito vector. Adult worms in the heart and large arteries of the lungs may cause heart failure. Dogs may carry the infection for several months or years. A sudden and unexpected heart attack can be fatal.

i.  *Dirofilaria immitis*