Microbiology

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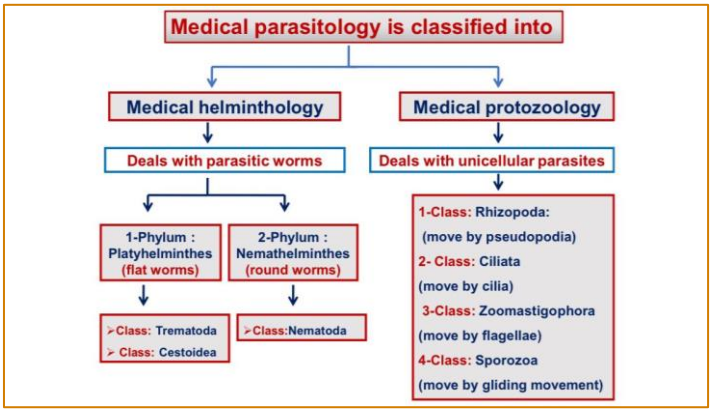
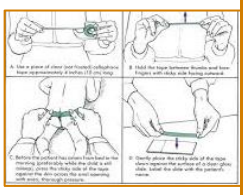
Parasitic Helminths



- **Nematode (Roundworm) Infections**

➢ ***Ascaris lumbricoides (Human Roundworm)***

- ✓ Infection: Eggs are resistant to environmental conditions.
- ✓ Eggs: 75x40 µm, brownish with a thick mamillated shell.
- ✓ Development: Eggs take 2-3 weeks to become infective (contain larva).
- ✓ Size:
  - Adult female: 20–35 cm
  - Adult male: 15–30 cm
- ✓ Transmission: Humans can also be infected by pig roundworm (Ascaris suum), which is indistinguishable from Ascaris lumbricoides (human roundworm). . It is unknown how many people worldwide are infected with Ascaris suum.
- ✓ Pathology:
  - If present in high numbers, adult worms may cause mechanical obstruction of the bowel and bile and pancreatic ducts.
  - Worms tend to migrate if drugs such as anesthetics or steroids are given, leading to bowel perforation and peritonitis, anal passage of worms, vomiting, and abdominal pain.
  - Larvae migrating through lungs induce an inflammatory response (pneumonitis), especially after second infection, leading to bronchial spasm, mucus production, and Löffler syndrome (cough, eosinophilia, and pulmonary infiltrates).



➢ ***Enterobius vermicularis (Pinworm)***

- ✓ Size: Female pinworms ~10 mm, male pinworms ~3 mm.
- ✓ Infection: Common in children, more frequent in temperate than tropical climates.
- ✓ Eggs: Football-shaped, 50–60 µm, visible larvae inside.
- ✓ Diagnosis: Scotch Tape technique to collect eggs from perianal area.
- ✓ Symptoms: Perianal pruritus, especially at night (caused by a hypersensitivity reaction to the eggs that are laid around the perianal region by female worms, which migrate down from the colon at night).

➢ ***Trichuris trichiura (Whipworm)***

- ✓ Size: Female whipworms ~30–50 mm, male whipworms smaller.
- ✓ Shape: Anterior end slender; posterior end thicker (whip-like appearance).
- ✓ Eggs: 50 µm with distinct polar plugs.
- ✓ Transmission: Eggs become infective after about 3 weeks of incubation in moist, shady soil.
- ✓ Habitat: Colon, where worms mate and release eggs that pass out with feces.

- ***Ancylostoma duodenale and Necator americanus (Hookworms)***
  - ✓ Size: Female hookworms ~10 mm, males slightly smaller.
  - ✓ Eggs: Oval, 60x40 µm, hatch into rhabditiform larvae, which transform into infective filariform larvae.
  - ✓ Transmission: Larvae penetrate skin or mucous membranes, typically through barefoot contact with contaminated soil.
  - ✓ Pathology:
    - Larvae cause skin irritation ("ground itch").
    - In the intestine, adult worms attach to intestinal villi and feed on blood, leading to anemia.
    - Symptoms: Abdominal discomfort, diarrhea.

- ***Strongyloides stercoralis (Threadworm)***
  - ✓ Size: Adult females ~2 mm long.
  - ✓ Reproduction: Parthenogenic (females reproduce without males).
  - ✓ Eggs: Laid within the intestine, hatch into larvae that are passed into feces.
  - ✓ Transmission: Some larvae develop into free-living male and female worms in the soil.
  - ✓ Pathology: Can cause chronic intestinal and tissue infections, and developmental adaptation to sustain population.

- ***Trichinella spiralis (Trichinosis)***
  - ✓ Transmission: Acquired by eating raw or improperly cooked pork infected with the larval stage.
  - ✓ Infection: Larvae molt into adult worms in the small intestine, release larvae which circulate in the blood and encyst in muscle tissue.
  - ✓ Pathology:
    - Early symptoms: Diarrhea, abdominal pain, nausea.
    - Later symptoms: Muscle pain and weakness from encysted larvae.

- ***Tissue Nematodes (Filariasis)***
  - ✓ Family Filariidae:
    - Thread-like worms that infect the lymphatic system or connective tissue.
    - Require intermediate hosts (e.g., mosquitoes, flies).
  - ✓ Examples:
    - *Wuchereria bancrofti* (Mosquito)
    - *Brugia malayi* (Mosquito)
    - *Loa loa* (Eye worm – transmitted by Chrysops flies)
    - *Onchocerca volvulus* (River blindness – transmitted by black flies)

- ***Lymphatic Filariasis (Elephantiasis)***
  - ✓ Transmission: Microfilariae (larval form) are carried by mosquitoes.
  - ✓ Pathology:
    - Lymphatic obstruction causes fluid to accumulate in tissues, leading to massive swelling (lymphedema), especially in limbs.
    - Severe cases can cause thickening of skin and tissues resembling an elephant's leg. [Elephantiasis]

- ***Platyhelminthes (Flatworms)***

  Flattened in cross section and are hermaphroditic. All medically important species belong to two classes:

A. *Cestoda (Tapeworms)*

- ✓ Characteristics: Hermaphroditic, lack digestive tract, complex life cycles.
- ✓ Acquisition: Infection through ingestion of undercooked meat (containing cysts).
- ✓ Examples:
  - Taenia saginata (Beef tapeworm)/ Taenia solium (Pork tapeworm)
  - Echinococcus granulosus (Hydatid cyst)
  - Diphyllobothrium latum (Broad fish tapeworm)

1. *Taenia saginata (Beef Tapeworm)*

- ✓ Size: Grows 4-8 m in length, 6-7 mm in width, with about 1000 segments.
- ✓ Transmission: Acquired by ingesting undercooked beef.
- ✓ Symptoms: Minimal, often asymptomatic.

2. *Taenia solium (Pork Tapeworm)*

- ✓ Size: Similar to T. saginata but slightly shorter and with a modified scolex.
- ✓ Cysticercosis: Involves the presence of larval cysts in human tissues (especially muscles and brain), leading to potential neurological issues such as epilepsy.

3. *Echinococcus granulosus (Hydatid Cyst)*

- ✓ Size: Adult tapeworm about 5 mm.
- ✓ Transmission: Eggs ingested from dogs or other canids.
- ✓ Pathology: Cysts develop in the liver and lungs, leading to hydatid disease.

4. *Diphyllobothrium latum (Broad Fish Tapeworm)*

- ✓ Size: Can exceed 10 m in length.
- ✓ Transmission: Acquired from improperly cooked or raw fish.
- ✓ Symptoms: Growth of tapeworm in the intestine, releasing millions of eggs daily.

B. Trematodes (Flukes) leaf shaped

- ✓ Life Cycle:
  - Fertilization occur either cross between 2 worms or self fertilization (hermaphroditic).
  - All trematodes undergo a complex asexual reproductive phase .
  - larval stage in a snail (their 1 st intermediate host).
  - eggs are oval, operculated, pass to fresh water, hatch and release a ciliated snail seeking the 1 st larval form –meracedium-swims to find its snail host and develops to the final larval stage –cercariae (infective stage)-these swarm out to penetrate a 2 nd intermediate host and may encyst as metacercariae (infective stage).
  - Infective stage : eggs
  - Intermediate stage: larval stage.
- ✓ Common Trematodes:
  - *Clonorchis sinensis* (Chinese liver fluke)
  - *Fasciola hepatica* (Sheep liver fluke)
  - *Paragonimus westermani* (Lung fluke)
  - *Schistosoma species* (Blood flukes)

1. ***Schistosomiasis***

- ✓ Species:
  - *S. mansoni*: Inferior mesenteric veins of the large intestine.
  - *S. japonicum*: Inferior and superior mesenteric veins of the small intestine.
  - *S. haematobium*: Veins of the urinary bladder.
- ✓ Pathology:

- The most significant pathology is associated with the schistosome eggs, not the adult worms. Female schistosomes can lay hundreds or thousands of eggs per day within the venous system. When eggs are released, many are swept back into the circulation and lodge in the liver (S mansoni and S japonicum) or urinary bladder (S haematobium), while other eggs are able to reach the lumen of the intestine and pass out with the feces or urine.
- A granulomatous reaction surrounds the eggs and leads to fibrosis of the liver with S mansoni and japonicum. In chronic cases, blood flow to the liver is impeded, which leads to portal hypertension, accumulation of ascites in the abdominal cavity, hepatosplenomegaly, and esophageal varices.
- With S haematobium infections, there is urinary tract involvement: urethral pain, increased urinary frequency, dysuria, hematuria, and bladder obstruction leading to secondary bacterial infections.

- Key concepts
  - Most intestinal helminthic infections are fairly benign, except when worm burdens are high and numbers of adult worms in the intestine reach the hundreds.
  - In intestinal worm infections, the intestine usually harbors the adult stage of the parasite, except for Strongyloides, Trichinella, and Taenia solium, which not only reside in the intestine as adults but also have larvae capable of migrating throughout tissues.
  - In the case of the three most common intestinal infections (whipworm, hookworm, and ascariasis), the eggs require incubation in the soil for several days or weeks in warm, tropical climates.
  - Most infections are acquired by ingestion of the egg or larval stage, with the exception of the hookworms, human threadworms, and schistosomes, whose larvae penetrate the skin, and the filarids, which are vectorborne

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