PARASITES

Parasitic Classification, Structure, and Replication

- intestinal and urogenital protozoa,
- blood and tissue protozoa,
- nematodes,
- trematodes,
- cestodes,
- arthropods

Protozoa – life cycle

- active (trophozoite)
- inactive stage-cyst - resistant stage of the parasite - infective to its human host.
- to reach a new host - transferred mechanically (carrier or by some intermediaries (insect-house-flies
- asexual method - sexual method or encystment
- sexual method - often in a different host (Plasmodia)

Protozoa - Flagellates:

- one or more flagella - locomotion
- In some cases - undulating membrane (Trypanosoma)
- intestinal and genitourinary flagellates :

  Giardia,

  Trichomonas,

  Dientamoeba,

  Chilomastix,
- blood and tissue flagellates :

  Trypanosoma,

  Leishmania,
- They reproduce asexually by binary fission.

Giardia

- intestinal flagellates
- *Giardia intestinalis*

cysts - can survive several months in cold water.

- ingestion of cysts - contaminated water, food, or by the fecal-oral route (hands or fomites)
- small intestine - excystation releases trophozoites
- Trophozoites –multiply - in the lumen of the proximal small bowel (free or attached to the mucosa by a ventral sucking disk .
- Encystation occurs as the parasites transit toward the colon.
- cyst - found in nondiarrheal feces
- cysts - infectious
- person-to-person transmission is possible.

Trichomonas

- genitourinary flagellates
- Incubation Period : 5 to 28 days
- No known cystic form
- May survive in a host for 2+ years
- **Morphology**
- *T. vaginalis* : pear-shaped protozoan
- Four flagella – movement, fifth - help with direction
- High motility - pathogenicity
- Reproduces through binary fission

Trypanosoma

T. gambiense

- massive stimulation of immune system and complement-mediated lysis of host cells (gives characteristic anemia)
- Generalized pain, weakness, cramps and swelling of neck lymph nodes (Winterbottom sign)
- invade all organs
- latter leads to apathy, mental dullness, tremors, convulsions and sleepiness, coma
- rapid weight loss
- Malnutrition
- heart failure,
- pneumonia

T. brucei rhodesiense

- no coma or nervous system symptoms (patient dies before these can develop)

T. cruzi - ***Rhodnius prolixus***"kissing bugs"

- Chagas Disease
- chronic symptoms : various digestive problems, weakening the heart muscle, cell lysis

Leishmania

- Human infection is caused by about 21 of 30 species that infect mammals:

***L. donovani* complex :**

- (*L. donovani*, *L. infantum*, and *L. chagasi*);

***L. mexicana* complex**

- (*L. mexicana*, *L. amazonensis*, and *L. venezuelensis*);
- morphologically indistinguishable

- 2 forms
- **cutaneous leishmaniasis**
  -one or more sores on their skin (volcano)
  - painless or painfu
- **visceral leishmaniasis (kala-azar)**
  - fever, weight loss, and an enlarged spleen and liver
    (spleen is bigger than the liver).
  - anemia, low white blood cell count, and low platelet count
  - important opportunistic infection - HIV.

Amoeba

- typically amoeboid

  Entamoeba,

  Endolimax,

  Iodamoeba,

  Naegleria,

  Acanthamoeba, etc.

shapeless mass of moving cytoplasm - divided in to granular endoplasm and clear ectoplasm.

- They move by pushing out the ectoplasm to form pseudopodia (false feet) into which the endoplasm then low.
- Amoebae reproduce asexually by simply dividing into two (binary fission)

Entamoeba

- *Entamoeba histolytica* -intestinal and extraintestinal infections
- Cysts and trophozoites are passed in feces

Naegleria

- lakes, swimming pools, tap water, and heating and air conditioning units
- acute, usually lethal, central nervous system (CNS) disease - primary amebic meningoencephalitis (PAM).

Sporozoa

- super-class
- complex life cycle with alternating
- sexual and
- asexual reproductive phases (two different hosts)
- Coccidia -intacellular parasites,
  asexually = schizogony (merogony)
  sexually = sporogony.
- Class Coccidia
  - Isospora and Toxoplasma
- class Haematozoa
  - malarial parasites- Plasmodium species.

Sporozoa- Toxoplasma

- eating undercooked meat of animals harboring tissue cysts .
- consuming food or water contaminated with cat feces or by contaminated environmental samples (such as fecal-contaminated soil or changing the litter box of a pet cat) .
- blood transfusion or organ transplantation .
- transplacentally from mother to fetus .

Toxoplasmosis

- Usually asymptomatic
- 10% - 20% ***cervical lymphadenopathy*** + flue like symptoms
- Clinically selflimiting – reactivation in IDS, in gravidity

Toxoplasma gondii - i.c. parasite

- Infiects different warm-blood annimals
- Cat is host for sexual stages of Toxoplasmy gondii (schisonts) – main source
- 3 stages
  – tachysoit (trophozoit) – quick multiplication and destruction of the invaded tissue –
  bradysoit – slowly multipliing in tissue cysts
  – sporosoit (male and female gamonts) in oocysts – in cat excrements

Sporozoa- Toxoplasma - Diagnosis

- **Observation of parasites** - **bronchoalveolar lavage** material from immunocompromised patients, **lymph node biopsy**.
- **Isolation** - from **blood** or other body fluids, by intraperitoneal inoculation into mice or tissue culture. The mice should be tested for the presence of *Toxoplasma* organisms in the peritoneal fluid 6 to 10 days post inoculation; if no organisms are found, serology can be performed on the animals 4 to 6 weeks post inoculation.
- **Detection - PCR**, - detecting congenital infections in utero.
- **Serologic testing is the routine method of diagnosis**.

Sporozoa- Plasmodium

- *P. falciparum*,
- *P. vivax*,
- *P. ovale*
- *P. malariae*

Malaria

- symptoms
- non-specific
- untreated malaria -may be rapidly (<24 hours) fatal,
- history of exposure (mostly: past travel or residence in disease-endemic areas).
- fever and chills, headache, myalgias, arthralgias, weakness, vomiting, and diarrhea.
- splenomegaly, anemia, thrombocytopenia, hypoglycemia, pulmonary or renal dysfunction, and neurologic changes.
- *P. falciparum* -to severe, potentially fatal forms with central nervous system involvement (cerebral malaria), acute renal failure, severe anemia, or adult respiratory distress syndrome.
- *P. vivax* -splenomegaly (with, rarely, splenic rupture),
- *P. malariae* - nephrotic syndrome.

Classification of Parasitic Helminths

- **Helminths**
- *A) Nemathelminthes*
- **Nematoda(Round Worms)**
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- *B) Platyhelminthes*
- **1)Cestoda(Tapeworms)**
- **2)Trematoda(Flukes)**

Nematodes

- Their body is elongated, cylindrical and unsegmented. Sexes are separate (diecious). They also lack hooks and suckers.
- They possess the complete alimentary canal and body cavity. Examples are:
- **1. Intestinal**
- i. **Small intestine only**: *Ascaris lumbricoides* (Common round worm), *Ancyclostoma duodenale* (The old world hook worm), *Necator americanus* (American hookworm)
- ii. **Caecum and vermiform appendix:** *Enterobius vermicularis* (Threadworm or pin worm), *Trichuris trichuria* (Whipworm).
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- **2. Somatic (inside the tissues and organs)**
- **i. Lymphatic system:** *Wuchereria bancrofti, Brugia malayi*
- **ii. Subcutaneous tissue:** *Onchocerca volvulus, Dracunculus medinensis*
- **iii. Lungs:** *Strongyloides stercoralis*
- **iv. Conjunctiva:** *Loa loa*

Nematodes- *Ascaris lumbricoides*

- Adult females: 20 to 35 cm;
- adult male: 15 to 30 cm

Ascaris lumbricoides

- **Laboratory Diagnosis:**
  Microscopic identification of eggs in the stool is the most common method for diagnosing intestinal ascariasis. The recommended procedure is as follows:
- Collect a stool specimen.
- Fix the specimen in 10% formalin.
- Concentrate using the formalin–ethyl acetate sedimentation technique.
- Examine a wet mount of the sediment.
- **Diagnostic findings**
- Microscopy
- Macroscopy
- Morphologic comparison with other intestinal parasites

Nematodes- *Enterobius vermicularis*

- Enterobiasis
- asymptomatic.
- perianal pruritus, especially at night, which may lead to excoriations and bacterial superinfection.
- Occasionally, invasion of the female genital tract with vulvovaginitis and pelvic or peritoneal granulomas can occur.
- Other symptoms include anorexia, irritability, and abdominal pain.
- **("Scotch test", cellulose-tape slide test)**

Nematodes- *Dracunculus medinensis*

- guinea worm disease

- The female guinea worm induces a painful blister
- after rupture of the blister, the worm emerges as a whitish filament
- in the center of a painful ulcer which is often secondarily infected.

Cestodes

- tape-like,
- segmented
- hermaphrodite organism
- suckers in their head and in some species also hooks that attach he tapewor to its host
- consists of a head (scolex) and many proglottids.
- Alimentary canal and body cavity are absent.
- *Diphyllobothrium, Taenia, Echinococcus, Hymenolepsis, etc*

Cestodes – Taenia

- *Taenia saginata* (beef tapeworm),
- *T. solium* (pork tapeworm)
- *T. asiatica* (Asian tapeworm)

Trematodes

- leaf-like
- unsegmented
- Sexes are not separate (except Schistosomes-diecious).
- don’t have hooks and suckers
- Alimentary canal -present but is not complete (anus absent).
- The body cavity is absent.
- ***Schistosoma****, Gastrodiscoides, Fasciolopsis, Fasciola, Clonorchis, Heterophyes*, etc.

Trematodes- *Schistosoma*

- *Schistosoma haematobium,*
- *S. japonicum,*
- *S. mansoni.*

Collect stool

- first step - collect a sample.
- stool - into a sample container – without contamination
- samples from 4-8 different days should be collected

Separate fecal matter from parasites and parasites eggs

- fecal matter needs to be separated from the parasites and parasite eggs
- centrifuges…multiple cycles - to increase concentration of all the parasites and ova.

Separate fecal matter from parasites and parasites eggs

Concentration procedure separate parasites from fecal debris and increase the chances of detecting parasitic organisms when these are in small numbers.

- ***Flotation techniques*** - solutions have higher specific gravity than the organisms -the organisms rise to the top and the debris sinks to the bottom.
- ***Sedimentation techniques*** - solutions of lower specific gravity than the parasitic organisms, thus concentrating in the sediment.

Polyvinyl alcohol (PVA) containing the fixative mercuric chloride is considered the "gold standard" for the fixation of ova and parasites in the preparation of permanently stained smears of stool specimens.

Thank you

- Sources:
- Kompanikova et all. Special microbiology basic laboratory tests.
- Murray et all. Medical microbiology. 7th edition