### **Protozoal Infections**

By: Nader Alaridah MD, PhD





### INTESTINAL PROTOZOAN INFECTIONS

#### GIARDIA LAMBLIA (INTESTINAL FLAGELLATE)

- Giardia lamblia (also referred to as Giardia duodenalis or Giardia intestinalis) is the causative agent of giardiasis and is the only common pathogenic protozoan found in the duodenum and jejunum of humans.
- Giardia exists in two forms: the trophozoite and the cyst forms.

## Giardia lamblia : Morphology

- The trophozoite of G lamblia is a heart-shaped organism, has four pairs of flagella, 2 nuclei with prominent central karyosome, 2 axostyles and is approximately 15 μ m in length.
- A large concave sucking disk on the ventral surface helps the organism to adhere to intestinal villi. As the parasites pass into the colon, they typically encyst, and the cysts are passed in the stool.
- The swaying or dancing motion of the trophozoits in fresh preparations is unmistakable .



- Cysts are found in the stool –often in enormous numbers. As the parasites pass into colon they typically encyst.
- They are ellipsoid, thick-walled, highly resistant, and 8–14 μ m in length; they contain two nuclei as immature forms and four as mature cysts.



## Pathology and Pathogenesis

- Giardia lamblia is usually only weakly pathogenic for humans.
- Cysts may be found in large numbers in the stools of entirely asymptomatic persons.
- In some persons, however, large numbers of parasites attached to the bowel wall may cause irritation and low-grade inflammation of the duodenal or jejunal mucosa, with consequent acute or chronic diarrhea associated with crypt hypertrophy, villous atrophy or flattening, and epithelial cell damage.

### Transmission

- Humans are infected by ingestion of fecally contaminated water or food containing giardia cysts or by direct fecal contamination, as may occur in day care centers, refugee camps, and institutions, or during oral—anal sex.
- Epidemic outbreaks have been reported at resorts, where overloading of sewage facilities or contamination of the water supply has resulted in sudden outbreaks of giardiasis.
- Cysts can survive in water for up to 3 months



### GIARDIASIS: CLINICAL ASPECTS

- The spectrum varies from asymptomatic carriage to severe diarrhea and malabsorption. Subclinical infections common in endemic areas.
- In acute outbreaks , Stools may be watery, semisolid, greasy, bulky, and foul smelling at various times during the course of the infection.
- The diagnosis of giardiasis is made by finding the cyst in formed stool or the trophozoite in diarrheal stools, duodenal secretions, or jejunal biopsy specimens.
- Commercially available, enzyme immunoassays( EIAs) detect Giardia antigen in stool

### Giardiasis Treatment

- Quinacrine and metronidazole are effective (70%-95%) and are preferred for patients capable of ingesting tablets.
- Tinidazole.
- Furazolidone is used by pediatricians.
- Close contacts should be examined

# CRYPTOSPORIDIUM (INTESTINAL SPOROZOA)

- Cryptosporidium species, typically C hominis, C parvum can infect the intestine in immunocompromised persons (eg, those with AIDS) and cause severe, intractable diarrhea.
- They have long been known as parasites of rodents, fowl, rhesus monkeys, cattle, and other herbivores and have probably been an unrecognized cause of self-limited, mild gastroenteritis and diarrhea in humans.
- Cryptosporidium inhabits the brush border of mucosal epithelial cells of the gastrointestinal tract, especially the surface of villi of the lower small bowel



## Clinical aspects

- Clinically, range from self-limited watery diarrhea (immunocompetent) to chronic, severe, non-bloody diarrhea with nausea, vomiting, abdominal pain, and anorexia resulting in weight loss and death (immunocompromised).
- Diagnosis depends on detection of oocysts in fresh stool samples.
- Stool concentration techniques using a modified acid fast stain are usually necessary. stool antigen detection by direct fluorescent antibody or EIA tests are now commercially available.
- Nitozoxanide, a synthetic drug, has been approved for use in all patients over 1 year of age in the United States and is reported to have a cure rate of 72% to 88% by the CDC.

# CYCLOSPORA (INTESTINAL SPOROZOA)

- The life cycle of Cyclospora is similar to that of Cryptosporidium and appears to involve only a single host. Cyclospora, however, differs from Cryptosporidium in that Cyclospora oocysts are not immediately infectious when passed in stools.
- Pathogenesis : Altered mucosal architecture with shortening of intestinal villi due to diffuse edema and infiltration of inflammatory cells leads to diarrhea, anorexia, fatigue, and weight loss.
- when examining stools for oocysts (8–10  $\mu$  m), which are acid-fast positive (reddish).
- Cyclospora infections are treatable with trimethoprimsulfamethoxazole (TMP-SMZ).

# Balantidium coli (Intestinal Cilliated protozoa)

- It causes balantidiasis or balantidial dysentery, is the largest intestinal protozoa of humans.
- The trophozoite is ciliated oval organism 60 X 45  $\mu$  m or larger. It has a steady progression and rotation around the long axis motion.
- Most infections are apparently harmless. However, rarely, the trophozoites invade the large bowel and terminal ileum causing erosions and ulceration.
- Treatment : Oxytetracycline , may be followed by Iodoquinol or Metronidazole.



### Sexually transmitted protozoan infection

# TRICHOMONAS (Urogenital flagellated protozoa)

- Trichomonads are flagellated protozoa with 3-5 anterior flagella.
- Three members of the genus Trichomonas parasitize humans (Trichomonas hominis, Trichomonas tenax, Trichomonas vaginalis) but only T vaginalis is an established pathogen.
- Trichomonas vaginalis cause trichomoniasis in human.
- It is peard- shaped with undulating membrane lined with flaellum and 4 anterior flagella. It is about 5-30 X 2-14 μm. it moves with wobbling or rotating motion.



- Direct contact of T vaginalis with the squamous epithelium of the genitourinary tract results in destruction of the involved epithelial cells and the development of a neutrophilic inflammatory reaction and petechial hemorrhages.
- In females, It causes low-grad inflammation limited to vulva vagina and cervix causing frothy yellow or creamy discharge.
- In males, it may infect the prostate, seminal vesicles and urethra.
- Wet mount examination for motile trophozoites sufficient in most symptomatic cases

Treatment: Topical and systemic Metronidazole.
Tinidazole, Ornidazole are equally effective with fewer side effects

### Blood and tissue protozoan infections

Haemflagellate

# Trypanosoma

# leishmania



Figure 49-8 Characteristic stages of species of *Leishmania* and *Trypanosoma* in human and insect hosts. (Illustration by Nobuko Kitamura.)



African trypanosomiasis : African sleeping sickness American trypanosomiasis (Chagas' disease)



# Morphology

 The morphologically differentiated forms include spindly, uniflagellate stages (trypomastigote, epimastigote, promastigote) and a rounded, amastigote form.





# ANTIGENIC VARIATION

- A unique feature of African trypanosomes is their ability to change the antigenic surface coat of the outer membrane of the trypomastigote, helping to evade the host immune response.
- The trypomastigote surface is covered with a dense coat of variant surface glycoprotein (VSG)
- Each time the antigenic coat changes, the host does not recognize the organism and must mount a new immunologic response



# AFRICAN TRYPANOSOMIASIS

- Is caused by 2 sub spp. :
- T. brucei gambiense :West African trypanosomiasis
- T. brucei rhodesiense: East African trypanosomiasis
- Vector: tsetse fly (Glossina spp.)
- Which is found only in rural Africa
- Glossina palpalis transmits T. b. gambiense
- Glossina morsitans transmits T. b. rhodesiense



# AMERICAN TRYPANOSOMIASIS

- Trypanosoma cruzi (Chagas' disease)
- Zoonosis
- Transmitted by vector : reduviid bugs.
- Reduviid bug defecates while taking a blood meal
- Definitive host:
- Human, dog, cat, rats...etc.
- Habitat in the Definitive host:
- Trypomastigote in blood
- Amstigote in tissue



# LEISHMANIA

- It is a flagellated protozoan
- Life cycle requires two hosts :

a) **vertebrate** ; mammalian host

b) Invertebrate vector ; female sand fly

- Obligate intracellular organism
- Infects primarily phagocytic cells and macrophages
- The incubation period ranges from 10 days to 2 years,





# Transmission

- 1. Bite of sand fly
- 2. Transfusion blood and transplantation
- 3. Mother to baby
- 4. Direct contact; from man to man through nasal secretion.





- Leishmaniasis is divided into clinical syndromes according to what part of the body is affected most.
- 1. Cutaneous Leishmaniasis(L.tropica, Leishmania major)
- 2. Mucocutaneous leishmaniasis(L. braziliensis)
- 3. Visceral Leishmaniasis(L.donovani).





# Plasmodium (Blood sporozoa)

- *Plasmodium* is a genus of parasitic alveolates, many of which cause malaria in their hosts.
- The parasite always has two hosts in its life cycle: <u>Dipteran insect host</u> and a <u>vertebrate host</u>.
- Species:
- 1.P. falciparum
- 2.P. malariae
- 3.P. vivax
- 4.P. ovale
- 5.Plasmodium knowlesi
- **Plasmodium falciparum** is the major species associated with deadly infections throughout the world.

# Mechanism of Infection

- The **vector** for malaria is the <u>female anopheline mosquito</u>.
- When the vector takes a blood meal, sporozoites contained in the salivary glands of the mosquito are discharged into the puncture wound.
- Within an hour, these infective sporozoites are carried via the <u>blood to the liver</u>, where they <u>penetrate hepatocytes</u> and begin to grow, initiating the pre-erythrocytic or primary exoerythrocytic cycle.
- The sporozoites become <u>round</u> or <u>oval</u> and begin dividing repeatedly.
- Schizogony results in large numbers of exoerythrocytic merozoites.
- Once these merozoites <u>leave the liver</u>, they <u>invade the red blood cells</u> (RBCs), initiating the erythrocytic cycle.

- A dormant schizogony may occur in <u>P. vivax and P. ovale organisms</u>, which remain quiescent in the liver.
- These resting stages have been termed hypnozoites and lead to a true relapse, often within 1 year or up to more than 5 years later.

- Once the RBCs and reticulocytes have been invaded, the parasites grow and feed on hemoglobin.
- Within the RBC, the merozoite (or young trophozoite) is vacuolated, ring shaped, more or less ameboid, and uninucleate.
- The excess protein and hematin present from the metabolism of hemoglobin combine to form malarial pigment.
- Once the nucleus begins to divide, the trophozoite is called a **developing schizont**.
- The mature schizont contains merozoites (whose number depends on the species), which are released into the bloodstream.

#### LABORATORY DIAGNOSIS (ALL SPECIES) \*Routine Methods:

- Thick and thin blood films.
- At least 200 to 300 oil immersion fields should be examined on both films before a negative report is issued.
- Stains:
- 1. Giemsa stain.
- 2. Wright's stain.
- 3. Fluorescent nucleic acid stains, such as acridine orange.
- Blood collected using (EDTA) anticoagulant.

#### THERAPY

- Antimalarial drugs are classified according to the stage of malaria against which they are targeted.
- QUINOLINES , ARTEMISININS
- <u>Tetracycline</u>, <u>doxycycline</u>, and <u>clindamycin</u> are used increasingly in combination with other antimalarials to improve their efficacy
- These drugs are referred to as :
- 1. Tissue schizonticides (which kill tissue schizonts).
- 2.Blood schizonticides (which kill blood schizonts).
- 3.Gametocytocides (which kill gametocytes).
- 4.Sporonticides (which prevent formation of sporozoites within the mosquito).

### Tissue protozoa

## Toxoplasma gondii (Tissue sporozoa)

- It is a coccidian protozoa with worldwide distribution that infects wide range of animals and birds but does not appear to cause disease in them.
- The normal final hosts are strictly the cats and its relatives, the only host of which the oocyst-producing sexual stage of toxoplasma can develop.
- When oocysts are ingested can either repeat its sexual life cycle in a cat, orif ingested by a human- can establish an infection in which it can reproduce asexually .Where it open and release sporozoits to duodenum then invade various cells especially macrophages where they form tachyzoits which spread infection to lymph nodes and other organs.
- Latent infections occur with Toxoplasma (parasites in tissue cysts are called bradyzoites).

- It produce either congenital or postnatal toxoplasmosis.
- Congenital infections occur in non-immune mothers during pregnancy.



### The End