PARASITOLOGY (BIOL 460)

UNIT 3

PARASITIC PROTOZOA

The Parasitic Protozoa

The Parasitic Protozoa

↙ ↘

Intestinal & Urogenital

Blood/Tissue

A. **Intestinal**

a. Amoebae

- ***Entamoeba histolytica***
- Only a few strains of this parasite are pathogenic. The infection causes the disease known as **Amoebiasis**.

Distribution

- Many parts of tropical and subtropical Africa, Asia, Mexico, S. America and China, and areas of inadequate sanitation and poor personal hygiene.

Intestinal (cont'd)

Transmission

- By ingestion of infective cysts in food or water contaminated with sewage or hands contaminated with faeces.
- Transmission may also occur by flies feeding on faeces with cysts and subsequently contaminating food

Intestinal (cont'd)

❖Life cycle

- ❖Cysts ingested excyst in the large intestine to produce amoebae which multiply repeatedly, and form single-nucleated cysts which develop into infective forms with four nuclei, and are invasive.
- ❖Cysts formed do not become amoebae again in the same host.

INTESTINAL CONT'D

Life cycle cont'd

- Infective cysts are passed out in faeces and can survive and remain infective for several weeks in sewage and water
- Amoebae passed in faeces are not infective to other people and die rapidly.

INTESTINAL CONT'D

Symptoms and Pathology

- About 90% of those infected develop/show no symptoms/signs
- Pathogenic strains invade the wall of the intestine.
- The amoebae multiply in the submucous layer, forming large-flask-shaped ulcers containing necrotic tissue.

Intestinal (cont'd)

Symptoms and Pathology

- At this stage, there is caused, low abdominal pain and acute attacks of dysentery with blood and mucus in the faeces.
- Development of invasive amoebiasis depends on;
  - The level of immunity
  - The level of nutrition, and
  - The intestinal environment of the host
  - Dysenteric attacks may continue for years, if not treated.

Intestinal (cont'd)

Symptoms and Pathology (cont'd)

- Occasionally, severe intestinal **amoebiasis** may cause overwhelming amoebic colitis which can be fatal.
- Other rare complications include appendicitis and inflammatory masses in the bowel (referred to as **AMOEBOMAS**) and
- amoebic liver abscess (this is when an intestinal ulcer extends to reach a blood vessel and amoebae enter the blood stream and are carried to the liver (and other parts).

INTESTINAL CONT'D

Symptoms and Pathology cont'd

- The symptoms include pain and tenderness in the region of the liver, wasting and a fever associated with chills and night sweats.
- Large and/or multiple abscesses may manifest as jaundice and anaemia.
- Most abscesses form in the right lobe of the liver. Prolonged contact of the skin with pathogenic amoebae or when a liver abscess drains through the skin following rupture, a destructive cutaneous **amoebiasis** may develop.

Intestinal (cont'd)

Prevention and control

- Hand washing after defaecation and before eating.
- Prevention of faecal contamination of water supplies
- Prevention of flies from contaminating food and water by covering these; the flies act as cyst carriers.

Intestinal (cont'd)

Prevention and control cont'd

- Health education on food handling and hygiene
- Not using human faeces as fertilizers for vegetable production
- Soaking vegetables in vinegar for 30 minutes
- Boiling suspected drinking water; cysts killed at 55^{o}C

Intestinal (cont'd)

Laboratory Diagnosis

- Examination of fresh faecal specimen or rectal scraping for motile *E. histolytica* amoebae
- Finding of motile amoebae containing red cells is diagnostic of amoebic dysentery.
- Examination of formed or semi-formed faeces for cysts which may indicate pathogenic or non-pathogenic strain.

Intestinal (cont'd)

- Other tests exist for diagnosis of amoebic liver abscess.
- Species of *Amoeba* that are free living but cause disease when in humans
  - *Naegleria sp* (see appended sheets)
  - *Acanthamoeba sp* (see appended sheets)

B. Flagellates

1 . *Giardia lamblia* (Intestinal flagellate parasite)

- The infection/disease caused by the flagellate protozoan parasite is known as **Giardiasis**

Distribution

- The Tropics and subtropics, and especially where water supplies and the environment are faecally polluted/contaminated.

1 . *Giardia lamblia cont'd*

Transmission

- By ingestion of cysts in water or food contaminated with faeces containing the cysts.
- Humans are the only reservoirs of infection. The cysts are infective right from the time they are passed in faeces.

1 . *Giardia lamblia (cont'd)*

Life cycle

- Ingested cysts excyst (in the upper part of the small intestine) to form flagellates which come to lie on the surface of the cells lining the wall of the duodenum and jejunum
- (part of the small intestine between the duodenum and
- the ileum (distal portion of the small intestine extending from the jejunum to the caecum)).

1 . *Giardia lamblia (cont'd)*

Life cycle cnt'd

- They become attached to the cells by a sucking disc and absorb nutrients through their body surface.
- They multiply rapidly and can invade the bile duct.
- They become detached from the cell linings and are carried down the intestinal tract whilst encysting in the process.
- Infective cysts are passed out in the faeces.

1 . *Giardia lamblia (cont'd)*

Symptoms and Pathology

- Infections may be without symptoms,
- however, the parasites and the toxins they produce may cause abdominal pain, severe diarrhea, vomiting, lethargy (a condition of drowsiness or indifference), weight loss and malabsorption with lactose intolerance.
- Faecal specimens have offensive smell, are bulky and pale-coloured or watery.

1 . *Giardia lamblia cont'd*

Symptoms and Pathology cont'd

- People who have gastro-intestinal disorders or bacterial infection of the intestine appear to be more susceptible to infection.
- Both hypochlorhydria (Deficiency of hydrochloric acid in the gastric juice) and pancreatic disease predispose to giardiasis.

1 . *Giardia lamblia (cont'd)*

Prevention and Control

- Improving sanitation and personal hygiene, and preventing food and water from contamination with faeces containing the cysts.
- Cysts remain infective for several weeks in water and are not killed at 4-6ºC
- The cysts are resistant to concentrations of Chlorine normally used for the treatment of domestic water supplies (just like cysts of *E. histolytica*).

1 . *Giardia lamblia (cont'd)*

Diagnosis

- By finding cysts in faeces
- Less commonly the motile flagellated parasite may be found in diarrhoeic faeces (the identity of the flagellates should be confirmed by examining stained faecal preparation.
- Faecal specimens have an offensive smell and are usually pale and fatty, often with mucus.
- The flagellates may be found in duodenal aspirates

2. *Trichomonas vaginalis* (a Urogenital flagellate parasite)

- This flagellated protozoan parasite is a common cause of vaginitis in women. The infection is known as **Trichomoniasis**.

Distribution

- Worldwide but especially in the tropics

Transmission

- It is sexually transmitted, the flagellates being the infective form; there is no known cyst stage.

2. *Trichomonas vaginalis cont'd*

Symptoms and Pathology

- The flagellates live and multiply in the urogenital tract of both women and men.
- In approximately 40% of infected women there is acute inflammation of the vagina; a yellow-green purulent discharge, sometime accompanied by urinary frequency.
- In men, the infection is usually without symptoms but occasionally there may be urethritis with a non-purulent urethral discharge.

2. *Trichomonas vaginalis cont'd*

Diagnosis

- Finding the flagellates in unstained or stained preparations of vaginal or urethral discharges.
- The parasite (flagellate) may also be found in the urine of men and women.

C. Ciliates

1. *Balantidium coli*

- This is a ciliate protozoan parasite normally of pigs but occasionally infecting humans and causing **Balantidiasis**. It is the only ciliate protozoan that parasitizes humans.

Distribution

- Worldwide but more common among those who keep pigs, especially in warm climates.

C. Ciliates (Cont'd)

Transmission

- By ingestion of cysts on faecally contaminated hands and in food and water/drinks.

Life cycle

- Ingested cysts excyst in the intestine, and each producing a single ciliate.
- The ciliates multiply by simple binary division in the colon, often after conjugation during which nuclear particles are exchanged between individuals
- The thick-walled cysts are formed which are excreted in the faeces; the cysts are infective when passed.

C. Ciliates Cont'd

Symptoms and Pathology

- Infection may be without symptoms unless the ciliates invade the intestinal wall when inflammation and ulceration may occur, leading to dysentery with blood and mucus being passed in the faeces.
- Intestinal perforation may occur as a rare but serious complication.

C. Ciliates Cont'd

Prevention and Control

- Avoidance of food and drinks likely to contain cysts, and contacts with pigs
- Observance of personal hygiene
- The cysts are rapidly killed by drying; in moist conditions they may remain infective for several weeks.

C. Ciliates Cont'd

Diagnosis

- By finding the ciliates in dysenteric faeces

- By finding the cysts in formed or semi-formed faeces

D. **Coccidia**

1. *Isospora belli*

- This is an intestinal coccidian parasite which is thought to infect only humans.
- Although infection is not common, it is widely distributed.

Transmission

- By ingestion of infective oocysts in water or food contaminated with faeces.

1. *Isospora belli (Cont'd)*

Life cycle

- Ingested oocysts excyst in the small intestine as sporozoites which enter the epithelial cells, develop and multiply by schizogony.
- Schizogony is followed by sporogony to form oocysts which are released in faeces.
- Oocysts are immature when passed but mature to the infective stage, whilst outside the host body, in 4-5 days.

1. *Isospora belli (Cont'd)*

Symptoms and Pathology

- Infection is often without symptoms and, although no serious disease may be caused, there may be abdominal pain and a mucous diarrhea associated with malabsorption
- Often there is an eosinophilia (formation and accumulation of an abnormally large number of eosinophils in the blood).

1. *Isospora belli (Cont'd)*

Symptoms and Pathology cont'd

- The infection is self-limiting in that any ulceration of the intestinal wall usually heals within a few weeks.

1. *Isospora belli (Cont'd)*

Prevention and control

- Personal hygiene and adequate sanitation
- Prevention of food and water contamination with faeces that may contain infective oocysts.

Diagnosis

- By finding oocysts in faeces, sometimes (in 50% of infected cases) Charcot Leyden crystals may be found in the faeces.

2. *Cryptosporidium (cont'd)*

- Another coccidian intestinal parasite of humans especially those with immune deficiencies,
- e.g. HIV (AIDS) or other conditions which reduce normal immune responses including treatment with immunosuppressive drugs.
- It also infects a wide range of animals. The disease caused is Cryptosporidiosis.

2. *Cryptosporidium (cont'd)*

Transmission

- Human infections are considered to be zoonotic (animal infections transmissible to humans) although person to person transmission is thought to occur also.
- Oocysts ingested from faeces contaminated hands, food or water.

2. *Cryptosporidium (cont'd)*

Life cycle

- Similar to that of other intestinal coccidian.
- The sporozoites bind to the epithelial cells of the small intestine and multiply and oocysts produced are passed out in faeces.

Symptoms

- In immune-deficient individuals the infection may cause acute and often fatal diarrhoeal disease and sometimes respiratory infection.

2. *Cryptosporidium (cont'd)*

Symptoms (cont'd)

- In normal immune persons the infection may cause gastroenteritis.
- In developing countries, the infection is a significant cause of diarrhea in children below the age of 5 years.
- The infection is rare in breast-fed infants.

2. *Cryptosporidium (cont'd)*

Prevention and Control

- By personal hygiene and good sanitation.
- The oocysts are resistant to many disinfectants but are killed in full-strength bleach, by formalin vapour or in solution.

Diagnosis

- By finding the small oocysts in stained faecal smears.
- In those with acute infections, faecal specimens are watery and have offensive odour; pus cells are not found.

3. *Toxoplasma gondii*

- This is another coccidian parasite of animals, causing the disease **Toxoplasmosis**.

Distribution

- Worldwide, with a wide range of animals acting as intermediate hosts of the parasites. The definitive hosts are the cat and the lynx.

3. *Toxoplasma gondii (cont'd)*

Transmission

- By ingestion of occysts in food, water or hands contaminated with faeces from an infected cat.
- Transmission may also occur transplacentally (i.e. congenitally) or by ingestion of the parasites in undercooked meat of an infected animal intermediate host.

3. *Toxoplasma gondii (cont'd)*

Life Cycle

- Naturally, a cat or lynx ingests pseudocysts (containing the trophozoites) in infected tissue from an intermediate host.
- Development occurs in the intestinal cells of the cat, oocysts are produced and excreted in the cat's faeces.
- Infected cats excrete oocysts for three weeks during which an intermediate host ingests the infective oocysts.

3. *Toxoplasma gondii (cont'd)*

Life Cycle cont'd

- Rodents, pigs, lambs (sheep), humans, chickens and other animals act as intermediate hosts.
- The parasites become intracellular and multiply in the liver, muscles, lymph glands, the central nervous system and other internal organs.
- In the early **acute stages** of infection the parasites (known/referred to as **TACHYZOITES**) invade phagocytic cells and mononuclear leucocytes.

3. *Toxoplasma gondii (cont'd)*

Life Cycle cont'd

- In the **chronic stages** of infection, the parasites (referred to as **BRADYZOITES**) multiply intracellularly in the tissues and form cysts (pseudocysts

3. *Toxoplasma gondii (cont'd)*

Symptoms and Pathology

- In humans, infection may be acquired and often be asymptomatic, but cause fever, a rash, enlargement of lymph glands with lymphocytosis and occasionally, inflammation of the eye (ocular toxoplasmosis), myocarditis, meningoencephalitis and atypical pneumonia.
- Serious and fatal opportunistic infections may occur in those with abnormal immune responses.

3. *Toxoplasma gondii (cont'd)*

Symptoms and Pathology (cont'd)

- Infection may be congenital in infants of infected mothers.
- Intra-uterine infection can cause severe and often fatal cerebral damage to a foetus. Infants who recover often show signs of mental defects.
- Infection occurring in early pregnancy may result in abortion or still-birth of a foetus, while infection late in pregnancy may cause symptoms to develop in the infant 2-3 months after birth.

3. *Toxoplasma gondii (cont'd)*

Prevention and Control

- Control of stray domestic cats and avoidance of contamination of hands, food and water with cat faeces.
- Not eating raw or undercooked meat (pork, mutton, beef or game) which may contain the parasites.
- Meat heated to 65^{o}C and above and kept at that temperature for 4-5 minutes or longer will not contain viable parasites.

3. *Toxoplasma gondii (cont'd)*

Prevention and Control (cont'd)

- The parasites can survive fridge temperatures (4-5^{o}C) for up to three weeks but are killed at freezing temperature (-15^{o}C) if kept for at least 3 days.

Diagnosis

- In acute infections diagnosis may be made occasionally by identifying the parasites in Giemsa or Field's stain preparations of:

3. *Toxoplasma gondii (cont'd)*

Diagnosis (cont'd)

- Lymph node aspirates
- Cerebrospinal fluid
- Peritoneal or pleural fluids
- Bone marrow aspirates
- Sputum

3. *Toxoplasma gondii (cont'd)*

Diagnosis (cont'd)

- Serological tests but with difficulties in results interpretation due to subclinical infections which are common in nearly all populations.
- A high IgM titre is considered in relation to the results.