Ch. 6, Other Flagellated Protozoa: Diplomonadida and Trichomonadida

Taxonomy

P. Retortamonada
C. Diplomonadea
O. Diplomonadida
G. *Giardia*

P. Axostylata
C. Parabasalea
O. Trichomonadida
G. *Trichomonas, Pentatrichomonas*

P. Chromista
C. Opalinea
O. Opalinida
G. *Opalina*

**P. Retortamonada**

Mitochondria and dictyosomes are absent; usually with four flagella (three anterior, one recurrent); typically parasites of the intestinal tract or free-living in anoxic environments

**O. Diplomonadida**

Possess two karyomastigonts; each mastigont with 4 pair of flagella (one recurrent)

**Genus Giardia**

They lack mitochondria
Phylogenetic analysis of rRNA suggests that they diverged somewhere near the point that prokaryotes and eukaryotes split
*Giardia* is cosmopolitan in distribution
*G. lamblia* is a common parasite of the intestinal tract of humans
Morphology

The trophozoite is rounded at its anterior end, tapered posteriorly, and flattened dorso-ventrally. The dorsal surface is convex; the ventral surface is usually concave and is dominated by a large adhesive disc with a nucleus in the center of each half. The rim of the adhesive disc is supported by microtubules and fascicles of microfilaments.

Four pairs of flagella arise from basal bodies (kinetosome complex) clustered between 2 nuclei lying side by side.

Another distinctive morphological feature of Giardia are 2 prominent, slightly curved median (transverse) bodies that lie behind the adhesive disc.

Life Cycle

Lives in the digestive system of humans, primarily the intestinal tract, but sometimes the bile duct. The trophozoite reproduces by binary fission. As trophozoites pass through the digestive tract, they usually encyst in the colon. The cysts (the transmission stage) are ovoid in appearance. The cysts are passed with the feces.

Humans are infected when they ingest cyst-contaminated food or water, or from direct hand to mouth contact.

Following ingestion, cysts pass through the stomach to the small intestine where they excyst and begin a new cycle.

Pathogenesis

Infections cause severe intestinal disorders, most commonly diarrhea. But other symptoms include abdominal distension (pain), nausea, flatulence, and weight loss. Attachment of the trophozoite to the mucosal surface by means of its adhesive disc causes shortening of the villi of the small intestine, inflammation of the crypts and lamina propria, and lesions on mucosal cells.

Severe infections produce malabsorption syndrome characterized by the inability of the small intestine to absorb essential fat-soluble substances such as carotene, vitamin B12, and folate.

These abnormalities may be accompanied by reduced secretion of a number of small intestinal digestive enzymes,
**Diagnosis and Treatment**

Identification of cysts in the stool is used in diagnosis of the parasite. Duodenal aspiration is a technique that is used to detect the presence of trophozoites. Treatment with either quinaclrine hydrochloride or metronidazole is recommended. Complete cure can occur in about one week.

**Epidemiology**

*Giardia* is the most prevalent intestinal parasite in humans. It is common in children ages 6-10. Outbreaks are frequent in day-care nurseries and in institutions where sanitation may be inadequate. *Giardia* infection has been noted among wilderness campers in the US, probably due to drinking polluted water.

**P. Axostylata**

Possess a complex mastigont system that includes an axostyle (tube-like organelle made of microtubules that extends the length of the body).

**Order Trichomonadida**

Common features include: 3 to 5 anterior flagella, an undulating membrane of varying length, a recurrent flagellum fused to the edge of the undulating membrane, and a stout median rod (*axostyle*) extending the length of the protozoan. There are no cyst stages in the life cycles of these organisms.

**Trichomonas tenax**

**Morphology**

The trophozoites are extremely small (5-16 µm x 2-15 µm), with 4 free flagella and the fifth fused to the undulating membrane which extends about 2/3 the length of the cell.
Biology

This flagellate is commonly found in the tartar and gums of the mouth, as well as the nasopharyngeal region. Transmission is by direct contact, usually kissing or using contaminated eating utensils. Drinking contaminated water from a community source may be another means of transmission. They are probably commensalistic and feed on microorganisms and cellular materials. The organism is not considered pathogenic and can be avoided through proper oral hygiene.

*Trichomomas vaginalis*

**Morphology**

Morphologically it is distinguishable from the other 2 human-infecting trichomonads by its larger size and its shorter undulating membrane, which extends only 1/3 the length of the cell. The trophozoite occasionally produces pseudopodia.

**Biology**

Of the 3 human-infecting trichomonads this is the only one that is pathogenic. *T. vaginalis* inhabits the vagina in the female and the urethra, epididymis, and prostate gland in the male.

It is transmitted primarily through sexual intercourse. Damp wash clothes and similar items also are sources of infection among children and adults.

**Pathogenesis**

*T. vaginalis* produces deterioration of the cells of the vaginal mucosa, resulting in low grade inflammation and persistent vaginitis. The condition is characterized by yellowish discharge accompanied by persistent itching and burning.

In males symptoms are much less noticeable, although there may be urethritis and swelling of the prostate gland.
**Diagnosis**

Diagnosis in females is confirmed by microscopic identification of motile trophozoites in vaginal discharge smears. Examination of the urine of both sexes and examination of prostate secretions of the male following prostate massage are also useful diagnostic procedures.

**Treatment**

Metronidazole is the most effective drug, although it is contraindicated in pregnant patients. Restoration of normal pH of the vagina by periodic vinegar douches is an effective preventative method and can control mild infections.

*Pentatrichomonas hominis*

This trichomonad is a smaller, highly motile organism with an anterior cytostome and 3 to 5 flagella.

Typically, 4 flagella beat synchronously, while the 5th beats independently. The 6th, a recurrent flagellum fused to the undulating membrane, extends the length of the cell, protruding beyond the posterior end as a trailing flagellum.

*P. hominis* is generally considered nonpathogenic in the human colon, and while it is often associated with diarrhea, there is no definitive evidence that it causes the condition.

No cyst stage, so transmission must occur via trophozoites, and flies may be used as vectors. The ability of the trophozoites to survive in feces-contaminated milk suggests that transmission may occur through contaminated food and drink and that trophozoites are able to withstand the acidic environment enroute to the intestine.

*P. hominis* infects dogs, cats, and mice and other rodents, with such hosts serving as reservoirs in nature.

Diagnosis is best made by identifying trophozoites in fecal preparations.
**P. Chromista**

Possess heterokont flagella - have at least two flagella with differing structures

**O. Opalinida**

They are common in the intestinal tract of amphibians and to a lesser extent they occur in fishes and snakes
They are unusual and yet interesting in that their reproductive cycles are largely controlled by host hormones

The parasites are flattened and covered with rows of cilia
Unlike the ciliates they possess only one type of nucleus
They reproduce sexually by anisogamous syngamy (asexual reproduction is binary fission)
Opalinids exhibit cortical folds and cortical ribbons of microtubules

**Life Cycle**

The best known genus is *Opalina* and the representative species if *O. ranarum* in Europe and *O. obtrigonoidea* in North America

During the non-breeding terrestrial phase of the amphibian host, only adult trophozoites *(trophonts)* are found; they divide occasionally by binary fission
As the breeding season approaches a marked change takes place and about 14 days before the host enters the water to breed, the fission rate accelerates and small precystic forms *(tomonts)* appear
These encyst to yield cysts
Encystation appears to be stimulated by breakdown products of androgenic steroid hormones excreted in the amphibian urine

Initially a few are found, but after ovulation and copulation are completed, the percentage of cysts rises, but falls gradually as they are passed with the feces

Cysts are passed into the water and excyst if ingested by tadpoles, giving rise to small multinucleate forms
By further division, these give rise to uninucleate heterogametes which conjugate to form a zygote
These zygotes can then divide to form trophonts

Cueing in on host hormones ensures that infective stages of the parasite overlap with the availability of new hosts