

PARA-201
General Parasitology and Protozoology

Final Lecture 1

CLASS RHIZOPODA

- Move by pseudopodia
- Stable form: Cyst
- Pleomorphic form: Trophozoite
- Replication: binary fission
- Important order: Amoebozoa

GENUS OF AMOEBA

- Genus Entamoeba: *E. histolytica*, *E. coli*. and *E. gingivalis*
- Genus Endolimax: *Endolimax nana*
- Genus Iodamoeba: *Iodamoeba butschli*
- Genus Dientamoeba: *D. fragilis*

AMOEBA CLASSIFICATION

- 1- Pathogenic:
 - Intestinal amoeba: *E. histolytica*
- 2- Non-pathogenic:
 - Mouth amoeba: *E. gingivalis*
 - Intestinal amoeba: *E. coli*, *Endolimax nana*, *Iodamoeba butschli* and *dientamoeba fragilis*.

A) ENTAMOEBIA HISTOLYTICA

Definitive Host: Humans

- Reservoirs hosts may include dogs, pigs, and monkeys.

Intermediate Hosts: None

Geographic Distribution: Cosmopolitan (Worldwide)

- 500 million people worldwide infected.
- 100 million people suffer acute symptoms
- 100,000 people die every year.
- Varies by location (depends on sanitation and climate)

Mode of Transmission: Fecal/oral transmission

- Cysts survive longer in water than in food
- Cysts can pass through intestines of cockroaches
- Also transmitted through the anal sex.

Location in Host: Usually in the caecum but can be found in any part of the small and large intestine.

- May be carried to liver, lungs, and other body parts if it perforates the intestines.

Morphology

Trophozoite: metabolically active invasive stage, moves with pseudopodia, ingests RBCs, lives in colon and is found in fresh diarrheal stool; divides by binary fission.

- trophozoites are 10-60 μm in length.
- There is wheel like distribution of nuclear chromatin: hematophagous.
- Unidirectional movement with pseudopodia.

Cyst: vegetative inactive form resistant to unfavourable environmental conditions outside human host.

- 4 nuclei
- This is the infective form resistant to stomach acid if swallowed.
- Survives up to 30 days; excyst to trophozoite on the passing through stomach.
- Cyst's size is about 10 to 20 μm .
- Chromotoidal body.

Pathogenesis:

- Causes Amoebic dysentery

- Trophs rupture and digest cell of the intestinal mucosa.
- Dissolves the mucosa to muscularis.
- When amoeba reach muscularis, they travel laterally.
- Causes large ulceration of the intestines.
- Ulcers are frequently invaded by bacteria.
 - o Bacteria may help dissolve intestinal lining
 - o Can lead to more serious complications of secondary bacterial infections.
- Once in the submucosa, the parasite can enter the blood stream and be swept to other organs.
- Liver most commonly invaded
 - o Digests liver cells
 - o Causes abscesses
- Lungs are usually invaded next.
- May also invade heart, brain, kidneys, skin and any other organ.

Symptoms

- Depends on host's previous exposure to parasite.
 - o Chronic, low-level exposure can result in host being symptomatic.
 - o Less frequent exposure result in sever symptoms.
- May also depend on the nutritional status of the host.
- Ameobic dysentery
 - o Ranges from minor cramping, tenesmus and mucoid diarrhea to sever cramping and 15 to 20 bloody stools a day.
- Amoebiasis: Symptoms depend on what organ the parasite invade.
- Abdominal cavity: peritonitis, abdominal pain, cramping and anemia.
- Liver: Symptoms are similar to hepatitis.
- Lungs, brains, or heart.
 - o May cause the death of the host.

Diagnosis

- Offensive dark brown semifluid stool mixed blood and mucus with naked eye.
- Trophs or cyst in the fecal sample.
 - o Cysts are more diagnosis due to 4 nuclei vs 8 for E.coli (next topic).
- Immunodiagnosis is difficult.
 - o Antigens for E.histolytica are very similar to commensal species, E.coli, E.dispar, and E.hartmanni
 - o An ELISA test for assays are the only way to diagnose extraintestinal amoebiasis

Treatment

- Metronidazole: treats both amoebic dysentery and amoebiasis @ 800 mg t.i.d. x 5 days
 - o Very sever side effects, particularly if mixed with alcohol.
- Other drugs, particularly antibiotics and iodochlorohydroxyquine @ 250 mg t.i.d. x 21 days, is effective for both diseases.

B) ENTAMOEBA COLI

Definitive Host: Humans

Intermediate hosts: None

Geographical Distribution: Cosmopolitan

- Much more common than E.histolytica
- More hardy, resistant to putrefaction.

Mode of Transmission: Ingestion of contaminated food and water.

Location in the Definitive Host: Caecum and large intestine.

Pathology and Treatment: None

- Harmless commensal
- Feeds on bacteria, yeast and wastes in the intestines.

Diagnosis: Important to distinguish between it and E.histolytica.

- Avoid unnecessary treatment
- 8 nuclei in cyst vs. 4 in E.histolytica
- Different shapes nuclei.

C) ENTAMOEBA HARTMANNI

Definitive Host: Humans

Intermediate Host: None

Geographical Distribution: Cosmopolitan.

Mode of Transmission: Ingestion of food and water contaminated by feces.

Location in Definitive Host: Caecum and large intestine

Pathology and Treatment: None

- Harmless commensal that does not lyse host cells
- Eats bacteria in intestine
- Life cycle similar to *E.histolytica*

Diagnosis: Important to distinguish between it and *E.histolytica*.

- *E.hartmanni* is much smaller (hint point)

D) ENTAMOEBAS DISPAR

- Recently recognized as a separate "strain" possibly species, from *E.histolytica*.
 - o Have different antigens on cell surface
- Appears to be non-pathogenic
- Identical in appearance to *E.histolytica*.
 - o Need to use antigen test or PCR to differentiate between the two.

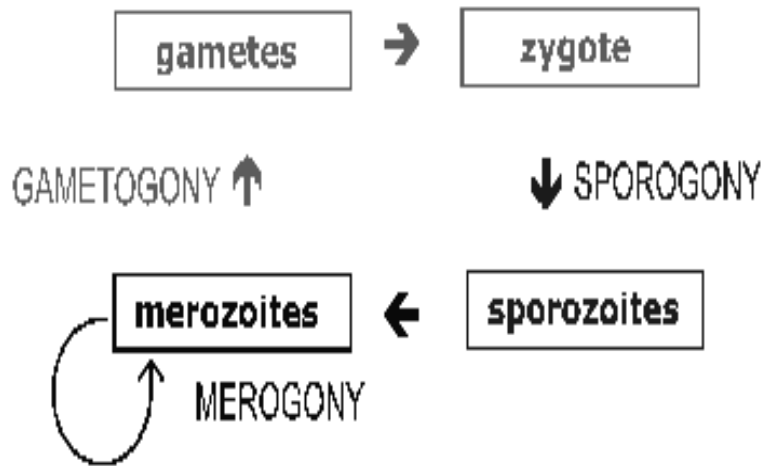
E) ENTAMOEBAS POLECKI

- Usually a parasite of pigs and monkeys.
 - o Occurs rarely in humans.
- Generally non-pathogenic
- Can be distinguished from *E.histolytica* in the cysts stage which has only 1 nucleus.

CLASS SPOROZA

- The important genera include in this class are:
 - 1. *Eimeria*
 - 2. *Isospora*
 - Members of these two genera are often called as Coccidia.
- The two genera contain large no. of species that infect a variety of animals throughout the world. The diseases caused by these parasites are called as coccidiosis. The life cycles of both genera are similar. A host is infected when it ingests oocysts that have been passed in the feces of another host.
- The oocyst excysts in the host's small intestine, and the sporozoites contained within oocyst are liberated. The sporozoites penetrate the cells of the host's small intestine and reproduce asexually.
- Each generation of asexual reproduction produces multiple merozoites; the merozoites are liberated from the cell and infect new cells.
- It is this stage of the infection that can result in destruction of massive no. of cells in the host's small intestine and ultimately leads to host death.
- Some of the merozoites transform into gametocytes. The gametocytes transform into gametes, the gametes fuse and resulting zygote develops to oocyst.
- The developing oocyst escapes from the host's cell, and it is passed in host's feces.
- Typically when the oocyst is passed in the feces, it is not infective because it does not contain sporozoites.
- After several days the oocyst completes development and sporozoites found within it is infective to the next host.

General Apicomplexan Life Cycle



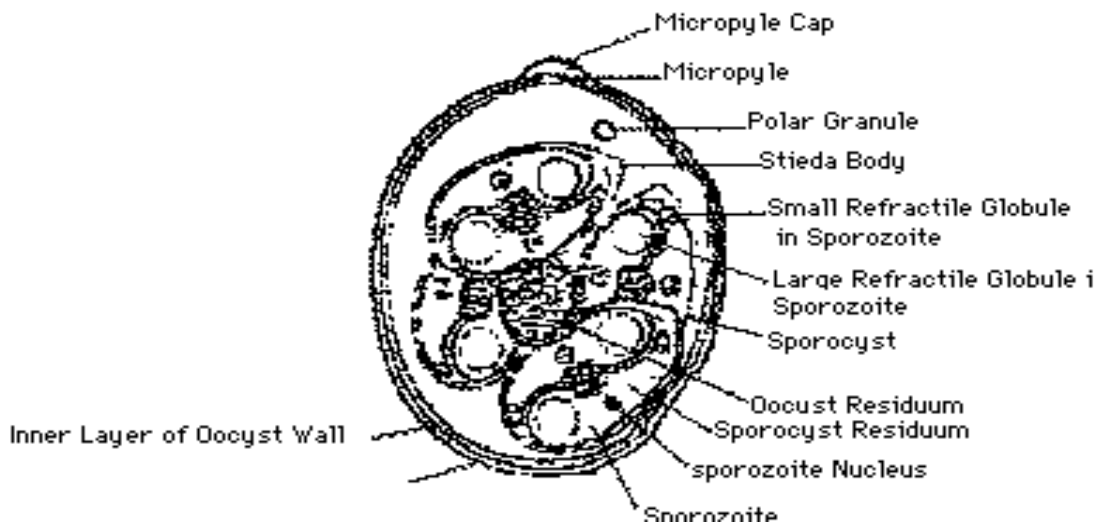
GENUS EIMERIA:

- Members of this genus has single host.
- Both asexual (schizogony) and sexual (gametogony) takes place within host cell and sporogony occurs outside the host body.
- The oocyst contain up to 4 sporocysts having one or more sporozoites.

GENERAL MORPHOLOGY:

- The oocyst wall is composed of 1 or 2 layers may be lined by a membrane. It may have micropyle, which may be covered by a micropylar cap.
- Within the oocyst are 4 sporocyst, each containing 2 sporozoites.
- There may be refractile polar granules in the oocyst.
- There may be an oocyst residuum in the oocyst.
- The sporocyst may have a knob, the stieda body, at one end.
- The sporozoites are sausage or comma-shaped, and contain 1-2 clear globules.

Figure 2.26: Structures of Sporulated *Eimeria* oocyst



GENERAL LIFE CYCLE

- The life cycle divided into 2 phases
 - i. Exogenous phase
 - ii. Endogenous

EXOGENOUS PHASE

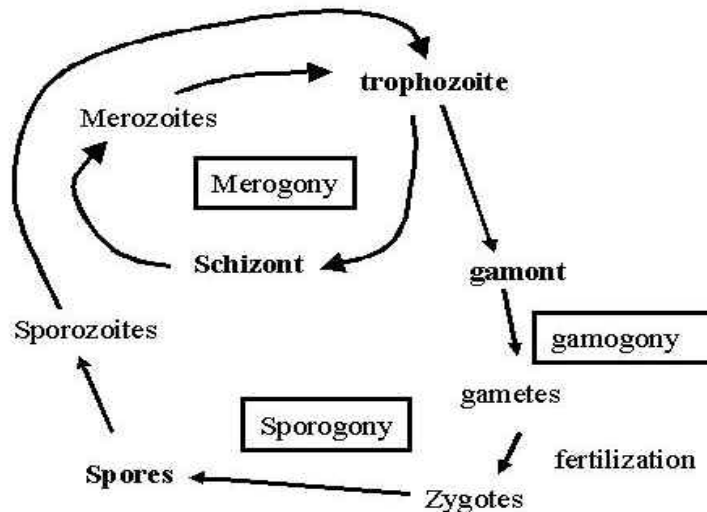
- The oocyst are passed in the feces; at this time they contain a single cell, the sporont.
- They must have oxygen in order to develop to the infective stage.
- The sporont divides to form 4 sporoblasts, each of which develops into a sporocyst.
- 2 sporozoites develop within each sporocyst.

ENDOGENOUS PHASE

- It begins with the ingestion of the sporulated oocyst and is the cycle within the host.
- Both asexual and sexual life cycle completed in this phase.

COCCIDIA OF POULTRY

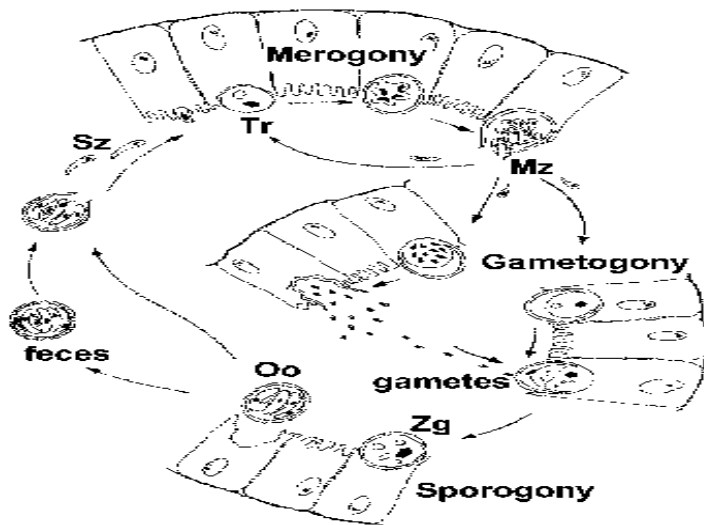
- Coccidiosis is a serious problem of poultry causing heavy economic losses through out the world.
- The parasites r located in different regions of the world.
- The each species is site specific.
- There r a no of species of coccidia, each of which produces a distinct disease process.



POULTRY SPECIES	COCCIDIA SPECIES	LOCATION OF INFECTION
Poultry	E.tenella	Caeca
	E.praecox	Duodenum
	E.maxima	Small Intestine
	E.mivati	Small Intestine
Turkey	E.brunetti	Small Intestine
	E.adenoides	Small Intestine
Pheasant	E.duodenalis	Small Intestine
	E.phasiana	Small Intestine

LIFE CYCLE:

- The life cycle consist of 3 principal processes:
 - Schizogony- asexual
 - Gametogony- sexual
 - Sporogony- asexual



- The life cycle is divided into 2 phases
- Exogenous
- Endogenous

TRANSMISSION:

- Coccidiosis is transmitted by direct or indirect contact with droppings of infected birds.
- Coccidia shed in droppings r incapable of infecting other birds until certain maturation changes (sporulation) takes place.
- Coccidia r extremely hardy and may survive long periods outside the birds body
- They r transmitted easily from one house to another by such things as dirty boots,freeflying birds, feed sacks and equipments.

SIGNS AND SYMPTOMS

- Affected birds become pale and droopy.
- Consume less feed water
- Have diarrhea and dehydrated.
- Drop in production.

Cecal coccidiosis: Caused by *E. tennella* is acute and characterized by bloody droppings.

Intestinal coccidiosis: may be acute but mostly chronic. Droppings are tan and watery.

POSTMORTEM FINDING:

- Chickens of cecal coccidiosis have ballooned cecal pouches full of free blood.
- Lesion of intestinal coccidiosis vary from a mild enteritis to a severe necrotic type.

DIAGNOSIS

- Cecal coccidiosis confused with blackhead and salmonellosis.
- Intestinal confused with haemorrhagic anemia.
- So diagnose intestine or ceca microscopically to see presence or absence of coccidial organism.

PREVENTION AND TREATMENT

- The litter should be kept dry.
- Young birds are keep apart from older.
- The feeder and waterer should be washed in boiling water before use.
- Flies, rat, and mice around poultry house should be eliminated.
- Damp area should be filled.

- Feeding coccidiostate.
- Special rubber shoes put.

VACCINATION:

- Vaccine is commercially available.
- Vaccine is more effective than anti-coccidial drugs.

GENUS BLANTIDIUM

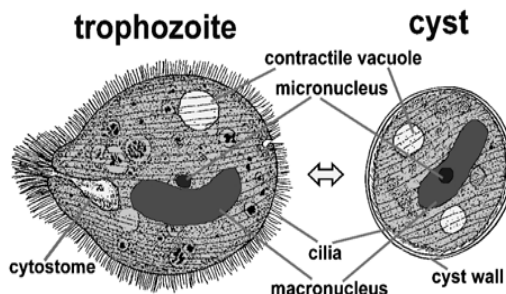
- Worldwide distribution
- Host spectrum includes human beings, Monkeys, dogs and pigs
- Swine are non-pathogenic carrier
- Mostly infect at Cecum, large intestine

BLANTIDIUM COLI

- world-wide distribution
- especially prevalent in tropics
- rarely exceeds 1%
- common in pigs and monkeys
- unlikely to be reservoirs

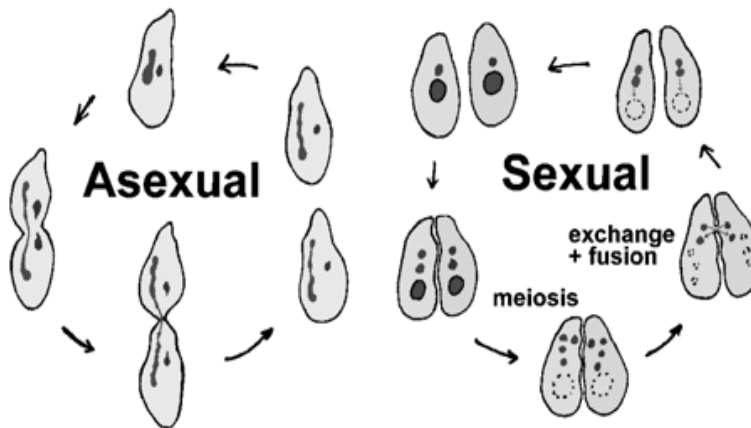
MORPHOLOGY

- Trophozoites ; they are large size
- Cilia: presence of cilia on the cell surface
- Cytostome
- Bean shaped macronucleus
- Smaller micronucleus



LIFE CYCLE

- Both asexual and sexual reproduction present
- Asexual by binary fission
- Sexual by conjugation
- Conjugation two opposite mating types pair & exchange genetic material



- ☐ Cysts are the stage responsible for transmission of balantidiasis .
- ☐ The host most often acquires the cyst through ingestion of contaminated food or water .
- ☐ Following ingestion, excystation occurs in the small intestine, and the trophozoites colonize the large intestine .
- ☐ The trophozoites reside in the lumen of the large intestine of humans and animals, replicate by binary fission, during which conjugation may occur .
- ☐ Trophozoites undergo encystation to produce infective cysts .

- ☐ Some trophozoites invade the wall of the colon and multiply.
- ☐ Some return to the lumen and disintegrate.
- ☐ Mature cysts are passed with feces .

PATHOGENESIS

- ☐ *Balantidium coli* produce proteolytic enzymes that break down and digest the intestinal epithelium.
Colon ulceration develops which allows for infiltration by lymphocytes and leukocytes.
Hemorrhaging and secondary bacterial infections will develop next.
Perforation of the large intestine and appendix will occur followed by death.

CLINICAL SIGNS

- ☐ Mild infections occur with diarrhea,
- ☐ Abdominal pain
- ☐ Alternating periods of constipation
- ☐ Ulceration of the gut wall

DIAGNOSIS

- ☐ Cysts-formed stools
- ☐ Active trophs-diarrheic stools

TREATMENT

- ☐ Tetracycline drug of choice,500mg twice a day
- ☐ Iodoquinol or metronidazole may be used as alternatives
- ☐ Metronidazole has not produced consistent results

CONTROL

- ☐ Eradication of fecal contamination of food and water.
- ☐ Cysts killed by boiling
- ☐ Resistant to low doses chlorine (halide tablets)
- ☐ Avoid practices that allow fecal-oral contact
- ☐ Improved sanitation in institutions.

GENUS TRICHOMONAS

- Its includes a group of flagellated protozoa It infect humans and animal
Human Trichomonads:
- 3 species of trichomonads found in human.
Two are normally harmless.
- *Pentatrichomonas hominis*
- *T. tenax*
- *T. vaginalis* which is a serious sexually transmitted pathogen.

PENTATRICHOMONAS HOMINIS

- Geographical distribution:
- Cosmopolitan in distribution.

- Host range: Non human primates, cats, dogs and various rodents.
- Location in the host: Large intestine.
- Morphology of trophozoites
- Do not have a cystic stage
- 5-15 mm in length
- 7-10 mm in width
- Pyriform shape

- Axostyle which run from the nucleus down the center of the body and extend from the end of the body.
- Possess an undulating membrane extend the entire length
- Characteristic number of flagellate is five.
- Single nucleus at the anterior end .
- Trichomonads swim with a characteristic wobby movement which make them unmistakable during diagnosis.

DIAGNOSIS:

- In a fresh stool, the flagellates move very rapidly in a jerky non directional manner.

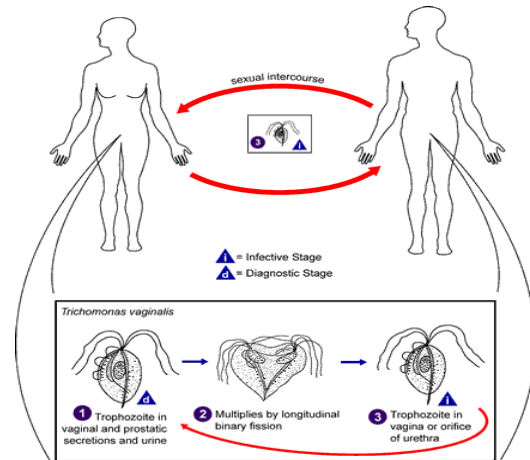
- Axostyle and undulating membrane are diagnostic.

TRICHOMONAS TENAX

- Also called T.buccalis
- Found in tartar and around the gums as well as in the nasopharyngeal region.
- Non considered pathogenic, but its presence is usually indicative of poor oral hygiene.

TRICHOMONAS VAGINALIS

- It is first described from purulent vaginal discharge in 1836 and is the etiological agent of trichomoniasis.
- Trichomoniasis is a common sexually transmitted disease with a worldwide distribution.
- T. vaginalis despite its name, infects both men and women.
- In females, the organism inhabits the vagina.
- In males, it is found in the urethra, prostate, or epididymis.
- The life cycle consists only of a trophozoite stage which is transmitted by direct contact during sexual intercourse.
- None venereal transmission is rare.
- The epidemiology of trichomoniasis exhibits features similar to other sexually transmitted diseases (STD).



SIGN AND SYMPTOMS

- T. vaginalis causes different manifestations in men and women.
- Women are more likely to exhibit symptoms which tend to persist longer.
- Incubation period is 4-28 days.

In females

- Vaginitis – with foul smelling discharge
- Vulvovaginitis
- Urethritis
- Discharge is gray, but can be yellow or green and occasionally frothy or blood tinged
- Many women experience painful or difficult coitus, dysuria

In Male

- Is likely to be asymptomatic
- Common symptoms include: Urethral discharge (ranging from scant to purulent), dysuria, urethral pruritus, some men experience burning immediately after coitus.

DIAGNOSIS

1. Vaginal pH
2. Whiff test
3. Wet mount
4. Pap smear
5. Culture
6. Direct immunofluorescence assay
7. Polymerase chain reaction
8. Evaluation for other STDs

TREATMENT:

- Metronidazole (Flagyl)
- Tinidazole is an alternative drug

CONTROL:

- The use of latex or polyurethane condoms during vaginal intercourse can prevent the transmission of trichomoniasis
- Limit the number of sex partners, and do not go back and forth between partners
- Practice sexual abstinence, or limit sexual contact to one uninfected partner
- Infected individuals should avoid sexual contact and see a health care provider.

Tritrichomonas foetus

This trichomonads is a parasite of the reproductive tract of bovines. Similar species is also reported from other mammals. The parasite is transmitted by coitus.

MORPHOLOGY:

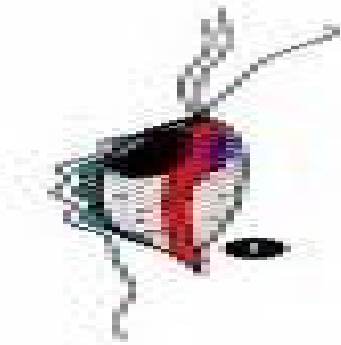
- This species has anterior three flagellates.
- Has a trailing flagella
- Axostyle is thick and hyaline and project a short distance from the posterior end of the parasite

SIGN AND SYMPTOMS:

- The severity of the disease varies from mild to sever
- Asymptomatic in bull
- Inflamed prepuce

In females:

- Low grade inflammation
- Severity
- Poor conception rate



LIFE CYCLE:

- Like all trichomonads, the organism multiple s by simple binary fission and does not possess a cyst stage.

DIAGNOSIS

- Diagnosis is based on microscopic evaluation of the trophozoite stage.
- Sample of vaginal mucus or exudate or saline washings from the vagina and preputal cavity are the best for microscopic examination.
- In case of abortion, allantoic fluid and amniotic fluids as well as fetal tissue and membrane should be examined
- Serological test including agglutination, ELISA, RIA are now available

TREATMENT

- Treatment is difficult and usually not attempted. Slaughter and breeding rest (females) are usual methods employed in dealing with bovine trichomoniasis.

Tritrichomonas gallinae:

- This is a cosmopolitan parasite of pigeons and doves
- Domestic birds, wild Turkeys, chicken, raptor (hawks, golden eagle) may also become infected
- The disease in pigeon is called Canker
- In falcon called frounce

LIFE CYCLE AND TRANSMISSION:

- *T. gallinae* is generally found in the oral- nasal cavity or anterior end of the digestive and respiratory tracts
- Multiply by binary fission
- Do not form a resistant cyst
- They therefore die quickly when passed out of the host

- Transmission of the parasite from one bird to another occur in three ways.
- 1. In pigeon, transmission occur s when infected older birds (carrier) feed pigeon milk to newly hatch squabs.
- 2. Turkey and chicken likely become infected through contaminated drinking water or food
- Because trichomands do not survive for a long outside the bird, transmission must occur rapidly
- 3. Transmission is more common to birds of prey. An infection may be established in a raptor that has fed on an infected prey bird

SIGN AND SYMPTOMS

- In acute cases, there may be little indication that the bird is infected, death may occur quite suddenly
- In other cases pigeon squab may stop feeding
- Lose weight
- Look dull
- Unable to stand or maintain their balance
- Diarrhea may also occur
- Death may occur within three weeks of infection
- Greenish fluid or cheesy material may accumulate in the mouth and crop
- This material may exude from the beak
- A pendulous crop may develop in turkey poults and chickens

DIAGNOSIS

- Characteristic yellowish-white nodules in the oral cavity, esophagus and crop strongly suggest trichomoniasis
- Infection is confirmed by finding the organism during microscopic examination of the greenish fluids, cheesy material or the lesion

TREATMENT:

- Dimetridazole
- Metronidazole

CONTROL:

- Trichomoniasis can be controlled in a flock by culling or treating carrier birds
- Food and water sources should be clean regularly and protected from contamination by wild pigeon and other birds

IMPORTANT SPECIES	HOST	LOCATION
T.canistomae	Dog	Mouth
T.felistomae	Cat	Mouth
T.anatis	Duck	Intestine
T.gallinae	Fowl	Upper digestive tract
T.gallinarum	Fowl	Caecum and liver
T.equibuccalis	Equine	Mouth
T.buttreyi	Pig	Caecum and colon
T.pavlovi	Cattle	Large intestine
T.tenax	Human	Vagina
T.macacovaginae	Monkey	Caecum
T.microti	Rodent	Caecum
Tt.eberti	Fowl	Caecum
Tt.caviae	Guinea pig	Caecum
Tt.muris	Rodent	Caecum
Tt.wenoni	Rodent	Caecum
Tt.equi	Horse	Caecum

To be Continued