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## Protozoan Appendix

(This is Supplemental Material that will NOT be on Exams)

### LECTURE #3: MUCOFLAGELLATES: *GIARDIA*, TRICHOMONADS

#### *Trichomonas gallinae*

- A. Life cycle - **direct transmission of trophozoites** no cysts- trophozoites die shortly after being deposited in environment - "pigeon milk"
- B. Pathology - **depressed, ruffled feathers, weight loss, cheesy or greenish fluid in mouth and crop; yellowish to greenish lesions in mouth, crop, esophagus; often found in bones and liver. 80 - 90% of young pigeons die, recovered birds are carriers.**
- C. Diagnosis - lesions, organisms in lesions and fluids
- D. Treatment and control - treat infected birds, prevent contact between wild and domestic fowl, may be problem in aviaries

#### *Histomonas meleagridis* - Infectious Enterohepatitis, Histomoniasis, Blackhead

- A. Life cycle - gallinaceous birds, especially turkeys-chickens, pheasants, quail, grouse, carriers. Direct life cycle by ingestion of freshly passed trophozoites in droppings (rare); incorporated into egg of *Heterakis*. *Heterakis* larvae may accumulate within earthworms.
- B. Pathology - droopy appearance, wings and tail drag, head hangs and becomes dark (blackhead); droppings sulfur-colored and liquid; pathognomonic depressed sulfur-colored lesions of liver. Anorexia, depression, droopy wings, sulphur yellow droppings, cyanotic discoloration of head/wattles.
- C. Diagnosis - specific lesions, organisms in tissues, history
- D. Treatment and control - destroy infected birds, control earthworms, ***Heterakis* control, raise turkeys and chickens separately, enheptin effective against *Histomonas*.**

#### *Hexamita meleagridis*

- A. **Binucleate cysts contaminate food/water.**
- B. Infects duodenum and small intestine - **catarrhal enteritis - foamy, watery diarrhea.**
- C. High mortality in **turkeys** (up to 80% of poults).  
Chicken, quail and adult turkeys are asymptomatic carriers.

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### LECTURE #5: COCCIDIA

#### *Eimeria* in horses- intestinal coccidia (*Eimeria leukarti*)

- A. Nonpathogenic, infection common – don't worry about this one.
- B. Large oocyst; long developmental time in environment

#### *Eimeria* in pigs. (3 species described)

- A. ***E. debliecki*** - jejunum and ileum, sporulation time 4-9d, patency 8 d  
***E. scabra*** - jejunum - sporulation time 9-12 d, patency 9 d.
- B. Morphology - typical *Eimeria*
  1. Mixed infection usually occur with the parasite being transmitted in the feces as unsporulated oocysts that must sporulate in the environment before becoming infectious
  2. **Coccidiosis usually affects piglets with older animals serving as carriers. Usually not a significant cause of disease in nursing, weaned or adult swine.**
- C. Pathology
  1. Acute enteritis limited to jejunum and ileum
  2. A characteristic finding is a yellow fibronectic pseudomembrane loosely adhered to a hyperemic mucosa. Hemorrhagic diarrhea.

- D. Diagnosis
  - 1. Histological examination of jejunum or ileum for the merozoites
  - 2. Oocysts are not usually shed during diarrheal phase
- E. Treatment and Control
  - 1. Elevated floors in farrowing facilities
  - 2. Coccidiostats to sows and pigs
  - 3. Often mixed infection with *Isospora*, which is clinically more significant.
- F. *Isospora suis*
  - 1. Causative agent of porcine neonatal coccidiosis. A significant cause of morbidity in nursing pigs. Nonhemorrhagic diarrhea in 7-10 day old pigs. Feces yellow > gray and pasty becoming more fluid as disease progresses. Dehydration. Asexual stages pathogenic with mild > severe clinical signs depending on # oocysts ingested. Villous atrophy, fusion, necrotic enteritis and crypt hyperplasia.
  - 2. Diagnosis in 7-14 day old pigs with diarrhea unresponsive to antibiotics oocysts (1-2 days following development of clinical signs) or biopsy.
  - 3. Warm temp favors rapid sporulation and outbreaks - contaminated farrowing crates implicated as reservoir. Effective chemotherapeutics not yet identified. Control - see *Eimeria* in pigs

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## LECTURE #8: *SARCOCYSTIS* & EPM

### *Sarcocystis* spp. in the horses

- A. *Sarcocystis bertrami* (*equicanis*) - heart, diaphragm, muscles. *Sarcocystis fayeri* - dog/horse  
Neither pathogenic in horse

### Sarcosporidiosis in the pig

- A. Morphology - same as for other *Sarcocystis* sp
- B. Life cycle and epidemiology
  - 1. An alteration of generations with parts of the life cycle in two different hosts. The asexual cycle is in the herbivore where cysts are formed in striated or cardiac muscle. The sexual stage found in intestinal epithelial cells of carnivores and has gametogony
  - 2. *S. miescheriana* - pigs to dog, wolf and red fox  
*S. porcifelis* - pig and cat.  
*S. suihominis* - pig and man.

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## LECTURE #9: *BABESIA* & *LEUCOCYTOZOON*

### *Babesia* in cattle (of worldwide importance – not responsible for cattle babesias in this course)

- 1. Historical and economical importance
  - a. First proven vector-borne disease
  - b. Western cattle industry - Texas cattle fever. Recent reintroduction into Texas.
- 2. Morphology intraerythrocytic forms - intraerythrocytic amoeboid or pyriform bodies.
- 3. Life cycle
  - a. Host stage - only meronts in mammal, sexual stages in ticks.
  - b. Vector stage (transovarian) – *Boophilus* (*Rhipicephalus*) sp. are vectors; significance of one-host tick (with exception of adult males, individual tick remains attached to single host for all molts.
- 4. Pathology
  - a. Erythrocyte destruction
  - b. Intravascular occlusion
  - c. Host mediated damage: activation of agglutination
- 5. Diagnosis
  - a. Clinical signs - anemia, fever, hemoglobinemia, CNS signs (where bovine rabies present clinical presentation similar)
  - b. Blood exam - look for *Babesia* in RBCs in 1st drop of blood

6. Epidemiology and control
  - a. Cattle and tick population density determine exposure and susceptibility; calves may be resistant to severe disease and become preimmunized.
  - b. Vector specificity - one host tick
  - c. Dipping campaign - every 14 days because tick remains attached for 21 d.
  - d. Vaccination - live virulent for calves or for adults followed by treatment, live attenuated.

**Equine Babesia -*Babesia caballi*; *B. equi*** (some isolates of *B. equi* now classified as *Theileria equi* because of development in lymphocytes)

1. Hemoprotozoa - *B. caballi* transmitted by *Dermacentor nitens* in US.  
Tick vector for *B. equi* in US ????
2. Disease mild > severe, age resistance as in *B. bovis*. Anemia, hemoglobinuria, jaundice, splenic and hepatomegaly, CNS signs, posterior paralysis, walking in circles.
3. Economic importance - limits importation, movement of horses. (Past problem for Atlanta Olympic games and continuing problem with importation of horses for competitive events)
4. Diagnosis - serology, blood smear, PCR.
5. Vectors and control - ticks, slaughter, quarantine. Treat *B. caballi*, *Theileria equi* (syn. *B. equi*)??

### ***Plasmodium* spp. 'malaria'**

- A. Complex life cycle. Gametocytes ingested by female mosquito >> gametes>>fertilization occurs producing zygote (ookinete) which develops into sporocyst. Sporocyst produces sporozoites which migrate to salivary gland and are injected when mosquito feeds. Sporozoites enter endothelial cells (liver, blood vessels) and produce merozoites. Merozoites reinvade endothelium or invade erythrocytes. Asexual reproduction in erythrocytes continues for many generations. Some then become gametocytes and circulate in blood awaiting mosquito.
- B. **Severe disease due to exoerythrocytic stages in endothelium**, physically causing vessel occlusion and resulting tissue anoxia, and anemia caused by erythrocyte stages
- C. **Factors affecting transmission include temperature, life span of mosquito in wild, host preference, feeding behavior.**
- D. *P. gallinaceum* - domestic fowl. Exoerythrocytic stages in endothelial cells of R-E system, spleen, brain, liver. Paralysis associated with involvement of brain endothelium, anemia. Up to 80% mortality, recovered birds carriers. Birds may die before stages in blood appear.
- E. Diagnose by blood exam, examination of tissue. Several good drugs. Eradicated from US but risk of reintroduction due to smuggling of birds.

### **Leucocytozoon (*L. simondi* - ducks and geese; *L. smithi* - turkeys)**

1. Life cycle - (similar to *Plasmodium*) sporozoites injected by *Simulium* produce two types of schizonts- hepatic schizonts and megaloschizonts (lymphoid cells or macrophages) - gametocytes in lymphocytes and erythrocytes.
2. Pathology - splenomegaly; liver hypertrophy and degeneration - anemia due to anti-erythrocytic factor. Anemia, emaciation, weakness and incoordination. Up to 90% mortality for turkey poults. May die 2-3 days following development of clinical signs (cough, bronchitis)
3. Diagnosis - find organisms - usually within white blood cells
4. Control - control vector (*Simulium*, black fly, buffalo gnat) - difficult to accomplish.

### ***Hemoproteus* spp.**

- A. Similar to *Plasmodium* - gametocytes only in erythrocytes, usually nonpathogenic **but needs to be differentiated from *Plasmodium* and *Leucocytozoon*.**

## **END of Protozoa Appendix**

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