VMP 930
Veterinary Parasitology

(aka Infection & Immunity III)

Dr. Bruce Hammerberg
Dr. Barbara Qurollo
James Flowers, PhD
(Office hours by appointment)
Studies in Infectious Diseases

- Microbiology
  - Virology
  - Bacteriology
  - Mycology
- Parasitology
  - Medical & Veterinary Protozoology
  - Helminthology
  - Medical & Veterinary Entomology
Parasites in Practice

- In a veterinary practice how much effort & time is spent on Parasite issues?
  - What parasites are often diagnosed in a veterinary practice?
  - What parasites do veterinary practices often try to manage?
**Parasitism**

- Intimate relationship between two hetero-specific organisms, in which the parasite, usually the smaller symbiont, is metabolically dependent on the host.

- One symbiont (host) is harmed, while the other symbiont (parasite) benefits.
Parasite Impact on the Host

- Pathogenesis
  - Production or Development of Disease

- Forms of Pathogenesis
  - Trauma
  - Nutrient Robbing
  - Toxin Production
  - Interactions with Host immune / inflammatory responses.

- Etiologic Agent - the agent that elicits DZ
Important concepts of Parasitic Infections

- Infection = presence of an agent that has the potential to cause disease
- Disease = the occurrence of dysfunction
- Infectious = capable of causing infection
- Infection ≠ Infectious ≠ Disease
Infection, Disease, and/or Infectious?

A. The dog showed no adverse symptoms to the 2 female *Dirofilaria immitis* in its right ventricle.  
   **Infection**

B. 1,000 juvenile *Haemonchus contortus* were causing severe anemia in the lamb.  
   **Infection + Disease**

C. Cats suffering from large bowel diarrhea due to *Tritrichomonas blagburni* pass active trophs in their stool.  
   **Infection + Disease + Infectious**

D. After using the bathroom, she was horrified to see that she had passed several active proglottids of the beef tapeworm, *Taenia saginata*.  
   **Infection**
Protozoa

- **Microparasites**
  - Small (single cell) parasites
    - (Protozoa, [bacteria, viruses])
  - Intracellular & Extracellular
  - **Individual organisms Multiply in the host.**
    - “mechanism” of protozoan induced pathology
Giardia sp. & other extracellular protozoa

Pathology:
Host organ dysfunction

Replication (binary fission)
Pathology:
- Cellular trauma
- Organ dysfunction
Coccidia (Eimeria bovis)

- Ingestion
- Unsporulated oocysts passed in feces
- Sporulation in 2-3 days
- Sporulated Oocyst
- Oocysts passed in the feces

Unsporulated Oocyst
Babesia canis

Injected when tick takes a blood meal

Tick Intermediate Host

Organisms within Erythrocytes

Ingested when tick takes a blood meal
Trematodes

■ Macroparasites
  ■ Large parasites
  ■ Individual ADULT organisms do Not multiply in the host.
Dicrocoelium dendriticum

Prepatent 80 days

NC STATE UNIVERSITY
Cestodes

- Macroparasites
  - Large parasites
  - Individual ADULT organisms do Not multiply in the host.
Taenia pisiformis
Dipylidium caninum

Prepatent: 21 days
Nematodes

- **Macroparasites**
  - Large parasites
  - *Individuals do Not multiply in the host.*
**Strongyloides ransomi**

- **Oral penetration**
- **Skin penetration**
- **Transmammary to piglets via arrested larvae in maternal tissues**
- **Prepatent in 5-7 days**
- **Ova in Piglet Feces**

**Homogonic Cycle**
- **L2 Environment**
- **L1 Environment**

**Heterogonic Cycle**
- **Free-living larvae in the Environment**
- **Male & Female in the Environment**
- **L1 in Environment**
**Trichuris vulpis**

- **Ingestion**
- **Prepatent period:** 3 months
- **about 1 month to infectivity**
Haemonchus contortus

L3 Larvae ingested while host is grazing

Prepatent in 3 weeks

Intectivity in 4 to 6 days, pending environmental conditions

Ova passed in the feces

L1 to L3 Larvae in the Environment

Ovum
**Ancylostoma caninum**

- **Reptiles**
  - Paratenic Hosts

- **Rodents**
  - Ingestion of infected paratenic host

- **Migrating larva**
  - Can cause Cutaneous Larval Migrans

- **Infective larva**
  - Penetrates the skin or are ingested.

- **Infected larva**
  - Penetrates exposed skin

- **Ovum**
  - Develop to Infective Larvae in 5-7 days

- **Ova**
  - Passed in the feces

- **Adult worms** in the small intestine

- **Transmammary** to puppies via arrested larvae in maternal tissues

- **Prepatent in 15 to 18 days**
Toxocara canis

Ingestion of infected paratenic host

Reptiles
Paratenic Hosts

Rodents

Transmammary very minor

Transuterine
Prepatent 3 weeks if transuterine 4-5 weeks if ingested

Ingestion of infective egg

Migrating larvae can cause Visceral Larval Migrans

Infective in 4 weeks

Ova in Feces

Ingestion of infective egg

Ingestion of infective egg

Ingestion of infective egg

NC STATE UNIVERSITY
**Oxyuris equi**

- **Ingestion**
- **Prepatent period** 5 months
- **Infected horse rubs ova on environmental structures**
- **Ova on environmental structures & in Feces**
- **Ova deposited on perianal area**

**Notes:**
- Infective in 4 to 5 days
Physaloptera rara

Paratenic Hosts

Frogs & Toads
Reptiles
Rodents

Intermediate Host

Infective L3 Larvae in Beetle

Ova in Feces

Prepatent 2 to 3 months

Ingestion

Ingestion

Ingestion
Dirofilaria immitis

L3 Larvae enter dermis when infected mosquito feeds.

Prepatent Period 6 Months

Mosquito Intermediate Host (Microfilaria to Infective L3)

Ingestion of Microfilaria

Microfilaria in Blood Stream
Arthropods

- Macroparasites
  - Large multicellular parasites
  - Individual organisms do Not multiply / replicate in or on the host.
  - Although the pathology of some arthropods (mites & lice) is due to their reproduction on the host.
  - Vectors for other disease agents
Trichodectes canis

Eggs (Nits) attached to Hair

All Stages occur on the Host's Integument

Nymphs hatch from nits in about 5 days

Transmission to Other Hosts via Direct Contact or Infested Grooming Tools
Demodex canis

- Eggs
- Larva
- Protonymph
- Deutonymph
- Adults

All Stages occur in the Host's Follicles and Sebaceous Glands

Transmission to Other Hosts via Direct Contact
Dermacentor variabilis

- Adults attack, feed, & mate on 3rd host
- Nymphs drop off & molt to adults
- Nymphs attack & feed on 2nd host
- Larvae drop off & molt to nymphs
- Engorged female drops off host & lays eggs
- Eggs hatch in environment
- Larvae attack & feed on 1st host
Controlling Parasites

Assume you are working at a Wildlife Rehab facility with limited funds for the treatment of parasites.

1. Which of the following 3 parasites would likely cause the most concern for re-infection & a build-up of parasites?

2. What would you generally do to control reinfection?
Concern for reinfection, build up of large parasite population in the host?

+ low concern
++ moderate concern
+++ high concern

*Cruzia americana*
Didelphodiplostomum variable

Concern for reinfection, build up of large parasite population in the host?

+ low concern
++ moderate concern
+++ high concern
Concern for reinfection, build up of large parasite population in the host?

+ low concern
++ moderate concern
+++ high concern

**Physaloptera turgida**

- Ingestion
- Rodents
  - Frogs & Toads
  - Reptiles
- Ova in Feces
- Infective L3 Larvae in Beetle
- Intermediate Host
- Paratenic Hosts
Take Home

Importance of knowing life cycles for successful clinical cases and disease control.

Concepts that should become “second nature”:

- Infection v/s Infectious v/s Disease
- Host Specificity: Low v/s High
- Life Cycles: Direct v/s Indirect
Take Home

- Concepts & Definitions that should become “second nature”:
  - Patent v/s Prepatent
  - Stage: Larval v/s Adult
  - Hosts: Definitive v/s Intermediate v/s Paratenic
  - Zoonosis