Cestodes

- Tapeworms
- Complex Life Cycles
- Definitive host
  - Adult worms
  - Sexual reproduction
- 1 or 2 Intermediate Hosts
  - Larval Tapeworms (Metacestodes)
  - Some show Asexual reproduction
Morphologic Characteristics

- **General Flatworm Characteristics**
  - Except lacks Digestive Tract
  - Absorbs food directly across Tegument

- **Adult Body**
  - **Scolex** => Holdfast organ
    - usually has suckers, retractable or non-retractable rostellum of Hooks
  - **Neck**
    - Germinative region produces "segments", asexually
  - **Strobila**
    - Series of Maturing "Segments" or Proglottids
    - Each Proglottid is an individual reproductive unit
    - immature, mature, gravid proglottids in series.
Scolex & Neck
Immature Proglottids
Mature Proglottids
Gravid Proglottid
Complex Life Cycle

- Definitive Host
  - Adult Worms
  - Sexual Reproduction
- Ova with Hexacanth
- Intermediate Host
  - Larval stage (various species types)
  - Some species show Asexual Reproduction
Adult Worm
Ovum
Cysticercus
Basic Tapeworm Life Cycle

*Taenia pisiformis*

- Prepatent: 56 days
Cestode Groups

Large Animals
- Adult Tapeworms
  - Anoplocephala (equine)
  - Moniezia (ruminants)
- Larval Tapes (condemnations)
  - Taenia saginata (cattle)
  - Taenia solium (swine)

Small Animals
- Adult Tapeworms
  - Taenia pisiformis (dogs)
  - Taenia taeniaformis (cats)
  - Echinococcus granulosus (dogs)
  - Dipyldium caninum (dogs, cats)
  - Mesocestoides sp. (dogs, cats)
  - Spirometra sp. (dogs, cats)

Human Zoonosis
- Adult Tapeworms
  - Taenia saginata
  - Taenia solium
  - Dipyldium caninum

- Larval Tapeworms
  - Echinococcus sp.
  - Taenia solium
  - Spirometra sp.
Cestodes for Today

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- Adult Tapeworms
  - Taenia saginata
  - Taenia solium
  - Dipylidium caninum
- Larval Tapeworms
  - Echinococcus sp.
  - Taenia solium
  - Spirometra sp.
**Taenia pisiformis**

- Large tapeworm of dogs (Worldwide)
- Scolex with non-retractable armed rostellum and 4 suckers
- Strobila (up to 6ft long) made of rectangular proglottids with irregularly alternating unilateral genital pores
Mature Proglottids
Life Cycle

- **Definitive Hosts**
  - Dogs, fox, coyote, wolf (small intestine)

- **Gravid proglottids passed in feces**

- **Ova disseminated in environment by motile proglottid**

- **Intermediate Host**
  - Rabbits or Squirrels
  - Cysticercus larvae (bladder worm) in liver and mesenteries.
  - Ingested by the Definitive host

- **Young Tapes**
  - Young Tapes attach to the intestinal lining and develop into mature tapeworms.
  - Prepatent period: 56 days
Egg: Single Spherical
Cysticercus larva
(Bladder worm)
Pathology

- **Definitive Host (Dog)**
  - No Pathology
    (nutrient competition in malnourished hosts)
  - "Client Worry" (proglottid aesthetics)

- **Intermediate Host (Rabbit)**
  - Organ displacement, damage, impairment of organ function.
“Pathology”
Active Segments on Poop
"Pathology"
Active Segments on Pet
Clinical Signs

- Segments presented by Client
- Pet usually shows no signs
- Occasionally dog drags tail
- Dietary History -- possibility of rabbit diet
Diagnosis

- Segment Squash
  - Rectangular segment
  - Single Spherical eggs with striated shell.
Treatment

- Praziquantel (*Droncit*) (5mg/kg)
- Pyrantel+Praziquantel+Febantel (*Drontal Plus Tablets*)
- Pyrantel+Praziquantel (*Virbantel Flavored Chewables*)
- Ivermectin+Pyrantel+Praziquantel (*Iverhart Max Chewable Tablets*)

- Epsiprantel (*Cestex*) (5.5 mg/kg)

- Fenbendazole (*Panacur*) (50 mg/kg SID for 3 days)
How would you prevent re-infection?

Taenia pisiformis

Prepatent 56 days
Control & Zoonosis

- Restrict access to Rabbits
- Not Zoonotic
**Taenia taeniaeformis**

- Large tapeworm of cats (Worldwide)
- Scolex with non-retractable armed rostellum and 4 suckers
- Strobila (up to 2 ft long) made of rectangular proglottids with irregularly alternating unilateral genital pores.
Life Cycle

- **Definitive Hosts**
  - Cats, Lynx (Bobcat) -- (small intestine)

- **Gravid proglottids passed in feces**

- **Ova disseminated in environment by motile proglottid**

- **Intermediate Host**
  - Rodents
  - Strobilocercus larvae in liver.
  - Ingested by the Definitive host

- **Young Tapes**
  - Young Tapes attach to the intestinal lining and develop into mature tapeworms.
  - Prepatent period: 40 days
**Taenia taeniaiformis**

- **34-80 days Prepative Period**

Diagram showing the lifecycle of the parasite.
Egg: Single Spherical
Strobilocercus larva
Pathology

- Definitive Host (Cat)
  - No Pathology
    (nutrient competition in malnourished hosts)
  - "Client Worry" (proglottid aesthetics)

- Intermediate Host (Rodent)
  - Organ displacement, damage, impairment of organ function.
“Pathology”
Active Segments on Poop
Clinical Signs

- Segments presented by Client
- Pet usually shows no signs
- Occasionally cat drags tail
- Dietary History -- possibility of rodent diet
Diagnosis

- Segment Squash
  - Rectangular segment
  - Single Spherical eggs with striated shell.
Treatment

- Praziquantel (*Droncit*) (5mg/kg)
- Pyrantel+Praziquantel (*Drontal tablets*)
- Emodepside+Praziquantel (*Profender*)
- Epsiprantel (*Cestex*) (2.75 mg/kg)
- Fenbendazole (*Panacur*) (50 mg/kg SID for 3-5 days) [extra-label]
Control & Zoonosis

- Restrict access to Rodents
- Not Zoonotic
Taenia saginata

- Beef tapeworm of humans (Worldwide)
- Scolex has 4 suckers but lacks hooks
- Strobila made of rectangular proglottids with irregularly alternating unilateral genital pores.
- 24 to 75 ft long, survives “many years”
- Larval tapeworms in cattle
Life Cycle

Definitive Hosts
- Humans - (small intestine)

Gravid proglottids passed in feces

Ova disseminated in the environment by the motile proglottid

Intermediate Host
- Cattle
- *Taenia saginata* = *Cysticercus bovis* in striated & cardiac muscles.
- Ingested by the Definitive Host

Young Tapes
- Young Tapes attach to the intestinal lining and develop into mature tapeworms.
- Prepatent period: 3 months
Cysticercus bovis
Pathology

- **Definitive Host (Human)**
  - No Pathology
  - Nutrient competition in malnourished hosts
  - Proglottid aesthetics

- **Intermediate Host (Cattle)**
  - *Cysticercus bovis*: Muscle & Heart damage
  - **Beef Condemnation** ("Measly Beef").
Diagnosis

- Definitive host (human)
  - Tapeworm segments in feces

- Intermediate Host (cattle)
  - *Cysticercus bovis* @ necropsy
Cysticercus bovis
Treatment

- **Definitive Host (Human)**
  - Niclosamide

- **Intermediate Host (Cattle)**
  - *Cysticercus bovis*: rely on control measures.
How would you control? 

Taenia saginata
Control & Zoonosis

- Restrict human defecation in cattle pastures.
- Restrict human from eating raw beef.
- USDA condemnation of "Measly beef".

- Not Zoonotic - Humans are the definitive host.
**Taenia solium**

- Pork tapeworm of humans (Worldwide)
- Scolex has 4 suckers and hooks
- Strobila made of rectangular proglottids with irregularly alternating unilateral genital pores.
- 15 to 24 ft long, survives up to 25 years
- Larval tapeworms in swine
Life Cycle

- **Definitive Hosts**
  - Humans -- (small intestine)
- **Gravid proglottids passed in feces**
- **Ova disseminated in the environment by the motile proglottid**

- **Intermediate Host**
  - Pigs (& humans)
  - *Taenia solium* = *Cysticercus cellulosae* in striated muscles.
  - Ingested by the Definitive Host

- **Young Tapes**
  - Young Tapes attach to the intestinal lining and develop into mature tapeworms.
  - Prepatent period: 3 months
Taenia solium
Pathology

- **Definitive Host (Human)**
  - No Pathology *(adult tapeworm)*
  - Nutrient competition in malnourished hosts
  - Proglottid aesthetics

- **Intermediate Host (Swine)**
  - *Taenia solium = Cysticercus cellulosae*: Muscle Damage
  - Pork Condemnation ("Measly pork").
Cysticercus cellulosae
Diagnosis

- Definitive host (human)
  - Tapeworm segments in feces

- Intermediate Host (swine)
  - *Cysticercus cellulosae* @ necropsy.
Treatment

- **Definitive Host (Human)**
  - Niclosamide

- **Intermediate Host (Swine)**
  - *Cysticercus cellulosae*: rely on control measures.
How would you control?

Taenia solium
Control

- Restrict human defecation in swine pastures.
- Restrict human from eating raw pork.
- USDA condemnation of "Measly pork".
Zoonosis

- Humans are the definitive host.

- If humans ingest ova from human feces (i.e. self-infection) then cysticercosis. (humans act as intermediate host)
  - cysticerci in muscles, eyes, brain.
  - most important cause of neurologic DZ in Latin America
Neural Cysticercosis
Neural Cysticercosis
In-class Discussion

Which tapeworms of the Genus *Taenia* are of:

1. Companion animal concern
2. Economic concern
3. Human Health concern
Echinococcus granulosus

- Minute tapeworms of Canids
- Scolex with armed rostellum and 4 suckers
- Strobila made of 3 to 4 proglottids with unilateral genital pores.
- Larval tapeworms infect a variety of animals & man
Life Cycle

- **Definitive Hosts**
  - Dogs, Wild Canids -- (small intestine)
- **Gravid proglottids passed in feces**
- **Ova disseminated in the environment**
- **Intermediate Host**
  - Sheep, other ruminants, swine and humans
  - Unilocular hydatid cyst in various organs
- **Ingested by the Definitive Host**
- **Young Tapes**
  - Young Tapes attach to the intestinal lining and develop into mature tapeworms.
  - Prepatent period: 1 to 1.5 months
Echinococcus granulosus

Diagram showing the life cycle of Echinococcus granulosus:
1. **Unilocular hydatid cyst in intermediate host**
2. The cyst is ingested by the final host, a dog.
3. In the dog, the cyst develops into a *Proenoplasm*.
4. The *Proenoplasm* matures into a *Echinocysticule*.
5. The *Echinocysticule* becomes an adult *Echinococcus*, ready to be ingested by the intermediate host, completing the cycle.

*Note: This diagram is a simplified representation of the life cycle.*
Geographic Distribution

- Sporadic Globally
- Endemic areas: Argentina, Peru, east Africa, central Asia, China
Pathology

- Definitive Host (Dog)
  - No Pathology

- Intermediate Host (Variety of animals)
  - Unilocular Hydatid cyst
  - Pressure atrophy of adjacent organs
  - Risk of anaphylactic reaction if cyst ruptures
Unilocular Hydatid Cyst
Multilocular Cyst in Cow Liver
Multilocular Cyst in Horse Liver
Multilocular Cyst in Vertebra
Diagnosis

- **Definitive host (dog)**
  - Purgative & search for small adult worms
  - Ova in fecal centrifugation.

- **Intermediate Host (Ruminant and others)**
  - Serology
  - Radiographs
  - CDC has ELISA to distinguish between the two species found in humans.
Purgative
Ovum
Treatment

- **Definitive Host (Dog)**
  - Praziquantel (*Droncit*)
  - Epsiprantel (*Cestex*)

- **Intermediate Host (Ruminant & other hosts)**
  - Aggressive treatments with Mebendazole or Albendazole
How would you control? 

Echinococcus granulosus 

unilocular hydatid cyst in intermediate host
Control

- Restrict canine access to ruminant pastures.
- Do not feed canids uncooked offal
- Regular deworming of dog
- Eliminate stray or wild canids
Zoonosis

- Very Important Zoonotic Potential
- Humans infected by ingestion of *Echinococcus* ova from dog poop.
- Unilocular cysts in various organs, including liver, lungs, brain.
Hydatid Disease
Hydatid Disease
In-class Discussion

Which tapeworms (studied so far) are of:

- 1. Companion animal concern
- 2. Economic concern
- 3. Human Health concern