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, retractible or non-retractible rostellum of Hooks
  - Neck
    - Germinative region produces "segments"
  - 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

NC STATE UNIVERSITY
# 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)
  - *Dipylidium caninum* (dogs, cats)
  - *Mesocestoides sp.* (dogs, cats)
  - *Spirometra sp.* (dogs, cats)

## Human Zoonosis
- **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
Taenia pisiformis

Prepatent 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 control?

*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
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
Taenia saginata
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
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

unilocular hydatid cyst in intermediate host
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 (Sheep & 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