

Lectures #12 & #13 CESTODES

Objectives:

1. Distinguish the life-cycle and characteristics of Tapeworms of veterinary importance.
2. List the intermediate and definitive hosts of representative cestodes (by genera).
3. Describe the lesions and pathogenesis of cestode infections.
4. Discuss management and treatment strategies for representative cestodes.

I. Tapeworms

A. General

1. Flatworms
2. The body of the adult tapeworm is usually divided into 3 regions
 - a. The scolex is the holdfast or anchoring organ. May have suckers, grooves, and/or hooks.
 - b. The neck is the area of cell division which gives rise to proglottids or segments.
 - c. The strobila is the rest of the body which is composed of individual and progressively mature proglottids.
 - Immature proglottids (development)
 - Mature Proglottids (reproductively active)
 - Gravid proglottids (bags of eggs)
3. The tegument is metabolically active and absorbs nutrients.
4. There is NO digestive tract.
5. Monoecious (hermaphrodites), with self-fertilization and /or cross-fertilization.
 - Number and position of the genital openings are useful in identification.
6. All adult tapeworms are found within the digestive system of a vertebrate host.
7. Most tapeworms need 2 to 3 hosts (i.e. 1 to 2 intermediate hosts, and 1 definitive host.)

B. Tapeworms of veterinary importance:

1. Order Cyclophyllidea (most are in this group)
Important Families: Taeniidae, Dipylidiidae, Anoplocephalidae, Mesocestoididae
2. Order Pseudophyllidea: *Spirometra*

II. CYCLOPHYLLIDEAN tapeworms in general

A. Life-Cycle:

1. The egg contains an embryo (oncosphere or hexacanth) with 6 hooks.
2. Gravid segments (containing eggs) are detached from the adult worm and are released into the environment.
3. The intermediate host ingests the eggs which hatch to release the first larval stage (L1).
4. The L1 develops into a second larval stage (L2) in the intermediate host. Typically, there is only 1 intermediate host. The definitive host ingests the intermediate host containing the infective L2 (i.e. PREDATOR-PREY TRANSMISSION.).
5. Depending on the tapeworm species the L2 stage will take a specific forms:
 - a. CYSTICERCUS or bladder worm has one scolex invaginated inside a bladder.
 - b. STROBILOCERCUS - cysticercus that is starting to elongate and segment.
 - c. HYDATID CYST - large, encapsulated cyst utilizes asexual reproduction (budding) to produce many protoscolices floating within.
 - d. CYSTICERCOID is unique to arthropod intermediate hosts; the scolex is depressed within a small solid cyst.

B. Treatment of tapeworm infections:

1. Drugs that are effective against cestodes include:
 - a. praziquantel and epsiprantel
 - b. bunamidine
 - c. benzimidazoles (fenbendazole, albendazole, etc.)
 - d. pyrantel (with horses)

C. Control of tapeworm infections:

1. Interrupt the life-cycle by preventing access to intermediate host tissue.

D. Cestode Groups

Large Animals

Adult Tapes

Anoplocephala perfoliata (equine)

Moniezia (ruminants)

Larval Tapes (condemnations)

Taenia saginata (ruminants)

Taenia solium (swine)

Small Animals

Adult Tapes

Taenia pisiformis (dog)

Taenia taeniaformis (cat)

Echinococcus granulosus (dog)

Dipylidium caninum (dog & cat)

Mesocostoides (dog & cat)

Spirometra (dog & cat)

Human (Zoonotic concerns)

Adult Tapes

Taenia saginata

Taenia solium

Dipylidium caninum

Larval Tapes

Echinococcus granulosus

Taenia solium

Spirometra sp.

III. Cyclophyllidean Tapeworms of importance

A. Family TAENIIDAE

1. A large group of mammalian tapeworms.
 - a. Definitive host = carnivore or human.
 - b. Intermediate host = herbivore or omnivore
2. Adults: generally not pathologically significant
3. Larval stages: can cause severe pathology in intermediate or accidental host.
4. General life-cycle: a) Egg is ingested by the intermediate host. b) Larvae develop to infective form in the intermediate host. c) Definitive host, when feeding on the intermediate host, ingests the larval tapeworm. d) The adult matures in the small intestine and pass segments and/or eggs in the host's feces.
5. Important taeniids with dog, cat and human definitive hosts:
 - a. *Taenia pisiformis* -- Dogs, coyotes or wolves get infected by ingesting rabbits or squirrels infected with the larval stages (Cysticercus).
 - b. *Taenia taeniaeformis* -- A common tapeworm of cats which have ingested rodents containing the larval stage (strobilocercus).
 - c. *Taenia saginata* -- Important medical tapeworm. The cysticercus encysts within the muscles of cattle, causing "measly beef" due to *Cysticercus bovis*. Results in condemnation by USDA inspectors. Infected human feces can contaminate cattle grazing pastures.
 - d. *Taenia solium* -- Important medical tapeworm. Larvae are generally found in the swine intermediate host. *Cysticercus cellulosae* refers to the larval stage in pork meat ("measly pork"). Man is usually the definitive host, but can also serve as intermediate host. Aberrant migration of the larval stage in an inappropriate intermediate host (such as a human) can result in ocular and neurological disease.
 - e. *Echinococcus granulosus* -- Important medical tapeworm.
 - Definitive hosts include the dog, coyote, wolf and dingo.
 - Globally sporadic. Endemic areas: Argentina, Peru, east Africa, central Asia, China
 - Larvae (Hydatid Cyst) develop in the lung, liver, brain, etc. Unilocular hydatid cyst can grow and cause pressure atrophy of near-by organs. Or a ruptured cyst releasing hydatid fluid can cause a severe anaphylactic reaction. (Hydatid Disease)
 - Hydatid disease can infect several intermediate host species such as sheep, swine, cattle, moose, caribou, kangaroos and even man.
 - Diagnosis:
 - i. The adult tapeworms are of minimal pathological concern to the dog. To identify, give the dog a mild purgative and examine feces for the small tapeworm. (Avoid self-contamination with ova).
 - ii. Larval stage and hydatid disease: Serology and radiography
 - To control hydatid disease in endemic areas:
 - i. Avoid contact with dog feces.
 - ii. eliminate stray canids
 - iii. regular deworming of dog to eliminate adult stage.
 - iv. avoid feeding uncooked offal to canids

<u>TAPEWORM</u>	<u>Definitive host (Adult worm)</u>	<u>Intermediate host (Larval worm)</u>
<i>Taenia pisiformis</i>	Dog	Rabbit
<i>Taenia taeniaeformis</i>	Cat	Rodent
<i>Taenia saginata</i>	Human	Cattle
<i>Taenia solium</i>	Human	Swine, human
<i>Echinococcus granulosus</i>	Dog	Sheep, human

B. Family DIPYLIDIIDAE

1. *Dipylidium caninum*

- a. This is the most common dog and cat tapeworm, and has a worldwide distribution.
- b. Adults can reach 30 - 50 cm; oval or cucumber seed-shaped proglottids. Each proglottid has bilateral genital pores. Adults within the definitive host are of little pathological concern.
- c. Egg packets are released with the terminal gravid segment. Insect larvae [fleas (*Ctenocephalides canis*, *C. felis*, *Pulex irritans*), and lice (*Trichodectes canis*)] feed on debris/eggs and the parasite develops into a cysticercoid within the insect. The flea is inadvertently ingested by the definitive host during grooming; children may be accidentally infected in similar fashion.
- d. The prepatent period is 2-3 weeks.
- e. Treatment for the tapeworm should include a flea eradication program (adulticide, insect growth regulator, vacuuming often, etc.).
- f. Emerging issue: Some cases of possible dewormer resistance.

C. Family ANOPLOCEPHALIDAE:

1. In General

- a. Adult tapeworms of large animals (equine & ruminant)
- b. Free-living oribatid mites are the intermediate hosts contain cysticercoid infective larval stage.
- c. Eggs have granular shells with irregular or angular shapes.

2. Tapeworms of horses.

a. *Anoplocephala perfoliata*

- found in the large and small intestine (especially the ileocecal junction)
- Inflammation & intestinal intussusception due to obstruction of ileocecal junction.
- Treatment with mebendazole or pyrantel (at 2x normal dose) is indicated even if eggs are not detected.

3. Tapeworms of ruminants.

a. *Moniezia spp.*

- Very common.
- Little, if any, clinical significance.
- Segments & eggs often seen in feces.

D. Family MESOCESTOIDIDAE

1. *Mesocestoides corti*

- a. Rare infections in dogs & cats in North Carolina.
- b. Requires 2 intermediate hosts
 - 1st intermediate host is a dung beetle [cysticercoid]
 - 2nd intermediate host can be a mammal, bird or reptile. [tetrathyridium]
 - Dogs or cats can also act as 2nd intermediate hosts
- c. Dogs and cats are typically infected by predation of snakes, birds, and small mammals.
- d. Prepatent period is ~ 2 weeks. Small, sesame seed-sized proglottids are seen in the feces.
- e. Adult worms in the intestine. (=> dog, cat as definitive host)
 - Can multiply by asexual fission, therefore, anthelmintics used must be 100% effective to eradicate the infection.
 - Can cause diarrhea
- f. Larval worms (tetrathyridium) in the peritoneal cavity. (=> dog, cat as 2nd intermediate host)
 - Can multiply by asexual fission, therefore, anthelmintics used must be 100% effective to eradicate the infection.
 - Can cause ascites.

IV. PSEUDOPHYLLIDEAN tapeworms

Spirometra sp.

A. Morphology:

- Scolex has 2 long shallow grooves called bothrium (bothria, plural) that help in attachment.
- Adults can be 2 to 12 m long.
- Genital organs and genital pores are centrally placed on the ventral surface of each proglottid.
- The egg is operculated, oval and brown, and easily confused with the eggs of trematodes!
- Unlike the taeniids

B. Life-cycle

1. Requires 2 intermediate hosts - the first host is a copepod, and the second host is a vertebrate.
 - a. Eggs are released through a uterine pore (not with in segments)
 - b. Eggs hatch in water to release a free-living coracidium.
 - c. A copepod ingests the coracidium, which becomes a proceroid larva.
 - d. A The second intermediate host (amphibian or reptile) ingests the copepod & a plerocercoid larva develops.
 - e. A paratenic host (reptile, mammal [raccoon, rodent or pig]) may become infected with the plerocercoid by ingesting the 2nd intermediate host.
 - d. The definitive host (bobcat, dog, cat, raccoon.) is infected by ingestion of the second intermediate host, or a paratenic host.
 - e. Infection is becoming more common in the southern U.S., including North Carolina.

C. Diagnosis is by observing eggs in a fecal sedimentation. Although the tapeworms usually release so many eggs that the ova can be detected on a direct smear. Do **not** confuse the ova of this tapeworm with that of the lung fluke, *Paragonimus*.

D. Human ingestion of a proceroid or plerocercoid can lead to the zoonotic disease, sparganosis.

=====