

Lectures #10 & #11 TREMATODES

Objectives:

1. Describe the life cycle of *Fasciola hepatica*
2. List the primary host and tissue location of adult flukes, and list intermediate or paratenic hosts if applicable.
3. Describe the lesions and pathogenesis caused by infection with select trematodes.
4. Discuss control strategies (management and treatment methods) for trematodes.

I. Platyhelminthes

A. Characteristics

Triploblastic, Bilateral, Acoelomate (=> Parenchyma), Dorso-ventrally Flattened, Longitudinal & Circular Muscle Layers, Syncytial Tegument, Incomplete Digestive System (Absent in Cestodes), Hermaphroditic = Monoecious (Except Blood Flukes are Dioecious).

B. Groups of Veterinary Importance

Class Trematoda = Flukes

Order Monogenea = Monogenetic Trematodes

Ecto-Parasites of Fish

(ex. *Gyrodactylus sp.*, *Polystomum sp.*, *Benedinia sp.*)

Order Digenea = Digenetic Trematodes

Endo-Parasites of Vertebrates

Group of Veterinary Importance

(ex. *Fasciola sp.*, *Paragonimus sp.*, etc.)

Class Cestoda = Tapeworms

Endo-Parasites of Vertebrates

Group of Veterinary Importance

(ex. *Taenia sp.*, *Anoplocephala sp.*, etc.)

II. Digenean Trematodes

A. General

1. Flatworms
2. Complex Life Cycles
 - a. digenea ==> (di = two), (genea = beginnings)
 - b. Sexual Reproduction => Adult worms in definitive host
 - c. Asexual Reproduction => Larval worms in snail host

B. Morphologic Characteristics

1. General Flatworm Characteristics
2. Suckers and/or holdfast organs
3. Incomplete gut
4. Reproductive organs (testes, ovary, vitellaria)

C. Complex Life Cycle

1. Definitive Host
 - a. Adult Worms (Sexual Reproduction)
2. Environment.
 - a. Ovum (Distribution)
 - b. Miracidium (Distribution)
3. Molluscan 1st Intermediate Host
 - a. Sporocysts and/or Redia (Asexual Reproduction)
4. Environment
 - a. Cercaria (Distribution)
5. 2nd Intermediate Host or Environment
 - a. Metacercaria (Transmission)
6. Marita or Young flukes (Development)

D. Digenean Groups

1. In general, grouped by location in definitive host.

Large Animals

Liver Flukes & Bile Duct Flukes

Fasciola (ruminants)
Fascioloides (ruminants)
Dicrocoelium (ruminants)

Intestinal Flukes

Acanthatrium (bat / horse)

Small Animals

Bile Duct & Pancreatic Duct Flukes

Playnosomum (cats)
Eurytrema (cats)

Lung Flukes

Paragonimus (dogs, cats)

Intestinal Flukes

Nanophyetus (dogs, cats)

Blood Flukes

Heterobilharzia (dogs)

Select Digeneans of Veterinary Importance

Fasciola hepatica

Common Liver Fluke

A. Morphology

- Large, leaf-like, liver/bile duct flukes
- Suckers: small, anterior
- Dendritic Intestines, Testes & Ovary

B. Life Cycle

1. Definitive Hosts

Cattle, Sheep, Goats, Camelids

2. Ova, Miracidia

3. Molluscan 1st Intermediate Host

Aquatic snails (pond / puddle snails)

Sporocysts and Redia

4. Cercaria

5. Environment

Metacercaria on Aquatic Vegetation

6. Young Flukes

a. Young flukes migrate through liver parenchyma => Acute DZ

b. Mature Flukes in bile ducts => Chronic DZ

7. Prepatent period: about 2 months

8. Entire Life Cycle: 3-6 months

C. Geographic Distribution

1. Florida & Puerto Rico

2. Gulf Coast States

3. Pacific Northwest

4. Not endemic in North Carolina

D. Pathology

1. Acute

- Due to migration of young flukes through liver
- Severe liver damage, hemorrhage, inflammation
- May result in sudden death, especially in goats & sheep
- Potential for hepatic clostridial infections thus "black disease" & death

2. Chronic

- Due to adults in bile ducts
- Loss of condition, weakness, anemia, hypoproteinemia
- Liver & bile duct fibrosis, cholangiohepatitis
- Stenosis of bile ducts w/ eventual calcification.
- Usually results in liver condemnation

E. Diagnosis

- Fecal Sedimentation (chronic DZ only)
- Clinical Signs: Loss of condition, weakness, anemia, edema & "bottle-jaw"
- Liver Enzyme Analysis
- Necropsy
- Herd History

F. Treatment

1. Clorsulon (*Curatrem & Ivomec Plus*)

- Not licensed for breeding dairy cattle
- 8 day pre-slaughter withdrawal time

2. Albendazole (*Valbazen Suspension PI*)

- Not licensed for breeding dairy cattle
- 27 day pre-slaughter withdrawal time

G. Control

1. Snail Control

- molluscicides
- adequate pasture drainage

3. Strategic Drug Control

- Ivermectin + Clorsulon (*Ivomec Plus*)
- Early fall in Southern US

2. Grazing Control

- Restrict access to wet areas

H. Zoonosis

1. Human Fascioliasis – ingest metacercaria w/ raw vegetation. (Europe, Africa, Cuba, South America)

2. Halzoun - Ingestion of raw liver. Adults attach to nasopharynx

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Fascioloides magna

Giant American Liver Fluke

A. Morphology

- Very Large, leaf-like, liver flukes
- Suckers: small, anterior
- Dendritic Intestines, Testes & Ovary

B. Life Cycle

1. Cervids (deer, elk)
2. Aquatic snails (pond / puddle / swamp)
3. Aquatic Vegetation
4. Marita or Young Flukes
 - Young flukes migrate through liver parenchyma
 - Adults mature in host cysts with connections to bile ducts
5. Dead-end Hosts
 - Sheep & Goats: migration of young flukes cause liver damage & death
 - Cattle: Adult worms walled off in fibrotic cysts

C. Geographic Distribution

1. Scattered throughout US
2. Prevents goat & sheep production in Minnesota & Michigan
3. Sporadic in white-tailed deer throughout North Carolina

D. Pathology

1. Wild Cervids
 - Minor liver damage, unless very heavy infection
2. Sheep & Goats
 - Severe liver damage, hemorrhage, inflammation
 - Usually results in sudden death
3. Cattle
 - Minor damage, unless very heavy infection
 - Liver Condemnations

E. Diagnosis

1. Wild Cervids
 - Fecal Sedimentation
 - Necropsy
2. Domestic Ruminants (non-patent)
 - Necropsy
 - Swampy pastures shared with wild cervids.

F. Treatment

1. Wild Cervids
 - Clorsulon
 - Albendazole
2. Domestic Ruminants
 - No good treatment

G. Control

1. Snail Control
 - molluscicides
 - adequate pasture drainage
2. Grazing Control
 - Restrict access to wet areas
 - Restrict wild cervid access to pastures w/ water feature (pond, ditch, etc.)

H. Zoonosis: NONE

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Dicrocoelium dendriticum

Lancet Fluke

A. Morphology

- Translucent, lancet-shaped bile duct flukes. (Lancet Fluke)
- Ventral sucker in anterior half of body.
- Globular tandem testes; posterior to the ventral sucker. Globular ovary posterior to testes.

B. Life Cycle:

1. Definitive Hosts & Distribution

- Ruminants (Sheep & Goats); Variety of others (Cattle, deer, rabbits, pig, etc.)
- Bile ducts
- Prepatent Period: 80 days
- Terrestrial snail & ants
- Northeast US & Canada, and widely distributed around the world

C. Pathology

- Non-pathogenic in younger animals
- Bile duct hyperplasia, hepatic cirrhosis
- Slow chronic progressive disease causing decreased productivity in older animals (ewes)

D. Diagnosis

- Edema & emaciation in older stock
- Ova in sedimentation

E. Treatment ---- Albendazole in high doses

F. Control ---- Eradicate Ant hills

G. Zoonosis --- Very Rare

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Paragonimus kellicotti

Lung Fluke

A. Morphology

- Oval, thick, lung flukes.
- Ventral sucker located mid-ventral.
- Lobed Opposite Testes Posterior, Lobed Ovary lateral to mid-ventral genital pore.

B. Life Cycle

1. Dogs, cats, pigs, Mink, Muskrats (lungs)
2. Ova passed in the lung mucus & sputum, swallowed then passed in the feces.
3. Pomatiopsid lotic snails.
4. Crayfish
5. Young Flukes
 - Young flukes migrate from intestine through the peritoneal cavity and across the diaphragm.
 - Adult flukes pair-up in cyst in lung parenchyma w/ bronchiole connections.
 - Prepatent period: about 4 week

C. Geographic Distribution

- Throughout North America
- Found in North Carolina (dogs, cats, mink, raccoons, bob cats)

D. Pathology

- Bronchiolar inflammation and eosinophilic granulomas in the lung parenchyma.
- Acute Pneumothorax and sudden Death

E. Diagnosis

- Clinical signs: lethargy, chronic intermittent cough, "rusty" sputum or mucus.
- Fecal Sedimentation
- Sputum Smear
- Thoracic radiographs 3-4 four weeks post-infection
- History of possible access to crayfish.

F. Treatment

1. Albendazole or Fenbendazole
 - Daily for 1-3 weeks
2. Praziquantel
 - 3 times a day for 3 days

G. Control

1. Snail Control
 - Molluscicides: check government restrictions
2. Environmental Control
 - Restrict access to crayfish (streams, creeks, rivers)

H. Zoonosis: Has been reported.

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Nanophyetus salmincola

Vector for Salmon Poisoning

A. Morphology

- Minute intestinal flukes.
- Ventral sucker located mid-ventral.
- Oval, Opposite, Posterior Testes; Spherical Ovary Anterior to Testes.

B. Life Cycle

1. Dogs, cats. Fox, Coyote, raccoon, opossum, otter, mink, lynx, etc.
2. Lotic snails (stream / river)
3. Salmon, Trout, etc.
4. Flukes mature in the small intestine.
 - Prepatent period: 5 to 8 days

C. Geographic Distribution ---- Only in the Pacific Northwest (northern CA, OR, WA)

D. Pathology

1. Flukes alone -- No Pathology to minor enteritis.
2. Flukes carrying the rickettsia, *Neorickettsia helminthoeca*
 - "Salmon Poisoning"
 - Severe pathology (50% to 90% mortality)
 - Only affects canids (dogs, fox, coyote)
 - 5 to 7 day incubation period
 - Sudden onset of fever & loss of appetite.
 - Later hemorrhagic enteritis with ocular discharge, profuse diarrhea, marked vomiting, swelling of lymph nodes.
 - Those that recover are immune for life.

E. Diagnosis

1. Fluke infection: Ova in feces.
2. Salmon Poisoning:
 - Clinical signs (diarrhea, vomiting, ocular discharge, etc.)
 - Demonstration of rickettsia in lymph node or splenic aspirate.
 - History of possible access to raw salmon or trout.

F. Treatment

1. Fluke infection: Injectable Praziquantel.
2. Salmon Poisoning: Broad Spectrum Antibiotics

G. Control ---- Prevent access to raw fish (streams, creeks, rivers), when in Northwest US

H. Zoonosis

1. Fluke Infection: YES
2. Salmon Poisoning: NO

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Acanthatrium oregonense

Vector for Potomac Horse fever

A. Life Cycle

1. Bats (small intestine)
2. Stream snails
3. Caddisflies & Mayflies

B. Pathology

1. Horse: Potomac Horse Fever
 - *Neorickettsia risticii* –in tissue of fluke
 - Colitis — diarrhea, fever, depression
 2. Accidental ingestion of caddisflies or mayflies infected with fluke metacercariae that is infected with *N. risticii*
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Platynosomum fastosum
Feline Liver Fluke
agent of “Lizard Poisoning”

- A. Morphology
1. Translucent, elongate flukes.
 2. Ventral sucker in anterior half of body.
 3. Lobed Opposite Testes Posterior to the Ventral sucker, Lobed Ovary posterior to testes.
- B. Life Cycle
1. Cats (Domestic & Wild) (bile ducts) & opossum
 - Terrestrial Isopods (Rolly-polly bugs)
 2. Ova passed in the feces.
 3. Miracidia develops in ova
 4. Ova ingested by snail host
 5. Terrestrial snails
 6. Cercaria released in “slime balls” ingested by 2nd Intermediate host
 7. 3rd IH or Paratenic hosts ??
 - Anoles, skinks, toads
 - Metacercaria
 8. Flukes mature in the bile ducts.
 - Prepatent period: 8 to 12 weeks
- C. Geographic Distribution
1. Florida & Hawaii
 2. Caribbean, South America, Central America, Malaysia, Korea, West Africa
- D. Pathology
1. Does not normally cause pathology
 2. May cause mild, temporary in-appetence with hepatic dysfunction
 3. The rare severe cases cause progressive icterus and possibly death. (“lizard poisoning”)
- E. Diagnosis
1. Clinical signs: diarrhea, vomiting (possibly continuous in severe terminal stages).
 2. Fecal Sedimentation
 3. History of possible access to lizards or toads.
- F. Treatment
1. Albendazole or Praziquantel.
 2. Surgical removal has also been suggested.
- G. Control
1. Environmental Control
 - Restrict access to lizards or toads (especially when in endemic areas like Florida)
- H. Zoonosis ---- None
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Eurytrema (Concinnum) procyonis
Raccoon Pancreatic Fluke

- A. Morphology
1. Translucent, elongate pancreatic duct flukes.
 2. Ventral sucker in anterior half of body.
 3. Lobed Opposite Testes Posterior to the Ventral sucker, Lobed Ovary posterior to testes.
- B. Life Cycle
- Raccoons, Fox, Cats (Pancreatic duct)
 - Terrestrial snail, Grasshopper
 - New York, Connecticut, Maryland, Kentucky, North Carolina
- C. Pathology --- Pancreatic duct fibrosis & Pancreatic atrophy
- D. Diagnosis: 1. Vomiting & chronic weight loss 2. Ova in sedimentation
- E. Treatment ---- Six day course of Fenbendazole is suggested
- F. Control ---- Restrict outdoor access
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Heterobilharzia americana

Canine Blood Fluke

A. Morphology

- Dioecious elongate blood flukes.
- Female resides in the gynecophoric canal of the male

B. Life Cycle

1. Definitive Hosts

- Dogs (mesenteric veins)
- Raccoons, wild canids, bobcat, nutria, etc.

2. Ova with miracidia passed in the feces.

3. Miracidia

4. Molluscan 1st Intermediate Host

- Aquatic snails (Pond / puddle / ditch)
- Sporocysts

5. **Cercaria penetrate definitive host**

6. Young Flukes or Schistosomula

- Flukes migrate to the mesenteric vessels to mature.

7. Prepatent period: 68 days

C. Geographic Distribution

1. Texas , other Gulf Coast States, Georgia, South Carolina & North Carolina

2. North Carolina: sporadic throughout

D. Pathology

1. Adults ---- Minor to no pathology.

2. Ova

- Lodge in mesenteric venules & transported to other organs.
- Granulomatous reaction
- Destruction & fibrosis of intestinal mucosa.
- Intestinal dysfunction that leads to wasting and death.

E. Diagnosis

1. Fecal sedimentation or smear.

2. Miracidial Hatching

3. Fecal PCR test @ Texas A&M

4. Clinical signs: lethargy, anorexia, intermittent vomiting, bloody liquid diarrhea, dehydration.

5. Laparotomy

6. History of possible access to water (streams, ponds, etc.).

7. Water Loving Breed

F. Treatment

1. Fenbendazole: repeat treatments.

2. Praziquantel: 5 times the dose for treatment of tapeworms.

G. Control --- Prevent access to bodies of water (streams, creeks, rivers, ditches)

H. Zoonosis --- "Swamp itch" or "swimmer's itch"

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