Introduction to the helminth parasites

BVM&S Parasitology
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Taxonomic Relationships of the Helminth Parasites

Parasitic Helminths

Platyhelminthes "Flatworms"
- Trematodes "Flukes"
- Cestodes "Tapeworms"

Nematelminthes "Roundworms"
- Nematodes
  - Roundworms
  - Lungworms
  - Hookworms
  - Pinworms

Acanthocephala "Spiny-headed worms"
Why are helminths important?

• Production losses due to
  – Competition for nutrients
  – Damage to body systems e.g. gut, liver
  – Death
• Animal welfare
  – Companion animals
  – Food animals
• Public health (zoonotic infections)
Where do helminths live?

- **BRAIN**
  - Tapeworm larvae

- **LUNGS**
  - Lungworm
  - Tapeworm larvae

- **MUSCLE**
  - Tapeworm larvae

- **SKIN**
  - Filarial worms

- **LIVER**
  - Fluke
  - Tapeworm larvae

- **SMALL INTEST.**
  - Nematodes

- **LARGE INTEST.**
  - Nematodes

- **ABOMASUM**
  - Nematodes

- **BLOOD**
  - Flukes
  - Filarial worms

- In the environment
Lecture topics

• Diagnosis & disease
  – Morphology
  – Feeding
  – Reproduction
  – Behaviour in the host

• Epidemiology & control
  – Life cycles
  – Survival strategies
Morphology

• **External features**
  – Size
  – Shape
  – Functional anatomy

• **Internal features**
  – Outer layer
  – Structural
  – Functional
Same parasite - different appearance

- Adults
  - Males
  - Females
- Eggs
- Juvenile
  - Cysts
  - Larvae
Feeding

• Passive feeders
• Browsers
• Tissue feeders
  – Solid tissues
  – Blood
Reproduction

• Asexual
  – Multiplication
  – Parthenogenesis

• Sexual
  – Monoecius
  – Dioecius
Behaviour in the host

- Non-migratory
- **Migratory**
  - Hepato-tracheal
  - Somatic
Life cycles

• Direct
• Indirect
  – Definitive Host
  – Intermediate host
  – Arthropod (vector) borne
Example of a simple, direct life cycle

- Adults
- Egg
- L₁
- L₂
- L₃
- L₄
- L₅
Example of a complex, indirect life cycle

Eggs pass out in faeces

Larval stage develops inside egg

Larval stage passed out in slime ball

1st intermediate host ingests egg

2nd intermediate host ingests slime ball

Definitive host ingests ant while grazing

Introduction to the helminths
Host types

- **Definitive host**
  - Host where adult stages develop

- **Intermediate host**
  - Host where immature stages develop, indirect life cycle only

- **Transport host**
  - Immature stage not retained, no parasite development

- **Paratenic host**
  - Immature stage retained but no parasite development
Survival strategies

- Permanent parasites
- Temporary parasites
  - Morphological adaptations
  - Physiological adaptations
    - Hypobiosis
    - Critical hatching conditions
    - Peripatruriant rise
Ascarid egg
Hypobiosis

• Physiological - Toxocara
  Larvae enter hypobiotic state in tissues
  Larvae reactivated during pregnancy in dogs & cats and infect foetus

• Seasonal - Ostertagia
  – Larvae taken in during Autumn overwinter in the gastric glands of the abomasum
  – Larval development resumes in Spring giving rise to new generation of adults
Critical Hatching Conditions

- Larvae overwinter on the pasture inside the egg stage.
- Larvae hatch onto pasture only after receiving an environmental trigger.
- Trigger is usually a change in temperature.
Periparturient (Spring) Rise

- Increase in parasite egg counts around parturition time – usually spring in UK
- Impact – large numbers of infective larvae on the pasture when
  - Pasture conditions optimum for survival
  - Young animals available for infection
Trichinella
## Characteristics of helminths

<table>
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<th>Trematode</th>
<th>Cestode</th>
<th>Nematode</th>
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<tr>
<td><strong>Appearance</strong></td>
<td>Leaf-like</td>
<td>Tape-like</td>
<td>Worm-like</td>
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<td><strong>Cross-section</strong></td>
<td>Flattened</td>
<td>Flattened</td>
<td>Cylindrical</td>
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<td><strong>Body cavity</strong></td>
<td>Absent</td>
<td>Absent</td>
<td>Fluid-filled</td>
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<td><strong>Gut</strong></td>
<td>Blind sack</td>
<td>Absent</td>
<td>True gut</td>
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<td><strong>Life cycle</strong></td>
<td>Indirect</td>
<td>Indirect</td>
<td>Direct &amp; indirect</td>
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<td><strong>Reproduction</strong></td>
<td>Monoecious</td>
<td>Monoecious</td>
<td>Dioecious</td>
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</table>
Internal structure - *Nematodes*

- Cuticle
- Nerve ganglion
- Dorsal nerve
- Ventral nerve
- Pharynx
- Intestine
- Pseudocoelom
- Excretory tube
- Testis
- Lateral hypodermal muscle
- Lateral nerve
- Ventral ray
- Ventral nerve
- Intestine
- Longitudinal muscle
- Oesophageal gland duct
- Hypodermis
- Pseudocoelom
Internal structure - *Trematodes*
Internal structure - Cestodes

- A) Hooks on scolex
- B) Suckers
- C) Young proglottids
- D) Genital pore
- E) Excretory canal
- F) Nerve cord
- G) Testes
- H) Sperm duct
- I) Vagina
- J) Uterus
- K) Ovary
- L) Vulva
- M) Uterus with eggs
Adult stages of the helminths (not to scale)

- **Trematodes**
- **Cestodes**
- **Nematodes**
Feeding adaptations

- Browsing
- Blood feeding
- Tissue feeding

Introduction to the helminths
Males & Females

Bursa

Vulval flap
Helminth Body Structure (TS)

**Nematode**
- Dorsal nerve
- Cuticle
- Ovary
- Intestine
- Excretory canal
- Uterus
- Muscle
- Hypodermis
- Ventral nerve

**Trematode**
- Solid parenchyma
- Uterus with eggs
- Gut

**Cestode**
- Nerve chord
- Testes
- Uterus with eggs

Solid parenchyma

Introduction to the helminths
Two forms of migration

Hepato-tracheal migration

Somatic migration