Roundworms of Veterinary/ Medical importance.

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Dr. J.N. Chege
Introduction

Helminthes:

1. **Round worms**
   a) True round worms
   b) Thorny headed worms

2. **Flat worms**
   a) Tape worms
   b) Flukes

3. **Annelids**
   a) Leeches
   b) Earthworms
Nematodes (Round worms)

Geographic distribution
• World wide

Hosts
• Domestic & wild animals including fish & reptiles
• May affect any body organ
• Mostly found in the gut
Nematodes- General life-cycle

- Eggs passed out in faeces/ urine/ sputum/picked by arthropod vectors
- Eggs hatch to release first stage larvae ($L_1$)
- Larvae moult 4 times (ecdysis)
- $1^{st}$ & $2^{nd}$ moult usually in the environment
- $L_3$ normally the infective stage
- $3^{rd}$ & $4^{th}$ moult usually in the final host resulting in adults
- In some species the infective stages can be $L_1$ or $L_2$
- In other species, eggs hatch in-uterine & pass out $L_1$
- In others, larval development occurs in eggs to the infective stages - i.e. $L_1$ or $L_2$ (Infection through egg ingestion)
- In others, larval development occurs in eggs to $L_3$ - hatched out to infect host
General life-cycle cont.

Factors influencing egg output

1. **Parasite factors**
   - Species of parasite (fecundity)
     - Haemochus: 5000-15000/day/female
     - Trichostrongylus: 100-200/day/female
   - Stage of infection

2. **Host factors**
   - Breed
   - Levels of host infection
   - Immunity/ age/ physiological stage (PPR)

3. **Climate**
   - Changing patterns of infection
Effects of age/physiological factors

- Lambs
- Ewes
- Yearlings
General life-cycle cont..

Development to infective larvae in the environment

Influenced by:

- **Temperature:** Optimum 22–26°C (5–30°C)
  - Little variation in tropics
- **Humidity:** 85 – 100%
  - High regional/seasonal variation
General life-cycle cont…

Survival of infective larvae in the environment

- Depends upon adequate moisture & shade
  - Microclimate
  - High moisture/ low vegetation cover: rapid movement/ fast death
  - Survive longest in cool weather

- Desiccation from lack of rainfall most lethal
  - Larvae protection from desiccation by crust of faeces or migration into soil
  - Larvae ingested during dry seasons undergo hypobiosis

- Effects of climate change
  - Changing patterns of infection
Survival of infective larvae

**NOVEMBER:** High moisture/ low vegetation cover, rapid $L_3$ movement, short live span

**MAY:** Low moisture/ heavy vegetation cover, Slow $L_3$ movement/ longer survival

**JULY:** Low moisture, dry herbage no $L_3$ recovered

Rainfall, 1999-2001
Levels of host infection

Depends on:

1. Number of infective larvae ingested as influenced by:
   - Climate
   - Levels of pasture contamination
   - Grazing patterns of ruminants present

2. Acquired resistance as influences by:
   - Parasite factors: Species & genetics
   - Host factors: Species, genetics, nutrition, physiological stress

3. Intrinsic multiplication rate of parasite as influences by:
   - Fecundity & pre-patent period
   - Development & survival rates of the species

4. Worm control practices: pasture mgt, deworming
Pathogenicity of nematode infestation

Depends on:

1. **Parasite factors**
   - Parasites species
   - Single/mixed infection: Usually mixed infection with additive pathogenic effects
   - Levels of infection

2. **Host factors**
   - Species/ breed
   - Nutritional status of host
   - Age of host, young most susceptible
   - Physiological status
Pathogenicity cont.

1. **Larval stage**
   - Damage of gut mucosa by barrowing larvae: Ostertegia
   - Migrating larvae cause tissue damage along the migratory route: Ascarids, strongylus
   - Hypersensitivity reaction eg skin (hook worms)
   - Blood/protein loss: Haemonchus, hook worms, Trichuris

2. **Adults**
   - Compete for nutrients with host
   - Obstruction: Ascarids, lungworms
   - Tissue irritation
   - Blood/protein loss
Manifestation of nematode infestation

• Anemia
  ✓ Pale mucus membranes
  ✓ Oedema- bottle jaw
Manifestation cont.

• Unthriftiness
  ✓ Poor body condition/ thin/ pot belly
  ✓ Weight loss/ decreased gain
  ✓ Rough hair coat
  ✓ Hair easily falls off
Manifestation cont..

- Low productivity
  - Milk, wool, meat
  - Reproductive ability
  - Poor quality products
- Diarrhoea/ constipation
- Hypersensitivity (skin)
- Respiratory distress/ coughs
- Death
Diagnosis of nematode infestation

• Clinical presentation
• Samples for laboratory analysis
  – Faecal epg
  – Faecal culture (L₃)
  – Sputum
  – Urine
  – Blood
  – Tissue biopsy
• Postmortem
  – Pm lesions
  – Worm recovery & identification (Morphology)
## Nematodes of ruminants

<table>
<thead>
<tr>
<th>Location</th>
<th>Genera</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oesophagus</td>
<td>Gongylonema</td>
</tr>
<tr>
<td>Stomach</td>
<td>Haemonchus*, Ostertagia, Trichostrongyulus</td>
</tr>
<tr>
<td>S/ intestines</td>
<td>Trichostrongyulus*, Cooperia, Nematodirus, Bunostomum, Gaigeria, Toxocara*, Capillaria, Strongyloides</td>
</tr>
<tr>
<td>L/ intestines</td>
<td>Trichuris*, Oesophagostomum*, Chabertia, Skrjabinema</td>
</tr>
<tr>
<td>Lungs</td>
<td>Dictyocaulus*, Protostrongyulus, Muellerius</td>
</tr>
<tr>
<td>Eye</td>
<td>Thelazia*</td>
</tr>
<tr>
<td>Skin/ C tissue</td>
<td>Stephanofilaria, Onchocerca, Parafilaria</td>
</tr>
<tr>
<td>Blood vessels</td>
<td>Elaophora</td>
</tr>
<tr>
<td>Ear</td>
<td>Rhabditis</td>
</tr>
</tbody>
</table>
Haemonchus
(Large stomach worm, twisted wire worm)

Species | Hosts
---|---
1. H. contortus | Sheep & goats
2. H. placei | Cattle

Morphology
- Reddish brown worms
- Have cervical papillae
- Ovaries spirally arranged around the intestines
- Ovaries white, intestines red (blood filled) gives barbed wire look, thus name barber pole
- Males are bursate
- Females have large vulva flaps
- Typical strongyle eggs
Pathogenicity & clinical manifestations

- Blood suckers
- Causes anemia (pale mucous membranes)
- Oedema - bottle jaw
- Unthriftiness
- Death
Trichostrongylus

Species          Predilection site
• T. axei         Stomach
• T. colubriformis Small intestines

Morphology
• Slender, small
• Size: 3 – 9 mm
• Males are bursate
• Females have no vulva flap
• Typical strongyle eggs

Pathogenicity & clinical manifestation
• Catarrhal enteritis / gastritis
• Diarrhoea/ black scour
• Unthriftiness
Ascarids in ruminants
Genus: Toxocara / Neoscaris (Cattle ascarids, large round worms of cattle)

Species  |  Hosts
---|---
• T. vitulorum  |  Cattle

Morphology
• Size: 25 - 30 cm
• Translucent cuticle, organs visible through
• Typical ascarid eggs
Ascarids cont.

Transmission

- Infection by ingestion of L₂ in eggs, through colostum, possibly transplacental

Pathogenicity & clinical manifestations

- Intestinal obstruction
- Pot belly
- Compete for food with host
- Poor appetite
- Diarrhoea
- Unthriftiness
Genus: Trichuris (Whip worms)

Species: T. ovis

Morphology
- Size: 5 – 7 cm
- Thin hair like anterior part & thick posterior part
- Posterior end curved in males
- Typical trichurid eggs

Pathogenicity & clinical manifestations
- Blood suckers: Anaemia
- Burrow anterior end into mucosa,
  - Irritate mucosa, causing diarrhoea
Oesophagostomum

Species | Hosts
--- | ---
O. ovis | Sheep & goats
O. radiatum | Cattle

Morphology

- Size: 6 - 24 mm
- Males are bursate
- Have leaf-crown
- Have cephalic vesicle
- May have cephalic papillae
- May have cephalic alae
Oesophagostomum cont.

Pathogenicity & clinical manifestations

1. Larvae arrested in gut wall form nodules
2. Irritate mucosa, causing diarrhoea
3. Unthriftiness
Lung worms in ruminants

1) *Dictyocaulus*

- **Species**
  - *D. viviparus*
  - *D. filaria*

- **Hosts**
  - Cattle & camel
  - Sheep & goats

**Morphology**

- Slender, thread-like
- Size: 3 - 10 cm
- Males are bursate

**Pathogenicity & clinical manifestation**

- Causes bronchitis, pulmonary emphysema, oedema
- Manifests as respiratory distress, persistent coughs & frothing
- Decreased production
Thelazia (Eye worm)

Species    Hosts
• T. rhodesii  Cattle
• T. bovis

Predilection site: Lacrymal ducts & conjunctival sac

Morphology
• Milky white
• Size: 8 - 18mm

Transmission: By muscid flies

Pathogenicity & clinical manifestations
• Eye inflammation, obstruction of lachrymal duct
• Lacrimation, blindness
# Nematodes of equine

<table>
<thead>
<tr>
<th>Location</th>
<th>Genera</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stomach</td>
<td>Habronema*, Trichostrongylus</td>
</tr>
<tr>
<td>S/ intestines</td>
<td>Trichostrongylus, Parascaris*, Strongyloides</td>
</tr>
<tr>
<td>L/ intestines</td>
<td>Strongylus*, Triodontophorus, Craterostomum, Oesophagondontus, Trichonema, Oxyuris*</td>
</tr>
<tr>
<td>Lungs</td>
<td>Dictyocaulus</td>
</tr>
<tr>
<td>Eye</td>
<td>Thelazia</td>
</tr>
<tr>
<td>Skin/ C tissue</td>
<td>Onchocerca</td>
</tr>
<tr>
<td>Peritonium</td>
<td>Setaria</td>
</tr>
</tbody>
</table>
Genus: Habronema

Species
H. muscae
H. Microstoma (H. majus)
H. Megastoma (Draschia)

Transmission
Musca domestica
Stomoxys calcitrans
M. domestica
Genus: Habronema cont…

Morphology

H. muscae & H. microstoma
- Yellowish
- Pharynx is cylindrical
- Size: 16 - 25 mm long

H. megastoma (Draschia)
- Whitish
- Head constricted off from the body
- Pharynx funnel shaped
- Size: 7 - 13
Genus: Habronema cont...

Pathogenicity & clinical manifestations

- Causes tumour-like lesions in stomach, eye & skin
- May be colics
- Causes catarrhal gastritis
Parascaris equorum

Morphology
• Size: 15 - 50 cm by 3 – 8 mm thick
• Stout worms with large heads
• Eggs: Typical ascarid

Pathogenicity & clinical manifestations
• Migrating larvae: Tissue damage
• Adults: intestinal obstruct & possible rupture
• Malnutrition
• Unthrifty
Strongylus spp.
(Migratory strongyles of horse, large strongyles, large blood worms, large red worms)

Morphology
• Size: 16 – 47
• Stout
• Large buccal capsule
• Well developed buccal crown
• May have teeth
• Males are bursate
• Typical strongyle eggs
Pathogenicity & clinical manifestations

- Plug feeders: Intestinal ulcers
- Blood suckers: Anaemia
- Nodular formation on gut wall: Interferes with function
- Damage to circulatory system: Haemorrhage, anaemia
- Liver damage
- Diarrhoea
- Colics
- Unthriftiness
- Lameness
Oxyuris equi (Pin worms of horses)

- Oesophagus with large posterior bulb
- Females with long pointed tail
- Males: One pointed pin shaped spicule
- Size: 9 - 150 mm long
- Eggs: One side flattened
  - Unipolar plugs
Pathogenicity & clinical manifestations

- Plug feeders: Intestinal ulcers
- Irritate intestinal mucosa & skin when depositing eggs
# Nematodes of poultry

<table>
<thead>
<tr>
<th>Location</th>
<th>Parasite</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oeso/ crop</td>
<td>Gongylonema ingluvicola, Capillaria spp.</td>
</tr>
<tr>
<td>proventriculus</td>
<td>Tetrameres spp., Capillaria spp., Dispharynx nasuta</td>
</tr>
<tr>
<td>Gizzard</td>
<td>Acuaria hamulosa</td>
</tr>
<tr>
<td>SI</td>
<td>Ascaridia galli, Capillaria spp.</td>
</tr>
<tr>
<td>Caecum</td>
<td>Heterakis spp., Allodapa spp., Capillaria spp.</td>
</tr>
<tr>
<td>Eye</td>
<td>Oxyspirura mansoni</td>
</tr>
<tr>
<td>Trachea</td>
<td>Syngamus trachea*</td>
</tr>
</tbody>
</table>
Tetrameres

Species: T. americana, T. fissispina

Intermediate hosts: Grass hoppers, cockroaches

Morphology:
- Males are white, slender & Filiform
  Females are globular or coiled
- Size: Males 5–5.5 mm long
  Females: 3.5–4.5 mm long by 3 mm wide

Pathogenicity & clinical manifestation:
- weight loss, decreased production, proventiculus thickens & oedematous, partial obstruction

Diagnosis:
- Eggs in faeces
- Demonstrate worms at PM
Ascaridia galli

**Hosts:** Chicken, guinea fowl, turkey, duck, goose, other birds

**Morphology**
- Size: 5 – 11.6 cm
- Eggs: Oval, smooth shell

**Pathogenicity & clinical manifestations**
- Young birds most susceptible
- Loss of appetite, weigh loss, dropping wings, ruffled feathers, anaemia, diarrhoea & mortality, decreased egg production
**Heterakis gallinarum**

**Hosts:** Chicken, guinea fowl, turkey, duck, goose, other birds

**Morphology**
- Have 3 lips anteriorly
- Size: 7 – 15 mm long
- Eggs: Thick, smooth shell

**Pathogenicity & clinical manifestation**
- Immature stages feed on mucosa leading to ulceration, thickening of mucosa, haemorrhages, & malnutrition
- Biological vector of *Histomonas meleagrisidis*
**Syngamus trachea**

**Hosts:** Chicken, guinea fowl, turkey, goose, other birds

**Predilection site:** Trachea & lungs

**Morphology**
- Reddish
- Two sexes in permanent copulation
- Size: 2 – 20 mm long
- Eggs: Thick operculum in both poles

**Pathogenicity & clinical manifestations**
Mucous in trachea, difficult breathing (gaping) death
Emaciation, weakness & anemia
# Nematodes of dogs & cats

<table>
<thead>
<tr>
<th>Location</th>
<th>Parasite</th>
<th>Host</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oesophagus</td>
<td>Spirocerca lupi</td>
<td>Dog</td>
</tr>
<tr>
<td>S/intestines</td>
<td>Ancylostoma caninum</td>
<td>Dog</td>
</tr>
<tr>
<td></td>
<td>A. tubaeforme</td>
<td>Cat</td>
</tr>
<tr>
<td></td>
<td>Toxocara canis</td>
<td>Dog</td>
</tr>
<tr>
<td></td>
<td>T. cat</td>
<td>Cat</td>
</tr>
<tr>
<td></td>
<td>Toxascaris leonina</td>
<td>Dog/Cat</td>
</tr>
<tr>
<td>L/intestines</td>
<td>Trichuris vulpis</td>
<td>Dog</td>
</tr>
<tr>
<td></td>
<td>T. Serrata</td>
<td>Cat</td>
</tr>
<tr>
<td>Resp/ tract</td>
<td>Filaroides osleri</td>
<td>Dog</td>
</tr>
<tr>
<td></td>
<td>Aelurostrongylus abstrasus</td>
<td>Cat</td>
</tr>
<tr>
<td>Cir/system</td>
<td>Dirofilaria immitis</td>
<td>Dog/Cat</td>
</tr>
</tbody>
</table>
Spirocerca lupi

Predilection sites:
• Walls of oesophagus, stomach & aorta,

Morphology
• Pink coloured worms, that are usually coiled into a spiral
• Size: 30 - 80 mm long
• Eggs: Thick walled, contain larvae at time of laying
Transmission

- Eggs ingested by coprophagous beetles
- Develop to infective $L_3$
- Dogs infected by ingesting beetles or paratenic host
Pathogenicity & clinical manifestations

1. Migratory larvae
   - Tissue damage: In aorta cause stenosis or aneurysms with possibility of rapture & sudden death

2. Adults: Nodules in oesophagus, stomach & aorta
   - In oesophagus cause obstruct, persistent vomiting & emaciation, may become cancerous (fibrosarcomas or osteosarcomas) & can metastasis to other organs
   - Thickening of long bones
Hook worms of dogs & cats

Ancylostoma caninum

Final host: Include the dog, fox & other wild carnivores

Morphology

• Grey or reddish coloured worms
• Fairly rigid worms
• Anterior end bent dorsally
• Has deep buccal capsule
• Three pairs of ventral marginal teeth on the buccal capsule
• Size: 10 - 16 mm
• Males are bursate
• Eggs: Typical strongyle
Ancylostoma caninum cont.

Transmission

1) Oral infection - by ingesting infective L₃
2) Skin penetration - larvae migrate to the lungs, up the trachea, coughed and swallowed
3) Prenatal infection of the fetus inuteral (L₃ arrested in liver)
4) Colostrol or lactogenic infection, larvae passed through milk to puppies
Ancylostoma caninum cont..

Pathogenesis & clinical manifestations

1. Migrating larvae:
   • Cause dermatitis & verminous pneumonia

2. L₄ to adults:
   • Are blood suckers causing anaemia & hypoprotenaemia (oedema)
   • Irritate intestinal mucosa, causing hypermotility, diarrhoea & vomiting
   • Plug feeders, causing haemorrhagic ulcer & bloody faeces
   • Animals become anorectic & loss weight
   • Death is common especially in young pups
Ancylostoma tubaeforme

Final host: Cats

Morphology
• Resembles A. caninum but much smaller
• Size: 9.5 - 15 mm long
• Bursate
• Three pairs of ventral marginal teeth on the buccal capsule longer than those of A. caninum
• Eggs: Typical strongyle

Pathogenicity & clinical manifestations
• As in A. caninum
Toxocara canis

Morphology
• Have three (3) well developed lips (1 dorsal, 2 sub-ventral)
• Sizes: Up to 18 cm long
• Have large cervical alae giving the anterior end an arrow like appearance
• Eggs: Sub globular with thick finely pitted shell

Modes of infection
1) Direct oral infection
2) Prenatal (uterine) infection
3) Lactogenic (colostral or neonatal) infection
4) Paratenic host infection
Toxocara canis cont.

Pathogenicity & clinical manifestations

• Infections are more severe in young puppies, especially in kennels with poor hygiene

A. migrating larvae
• Damage tissues & verminous pneumonia

B. Adult worms
• Irritate intestines causing diarrhea, vomiting, anorexia, aspiration pneumonia & deaths
• Intestinal obstruction & possible rupture
• Mild infections cause general unthriftiness, pot-belly appearance, intermittent diarrhea
Toxocara cati

- Commonly affects kittens
- Size: 3 – 10 cm
- Cervical alae may be very broad & striated

Transmission
- Direct oral
- Lactogenic
- Paratenic host (most important)
- Paratenic hosts include, rodents, chicken, earthworms, cockroaches & sheep

Pathogenicity & clinical manifestations
- Unthriftiness, pot-belly, intermittent diarrhea
- Adults may cause intestinal obstruction
Filaroides (Oslerus) osleri

Final host: dog

Morphology
• Generally slender worms
• Size: 5 - 15 mm
• Larvae: Short, S–shaped tail

Pathogenicity & clinical manifestations
• Development of granulomatous nodule
• Tracheo-bronchitis
• Chronic rasping coughs
2. *Aeluropostongylylus abstrusus*

**Final host:** Cats

**Intermediate hosts:** Snails / slugs

**Morphology**
- Males are bursate
- Size: 7.5 - 9.9 mm

**Pathogenicity & clinical manifestations**
- Adults lead to the development of typical sub-plural nodules
- Chronic rasping coughs
- Fatal in heavy infections
**Dirofilaria immitis**

**Final host:** Dogs, cat, fox, wolf, horse & man

**Intermediate hosts:** Mosquitoes

**Predilection sites:** Right ventricle, Pulmonary artery

**General Morphology**
- Slender whitish worms
- Size: 12 - 30 cm
Dirofilaria immitis cont.

Heartworm Life Cycle

The life cycle of the heartworm begins when a mosquito bites and feeds on the blood of an infected dog that is carrying tiny immature heartworms in its blood. During the next two to three weeks, the larvae develop into the infective stage within the mosquito. When the infected mosquito feeds again, it can transmit heartworm larvae to a healthy cat or dog.

A mosquito bites an infected dog, taking in heartworm microfilariae as it feeds.

The microfilariae develop into infective stage larvae within the mosquito.

Heartworms can grow up to 12 inches in length. Left untreated, heartworm disease may be fatal.

The mosquito transmits the infective stage larvae to a healthy dog. The larvae migrate through the tissues, eventually reaching the heart.
Dirofilaria cont..

Pathogenicity & clinical manifestations
Chronic disease resulting in multi-system dysfunctions

1. **Heart**: Interfere with valvular function
2. **Lungs**: Pulmonary hyper-tension:
   • Increased resistance to pulmonary circulation, congestive heart failure, ascitis, anasarca & hydrothorax
   • Clinically: Coughs, dyspnoea, tiring or collapse on exercise or death
3. **Liver**: Acute hepatic injury:
   • Anorexia, anaemia & icterus (dark brown urine)
   • Sudden death due to hepatorenal failure
4. **Kidney damage**:
   • Due to deposition of immune-complex substances in the kidney (ab-ag) & products of rbc breakdown
Dirofilaria immitis microfilaria

Identification of the Microfilariae of the Dog

Dirofilaria immitis

Dipetalonema reconditum
Enterobius vermicularis

**Host:** Man / other primates

**Predilection sites:** Caecum, appendix ascending colon

**Morphology**
- Cream coloured
- Males: single pin like spicules
- Females: Long pointed tails
- Size: 2-13 mm
- Oesophagus: large posterior bulb

**Pathogenicity**
- Irritate intestinal mucosa & skin when depositing eggs especially at night
- May invade female genitalia
Human filariasis

• One of the neglected diseases of man (WHO)
• Adult worms range from 2 to 50 cm in length

1. Onchocerca volvulus

Vector: Similium

Predilection sites: Adults inhabit the sub-cutaneous & connective tissues

Pathogenicity:
• Dead micro-filaria: Severe allergic reactions
  – In the eye causes blindness (river blindness)
2. **Wuchereria bancrofti**

**Vector:** Mosquitoes

**Predilection sites:** Adults inhabit the lymphatics

**Pathogenicity:** Causes elephantiasis
- Obstruct of lymphatics is the primary cause of the disease
- Mostly involves upper & lower limbs, scrotum, vulva & breasts
3. Dracunculus medinensis

**Vector:** Crustaceans – Cyclops

**Morphology:** Female up to 1 m long, 0.9 – 1.7 mm wide

**Predilection sites:**
- Interstitium, subcutis & connective tissues
- Mostly affects limbs

**Pathogenicity:**
- Vesicle is formation
- Ulceration of affected skin
- Can be disabling