Superfamily STRONGYLOIDEA

- horses
  strongyles of large intestine
- ruminants
  nodular worms of large intestine
- swine
  kidney worms and nodular worms
- birds
  tracheal “gapeworms”
Morphology

- large, thick body
- large buccal cavity
- leaf crown
- teeth (+/-)
Male worm:
Copulatory bursa is well-developed
Horses:

LARGE and SMALL strongyles in large intestine
Large intestine mucosal surface

large strongyle

small strongyle

large strongyle
Superfamily Strongyloidea

• Life cycle
  – direct (strongyles of horses)
  – a few exceptions: earthworm as transport host
    • e.g. kidney worm of pigs
    • e.g. tracheal worm of birds
In horses:

- *Strongylus* species (large strongyles)
  - *S. vulgaris*
  - *S. edentatus*
  - *S. equinus*
- *Triodontophorus* species
- Cyathostomes (small strongyles)
Life-cycle of *Strongylus vulgaris*

- L3 ingested when horse is grazing on infected pasture (only route of infection). Just like trichostrongyles in ruminants.

- Larva penetrates intestinal wall (~1-7 days)
Life-cycle of *Strongylus vulgaris*

- migrates in vessel wall up to the cranial mesenteric artery or aorta taking 8-21 days

- *L₄* break into blood stream and carried back to colon & cecum, develop to adult stage during 2-4 months

- total prepatent period ~6 months
Strongylus equinus

• 25 to 45 mm long
• Teeth: 3 pointed
• L3s migrate to & within liver ~ 2 months enter the pancreas or abdominal cavity, then return to intestine
• Prepatent period is ~ 9 months
**Strongylus edentatus**

- 25 to 45 mm long (like *S. equinus*)
- Teeth: None.
- L3s migrate to & within the liver, 2 months, then return via peritoneal cavity to the intestine
- Prepatent period is ~ 11 months
Prepatent periods of large strongyles

Large strongyles are easily controlled and not found often. Why?
Remember these strongyles do not arrest, no hypobiosis. Current drugs effective against all stages. Hint: how often would you need to treat to prevent patency?
Signs/Pathology: *Strongylus vulgaris*

Acute disease: (soon after turnout)
fever, depression, colic, diarrhea/constipation
due to infarction/obstruction of arteries and inflammation from entering larvae

Chronic disease:
Episodes of colic, with/without sudden death, from thromboemboli and/or rupture of an aortal aneurism
ISCHEMIA

↓

INFARCTION
Felt on rectal palpation: Hypertrophy of arterial cranial mesenteric aneurism. walls
Pathology

COLIC:
- blood flow disrupted
- thrombo-embolism
- mechanical damage to intestine
- altered motility
- allergic irritation
- innervation abnormalities
Pathology

Blood chemistry:
- eosinophilia
- hypergammaglobulinemia
- hypoalbuminemia, esp. with migratory larvae
Diagnosis

- Eggs in feces, but same type as small strongyles

......BUT IF..... clinical signs +
       fecal -

What’s your explanation?
Cyathostomes, the small strongyles

- >40 species in large intestine of horses
- also species specific to elephants, pigs, marsupials, turtles
- distinct buccal capsules
- 'smaller' than the large strongyles, ~15 mm
Cyathostomes

- larvae do **NOT** migrate beyond large intestine
- $L_4$ can arrest in intestinal mucosa and reactivate at later times, especially when horse is stressed or in spring time/foaling season or after removal of adult worms by deworming.
- prepatent period is ~ 2.5 - 3 months without arrest
Cyathostomes

- granulomatous colitis from larvae in mucosa
- major loss of protein, **not** blood, edema
- Progressive emaciation
- emerging larvae=colitis+diarrhea

Massive numbers of emerging larvae
Cyathostomes

• Control:
  – All ages of horses can be source of contamination
  – cyathostomes produce >75% of eggs in the feces
  – arrested larval forms are resistant to many drugs
  – drug resistant strains have evolved
  – steroid therapy in face of clinical signs
  – drugs: “drug dejour” combinations and reformulations, plus new compounds
Treatment & Control

• pasture management
  – remove manure;
  – keep grass short
  – avoid mixing foals with yearlings (Why?)

• monitor fecal egg counts (McMasters) on individual horses as a basis for selective deworming at 3 years of age and older.
Control program against strongyles

• deworming schedule - strategic
  – during grazing season
  – with larvicidal drug at beginning and end of grazing period

• use a larvicidal drug q 6 months to kill emerging and arrested L4s
  e.g. fenbendazole elevated/prolonged dosage, moxidectin

Any drug that kills metabolically active larvae will kill adults
Eggs per Gram (EPG)

- Strongyle-type eggs
  - Genus??

- Variability in results: technique is important
- 20% of individuals in herd produce 80% of eggs deposited on pasture. Justification for “selective deworming”.
- Interpretation of data for tactical treatment
  Horses: >200 - 500 epg
EPG tells you the horse is……

– Infected with mature strongyle adult worms; probably also has larval stages in mucosa. But low or negative epg does not rule out mucosal larval stages that may be causing disease.

• Is contaminating the pasture with eggs (which will become *infective* larvae)
“So, what’s a good deworming schedule for horses?!!?”
**First year** (foals, weanlings, yearlings): deworm at least 4 times starting at 2-3 months of age, again at 4-6 months old, 9 months and 12 months if on pasture.
**>3 years old**: two treatments at six month interval minimum for small strongyles (also covers large strongyles, tapeworms, bots and spirurids). Do fecal egg counts to adjust treatment frequency upward on individual basis.
**Some common dewormers FYI:**

- **Pyrantel**
  - STRONGID-C (Pellets; tartrate salt; daily)
  - STRONGID-T (Paste; pamoate salt)
- **Fenbendazole**
  - PANACUR
- **Ivermectin**
  - EQVALAN paste/liquid, DURAMECTIN, ZIMECTIN (with praziquantel)
- **Moxidectin**
  - QUEST GEL
- **Abamectin/Praziquantel**
  - EQUIMAX
Superfamily Strongyloidea (cont)

- NODULAR worms of cattle, sheep, goats, swine - *Oesophagostomum*

**Adult worms:**
- in large intestine
- 15-20 mm long, stout
- cephalic collar at anterior end
**Oesophagostomum**

- L3s are ingested while grazing
- Larvae are within encapsulated cysts in both large and small intestine
  * NODULES *

Serosal view of cystic nodule response to larvae
Oesophagostomum

- Pathogenesis: due mostly to larvae
  - adhesions, calcified cysts
  - Enteritis/diarrhea when L4s emerge i.e. acute inflammatory reaction
Oesophagostomum in PIGS

- Ingestion of infective larvae
- Transmission of infection to piglets - due to peak egg production by sow at ~6 weeks after farrowing
*Syngamus trachea*, ‘gapeworms’

- turkey, pheasants, fowl, captive emus in NC
- 2-20 mm long adults, in permanent copula
**Syngamus trachea**, ‘gapeworm’

- life-cycle is direct or via a transport host (earthworm, snail, slug)
- larvae migrate, enter the airways, mature in lungs; PPP ~3 weeks
- eggs are coughed up and swallowed
- bi-operculated egg in feces
Order Strongylida

Superfamilies:
- Trichostrongyloidea
- Strongyloidea
- Metastrongyloidea = infect lungs
- Ancylostomatoidea
Not enteric

• Metastrongyles of respiratory system, but some affect the vascular and nervous systems.
• Life-cycle can be:
  – INDIRECT requiring snails, slugs, earthworms
  – Direct (Filaroides sp. not covered here)
Metastrongylus - PIGS

- adults worms are large, white, in bronchi
- larvated eggs are released from the female in the bronchi, coughed up, swallowed and passed out in feces
**Aelurostrongylus abstrusus**

- Adults in lung parenchyma of CATS
- Occasionally seen in N.C.

Grayish subpleural nodules
Adult worms in lungs produce eggs; larvae hatch from eggs

Larvae move to intestine via tracheal migration

Tissues of transport host ingested by cat

Tissues of intermediate host ingested by cat

Transport host ingests intermediate host

Larvae ingested by intermediate hosts

Larvae passed in feces
Aelurostrongylus abstrusus

- Cat infected by eating
  - infected snail/slug
  - infected paratenic host e.g. bird
- Larvae migrate from stomach to lungs
- Prepatent period is 5-6 weeks
- L1 coughed up, swallowed, in feces
Pathogenesis:

Egg masses - small, grayish subpleural nodules

Adult worms – 7-10mm long

Cause smooth muscle hyperplasia and pulmonary hypertrophy
Adult worms in cross section

- intestine
- uterus
- cuticle

Adult worms in cross section
Aelurostrongylus abstrusus

*Heavy burden can be fatal

**Diagnosis:** Respiratory signs
Thoracic radiographs

- parenchymal densities
**Aelurostrongylus abstrusus**

**Diagnosis:**
L1 larvae in feces or sputum
- Baermann OR direct smear

- Spine at posterior end
Aelurostrongylus abstrusus

Control:
fenbendazole, ivermectin
restrict access to paratelic hosts