Order: STRONGYLIDA I.

- gastrointestinal worms
- lung worms
- worms of other organs

(ruminants, horses, pigs, carnivores, rabbits, poultry) – the main species according the hosts, morphology, life cycles, epidemiology, prevalence, pathogenesis and clinical signs, diagnosis, treatment and control.

prof. Alica Kočišová, DVM, PhD.

The order Strongylida comprises 4 superfamilies

Order: STRONGYLIDA

Superfamily: **STRONGYLOIDEA**

ANCYLOSTOMATOIDEA

TRICHOSTRONGYLOIDEA

METASTRONGYLOIDEA

Superfamily: STRONGYLOIDEA

Family: STRONGYLIDAE
- **Subfamily: Strongylinae (*Bidentostomum, Craterostomum, Oesophagodontus, Strongylus, Triodontophorus*)**
- **Cyatostominae (*Caballonema, Coronocyclus, Cyathostomum, Cylicocyclus, Cylicodontophorus, Cylicostephanurus, ...*)**
- **Gyalocephalinae (*Gyalocephalus*)**

CHABERTIIDAE
- **Subfamily: Chabertiinae (*Chabertia*)**
- **Oesophagostominae (*Oesophagostomum*)**

SYNGAMIDAE
- **Subfamily: Syngaminae (*Cyatostoma, Mammomonogamus, Syngamus*)**
- **Stephanurinae (*Stephanurus*)**

Family: STRONGYLIDAE

Strongylinae and Cyathostominae of horses

- **Includes both large and small strongyles**
- **Most common**
- **Commonly referred to as bloodworms**
  Because of color after it ingests blood from host animal

Genus: *STRONGYLUS*

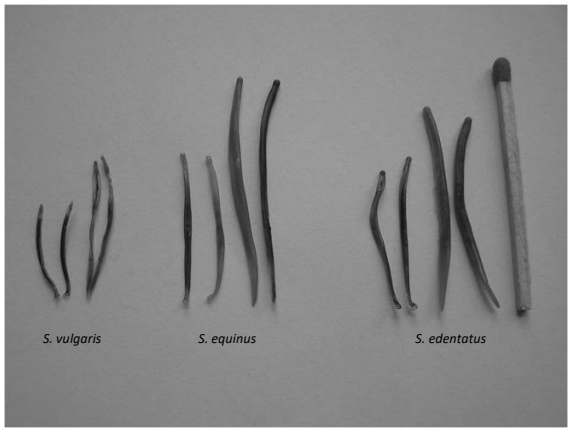
- **Members of this genus live in the large intestine of horses and donkeys and, with *Triodontophorous*, are commonly known as large strongyles.**
- **Site of infection: Caecum and colon**
- **Species: *S. vulgaris; S. edentatus; S. equinus***
- post infection larvae – **parenteral migration in the host**

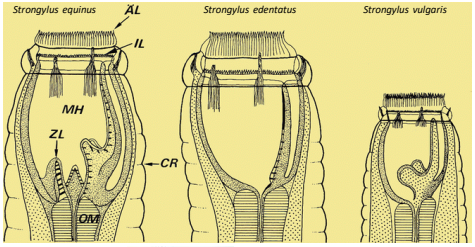
Genus: *TRIODONTOPHOROUS*

Members of this genus **are non migratory large strongyles** frequently occur in the large numbers in the colon and contributes to the deleterious effect of mixed strongyle infection.

Species

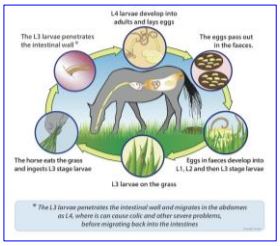
- ***T. serratus***
- ***T. tenuicollis***
- ***T. brevicauda***
- ***T. minor***





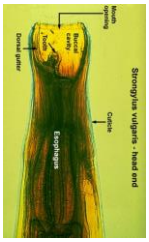
LIFE CYCLE

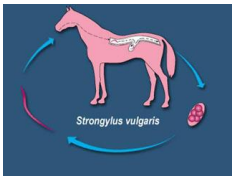
➢ **The adult parasites live in the caecum and colon (large intestine).**



The life cycle of these worms involves the migration of larvae through the blood vessels of the intestine and liver, where they can cause inflammation and obstruction of the blood vessels resulting in damage to the intestine supplied by the damaged vessel.

Symptoms of infestation can include colic, ill thrift, and diarrhea.





Strongylus vulgaris

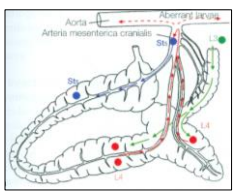
➢ The L3 penetrate the intestinal mucosa and **moult** to L4 **in the submucosa**.

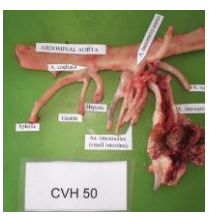
➢ These then **enter small arteries** and migrate on the endothelium to their predilection site in the **cranial mesenteric artery** and its main branches.

➢ After a period of several months the **larvae moult to L5 and return to the intestinal wall** via the arterial lumina.

➢ **Nodules** are formed around the larvae **mainly in the wall of caecum and colon**.

➢ **The Prepatent period is 6-7 months**.





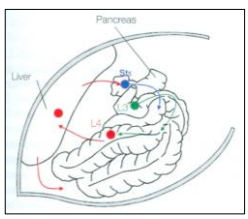
Strongylus equinus

➢ Exsheated L3s **invade the wall of the small intestine**, **cecum** and **colon** and become **encapsulated in nodules** in which they moult to L4s by 12-14 days after infection.

➢ L4s leave their nodules and cross the peritoneal cavity to the **liver.**

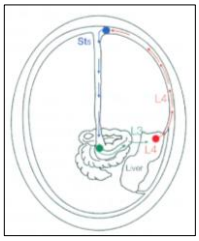
➢ Finally, they begin to **migrate back to the large intestine** by leaving the liver and crossing the abdominal cavity directly or by first **passing through the pancreas** and then the abdominal cavity.

➢**Prepatent period is approximately 9 months.**



Strongylus edentatus

- **L4** migrate to root of mesentery, some going to liver and lungs and then to wall of caecum and right ventral colon
- **Immature adults** then appear in lumen of these portions of the large intestine
- **Prepatent period - 11 Months**

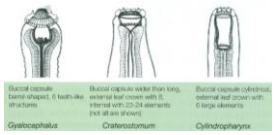


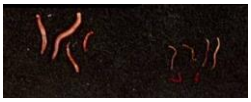
Subfamily: Cyathostominae - small Strongyles

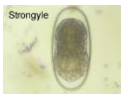
Genera: *Cyathostomum*, *Caballonema*, *Coronocyclus*, *Cylicocyclus*, …

These parasites are present in the **large intestine** of horses.

Their effects on the host range from poor performance to clinical signs of **severe enteritis**.







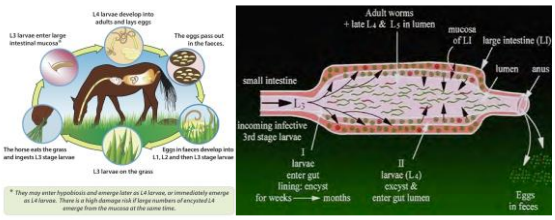
LIFE CYCLE (Stages)

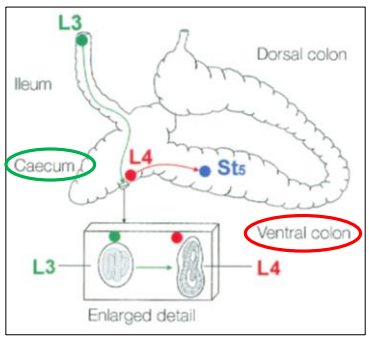
Free living stages same as large strongyles.

L3 infective; exsheath in stomach, small intestine but **do not migrate - only forms nodules**

L 3 enter walls of caecum, colon; develop and moult; return to gut lumen as early L 5

Prepatent period - 4 to six weeks up to 3 to 4 Months.





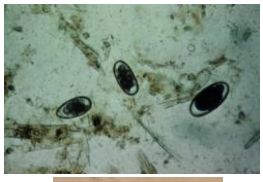
Internal development

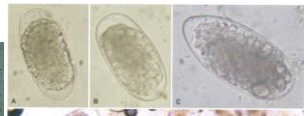
PATHOGENESIS

- **Granulomatous colitis; masses of cyathostomin larvae embedded in mucosa = bright red L 4**
- **May be large numbers of L4 , early L5 in faeces with watery diarrhoea**

Encysted larvae

Diagnosis of Strongyles
Fecal flotation
Necropsy





Treatment

► Benzimidazoles - BZ resistance shown by several spp; Moxidectin (best to date) approved for horses Ivermectin or other avermectins
► Pyrantel salt - probably some resistance

Spectra of Various Anthelmintics Labeled for Efficacy against Strongylid Nematode Parasites of Horses

			LARGE STRONGYLES		CYATHOSTOMINS	
CHEMICAL CLASS	COMPOUND	DOSAGE	ADULTS	MIGRATING LARVAE	ADULTS AND LUMINAL LARVAE	ENCYSTED LARVAE
Benzimidazoles	Fenbendazole	5 mg/kg	Yes	Yes*	Yes	Yes *†
	Oxfendazole	10 mg/kg	Yes	No	Yes	No
	Oxibendazole	10 mg/kg	Yes	No	Yes	No
Heterocyclic compounds	Piperazine	88 mg/kg	No	No	Yes	No
Macrocyclic lactones	Ivermectin	0.2 mg/kg	Yes	Yes	Yes	No
	Moxidectin	0.4 mg/kg	Yes	Yes	Yes	Yes‡
Tetrahydropyrimidines	Pyrantel pamoate	6.6 mg/kg	Yes§	No	Yes	No
	Pyrantel tartrate¶	2.64 mg/kg/day	Yes	No	Yes	No

*Requires a regimen of 10 mg/kg daily for 5 consecutive days.
†Label claims for efficacy against early third-stage (EL_3), late third-stage (LL_3), and fourth-stage (L_4) cyathostomin larvae.
‡Label claims for efficacy against late third-stage (LL_3) and fourth-stage (L_4) cyathostomin larvae.
§Efficacy against *Strongylus edentatus* is less than 90%.
¶When fed daily, aids in the control of certain nematode parasites.

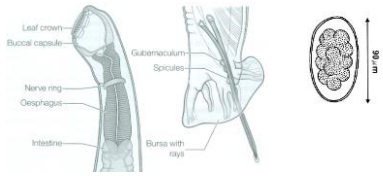
Control Measures

➢ Clean bedding in stalls
➢ Not running young foals with older, more immune horses
➢ Rotation onto "clean" pastures
➢ Strategic, regular treatment programs
➢ Alternate dewormer types annually (one type each year, using the same type each time a dewormer is administered in one year)
➢ Pasture contamination due to large number of parasites and eggs produced makes management difficult - it is practically impossible to remove all parasites from a horse's gut.

Superfamily: **STRONGYLOIDEA**

Family: CHABERTIIDAE
Subfamily: Chabertiinae (*Chabertia*)
Oesophagostominae (*Oesophagostomum*)

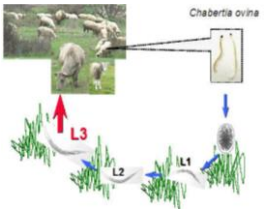
Gastrointestinal worms of ruminants and pigs



13-17-20 mm

Chabertia ovina / CHABERTIOSIS

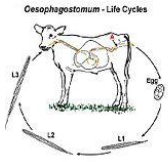
➢ catarrhal - nodular enteritis colitis (column wall - edematous, bloodied, thickened with haemorrhages)
➢ small and caecum - larval stages
➢ large intestine - adult worms most pathogenic - L5 and adult worms - drawing intestinal mucosa into the oral capsule (already with 300 worms)!
➢ diarrhea with blood
➢ anemia, weight



➢ Pyrantel; benzimidazols; Ivermektin

OESOPHAGOSTOMOSIS OF RUMINANTS

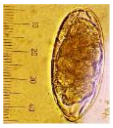
➢ *Oesophagostomum columbianum*
➢ *Oe. venulosum*
➢ *Oe. asperum*
➢ *Oe. multifoliatum*
➢ *Oe. radiatum*



➢nodules in caecum (adult worms)
➢larval stages: from pyloric to rectum
➢ direct development (prepatent period: about 45 days)
➢ severe enteritis (also *Oe. venulosum*, which does not form nodules)
➢ local inflammatory reaction - encapsulation
➢ impairment of normal intestinal motility and absorption
➢ thickening of the intestinal wall
➢ intensive mucus production

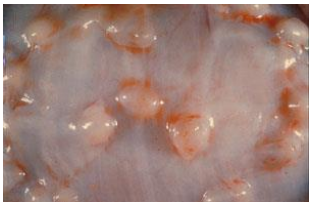
***Oesophagostomum columbianum* - ovce**

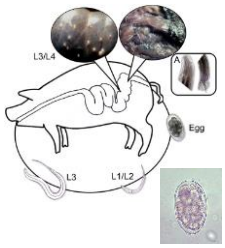
- Diagnosis – coprocultures
- post mortem
- Te: Pyrantel; benzimidazols; Ivermektin



OESOPHAGOSTOMOSIS OF PIGS

- ***Oesophagostomum dentatum***
- ***Oe. brevispiculum***
- ***Oe. quadrispinulatum***





- prepatent period: 43-55 days;
- resistant larvae - survive in the environment for a year or more;
- Ivermectin, benzimidazoles

Superfamily: **STRONGYLOIDEA**

Family: SYNGAMIDAE

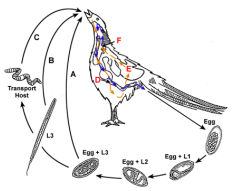
Subfamily: Syngaminae (*Cyatostoma, Mammomonogamus, Syngamus*)

Stephanurinae (*Stephanurus*)

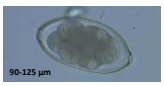
- respiratory tract of poultry
- kidney of pigs

Syngamus trachea / SYNGAMOSIS

- 7-20 mm;
- forked worms; a male of 2-6 mm
- direct life cycle



- Prepatent period: 12-17-20 days
- Adult worms survive 23-147 days in chickens, 48-224 days in turkeys, 98 days in guinea fowl.



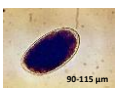
- winter season in paratenic hosts (earthworms, beetles, flies, snails, ...)
- disease of young birds (pheasants, turkeys, mustard, chickens, ...)
- petechial and hemorrhagic bleeds;
- mucosal inflammation;
- creation of knots;
- bronchopneumonia - migrating larvae;
- pulmonary edema;
- dg: eggs

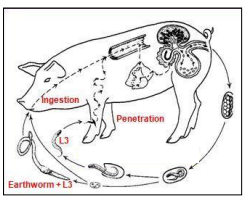
- Te: benzimidazols, ivermectin

- For aquatic poultry: *Cyathostoma bronchiale*
- male and female – live separately;
- already 2-3 worms can cause death by asphyxiation

Stephanurus dentatus / STEPHANUROSIS

- 30-45 mm; 20-30 mm
- cysts in the kidneys
- inflammation of the abdominal and thoracic cavities





Prepatent period: 6-19 months

Adult worms live cca 2 years

- percutaneous infection - nodules in the skin, swelling and enlargement of regional Lymphatic nodules;
- migrating larvae - abscesses and liver cirrhosis;
- adult worms - kidney cysts;

- Dg: eggs in urine
- Te: levamizol, ivermectin, benzimidazols

Superfamily: **TRICHOSTRONGYLOIDEA**

Family: **Amidostomatidae (*Amidostomum, ...*)**
Trichostrongylidae (*Cooperia, Graphidium, Haemonchus, Hyostrongylus, Marshallagia, Ostertagia, Teladorsagia, Trichostrongylus, ...*)
Molineidae (*Nematodirus, Ollulanus, ...*)
Ornithostrongylidae (*Ornithostrongylus*)
Helligmonellidae (*Nippostrongylus, Heligmosomoides*)
Dictyocaulidae (*Dictyocaulus*)

Genus: *Trichostrongylus*

Trichostrongylus spp. are widely distributed throughout the world.

- *Trichostrongylus* species are the smallest members of the family **Trichostrongylidae.**
- They are thin and with a length of 7 mm or less are difficult to see without a microscope

Species of Trichostrongylidae and *Nematodirus*, autochthonous in Europe.

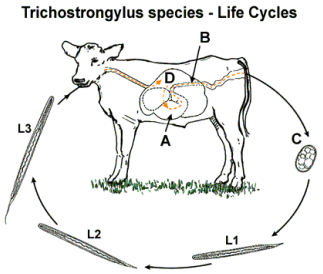
Predilection site of adults[1]	Species (prepatent period in days of selected species)	Length of females (mm)[2]	Prevalence[3]		
			Cattle	Sheep	Goat
Abomasum	*Haemonchus contortus* (18-19)	20-30	(+)	++/+++	+++
	Ostertagia ostertagi (18-21)	8-9	+++/++++	(+))	(+)
	Ostertagia[4] *lyrata*	up to 10	+/+++	(+)	(+)
	Ostertagia leptospicularis (17)	8-11	+/+++	+	+
	Teladorsagia[5] *circumcincta* (16)	12-13	(+)	+++/++++	++++
	Teladorsagia[5] *trifurcata*	9-11	(+)	++/++++	++++
	Trichostrongylus axei (20)	5-6	+/+++	++	++
Small intestine	*Trichostrongylus colubriformis* (15)	5-6	(+))	++/+++	+++
	Trichostrongylus vitrinus (18-19)	5-8	(+))	++/+++	++
	Trichostrongylus capricola	5-7	(+))	+	+
	Trichostrongylus longispicularis	5-7	+		
	Cooperia curticei (14)	5-6	+	+++/++++	++
	Cooperia oncophora (17)	8-12	++/+++	+	
	Cooperia zumabadi[6]	7-9	+/++++	+	
	Cooperia pectinata	7-9	+		
	Cooperia punctata (14)	6-7	+/++	(+)	
	Nematodirus helvetianus (21-26)	15-24	+/++++	(+)	
	Nematodirus filicollis (21)	12-20	(+)	++/++++	++
	Nematodirus battus (15-28)	18-15	+	+/++++	++
	Nematodirus spathiger (15-21)	12-20	(+)	++	

[1] At necropsy, specimens of the species typically inhabiting the abomasum may be found in anterior parts of the small intestine, and (more rarely) the species from the small intestine in the abomasum.
[2] For sake of clarity, only the body length of females is listed; males are a little shorter.
[3] Approximate prevalences: ++++: >75%, +++: >50-75%, ++: >25-50%, +: 10-25%, (+): <10, ((+(: sporadic, empty fields: no data. Prevalences are subject to wide variation; data predominantly from AT, CH and DE.
[4] Syn.: *Skrjabinagia*.
[5] Formerly allocated to the genus *Ostertagia*. *T. trifurcata* and *Ostertagia pinnata*, both occurring in sheep and goats, are morphologically very similar and described either as distinct species or as synonyms.
[6] Alternative spelling: *O. sumabada*.

Epizootiology

- *Trichostrongylus* species are not usually primary pathogens in temperate regions of the world.
- Their role is usually contributory to parasitic gastroenteritis in which *Ostertagia* or *Haemonchus* are the primary pathogens in ruminants.
- However, in warmer subtropical areas *Trichostrongylus* species are important pathogens in grazing ruminants and counts of 10,000 or more worms per animal are not unusual in clinical outbreaks.
- **Hypobiosis** occurs at the L3 stage and is an important controlling feature of life cycles in temperate areas of the world.
- **Survival of preparasitic stages**
- Eggs and infective L3s are able to survive both heat and cold. In temperate zones of both hemispheres enough L3s may survive winter and produce clinical outbreaks of trichostrongylosis in grazing ruminants in early spring.
- The ability of *T. axei* to cross-infect between horses and ruminants may lead to amplification of *T. axei* infections in horses when mixed grazing of pastures with horses and ruminants is used as a parasite control measure.

Life cycle



Data on the parasitic development of some trichostrongylid and *Nematodirus* species

Species (host animal)	Days p.i.	Development and prepatency M: moulting, L3: parasitic L3[1], L4: 4th stage larva, St. 5: preadult 5th stage	Stage of hypobiosis
Haemonchus contortus (sheep)	1-8	L3 → abomasum, crypts, some in lumina of gastric glands	L4
		M → to L4, return to mucosa surface	
	9-11	M → to St. 5, further development	
	18	prepatency	
Ostertagia ostertagi (cattle)	1-8	L3 → abomasum, lumina of gastric glands (mostly in fundus region)	L4
		M → to L4	
	8-15	M → to St. 5 in lumina of gastric glands	
	>15	emergence from gastric glands to mucosa surface, further development	
	18	prepatency	
Trichostrongylus colubriformis (sheep)	1-4	L3 → small intestine → M to L4	L3
	6-10	M to St. 5	
	15	prepatency	
Cooperia curticei (sheep)	1-2	L3 → lumen of anterior small intestine	L4
	3-4	migration of L3 into crypts, M → to L4	
	5	most of L4 free in intestinal lumen	
	9-10	M → to St. 5, further development	
	14	prepatency	
Nematodirus battus (sheep)	1-5	L3 → small intestine, M → to L4	?
	12	nearly all parasites in St. 5	
	14	prepatency	

[1] Parasitic L3 = infectious larva after ecdysis.

Pathogenesis

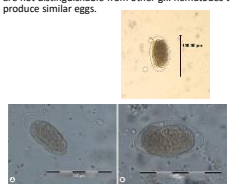
- Inflammatory reactions of the abomasum (abomasitis)
- And small intestine (enteritis)

Clinical signs

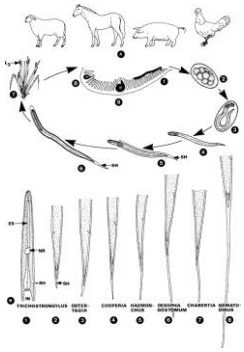
- **Light infections** are usually asymptomatic but may contribute to poor appetites, diminished growth rates and soft faeces
- **Heavy infections** (10,000+ worms) will produce a diarrhoea that is serious and can be debilitating, especially in ruminants. The term "black scours" is sometimes used to describe the diarrhoea because it is often watery and dark green (almost black) in colour.

Diagnosis

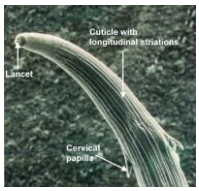
- A diagnosis of trichostrongylosis is made on the basis of a combination of factors
- **Clinical signs**
- **Seasonal occurrence of disease**
- **Necropsy findings**
- **Presence of Strongyle-type eggs in the feces of infected animals**
- **Fecal cultures to identify Trichostronglyus L3s**
- Trichostrongylus eggs are "strongyle-type" and, as such, are not distinguishable from other g.i. nematodes that produce similar eggs.



Light microscope view of *Trichostrongylus colubriformis* (A) and *Trichostrongylus axei* (B) eggs



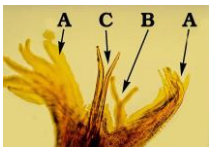
Genus: *Haemonchus*



- *Haemonchus* species are the largest of the nematodes found in the abomasum of ruminants.
- They range from 10-30mm in length and are reddish when fresh because they are blood suckers.
- They achieve this by using a tiny **lancet** in their small buccal capsule. Because they feed on blood, the female has a striking appearance, looking like a barber pole because the white ovaries wind around the red blood filled intestine.

Haemonchus

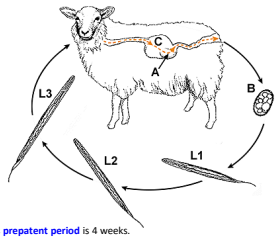
- The copulatory bursa (**A**) of the male is distinct because it has an asymmetrical dorsal lobe with
- a Y-shaped dorsal ray (**B**), which is sometimes confused with the spicules (**C**).



Nematode species	Host species	Predilection site
Haemonchus contortus	**sheep and goats**	**Abomasum**
Haemonchus placei	**cattle**	**Abomasum**

***Haemonchus* - Life Cycle**

The predilection site is the abomasum of sheep and goats. "strongyle-type" eggs which pass to the external environment in host faeces.



The prepatent period is 2-3 weeks in sheep.
The cattle species, *H. placei,* has a similar life cycle but its **prepatent period** is 4 weeks.

Pathogenesis

- Haemonchosis is characterized by a hemorrhagic anemia attributable to blood loss via the blood-sucking activities of worms in the abomasum.
- Fourth stage larvae as well as adults are blood suckers which means that blood losses, sufficient to cause a clinically obvious anemia, may occur before an infection is patent.
- The actual mechanism of blood sucking involves the worm attaching to the mucosa and extruding its oral lancet to slit capillaries in the abomasal mucosa. They ingest blood flowing from these slit capillaries.
- Worms also secrete an anticoagulant into the bleeding lesion ensuring that these lesions will continue to bleed after the worm is replete and has moved away.

Trichostrongylidosis in ruminants: selected pathophysiological features

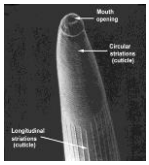
Clinical signs

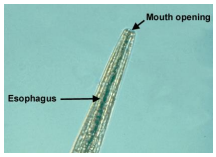
- In **hyperacute haemonchosis**, sudden deaths in a flock of previously healthy sheep are seen.
- This syndrome results from ingestion of large numbers of infective larvae by sheep grazing on a heavily contaminated pasture.
- In **acute haemonchosis**, grazing sheep develop a sudden onset anemia. In the absence of treatment, and if grazing continues, these animals will progressively worsen.
- The PCV drops initially, plateaus, then falls even further, signaling exhaustion of the erythropoetic system. Without treatment, death is the usual outcome

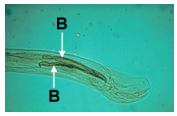
- ascites and submandibular edema - "bottle jaw"

Genus: *Ostertagia*

- small (~10mm) reddish brown worms found in the abomasum of ruminants.
- On a global basis they are the major cause of parasitic gastritis (Ostertagiosis) of ruminants in temperate climates.







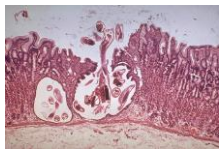
Nematode species	Host species	Predilection site
Ostertagia ostertagi	cattle	Abomasum
Ostertagia circumcincta (*Teladorsagia*)	sheep and goats	Abomasum
Ostertagia trifurcata	sheep and goats	Abomasum

Other, less common species include *O. lyrata*, and *O. kolchida* in cattle plus *O. leptospicularis* found in cattle, sheep and goats.

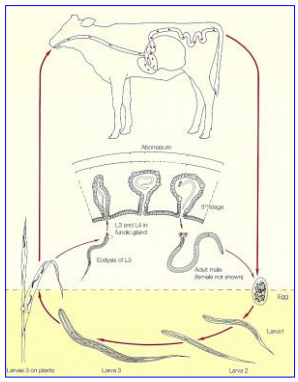
Ostertagia species are found throughout temperate and subtropical areas of the world.

The cattle species, *Ostertagia ostertagi* is particularly important in temperate areas wherever cattle are raised.

Life cycle



Larva emerges from the gastric glands



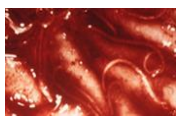
Epizootiology

The epidemiological patterns of ostertagiosis have been well defined in most areas of the world. There are also four common features that influence these epidemiological patterns despite the wide range of climates and management conditions under which cattle are raised.

1. **The influence of temperature and moisture on the survival and development of preparasitic stages of the life cycle.**
2. **The different ways in which pasture is used to raise dairy replacement heifers and beef calves.**
3. **The influence of seasonal arrested development (hypobiosis) on the parasitic phase of the life cycle.**
4. **The influence of the immune response on infection and disease.**

Pathogenesis

Nodules in mucosa



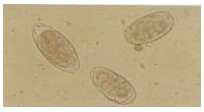
Ostertagiosis type I and type II in cattle

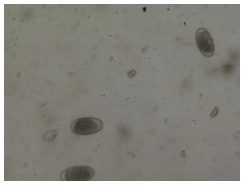
	Ostertagiosis type I 'summer ostertagiosis'	Ostertagiosis type II 'winter ostertagiosis'
Season	July until end of grazing season	January until May
Animal group	young animals during their first grazing period	young animals after their first grazing period, rarely cattle after several grazing periods
Morbidity	high, mainly or all young animals of a herd more or less affected, older cattle usually without clinical signs	usually only a few animals affected
Mortality	usually low, high in some years	low
Lethality	mostly low	high
Clinical signs[2]		
Inappetence	+	+
Diarrhoea	+ (profuse, without blood)	+ (profuse, occasionally intermittent)
Weight loss	+	+ (rapid and marked)
Exsiccosis	+	+ (rare)
Subcutaneous oedema	–	+ (approximately 40% of clinical cases)
Fever	–	–
Anaemia	–	+ (in some cases)
Serum pepsinogen	elevated	mostly elevated
Serum albumin	in severe cases decreased	mostly decreased
Parasitology		
Egg detection in faeces	positive	positive or negative
EpG	low up to >1000	very low to high
Worm burden in abomasum	predominantly adults of *O. ostertagi* (often >40,000 specimens/animal)	in heavy infections up to >100,000 specimens with high proportion (50-80%) of hypobiotic and other immature stages
Pathology	abomasum: typical nodules, inflamed mucosa, oedema of abomasal folds, pH elevated in severe cases (>3)	like in type I, usually less nodules, but marked oedema, pH often elevated (>3)
Therapy	broad-spectrum anthelmintics effective	only certain broad-spectrum anthelmintics effective against hypobiotic stages (▶ Table 19.2, p. 579)

[1] Modified after Armour et al. (1973) Bovine ostertagiasis. In: Urquhart GM, Armour J, Jacks J Helminth diseases of cattle, sheep and horses in Europe. Glasgow, UK: Robert MacLehose/Comp., pp. 11-22; ISBN 0 9502334 59.
[2] + : usually present, – : usually absent.
Remark: regularly, *C. oncophora* and some other species are involved in the infection, but detrimental effects caused by *O. ostertagi* predominate.

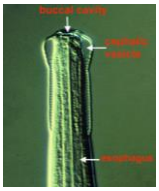
Diagnosis

- The presence of **strongyle type eggs** in the faeces of affected animals will merely confirm the presence of adult strongyle nematodes in the g.i. tract.
- In Type I disease, egg counts greater than 1,000 EPG are usually seen but counts are much more variable in Type II disease.

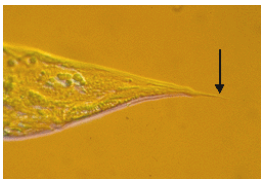


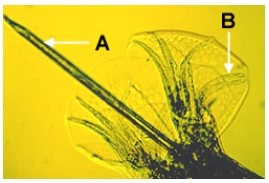


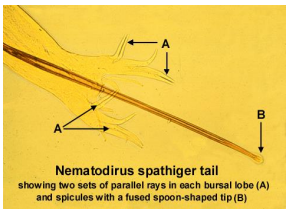
Genus: *Nematodirus*



- These are slender, relatively long worms (up to 2.5 cm long). As the accompanying image shows, they are distinguished morphologically by an inflated cuticle around the anterior end which may also show **transverse striations**.
- Large numbers of these long slender worms are usually seen at necropsy, in the small intestine, as clumps resembling cotton wool.







Nematodirus spathiger tail
showing two sets of parallel rays in each bursal lobe (A) and spicules with a fused spoon-shaped tip (B)

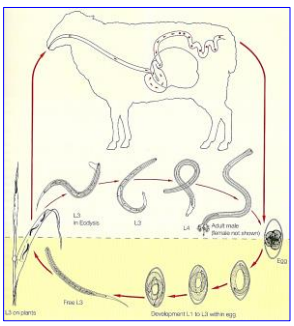
Nematodirus female
showing blunt tail with attached spine

Nematode species	Host species	Predilection site
Nematodirus battus	sheep	small intestine
Nematodirus spathiger	sheep and goats	small intestine
Nematodirus filicollis	sheep and goats	small intestine
Nematodirus helvetianus	cattle	small intestine
Nematodirus abnormalis	sheep and goats	small intestine

Life-cycle

Nematodirus is of special importance as a parasite of lambs in temperate regions.
Its hosts are ruminants, and its predilection site is the small intestine.
Nematodirus species are distributed worldwide, but more commonly in temperate zones.

Preparasitic phase of development occur within the egg.



Epizootiology

- The most important factor influencing transmission of Nematodirus species is the ability of L3s to **survive from year to year** enclosed inside their protective egg shells.
- Arrested development has been recorded in sheep (Canada, United States) and has been attributed to hypobiosis at the L4 stage as a mechanism for survival over winter.

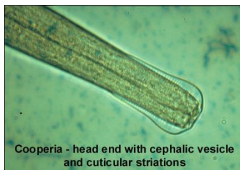
Pathogenesis and clinical signs

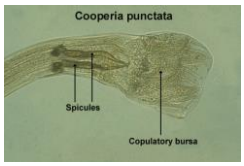
- Nematodirus is not usually a primary pathogen in ruminants. Its importance therefore is as an **additive** affect in mixed infections of nematodes causing parasitic gastroenteritis.
- Diarrhea followed rapidly by dehydration are the primary clinical signs. Adult ewes have developed a strong immunity to *Nematodirus* and are usually unaffected.

Diagnosis

Genus: *Cooperia*

Cooperia species are nematodes of the small intestine of ruminants. Species in domestic animals are usually 5-9 mm long and males have a prominent bursa in relation to their size.

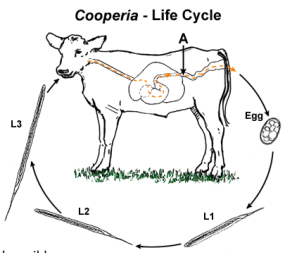

Cooperia - head end with cephalic vesicle and cuticular striations



Nematode species	Host species	Predilection site
Cooperia curticei	**sheep and goats**	**small intestine**
Cooperia oncophora	**cattle**	**small intestine**
Cooperia pectinata	**cattle**	**small intestine**
Cooperia punctata	**cattle**	**small intestine**
Cooperia surnabada	**cattle and sheep**	**small intestine**

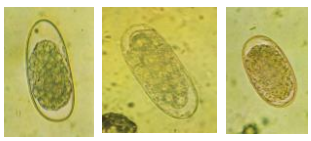
Life cycle

Following ingestion of infective L3s, the larvae reach the small intestine and develop into adults.
The prepatent period varies from 15 to 18 days.



Cooperia are generally considered to be mild pathogens. They contribute secondary effects to the primary pathogens;
A variety of clinical signs have been attributed to *Cooperia* species and these include: **diarrhea, weight loss, anorexia and poor weight gains;**

Eggs of family Trichostrongylidae

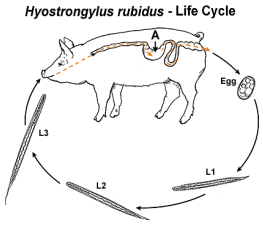


Genus: *Hyostrongylus*

The only species of importance in domestic animals is *Hyostrongylus rubidus* , commonly called the "red stomach worm" of pigs. It is a slender worm, 5-10 mm in length.


Hyostrongylus rubidus in situ stomach of a pig

Life cycle



➢Pathogenic effects of *Hyostrongylus* infections are similar to *Ostertagia* in cattle.

Therapy - trichostrongylidosis

- Benzimidazoles (albendazole, fenbendazole, mebendazole, oxfendazole)
- Imidazothiazoles (levamizole)
- Macrocyclic lactones (ivermectin, doramectin, eprinomectin, moxidectin)
- Amino-acetonitril derivates (monepantel)
- Spiroindoles (derquantel)