Class: ADENOPHOREA (Aphasmidia)

Order: ENOPLIDA
Superfamily: DIOCTOPHYMATOIDEA
Family: Dioctophymatidae (*Dioctophyme, Eustrongylides, Hystrichis*)
TRICHINELLOIDEA
Family: Trichuridae
Subfamily: Trichurinae (*Trichuris*)
Capilariinae (*Capillaria, Eucoleus, ...*)
Trichosomoidinae (*Trichosomoides, ...*)
Family: Trichinellidae (*Trichinella*)

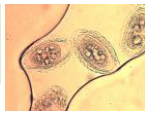
Infectious larvae: L_1

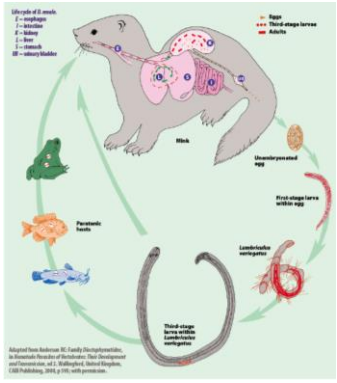
⬇

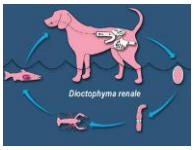
Exception: Dioctophymatidae

Superfamily: DIOCTOPHYMATOIDEA
Family: Dioctophymatidae
Dioctophyme renale / DIOCTOPHYMOSIS

- upper urinary tract of carnivores (dog, cat, fox, ...), but also humans;
- North, South America, Asia, Southern Europe;
- typical red-pink color;
- male: 14-45 cm; female: 20-100 cm;
- localization: **kidney pan**;
- Life cycle - indirect;
- IH: **water worms** (headwaters); **earthworms**;
- Paratenic hosts: fish, amphibians, ...
- Eggs: barrel shape, (60-80 µm), three shells (porous surface), non-embryonated, brown;
- urine;







- L1 develops in the egg 2-4 (sometimes up to 7) months;
- IH: Development of 2-4 months of infectious larvae L3;
- **Prepatent period: 5-6 months**

Pathogenesis and clinical signs

- 60% of parasites remain in dogs in the abdominal cavity;
- females are not fertilized and produce a large number of sterile eggs - **peritonitis**.

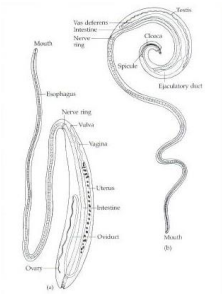
- asymptomatic course;
- peritonitis;
- liver damage;
- increase of fluid in the abdominal cavity;
- in the case of kidney disease, **the right kid**ney is affected in 80%; left - hypertrophied;
- Parasite - **Pressure** = **atrophy** and **fibrosis** = **hydronephrosis**;
- **haematuria**
- **uremia**
- **kidney colic**

Dg: eggs in urinary sediment

Te: surgical removal of the parasite;
+ 10-day application of **fenbendazole**

Family: Trichuridae

- **Whipworm** - this worm gets its common name because of its **whip-like appearance**.
- The **anterior two-thirds of the body is slender** and thread-like, while the **posterior third is much thicker**.
- The **tail of the male is coiled with** a single spicule enclosed in a spinose, retractile cuticular sheath; that of the female is straight. Adult are ~5 cm long
- In both sexes, a **capillary like esophagus extends 2/3 of the body length** and it is encircled along much of its lenght by a series of unicellular glands, the ***stichocytes.***



Genus: **Trichuris**

- *Trichuris ovis*
- *T. discolor*
- *T. globulosa*

→ ruminants

- *T. suis* → pigs
- *T. vulpis* → dogs, fox
- *T. campanula*
- *T. serrata*

→ cats

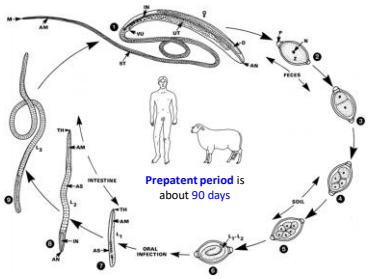
- *T. trichiura* → human




Ov, Cap, HD, Sus – course asymptomatic;

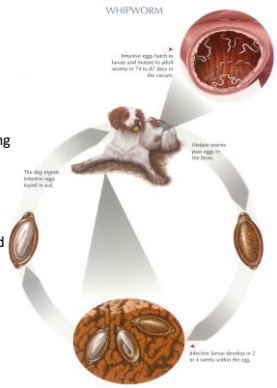
Trichuriosis - stable helminthosis - eggs are infections capable of 3-4 years;

Localization:
caecum, large intestine



Pathogenity

- ***Trichuris spp***. are probably blood feeder
- ***Trichuris*** spp. have a **mouth stylet**, projecting through their mouth opening
- The adults tunnel into the intestinal mucosa with their anterior ends and the stylet is used to enter vessels or lacerate tissues creating pools of blood which the nematodes ingest (dogs, pigs)



Clinical signs

- Light infections are asymptomatic.
- Diarrhea, often with large amounts of mucus and some frank blood on the stool, are seen in heavy infections
- Dehydration, anorexia
- Nausea, anemia
- Weight loss; and in severe cases, electrolyte abnormalities such as hyponatremia and hyperkalemia that may cause seizures
- Caecitis, colitis, with mucosal necrosis and areas of haemorrhage
- Mucosa is oedematous, catarrhal inflamation may be seen


Diagnosis

Treatment

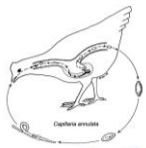
- Butamisole Hydrochloride, Febantel, Febantel and Pyrantel embonate, Fenbendazole
- Mebendazole, Milbemycin oxime

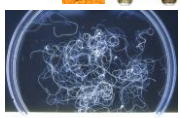
Family : Capillaridae

- The esophageal part of the body is shorter than the posterior part
- The worms are small and slender and the posterior part of the body is not conspicuously thicker than the anterior part (as in Trichurida)
- The life cycle may be direct or indirect
- The eggs are unsegmented when laid, barrel-shapped

Capilariinae: *Capillaria* / Birds

- ***Capillaria caudinflata*** (in direct, earthworm) — intestine
- ***Capilaria obsignata*** (direct)
- ***C. anatis*** (direct)
- ***C. retusa*** (direct)
- ***C. annulata*** nin-direct
- ***C. contorta*** Oesophagus, intestine, direct

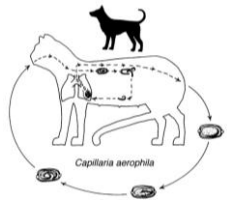




- inflammation of the crop mucosa
- catharal - hemorrhagic enteric inflamation

Species found in mammals

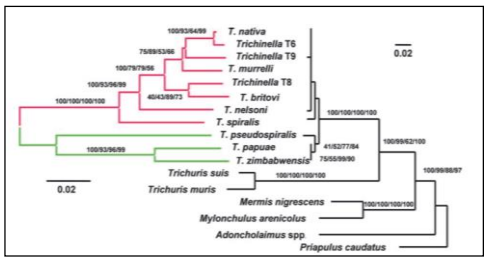
- *Capilaria bovis*
- *C. plica* (dogs, urinary bladder)
- *C. felis* (cat)
- *C. hepatica* (rodents)
- *C. aerophila* (carnivores, lung)
- *C. philippinensis* (man)

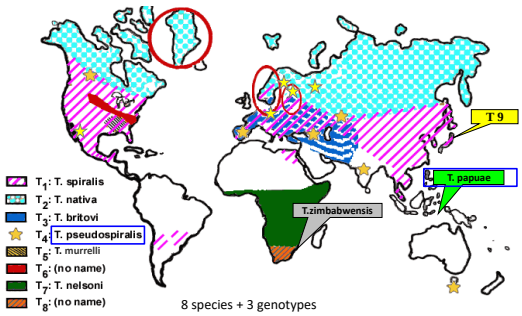


Te: Fenbendazol

Family: Trichinellidae

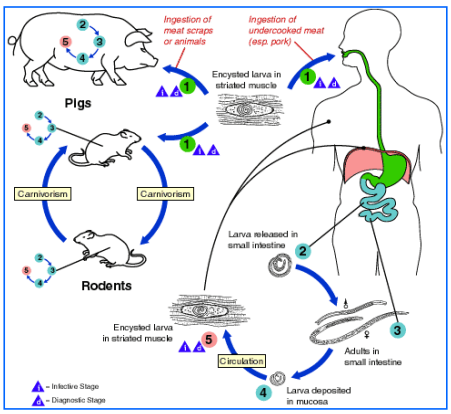
***Trichinella* is one of the most widespread parasites infecting people and other mammals all over the world in most climates, except for deserts.**





8 species + 3 genotypes

Host Spectrum



- the transplacental transmission is possible

documented in human

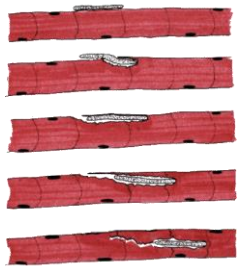
experimentally: fox, ferret, rat, guinea pig,

accidental infection (low number of larvae)

Nurse cell formation

INVASION OF MUSCLE CELL

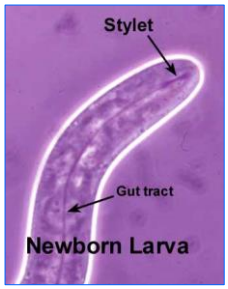
the mechanism by which the newborn larva enters the host cell is not fully known;



- larva penetrates out of the capillary and braces itself against the adjacent muscle cell;
- larva depress the sarcolemmal membrane to the point of breaking;

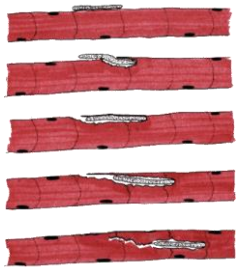
Nurse cell formation
INVASION OF MUSCLE CELL

- it likely brings its stylet into play, causing the host cell to "explode"..
- ...and it is thought that secreted enzymes are not necessary



Nurse cell formation
INVASION OF MUSCLE CELL

- larva penetrates completely into muscle cell;



Pathogenicity for humans

T.spiralis T.nativa
T.pseudospiralis
T.murrelli
high

T.britovi
T.nelsoni
low

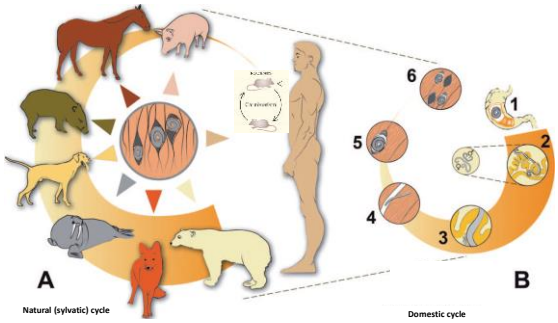
Trichinella T6
moderate

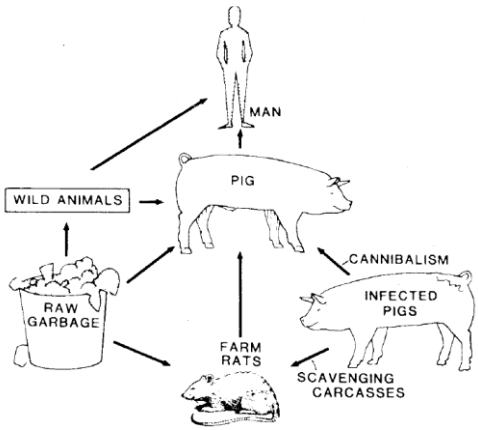
T.papuae
Trichinella T8 ,T9, T. zimbabwensis
?

Trichinellas **are maintained in nature by sylvatic or domestic cycles**

the sylvatic cycle is widespread on all continents and in maintained by cannibalism and scavenger behavior of carnivors.

only *Trichinella spiralis* is transmitted and maintained in domestic cycle





- **sylvatic species of *Trichinella* can invade the domestic habitat and vice-versa**
- **synanthropic animals (rats, foxes, mustelids, cats, dogs…) contribute to the flow of sylvatic genotypes from wildlife to domestic animals**
- **human behavior in both directions**

CURRENT STATUS OF TRICHINELLOSIS IN HUMANS

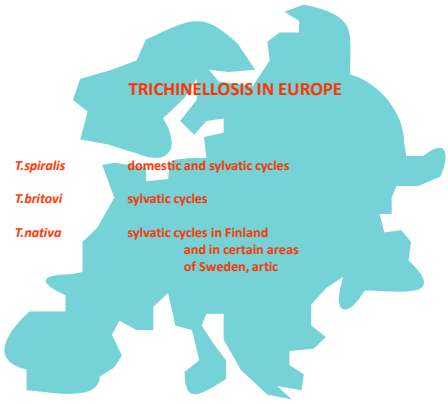
- **the global prevalence in people is difficult to evaluate**
- **11 millions could be infected**
- **> 10.000 cases (ICT 95-97)**
- **outbreaks occur in countries regardless of socio-economic development**

Animals responsible for human trichinellosis around the world 1994-98

- **pigs** — ***T.spiralis***
- **wild pigs** — ***T. nativa***
- **wild boar** — ***T. britovi***
- **dogs** — ***T. pseudospiralis***
- **racoon** — …
- **bear**
- **others wild game (fox, badger….)**

Risk factors for humans different across countries

- Consumption of row or undercooked meat of
- swine
- game animals
- horses
- dogs
- Consumption of cured meat
- (sausage, salami, meat preserved in oil or lard, smoked meat)



T. spiralis in EUROPE

- domestic, synanthropic, sylvatic cycles (Bulgaria Byelorusia, Croatia, Finland, Georgia, Lituania, Poland, Romania, Russia, Serbia, Spain, Ukraine)
- only sylvatic cycles (Austria, Czech Rep., France, Germany, Hungary, Slovak Rep., Sweden, The Netherlans)
- demonstrated not to exist (Italy and Switzerland)

Main hosts are animals with "scavenger behaviour":

- fox
- wolf
- bear
- racoon
- hyena, jackal

- » in lesser extent the true Carnivora :
- » lion
- » leopard
- » puma
- » tiger

...hosts

- rodents (they seem to have a marginal role)
- wild boar and domestic pigs (mainly not industrially bred)

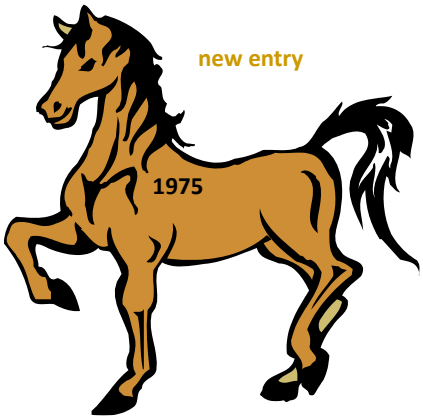
- sea mammals (walrus)

- herbivores
- reptiles and fishes

- invertabrates

about infection in pigs (*T. spiralis*)

- eating scraps from other infected pigs
- ingestion of infected rats
- tail-biting from infected pigs
- ingestion of faeces of pigs that had eaten infected meat 1-2 days previously
- ingestion of infected synantropis or sylvatic animals



Identified species in horses

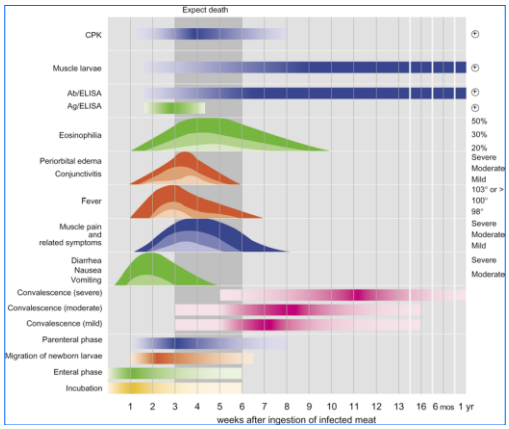
- *T. spiralis* 16 (61.5%)
- *T. britovi* 3 (11.5%)
- who knows? 7 (27%)

Distribution of tissue cysts

- more infected muscle district
  - head
  - cervical region
  - dorsal region
  - thoracic region
  - diaphragm
  - muscles of limbs
- less infected muscle district
  - shoulder
  - tight
  - sub-cutaneous muscle

Clinical signs

- in domestic animals usually asymptomatic
- if hundreds larvae are ingested (man and wild predator) intestine inflammation
- after 1-2 weeks (muscle invasion):
  - myositis
  - fever
  - eosinophilia
  - myocarditis
  - ascites and periorbital oedema (man)
- if untreated, can lead to death



Clinical signs

Conjunctivitis

Splinter hemorrhages

Diagnosis in the animals

- In practice at the slaughter-house only by means of muscle larvae research:
  - simple compression of a small bit of muscle and microscope observation (trichinoscopy)
    - sensitivity: 3 larvae/gr
  - pooled-sample digestion of muscle
    - sensitivity: 1 larva/gr

In living animals:
serologic tests (IFI or ELISA)
sensitivity: 0.1 larva/gr

Diagnosis in the animals
in wich muscle to search larvae

animal species	predilection sites
domestic pig	diaphragm, tongue, masseter
horse	tongue, masseter
wild boar	forearm, diaphragm
bear	diaphragm, masseter, tongue
walrus	tongue
fox	diaphragm, forearm muscle
raccoon dog	diaphragm, forearm muscle

Diagnosis in man

- clinical signs
  - serological tests
  - muscle biopsy
  - PCR
- early diagnosis: ELISA

Therapy in man

- anthelminthics
  - mebendazole
  - albendazole
  - thiabendazole
  - pyrantel

Control

- inspection for all pigs and horses
- freezing of imported meat that was not controlled for trichinellosis
- destruction of meat eventually infected
- swill feeding only after sanitization for pigs

ACANTOCEPHALA
(thorny-headed/spiny-headed worms)

ORDER	FAMILY	GENUS
Oligacathorhynchida	**Moniliformidae**	***Moniliformis***
	Oligacanthorhynchidae	***Macracanthorhynchus***, *Prosthenorchis*
Echinorhynchida	Echinorhynchidae	*Acanthocephalus*, *Echinorhynchus*
	Pomphorhynchidae	*Pomphorhynchus*
Polymorphida	**Polymorphidae**	*Corynosoma*, ***Filicollis***, ***Polymorphus*** (syn. *Carinella*)
Neoechinorhynchida	Neoechinorhynchidae	*Neoechinorhynchus*
	Tenuisentidae	*Paratenuisentis*

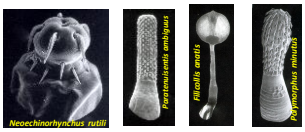
Thorny headed worms

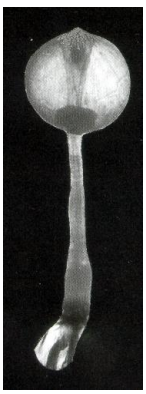
- about 1100 species (mainly in freshwater fish and birds, but also rodents, pigs and humans)
- significant adaptation to parasitism
- they parasitize exclusively in the intestines of vertebrates ;
- adults have a cylindrical body ranging in size from 1 mm to more than 60 cm;
- females are always significantly longer and heavier;
- a typical feature is the fixation organ - proboscis, covered with thorns;
- the obligatory dual-host development cycle (intermediate invertebrates are various invertebrates);



MORPHOLOGY

The shape of the body is cylindrical, light in colour. The body is divided into the anterior part (praesoma) - the trunk with a vagina, neck, lemnisci, cerebral ganglia and retractable muscles of the trunk.
The posterior part of the body (metasoma) is characterized by organs of the reproductive system.
Proboscis - fixation of the parasite in the intestine of the host and intake of nutrients.
Glycocalix – part of the surface - protection against the host's immune system.

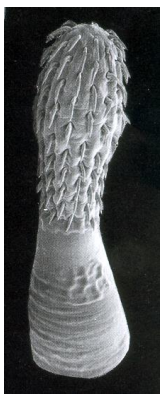



Filicollis anatis

Neck - between the trunk and your own body, without hooks.

Proboscis vagina - muscle sac, protection and movement of the proboscis.

Lemnisci - pair, on the sides of the octopus vagina (secretory function and/or mechanism of movement of the proboscis).


Polymorphus minutus

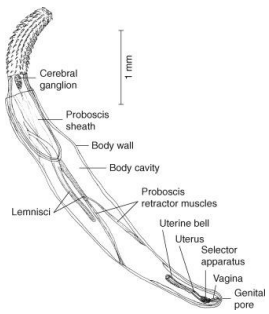
Digestive system - not developed, they receive food all over the body.

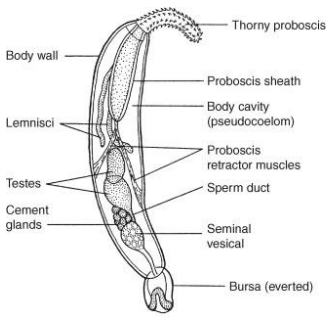
Body surface - is formed by a massive syncytial tegument.

Nervous system - nerve ganglion - octopus vagina; u ♂ paired genital ganglia in the back of the body (innervates the excretory tracts of the genital tract).

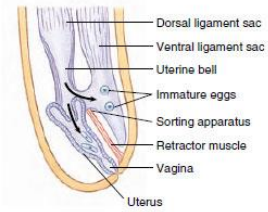
Excretory system - is known only in some species and is of the protonephridial type. It leads to the outlets of the reproductive organs.

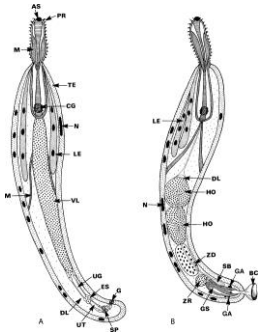
Genitals - are stored in the body cavity (pseudocel), which is defined by ligament sacs.





Reproductive organs





Life cycle - general

- **biohelmints**
- IH = arthropods (crustaceans - aquatic, insects - terrestrial species)
- **Paratenic hosts (vertebrates – fish)**

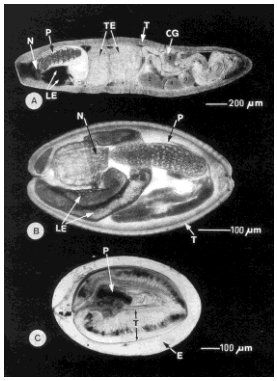
1. Eggs **2. Acanthor - IH** **3. Preacantela**

4. Acantela - proces encystation → cystacant = infectious for definitive hosts

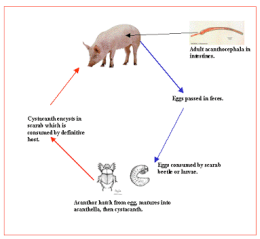
Acanthocephalus anguillae

Fillicolis anatis

Monoliformis moniliformis

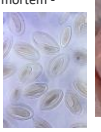


O l i g a c a n t h o r h y n c h i d a e
Macracanthorhynchus (***Macracanthorhynchus hirudinaceus***)

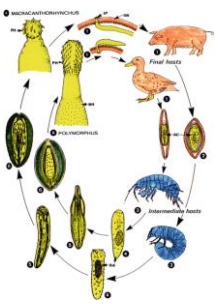


- clinical signs appear only if> 15 hooks parasitize in the intestine;
- diarrhea (bloody) anorexia stomach convulsions
- weight loss stunting
- ovoscopic examination, post mortem - autopsy;

- te: tiabendazole



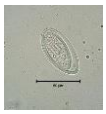
P o l y m o r p h i d a e
Filicollis (***Filicollis anatis***)
Polymorphus (***Polymorphus minutus, P. rubra***)



Prepatent period: 30 days

- mechanical damage to the wall of the small intestine;
- local inflammation;
- tissue proliferation - nodule formation;
- impaired digestion;
- diarrhea;
- anorexia, lagging behind in growth; deaths, especially of young individuals;
- bitionol;

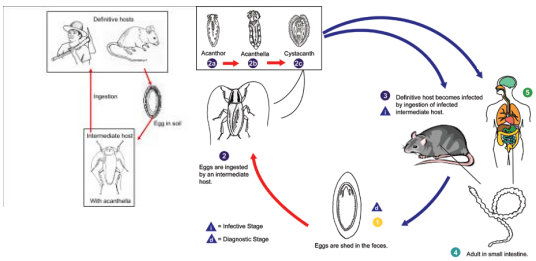
Filicollis anatis

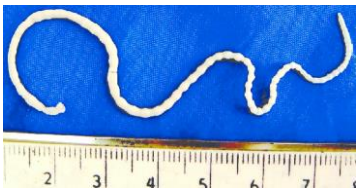


- bitionol

M o n i l i f o r m i d a e

Moniliformis (***Moniliformis moniliformis***)





- **mebendazol, fenbendazol, pyrantel pamoate, ivermektin**