Ideas on Parasitology

Adult black fly (Simulium yahense) with (Onchocerca volvulus) emerging from the insect's antenna. The parasite is responsible for the disease known as river blindness in Africa. Sample was chemically fixed and critical point dried, then observed using conventional scanning electron microscopy. Magnified 100×.

Parasitology is the study of parasites, their hosts, and the relationship between them. As a biological discipline, the scope of parasitology is not determined by the organism or environment in question, but by their way of life. This means it forms a synthesis of other disciplines, and draws on techniques from fields such as cell biology, bioinformatics, biochemistry, molecular biology, immunology, genetics, evolution and ecology.

Fields

The study of these diverse organisms means that the subject is often broken up into simpler, more focused units, which use common techniques, even if they are not studying the same organisms or diseases. Much research in parasitology falls somewhere between two or more of these definitions. In general, the study of prokaryotes falls under the field of bacteriology rather than parasitology.

Medical parasitology

See also: Human parasites

The Italian Francesco Redi, considered to be the father of modern parasitology, he was the first to recognize and correctly describe details of many important parasites.
Humans are hosts to nearly 300 species of parasitic worms and over 70 species of protozoa, some derived from our primate ancestors and some acquired from the animals we have domesticated or come in contact with during our relatively short history on Earth.\[2\]

One of the largest fields in parasitology, medical parasitology is the subject which deals with the parasites that infect humans, the diseases caused by them, clinical picture and the response generated by humans against them. It is also concerned with the various methods of their diagnosis, treatment and finally their prevention & control. A parasite is an organism that live on or within another organism called the host. These include organisms such as:

- **Plasmodium** spp., the protozoan parasite which causes malaria. The four species of malaria parasites infective to humans are *Plasmodium falciparum*, *Plasmodium malariae*, *Plasmodium vivax* & *Plasmodium ovale*.
- **Leishmania donovani**, the unicellular organism which causes leishmaniasis
- **Entamoeba** and **Giardia**, which cause intestinal infections (dyentery and diarrhoea)
- Multicellular organisms and intestinal worms (helminths) such as **Schistosoma** spp., **Wuchereria bancrofti**, **Necator americanus** (hookworm) and **Taenia** spp. (tapeworm)
- Ectoparasites such as ticks, scabies and lice

Medical parasitology can involve drug development, epidemiological studies and study of zoonoses.

**Veterinary parasitology**

Main article: Veterinary parasitology

The study of parasites that cause economic losses in agriculture or aquaculture operations, or which infect companion animals. Examples of species studied are:

- **Lucilia sericata**, a blowfly, which lays eggs on the skins of farm animals. The maggots hatch and burrow into the flesh, distressing the animal and causing economic loss to the farmer
- **Otodectes cynotis**, the cat ear mite, responsible for Canker.
- Gyrodactylus salaris, a **monogenean** parasite of **salmon**, which can wipe out populations which are not resistant.

### Structural parasitology
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*Main article: *Structural parasitology
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This is the study of structures of proteins from parasites. Determination of parasitic protein structures may help to better understand how these proteins function differently from **homologous proteins** in humans. In addition, protein structures may inform the process of **drug discovery**.

### Quantitative parasitology
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*Main article: *Quantitative parasitology
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Parasites exhibit an aggregated distribution among host individuals, thus the majority of parasites live in the minority of hosts. This feature forces parasitologists to use advanced biostatistical methodologies.

### Parasite ecology
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Parasites can provide information about host population ecology. In **fisheries biology**, for example, parasite communities can be used to distinguish distinct populations of the same fish species co-inhabiting a region. Additionally, parasites possess a variety of specialized traits and life-history strategies that enable them to colonize hosts. Understanding these aspects of parasite ecology, of interest in their own right, can illuminate parasite-avoidance strategies employed by hosts.

### Conservation biology of parasites
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*Main article: *Conservation biology of parasites
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Conservation biology is concerned with the protection and preservation of vulnerable species, including parasites. A large proportion of parasite species are threatened by extinction, partly due to efforts to eradicate parasites which infect humans or domestic animals, or damage human economy, but also caused by the decline or fragmentation of host populations and the extinction of host species.

### Taxonomy and phylogenetics
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The huge diversity between parasitic organisms creates a challenge for biologists who wish to describe and catalogue them. Recent developments in using **DNA** to identify separate species and to investigate the relationship between groups at various **taxonomic** scales has been enormously useful to parasitologists, as many parasites are highly **degenerate**, disguising relationships between species.

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Which cestode species is zoonotic?

Echinococcus multilocularis; Echinococcus granulosa; Dipyridium caninum; 

Cestodes For Different Species? And their IH?

- Dogs and Cats: Dipyridium caninum (IH-flea); Echinococcus multilocularis(IH small mammals) and granulosa(IH large mammals); Taenia spp(IH small vertebrates{rodents}) - Horses: Anopolcephela sp. (IH pasture mite) and Paranopolcephela -Ruminants: Moniezia spp.(IH arthropod) -Pigs Taenia solium (DH humans) -Birds Choanotaenia spp (IH arthropods)
Explain the lifecycle of cestodes

- All have an indirect lifecycle so they require an intermediate host. - An adult tape in the DH small intestine - detached segments or eggs in feces - IH eats eggs - migrating larvae in tissue of IH (mucosal migration) - after 1-2 mos. larvae are mature - DH ingests the IH - larvae perform mucosal migration in DH - Adult tapeworm in small intestine of DH

The ELISA test is available for which species of cestode?

It is available for Echinococcus granulosa

Which cestode species causes Hydatid disease and where do cysts develop in the body?

- Echinococcus spp - Bladder cysts surrounding larvae develop in the internal organs - Humans act as the intermediate host following digestion of contaminated stool with eggs - Can cause death

Which are the three most important genera of cestodes?

- Echinococcus spp. - Dipylidium spp. - Taenia spp.

T or F Diphyllobothrium latum is a pseudophyllidean tapeworm?

T

T or F Echinococcus tapeworms are classified as cyclophyllidea tapeworms?

T

T or F Pseudophyllidean tapeworms utilize terrestria food chains to complete their lifecycles?

F

T or F Man can be infected with the larval form of a tapeworm

T
What is the name for the larval portion a tapeworm? The chain of proglottids?

-Metacestode - Strobila

What are the three methods of diagnosing a dog or cat with a cestode infection?

-Visualizing segments in the feces or vomit
-Necropsy will find adults in the small intestine
-ELISA test for Echinococcus granulosa

What is the more common species of tapeworm found in Felines?

Taenia Taeniaformis

Are equine or ruminant cestodes considered a problem or pathogenic?

They are usually considered non-pathogenic

What is the only cestode that infects pigs? What happens if this parasite infects humans?

-Taenia solium - Humans are the definitive hosts and are infected by eating the IH- pork - can develop cystercosis and the adult tapeworm will parasitize the small intestine

What are the Nemoatodes that Affect Each Species?

-Cats: and Dogs: Toxocara cati or canis; Toxascaris leonina; Dirofilaria immitis; Ancylostoma sp.; Uncinaria spp.; Trichuris vulpis; Capillaria spp.; Strongyloides - Horses: Strongylus spp.; Strongyloides westeri.; Oxyurus equi; Parascaris equorum; Dictyocaulus arnfieldi. - Ruminants: Trichostrongylus spp.; Nematodirus spp; Dictyocaulus spp.; Trichuris ovis; Strongyloides; Capillaria spp.; - Pigs: Ascaris suum; Trichuris suis; Oesophagostomum dentatum; Hyostrongylus rubidus; Strongyloides spp; Trichinella spiralis; - Birds: Ascaridia galli; Heterakis gallinarium; Capillaria spp;

What is the most dangerous nematode for horses? Why?
-Strongulus vulgaris -The larvae migrate up the mesenteric artery for hypobiosis causing damage, a partial or complete block and colic symptoms -Can cause sudden death

Name the Large and Small Strongyles

Large Strongyles: Strongylus vulgaris and endentatum and equinus
Small Strongyles: Cyathostomes

What is a Cyathostome?

Another name for a small strongyle

What are three types of Ascarids that infect Dogs and Cats?

-Toxocara cati or canis; Toxascaris leonina;

What are the two diseases Toxocara canis can cause in humans?

Ocular larval migrans (OLM): larva spread to eyes and Visceral Larval Migrans (VLM): larva undergo somatic migration through liver and lungs

What are the four ways canines can acquire an infection with Toxocara canis?

1. Ingesting the larvated eggs in the environment
2. Ingesting an infective paratenic host who has the infective stage
3. Transmammarily - Ingesting larva when nursing an infected bitch
4. Transplacentally infected from bitch in utero

What are the four clinical signs in a dog with T. canis?

1. Rough, dry skin and hair coat with pot belly
2. Anemia
3. Diarrhea
4. Coughing (due to larvae undergoing tracheal migration)

T or F ascarids require an intermediate host to complete their lifecycle?
They may or may not require an intermediate host can have direct or indirect lifecycles depending on the species.

Name the order, genus and two species of fleas that can infect small animals? Which is most common?

- Order: Siphonaptera - Genus: Ctenocephalides - Species: canis and felis - Most common is the cat flea: Ctenocephalides felis

What stage of the flea lifecycle is hardest to kill and why?

- The non adult stages (eggs, larvae and pupae) are the hardest to kill because they spend all of their time in the environment and eggs and pupa are resistant to most flea products.

Fecal floats for ascarids often won't show eggs in the feces with what age of dog?

- Under six weeks old as the prepatent period is not complete

Hookworms mainly infect which species? What do they cause in humans and how are humans infected?

- Dogs - They cause Cutaneous Larval Migrans (CLM) in humans usually on hands or feet as the larvae penetrate the skin upon contact (Plumbers are the profession most infected)

What are two methods of diagnosing nematodes?

1. Fecal floatation shows eggs  
2. Gross examination of feces or vomit

What is the common and scientific name of the most important intestinal parasite of horses? What kind of lifecycle does it have?

- Strongylus spp. or Bloodworms - Direct

What is the largest ova found in bovine species? What is it's common name?

- Nematodirus spathiger - Thin-necked worm
What two types of syndromes does Fasciola hepatica cause in ruminants?

- Acute Syndrome: hepatitis and possible death due to migration in the liver
- Chronic Syndrome: weight loss, decreased production and weaning weights

What is the most important intestinal parasite of ruminants? Why? What are the five species in this group? What is their life cycle and migration pattern?

- Trichostrongyloidea
- Single most important cause of economic loss (death and poor growth) on pasture
  1. Trichostrongylus spp.
  2. Ostertagia spp.
  3. Haemonchus spp.
  5. Nematodirus spp. (the only one that can be differentiated)
- Direct Lifecycle with a mucosal migration

In Western Canada there is a well known lifecycle of the most important intestinal parasite in ruminants, what is it called?

Osteragiasis

What are the two species of lungworm affecting the ruminant? What is the fecal test done to show the parasite and what would you be looking for?

- Dictyocaulus viviparatus and filaria - The Baermann technique - The larva hatch in the intestine so a fecal float wouldn't work, I would look for the larval form

What are the three types of Ostertagiasis?

- Type I Ostertagiasis: routine direct lifecycle through host (subclinical losses, some destruction of mucosal and glandular tissue)
- Pre Type II Ostertagiasis: larva encyst in host's abomasal mucosa (hypobiosis/overwinter) and are in an inhibited state (no clinical signs)
- Type II Ostertagiasis: at opportune time larva excyst en masse into the abomasal lumen causing clinical symptoms in host (diarrhea, edema, rapid weight loss, emaciation, death)

What three things stimulate the hatching of flea pupa?
- Warmth - Movement - CO2 (breath)

What three products are most popular for flea control and what is frequency of administration?

- Topical medications like Revolution, Advantage and Active - Treat pet monthly according to product directions or prior to going into a flea infested area.

Name two clinical signs of flea infestation and how you can diagnose it (tests)

Clinical Signs: Pruritis; FAD (Flea Allergy Dermatitis) causing alopecia and bacterial pyoderma
Diagnosis: visualize adult flea on pet (jump, hide in hair, could only be a few of them)

How long does an adult heartworm live in a dog? In a cat?

- Dog: Adults reside primarily in the pulmonary arteries and can live for 5-9 years
- Cat: Adults can live from 16-30 months

What is the prepatent period of Dirofilaria?

6 - 6.5 months

What is unique about the cat that makes it less susceptible to Dirofilaria?

- Cats have an increased capacity to clear microfilariae from the blood through an immune mediated response
- It is not a natural host of D. immitis
- The prepatent period is increased to up to 8 mos and only 50% of cats develop patent infections (-Smaller worm burdens)

T or F All heartworm infections cause clinical signs

- F - With low burdens the animal may be asymptomatic for several years

What are the dangers of adulticidal therapy for Dirofilaria?

- The most common complication associated with heartworm adulticide therapy is pulmonary thromboembolism (PTE), which results from embolization of the dead worms into the pulmonary
vasculature
-Immiticide is actually arsenic and must be given only if positive for heartworm and the patient must be hospitalized during this treatment to monitor for reactions
(Only after the adult heartworms (retest) are gone then the microfilaria can be dealt with)

Why is heartworm a problem in Alberta?
-Because Alberta has the right species of mosquito which transmits the disease

What is the intermediate host of Heartworm?
-The mosquito

How do you test for Heartworm?
1. Detecting of microfilaria in a blood smear 2. Serological test detecting antigens (ELISA which can detect occult infections-the preferred method)

Why do blood smears of an infected animal not always show microfilaria?
-25-65% of heartworm cases are occult infections with no microfilaria

What is an occult case of heartworm and what are its four causes?
-Occult case refers to a heartworm infection with no microfilaria in the blood
  -Can occur due to: 1. Prepatency (immature heartworms) 2. Unisex infection (no baby microfilaria) 3. Treatment with heartworm prophylactics (kill microfilaria and cause adult females to become sterile) 4. Immune reactions of host eliminated the microfilaria

In Canada when should Heartworm testing begin?
-In early April (six and a half months from the end of the transmission period (end of mosquito season))
-Or six and a half months after travel to an endemic area

If microfilaria are detected in a blood smear, what must be differentiated before treatment?
-Must differentiate between microfilaria of a non pathogenic blood circulating worm called Dipetalonema reconditum which look similar to D. immitis (D.reconditum has a button, hook on head and tail curls)

What are the three phases of heartworm treatment?

1. Prophylactic therapy (prevent infection, most concerned with this in Western Canada) 2. Adulticidal therapy (kill adult worms present) 3. Microfilaricidal therapy (kill all circulating microfilaria)

What are four drugs commonly used for Heartworm prophylactic therapy?


What are the clinical signs of Heartworm?

-Dogs: Depends on the size of worm load; Heavy burdens have the clinical signs of heart failure (fatigue and exercise intolerance; respiratory impairment and coughing); radiographically evidence of an enlarged right side of heart
-Cats: Can develop severe lesions early in the disease even with low burdens; the reaction to heartworm in the pulmonary arteries is extreme and the most common clinical sign is sudden death; (other clinical signs are variable but can be coughing, vomiting, tachyapnea and dysapnea)

What areas in Canada are endemic for Heartworm?

-Southern Manitoba, Ontario, Quebec, and the Okanagan Valley

Why is heartworm a problem in cats?

1. It is difficult to diagnose: early feline heartworm and feline asthma are clinically similar and both respond to steroid treatments; low worm numbers may have an undetectable amount of antigen for ELISA; microfilaremia is mild and transient 2. Low burdens cause severe reactions and sudden death

T or F do adult heartworms produce eggs?

-F -they produce live offspring called microfilaria
How long will microfilaria circulate in the blood until taken up by a mosquito?

- up to 2.5 years

What two types of Demodectosis are there?

1. Generalized: entire body affected; secondary bacterial infections; extensive bloody, crusty, purulent lesions; associated with an inherited immune system defect (breed predisposition: Shar pei, Bull Terrier) 2. Localized: often seen in dogs <2 yrs; generally self-limiting; small local areas of alopecia; usually caused by a transient immunosupression (ie stress, illness)

Which type of Demodectosis is harder to treat?

- Generalized Demodectosis has a poor prognosis, even if the treatment is successful it usually reoccurs

Is Demodex considered normal flora?

Yes, can be found on healthy animals in small numbers

Which toxic compound if used to treat Demodex?

Mitaban (amitraz) dips are used (also ivermectin or milbemycin off label)

What does Demodex look like microscopically?

- They are cigar shaped and very unique compared to other mites
What species of animals can ear mites be found in? Which is most common?

-Dogs; Cats (most common); Rabbits; Foxes; Ferrets

What is the scientific name of the ear mite?

Otodectes cynotis

Does Otodectes burrow in the skin?

No.

What is the clinical signs for Otodectes?

- Inflammation - exudation - crust formation - animal will scratch at ear and shake their heads - Ears appear full of dirt (digested debris of mites)

What is the treatment of choice for Otodectes?

Revolution (Selamectin)

What are the clinical signs of Sacroptes spp.?

- Severe pruritis - secondary bacterial infections - severe thickening of skin with folds and crusts - emaciation - possibly death in severe cases - can be asymptomatic carrier (scabies incognito)

What are the two species of mite that cause Sarcoptic mange?

Sarcoptes scabiei and Sarcoptes canis

What wild animal is a common carrier for Sarcoptes?

the coyote
How can you identify Sarcoptes?

- Legs of the mite have long, unjointed, pedicels with distal suckers

| 1 | 2 | 3 |

Is Sarcoptes zoonotic? What affect do they have on people?

- Yes - Cause severe itching

| 1 | 2 | 3 |

How do dogs become infested with Sarcoptes? What is the treatment of choice

- Through direct contact with an infected animal or the infected animal's bedding
- Revolution (Selamectin)

| 1 | 2 | 3 |

What is the common term used for Cheyletiella?

- Walking Dandruff

| 1 | 2 | 3 |

T or F Cheyletiella burrows in the skin

- F - they live only on the surface of skin

| 1 | 2 | 3 |

Is Cheyletiella zoonotic? What is the treatment of choice?

- Yes, it is very contagious - Revolution

| 1 | 2 | 3 |

By what method do you identify Cheyletiella?

- Usually by scotch tape mount, superficial skin scrapings or flea combing
- Has a "waist" and a pair of claws on each side of the mouth parts

| 1 | 2 | 3 |

What are the two syndromes of Toxocarasis in people? What ages of people are affected by each syndrome?

1. Visceral Larval Migrans (VLM) - <4 years
2. Ocular Larval Migrans (OLM) - older children and adults

| 1 | 2 | 3 |
T or F Toxocariasis infections can be asymptomatic with eosinophilia as the only symptom

T

Who is at greatest risk for a Toxocariasis infection?

Toddlers are at the greatest risk due to geophagia

What species of Toxocara affect people?

Toxocara canis and Toxocara cati

What are the clinical signs of VLM?

- Eosinophilia - rash - fever - cough (tracheal migration) - seizures - hepatosplenomegaly - involvement of the CNS or myocardium can result in death

What are the clinical signs of OLM?

- Migrating larvae invade the eye and cause a granulomatous retinitis - usually presents as unilaterally reduced vision

T or F are crypto oocysts infective when passed from the host?

Cryptosporidium oocysts are immediately infective as soon as they are passed in the feces. (in fact 20% are reinfective to host before leaving the body)

What is the most common species of Cryptosporidium affecting people?

Cryptosporidium parvum

How would you prevent the spread of crypto during calving season?

- Practice good hygiene - Avoid water and food that might be contaminated - The disease is acquired through contact with contaminated fecal matter (diarrhea) so care is needed to avoid spreading
What animals are commonly affected by Cryptosporidium?

- Calves
- Lambs
- Humans

What are common clinical signs of Cryptosporidiosis?

- Lambs and Calves: mild to severe diarrhea; healthy appetite; can have asymptomatic carriers
- Humans: "traveller's diarrhea"; can be asymptomatic; immunodeficient hosts may have chronic life threatening diarrhea; immunocompetent hosts may have short term diarrhea

What is a unique characteristic of the protozoon Cryptosporidium parvum?

- They can be seen in an acid fast smear sometimes -are extremely difficult to identify on a normal fecal float or smear usually need to be sent away to lab

Which is the only host in which Toxoplasma gondii develops it's sexual form?

- Feline

What are the three forms of Toxoplasmosis infection in an immunocompromised host?

1. Ocular: reactivation due to an infection acquired in utero causing eye disease
2. Congenital: occurs only after a woman acquires a primary infection while pregnant; can ause abortion in early pregnancy and severe disease in infants affected during the first two trimesters
3. Reactivation: of encysted bradyzoites acquired in a previous exposure can occur during immunocomprimised state; CNS involve

What happens once a sporulated oocyst of T.gondii is ingested?

- In the GIT the sporozoites multiply forming tachyzoites which spread via the blood and lymphatics to the nervous system, skeletal and cardiac muscle, and liver to encyst in these tissues

What drug is used to treat Toxoplasmosis?

- The antibiotic clindamycin
- It must be continued for at least four weeks
What are the three ways where human's acquire an infection with Toxoplasma gondii?

1. Ingestion of cysts from raw or undercooked meat
2. Ingestion of sporulated oocysts from cat feces (usually in garden soil)
3. Transplacental transmission

What are some causes of immunocompromisation?

- Organ transplant recipients
- HIV or AIDS
- Malnutrition
- Age (very young or old)
- Other diseases (leukemia, cancer)

How can Toxoplasmosis be prevented?

- Cat litter should be disposed of daily or EOD
- Cats should be prohibited from entering buildings where food producing animals are housed
- Feed storage areas should be locked to prevent fecal contamination of food

How can Toxoplasmosis be prevented in pregnant women (5)?

- Pregnant women should:
  1. not obtain a new young kitten unless she has a known high titer or obtains a seropositive cat (they only shed once)
  2. limit contact with cats to those which stay indoors
  3. Wear gloves or avoid handling cat feces
  4. Avoid eating raw meat and wash hands after handling
(5. Vaccination)

Name the two hookworms responsible for Cutaneous Larval Migrans (CLM)

1. Ancylostoma spp. (Southern Hookworm) 2. Uncinaria spp. (Northern Hookworm)

What is another name for CLM

"Creeping Eruption"

Is CLM self limiting?
Yes, but it can last several weeks. The larva can invade human skin but are confined to the epidermis preventing completion of their life cycle.

How can humans be infected with CLM? Which is most common?

1. Most common: Through direct contact with larvae in areas contaminated with animal feces (playgrounds, beaches, or crawl spaces under houses)
2. Ingestion of larvae

T or F In CLM eosinophilia is a common sign

F

What occupation/trade is most susceptible to CLM?

Plumbers

T or F Humans are a definitive host for E. multilocularis

-F -They are the intermediate host

T or F Sheep and cattle are the intermediate hosts of E. granulosa

-T -Dogs and other carnvores are the definitive hosts

T or F Humans are infected with Echinococcus when they ingest from the intermediate host

-F -Humans are infected when they ingest the ova in contaminated feces of definitive host

Once Echinococcus is localized in the tissues what can happen to larva?

They are either destroyed by a local inflammatory response or they form hydatid cysts

What are the sites where hydatid cysts are commonly found?

-liver -lung -muscle -bone -kidney -brain
Where does the larval development of Dipylidiasis take place?

- In fleas the intermediate hosts

What species are the definitive hosts of Dipylidium caninum?

- Dogs - Cats - Humans

What is the most common form of prevention of Dipylidiasis?

Control of both endo and ecto parasites

Where can you find the adult form of Dipylidium caninum?

- In the definitive host's small intestine

How many eggs per day can Ascarids produce? What does this tell us about prevention?

- 200,000 eggs/day/worm
  - Prevention is impossible

Why are coccidial infections considered to be self limiting?

- Because after the asexual cycles of the coccidia are complete, the sexual cycle ends the infection

Which group of parasites has a complete digestive tract? (mouth- anus)

Nematodes

Can dogs and cats acquire pinworm infections?

No, only horses can get pinworms (Oxyuris equi)
What causes the itching in pinworm infections?

- The female worms exiting the anus to lay eggs on the perineal hair and skin

T or F You cannot use a fecal analysis to diagnose a pinworm infection

- T - Eggs are not passed in the feces - use the scotch tape method (best at night when they are most active)

How long can small strongyles remain encysted in the mucosa?

- up to 2 1/2 years

Which nematodes larvae can be passed transplacentally and transmammarily in dogs?

Toxocara canis

What is the scientific name of the "giant kidney worm"?

Dictyophyema renale

Why is timing important in regards to preparing fecal floats?

The sodium nitrate will eventually start to crystalize making the test unreliable as the crystals can obscure ova

What are the typical signs of parasitism?

- pot belly - poor growth rate - rough hair coat - poor doing

Where are Trichuris adults found?

- the large intestine

What parasite causes trichinosis?
Trichinella spiralis

T or F Nematodes can live in any organ of their host and can survive different environments and temperatures

T

What is the natural host of the trematode? What is the intermediate host?

- Natural host: deer
- Intermediate host: snail

What zoonoses causes muscle pain and can result in death in humans?

Trichinella spiralis

History

"Our knowledge of parasitic infections extends into antiquity, and descriptions of parasites and parasitic infections are found in the earliest writings and have been confirmed by the finding of parasites in archaeological material".

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