Welcome to ***Parasitic Diseases***
Fall 2008

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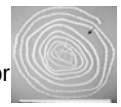
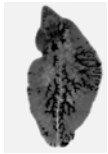
Helminths (Worms)

Nematodes - non-segmented round worms

Cestodes - segmented flat worms



Trematodes - non-segmented flat worms



Parasite

Any organism that takes metabolic advantage of another organism

- Viruses
- Rickettsiae
- bacteria
- Fungi
- Protozoa*
- Helminths*
  - Nematodes - round worms
  - Cestodes - segmented flat worms
  - Trematodes - non-segmented flat worms
- Arthropods* - six and eight-legged critters

* Covered in ***Parasitic Diseases***

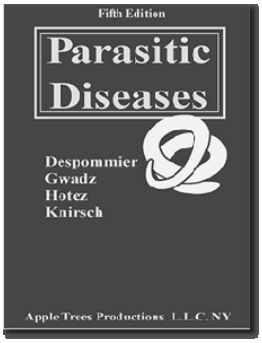
Nematodes - round worms

1. All are eukaryotes - *Caenorhabitis elegans* is the best known example and is free-living in soil.

2. Most nematodes are non-parasitic.

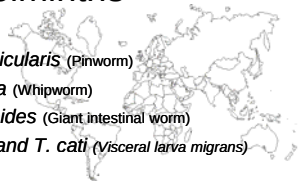
3. Almost 4 billion people harbor at least one species of parasitic nematode. Many have more than one.

Highly Recommended textbook*
Available at bookstore.
Still only $69.95



* Lots of really gross pictures!!!

Geohelminths



- *Enterobius vermicularis* (Pinworm)
- *Trichuris trichiura* (Whipworm)
- *Ascaris lumbricoides* (Giant intestinal worm)
- *Toxocara canis and T. cati* *(Visceral larva migrans)*
- Hookworms
  - *Ancylostoma duodenale*
  - *Necator americanus*
- *Strongyloides stercoralis*

Site Location For Helminth Infections Of Humans

Alimentary tract	197 species
Cavities, organs, and tissues	107 species
Circulatory system	21 species
Skin and tissues	56 species

Going Green !

(with brown and yellow)

Helminths That Infect Humans

Acanthocephala	7 species
Nematoda	138 species
Nematomorpha	24 species
Platyhelminthes	173 species
Digenea	113 species
Eucestoda	57 species
Turbellaria	3 species
TOTAL	342 species

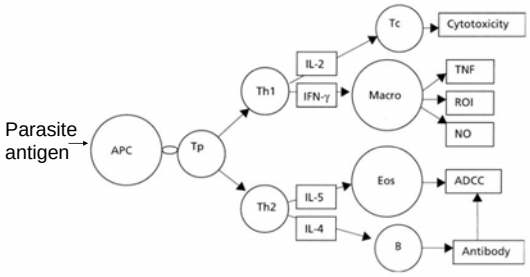
Food Plus

Why so many parasite specie

We live everywhere.
We eat everything.

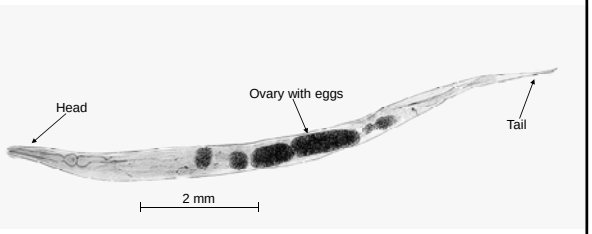
This should never happen!

Immunity and Parasitism



Worm infections elicit Th2 protective immune responses.
Protozoan infections elicit Th1 protective immune responses.

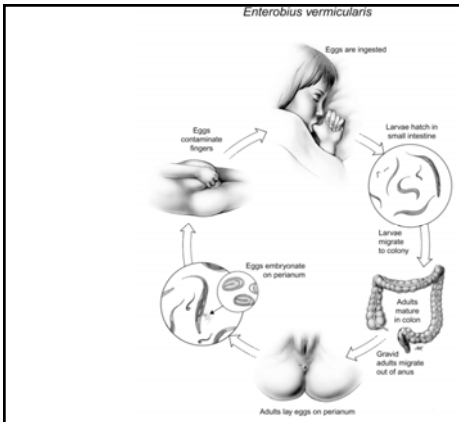
Adult Female *Enterobius vermicularis*



Cytokines and Immunity to Parasites

Th1 cytokines	Th2 cytokines	Pro-inflammatory cytokines	Counter-inflammatory cytokines	Cytokines that can lead to pathology (e.g. increased vascular permeability, tissue damage, circulatory collapse, multi-organ failure etc.)
IFN-γ*	IL-4*	IL-12	IL-4	IL-1
IL-2	IL-5*	IL-15	IL-10	IL-6
IL-3	IL-3	IL-18	TGF-β	IL-8
TNF-α	IL-13	IFN-γ		IL-12
TNF-β	IL-6			TNF-α
GM-CSF	IL-10			MIF
	TGF-β			

*most important in immune expulsion of protozoa and worms



Helminths:
Nematoda

Enterobius vermicularis
(Pinworm)

Heavy Infection of *Enterobius vermicularis*

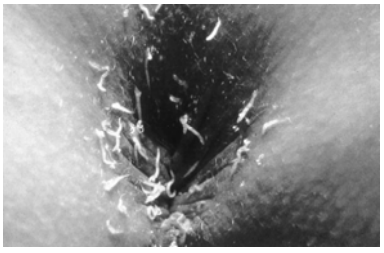


Photo: Martin Weber, MD, Children's Hospital; Hannover Medical School; Hannover, Germany

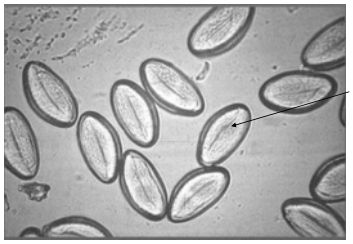
Eggs of *Enterobius vermicularis*

Unembryonated

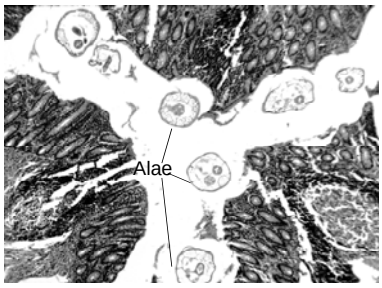
Embryonated

Diagnosis:

Eggs found on microscopic examination of clear sticky tape.

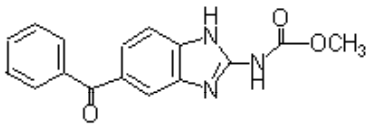


Enterobius vermicularis in appendix



Drug of Choice:

Mebendazole



Mode of Action:

De-polymerizes invertebrate tubulins, only.

Clinical Disease:

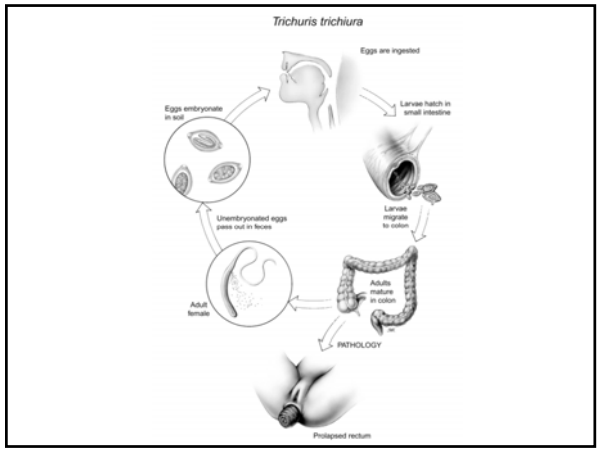
None

Prevention and Control:

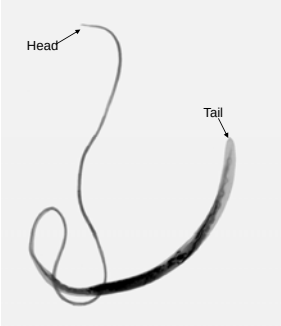
Prevention is difficult among children, especially those attending day care facilities and lower grades in school. We “out-grow”our pinworm infections once we reach puberty.

Helminths:
Nematoda

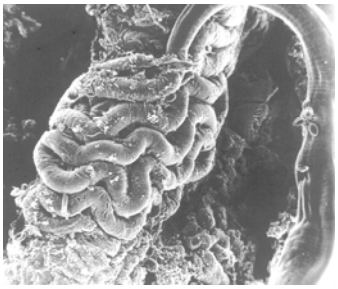
Trichuris trichiura
(Whipworm)



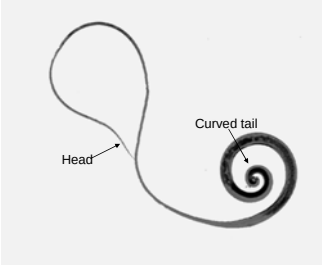
Female adult *Trichuris trichiura*



Adult *Trichuris muris* in situ (SEM)



Adult male *Trichuris trichiura*



Pathogenesis:

Trichuris spp. secrete a pore-forming protein that may play a role in anemia and diarrhea. Adult worms ***do not*** feed directly on blood or other host tissues. Mechanism of anemia still unknown.

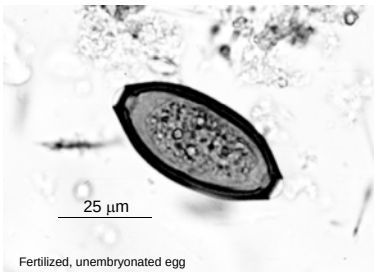
Approaches to helminth-based therapy of IBD

World J Gastroenterol. 2008 Sep 7;14(33):5125-32.
Helminth infections and intestinal inflammation.
Wang LJ, Cao Y, Shi HN.
Mucosal Immunology Laboratory, Massachusetts General Hospital, Building 114 16th Street, Room 3504, Charlestown, Massachusetts 02129, United States. shiha@helix.mgh.harvard.edu

Evidence from epidemiological studies indicates an inverse correlation between the incidence o certain immune-mediated diseases, including inflammatory bowel diseases (IBD), and exposu to helminths. Helminth parasites are the classic inducers of Th2 responses. The Th2-polarized T cell response driven by helminth infection has been linked to the attenuation of some damag Th1 driven inflammatory responses, preventing some Th1-mediated autoimmune diseases in host, including experimentally induced colitis. Helminth parasites (the porcine whipworm, *Trichuris suis*) have been tested for treating IBD patients, resulting in clinical amelioration of the disease. As a result, there is a great deal of interest in the research community in explorin the therapeutic use of helminth parasites for the control of immune-mediated diseases, includi IBD. However, recent studies have provided evidence indicating the exacerbating effects of helminths on bacterial as well as non-infectious colitis in animal models. Therefore, a better understanding of mechanisms by which helminths modulate host immune responses in the gut reveal novel, more effective and safer.

Diagnosis:

Microscopic examination of feces for eggs

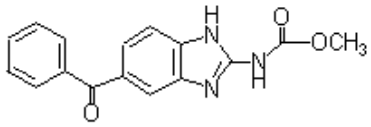


Fertilized, unembryonated egg

Prolapsed rectum with adult
Trichuris trichiura

Drug of choice:

Mebendazole



Mode of Action:
De-polymerizes invertebrate microtubules, only

Clinical Disease:

1. Diarrhea

2. Anemia

3. Malnutrition (protein calorie deficiency?)

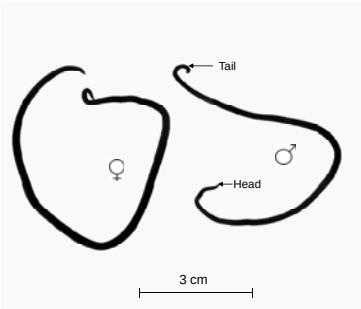
Prevention and Control:

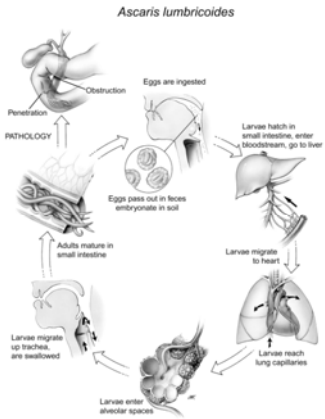
Sanitary disposal of feces

Helminths:
Nematoda

Ascaris lumbricoides
(Giant intestinal worm)

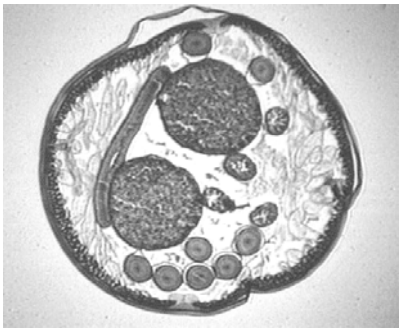
Adult *Ascaris lumbricoides*



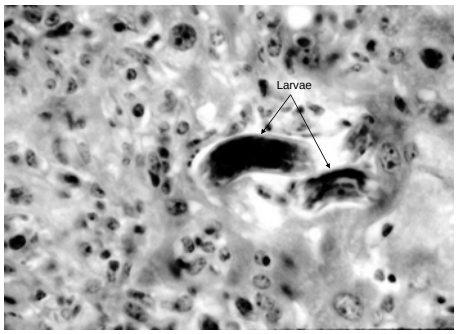


"Jar-O-Worms"
Collected from one rural village in Bangladesh in a single day!

Cross section of adult *Ascaris lumbricoides*



Larvae of *Ascaris lumbricoides* in liver

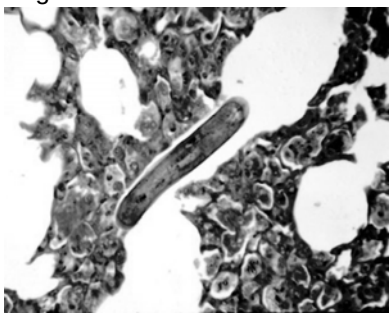


Clinical Disease:

1. Light infections are asymptomatic as long as the adult worms do not migrate.

2. Heavy infection leads to:
   a. protein calorie malnutrition - "failure to thrive" syndrome.
   b. bowel obstruction.
   c. aberrant migratory events.

Larva of *Ascaris lumbricoides* in lung



Child with heavy *Ascaris lumbricoides* infection

Pathogenesis:

1. "Verminous" pneumonia, lung tissue damage due to migratory larvae.

2. Bowel obstruction - too many adult worms.

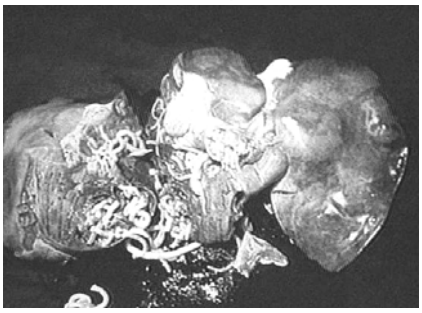
3. Parasite secretes trypsin inhibitor, prevents host from digesting proteins.

4. Aberrant migration of "irritated" adult worms to:
   a. Ampula of Vater
   b. Common duct
   c. Liver
   d. Pharynx
   e. Peritoneum

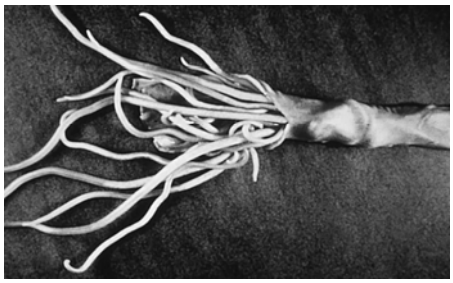
The result of successful treatment!

Infant with heavy Ascaris infection

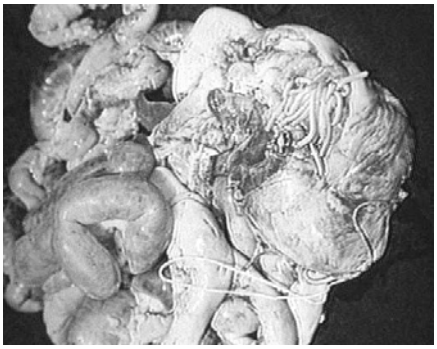
Ascaris adults in liver (fatal case)



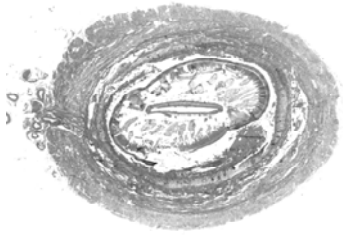
Bolus of *Ascaris lumbricoides* in small intestine



Bolus of *Ascaris lumbricoides* (fatal case)

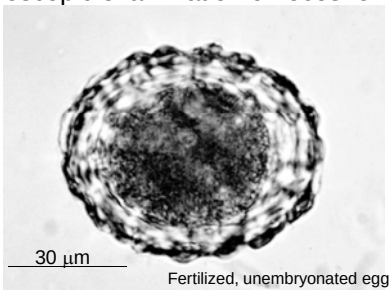


Ascaris lumbricoides adult in appendix



Diagnosis:

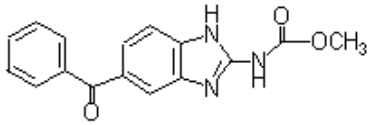
Microscopic examination of feces for eggs



Fertilized, unembryonated egg

Drug of choice:

Mebendazole

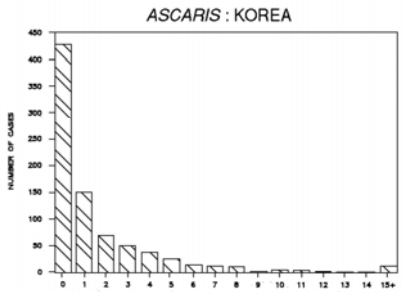


Mode of Action:
De-polymerizes invertebrate microtubules, only

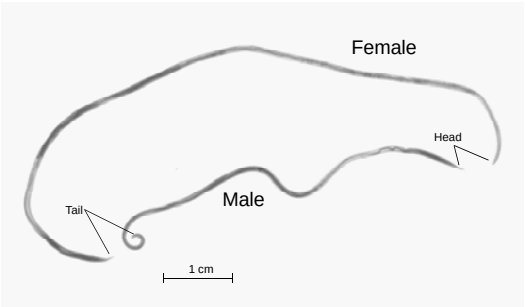
Helminths: Nematoda

Toxocara canis
Toxocara cati
Visceral and ocular larva migrans

Medical Ecology

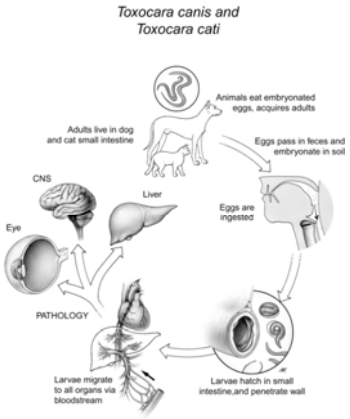


Adult *Toxocara canis*

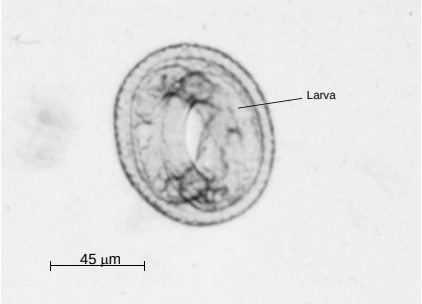


Prevention and Control:

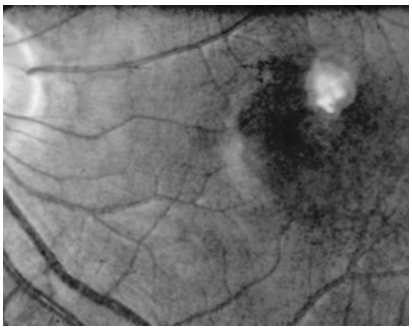
Sanitary disposal of feces



Embryonated egg of *Toxocara canis*



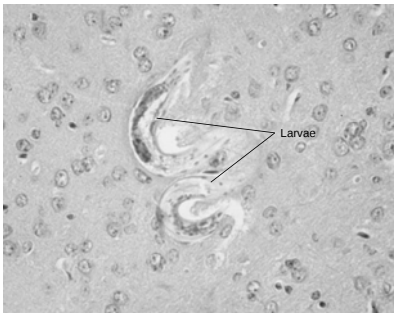
Granuloma in retina due to *Toxocara canis*



Pathogenesis:

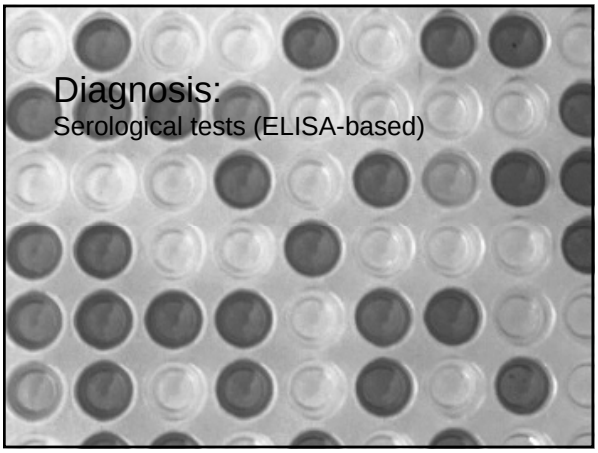
Tissue damage (systemic) due to migratory 3rd stage larva

Larvae of *Toxocara canis* in mouse brain



Clinical Disease:

1. Fever
2. Loss of visual acuity
3. Blindness
4. Learning disabilities

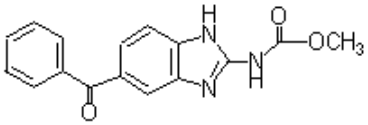


Diagnosis:

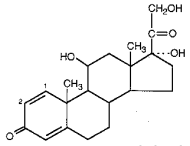
Serological tests (ELISA-based)

Drugs of choice:

Mebendazole



Steroids



Prednisolone

Prevention and Control:

Sanitary disposal of dog and cat feces

Not practical

Pooper-scooper

Potty-trained cat!

Prevention and Control (cont'd):

2. Periodically de-worm pets.
3. Cover public sand boxes at night.