47 – Worms and More Worms

Speaker: Edward Mitre, MD

2020 INFECTIOUS DISEASE BOARD REVIEW

Worms and More Worms

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Disclosures of Financial Relationships with Relevant Commercial Interests

- None

What are helminths?

What are helminths?

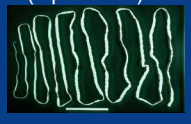
The most complex and fascinating organisms that routinely infect people

Pathogenic Helminths

Eukaryotic, multicellular animals

----- phylum Platyhelminths -----

--Its own phylum!!--

TREMATODES (flukes)	CESTODES (tapeworms)	NEMATODES (roundworms)
		
Fasciolopsis	*Taenia*	*Ascaris*

Images CDC DPDx

How helminths differ from other pathogens

- **Lifespan → most live for years**
- **Metazoans – eukaryotic, multicellular organisms**
- **often have complex lifecycles**
- **induce Th2 responses with eosinophilia and IgE**
- **with few exceptions*, DO NOT MULTIPLY WITHIN HOST**

(Strongyloides, Paracapillaria, Hymenolepis)*

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Major Helminth Pathogens

TREMATODES	CESTODES	NEMATODES
Blood flukes *Schistosoma mansoni* *Schistosoma japonicum* *Schistosoma haematobium*	Intestinal tapeworms *Taenia solium* *Taenia saginata* *Diphyllobothrium latum* *(Hymenolepis nana)*	Intestinal *Ascaris lumbricoides* *Ancylostoma duodenale* *Necator americanus* *Trichuris trichiura* *Strongyloides stercoralis* *Enterobius vermicularis*
Liver flukes *Fasciola hepatica* *Clonorchis sinensis* *Opisthorchis viverrini*	Larval cysts *Taenia solium* *Echinococcus granulosus* *Echinococcus multilocularis*	Tissue Invasive *Wuchereria bancrofti* *Brugia malayi* *Onchocerca volvulus* *Loa loa* *Trichinella spiralis* *Angiostrongylus cantonensis* *Anisakis simplex* *Toxocara canis/cati* *Gnathostoma spinigerum* *(Dirofilaria repens)* *(Baylisascaris procyonis)*
Lung flukes *Paragonimus westermani*		
Intestinal flukes *Fasciolopsis buski* *Metagonimus yokagawai*		

World Prevalence

Ascaris	> 400 million
Trichuris	> 200 million
Hookworm	> 200 million
Schistosoma	> 150 million

http://ghdx.healthdata.org/gbd-data-tool

ID Board Prevalance

Low

Parasitology ~ 9 out of 180 total questions

In addition to all helminths, includes:

- Protozoa
- Ectoparasites
- Principles of Travel Medicine

Question #1

28 yo F presents with recurrent crampy abdominal pain for several months. She recently returned to the U.S. after living in Tanzania for two years. Colonoscopy reveals small white papules. Biopsy of a pupule reveals an egg with surrounding granulomatous inflammation.

Most likely diagnosis?

A. *Entamoeba histolytica*
B. *Strongyloides stercoralis*
C. *Wuchereria bancrofti*
D. *Schistosoma mansoni*
E. *Paragonimus westermani*

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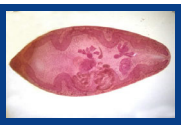
Trematodes (flukes)

- flat, fleshy, leaf-shaped worms
- usually have two muscular suckers
- usually hermaphroditic (except Schistosomes)
- require intermediate hosts (usually snails or clams)
- praziquantel treats all (except *Fasciola hepatica*)



Paragonimus (CDC DpDx)

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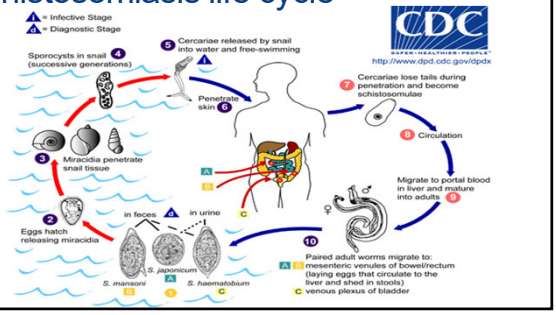
Schistosomiasis life cycle



Acute Schistosomiasis (Cercarial dermatitis or Swimmer's Itch)

Urticarial plaques and pruritic papules upon reexposure to cercariae penetrating skin in a sensitized individual.

Can occur in response to human or avian schistosomes.

Acute Schistosomiasis: Katayama Fever

- Occurs in previously unexposed hosts.
- Occurs at onset of egg-laying (3-8weeks)
- Symptoms: fever, myalgias, abdominal pain, headache, diarrhea, urticaria
- Eosinophilia, ↑ AST, ↑ alkaline phosphatase
- **No reliable way to confirm the diagnosis acutely as serology and stool O/P frequently negative.**

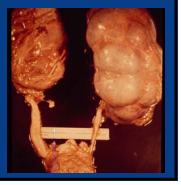
Schistosomiasis

Chronic disease

→ granulomatous colitis (*S. mansoni*)
→ portal hypertension (*S. mansoni*)

→ granulomatous cystitis *(S. haematobium)*
→ bladder fibrosis and cancer *(S. haematobium)*
→ obstructive uropathy (S. haematobium)

→ CNS disease (eggs to brain/spinal cord, esp *S. japonicum*)



Schistosomiasis

Chronic genital disease
increasingly recognized
primarily due to *S. haematobium*

men
- epididymitis
- prostatitis

women (see vaginal and cervical lesions)
- pelvic pain
- dysmenorrhea
- dyspareunia
- post-coital bleeding
- endometritis/salpingitis


sand grains


sandy yellow patches

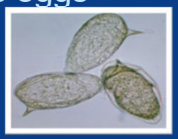

abnormal vessels


rubbery papules

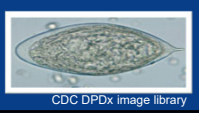
WHO Female Genital Schistosomiasis Pocket Atlas

Schistosome eggs

S. mansoni
(lateral spine)


CDC DPDx image library

S. haematobium
(terminal spine)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When to consider Schistosomiasis

- Fresh water exposure in an endemic region.
- Clinical syndrome compatible with acute schistosomiasis (F, abd pain, myalgias, eosinophilia)
- Clinical syndrome compatible with chronic schistosomiasis (abdominal/pelvic pain, blood in stool, loose stools, evidence of portal HTN, hematuria, eosinophilia)

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Fasciola hepatica (a liver fluke)

→acquired by eating encysted larvae on aquatic vegetation (e.g. water chestnuts)

→fluke migration through the liver: RUQ pain and hepatitis

→arrive at biliary ducts in liver and mature over 3-4 months

→can induce biliary obstruction

Dx: eggs in stool exam (low sensitivity), serology

Rx: triclabendazole (FDA approved in 2019!)
(***note: the only trematode that don't respond well to praziquantel)

Clonorchis sinensis

"Chinese Liver Fluke"

- eggs→snails→freshwater fish
- Acquisition by ingestion of undercooked fish
- Flukes develop in duodenum then migrate to liver bile ducts
- Can live for 50 years, making 2000 eggs/day

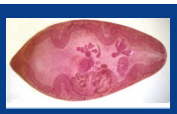
Opisthorchis viverrini

"Southeast Asian Liver Fluke"

- similar lifecycle
- also acquired by eating fish

Both can cause
biliary obstruction
cholelithiasis
cholangiocarcinoma

Paragonimus westermani
"lung fluke"



CDC

eggs→snails→freshwater crabs and crayfish
Ingestion of undercooked seafood
Adults migrate to LUNGS, frequent EOSINOPHILIA
Symptoms:

- *fever, cough, diarrhea during acute migration*
- *later, may have chest pain as worms migrate through lungs*
- *can develop chronic pulmonary symptoms*

Dx: Sputum and/or stool exam for eggs.

NOTE: Cases of Paragonimus kellicotti acquired in U.S. by ingestion of raw crayfish in rivers in Missouri

CID 2009 Sep 15;49(6):e55-61.
Clin Microbiol Rev 2013 Jul;26(3):493-504

Intestinal Flukes

Fasciolopsis buski
("Giant Intestinal Fluke" 2cm w x 8 cm)

- acquisition: eating encysted larval stage on aquatic vegetation
- symptoms: usually asymptomatic
  - can cause diarrhea, fever, abdominal pains, ulceration, and hemorrhage

Dx: eggs in stool

Metagonimus yokagawi
(2.5mm x 0.75mm)

- acquisition: eating larvae in undercooked fish
- symptoms: diarrhea and abdominal pain

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Question #2

A 25 yo F reports passing thin, white, flat tissue fragments in her stool several times over the past few weeks. She is healthy and has been in Madagascar for 3 years as a Peace Corps volunteer. The microbiology lab confirms the tissue fragments are parts of a helminth.

A long-term complication that can occur as a result of infection with certain species of this type of helminth is:

A. HTLV-1 infection
B. bladder cancer
C. appendicitis
D. liver abscess
E. seizures

Major Helminth Pathogens

TREMATODES

Blood flukes
- *Schistosoma mansoni*
- *Schistosoma japonicum*
- *Schistosoma haematobium*

Liver flukes
- *Fasciola hepatica*
- *Clonorchis sinensis*
- *Opisthorchis viverrini*

Lung flukes
- *Paragonimus westermani*

Intestinal flukes
- *Fasciolopsis buski*
- *Metagonimus yokagawai*

CESTODES

Intestinal tapeworms
- *Taenia solium*
- *Taenia saginata*
- *Diphyllobothrium latum (Hymenolepis nana)*

Larval cysts
- *Taenia solium*
- *Echinococcus granulosus*
- *Echinococcus multilocularis*

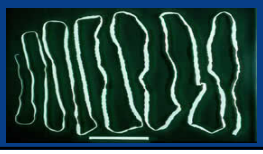
NEMATODES

Intestinal
- *Ascaris lumbricoides*
- *Ancylostoma duodenale*
- *Necator americanus*
- *Trichuris trichiura*
- *Strongyloides stercoralis*
- *Enterobius vermicularis*

Tissue Invasive
- *Wuchereria bancrofti*
- *Brugia malayi*
- *Onchocerca volvulus*
- *Loa loa*
- *Trichinella spiralis*
- *Angiostrongylus cantonensis*
- *Anisakis simplex*
- *Toxocara canis/cati*
- *Gnathostoma spinigerum*
- *(Dirofilaria repens)*
- *(Baylisascaris procyonis)*

Cestodes (tapeworms)

- all except *D. latum* have suckers with surrounding hooklets on the scolex (head) to attach to intestinal lining
- have flat, ribbon-like bodies composed of proglottid segments which contain reproductive organs
- have no digestive systems (food absorbed through soft body wall of worm)



INTESTINAL TAPEWORMS

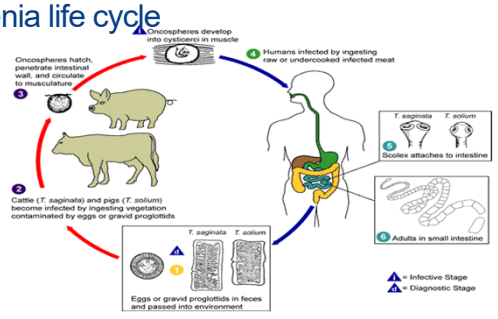
Taenia solium
tapeworm is acquired by eating larvae in pork
adult tapeworm causes few symptoms

Taenia saginatum
acquired by eating larvae in undercooked beef
causes few symptoms
can grow to 10 m

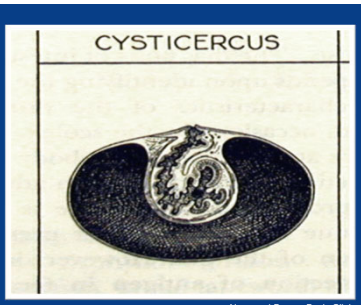
Diphyllobothrium latum *(can grow > 10 m)*
acquired by ingesting fish with larvae
***B12 deficiency in up to 40% of patients**

Dx: eggs/proglottids in stool **Rx:** praziquantel (not FDA-approved)

Taenia life cycle



Cysticercus: a fluid filled bladder containing the invaginated head (scolex) of the larval form of a tapeworm.



Neva and Brown, Basic Clinical Parasitology 6th Edition

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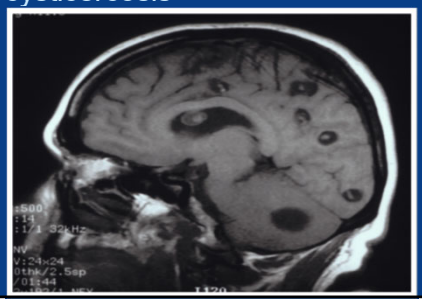
Neurocysticercosis



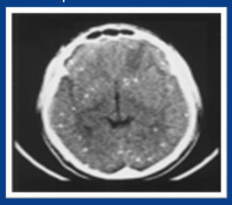
Neurocysticercosis

Can cause:

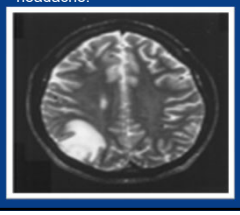
- seizures
- hydrocephalus
- headaches
- focal neurologic deficits

Neurocysticerosis

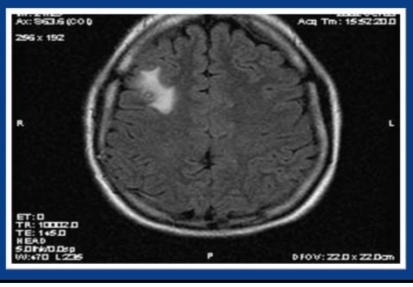
Multiple old calcifications



Perilesional edema – typically occurs around dying cysts and is a frequent finding on initial presentation of seizure or terrible headache.



Cysticercosis – single lesion disease is diagnostic challenge



Neurocysticercosis

Diagnosis:

Definitive = tissue biopsy
multiple cystic lesions each with scolex on imaging
retinal cysticercus seen on fundoscopic exam

Presumptive = suggestive lesions on imaging

Cysticercosis serology → supportive (sensitive if high burden of disease)

Treatment: *Medical therapy decreases risk of future seizures, but has immediate risk of increasing seizures/brain inflammation*

If hydrocephalus or diffuse cerebral edema, treat with steroids and/or surgery, not anti-parasitic therapy

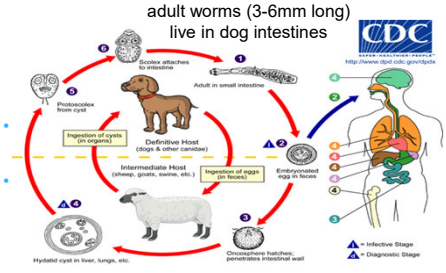
If no increased ICP: 1-2 viable cysts → albendazole for 1-2 viable cysts
> 2 viable cysts → albendazole + praziquantel

AND corticosteroids started before anti-parasitic therapy

****2017 IDSA Guidelines for Diagnosis and Treatment of Cysticercosis****

Echinococcus granulosus

adult worms (3-6mm long)
live in dog intestines



humans = accidental hosts

infected by ingestion of eggs in dog feces

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Echinococcus granulosus

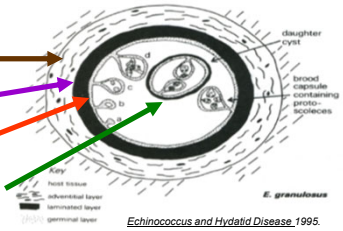
hydatic cyst = "watery vessel"

surrounding inflammatory response of fibrosis and chronic inflammation

outer acellular laminated layer

inner, nucleated germinal layer (PLURIPOTENTIAL TISSUE!)

internal cystic fluid and daughter cysts



Echinococcus and Hydatid Disease 1995.

Echinococcus granulosus - presentation

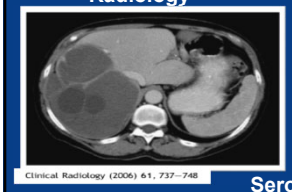
Most cysts (65%) in the liver
25% in the lung, usually in the right lower lobe
Rest occur practically everywhere else in the body

Common presentations
- allergic symptoms/anaphylaxis due to cyst rupture after trauma
- cholangitis and biliary obstruction due to rupture into biliary tree
- peritonitis b/c intraperitoneal rupture
- pneumonia symptoms due to rupture into the bronchial tree

Uncommon presentations
- bone fracture due to bone cysts
- mechanical rupture of heart with pericardial tampanode
- hematuria or flank pain due to renal cysts

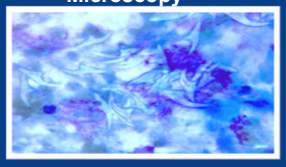
Echinococcus granulosus - diagnosis

Radiology



Clinical Radiology (2006) 61, 737–748

Microscopy



Serology

IgG ELISA about 85% sensitive for liver cysts of E. granulosus

only 50% sensitive in cases of single pulmonary cyst

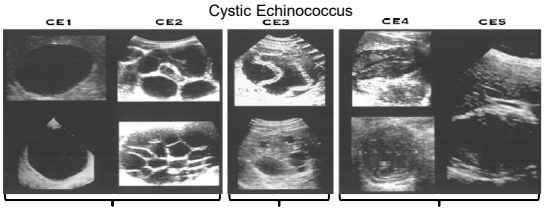
Echinococcus granulosus – treatment

Reasons for not spilling cyst contents
1. Anaphylaxis may occur
2. Spilled protoscoleces can reestablish infection

Typically treat with albendazole for several days before surgery or PAIR (usually 2d-1wk before, and 1-3 months after)

Treatment – WHO Guidelines 2010

Cystic Echinococcus



Acta Tropica 114 (2010) 1–16

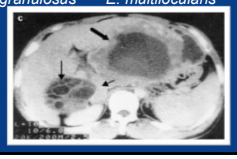
ACTIVE		TRANSITIONAL	INACTIVE
Unilocular Simply cyst Cyst wall visible	Multivesicular Multiseptated cysts	Anechoic content Detached membrane Solid matrix	Heterogenous, hypoechoic or hyperechoic No daughter cysts CE5 with thick calfied wall
---PAIR or SURGERY---	---SURGERY---	---SURGERY--- ---PAIR if no solid matrix---	---NO TREATMENT---

Echinococcus multilocularis

fox/rodent lifecycle

causes an infiltrative, tumor-like growth in liver
- → poorly demarcated
- → has a semi-solid nature (does not form large cysts)

E. granulosus *E. multilocularis*



Lancet 2003; 362:1295–304

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Question #3

A 13 year old girl developed a pruritic rash on her foot after moving to rural northeast Florida. Which of the following helminths is the most likely cause of the rash?

A. *Enterobius vermicularis*
B. *Ascaris lumbricoides*
C. *Trichuris trichiura*
D. *Toxocara canis*
E. *Anyclostoma braziliense*

Am Fam Physician 2010, 81(2): 203-4.

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Nematodes (roundworms)

→ Nonsegmented round worms

→ Flexible outer coating (cuticle)

→ Muscular layer under the cuticle

→ Nervous, digestive, renal, and reproductive organs.

How do people get infected with nematodes?

1. Eating eggs in fecally contaminated food or soil
   Ascaris, Trichuris, Enterobius, and Toxocara
2. Direct penetration of larvae through skin
   Hookworms, Strongyloides
3. Eating food containing infectious larvae
   Trichinella, Angiostrongylus, Anisakis
4. Vector transmission
   Wuchereria, Brugia, Oncho, Loa

Intestinal Helminths - Lifecycles

Strongyloides and Hookworms

SKIN → LUNGS → GUT

Ascaris

GUT → LIVER → LUNGS → GUT

Ascaris lumbricoides

- Large numbers of worms can cause abdominal distention and pain or intestinal obstruction
- can cause "Loeffler's syndrome" - an eosinophilic pneumonitis with transient pulmonary infiltrates
- cholangitis and/or pancreatitis b/c aberrant migration

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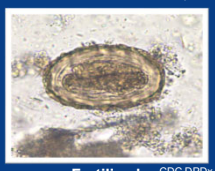
Ascaris lumbricoides - Diagnosis

Will not find eggs until 2-3 months after pulmonary symptoms occur
After 2-3 months, easy to find eggs since females make 200,000/day

Unfertilized



Fertilized

CDC DPDx

Rx: albendazole or mebendazole

HOOKWORMS
Ancylostoma duodenale and Necator americanus

- MAJOR cause of ANEMIA and protein loss (b/c plasma loss)
- pneumonitis associated with wheezing, dsypnea, dry cough (usually a few days to weeks after infection)
- urticarial rash
- mild abdominal pain

If sensitized → papulovesicular dermatitis at entry site "ground itch"

If worms migrate laterally → **cutaneous larvae migrans**
(especially dog and cat hookworms, as late as 2-8 wks after exposure to A. braziliense)

Still endemic in the U.S. → 35% of individuals from a rural community in Alabama had N. americanus in their stool samples

Am. J. Trop. Med. Hyg., 97(5), 2017, pp. 1623–1628

Trichuris trichiura (whipworm)

4cm long nematode

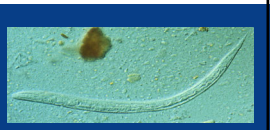
Life cycle: Fecal-oral

In heavy infections:
- loose and frequent stools
- tenesmus
- occ blood to frank blood
- in heavily infected children: rectal prolapse

Dx: eggs are football shaped with two polar plugs

CDC DPDx

Strongyloides stercoralis
(can complete lifecycle in host!)



Usual manifestations
GI: mild abdominal/epigrastric pain
Pulm: wheezing, transient infiltrates
Skin: urticarial rashes, larva currens

Hyperinfection syndrome
→immunocompromised state
steroids, TNF-inhibitors, HTLV-1, malignancy, malnutrition….NOT HIV
→large burden of parasites

GI:	Nausea, vomiting, abdominal pain, diarrhea, erosions b/c millions of larvae in intestinal mucosa
Pulmonary:	diffuse infiltrates, wheezing, dyspnea, cough
Systemic:	fever and hypotension due to gram negative sepsis

-- Often do not see eosinophilia in hyperinfection --

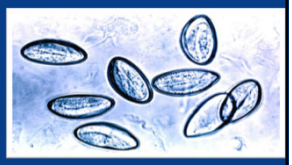
Strongyloides stercoralis

Diagnosis
- stool o/p (sensitivity is low - 30-60%)
- serology

Treatment of choice: ivermectin

Prevention in pts from endemic countries who are about to be immunosuppressed
- Empirically treat, or check serology and treat if positive.

Enterobius vermicularis
(pinworm)



- Found everywhere
- Fecal/oral
- Humans are the only hosts
- peri-anal itching in some pts

Dx: "scotch tape test" or swube, eggs with one flat side

Rx: albendazole, mebendazole, or pyrantel pamoate single dose repeat in 2 wks b/c risk reinfection.
→ treat all members of households
→ careful trimming of fingernails, handwashing, washing of bedclothes to rid house of eggs

47 – Worms and More Worms

Speaker: Edward Mitre, MD

Question #4

A 6 yo boy from Indiana who has a pet dog and likes to play in a sandbox presents with fever, hepatosplenomegaly, wheezing, and eosinophilia. He has never travelled outside the continental U.S.

The most likely causative agent acquired in the sandbox is:

A. *Anisakis simplex*
B. *Onchocerca volvulus*
C. *Enterobius vermicularis*
D. *Toxocara canis*
E. *Anyclostoma braziliense*

Major Helminth Pathogens

TREMATODES

Blood flukes
- *Schistosoma mansoni*
- *Schistosoma japonicum*
- *Schistosoma haematobium*

Liver flukes
- *Fasciola hepatica*
- *Clonorchis sinensis*
- *Opisthorchis viverrini*

Lung flukes
- *Paragonimus westermani*

Intestinal flukes
- *Fasciolopsis buski*
- *Metagonimus yokagawai*

CESTODES

Intestinal tapeworms
- *Taenia solium*
- *Taenia saginata*
- *Diphyllobothrium latum (Hymenolepis nana)*

Larval cysts
- *Taenia solium*
- *Echinococcus granulosus*
- *Echinococcus multilocularis*

NEMATODES

Intestinal
- *Ascaris lumbricoides*
- *Ancylostoma duodenale*
- *Necator americanus*
- *Trichuris trichiura*
- *Strongyloides stercoralis*
- *Enterobius vermicularis*

Tissue Invasive
- *Wuchereria bancrofti*
- *Brugia malayi*
- *Onchocerca volvulus*
- *Loa loa*
- *Trichinella spiralis*
- *Angiostrongylus cantonensis*
- *Anisakis simplex*
- *Toxocara canis/cati*
- *Gnathostoma spinigerum (Dirofilaria repens) (Baylisascaris procyonis)*

Filariae

- Threadlike
  - (from Latin *filum* = thread)
- Tissue-invasive
- Roundworms
- Transmitted by insect vectors

Body location of filarial infections

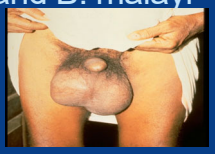
	Adults	Microfilariae
Wuchereria bancrofti *Brugia malayi* (lymphatic filariasis) --mosquitoes--	lymphatics	blood (night)
Loa loa (eyeworm) --Chrysops flies--	SQ tissues (moving)	blood (day)
Onchocerciasis (river blindness) --blackflies--	SQ tissues (nodules)	skin

Treatment of Filariasis

	Treatment	Avoid
Lymphatic filariasis	**DEC**	**-----**
Loa Loa	**DEC**	**DEC and Ivermectin if high microfilaria level**
Onchocerciasis	**ivermectin**	**DEC**

ADVERSE EFFECTS
Loa with high microfilaremia → encephalopathy and death
Onchocerciasis → severe skin inflammation and blindness

W. bancrofti and B. malayi



- Asymptomatic microfilaremia
- Lymphangitis
  - retrograde (filarial lymphangitis)
  - bacterial skin/soft tissue infections (dermatolymphangioadenitis)
- Lymphatic obstruction
  - Lymphedema, elephantiasis, hydrocele, chyluria

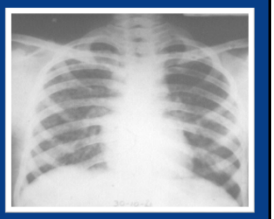
47 – Worms and More Worms

Speaker: Edward Mitre, MD

Tropical pulmonary eosinophilia

- Paroxysmal nocturnal asthma
- Pulmonary infiltrates
- Peripheral blood eosinophilia (>3,000/mm^3)
- Elevated serum IgE
- Rapid response to anti-filarial therapy

Likely due to excessive immune response to microfilariae in lung vasculature

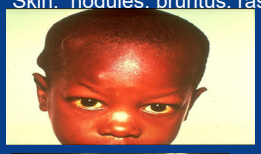


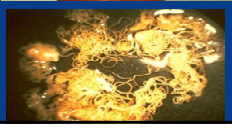
Lymphatic filariasis: diagnosis

- Definitive diagnosis
  - Identification of microfilariae in nighttime blood
  - Detection of circulating antigen in blood (only Wb)
  - Identification of adult worm (by tissue biopsy or ultrasound "filaria dance sign")
- Presumptive diagnosis
  - Compatible clinical picture + positive antifilarial antibodies
- Treatment:
  - DEC, doxycycline
  - NOTE: Triple drug therapy (DEC/albendazole/ivermectin) is now recommended by W.H.O. for eradication campaigns in areas that are NOT co-endemic for Loa loa or Onchocerca

Manifestations of Onchocerciasis

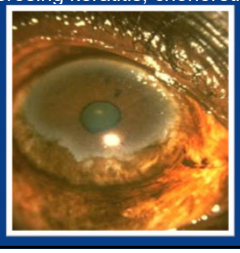
Skin: nodules, pruritus, rash, depigmentation, lichenification





Manifestations of Onchocerciasis

- Eye: punctate keratitis, sclerosing keratitis, chorioretinitis



Onchocerciasis

Diagnosis
- Serology
  - anti-filarial
  - onchocerca-specific
- Parasitologic: skin snips, nodulectomy

Treatment

Ivermectin

Moxidectin (FDA approved in 2018…has much longer half-life)
→ both are primarily microfilaricidal
→ therefore need repeated treatments for many years

(alternative: **doxycycline** for 6 weeks, which kills endosymbiotic *Wolbachia* bacteria, kills adult worms)

Onchocerciasis in the U.S.?

The Emergence of Zoonotic *Onchocerca lupi* Infection in the United States – A Case-Series

Clinical Infectious Diseases® 2016;62(6):778–83

- *Onchocerca lupi → an infection of wolves*
- *as with O. volvulus, is transmitted by blackflies*
- *6 human cases reported to date*
- *3 with deep nodules near cervical spinal cord*
- *Southwestern U.S.(Arizona, New Mexico, Texas)*

47 – Worms and More Worms

Speaker: Edward Mitre, MD

Nodding syndrome

Neurological disease

- *Progressive cognitive dysfunction*
- *Nodding seizures – especially when children start to eat*
- *Growth stunting*

→ ***associated with Onchocerciasis***

Tanzania 1960s
South Sudan 1990s
Northern Uganda 2007

A child in Uganda with nodding syndrome. NPR 2/15/2017

May be due to cross-reactive antibodies, triggered by Onchocerca infection, that recognize leiomodin-1 in the hippocampus

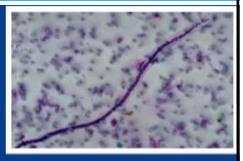
Johnson et al, Science Translational Medicine 2017 v9 issue 377

Loiasis: clinical manifestations

- Asymptomatic microfilaremia
- Non-specific symptoms
  - fatigue, urticaria, arthralgias, myalgias
- Calabar swellings
- Eyeworm
- End organ complications (rare)
  - endomyocardial fibrosis, encephalopathy, renal failure

Calabar swelling

Loiasis: Diagnosis



Definitive diagnosis

- Identification of adult worm in subconjunctiva
- Detection of Loa microfilaria in **noon blood**

Presumptive diagnosis

Compatible clinical picture + positive antifilarial antibodies

Trichinellosis

1. Eat meat containing cysts (pork, boar, horse, wild game)
2. Larvae released from cysts by gastric acid.
3. Adults invade small bowel, mature into adults over 1-2wks.
   --> ABDOMINAL CRAMPS and DIARRHEA IF HEAVY INFXN
4. Adults (who only live for about a month) make larvae.
5. Larvae migrate to striated muscle, encyst, and live in "nurse cells"
   → **SEVERE MUSCLE PAIN**
   → **PERIORBITAL EDEMA**
   → **EOSINOPHILIA**
   +/- fever and urticaria

CDC DPDx

Diagnosis: serologies are supportive, + biopsy is definitive
Treatment: albendazole + steroids

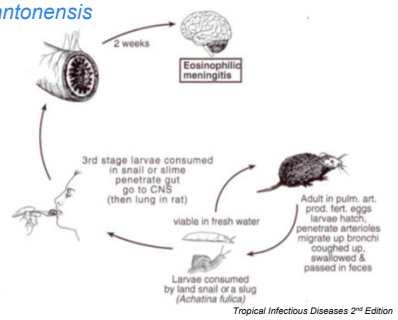
Angiostrongylus cantonensis

Human acquisition by eating

- Snails or slugs (often on vegetables!!)
- Paratenic hosts (Freshwater shrimps or crabs, frogs)

Nice CDC movie on angiostrongylus:

https://www.youtube.com/watch?v=V_f1IK93ZIE



Tropical Infectious Diseases 2nd Edition

47 – Worms and More Worms

Speaker: Edward Mitre, MD

Angiostrongylus cantonensis

→ *Numerous case reports in Hawaii past two years*

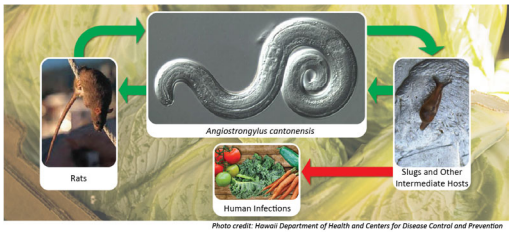


Photo credit: Hawaii Department of Health and Centers for Disease Control and Prevention

Angiostrongylus cantonensis summary (the rat lungworm)

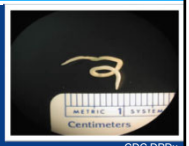
- The most common parasitic cause of eosinophilic meningitis worldwide
- SE Asia, Pacific basin, Caribbean (Jamaica)
- Caused by
  - ingestion of parasites in snail or slugs (often on vegetables!!)
  - OR
  - ingestion of paratenic hosts (prawns, shrimps, crabs, frogs)
- In rats, develop to adults in 2-3 weeks and migrate from surface of brain through venous system to the pulmonary arteries
- In humans, develop to young adults and cause meningitis 1-2 weeks after infection

Rx: primarily supportive
corticosteroids often given…benefit unclear but some data suggests they may be helpful
anthelmintic therapy controversial as may cause exacerbation of meningitis

Anisakis

Ingestion of larvae in raw or undercooked seafood (found worldwide)

In humans, parasite buries its head into gastric mucosa. Eosinophilia common.



CDC DPDx

Symptoms

1) due to invasion of worm (pain, vomiting)
2) due to allergic rxn to worm

(mild urticaria, itchy sensation back of throat, naphylactic shock)

Treatment

→ usually simple endoscopic removal
→ for allergic symptoms, avoid contaminated fish

Toxocariasis (and Baylisascariasis)

Due to dog (*Toxocara canis*), cat (*Toxocara cati*), and raccoon (*Baylisascaris procyonis*) ascarids.

Humans acquire infection by ingestion of animal feces.
In humans → larvae hatch in intestine and migrate to liver, spleen, lungs, brain, and/or eye.

Symptoms

Visceral Larva Migrans (VLM)
usually 2-5 year olds
fever, eosinophilia, hepatomegaly
also wheezing, pneumonia, splenomegaly

Ocular Larva Migrans (OLM)
often in 10-15 year olds
retinal lesions that appear as solid tumors

***Baylisascaris* often more severe and more likely to cause CNS disease (eosinophilic meningitis)**

Toxocara larva in liver (VLM)

CDC DPDx

Toxocariasis

Dx: Clinical picture + Toxocara antibody testing
(serum and intraocular fluid by ELISA testing)

NOTE: Toxocara IgG is only supportive b/c many individuals have + Ab due to prior exposure

Rx: usually self-limited disease.
acute VLM or OLM can be Rx with albendazole and steroids

Gnathostoma spinigerum and hispidum

Undercooked freshwater fish (ceviche!), frogs, birds, reptiles
Asia (esp Thailand), Central/South America, parts of Africa

→ Disease due to migrating immature worms.
→ Often with peripheral eosinophilia

SKIN: migratory, painful subcutaneous swellings (recur every few weeks, can last for years)
creeping eruption/cutaneous larva migrans

TISSUE: visceral larva migrans
eosinophilic meningoencephalitis
radiculomyelitis
ocular disease (anterior and posterior uveitis)

Dx: empiric or by biopsy, no antibody test

Rx: can be difficult, may require 3 weeks of albendazole

47 – Worms and More Worms

Speaker: Edward Mitre, MD

Areas of focus for helminth infections

Trematodes:
- Schistosomiasis
- Paragonimus

Cestodes:
- Cysticercosis
- Echinococcus

Nematodes:
- Hookworms
- Strongyloides
- Lymphatic filariasis
- Onchocerciasis
- Trichinella
- Angiostrongylus

Possible question hints

Freshwater exposure + eosinophilia → Schistosomiasis
Crab/crayfish + pulmonary sxs + eosinophilia → Paragonimus
Cysticercosis → ANY food contaminated with tapeworm eggs
Allergic symptoms after trauma → Echinococcus
itchy feet return to tropics → ground itch due to hookworms
Gram- sepsis after TNF inhibitor → Strongyloides hyperinfection
Subcutaneous nodules → Onchocerca volvulus
Blood microfilaria night → lymphatic filariasis (day = Loa loa, skin = Ov)
Muscle pain + eosinophilia → Trichinella
Eosinophilic meningitis → Angiostrongylus
Abdominal pain after sushi → Anisakis
Eosinophilia + F + ↑ AST/ALT in child → visceral larva migrans

Caveat to today's talk – a bit simplistic

Multiple parasites can cause similar diseases

Eosinophilic meningitis

Nematodes:
- Angiostrongylus cantonensis
- Baylisascaris procyonis
- Gnathostoma species
- Toxocara canis & T. cati
- Trichinella spiralis
- Strongyloides stercoralis
- Loa loa
- Meningonema peruzzi

Trematodes:
- Schistosoma species (larvae or eggs)
- Paragonimus westermani
- Fascioliasis

Cestodes:
- Neurocysticercosis
- Echinococcus

Good Luck!

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