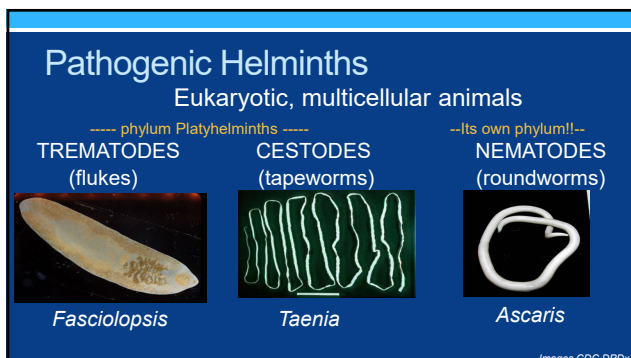
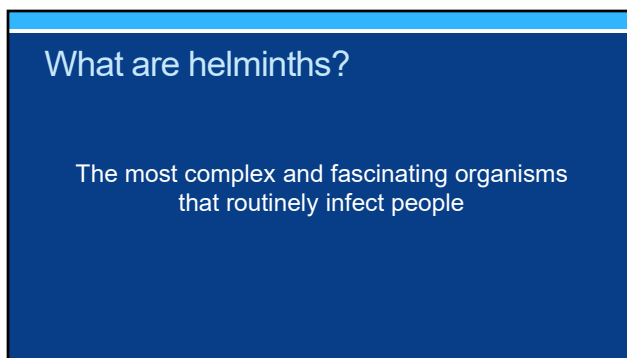
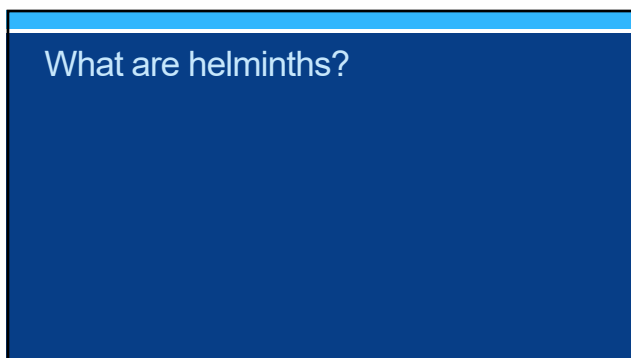
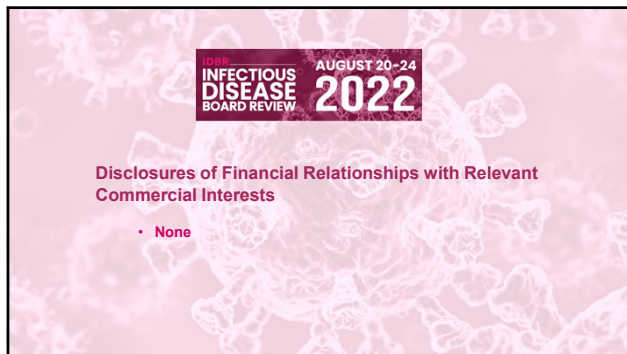
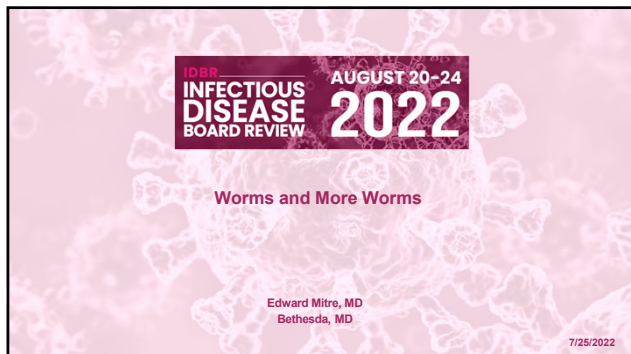


## 52 - Worms and More Worms

Speaker: Edward Mitre, MD



# 52 – Worms and More Worms

Speaker: Edward Mitre, MD

## World Prevalence

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

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

But very low ID Boards prevalence  
 5% of questions are on helminths, protozoa, travel medicine, and ectoparasites

## Question #1

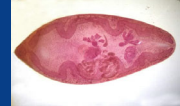
28 yo F presents with recurrent crampy abdominal pain for several months. She recently returned to the U.S. after living in Tanzania for two years. Colonoscopy reveals small white papules. Biopsy of a papule reveals an egg with surrounding granulomatous inflammation.

- Most likely diagnosis?
- A. *Entamoeba histolytica*
  - B. *Strongyloides stercoralis*
  - C. *Wuchereria bancrofti*
  - D. *Schistosoma mansoni*
  - E. *Paragonimus westermani*

## Major Helminth Pathogens

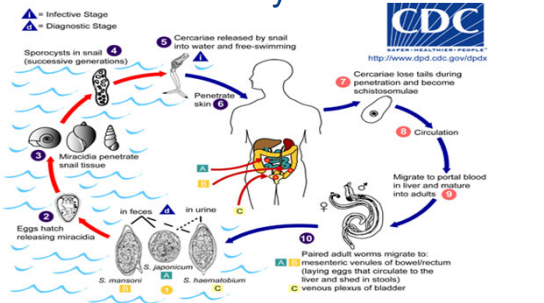
TREMATODES	CESTODES	NEMATODES
<b>Blood flukes</b> <i>Schistosoma mansoni</i> <i>Schistosoma japonicum</i> <i>Schistosoma haematobium</i>	<b>Intestinal tapeworms</b> <i>Taenia solium</i> <i>Taenia saginata</i> <i>Diphyllobothrium latum</i> <i>Hymenolepis nana</i>	<b>Intestinal</b> <i>Ascaris lumbricoides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

## Trematodes (flukes)



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

## 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.

# 52 – Worms and More Worms

Speaker: Edward Mitre, MD

## 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

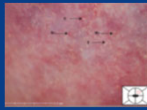
increasingly recognized primarily due to *S. haematobium*

#### 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

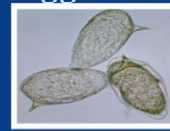


rubbery papules

WHO Female Genital Schistosomiasis Pocket Atlas

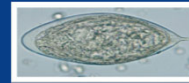
## Schistosome eggs

*S. mansoni*  
(lateral spine)



CDC DPDx image library

*S. haematobium*  
(terminal spine)



CDC DPDx image library

## 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*
- Paracapillaria philippinensis*
- Enterobius vermicularis*

#### Tissue Invasive

- Wuchereria bancrofti*
- Brugia malayi*
- Onchocerca volvulus*
- Loa loa*
- Trichinella spiralis*
- Angiostrongylus cantonensis*
- Amisasis simplex*
- Toxocara canis/cati*
- Baylisascaris procyonis*
- Gnathostoma spinigerum*

## *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)

# 52 – Worms and More Worms

Speaker: Edward Mitre, MD

<p><b><i>Clonorchis sinensis</i></b> "Chinese Liver Fluke"</p> <ul style="list-style-type: none"> <li>eggs → snails → freshwater fish</li> <li>Acquisition by ingestion of undercooked fish</li> <li>Flukes develop in duodenum then migrate to liver bile ducts</li> <li>Can live for 50 years, making 2000 eggs/day</li> </ul>	<p><b><i>Opisthorchis viverrini</i></b> "Southeast Asian Liver Fluke"</p> <ul style="list-style-type: none"> <li>similar lifecycle</li> <li>also acquired by eating fish</li> </ul>
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Both can cause  
biliary obstruction  
cholelithiasis  
cholangiocarcinoma

***Paragonimus westermani***  
"lung fluke"

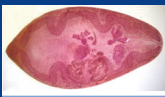
eggs → snails → freshwater crabs and crayfish  
Ingestion of undercooked seafood  
Adults migrate to LUNGS, frequent EOSINOPHILIA

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



CDC

CID 2008; 16(1):45-51  
Clin Microbiol Rev 2013 Jul;26(3):493-504

## Question #2

A 25 yo Peace Corps worker in Madagascar reports passing thin, white, flat tissue fragments in her stool. The microbiology lab reports the tissue fragments are proglottid segments of *Taenia solium*.

A long-term complication that can occur as a result of infection with the larval form of this parasite is:

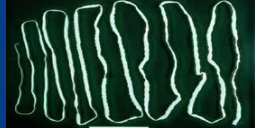

- HTLV-1 infection
- bladder cancer
- appendicitis
- liver abscess
- seizures

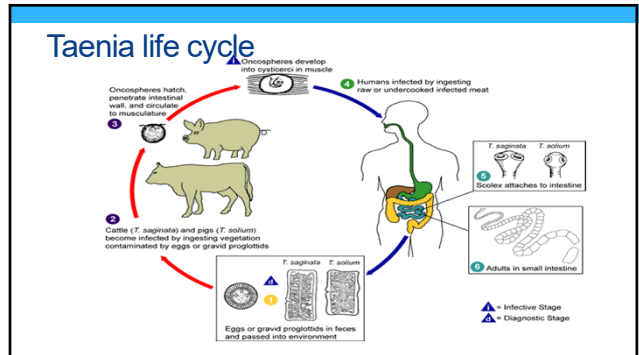
## Major Helminth Pathogens

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




# 52 – Worms and More Worms


Speaker: Edward Mitre, MD

**INTESTINAL TAPEWORMS**


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



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

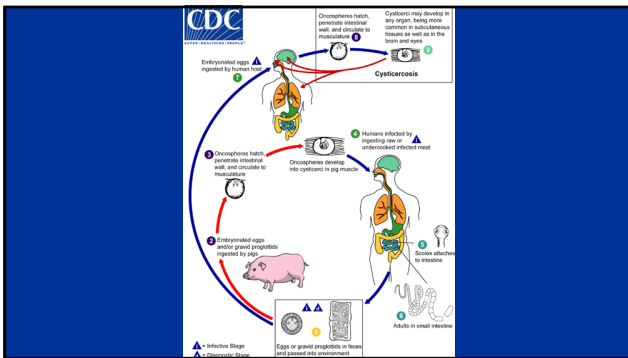


**Diphyllobothrium latum** (can grow > 10 m)  
acquired by ingesting fish with larvae  
\*B12 deficiency in up to 40% of patients

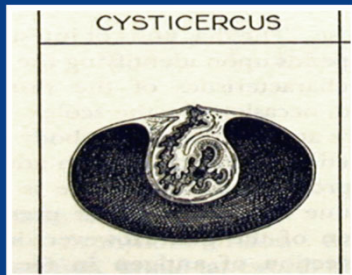


Dx: eggs/proglottids in stool Rx: praziquantel (not FDA-approved)

For some cestodes, humans can be infected by the larval stages and this can cause severe pathology.

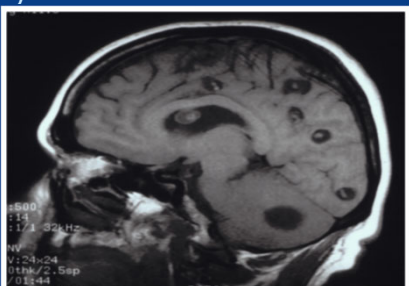


Cysticercus: a fluid filled bladder containing the invaginated head (scolex) of the larval form of a tapeworm.



Neiva and Brown, Basic Clinical Parasitology 6th Edition

Neurocysticercosis



1550  
113  
11/1 32 Hz  
NY  
V:24-24  
11/18/02, 5ap  
7 01:44

Neurocysticercosis

Can cause:

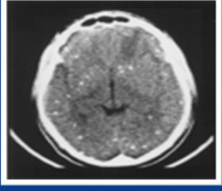
- seizures
- hydrocephalus
- headaches
- focal neurologic deficits

# 52 – Worms and More Worms

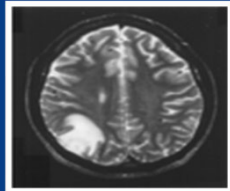
Speaker: Edward Mitre, MD

## Neurocysticercosis

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)

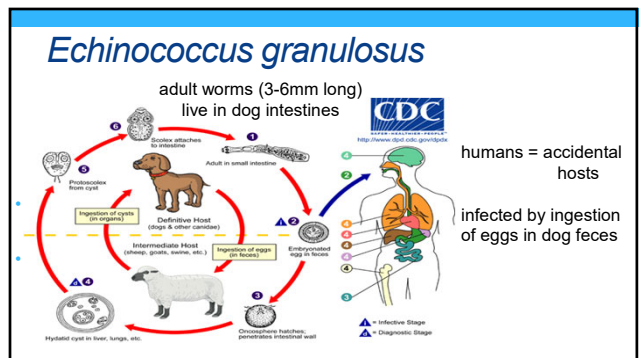
**Treatment:** Medical therapy decreases risk of future seizures, but has immediate risk of increasing seizures/brain inflammation

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

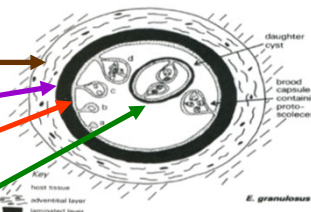
AND corticosteroids started before anti-parasitic therapy

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



## Echinococcus granulosus

hydatid 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

*E. granulosus*

## 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 tamponade
- hematuria or flank pain due to renal cysts

# 52 – Worms and More Worms

Speaker: Edward Mitre, MD

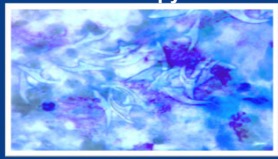
## Echinococcus granulosus - diagnosis

**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

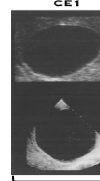
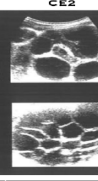


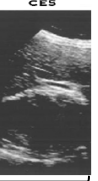
Reasons for not spilling cyst contents

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 Echinococcosis

CE1	CE2	CE3	CE4	CE5
				
<b>ACTIVE</b>	<b>ACTIVE</b>	<b>TRANSITIONAL</b>	<b>TRANSITIONAL</b>	<b>INACTIVE</b>
Unilocular Simply cyst Cyst wall visible ---PAIR or SURGERY---	Multivesicular Multiseptated cysts ---SURGERY---	Anechoic content Detached membrane Solid matrix ---SURGERY---	Heterogenous, hyperechoic or hyperechoic No daughter cysts CE5 with thick calcified wall ---PAIR if no solid matrix---	---NO TREATMENT---

Acta Tropica 114 (2010) 1–16

## Question #3

A 25 yo F from rural Peru presents with shortness of breath, bilateral interstitial infiltrates, fever, loose stools, hypotension, and *E. coli* bacteremia. She has received > 4weeks of high dose corticosteroids and cyclophosphamide for a recent diagnosis of lupus nephritis. Which of the following anthelmintic agents should be included in her treatment regimen:


- Albendazole
- Ivermectin
- Praziquantel
- Pyrantel pamoate
- Diethylcarbamazine

## Major Helminth Pathogens

TREMATODES	CESTODES	NEMATODES
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<b>Intestinal flukes</b> <i>Fasciolopsis buski</i> <i>Metagonimus yokagawai</i>		

## Nematodes (roundworms)

- Nonsegmented round worms
- Flexible outer coating (cuticle)
- Muscular layer under the cuticle
- Nervous, digestive, secretory, and reproductive systems



# 52 - Worms and More Worms

Speaker: Edward Mitre, MD

## 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

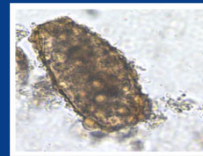
## Ascaris lumbricoides

- 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

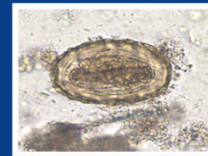


## Ascaris lumbricoides - Diagnosis

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*  
also *Ancylostoma ceylanicum* (zoonotic from dogs/cats in Asia)

- MAJOR cause of ANEMIA and protein loss (b/c plasma loss)
- pneumonitis associated with wheezing, dyspnea, 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 larva 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)

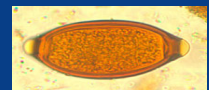
4cm long nematode

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



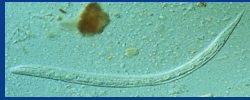
# 52 - Worms and More Worms

Speaker: Edward Mitre, MD

## Strongyloides stercoralis

(can complete lifecycle in host!)

**Usual manifestations**  
 GI: mild abdominal/epigastric 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.

## Question #4

A 32 yo M from Cameroon reports intermittently experiencing a worm crawling across his eye. Which of the following tests can be used to confirm the most likely diagnosis?

- Brain MRI scan
- Midnight blood draw
- Noon blood draw
- Skin snip
- Scrotal ultrasound

## Major Helminth Pathogens

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

## Filariiae: tissue-invasive, thread-like nematodes, transmitted by arthropod vectors

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

## Treatment of Filariasis

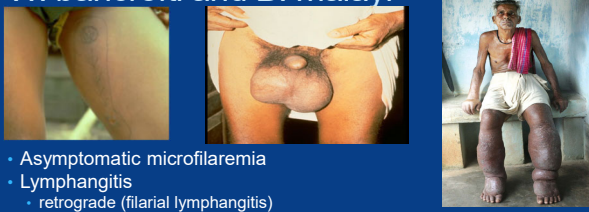
	Treatment	Avoid
Lymphatic filariasis	DEC	----
Loa Loa	DEC	DEC and Ivermectin if high microfilaria level
Onchocerciasis	ivermectin	DEC

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

# 52 – Worms and More Worms

Speaker: Edward Mitre, MD

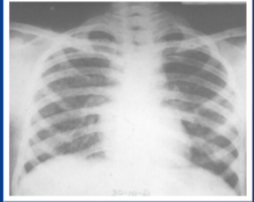
## W. bancrofti and B. malayi



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

## Tropical pulmonary eosinophilia

- Paroxysmal nocturnal asthma
- Pulmonary infiltrates
- Peripheral blood eosinophilia (>3,000/mm<sup>3</sup>)
- 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 single dose therapy (DEC/albendazole/ivermectin) is now recommended by W.H.O. for mass drug administration 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)

# 52 – Worms and More Worms

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## 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

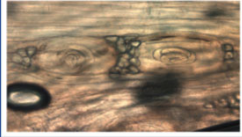


CDC DpDx

## Trichinellosis

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

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



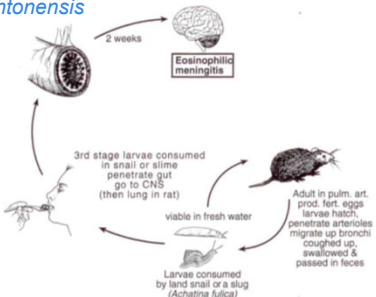
CDC DPDX

## 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

## Angiostrongylus cantonensis



Human acquisition by eating

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

3rd stage larvae consumed in snail or slime penetrate gut go to CNS (then lung in rat)

Adult in pulm. art. prod. fert. eggs larvae hatch, penetrate arterioles migrate up bronchi coughed up, swallowed & passed in feces

Larvae consumed by land snail or a slug (Achatina fulica)

viable in fresh water

2 weeks

Eosinophilic meningitis

Nice CDC movie on angiostrongylus:  
[https://www.youtube.com/watch?v=V\\_H1K93ZIE](https://www.youtube.com/watch?v=V_H1K93ZIE)

Tropical Infectious Diseases 2nd Edition

# 52 – Worms and More Worms

Speaker: Edward Mitre, MD

## Angiostrongylus cantonensis

→ Case reports in Hawaii past few years

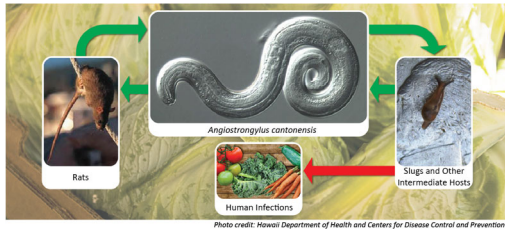
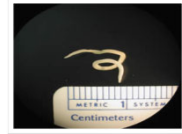


Photo credit: Hawaii Department of Health and Centers for Disease Control and Prevention

## Anisakis

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



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

### 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

## Possible question hints

- Freshwater exposure + eosinophilia → Schistosomiasis
- Crab/crayfish + pulmonary sx + 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 corticosteroids or 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!

Ed Mitre

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