Lecture 2: Emerging Parasitic Helminths part 1 (Trematodes pt. 2)

Presented by Matt Tucker, M.S., MSPH
mtucker@health.usf.edu

Readings-Trematodes

- Ch. 11 (pp. 301-303, 367 [table 14.1])

Monsters Inside Me

Check out the following links for fun:

- **Paragonimiasis** (*Paragonimus westermani*, human lung fluke):

- **Schistosomiasis** (*Schistosoma* spp., blood fluke):

On the Menu: Lecture 2

- **Metorchis conjunctus**
- **Heterophyes heterophyes**
- **Metagonimus yokagawai**
- Human lung fluke Disease — *Paragonimus* spp.
- **Schistosomiasis**

**Metorchis conjunctus**

- North American liver fluke
- Causes a zoonotic foodborne infection, similar to *Opistorchis* sp.
- Infects a wide range of fish-eating mammals including bears, wolves, foxes, coyotes, raccoons, muskrats, mink, fisher, dogs and cats, and occasionally, man.
- Snail and fish intermediate hosts are widespread in eastern U.S. and Canada

**Metorchis life cycle**
Outbreak in Canada

- Montreal, 1993
- Outbreak of acute illness among 27 people who ate raw fish (sashimi) prepared from the white sucker fish, *Catostomus commersoni*
  - Persistent upper abdominal pain, low grade fever, high blood eosinophil concentrations, and raised liver enzymes.
  - After 10 days, worm eggs were found in stools.
  - Symptoms persisted for 3 days to 4 weeks without treatment, but responded rapidly to praziquantel therapy.
  - Necropsy of golden hamsters infected with metacercariae from uneaten fish revealed adult flukes identified as *Metorchis conjunctus*.

Areas of high prevalence

- Red = reported *M. conjunctus* in humans
- Blue = reported *M. conjunctus* in animals
- Grey shading = *Catostomus commersoni* (white sucker fish) distribution

Disease and Prevention

- Similar in nature to Opisthorchiasis, Clonorchiasis
  - The encysted stage of the flatworm can survive freezing in the muscle of fish.
  - Fish should be cooked thoroughly before it is fed to dogs or eaten by humans

Other important flukes

- *Heterophyes heterophyes*
  - Egypt, the Middle East, and Far East
- *Metagonimus yokogawai*
  - Mostly the Far East, as well as Siberia, Manchuria, the Balkan states, Israel, and Spain.
  - Heavy infections can lead to perforation of mucosa and eggs entering blood, lymph- heart failure. Rare cases- brain infiltration (H. heterophyes)

Common life cycles: *Heterophyes* and *Metagonimus*

Location of adult worms and disease
Contextual determinants of foodborne trematodiasis

Paragonimus spp.
- 48 species and subspecies described of carnivorous mammals (reservoirs)
  - P. westermani most widespread, first described in 1878
  - Over 20 million cases a year

- Human to human transmission possible
  - Via snail and crab host (2nd intermediate hosts)

- Humans usually an accidental host
  - Paratenic hosts contribute to human disease

Paragonimus life cycle

Distribution of Paragonimus sp.

*Paragonimus westermani is distributed in southeast Asia and Japan.
* In Asia, an estimated 80% of freshwater crabs carry P. westermani
**Paragonimiasis**

Clinical Features
- Acute phase (invasion and migration): diarrhea, abdominal pain, fever, cough, hepatosplenomegaly, pulmonary abnormalities, and eosinophilia.
- Chronic phase: pulmonary manifestations, chest radiographic abnormalities. Symptoms similar to pulmonary tuberculosis
- Adult worms can cause severe manifestations, especially when the brain is involved.

Laboratory Diagnosis
- Based on microscopic demonstration of eggs in stool or sputum, but not present until 2-3 months after infection.

Prevention
- Avoidance of raw or undercooked food (meat, fish, crabs etc.).
- Praziquantel – drug of choice for lung disease

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**Example of zoonotic infection in U.S.**

- *Paragonimus kellicotti* is endemic to North America—found in a variety of mammals east of Rocky Mountains
  - 1986-1st case reported in U.S. in a non-immigrant
  - Rare cases
  - Ingestion of raw crab, crayfish

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**Schistosoma spp.**

- Dates back to old Egyptian writings, calcified eggs in mummies (1200 B.C.)
- After malaria, schistosomiasis is the second most important parasitic disease for public health and economic impact
  - WHO estimates 500-600 million people in 74 tropical and subtropical countries are at risk for schistosomiasis.
    - More than 200 million people are infected.
    - Of these, 120 million are symptomatic, with 20 million having severe clinical disease.
- Species with medical significance:
  - *S. mansoni*, *S. haematobium*, *S. japonicum*, *S. mekongi*, *S. intercalatum*
  - *S. japonicum*: only zoonotic species

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**Animated life cycle**

- If you like cartoons, visit:

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**Schistosoma spp.: life cycle**

- The parasites do not replicate in their definitive host
- Have separate sexes, male has pouch which holds female
- Very important: Adults live in blood vessels of definitive hosts (spot depends on species) see life cycle

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**Snails and Schisto**

- *Biomphalaria spp.* - *S. mansoni*—widespread in old and new world
- *Bulinus spp.* - *S. haematobium*—widespread in Africa and middle east
- *Oncomelania* - *S. japonicum*—eastern Asia and nearby Pacific islands
Schistosoma mansoni is found in parts of South America and the Caribbean, Africa, and the Middle East; S. intercalatum in central West Africa.

Why is S. mansoni found in the old world and new world whereas other species are not?

• S. haematobium is primarily in Africa and the Middle East; and S. japonicum in the Far East. Schistosoma mekongi found focally in Southeast Asia.

The pathophysiology of schistosomiasis mainly involves the immune response against schistosome eggs.

• The clinical manifestations depend on the species of parasite, intensity of worm burden, and immunity.
• Eggs cause granulomas, fibrosis, impeding portal blood flow leading to portal hypertension and cirrhosis, hepatosplenomegaly
  — Occasionally central nervous system lesions occur
• Bladder cancer due to S. haematobium?
• S. japonicum causes most serious disease because more eggs produced

Schistosomiasis (1)

3 phases of pathology

• Migratory (penetration to maturity/egg production)
  — Symptomless, some dermatitis at penetration (~24 hrs.)
• Acute (begins at egg production)—may occur weeks after the initial infection
  — High eosinophils, chills, fever, fatigue, headache, malaise, muscle aches, lymphadenopathy, GI discomfort
• Chronic: asymptomatic or mild, chronic diarrhea, mild abdominal pain, lethargy
  — Eggs can become trapped in capillaries of the liver, bladder
  — Hepatosplenic schistosomiasis occurs in S. mansoni and S. japonicum infections; it results from egg blockage in hepatic venules, granulomas, portal fibrosis.
• Continuous aggravation in the bladder wall leads to carcinoma of the bladder (S. haematobium)

Factors Contributing to Transmission of Schistosomiasis

• Water - Uses & Abuses
  — Development (Dams; Irrigation), Socioeconomic (Sanitation)
• Snail hosts
  — Habitat (geography & weather), Dams, Marshes
• Adult worms - Longevity & reproductive potential
• Human & animal reservoir hosts
  — Contamination & Contact Patterns; Occupational aspects
  — Age and Prevalence, immunity, re-infection and resistance
• Focal Transmission sites
  — Rural and Urban settings

Diagnosis and Treatment

• Identification of eggs in stool or urine
• Tissue biopsy (rectal biopsy for all species and biopsy of the bladder for S. haematobium) may demonstrate eggs when stool or urine examinations are negative.
• Praziquantel for infections caused by all Schistosoma species.
• Oxamniquine when praziquantel is less effective for S. mansoni

What is different about eggs of various species?
**Prevention of Schistosomiasis**

- Prevent eggs from contaminating water supplies
  - Sewage treatment
  - Eliminate night soil
  - Latrines
- Avoid swimming or wading in questionable freshwater, using irrigation water for washing
- Human contact with water infested with cercaria
- Education, protective gear
- Vigorous towel drying after an accidental, very brief water exposure may help to prevent the *Schistosoma* parasite from penetrating the skin.

**Control of Schistosomiasis**

- Behavior
- Habitat
- Occupation
- Sewage
- Season
- Behavior
- Bathing

**Infected People**

- contact

**Uninfected People**

- contact

**Reservoirs**

Source: Matt Bolek

**Schistosomiasis Control Initiative**

http://www.schisto.org

- 1. To encourage development of a sustainable NTD control program in sub Saharan Africa.
- 2. In the selected countries
  - To reach at least 75% of school-age children and other high-risk groups with chemotherapy - praziquantel and albendazole.
  - Reduce schistosomiasis-related morbidity in high risk groups.
  - Reduce prevalence and intensity of schistosomiasis infections.
  - Reduce burdens due to intestinal helminths in the targeted populations.
- 3. To promote access to antihelminthic drugs and good case management in the regular health system.

**Emerging Schistosomiasis**

- Since the mid-1990s, *S. japonicum* has been resurging in previously controlled areas of China
  - Nearly 800,000 people are infected annually and 60 million people are at risk of infection in China (WHO)
- *S. mekongi* migration north from Vietnam towards Cambodia, Laos
  - Twelve Israeli travelers acquired schistosomiasis in Laos during 2002–2008
- Resistance to drugs?
  - Isolates from Egypt and Senegal have higher tolerance to praziquantel