Schistosomiasis

(Bilharzia, Snail fever)
Trematode (Fluke)

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Prepared as part of an education project of the Global Health Education Consortium and collaborating partners

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9.1 Epidemiology

• Parasitic helminth endemic to >70 countries
  o At least 240 million people affected, and 700 million at risk
  o Annual deaths from schistosomiasis difficult to estimate: disease can kill directly & indirectly (e.g. associated carcinomas)
  o Revised estimates put death toll from disease at over 200,000/yr, mostly in Africa

• In endemic areas usually acquired in childhood
  o Infection increases in prevalence with age
  o Peak age 15-20 years old
  o Risk is related to occupation and exposure routes
9.1 Epidemiology

- Infection intensity decreases with age
  - Acquired immunity, change in water contact, change in egg production by worms

- Although relatively low (direct) case-fatality ratio, disease has extremely high morbidity and enormous impacts on health and socioeconomics
  - Decreased productivity in chronic disease
  - Associated impacts on families of those affected, in the form of treatment costs and loss of income

- Two main types of disease: Urinary and Intestinal
9.2 Risk factors

- Poor sanitation practices
  - Excretion of eggs into water sources used for drinking, bathing, domestic use, etc.

- School-age children (less immunity)

- Fresh-water exposure by swimming or bathing in water containing infectious cercariae

- Occupational exposure through e.g. irrigation ditches, rice farming, etc.
  - Particularly in/near standing or slow-moving water, where the snail hosts can attach to vegetation
9.3 Biology

- Bisexual trematodes (flukes)
  - Eggs distinguished by spicule and its location
- Snail – first intermediate host
- Human – definitive host

Different species (eggs differentiated by location of spine):
- *Schistosoma hematobium* – renal and bladder dysfunction
- *Schistosoma mansoni* & *S. japonicum* – liver and intestinal disease
- *Schistosoma mekongi* & *S. intercalatum* – colonic disease
Eggs of *S. mansoni*, showing lateral spine

Photo credit: WHO-TDR-Pasteur Inst
Egg of *S. haematobium*, showing terminal spine

Photo credit: WHO-TDR-Stammers
Egg of *S. japonicum*, with vestigial spine (arrow). The eggs are smaller than those of *S. haematobium* or *S. mansoni* and are oval or subspherical.
* Different snails act as intermediate hosts for different species of Schistosoma.
9.4 Symptoms (general)

- Two syndromes typically seen
  - Early/Acute
    - Cercarial dermatitis, “swimmer’s itch”
    - Katayama fever/Katayama syndrome
  - Chronic disease (various manifestations)
  - Pathogenesis primarily through cell mediated immunity
    - Egg granuloma formation leads to fibrosis

- Cercarial dermatitis
  - Result of penetration of cercariae through skin
  - Commonly with *S. hematobium, S. mansoni*
  - Pruritis, papular rash at the site of cercarial penetration
  - Occurs mostly within 24h of exposure, but reports range from minutes up to 1 week
9.4 Symptoms- Acute disease

- Acute schistosomiasis- Katayama fever/syndrome
  - Early clinical manifestation with 1st infection or heavy reinfection (primarily *S. japonicum/mansoni*)
  - More likely in traveler or new immigrant to endemic region
  - Symptoms 4-8 weeks after exposure with beginning of egg deposition in tissue
  - Non-specific symptoms: fever, sweat, chills, cough, diarrhea, headaches
  - Lymphadenopathy
  - Hepatosplenomegaly
  - Urticaria
  - Respiratory symptoms – interstitial pneumonitis (more commonly seen in *S. haematobium*)
  - Eosinophilia, hyperglobulinemia
  - Immune complex reaction = Serum sickness
9.4 Symptoms - Chronic disease

• Chronic intestinal disease
  o *S. mansoni*, *S. japonicum*, *S. mekongi*
  o Eggs in the intestinal wall
    ▪ Inflammation
    ▪ Microabscesses
    ▪ Polyposis
  o Symptoms
    ▪ Diarrhea – commonly in children
    ▪ Left lower quadrant pain
    ▪ Occult or visible blood in stool
    ▪ Polyposis – protein-losing enteropathy
    ▪ Severe – colonic obstruction
    ▪ Abdominal distention/ascites

*S. mansoni*

http://www.path.cam.ac.uk/~schisto/schistosoma/S.mansoniegg.gif
9.4 Symptoms - Chronic disease

- Chronic hepatic disease
  - *S. mansoni, S. japonicum*
  - Eggs embolize to liver
  - Granulomatous inflammatory reaction (hepatomegaly)
    - Presinusoidal inflammation, periportal fibrosis
    - Clay-pipe-stem fibrosis
  - Periportal collagen deposits
    - Obstruction of blood flow $\rightarrow$ portal hypertension $\rightarrow$ varices, splenomegaly/hypersplenism

Photo: http://www.path.cam.ac.uk/~schist o/helminth_eggs/S.japonicum.egg.gif
9.4 Symptoms - Chronic disease

- Chronic cardiopulmonary/pulmonary disease
  - Cardiopulmonary hypertension
  - Associated with hepatosplenic disease
    - Presinusoidal portal hypertension → portocaval shunts → eggs travel and lodge in pulmonary vasculature
  - Pulmonary hypertension: antiparasitic treatment = no effect

- Chronic CNS disease
  - *S. japonicum* – brain lesions (seizures)
  - *S. mansoni* – spinal cord lesions (more likely to be symptomatic, transverse myelitis)
  - Ectopic worm or egg dissemination (egg embolizes)
  - Diagnosis usually difficult, since rarely systemic symptoms
9.4 Symptoms - Chronic disease

- Chronic urinary tract disease
  - Usually in children
  - Egg deposits in distal ureter and bladder wall
  - Hematuria 10-12 weeks after exposure
  - Dysuria
  - Late manifestations:
    - Nephrotic range proteinuria
    - Bladder calcifications
    - Ureteral obstruction
    - Renal colic
    - Renal failure
    - Secondary bacterial infections
    - Bladder carcinoma (squamous cell – well differentiated with local spread; accounts for up to 31% of all cancers in Egypt)

9.4 Symptoms - Chronic disease

- Chronic urogenital disease*
  - Newly described entity associated with *S. hematobium*
  - Bleeding, abdominal pain, ectopic pregnancies
  - Association with increased risk of acquiring HIV and other STD’s

* "Female genital schistosomiasis as an evidence of a neglected cause for reproductive ill-health: a retrospective histopathological study from Tanzania"

*BMC Infectious Diseases* 2006, 6:134 doi:10.1186/1471-2334-6-134
9.5 Diagnosis

• Gold Standard: Eggs in stool of patient

• Intestinal and hepatic schistosomiasis
  o Eggs identified in tissue of patient (liver/intestinal biopsy)
  o Serology: FAST ELISA
    ▪ No distinction between past and current infection
    ▪ Useful if negative – rule out
    ▪ Useful in travelers

• Urinary schistosomiasis
  o Eggs in urine or on bladder biopsy
  o FAST ELISA
  o After diagnosis: evaluation of ureters, squamous cell carcinoma
9.6 Treatment

• Praziquantel
  o All species
  o Works against adult worms
  o Cure rate 60-90%
  o Exact mechanism of action unknown
  o Causes tetanic contraction and paralyzes adult worm
  o Sequestered antigens get exposed, which facilitates host immune destruction

• Treatment of complications of schistosomiasis, e.g. cancers, intestinal disease
9.7 Control

• Ecological approaches for snail control
  o Shown to be successful in Japan, where *S. japonicum* largely eliminated from islands; considered eradicated since 1976
  o E.g. current speed of rivers, streams, etc.
    ▪ This has significant effect on snail host density

• Community-based control measures
  o Public health education on disease & infection routes
  o Improved sanitation and sanitation practices
    ▪ No urination/ defaecation in water sources!
  o Mass chemotherapy (praziquantel)
Other Liver Flukes and Lung Flukes

- *Clonorchis sinensis* - Liver
- *Opisthorchis felineous* - Liver
- *Fasciola hepatica* - Liver
- *Paragonimus spp.* - Lung

Photo: http://upload.wikimedia.org/wikipedia/commons/thumb/3/35/Fasciola_hepatica2.jpg/250px-Fasciola_hepatica2.jpg
Neurocysticercosis

Tapeworm (Cestode)
10.1 Epidemiology

- Infection of the CNS by larval form of pork tapeworm (*Taenia solium*)

- Estimated 50 million affected worldwide, with 50,000 deaths resulting from the condition

- Prevalence greatly reduced in Western Europe, where prevalence used to be close to the current prevalence in Mexico (1.9%)
  - Remains common in most developing countries

- A major cause of epilepsy in developing countries
  - Main cause of acquired epilepsy
10.1 Epidemiology

Photo: http://www.who.int/zoonoses/diseases/approximate%20global%20distribution%20of%20cysticercosis.jpg
10.2 Risk factors

• Ingestion of parasite eggs, larvae by any route along the faecal-oral transmission pathway
  o Poor hygiene practices (esp. handwashing) of infected people, as *T. solium* eggs excreted in faeces
  o During food preparation, handling
  o Autoinfection

• However, infection with parasite does not mean person will develop neurocysticercosis
  o Not all persons with taeniasis have CNS involvement

• Vegetarians equally at risk if they are exposed to person excreting eggs!

*Eating undercooked meat only leads to *T. Solium* infection – which is asymptomatic for this person, excreted eggs in faeces of this person are infectious and causes NCC.*
10.3 Life cycle

- Only if eggs are ingested by human can they cause neurocysticercosis
- Ingested taenia eggs are activated by gastric and duodenal environment → develop into invasive larvae (oncospheres) in the small intestine → migrate across the intestinal wall → carried by bloodstream where they eventually settle and mature into cysticerci (process duration up to 2m)
- Tropism for soft tissue, muscle and CNS
- Cysts can be up to 1cm large. Largest in the ventricles/ subarachnoid space, smaller in brain parenchyma
- Little immune response elicited by established cysticerci if they are not actively growing or degenerating.
10.4 Symptoms

- Majority of cases are asymptomatic, and can remain so for decades
  - Little immunological reaction from intact cysticercal larvae; more serious reactions to dying, degenerating cysticerci
- Leads to seizures, headaches (common) and stroke
- Cases with many lesions and brisk inflammatory response (particularly with degenerating cysts): sub-acute encephalitis
- If space-occupying lesion: any focal symptomatology including weakness and extrapyramidal symptoms
10.4 Symptoms

- **Ventricular disease:** 15% of cases, obstructive hydrocephalus
  - May spontaneously remit due to ball-valve effect upon motion intermittently occluding the ventricular outlet foramina
  - Untreated, most cases progress to sustained hydrocephalus

- **Spinal disease:** cysts in and around the cord have been reported
  - Progressive paraplegia developing over period of weeks

- **Changes in mental status, cognitive impairment, psychiatric disease, balance problems**

- **Ocular disease:** cysts subretinal or intravitreous
10.5 Diagnosis

- Cysts on neuroimaging
  - CT (better at diagnosing calcified lesions)
  - MRI (better at diagnosing cysts)

- Spinal disease per myelography

- Serology:
  - ELISA sensitivity > 90% - crossreactivity with other helminths
  - Detection of Ab or Ag in CSF


Tapeworms in the human intestine can grow to over 3m in length

(Photo credit: http://mtherald.com/images/tapeworm.jpg)
10.6 Treatment

- Treatment is complex and treatment plan controversial

- Some advocate only treating certain cases due to the adverse reactions associated with immune reaction to dying parasite
  - Most viable cystic lesions either calcify or disappear, in viable lesions antihelminthic therapy may hasten the death of parasite, but not change clinical outcome
  - Advocate treating with corticosteroids and anti-epileptic drugs, optimal duration is subject to debate

- Medications
  - Praziquantel
  - Albendazole
10.6 Treatment

- Always pre-treat with corticosteroids, and continue during treatment
  - Decreases inflammatory reaction elicited by dying cysticerci

- Surgical treatment only in selected cases of ventricular cysts, eye involvement

- Shunt placement in case of hydrocephalus
10.7 Control

- Avoid contact with pig faeces, either direct or indirect (e.g. occupational exposures)

- Thorough cooking of pork meat

- Cooking/peel fruits and vegetables that may have come into contact with pig feaces (e.g. during cultivation)

- Avoid drinking from water sources that may be contaminated by pig faeces

- Washing hands after using toilet and before food handling
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End of module

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