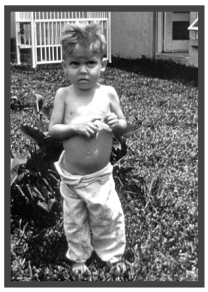
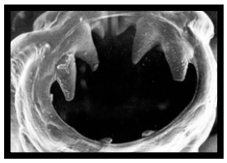
ENT 156 Topic 8: Hookworms & CLM



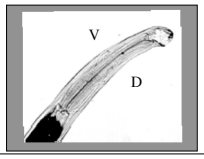
"The disease induced by the hookworm… was never suspected to be a disease at all. The people who had it were merely supposed to be lazy, and were therefore despised and made fun of, when they should have been pitied."

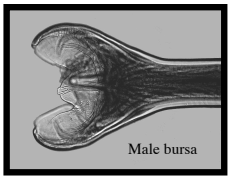
-Mark Twain



Hookworms

- Order Strongylida, Superfamily Ancylostomatoidea - "nested within" Rhabditina
- Strongylida includes many economically important parasites of large animals
- Hookworms named for their body shape, a dorsal curve anteriorly





Hookworms (cont.)

- Parasites of the small intestine -- feed on mucosa, rbc and plasma
- Why do hookworms take blood? Mostly undigested.
- Two main species in humans, each about 10mm long as adults
  - *Ancylostoma duodenale*
  - *Necator americanus*

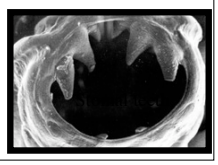
  } Only in humans
- Rarely, *Ancylostoma caninum* (dog hookworm) will develop to adults in humans

"Old World" hookworm

- *Ancylostoma duodenale* - originally distributed in Europe, Orient, Mid-East
- Has distinct teeth in stoma
- Consumes ~10x more blood/day (~0.2 ml/day/worm) than *Necator americanus*
- Has alternative life histories

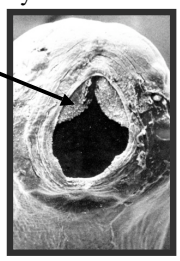
(arrest, transmammary, oral)

- More fecund than *Necator*



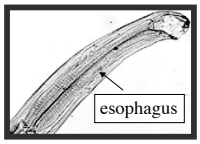
"New World" hookworm

- *Necator americanus* - discovered in Americas, but present in Africa (distributed by human movement)
- Has cutting plates in stoma
- Consumes less blood/day (~0.03 ml/day/worm), produces fewer eggs/day/female

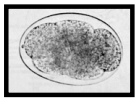


Some hookworm facts..

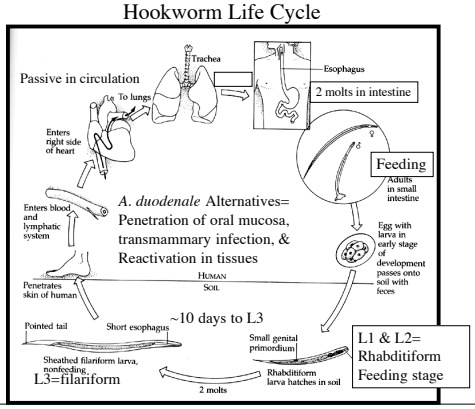
- Eggs of *Ancylostoma* and *Necator* are not distinct
- Hookworms have an extremely muscular esophagus for pumping blood
- ~17% population of China infected
- Worldwide blood loss >1 million liters daily



Hookworm egg



Hookworm Life Cycle



Hookworm life history & alternatives

- J3 is non-feeding, lives on reserves in intestine (up to several months), move vertically during the day
- *A. duodenale* J3 can be arrested in muscle for years, reactivated to complete infection
- *A. duodenale* has oral & transmammary routes of infection (2 molts w/o tracheal migration)
- Life-span: *A. duodenale* (~1 year), *N. americanus* ~3-5 years

Hookworm infection vs. disease

Factors influencing clinical disease state

- Number of worms per host
- Species of hookworm
- Nutritional condition of host
  - Protein intake
  - Iron intake

Ventral tooth in stoma

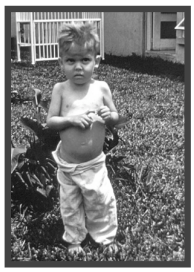
Hookworm disease

- 100 *A. duodenale* or 500 *N. americanus* will result in anemia
- 1,000 *A. duodenale* = ~200ml blood loss per day
- Tremendous energy loss due to protein deficiency & anemia
- In youngsters, hookworm disease reduces growth and cognitive development
- During pregnancy, reduces birth weight & increases premature birth

Infection Symptoms

1. Ground itch - due to penetration of J3 & allergic rxns to secreted proteins
2. Pneumonia due to migration thru lungs (depends on infective dose)
3. Anemia - if worm burden high enough
4. Symptoms of protein deficiency, including edema of limbs (↓growth in children)
5. Geophagy when anemia is severe

Some Symptoms of Severe Hookworm Disease



Poor general condition
(large abdomen, thin extremities)

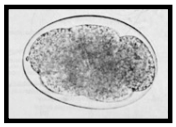
Protein deficiency
(flag sign)

Edema

Diagnosis of Hookworm infection

- Eggs in fresh or refrigerated stool samples
- Rhabditiform larvae in older stool samples
- Eggs are not diagnostic for genera (need a PCR-based test)
- Often need concentration methods to enhance detection

Embryonated hookworm egg



Treatment of Hookworm Disease

- Benzimidazole drugs (bind to tubulin)
  - not during 1st trimester, children <2?
  - drug resistance has been found
- Dietary supplementation
  - Iron supplements
  - Protein supplements

Control of Hookworms

Simple in theory, <u>difficult in practice</u>

- Prevent soil pollution by human feces
  - But do people have latrines to use and will they use them?
- Protect skin from exposure (shoes/boots) (but not only mechanisms for *A. duodenale* transmission)
- Don't use human waste as fertilizer
- Mass drug campaigns? Difficult (2-3x drug treatment/year for many years, according to models)

Hookworm Control

- Humans without "facilities" will defecate in shady areas for privacy
  - Defecation grounds become sources of infection
  - Daily time pattern of defecation influences probability of hookworm infection
- Rockefeller Sanitary Commission formed for hookworm control (eventually led to Rockefeller Foundation and University) $1 million in 1909 by J.D. Rockefeller Sr.

Hookworm Eosinophilic Enteritis

Causative agent - *Ancylostoma caninum*

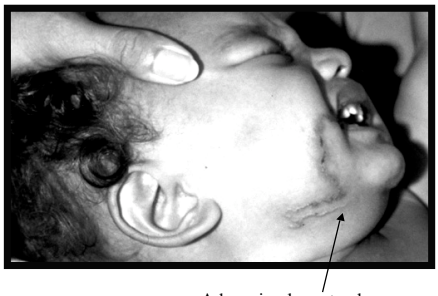
A. caninum - the most common domestic dog hookworm in North America

- Immature *A. caninum* in human intestine
  - No egg production -- difficult to detect
  - Symptoms -- abdominal pain and peripheral blood eosinophilia
- Symptoms can be caused by a single worm!

Cutaneous **L**arva **M**igrans (creeping eruption)

- Caused by hookworm L3 that don't normally mature in humans
- Juveniles migrate in skin for weeks to months (but self-limited infection)
- Usually caused by dog or cat hookworms
  *A. braziliense (*also *A. caninum, Uncinaria stenocephala,* and others*)*
- Common in Gulf Coast States

CLM



Advancing larva track

Cutaneous Larva Migrans (creeping eruption)

- Begin with small red itchy papules
- Within 2-3 days, slightly elevated red tunnels
- Tunnels move up to 1 inch per day
- Skin surface becomes dry; itching intense
- Secondary bacterial infections common
- Treatment - topical anthelminthics

CLM Cases

Plumber's Hazard

Beach Hazard