Estimated Prevalence

Hookworms 740,000,000
Ascaris lumbricoides 1,472,000,000
Trichuris trichiura 1,049,000,000
Wuchereria bancrofti 107,000,000
Schistosomes (all) 200,000,000

Source: American Society For Parasitologists 2003

Morbidity and Mortality

Antonie Dubini* and the Saint Gotthard Tunnel Hookworm Epidemic of 1880

Length - 15 kilometers
Depth - 1,700 meters

Table 1. Estimated global prevalence and associated morbidity and mortality due to soil-transmitted helminthiases and hookworms.

<table>
<thead>
<tr>
<th>Parasite</th>
<th>Prevalence (infected cases, million)</th>
<th>Mortality (deaths, thousands)</th>
<th>Morbidity (cases, million)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Entamoeba histolytica</td>
<td>400</td>
<td>60</td>
<td>200</td>
</tr>
<tr>
<td>hookworms</td>
<td>1,300</td>
<td>16</td>
<td>230</td>
</tr>
<tr>
<td>Schistosoma</td>
<td>65</td>
<td>10</td>
<td>150</td>
</tr>
<tr>
<td>ascariasis</td>
<td>200</td>
<td>26</td>
<td>20</td>
</tr>
</tbody>
</table>


Hookworm Epidemic of 1880

An effort….. to build a rail tunnel through the St. Gotthard massif was treacherous. That construction between 1872 and 1882 was plagued by bad rock and flooding. It killed 310 workers, incapacitated 877 others and bankrupted the contractor.

Helminths Nematoda:

The Hookworms

Ancylostoma duodenale
Necator americanus

Civil War -1861-1865

Gen. R. E. Lee
Gen. G. G. Meade

Pickett's Charge
One theory suggests that hookworm disease may have influenced the outcome of the Civil War. Southern troops grew up with the infection and had little in the way of sturdy clothing or shoes. Hookworms were brought to America from Africa in the early 1800s via the slave trade. They have been here ever since.

Economic recovery was slow following the Civil War, and J. D. Rockefeller wanted to know why!

John D. Rockefeller
Oil Baron par excellent
Dr established a sanitary commission (1909-1915) headed by Charles Wardell Stiles to look into the matter of "southern laziness".
Adult male *Ancylostoma duodenale*

Histological section of adult hookworm attached to villus of small intestine

Adult *Ancylostoma duodenale*

Histological section of adult hookworm attached to villus of small intestine

Adult *Necator americanus*

Hookworm larvae in dog skin
Pathogenesis:
Adult worms suck blood and feed on villus tissue.

In order to do all this, the worm has evolved a set of powerful anti-coagulants* even more effective than those of the medical leech. The cDNAs for these HW peptides have been cloned and may offer some interesting practical applications for medical use.


Clinical Disease:
1. Iron-deficiency anemia
2. Failure-to-thrive syndrome (idiopathic endocrinopathy)

Drug of choice:
Mebendazole
Mode of Action: De-polymerizes invertebrate microtubules, only
Prevention and Control

"To prevent this (hookworm) it is only necessary to prevent soil pollution with the feces of infested individuals."

Hookworm Disease
Asa Chandler, 1929

Greatest single invention of the 20th century!

Ancylostoma In India

Infectious larva of Ancylostoma sp.

Hookworm in Zimbabwe

"Creeping eruption" on the foot of a patient who stepped on an infective larva of A. braziliense

Dogs and Ancylostoma caninum

Paro, Bhutan

Number Of Worms

Number Of People

Heavy Infection

Light Infection

Serpiginous lesion

photo: E. Grave

photo: G. Zalar
Helminths
Nematoda:

*Strongyloides stercoralis*

Free-living female *Strongyloides stercoralis*

Parasitic female *Strongyloides stercoralis*

*Strongyloides stercoralis* in situ
Larva of *Strongyloides stercoralis* in skin

Pathogenesis:

Worms invade epithelial cells, induce cell death

Clinical Disease:

1. Diarrhea
2. Malabsorption syndrome
3. Secondary bacteremia/septicemia as larvae migrate throughout body and defecate microbes that they ingested in large intestine.
4. Death due to overwhelming bacterial septicemia.

Diagnosis:

1. Microscopic examination of feces (x 6)
2. “String” test

Drug of choice:

Ivermectin*

Mode of Action:
Blocks Cl\(^{-}\) ion channels, inhibits \(\gamma\)-aminobutyric acid receptor complex.

Prevention and Control:

Sanitary disposal of human feces*

*Dog is a common reservoir host. Cannot control spread of dog feces which may contain infective larvae.