HOOKWORMS

Kingdom    Animalia
Phylum      Nematoda
Class       Secerentea
Order       strongiloida
Family      Ancylostomatidae
Genus       Necater/ Ancylostoma
Species     Necater.americanus and Ancylostoma .duodenale

The hookworm is a parasitic nematode that lives in the small intestine of its host, which may be human, cat, or dog. Two species of hookworms commonly infect human, *Ancylostoma duodenal* and *Necater americanus*. A *duodenal* predominates in the Middle East, North Africa, India, while *N.americanus* predominates in the Americas, sub-saharan Africa, Southeast Asia, China, and Indonesia. Hookworms are thought to infect more than 600 million people worldwild. Hookworm are much smaller than the larger roundworm *Ascaris lumbricoides*, and the complications of tissue migration and mechanical obstruction so frequently observed with roundworm infestation are less frequent in hookworm infestation. The most significant risk of hookworm infection is anemia, secondary to loss of iron [and protein] in the gut. The worms suck blood voraciously and damage the mucosa. However, the blood loss in the stools is not visibly apparent.
Ancylostomiasis, also known by several other names, is the disease caused when A. duodenal hookworms present in large numbers, produce an iron deficiency anemia by sucking blood from the host's intestinal wall. Hookworm is a leading cause of maternal and child morbidity in the developing countries of the tropics and subtropics. In susceptible children hookworms cause intellectual, cognitive and growth retardation, intrauterine growth retardation, prematurity, and low birth weight among newborns to infected mothers. In developed countries, hookworm infection is rarely fatal, but anemia can be significant in heavily infected individual.

Morphology

The adult parasites are small cylindrical worm. A. duodenale are grayish white or pinkish with the head slightly bent in relation to the rest of the body. This bend forms a definitive hook shape at the anterior end for which hookworms are named. They possess well developed mouths with two pairs of teeth. While males measure ~ one cm x 0.5 millimeter, the females are often longer and stouter. Additionally, males can be distinguished from females based on the presence of a prominent posterior copulatory bursa. N. americanus is very similar in morphology to A. duodenal. N. americanus is generally smaller than A. duodenal with males usually 5 to 6mm long and females about 1 cm long.

Whereas A. duodenal possess two pairs of teeth, N. americanus possesses a pair of cutting plates in the buccal capsule. Additionally, the hook shape is much more defined in Necater than in Ancylostoma.

The eggs are blunting rounded, thin shelled, and are almost indistinguishable between the different species, measuring 60 x 40
micrometer, the eggs of *Ancylostoma* being slightly larger than those of *Necater*.

**The life cycle**

The life cycle of all the hookworms are very similar. The eggs are passed in feces, once exposed to air they mature rapidly if conditions are right, with both moisture and warmth essential for development. When mature they hatch to liberate a Rabditiform (i.e. having an esophagus where a thick anterior region is connected via a neckline region with a posterior bulb) **L1** larvae after a few days [The feeding non-infective rhabditoform stage].

These larval nematodes feed on bacteria and organic material in the soil, where they live and grow for about 2 days before undergoing the first molt **L2** larvae. After about 5 days more growth they molt again, to produce a much more slender **L3** larvae. The **L3** has a much shorter esophagus, is a non-feeding form, and is infective form of parasite [The filariform stage of the parasite. Also called filariform larva].

Infection takes place by penetration of "filariform larva" the skin, for example when walking with bare feet over contaminated dump soil, followed by entry into the circulatory system. Here they are carried to the heart, and then the lung. Once in the lungs, they are too large to pass through the capillary bed there. Instead they become trapped, and they burrow through the capillary epithelium, entering the air spaces. They then migrate up through bronchi and trachea, and are then swallowed. Once swallowed they pass into the intestine and bury themselves between the intestine villi. Here they molt to form the **L4** larvae, equipped with a buccal capsule allowing adherence to the gut wall. After about 13 days post-infection they molt for the final time producing immature adult
worms which become mature after 3-4 weeks (i.e. 5-6 weeks after infection), then mat and commence egg laying to complete the life cycle.

These parasites show a very high fecundity, female Necator producing up to 10,000 eggs daily, whilst female Ancylostoma produce up to 20,000 eggs daily.

Infection of host is by larvae, not the eggs. The usual method of infection is through the skin. While the larvae of A. duodenum may penetrate the buccal mucosa to reach the venous circulation and complete their migration via the lung (the filariform larvae being carried on contaminated vegetables or fruits). Also transmammary and transplacental transmission has been reported for Ancylostome,

Pathogenesis and clinical symptoms.

Pathogenesis and clinical symptoms depend on the site where the worms present and their burden (light infection may be not noticed). The clinical disease in hookworm infection may be due to larvae or adult worms.

Dermal:

When filariform larvae enter the skin they cause:

* Sever local itching.

* An erythematous popular rash may develop (becoming vascular)

* Scratching and secondary bacterial infection.

This condition, known as Ground-itch, is more common in infection with Necator than with Ancylostoma.
Pulmonary:

When filariform larvae break out the pulmonary capillaries and enter the alveoli may cause:

* Minute local hemorrhages
* Coughing.
* Chest pain.
* Wheezing.
* And sometimes fever (with large number of larvae).

Gastrointestinal:

When the adult worms attach themselves to the gut mucosa by their buccal capsules they suck into their mouth a portion of intestinal villi, they utilize gut epithelial cells and plasma for their food, are the most important manifestations of Ancylostomiasis (or hookworm disease).

- By the pumping action of the esophagus the worm sucks in blood, which pass out undigested and unutilized through its intestine.
- The adult Ancylostoma can suck about 0.2 ml blood a day, while the smaller Necator suck about 0.03 ml a day.
- The secretions of the worm contain anticoagulant activity, bleeding from the site may continue for sometimes, this add to blood loss.

Major morbidity associated with hookworm is caused by:

* Intestinal blood loss.
* Iron deficiency anemia.
And protein malnutrition.

All these result mainly from adult hookworms in the intestine ingesting blood, rupturing R.B.Cs, and degrading hemoglobin in the host. This long-term blood loss can manifest itself physically through:

* Facial and peripheral edema.
* Eosinophilia.
* Pica caused by iron deficiency anemia.

Children who suffer from chronic hookworm infection can suffer from growth retardation as well as intellectual and cognitive impairments.

Early stage symptoms of gastrointestinal infection are:

. Epigastric pain.
. Indigestion.
. Nausea.
. Vomiting.
. Constipation.
. Diarrhea can occur early or in later stage.

Signs of advanced severe infection are those of anemia and protein deficiency including:

. Emaciation.
. Cardiac failure.
Diagnosis

Depend on finding characteristic worm eggs on microscopic examination of the stools, although this is not possible in early infection.

The eggs are oval or elliptical, measuring about 60 micrometers by 40 micrometers, colorless, not bile stained and with a thin transparent hyaline shell membrane. When released by the worm in the intestine, the eggs contain an unsegmented ovum. During its passage down the intestine, the ovum develops and thus the eggs passed in feces have segmented ovum, usually with 4 to 8 blastomeres.

Note:

If the fecal sample is left for a day or more under tropical conditions, the larvae will have hatched out, so eggs might no longer be evident. In such cases, it is essential to distinguish hookworms from strongyloides larvae. Adult worms are rarely seen, but if found, would allow definitive identification of the species.

Differentiation between hookworm and strongyloides larvae based on the length of the buccal cavity, the space between the oral opening and the esophagus in hookworm rhabditiform larvae have long buccal cavities whereas strongyloides rhabditiform larvae have short buccal cavities.

Prevention

The infective larvae develop and survive in an environment of damp dirt, particularly sandy and loamy soil. They cannot survive in clay or
muck. The main lines of precaution are those indicated by sanitary science:

1- Do not defecate in places other than latrines, toilet, etc.

2- Do not use human excrement or raw sewage or untreated night soil as manure/fertilizer in agriculture.

3- Do not walk barefoot in known infected areas.