



Hookworms

Hookworms for Dog Last updated:

Oct 1, 2016

Synopsis

CAPC Recommends

CAPC recommends testing all dogs for hookworms by fecal flotation with [centrifugation](#). Fecal tests for specific parasite antigens have been optimized for use in companion animals and are also available to aid in identification of infection.

Puppies should be tested more frequently than adult dogs. CAPC recommends testing for intestinal parasites, including hookworms, at least four times in the first year of life and at least two times per year in adults depending on patient health and lifestyle factors.

Administer year-round broad-spectrum parasite control with efficacy against hookworms, and reduce exposure by timely removal of feces from the environment.

As a parasite with zoonotic potential, control of hookworms is essential.

Species

Canine
Ancylostoma caninum
Ancylostoma braziliense
Uncinaria stenocephala

Overview of Life Cycle

Adult hookworms live in the small intestine and shed eggs in feces and into the environment, where they larvate, hatch, and develop into infective third-stage larvae. This development occurs in approximately 2 to 9 days, depending on temperature and humidity.

Dogs become infected with hookworms via ingestion of the third-stage larvae from a contaminated environment, larval penetration of the skin, and/or ingestion of other vertebrate hosts with infective larvae in their tissues. Dogs may also become infected by eating cockroaches that contain infective larvae.

Transmammary transmission of larvae from the bitch to pups is an important route of infection for *A. caninum*. In dogs more than 3 months of age, some *A. caninum* will migrate through the lungs and enter somatic tissue, where the larvae become dormant, or arrested. Arrested development may also occur in the mucosa of the small intestine. These arrested larvae are activated after removal of adult worms from the intestine; activation also occurs during pregnancy, with the larvae accumulating in the mammary glands and secreted in the milk.

When infective larvae are ingested, some may penetrate the oral cavity and the gastro-intestinal tract mucosae and migrate as described; many of these larvae, however, remain in the alimentary tract and mature to adults in the small intestine.

Larvae that infect other animals (paratenic/transport hosts) do not develop further in these hosts but become dormant (hypobiosis/arrested development) in various host tissues. When a dog ingests these larvae in animal tissues, the larvae travel to the small intestine, where they are released and mature into adult worms.

Immature and adult worms attach to the mucosa of the small intestine, digest the tissue, inject anticoagulants, and suck blood. Worms may detach and move to new sites and reattach. Small bleeding ulcers form where the worms once fed.

Adult worms may live for 4 to 24 months in the small intestine.

a caninum wiggling in colon



Stages

Morulated hookworm eggs are passed in the feces of infected dogs; the most commonly seen species is *A. caninum* in the dog.

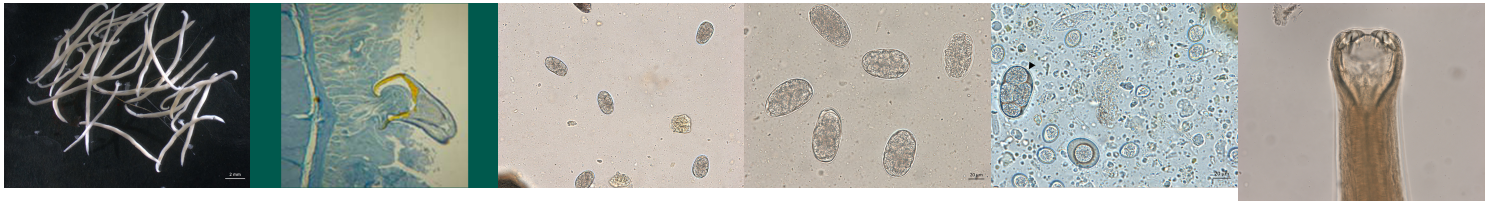
Adult hookworms in the small intestine of infected dogs are attached to the intestinal villi by a large mouth cavity (buccal cavity).

Male hookworms have a posterior copulatory bursa, and it is not uncommon to observe worms in copula in the small intestine.

The anterior ends of both males and females are bent dorsally, giving them a "fishing hook" appearance. *A. caninum* have three pairs of teeth in the buccal cavity. *Ancylostoma braziliense* has one pair of teeth (although some references mention a second, inconspicuous pair). *Uncinaria stenocephala* has cutting plates instead of teeth.

Dog hookworms range in size from 10 to 20 mm by 0.4 to 0.5 mm.

Eggs range in size from 55 to 90 μm by 30 to 55 μm , depending on the species. *Ancylostoma* spp. eggs are 55 to 75 μm by 34 to 47 μm ; *U. stenocephala* eggs are 71 to 93 μm by 35 to 58 μm .



Ancylostoma caninum adults

Adult hookworms in the small intestine of infected dogs or cats are attached to the intestinal villi by a large mouth cavity (buccal cavity).

Ancylostoma spp. eggs canine 200X

Ancylostoma spp. eggs canine 400X

Ancylostoma sp. egg (arrow) and *Cystoisospora* spp. oocysts

Ancylostoma caninum anterior end

a caninum curling up in duode



Disease

All hookworms suck blood, but *A. caninum* is a voracious bloodsucker and can actually bleed a puppy to death. Disease in dogs caused by infection with *A. caninum* is most severe in young pups that are infected through nursing (the transmammary route) shortly after birth.

Infected pups may present with pale mucus membranes and anemia, ill thrift, failure to gain weight, poor hair coat, dehydration, and dark, tarry diarrhea (melena). Puppies harboring many worms will develop an acute normocytic, normochromic anemia followed by hypochromic, microcytic anemia due to iron deficiency. Without immediate intervention, these animals may die of the infection. Those that survive may continue as "poor doers" with chronic anemia.

Although some immunity to infection does develop, mature dogs may harbor small numbers of worms and contaminate the environment. If well-nourished and immunocompetent, these dogs will show few, if any, signs of disease. Adult dogs (particularly those that acquire many worms over a short period of time) may develop anemia, anorexia, emaciation, and weakness along with the characteristic dark, tarry diarrhea. These outcomes are more likely to occur in dogs that are stressed and malnourished.

Respiratory disease and pneumonia may occur in puppies when large numbers of larvae migrate through the lungs. Respiratory signs may also be associated with hookworm-induced anemia.

Ancylostoma caninum is more pathogenic than *A. braziliense* because they are voracious bloodsuckers and consume much more blood than the latter.

Penetration by larval hookworms occasionally causes a dermatitis with erythema, pruritus, and papules. These lesions are most commonly seen on the animal's feet, particularly in the interdigital spaces. *Ancylostoma caninum* and *A. braziliense* are most often the culprits

a caninum as scope advances



Prevalence

Ancylostoma caninum is a common parasite of dogs throughout the United States and are found in most tropical and subtropical environments.

Both young and adult canine and feline hosts can harbor hookworms and pass eggs in their feces.

In a survey conducted in 1996 using fecal samples collected from dogs across the United States, 19% of the fecal samples contained *Ancylostoma* spp. eggs and 1.02% contained *Uncinaria* spp. *Ancylostoma* prevalence ranged from less than 5% in the west to 36% in the southeastern United States.

The geographic distributions of *A. braziliense* and *U. stenocephala* are more limited.

In the United States, *A. braziliense* occurs in warm coastal areas; however, this parasite is most common in tropical and subtropical regions of Central and South America and the Caribbean.

Uncinaria stenocephala, or the northern carnivore hookworm, prefers colder climates and is most common in the northern United States, Canada, and Europe.

The transfer of *A. caninum* larvae from mother to nursing offspring contributes to the high prevalence of infection in puppies, even in pets that are well cared for and routinely treated for intestinal parasites. Because somatic infection is common in adult dogs (even those on routine monthly intestinal parasite control), veterinarians should assume that essentially every nursing pup is at risk for hookworm anemia. Puppies should be routinely dewormed for hookworms. Deworming does not kill arrested larvae in the tissues (see Treatment).

Infection with hookworms occurs in all dogs, but infection rates are likely to be higher in pets kept outdoors.

[Click here to view our Prevalence Maps](#) and to sign up for updates on reported cases in your area

Host Associations and Transmission Between Hosts

Dogs become infected with hookworms through ingestion of infective larvae from a contaminated environment, larval skin penetration, and/or ingestion of larvae in the tissues of vertebrate hosts (usually rodents).

Puppies are infected with *A. caninum* when they ingest larvae while nursing. In adult dogs, *Ancylostoma* spp. larvae become arrested in somatic tissues rather than completing the migration to the small intestine. During pregnancy, these arrested larvae are activated and accumulate in the mammary glands.

In dogs that are cleared of their adult worm infections, the intestinal tract can be repopulated by preexisting, dormant larvae from the somatic tissues that periodically become activated and resume development.

Prepatent Period and Environmental Factors

Ancylostoma caninum usually becomes patent in 2 to 3 weeks, but puppies infected while nursing may shed eggs as early as 10 to 12 days after birth. Similar variations are seen in other hookworm species, but in general, the prepatent periods are 18 to 28 days for *A. tubaeforme* and 13 to 27 days for *A. braziliense* and *U. stenocephala*.

Most hookworm eggs larvate, hatch, and develop into infective third-stage larvae in the environment in approximately 2 to 9 days, depending on temperature and humidity. In general, the environmental stages thrive best away from direct sunlight in warm, moderately moist, aerated soils. Freezing kills *Ancylostoma* spp. eggs, but *Uncinaria* eggs are hardier.

Unlike ascarid eggs, hookworm larvae do not persist in the environment for years. Under optimal conditions, infective hookworm larvae can survive in the soil for a few months until their metabolic reserves are depleted. In addition, larvae usually are killed by freezing temperatures

Site of Infection and Pathogenesis

Most hookworm species can penetrate the skin. As noted previously, occasionally the penetration of larval hookworms causes a dermatitis with erythema, pruritus, and papules. These lesions are most commonly seen on the pet's feet, particularly in the interdigital spaces.

After skin penetration, hookworm larvae move via the lymphatics to the veins and lungs where they penetrate alveoli and migrate up the respiratory tree to the trachea. They are swallowed and return to the small intestine where they attach to the mucosa and mature into adults. Respiratory disease and pneumonia may occur in puppies when large numbers of larvae migrate through the lungs. Respiratory signs also may be associated with hookworm-induced anemia.

Hookworms in the small intestine attach and secrete enzymes and anticoagulants to digest intestinal mucosa and facilitate bloodsucking. Hookworm platelet inhibitor decreases platelet aggregation and adhesion. Intestinal villi are damaged and villus blunting occurs, resulting in malabsorption and diarrhea. Adult hookworms move to new feeding sites, leaving small bleeding ulcerations behind. Enteritis and diarrhea may develop during this intestinal phase.

The major disease syndrome produced by hookworms is acute or chronic anemia from blood loss

Diagnosis

CAPC recommends testing all dogs for hookworms by fecal flotation with [centrifugation](#). Fecal tests for specific parasite antigens combined with centrifugal fecal flotation in companion animals has been shown to aid in identification of infection. The combination of tests may aid in identification of hookworms where few to no eggs are recovered from a fecal sample due to few adult worms being present, an infection with only young worms, or single sex infections.

Puppies should be tested more frequently than adult dogs. CAPC recommends testing for intestinal parasites, including hookworms, at least four times in the first year of life and at least two times per year in adults depending on patient health and lifestyle factors.

Dogs of any age may have subclinical infections and show no signs of disease. However, when hookworm infections are allowed to persist, contamination of the environment with these potentially zoonotic parasites can occur.

Ancylostoma caninum and *A. tubaeforme* begin sucking blood before eggs are produced. In puppies infected by nursing their mother's milk, acute anemia and death may result before any eggs have passed in the feces.

Fecal flotation with centrifugation

Diagnosis of patent hookworm infections via fecal flotation is straightforward. Hookworm eggs float readily in most flotation solutions.

Mix 1 to 5 g feces and 10 ml of flotation solution (ZnSO₄ sp.gr. 1.18; sugar sp. gr. 1.25) and filter/strain into a 15-ml centrifuge tube.

Top off with flotation solution to form a slightly positive meniscus, add coverslip, and centrifuge for 5 minutes at 1500 to 2000 rpm.

Examine for characteristic eggs.

Eggs of *Ancylostoma* spp. can be differentiated from those of *Uncinaria stenocephala* by size (see images under Life Cycle) although the ranges overlap somewhat. Mixed infections sometimes occur.

Ancylostoma spp.: 52-79µ x 28-58µ

Uncinaria stenocephala: 71-92µ x 35-58µ

Fecal test for hookworm antigen

Commercial assays are available for detection of antigen produced by immature and adult hookworms in the lumen of the small intestine. Both male and female worms can be detected, and antigen production is not linked to egg production.

Diagnosis by detection of antigen allows identification of prepatent and single sex infections, supporting use of preventives and allowing earlier treatment.

Both centrifugal fecal flotation and fecal antigen tests have their strengths and weaknesses, however to ensure the widest breadth of detection of intestinal parasites in dogs, fecal tests for antigen should be combined with microscopic examination of feces for eggs.

Treatment

In severely affected animals, anthelmintic treatment must be combined with supportive therapy to keep the animal alive until the drugs can kill the worms. In addition to keeping the patient warm, supportive treatment can include electrolyte and fluid therapy, iron supplements, a high-protein diet, and when clinically indicated, blood transfusions.

Routine anthelmintic therapies do not kill arrested third-stage larvae in tissues.

Fenbendazole, milbemycin oxime, moxidectin, and pyrantel pamoate are approved for adult *A. caninum*; pyrantel pamoate, fenbendazole, and moxidectin are approved for adult *U. stenocephala*; and pyrantel pamoate is approved for adult *A. braziliense*.

Moxidectin is approved for fourth-stage and young adult *A. caninum* and *U. stenocephala* in the intestine.

Ancylostoma caninum: The following products are approved for the treatment (and in some cases control*) of adult *A. caninum* infections in dogs:

Advantage Multi® Topical Solution for Dogs (imidacloprid + moxidectin) (Bayer Animal Health)*

Coraxis™ Topical Solution for Dogs (moxidectin) (Bayer Animal Health)*

Drontal® Plus Tablets (praziquantel/pyrantel pamoate/febantel) (Bayer Animal Health)

Drontal® Plus Taste Tabs® (praziquantel/pyrantel pamoate/febantel) (Bayer Animal Health)

HEARTGARD® Plus Chewables for Dogs (ivermectin/pyrantel) (Merial)*

HeartShield™ Plus Flavored Chewables (ivermectin/pyrantel) (TruRx)*

Interceptor® Flavor Tabs® for Dogs & Cats (milbemycin oxime)(Elanco)*

Iverhart Max® Chewable Tablets (ivermectin/pyrantel/praziquantel) (Virbac)*

IVERHART PLUS® Flavored Chewables (ivermectin/pyrantel) (Virbac)

Panacur® Granules 22.2% (fenbendazole) (Intervet/Merck Animal Health)*

PetTrust™ Plus Chewable Tablets (ivermectin/pyrantel) (Sergeant's)

ProHeart® 6 (moxidectin) (Zoetis)

Sentinel® Flavor Tabs® (milbemycin oxime/lufenuron) (Virbac)*

Sentinel® Spectrum® Chewables (milbemycin oxime/ lufenuron/praziquantel) (Virbac)*

Trifexis® (milbemycin oxime/spinosad) (Elanco)*

Tri-Heart® Plus Chewable Tablets (ivermectin/pyrantel) (Intervet/Merck Animal Health)*

The following products are also approved for fourth-stage larvae (L4) and/or young adult *A. caninum* in dogs:

Advantage Multi® Topical Solution for Dogs (imidacloprid + moxidectin) (Bayer Animal Health)

Coraxis™ Topical Solution for Dogs (moxidectin) (Bayer Animal Health)*

ProHeart® 6 (moxidectin) (Zoetis)

Ancylostoma braziliense: The following products are approved for the treatment (and in some cases control*) of adult *A. braziliense* infections in dogs:

HEARTGARD® Plus Chewables for Dogs (ivermectin/pyrantel) (Merial)*

HeartShield™ Plus Flavored Chewables (ivermectin/pyrantel) (TruRx)*

Iverhart Max® Chewable Tablets (ivermectin/pyrantel/praziquantel) (Virbac)*

IVERHART PLUS® Flavored Chewables (ivermectin/pyrantel) (Virbac)

Tri-Heart® Plus Chewable Tablets (ivermectin/pyrantel) (Intervet/Merck Animal Health)*

Uncinaria stenocephala: The following products are approved for the treatment (and in some cases control*) of adult *U. stenocephala* infections in dogs:

Advantage Multi® Topical Solution for Dogs (imidacloprid + moxidectin) (Bayer Animal Health)*

Coraxis™ Topical Solution for Dogs (moxidectin) (Bayer Animal Health)*

Drontal® Plus Tablets (praziquantel/pyrantel pamoate/febantel) (Bayer Animal Health)

Drontal® Plus Taste Tabs® (praziquantel/pyrantel pamoate/febantel) (Bayer Animal Health)

HEARTGARD® Plus Chewables for Dogs (ivermectin/pyrantel) (Merial)*

HeartShield™ Plus Flavored Chewables (ivermectin/pyrantel) (TruRx)*

Iverhart Max® Chewable Tablets (ivermectin/pyrantel/praziquantel) (Virbac)*

IVERHART PLUS® Flavored Chewables (ivermectin/pyrantel) (Virbac)

Panacur® Granules 22.2% (fenbendazole) (Intervet/Merck Animal Health)*

PetTrust™ Plus Chewable Tablets (ivermectin/pyrantel) (Sergeant's)

ProHeart® 6 (moxidectin) (Zoetis)

Tri-Heart® Plus Chewable Tablets (ivermectin/pyrantel) (Intervet/Merck Animal Health)*

The following products are also approved for fourth-stage larvae (L4) and/or young adult *U. stenocephala* in dogs:

Advantage Multi® Topical Solution for Dogs (imidacloprid + moxidectin) (Bayer Animal Health)

Coraxis™ Topical Solution for Dogs (moxidectin) (Bayer Animal Health)*

ProHeart® 6 (moxidectin) (Zoetis)

Click here to view [CAPC's Parasite Product Applications](#) page

Control and Prevention

Puppies require more frequent anthelmintic administration than adult dogs because (1) they often are serially reinfected via nursing and from the environment and (2) they often harbor migrating parasite larvae that later mature and commence laying eggs.

Hookworm infections in puppies may cause serious illness or even death before a diagnosis is possible by fecal examination.

In light of the hookworm prepatent periods, puppies and their dams should be treated with appropriate anthelmintics when the young are 2, 4, 6, and 8 weeks of age. Puppies should be put on monthly preventives as soon as label recommendations allow. If puppies are not treated until 6 to 8 weeks of age or later, they should be put on a monthly preventive according to label recommendations, dewormed again in 2 weeks, and then maintained on monthly preventives thereafter.

Beginning treatment when puppies are 2 weeks of age will help minimize environmental contamination.

Pregnant bitches may be treated during pregnancy with daily fenbendazole (from the 40th day of gestation through the 14th day of lactation) or 2 to 4 times with a high dose of ivermectin to prevent transmammary transmission of hookworm larvae to the pups. Both protocols involve off-label use of anthelmintics. High dose, off-label ivermectin should not be used in any dog with the MDR1 gene mutation.

Efficacy of the initial dewormings, effectiveness of the monthly control product, and client compliance should be monitored by performing a fecal examination 2 to 4 times in the first year and 1 to 2 times annually thereafter, depending on the age of the animal and its prior history of infection.

Preventing predation and scavenging activity by keeping cats indoors and dogs confined to a leash or a fenced yard will limit the opportunity for dogs to acquire infection with hookworms through ingestion of vertebrate hosts (usually rodents) or from an environment contaminated with feces from untreated animals.

Prompt removal of feces from the yard or litter box will also help prevent hookworm eggs from hatching and larvae developing and dispersing into the environment.

Enforcing leash laws and requiring owners to remove feces deposited by their pets can protect public areas from contamination with hookworm larvae.

Public Health Considerations

Animal hookworms are well-documented zoonotic disease agents and are the most common cause of cutaneous larva migrans (CLM) in people. The larvae migrate in the skin, producing intensely pruritic, serpentine lesions. Usually these infections are self-limiting. *Ancylostoma braziliense* migrates more extensively in the skin than do the other hookworms.

Humans are most likely to be infected with the hookworms of dogs and cats via direct skin penetration of infective larvae. *Ancylostoma caninum* can penetrate into deeper tissues and may arrest. On occasion, *A. caninum* can cause visceral larva migrans (VLM) when larvae migrate to the intestine and produce an eosinophilic enteritis. The worms do not mature to adults and no eggs are produced, but infected people may experience severe abdominal pain and eosinophilia.

Most CLM and other hookworm-associated syndromes are diagnosed in the southeastern and Gulf Coast states. People at higher risk include individuals in contact with larvae-contaminated soils such as electricians, plumbers, exterminators, and other workers who crawl beneath raised buildings; farmers and gardeners with close soil contact; sunbathers reclining on larvae-contaminated sand; and children playing in contaminated areas.

CLM is the most common travel-related skin infection in tourists to tropical areas.

Early and regular deworming is essential in preventing contamination of the environment with hookworm eggs and larvae.

Strict adherence to leash laws and prompt removal of feces from environments where pets defecate are key to protecting public areas from contamination; receptacles for the disposal of feces should be provided.

Children's sandboxes should be covered when not in use; outbreaks have occurred where larvae have developed to the infective stage in sandboxes and caused CLM in children.

To avoid larval penetration, individuals should wear shoes and gloves when gardening.

People whose occupations may require contact with moist soil for extended periods of time should cover the contact area with a waterproof liner.

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