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Hookworm Infections In Dogs: A Brief Review

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Abstract: Hookworms (*Ancylostoma braziliense*, *Ancylostoma caninum* and *Uncinaria stenocephala*) are the common helminths of dogs and cats, particularly puppies and kittens. Some species are zoonotic and dogs play a major role in transmitting these zoonotic hookworms by excreting the parasitic eggs directly into the human environment, without the involvement of vectors or intermediate hosts. Adult worms reside in the small intestine and suck large quantities of blood from the sites of attachment on the mucosa which may lead to anaemia, weakness, melena, and hypoproteinemia. Diagnosis of the disease is based on the faecal examination for the presence of parasitic ova or antigen. Although multiple anthelmintics are effective against hookworms, drug resistance has become an emerging problem. Hence a proper understanding of the biology of these parasites, risk factors associated with the transmission, significance of the anthelmintics in the treatment and control of parasites, and preventive strategies are of prior importance.

Introduction

Hookworms specifically, *Ancylostoma caninum*, *Ancylostoma braziliense* and *Uncinaria stenocephala* are the common parasites of dogs. They get their name because of the characteristic hook posture of the anterior end. *Ancylostoma caninum* is one of the most prevalent and pathogenic gastrointestinal parasites of dogs in tropical and subtropical regions of the world that may result in death in young dogs and in addition, poses a significant public health risk to humans (Kopp *et al.*, 2007). The eggs of this parasite are shed in the faeces of infected animals and can contaminate the ground where the animal defecates. People become infected when the zoonotic hookworm larvae penetrate unprotected skin, especially when walking barefoot or sitting on contaminated soil or sand (Prociv *et al.*, 1996; Brahmbhatt *et al.*, 2015). This can result in eosinophilic enteritis and cutaneous larva migrans (CLM) or "creeping eruption" which causes severe itchiness, red twisting lesions, and swelling. Rarely hookworm may infect the intestine and cause abdominal pain, discomfort, and diarrhoea. Heavy infection with *A. braziliense* can cause diarrhoea, but symptoms are less severe than for dogs infected with *A. caninum.*

Morphology

Ancylostoma caninum occurs in the small intestine of dogs and foxes, and very rarely in man. The male is 12 mm and the female is 14 mm in length. The worms are reddish or greyish depending on the presence of blood in the intestine of the worm. The worms are fairly rigid and their anterior end is bent dorsally. The oral aperture is anterio-dorsal and buccal capsule is deep with a pair of triangular dorsal teeth and a pair of centro-lateral teeth. The eggs measure 56-75 mm × 34-53 mm. *Ancylostoma braziliense* occurs in the small intestine of dog, cat, fox, and other wild carnivores. They are slightly smaller than *A. caninum* with a large and small ventral tooth on either side.

Life-cycle

Adult hookworms reside in the small intestine of the definitive host and pass thin-walled eggs (8-celled) in the faeces, 15-20 days post-infection. Embryonation occurs under optimum conditions and larvae develop from L_1 to L_3 stage. *Ancylostoma caninum*, infection occurs

in four ways. By oral ingestion, skin penetration, prenatal and Transmammary/ colostral route.

Oral ingestion and skin penetration

Ingested larvae (L_3) will move to the dog's intestinal tract to complete their lifecycle (L_3 to L_5). A few larvae may make their way into the trachea and are then coughed up and swallowed. The larvae may also burrow into the skin if the dog walks or lies on contaminated ground. Once in the host's body, the larvae migrate to the lungs and trachea where they moult to L_4 in the trachea and bronchi. The dog will then cough up and swallow the larvae which then migrate to the intestinal tract, where they mature (L_5) and complete their life cycle. Part of the hookworm lifecycle involves migration through muscle tissues, where they may become dormant until the bitch is pregnant.

Prenatal/Intrauterine infection

In the pregnant bitches, dormant larvae are activated by hormonal influence. These activated larvae enter the foetus via placental circulation and the worms do not mature until the birth of the pups. They mature within 30 days after the birth of pups and eggs can be seen in faeces. Prenatal infection is common in pups.

Transmammary/colostral/lactogenic infection

The dormant larvae get reactivated during pregnancy and are passed in the milk of the bitch for three weeks after whelping. This is called transmammary/colostral/lactogenic transmission. These larvae which are acquired by the pups through colostrum directly develop into adults without any migration.

Pathogenesis

The immature adults in small intestine feed on the mucosa containing arterioles. Each worm sucks about 0.1 ml of blood daily. The adult worms attach to the mucosa of small intestine by their buccal capsule where they continue to bleed even after detachment of worms due to anticoagulant secretions. This eventually leads to depletion of blood resulting in severe anemia. In dogs under one year of age and young pups, hookworms cause acute or chronic haemorrhagic enteritis. In older dogs, light infection occurs that causes iron deficiency and develops microcytic hypochromic anaemia. In sensitized dogs, skin reactions like eczema and ulceration occur at the site of percutaneous infections.

Clinical signs

An acute normocytic, normochromic anaemia followed by microcytic hypochromic anaemia in young puppies is the characteristic clinical manifestation of *A. caninum* infection. Listlessness, respiratory distress, diarrhoea with bloody mucous, tarry-colored faeces, and epistaxis are noticed. Dermatitis due to larval invasion of the skin may be seen with any of the hookworms, most frequently in the interdigital spaces. Hypoproteinemia is characteristic in puppies. Emaciation, poor coat, anaemia, anorexia, pica, respiratory distress, pneumonia, skin lesions and lameness develop in chronic infections.

Post-mortem lesions

Edema, ascites, fatty infiltration of the liver, intestine filled with worms and swollen mucosa covered with mucus and small bite marks of the worms.

Diagnosis

- Based on clinical symptoms *i.e.*, anaemia with haemorrhagic diarrhoea/ tarry-colored faeces.
- In pups, dermatitis with licking and scratching in interdigital spaces & lower parts of the legs.
- Faecal smear examination (flotation technique) under the microscope (10x) for the demonstration of thin-shelled, oval eggs with blunt ends and deeply pigmented glistening embryonic cells.

Treatment

- Regular deworming with good anthelmintics *i.e.*, Fenbendazole@ 50 mg/kg bwt orally, Levamisole @ 7.5 mg/kg bwt orally, Pyrantel pamoate @10 mg/kg bwt orally, Ivermectin @200 mcg/kg bwt subcutaneously.
- Supportive treatment with Iron injections like Imferon @1-2 ml, Intramuscular on alternate days for 1-2 weeks to cure anaemia.
- Liver extracts with vitamin b_{12} @1-2 ml, Intramuscular.
- Multivitamin, Liv-52 and Sharkoferol oral syrups according to body weight for 15 days.
- Dogs suffering from significant anaemia and/or secondary complications, such as pneumonia, will most likely require more extensive therapies, such as:
  - Blood transfusions
  - Intravenous fluids
  - Feeding tubes
  - Iron and/or vitamin supplements
  - Additional supportive medications

- High quality and high protein diets

Preventive measures

- Routine veterinary care of dogs and cats, including regular deworming, will reduce environmental contamination with zoonotic hookworm eggs and larvae.
- Grounds or surroundings and kennels should be maintained dry and crack-free. Maintain a sanitary home environment. The floors should be treated with common salt or sodium borate solution to kill larvae.
- Routine faecal monitoring to evaluate the efficacy of anthelmintics.
- Prompt disposal of animal faeces prevents eggs from hatching and contaminating soil, which makes it important for control of this parasitic infection. Wearing gloves when picking up and disposing of faeces.
- Avoid walking barefoot in contaminated soil and avoid contact with contaminated water.

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