PREVALENCE OF HOOKWORM PARASITES IN DOG FROM THE AREA OF THESALONIKI AND THEIR ZOONOTIC IMPORTANCE

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Abstract: Hookworm parasites of dog, are in great importance for dog as well as for human, because their ability to be a zoonosis. The prevalence of hookworm parasites in dogs from the area of Thessaloniki, was estimated in 8.5% for Uncinaria stenocephala and 1.89% for Ancylostoma caninum.

INTRODUCTION

Hookworms (Ancylostoma spp., Uncinaria) are common intestinal parasites of dogs. Puppies acquire hookworm infection through ingestion of or skin penetration by infective larvae, or from infective larvae passed in their dam’s milk (A. caninum), (Burke and Roberson, 1985). Hookworms suck large amounts of blood from their hosts and while infected animals may look healthy in the first week of life, they can develop a rapidly severe, often fatal, anemia (Bowman, 1999). Patent intestinal infections can occur as early as 2 weeks of age, leading to environmental contamination with infective larvae. (Hedrix et al, 1996 ; Kalkofen, 1987). The growing popularity of dogs in Greece, together with high rates of hookworm infections, has resulted in widespread contamination of the soil with infective eggs and larvae. Epidemiologic studies have implicated the presence of dogs, particularly puppies, in a household, and pica (dirt eating) as the principal risk factors for human disease. Children’s play habits and their attraction to pets put them at higher risk for infection than adults.

Humans can become infected with hookworms through ingestion of infective larvae or through direct penetration of the skin. (Glickman and Schantz, 1981), when infective larvae penetrate the skin, they undergo a prolonged migration that causes a condition known as cutaneous larva migrans. These larval migrations are characterized by the appearance of progressive, intensely pruritic, linear eruptive lesions, which are usually more extensive with A. braziliense infections. A. caninum larvae may also penetrate into deeper tissues and induce symptoms of visceral larva Hookworm larvae can penetrate the surface of a person's skin (usually through bare feet) and migrate through it, causing a disease called 'cutaneous larva migrans' or 'creeping eruption.' The lesions appear as red lines under the skin and sometimes break open at the skin's surface. These lesions cause severe itching. Usually, the larvae will die in several weeks and the condition will disappear. In severe cases, the larvae may make their way through the skin and enter deeper tissues. This may cause lung disease and painful muscles.

There have been some reports of humans having intestinal infections with canine hookworms. Generally, these infected people do not show clinical signs of disease.migrants, or migrate to the intestine and induce an eosinophilic enteritis. (Litle et al, 1983 ; Prociv and Croese, 1990).
Larva migrans syndromes are not reportable in Greece, so the actual number of human cases is unknown.

MATERIALS AND METHODS

Nine hundred fifty dogs (485 male and 467 female, 381 young and 571 older than 6 months of age), from the area of Thessaloniki, Greece were examined using the fecal flotation method, in order to find eggs of hookworm parasites. The samples were collected directly from the rectum of each dog, or were gathered by the dog’s owner and were handed over in fresh condition for the study. The samples were examined before any anthelminthic therapy was administered. The examination method of all samples was executed in a diagnostic system Fecalyzer (Fecal Examination of EVSCO pharmaceuticals, USA) by means of flotation. (Stable solution of sodium nitrate, with stable special gravity 1,2)

RESULTS

From totally 952 examined fecal samples, 18 (1.89%) recorded to be positive for Ancylostoma caninum and 81 (8.5%) for Uncinaria stenocephala eggs.

From Ancylostoma caninum egg positive samples the 11 were belonged to male and the 7 female dogs, the 12 were belonged to young and the 6 to adult dogs.

Concerning Uncinaria stenocephala egg positive samples the 50 were belonged to male and the 31 female dogs, the 29 were belonged to young and the 52 to adult dogs.

DISCUSSION

Regarding the prevalence, this study has record that the most prevalent hookworm parasite in dogs from Thessaloniki, was Uncinaria stenocephala. Statistical analysis, (with importance factor P>0.005) has record that, the male and older dogs were infected more often than the female and young, by Uncinaria stenocephala.

Regarding Ancylostoma caninum prevalence the statistical analysis (with importance factor P>0.005) has record, the male and young dogs were infected more often than the female and older dogs.

Previous studies from Greece had recorded that the prevalence of Ancylostoma caninum was estimated in 0.5-2% in the area of Makedonia (Haralabidis, 2003) in other studies showed the following percentages:, 0.5% in 1993 (Haralabidis, 1993), and 0.8% in 1999 (Haralabidis, 1999). Regarding Uncinaria stenocephala previously studies in Greece was estimated in 8-32.8% in the area of Makedonia, 1.3 in Crete (Haralabidis, 2003) in other studies showed the following percentages: 3% in 1988 (Haralabidis et al, 1988), 32.8% in 1993 (Haralabidis, 1993), 2.7% in 1994 (Eudoridou et al, 1994) and 10.6% in 1999 (Haralabidis, 1999).

Studies in soil samples from the same area estimate the prevalence of feces samples taken from public places and parks in 22% for Ancylostoma spp and 3.5% for Uncinaria stenocephala (Haralabidis, 2003). An adult A. caninum worm can lies between 7,000 and 28,000 eggs per day.

The optimum temperature for A. caninum development is between 23 and 30°C. They do not develop to this stage at temperatures below 15°C. When the temperature is 15°C, infective larvae may appear in the feces 22 days after the eggs were shed, and at 37°C infective larvae may appear in as little as 47 hours. Most larvae cannot survive temperatures
above 37°C. Free-living larvae of hookworms from dog feces were observed to emerge for about a four-week period in summer weather. Infective larvae crawl out of the feces and into the soil or onto vegetation, and they then wait until an appropriate host comes along. They may enter the host directly through the skin or through being ingested.

*Uncinaria stenocephala* worms are less pathogenic than *Ancylostoma caninum*, as they consume much less blood (Georgi et al, 1990). An infection of an eight week old beagle puppy with 1000 *Uncinaria stenocephala* caused no clinical signs (Georgi et al, 1990), though diarrhea with mucus may be seen in heavy infections. Because *Uncinaria stenocephala* larvae are able to penetrate skin, cutaneous lesions may be seen in dogs kept in living conditions allowing for direct skin contact with a large number of larvae.

*Uncinaria stenocephala* infestation is primarily a problem in kennels and other such locations where high levels of localized environmental contamination facilitate spread by ingestion. Moisture and warmth sufficient for the parasite’s development can be found in the grassy areas of the exercising paddock or grass runs, and so these areas can also serve as a source of infection (Bogan et al, 1984; Borgsteede, 1984; Bosse et al, 1981).

In Greece the prevalence for *Uncinaria stenocephala* was estimated in 8-32.8% in the area of Makedonia, 1.3 in Crete (Haralabidis, 2003) in other studies showed the following percentages: 3% in 1988 (Haralabidis et al, 1988), 32.8% in 1993 (Haralabidis, 1993), 2.7% in 1994 (Eudoridou et al, 1994) and 10.6% in 1999 (Haralabidis, 1999). *A.caninum* of dog is just becoming well recognized as a parasite of humans Prociv and Croes, 1990; Standford and Prociv, 1991; Croece et al, 1990; Croece etal, 1994). It is a cosmopolitan species, exceedingly common in both tropical and temperate areas. *A. caninum* larvae can produce two syndromes in human, the coutaneous larva syndrome and the eosinophilic enteritis syndrome. The first syndrome is a skin condition caused by the migration of *Ancylostoma spp* larvae through the skin of a human host. This type of infection has also been termed creeping eruption, dermal larval migrans, ground itch, plumber’s itch, and sandworms. Cutaneous larva migrans is an infection caused most commonly by the larvae of the hookworm parasite *Ancylostoma braziliense*, and less frequently by the larvae of *Ancylostoma caninum*. It is primarily seen in the southern United States, Central and South America, and other subtropical climates. The infection presents itself in the form of a severe dermatitis that is a result of larvae penetrating the skin and migrating through the subcutaneous tissue, causing pruritic skin lesions that appear reddened, elevated, and serpentine. The infection of humans with *Ancylostoma caninum* larva begins with eggs being passed along with the feces of the host dog, and landing in warm, sandy soil. After a few days under favorable conditions, these ideally being moist, warm, well-aerated sandy soil shielded from direct sunlight, and temperatures between 20 and 30 C, the eggs hatch and develop into rhabditiform larvae, which rapidly grow while feeding on organic matter in the soil. They then molt and develop into third-stage filariform larvae, the non-feeding, infective form of the parasite. Larvae fail to develop at temperatures of less than 13 C, and cannot survive temperatures below 0 C or above 45 C, nor can they survive direct sunlight or drying. Humans become infected with the *Ancylostoma* filariform larvae when these larvae penetrate unprotected skin, which generally occurs as a result of the skin coming into contact with moist, sandy soil contaminated with larval hookworms, as the larvae are found in the top layer of soil, to a half-inch depth. Anyone whose skin comes into direct contact with damp soil contaminated with feces from infected animals can become infected. Plumbers, electricians, masons, and technicians working in the crawl space beneath buildings, all have increased chances of being infected in this manner as a result of prolonged skin contact with potentially contaminated soil. Sunbathers lying out or walking without footwear on the beach, and children who go barefoot
or play in yards or sandboxes where dogs or cats may have gained access and deposited infected feces, are also prime candidates for infection (Chadhry et al, 1989). The human is not a natural host for Ancylostoma caninum, but an accidental one. The severity of skin lesions is related to the burden of the infective larvae, which come into contact with the skin. The larvae, using their proteases, can rapidly penetrate the skin through the hair follicles, small fissures, or even intact areas. After penetrating the skin, the larvae migrate through it, and in most cases they are not able to complete their life cycle by maturing to adults in the small intestine. Once they have penetrated the stratum corneum, the larvae shed their natural cuticle. Before this unsheathing, they are not able to secrete sufficient protease to migrate within the epidermis (Miller et al, 1991). The larvae rarely fully penetrate the dermis, migrating for the most part in within the epidermis, just above the basal layer. As the larvae migrate and the lesion progresses, proteolytic enzymes in the larval secretions may cause an inflammatory reaction associated with intense pruritus. Symptoms are characterized by red, raised migration tracks, exhibiting the aforementioned severe pruritus. After skin invasion, the larvae reside in the superficial layers of the skin. There, they produce and secrete hyaluronidase, an enzyme that aids in the creation of tunnels through the skin. Usually the larvae begin migration within a few days, but it may be several weeks before they start. Once they begin, the organisms usually migrate a few millimeters to a few centimeters per day along the basal layer of the epidermis, and the offending larva is located 1 or 2 cm beyond the advancing edge of the visible lesion (Chadhry et al, 1989). The visible migration tracks usually begin 3 to 4 cm away from the point of penetration. The larvae die off after a few weeks to some months, and are absorbed by the host. Although the larvae cannot reach the intestine to complete their life cycle in the accidental human host, some may manage to migrate to the lungs where they elicit the production of pulmonary infiltrates, and both larvae and eosinophils have been found in the sputum of humans with this kind of pulmonary involvement. Peripheral eosinophilia is a common finding. While a hypersensitivity reaction to the parasite has been known to occur, protective immunity does not develop, and subsequent exposure leads to repeated infections. While most hookworm infections are self-limiting, massive infections can lead to infection of deeper tissues. (Schantz, 2002). The interesting information reported by Croese and colleagues (Croese et al, 1994), indicates that this parasite can develop to adulthood in the human intestine. It causes a new kind of hookworm disease, even in an infection apparently constituted of a single worm. The Australian investigations suggest that the recognition of human infections will become more prevalent (Croese et al, 1994). Croese and colleagues (Croese et al, 1994), report nine cases of human infection with Ancylostoma caninum in Australia and describe associated enteric disease, which is frequently, but not invariably, eosinophilic enteritis.

Human enteric infections with A. caninum are being diagnosed with increasing frequency in northeastern Australia and lately in the southern United States of America as well. Pulmonary involvement and corneal opacities also have been reported in humans infected with Ancylostoma caninum and an Ancylostoma larva was recovered from the muscle fiber of a patient with cutaneous larva migrans.

In most cases the larvae penetrate and migrate within the skin and they do not complete their life cycle after maturing to adults in the small intestine. However in the case of enteric hookworm disease, the larvae do manage to complete their life cycle and mature to adults in the small intestine. For the most part, infection remains subclinical, but when there are symptoms the major complaint is of abdominal pain, which can sometimes appear suddenly, and be severe. Occult infections can be discovered with the help of serologic testing. Findings of focal or diffuse eosinophilic inflammation indicate a type 1 hypersensitivity response to
secreted antigens. The parasite is poorly adapted to the human host, and as a result infection by sexually immature worms leads to a mild, non-patent infestation. Because of the ever-increasing number of infected domestic pets, which act as a reservoir for the parasite, even the scholastic practice of proper hygiene and sanitation offer little protection against human infection. Sporadic accounts of its occurrence as an adult worm in the human intestine have been reported from the Philippines (Manalang, 1925), South America (Deane, 1950; Carrias et al, 1985), and Israel (Witenberg, 1951). In 1988, it was reported that 33 Australian patients with abdominal pain and eosinophilia were examined, one of which suffered from ileal obstruction caused by an eosinophilic phlegmon to which a hookworm was attached (Croese, 1988). Histologic sectioning precluded specific identification of the parasite. Since at that time human hookworm infection was no longer endemic in urban Australia, and was uncommon among the aboriginal communities in that area (Carroll et al, 1980; Prociv et al, 1980), a dog hookworm was considered as a possible common cause. Two more cases were soon reported, having been detected after colonoscopy, one of which was associated with eosinophilic ileitis (Prociv et al, 1990; Standford et al, 1991). An enzyme-linked immunosorbent assay (ELISA) was developed, and that along with Western blot (Loukas et al, 1992; Loukas et al, 1994) helped to determine the diagnosis. In eastern Australia, *Ancylostoma caninum* is now considered a common cause of the syndrome involving abdominal pain and eosinophilia. Most cases of human hookworm infections can be prevented by practicing good personal hygiene, eliminating intestinal parasites from pets through regular deworming, and making potentially contaminated environments, such as unprotected sand boxes, off limits to children (Kazacos, 1991; Kazacos, 2000; Schantz, 1989). It is also important to clean up pet feces on a regular basis to remove potentially infective eggs before they become disseminated in the environment via rain, insects, or the active migration of the larvae. Hookworm eggs can develop into infective stage larvae in the soil in as little as 5 days, depending on temperature and humidity (Bowman, 1999).

Control of human infections depends on responsible pet ownership. Dogs should be examined periodically for intestinal parasites and given anthelmintic drugs on a regular basis. Also, it is absolutely necessary that pet feces be disposed of in a sanitary way, and particular care must be taken that feces, is never left in areas where it is known that children play. Pet owners should not allow their dog’s feces to accumulate in the lawn or garden, and children’s sandboxes should remain covered when they are not in use. Pet owner education regarding intestinal parasites and their effects on the health of both their pets and family members should be included in a well-pet exam. Dog owner education should focus on prevention and include the following, description of hookworms that infect dogs, early signs of illness, and when pets are at greatest risk for infection, how hookworms cause disease in humans, especially in children whose play habits and attraction to pets put them at increased risk, how prophylactic treatment of pregnant and nursing pets and their offspring can protect their pets from becoming infected, thus preventing them from shedding eggs into, and contaminating, the environment, the need for regular diagnostic fecal examinations of pups or prophylactic treatment of older pets, the need for prompt collection and disposal of pet feces, especially in areas where children play, to remove eggs from the environment before they can become a problem, the need to keep children away from areas that may be contaminated with pet feces. Persons who will have contact with the ground, especially for long periods of time, e.g., plumbers or electricians working in crawl spaces, should place an impervious material between themselves and the ground. (Hookworm infestation in man is sometimes known as 'plumber's itch.') Sunbathers, especially those lying on wet sand or ground may also be at an
increased risk of becoming infected. Animals should not be allowed to defecate on beaches, and people should not walk barefoot through the sand.

BIBLIOGRAPHY


