COMPANION OR PET ANIMALS

Fatal strongyloidiasis in a puppy from France

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SUMMARY

The present case report describes fatal strongyloidiasis in a three-month-old male dog born in France without any travel history. It presented unconscious and in hypothermia at the clinic, without any prodromal symptoms the hour before. The animal was hospitalised and treatments were initiated. Investigations revealed blood eosinophilia and first-stage larvae of *Strongyloides stercoralis* on stool smear. Following these results, treatment with fenbendazole was initiated. After a short-lived improvement of the puppy's clinical condition, it rapidly deteriorated, leading to the death of the animal. The necropsy revealed congestion of the small intestine mucosa and the presence of different stages of *S. stercoralis*. This parasitic disease is poorly described in France and might be underdiagnosed. Our clinical case should serve as a reminder to veterinary clinicians of its occurrence in Europe and potential fatal evolution and to discuss the difficulties of its diagnosis and treatment.

BACKGROUND

Strongyloidiasis is a parasitic disease of dogs, cats and humans caused by the nematode *Strongyloides stercoralis*, also called threadworm.[1 2] It is mostly present in areas with relatively warm and moist environmental conditions (ie, tropical and subtropical countries),[2 3] but it has been observed in dogs from different countries in Europe, including Northern Europe.[1 4] In France, it is considered a rare parasitic disease in dogs, with only one published case in an immunosuppressed individual.[5]

The life cycle of *S. stercoralis* is uncommon, with the occurrence of both free-living and parasitic (parthenogenetic females only) generations (figure 1).[2 4] It is classified as a soil-transmitted helminth because free-living larvae are able to penetrate the skin when in contact. In addition, contamination of neonates and puppies can occur via the milk,[6] and autoinfection can be observed in immunosuppressed individuals, leading to massive infestations[7 8] (figure 1).

In adults, infestations are chronic and asymptomatic or with moderate clinical signs, but heavy infections with acute and life-threatening symptoms can occur, especially in puppies and immunosuppressed individuals.[1 7]

CASE PRESENTATION

A three-month-old male Yorkshire terrier, weighing 520 g, was presented unconscious late in the morning for urgent care. This puppy presented no symptoms earlier than the morning (ie, ate, drank and played normally). Faeces had a normal consistency, and no vomiting was reported. Clinical signs appeared very suddenly one hour before the consultation with signs of weakness that motivated the owner to bring the dog to the veterinarian. The animal was subsequently presented at the clinic recumbent and in shock.

The puppy was bought 10 days ago from a breeder and had received an injection three weeks earlier of Enduracell 7 (DA2PParvoL, Pfizer). He was born in France and never left the country. Moreover, the owner reported that it fell off a chair the night before without any observed disorder afterwards.

Physical examination revealed hypothermia (34.5°C) and pale mucosa with a capillary refill time greater than two seconds. The animal was poorly conscious and unresponsive. Cardiopulmonary auscultation was normal, abdominal palpation was soft and painless, with intestinal contents partially gaseous. Faeces collected on the thermometer were black with mucus.

INVESTIGATIONS

Blood analysis revealed a glucose level of 0.82 g/l and eosinophilia was assessed to be 15 per cent based on the observation of a blood smear with RAL coloration (RAL Diagnostics, France). Direct examination of stools did not reveal any parasitic eggs, but numerous nematode larvae with rhabditiform oesophagus, identified as first-stage larvae of *S stercoralis*, were observed and identified according to morphological keys.[9]

DIFFERENTIAL DIAGNOSIS

Differential diagnosis of the puppy's presentation included hypoglycaemia, head trauma, and viral, bacterial and/or parasitological gastroenteritis. The direct observation of a large amount of parasite larvae in the stool smear, eosinophilia and the acute symptoms were in favour of strongyloidiasis.

TREATMENT

The animal was hospitalised, warmed up and a venous catheter was placed to administer fluid therapy (Ringer Lactate, B Braun, 50 ml/kg/hour until clinical rehydration, then 10 ml/kg/hour). Butylscopolamine (Estocelan injectable, Bayer, 0.5 ml subcutaneous) and amoxicillin (Clamoxyl LA, Pfizer, 0.1 ml/kg subcutaneous) were given, along with fenbendazole (Panacur 250 for dog, Intervet, 50 mg/kg oral) after results of the stool smear came back.

OUTCOME AND FOLLOW-UP

A marked improvement of dog's clinical condition was then observed with the rectal temperature

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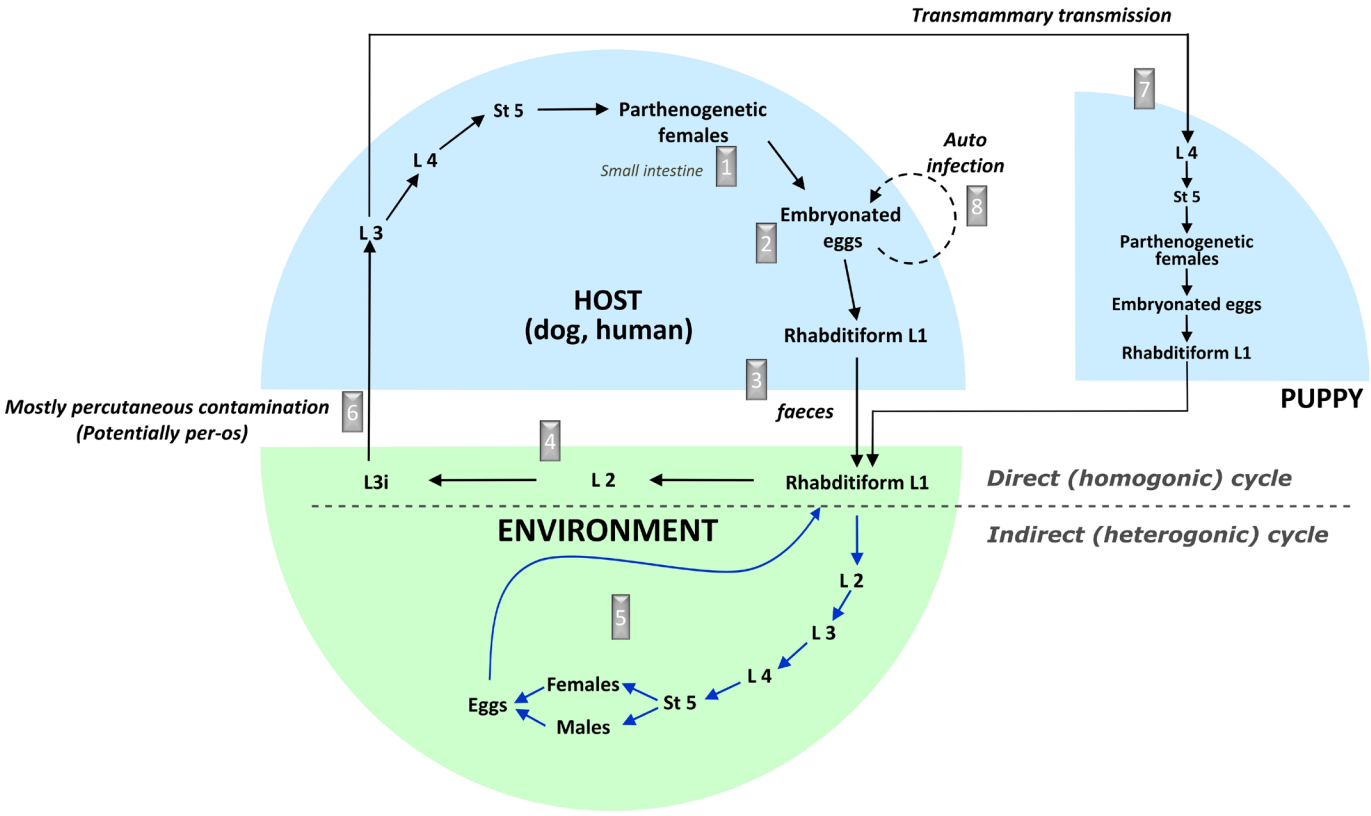

FIGURE 1 Life cycle of *Strongyloides stercoralis*: adult parthenogenetic females are present in the small intestine [1] and produce embryonated eggs [2] that hatch in the host to release rhabditiform larvae (L1). L1 are voided to the environment in the faeces [3] where they will develop either into infective third-stage filariform larvae (L3i; direct or homogonic cycle) [4] or, under favourable environmental conditions, into free-living rhabditiform adult male and female worms [5]. After reproduction, free-living females produce eggs in the environment that give rise to L3i (indirect or heterogonic cycle). Host infestation mostly occurs percutaneously, and to a lesser extent, orally [6]. After migration through the host body and moulting, parthenogenetic adult females are found in the small intestine. L3 can be found in the milk of the infected bitch and infect puppies [7]. Autoinfection can occur in immunocompromised or neonatal hosts with the development of L1 into L3 directly within the gut of the host [8]. These L3 penetrate the tissues of the host (wall of the large intestine or perianal skin), migrate to reach the small intestine and give rise to parthenogenetic females.[2 6 35 36]

returning to normal, and the dog reacting to stimuli and trying to walk out of its cage. However, in the afternoon, melena was observed along with abdominal pain. A morphinic analgesic injection was repeated and liquid food (Fortol, MSD, France) was orally administered. The dog remained stable until the next morning, when it appeared tired and in a prostrate state. Morphinic analgesic injection was once again repeated, but, in the early afternoon, its condition rapidly deteriorated with bradycardia and dyspnoea, leading to its death despite all the urgent care provided.

Necropsy of the dog showed an entero-colo-proctitis with severe congestive infestation of the small intestine mucosa. Microscopic examination of a scraping of the small intestine mucosa revealed the presence of adult females, larvated eggs and immature stages of *S. stercoralis*. No other macroscopic lesions were observed.

DISCUSSION

Strongyloidiasis is a helminthiasis occurring mainly in warm and humid countries (eg, tropical, subtropical areas, and southern Europe). However, the published scientific literature shows its presence in European temperate countries, with clinical cases reported as far north as Lancashire and even Finland, and points out the potential for dogs to serve as reservoir for humans.[1 4 10–13] Even if this infection is considered rare in France, with only one clinical case of strongyloidiasis in a immunosuppressed dog published,[5] no real knowledge on the prevalence and epidemiology of this infection is currently available. All these facts show the importance of reminding clinicians that the existence of strongyloidiasis is not this uncommon and can sometimes lead to death. The occurrence of this clinical case also supports the importance of discussing the challenges in the diagnosis and treatment of this disease.

Generally, infected individuals with normal immune systems have chronic asymptomatic strongyloidiasis or moderate clinical signs.[2 14] However, acute symptoms can be observed, especially in puppies or immunocompromised adults with much more marked and rapid changes. Among the observable symptoms, the animal may have an impaired general condition (depression, fever, anorexia, anaemia), gastrointestinal symptoms (diarrhoea and sometimes bleeding, colic, vomiting), bronchopneumonia and skin symptoms due to the penetration of infective larvae.[2 4 14] The outcome can be fatal, especially in immunocompromised individuals unable to control parasite multiplication (autoinfection leading to hyperinfection, figure 1), resulting in widespread infestation.[7 8] Hyperinfection probably occurred in this puppy given the acute form of its strongyloidiasis, the easy detection of larvae in faeces with the direct smear and the discovery of intermediate larval stages in the small intestine during necropsy. Moreover, in this case, due to the age of the puppy, the prepatent

period of *S. stercoralis* (8–17 days[15]) and its purchase 10 days earlier, the dog was probably infected while still at the breeder, even if we cannot exclude a contamination after adoption. The autoinfection may result from the stress associated with its acquisition by the new owner.

A major problem with strongyloidiasis is, that because it is considered rare, clinicians do not include it in their first differential diagnosis, even if they think of intestinal parasites. Moreover, classic parasitological techniques for the detection of intestinal parasites, such as flotation or a direct stool smear, are not adapted to detect larvae.[16–18] The usually highly variable production and release of larvae in faeces of the host over time may also complicate this detection. To detect *S. stercoralis* infection, the Baermann[19] and the modified Koga agar plate[20 21] methods[17 22 23] should be preferred and we advise to collect several samples on consecutive days.[23 24] Detection of *S. stercoralis* larvae in individuals with hyperinfection is easier due to the high quantity of worms involved,[25] as in the case of this dead puppy for which it was possible to observe larvae on direct smear preparation.

Serological tests have also been developed in humans and dogs to detect specific antibodies against *S stercoralis*, such as an indirect fluorescent antibody test[26 27] and an ELISA.[27–29] However, serological results only reveal to the clinician previous exposure of the patient to *S. stercoralis*, and it is not possible to determine if it corresponds to a current or a past infection. The recently developed molecular methods allowing to detect *S. stercoralis* DNA in faecal samples[30 31] have great potential for the diagnosis of current infection due to their high sensitivity and specificity but are not yet used routinely.

Few molecules have been shown to be effective against this parasite in dogs, and data on the efficacy of treatments are limited. Among the molecules used, there are fenbendazole (50 mg/kg orally for three to five days)[10 32 33] and ivermectin (single dose: 200 mg/kg oral).[34] Unfortunately, available drugs do not kill migrative autoinfective L3. In the cases of hyperinfections, Nolan[33] advises to lengthen the treatment to 7–15 days for fenbendazole or once every four days for three or four doses for ivermectin, in order to remove adults as they mature in the small intestine and, therefore, prevent new autoinfective larvae from being produced. Generally, treatment is initiated with benzimidazole in dogs given the absence of any indication for ivermectin and the potential risks associated with the use of this molecule. However, in a recently reported case of strongyloidiasis in an immunosuppressed dog, fenbendazole was not effective, but the use of ivermectin allowed the control of the infection by *S. stercoralis*.[5] In another study, fenbendazole was used alone or in combination with moxidectin and imidacloprid spot-on, without better results.[10] A control coproscopy is recommended within two to three weeks after the end of the treatment to check its effectiveness. It may be necessary to repeat or to treat for longer periods, especially in cases of suspected malignant strongyloidiasis, since these molecules are not effective against larval migration.[34]

According to the epidemiology of this parasite, the treatment of infected individuals should be associated with prophylactic measures. Such measures include the detection and treatment of asymptomatic carriers to control the contamination of the environment via excretion of larvae, and the management of free-living stages in the environment (eg, regular cleaning and disinfection of the premises, avoiding humidity).

In addition, *S. stercoralis* is a zoonotic parasite. Therefore, a dog carrier or patient could be a source of infection for humans. It is necessary to inform people who have been in contact with the animal or its environment on the risks associated with this parasite, especially in the case of sensitive individuals (eg, immunocompromised).

This clinical case serves as a reminder that *S stercoralis* is present in France, although it is rarely described. This parasitic disease should be considered in differential diagnoses all around Europe, and especially in susceptible individuals. Further studies on the prevalence of this parasite in Europe, especially in kennels, would help improve our knowledge on its epidemiology and to provide adequate information to veterinarians.

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