CASE BY CASE: PARASITOLOGY

Toxocara cati Infection in Cats

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Toxocariasis in cats, caused by infection with *Toxocara cati* (syn. *Toxocara mystax* [Zeder, 1800]), is diagnosed worldwide; in the United States, *T cati* was detected by fecal flotation for 4% of cats in 2022, although those results may underestimate the exact prevalence.[1] Although cases have been reported in every U.S. state, risk for infection is higher in the northeastern states but is also high in certain southern states (e.g., Mississippi) and midwestern states (e.g., South Dakota).[1]

PARASITE LIFE CYCLE

In cats infected via ingestion of larvated eggs in feces or soil, the larvae will migrate through the liver, lungs, and trachea, where they are ultimately coughed up and swallowed, and then mature to adults in the small intestine. In contrast, when a cat is infected via ingestion of larvae in a paratenic host (e.g., a mouse or, less commonly, an earthworm, cockroach, chicken, or sheep), the larvae mature without migrating to the liver or lungs. Rarely, kittens are infected by transmammary transmission from an acutely infected lactating queen; in these kittens, larvae mature without hepatopulmonary migration.[2,3] The prepatent period (before eggs are shed in the feces) is 8 weeks. Compared with *Toxocara canis* (*T canis*), the life cycle of *T cati* (**FIGURE 1**) nematodes differs in that tracheal migration and maturation to adult worms continue into adulthood in cats (whereas tracheal migration is considered unlikely in dogs greater than 2 months old) and because transplacental transmission is not considered a route of infection for *T cati*.[2]

Abstract

Toxocara is a genus of ascaridoid nematodes that inhabit the small intestine of mammals as adults. *Toxocara cati* (*T cati*) is a roundworm that infects cats through ingestion of eggs in soil or feces, ingestion of larvae in paratenic hosts, or, rarely, via transmammary transmission. Clinical signs in cats are uncommon but can involve the gastrointestinal and/or respiratory tracts. Although not considered life-threatening, *T cati* infections should be diagnosed and treated as they represent a zoonotic risk for humans and are difficult to eradicate from a contaminated environment.

Take-Home Points

- *Toxocara cati* is a common parasite that infects cats of all ages.
- Infection can occur by ingesting eggs in soil or feces, by ingesting larvae in paratenic hosts, or, rarely, through transmammary transmission.
- Clinical signs are uncommon but may include diarrhea, vomiting, and coughing.
- Many drugs are available for treatment, and some can prevent vertical transmission of the parasites to offspring.
- *Toxocara cati* has zoonotic potential; therefore, environmental decontamination is valuable, although often difficult.
- Infection can be prevented by early diagnosis and treatment as well as restricting hunting by cats.

DIAGNOSIS

Infected kittens will exhibit illthrift, diarrhea, and a pot-bellied appearance; adult cats may vomit, and adult ascarids are occasionally found in the vomitus.[1] Necropsy of currently or previously infected cats may reveal focal scarring of the liver secondary to hepatic migration of larvae, but this finding is considered incidental. Larval migration through the lungs may result in hemorrhage and inflammation of the pulmonary alveoli, resulting in overt pulmonary disease.[1] Previous reports have described perforated gastric ulcers and pulmonary artery hypertrophy with *T cati* infection, but these findings have not been corroborated in recent years.[4,5] Typically, the clinical signs of *T cati* infection are not as severe as those caused by *T canis* infection in dogs (which can be fatal after intestinal obstruction or rupture).[3]

Adult worms can be found not only in the vomitus of infected cats but also in the feces of cats after appropriate treatment. Male *T cati* worms are typically 3 to 6 cm long while the females are generally longer,

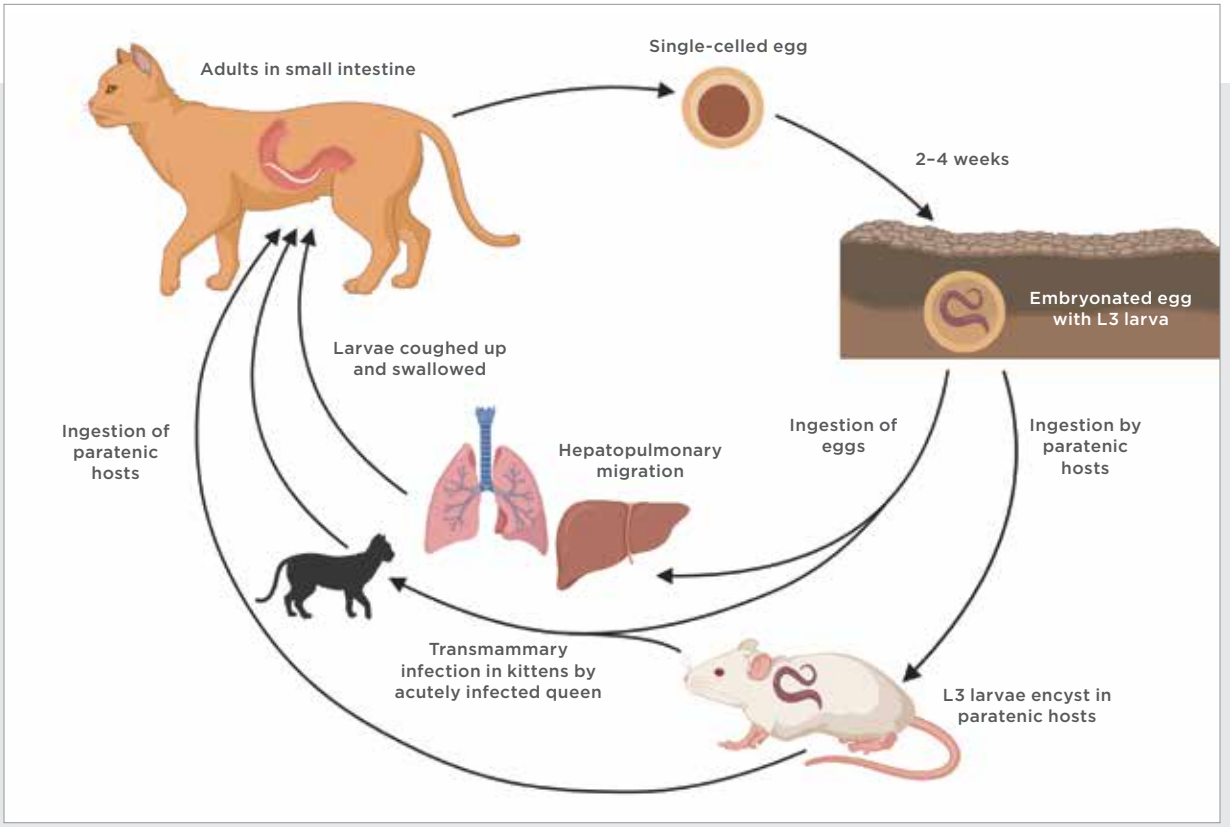

FIGURE 1. Life cycle of *Toxocara cati* parasites.

Antigen testing enables detection of prepatent infections and infections in which only males are present, and therefore no eggs are shed.

ranging from 4 to 10 cm.[3] *T cati* worms are recognizable by their broad cervical alae, resulting in an arrowhead shape, for which they are named (*toxo* = "arrow," *cara* = "head"). These alae, coupled with the often ventrally curved anterior end, give these nematodes a cobra-like appearance. Examination of the anterior end may also reveal a glandular esophageal bulb, although visualization of this structure may require staining the specimen.[2]

T cati eggs are distinguished by their dark brown to black coloration and round to elliptical, thick-shelled, pitted walls containing a single-celled embryo (**FIGURE 2**).[6] Egg sizes vary, but they are generally described as being 61 to 65 × 71 to 75 µm. Aside from identification of adult worms or eggs, *T cati* infection can also be diagnosed by fecal antigen test.[1] Antigen testing enables detection of prepatent infections and infections in which only males are present, and therefore no eggs are shed.

TREATMENT

Treatment of toxocariasis typically involves benzimidazoles (e.g., fenbendazole), which are considered more effective than other drugs against larval ascarids.[3] In addition, benzimidazoles may prevent vertical transmission of parasites in dogs and cats.[2] Other drugs (e.g., piperazine, ivermectin, eprinomectin, moxidectin, selamectin, emodepside, milbemycin oxime, pyrantel pamoate) have also been used as treatment.[3] Of note, emodepside (available as a topical solution in combination with praziquantel) has also been shown to reduce vertical transmission.[7] Although approved for treatment, piperazine may be less effective than the other drugs listed.[1] Pyrantel pamoate is the only drug labeled for kittens as young as 2 weeks of age.[2]

The Companion Animal Parasite Council recommends testing kittens for intestinal parasites at least 4 times in the first year of life and twice a year thereafter.[1] Although the prepatent period for *T cati* infection is 8 weeks, to combat any potential of hookworm infection, treatment for parasitic infection should be initiated at 2 weeks of age and repeated every 2 weeks until regular broad-spectrum parasite control is begun.[1]

OUTCOMES

Although the consequences of *T cati* infection are not as lethal for cats as are the consequences of *T canis* infection for dogs, *T cati* infection remains a threat to humans (although less so than *T canis*), who may acquire the infection by ingesting eggs in contaminated soil or larvae in raw meat from paratenic hosts, most commonly raw liver.[2] Eggs passed in cat feces develop to larvae in the environment after 2 to 4 weeks, after which time they are infective.[1] The eggs are very hardy in the environment and can remain infective for years. Infected humans can experience a variety of conditions secondary to larval migration throughout the body, including visceral larva migrans (which causes hepatomegaly and pulmonary disease) and ocular larva migrans (which causes granulomatous retinitis and potentially blindness).[1,2] Covert toxocariasis may also develop in humans, with nonspecific clinical signs such as chronic abdominal pain.[1]

PREVENTION

Decontamination of the environment is difficult because *T cati* eggs are resistant to many common

FIGURE 2. *Toxocara cati* egg as seen on fecal flotation. The egg is circular and has a thick, pitted shell and a single-celled embryo. Bar indicates 100 µm.

disinfectants.[2] The most effective method, although not always the easiest, is to cover the eggs with concrete or a foot of gravel.[2] The best way to avoid zoonotic infection is to prevent contamination by routinely testing and treating infected animals, preventing hunting behaviors, promptly removing feces from the environment, and stopping indiscriminate defecation.

CASE SCENARIO

Signalment and History

A 9-week-old, intact male domestic shorthaired kitten was presented to an animal hospital for evaluation of general unthriftiness and diarrhea. The clients had recently adopted the kitten from a neighbor, whose outdoor barn cat had given birth. Questions posed to the neighbor indicated that the barn cat had recently had repeated bouts of vomiting, with "white sticks" appearing in the vomitus, which were saved in a plastic bag and brought in by the kitten's owner for evaluation.

Physical Examination

The results of physical examination were unremarkable except for vague intestinal thickening detected by abdominal palpation.

Diagnostic Test Results

The "white sticks" from the vomitus of the adult cat were thin white nematodes, some as long as 12 cm, with 3 large fleshy lips at the anterior end and prominent lateral alae (**FIGURE 3**).[2] The 3 lips and cervical alae were consistent with an ascaridoid nematode, possibly *T cati* or *Toxascaris leonina*. The prominence of the lateral alae and the almost 90˚ angle at the junction of the posterior margin with the body differentiated this nematode from *T leonina* worms, in which the alae are much narrower and taper at the posterior junction with the body.[3]

FIGURE 3. Adult *Toxocara cati* nematode, anterior end. The prominent fleshy lips and broad lateral alae form a right angle at the junction of the posterior margin and the body.

Fecal examination consisted of centrifugal flotation with zinc sulfate (1.18 specific gravity). Examination revealed 65 × 75–µm dark brown eggs with thick, rough, pitted shells (**FIGURE 2**), which differentiated these eggs from those of *T leonina* eggs, which have a smooth outer shell wall.[1]

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Treatment Plan

A topical broad-spectrum dewormer containing moxidectin and imidacloprid was applied to the kitten. The client was advised to monitor the kitten for adverse effects (e.g., hypersalivation, lethargy, application site pruritus or alopecia, decreased appetite, vomiting, ataxia) and to discontinue treatment if any were noted.[8]

Outcome

After treatment, the kitten expelled adult worms in the feces for the next few days and rapidly improved. On follow-up examination 2 weeks later, fecal flotation with centrifugation was performed to evaluate drug effectiveness, and no eggs were found. The client was instructed to continue topical application once monthly to treat any newly acquired internal parasites or ectoparasites (e.g., fleas, ear mites) and to prevent heartworm infection.

SUMMARY

T cati infection is a common, non–life-threatening condition of kittens and adult cats. Kittens can acquire

this infection through transmammary transmission if the queen is acutely infected while lactating. Other, more common, routes of infection include ingestion of larvated eggs in contaminated soil or feces or encysted larvae in paratenic hosts. Diagnosis and treatment are rather straightforward; diagnosis often depends on fecal flotation results, and treatment involves available drug formulations. Although not often a severe infection in cats, recognizing and treating toxocariasis are important because they represent a human health hazard as well, and because infective eggs are difficult to eradicate after an environment has been contaminated. TVP

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Dr. Wu received his DVM degree in 2017 and completed a residency in anatomical pathology in 2020, both at Cornell University. He is currently participating in a combined PhD/residency program in parasitology at Cornell, with sponsorship through the National Center for Veterinary Parasitology and IDEXX Laboratories. Dr. Wu is a third-year PhD student, studying with Dr. Dwight Bowman, MS, PhD, and training as a clinical parasitology resident in the New York State Animal Health Diagnostic Center. His long-term goal is to work in an academic setting, where he can combine his passion for pathology and parasitology in a teaching and diagnostic setting.