

Toxocariasis: A Global Public Health Challenge and Its Preventive Strategies

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Introduction

Toxocara canis or *Toxocara cati* infections in humans are referred to clinically as toxocariasis. Both of them belong to the family Toxocaridae, superfamily Ascaridiodea, and order Ascaridida. Their definitive hosts are domestic dogs and cats, where they reside in the small intestinal lumen as adults. Man becomes infected when he accidentally consumes eggs that contain larvae, which are frequently found in contaminated soil, animal excrement, or environmental sources. The two separate clinical entities that represent the illness in humans are ocular larva migrans and visceral larva migrans (VLM). The public health importance of toxocariasis depends on its relatively high prevalence, particularly on those areas with inadequate sanitation and where pet animals are not regularly dewormed. Children's inclination for hand-to-mouth actions and increased chance of coming into contact with contaminated dirt put them at higher risk. Early detection and appropriate intervention are crucial because of the long-term effects of misdiagnosed or undetected cases, which include developmental delays or irreversible vision impairment. A major but sometimes overlooked public health issue, toxocariasis requires coordinated efforts from all sectors to lessen its effects and lower its incidence worldwide.

History

This helminthiasis was considered a rare pediatric disease for many years after it was first described in the early 1950s. Since about 20 years ago, the development of sensitive and specific

immunodiagnostic testing has significantly advanced our understanding of toxocariasis, which is undoubtedly the most common helminthiasis in developed nations. Beaver *et al.* discovered *Toxocara canis* larvae, a common canine hookworm, in the liver and lung tissue of three children in the United States in 1952, which led to the first recognition of human toxocariasis. In 1966, Beautyman *et al.* correctly recognized the larvae found in children's brains that had been reported to be *Ascaris lumbricoides* as *Toxocara*. It was not until 1959 that Irvine reported seeing *Toxocara* larvae in a child's eye in California. Since then similar condition described as "Ocular larva migrans" has been reported from various parts of world.

Visceral larva migrans (VLM), a condition brought on by *Toxocara* spp., was the patient's diagnosis in 1993, marking the first known instance of human toxocariasis in India. This was the first time *Toxocara* infection in humans was identified in the nation. The existence of human toxocariasis in different parts of India has been brought to light by later investigations. For example, according to a 2002 study conducted in Kashmir, 82.6% of ascariasis patients also exhibited antibodies against *Toxocara canis* (Ahmed *et al.*, 2002). In 2024, the first ocular toxocariasis diagnosis in India was reported utilizing polymerase chain reaction (PCR) testing of aqueous humor. The diagnostic difficulties of ocular toxocariasis and the usefulness of PCR in cases when serological testing is not convincing were highlighted by this case (Jadhav *et al.*, 2024). These results raise the possibility that human toxocariasis is

underdiagnosed in India, especially in areas with large numbers of stray dogs and cats, which serve as *Toxocara* species' main hosts. Addressing this underappreciated zoonotic illness requires increased diagnostic awareness and public health initiatives.

The parasite

The parasite *Toxocara canis* is a nematode that infects canids, wolves, foxes, and most significantly domestic dogs. Worm adults reside in the small intestine and release their eggs into the environment through the host's excrement. When the eggs are first released, they cannot infect another host. The eggs need 2-7 weeks to reach the infectious, embryonated L2 stage under ideal environmental circumstances. Compared to males, girls are comparatively longer. Females are larger, usually 6.5–15 cm long, however some report up to 18 cm. Males are often 4-6 cm long (1.5–2.5 cm broad of the body, 2 mm diameter). Both sexes are stout-bodied, white to cream-colored nematodes. Large cervical alae and a dorsal bend give the front portion of the body an arrow-like look. As a result, they are referred to as "Arrow-headed worms" of cats and dogs. The egg is round with the characteristic pitted shell and do not contain any embryo at the time of their excretion in faeces (Roberts and Janvory, 2000).



Fig. 1 Adult worm

of *Toxocara canis*

Life cycle

Humans are unintentional hosts of *Toxocara canis*, which completes its life cycle in dogs. The definitive host's feces contain unembryonated eggs. As they develop, eggs spread over their surroundings. The infectious eggs hatch after being consumed by dogs, and the larvae pierce the

intestinal wall. The adult worms mature and oviposit in the small intestine, while the larvae in younger dogs travel through the lungs, bronchial tree, and esophagus. Although larval encystment in tissues is more frequent in older dogs, patent infections can still happen.

The encysted stages are reactivated in female dogs in the latter stages of pregnancy and infect the puppies through the transplacental and transmammary routes, where the adult worms establish themselves in the small intestine. A significant source of environmental egg contamination is puppies. Additionally, *Toxocara canis* can spread by ingestion of paratenic hosts. When small mammals, like rabbits, ingest eggs, the larvae hatch, pierce the intestinal wall, and go into other tissues where they encyst. When dogs consume these hosts and the larvae mature into adult worms that lay eggs in the small intestine, the life cycle is complete.

Humans are unintentional hosts who contract the disease by eating infectious eggs from contaminated soil or infected paratenic hosts. Following ingestion, the eggs hatch, the larvae pierce the intestinal wall, and through blood circulation reached to a wide range of tissues, including the liver, heart, lungs, brain, muscles, and eyes. Even though the larvae don't develop further in these locations, they might still trigger the severe local reactions that lead to toxocariasis. Ocular larva migrans and visceral larva migrans are the two primary clinical manifestations of toxocariasis.

Epidemiology & Public health importance

Ingestion of eggs from contaminated soil through contaminated fruits and vegetables can infect humans. With 12.5% of the dogs sampled having *T. canis* eggs in their coats, individuals have a direct and convenient way to be exposed without having to deal with contaminated soil. Anyone who kept dog with *T. canis* eggs on its coat runs the risk of ingesting the eggs; they do not have to eat the hair. It is more likely that eggs may be consumed through direct contact with dogs rather than through soil contact because the densities of the eggs on dogs' coats were significantly higher than their normal densities in soil.

In the epidemiology of human toxocariasis, it is thought that direct contact with dogs may be more

significant than soil exposure. Uncooked vegetables, particularly those from farms that use human or animal waste as fertilizer, have also been identified as a potential source of infection. Poor hygiene practices and egg exposure make it easier to contract hand-to-mouth infections especially in children.

Dog infections with *T. canis* are common worldwide. The calculation of the prevalence of infection varies depending on the dogs' age, origin, and infection estimation technique. Infection prevalence in dogs in India has been reported to range from 2.7 to 55% based on fecal investigation and up to 84.5% based on autopsy. The intra uterine transmission of the agent by paratenic host and resistance of ova to environmental condition are the key factor which contribute for high incidence of infection in dogs.

Clinical Aspects

Heavy infection in dog mostly acquired prenatally and usually associated with distended abdomen called as pot-belly appearance, dull and harsh coat, vomiting, diarrhoea and anemia. Death of puppy or even a whole litter may occur where kennel hygiene is poor. Occasionally adult worms may involve the bile duct or wall of intestine lead to biliary obstruction and peritonitis. The presence of larvae in the aberrant sites such as brain and eye similar to man has also been reported.

Human Toxocariasis

Young children (less than five years old) who have a history of soil ingestion are primarily affected by visceral larva migrans (VLM). The illness is rarely deadly, self-limiting, and typically asymptomatic. It manifests as fever, liver and spleen enlargement and necrosis, lower respiratory symptoms (especially asthma-like bronchospasm), eosinophilia, and hyper-gammaglobulinemia of immunoglobulin M (IgM), IgG, and IgE classes. IgE/anti-IgE immune complex levels are elevated in the latter of these cases, and symptoms are more noticeable. There have been reports of CNS involvement, nephritis, and myocarditis. CNS involvement may result in encephalopathy, convulsions, or neuropsychiatric problems.

Children aged 5 to 10 are generally affected by ocular larva migrans (OLM), which manifests as unilateral visual impairment with strabismus

occasionally present. The infection's most dangerous side effect is retinal invasion, which usually happens in the posterior pole or on the periphery and results in the creation of granulomas. These granulomas cause the retina to be pulled, which can lead to heteropia, macula detachment, or distortion. Blindness is frequent, and the extent of visual acuity damage varies depending on the particular location affected. Additionally, OLM may result in papillitis or generalized endophthalmitis, which may lead to secondary glaucoma. At least one rare case of choroidal neovascular membrane formation after a long-term *Toxocara* infection began as chorioretinitis.

Diagnosis

The presence of eggs in feces makes it easy to diagnose a dog infection with *Toxocara canis*. While some *T. canis* roundworms can grow up to 7 inches in length, adult worms typically measure 3–4 inches. The feces are used to identify the eggs. The eggs are separated from the remainder of the stool using a flotation solution, and the resulting sample is inspected under a microscope. Experienced individuals can differentiate between the three roundworms' eggs due to their very tiny changes in appearance.

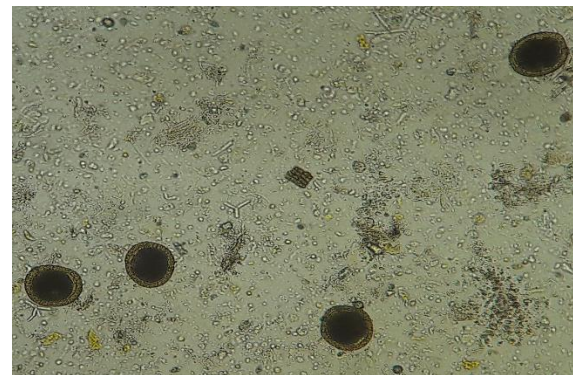


Fig. 3 Egg of *Toxocara canis* in dog (40X)

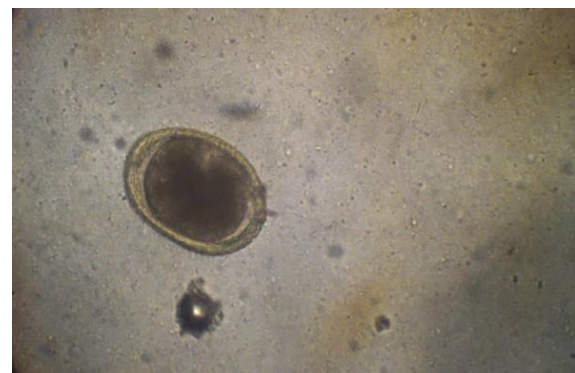


Fig. 2 Egg of *Toxocara canis* in dog (10X)

Any patient with an unexplained febrile illness and eosinophilia should be suspected of having VLM. Hepato-splenomegaly and evidence of multisystem disease and history of pica make the diagnosis of VLM more likely. Similarly, OLM should be suspected in any child with unilateral vision loss and strabismus. The majority of VLM diagnostic tests are immunological. Cross-reactions between the precipitin test and blood group substance A and common larval antigens are possible. The best indirect test for identifying this infection is the enzyme-linked immune-sorbent assay (ELISA), which uses antigens released by the second-stage larva and has a high enough specificity. The second-stage larvae of *T. canis* have been used to create recombinant antigens, which should increase the specificity of an already dependable test (around 92%) using ELISA. At a titer higher than 1:32, the ELISA also offers a respectably high degree of sensitivity (about 78%). An increased isohemagglutinin titer and hypergammaglobulinemia are further signs of infection. Therefore, the diagnosis is highly supported by the combination of the above-described clinical illness, a history of pica, eosinophilia, and positive serology. Although a liver biopsy may show a granuloma encircling a larva, this method is not advised and is at best a chance diagnosis. During an ophthalmologic examination, OLM is generally diagnosed using clinical criteria.

Treatment

There are a number of anthelmintics that are very good in treating *T. canis* infections in bitches and puppies. These include of corticosteroids, Mebendazole, Thiabendazole, Fenbendazole. In general, toxocariasis has a good prognosis. Dogs and cats afflicted with roundworm should be dewormed very away, and any contaminated soil should be removed or the area should be cordoned off to children. Regular treatment of puppies should begin between the ages of 2-3 weeks. To reduce environmental contamination with eggs, further treatment should be administered every two weeks until the eggs are 12 weeks old. It is recommended that adult dogs and cats receive treatment twice a year. There are currently no effective anti-larval medications available to treat the illness in humans.

Compounds containing diethylcarbamazine and benzimidazole showed promise in this disease. For the majority of patients with involvement of the liver, lungs, or eyes, chemotherapy is the preferred course of treatment. Sometimes ocular surgery is necessary due to ocular involvement.

Prevention and control

Public health education is a useful tool for lowering the amount of *T. canis* eggs that contaminate the environment. Fencing home gardens will keep dogs and cats from contaminating them with their faeces. Consuming raw or undercooked meat that may contain *Toxocara* larvae should be avoided, as should any vegetables and salads collected from potentially infected gardens. A suitable healthcare professional should be consulted in order to treat geophagia. Additionally, hand washing should be promoted, particularly before meals, and hand-to-mouth activity should be discouraged at all times to improve personal hygiene. Municipal laws that forbid dogs from entering parks and playgrounds and mandate that pet owners remove their animals' waste from public spaces should be taken into consideration.

Conclusion:

- ✓ Toxocariasis is a zoonotic infection caused by *Toxocara canis* (dogs) and *T. cati* (cats), transmitted to humans via ingesting embryonated eggs from contaminated soil, water, or undercooked meat.
- ✓ It often affects children, causing visceral larva migrans (e.g., respiratory and abdominal symptoms) or ocular larva migrans, which can lead to blindness or neurological issues.
- ✓ Most infections are asymptomatic or mild, but severe cases require antiparasitic treatment (e.g., albendazole or mebendazole) and may need corticosteroids.
- ✓ Prevention hinges on regular deworming of pets, proper disposal of faeces, covering play areas, hand hygiene, and public education, especially in low-resource settings.
- ✓ Despite its global reach, especially in disadvantaged communities, toxocariasis remains underdiagnosed due to limited awareness and diagnostic tools, underscoring

the need for enhanced surveillance, education, and One Health interventions

References

- 1) Ahmad, B., Bhatti, G., Thokar, M. A., & Malla, N. (2002). Human toxocariasis and ascariasis: concomitant parasitism in Srinagar, Kashmir, India. *Indian Journal of Pathology and Microbiology*, 45(3), 315-318.
- 2) Ahmad, N. Maqbool, A. Saeed, K. Ashraf, K. And Qamar, M.F (2011). Toxocariasis, Its Zoonotic Importance and Chemotherapy in Dogs. *J. Anim. Plant Sci.* 21(2):142-145.
- 3) Bhatia B.B, Pathak K.M.L and Juyal P.D (2010). Textbook of Veterinary parasitology. 3rd ed., Kalyani publishers, New Delhi.
- 4) Carvalho, E. A, Rocha R. L (2011). Toxocariasis: visceral *larva migrans* in children. *J Pediatr (Rio J)*, 87(2):100-110.
- 5) Dryden, M.W, Payne, P.A, Ridley, R, Smith, V (2005). Comparison Of Common Fecal Flotation Techniques For The Recovery of Parasite Eggs And Oocysts. *Vet Ther*, 6: 15-28.
- 6) Jadhav, S., Eswaran, B. V., Raman, M., & Biswas, J. (2024). Role of polymerase chain reaction from aqueous humor in a suspected case of ocular toxocariasis—A report of a case. *Indian Journal of Ophthalmology-Case Reports*, 4(2), 420-422.
- 7) Macpherson C.N (2013). The epidemiology and public health importance of toxocariasis: a zoonosis of global importance. *Int J Parasitol*, 43:12-13.
- 8) Magnaval, J. F, Glickman, L.T, Dorchies, P and Morassin, B (2001). Highlights of human toxocariasis. *Korean J Parasitol*, 39(1): 1–11.
- 9) Overgaauw, P.A.M, Van Knapen, F (2008). Toxocarosis, an important zoonosis *EJCAP*, 18(3):259-266.
- 10) Roberts, L., J. Janvory, Jr. 2000. Gerald. D. Schmidt & Larry S. Roberts' Foundations of Parasitology, Sixth Edition. United States: McGraw-Hill Companies, Inc..
- 11) Schantz, P.M (2006). Toxocariasis: The Veterinarian's Role In Prevention of Zoonotic Transmission. In: Toxocara, The Enigmatic Parasite. Holland C.V, Smith H.V. Eds. CABI Publishing, 253-259.
- 12) Soulsby E.J. L. (1987). Larva migrans in perspective. In: Geerts S, Kumar V, Brandt J, editors. Helminths Zoonoses. La Haye, The Netherlands: Martinus Nijhoff; 137–149.
- 13) Wolfe, A. Wright, I. P (2003). Human Toxocarosis and direct Contact with dogs. *Vet Rec*, 152: 419-22.
- 14) Woodhall, D. M, Eberhard, M. L and Parise, M. E (2014). Neglected Parasitic Infections in the United States: Toxocariasis. *Am J Trop Med Hyg.* 90(5): 810–813.