

Crenosoma vulpis larva (fox lungworm) in a juvenile opossum from Northern Virginia, USA

Abstract

A juvenile opossum, seeking warmth in a stairwell in Northern Virginia, was pale, underweight and subsequently found to be infected with *Crenosoma vulpis*, a type of lungworm. To our knowledge, this parasitic infection has not previously been reported in the Virginia opossum (*Didelphis virginiana*). The opossum was treated and released.

Keywords: *Crenosoma vulpis*, lungworm, metastrongyloidea, snail parasite, *Didelphis virginiana*, opossum, wildlife rehabilitation

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Introduction

Crenosoma vulpis is a lungworm parasite in Superfamily Metastrongyloidea, in the phylum Nematoda and is commonly found in the red fox (*Vulpes vulpes*). It is also reported in dogs (*Canis familiaris*) and badgers (*Meles meles*) in Europe and North America,¹ and domestic dogs in Europe.² The intermediate hosts of *Crenosoma vulpis* include snails and slugs³ which are abundant in Virginia. The Carnegie Museum of Natural History reports 220 species of land snails in Virginia. *Crenosoma vulpis* has an indirect life cycle in the known hosts, unlike other lungworm infections, e.g. *Aelurostrongylus*. When foxes, dogs or other hosts eat infected snails or slugs, the infective larvae are released in their stomach, penetrate the gut's wall and migrate towards the lungs along the blood vessels. Adult worms in the bronchi and bronchioles release eggs, develop into larvae, migrate or are coughed up to the mouth, and are then swallowed and passed in the feces. It takes about 20 days for larvae to appear in the feces.⁴ Larvae in the feces are observed with no associated ova. It is generally considered a non-fatal infection; however, it can be fatal in severe cases.

A study from Prince Edward Island in Canada, an area highly endemic for *Crenosoma vulpis*, revealed a prevalence of 3% of dogs, with 27% showing clinical signs, including cough.⁵ The prevalence in foxes in Newfoundland, Canada, has been reported as high as 87%.⁶ Lungworms and heartworms causing respiratory disease in animals include metastrongyloids *Aelurostrongylus abstrusus*, *Angiostrongylus vasorum* and *Crenosoma vulpis*; the filarioid *Dirofilaria immitis* and the trichuroid *Eucoleus aerophilus* (syn. *Capillaria aerophila*). All are considered underreported in the cat and dog in Europe.⁷ *Didelphostrongylus hayesi*, also a lungworm infection, has been reported in the Virginia opossum.^{8,9} Multiple infections were found in a debilitated opossum which included *Capillaria aerophila* and metastrongyloid nematodes.¹⁰ A compilation of all reports from North America, on parasites found in the North American opossum through 1995 are presented by Kris J. Alden.¹¹ Some common fecal parasites in the opossum, with prevalence of infection, include *Toxascaris* sp. (45%), *Uncinaria* sp. 20%, *Physaloptera* sp. 10%, *Trichuris* sp. 5%. *Trematode* sp. 5%, *Sarcocystis* sp. 5% (Apicomplexa), and *Cruzia* sp.

5%. *Monocystes* sp., which are not harmful in mammals, were found in 65% abundance.¹²

Case presentation

The juvenile opossum, first presented as lethargic and underweight at 320 grams. The body of the opossum was about 15cm long, very thin, fur unkempt, and demonstrated only weak hissing. The opossum was so thin, it climbed through the bars of a cage with 3.75 to 5cm spacing and had to be put into a solid-walled pet carrier. A fecal sample, well-formed and medium-brown in color, was found under the opossum's water bowl and examined in-house. The stool was floated in heptahydrate Zinc Sulfate Detect solution and centrifuged 900 to 1300 rpm. Two larvae were observed at x100 magnification. In addition, individual earthworm sporozoites, a feature resembling a round intact *Monocystis* sp. oocyte, and a second similar irregular feature were observed. No ova, which could be associated with the larvae, were observed. The opossum received 5 ml of Lactated Ringers fluids SC. After consultation with a wildlife veterinarian, supplementation with Ensure (Abbott Laboratories, Abbott Park, Illinois 60064-3500) was given on day 2. A blanket and heated pad were offered under a portion of cage and the opossum hid and remained under cover. On the 3rd morning, the opossum was not seeking heat anymore and was on top of the blanket. Our wildlife veterinarian determined on day 3 that the heart was ok, the opossum was female, and low in weight at 0.4 kg. The opossum urinated and dropped a stool in the veterinary examination room. That sample was sent to Antech Diagnostics Laboratory (Fountain Valley, CA 92708) for ova/parasite evaluation. Panacur (Intervet, Inc, Millsboro, Delaware 19966, USA), 0.15 cc, 100 mg/ml, was given PO for malnutrition. The opossum ate very well on the 3rd night, taking in yogurt, cat food and vegetables.

Antech Diagnostics Laboratory (Fountain Valley, CA 92708) observed larvae in the stool and identified the larvae as *Crenosoma vulpis* 1+ (2-4 parasites per slide). A second in-house fecal was done specifically for larvae using the Baermann technique. This was done using gauze as the separation medium, a 50-ml centrifuge tube with cone-shaped bottom as the collection device, adding the fecal sample and warm water, and leaving overnight. The presence of larvae again was observed at x100 magnification. In addition, several highly

motile, protozoa-like organisms were observed from direct smear of the solution from the bottom of the collection tube. They were rotating and fast-moving organisms observed at x400 magnification. Over a matter of a few minutes, these roundish, clustered organisms became sluggish and inactive while under observation under the microscope. These resembled the species of *Tetratrichomonas*, which has been observed in the opossum.^{13,14} After the lungworm infection was identified, the opossum was treated with Baytril (Bayer Healthcare LLC, Shawnee Mission, Kansas 66201 USA) for 14 days (10mg/kg), once a day, PO and Panacur (Intervet, Inc, Millsboro, Delaware 19966, USA) for 14 days, once a day, PO, 50 mg/kg. The Panacur treatment was based on the treatment given to an opossum for another lungworm infection reported in ref.¹⁵ The opossum's weight 7-8 days after capture was 580 grams, an increase of 280 grams. The opossum was then sent to a rehabilitator where the opossum continued to improve and was released to the wild after about one month's time.

Discussion

The opossum may have been infected from eating snails, similar to that of the red fox. Earthworms are another intermediate host of *Crenosoma vulpis* and the earthworm parasite, *Monocystes* sp, was found in the feces of this opossum. However, these parasites have high prevalence in opossums and there has been no report of *Crenosoma vulpis* in the opossum to date. Opossums are known to eat slugs and snails and also earthworms. Ingestion of red fox scat may be another less probably route of infection for the opossum. There is overlap of the domains of snails and slugs, red fox, and opossum, in suburban Northern Virginia and all these species have been observed within the immediate area where the opossum was found. Although the larvae were identified as *Crenosoma vulpis*, one may consider the possibility that the opossum may have its own species of *Crenosoma*. We know of no previous reports finding *Crenosoma vulpis*, or any of the other known *Crenosoma* species, in the Virginia opossum. There may be as many as 12 *Crenosoma* species identified to date and many are associated with an individual wildlife species. We encourage further studies of this organism in the opossum to confirm and expand the findings presented here.

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Conflict of interest

The author has neither financial interest nor conflicts of interest related to research in this article.

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