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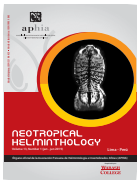

ORIGINAL ARTICLE / ARTÍCULO ORIGINAL

ANGIOSTRONGYLUS VASORUM (BAILLET, 1866) KAMENSKY 1905 IN *LYCALOPEX GYMNOCERCUS* (FISCHER, 1814) (*PAMPAS FOX*) IN BRAZIL

ANGIOSTRONGYLUS VASORUM (BAILLET, 1866) KAMENSKY 1905 IN *LYCALOPEX GYMNOCERCUS* (FISCHER, 1814) (*PAMPAS FOX*) IN BRAZIL

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ABSTRACT

Angiostrongylus vasorum (Baillet, 1866) Kamensky 1905 is a parasitic nematode of the Metastrongilidae family that infects the pulmonary artery and right-heart of many carnivore species. The host infection occurs by the ingestion of the infecting larvae present in aquatic and terrestrial gastropod mollusks. The infected vertebrate hosts may develop clinical symptoms ranging from asymptomatic to severe complications. From 2011 to 2013, seven species of canids were found run over on the Mountain Region highways in the Santa Catarina State, South Brazil. Fecal samples obtained in necropsy were analyzed by simple spontaneous flotation method. Only one species of *Lycalopex gymnocercus* (Fischer, 1814) was diagnosed as infected with *A. vasorum*. This is the first report of this nematode in this species. Parasitosis can be considered a health problem in areas where the parasite is endemic and *L. gymnocercus* is considered of conservation interest.

Key words: *Angiostrongylus vasorum* - Canid - *Lycalopex* - Lung parasites - Parasitosis

RESUMEN

Angiostrongylus vasorum (Baillet, 1866) Kamensky 1905 es un nematodo parásito de la familia Metastrongilidae que infecta la arteria pulmonar y el corazón derecho de muchas especies de carnívoros. La infección del huésped se produce por la ingestión de las larvas infectantes presentes en los moluscos gasterópodos terrestres y acuáticos. Los huéspedes vertebrados infectados pueden desarrollar síntomas clínicos que van desde asintomáticas hasta complicaciones graves. Entre 2011 y 2013, se encontraron siete especies de cánidos en las carreteras de la región montañosa en el estado de Santa Catarina, sur de Brasil. Las muestras fecales obtenidas en la necropsia fueron analizadas por un método simple de flotación espontánea. Sólo la especie *Lycalopex gymnocercus* (Fischer, 1814) fue diagnosticada con *A. vasorum*. Este es el primer reporte de este nematodo en esta especie. La parasitosis puede considerarse un problema de salud en áreas donde el parásito es endémico y *L. gymnocercus* se considera de interés para la conservación.

Palabras clave: *Angiostrongylus vasorum* - Cánidos - *Lycalopex* - Parasitos Pulmonares - Parasitosis

INTRODUCTION

The canid family has 16 genera and 36 species with large geographical distribution, found from the tropics to the Arctic. Twenty nine earth bound species, of the Carnivore order, occur in Brazil (Reis *et al*., 2007).

In South America there are seven genera and 11 wild canid species (Ruas *et at*., 2008). In the State of Santa Catarina there are reports of only two species *Cerdocyon thous* and *Lycalopex gymnocercus* (Fischer, 1814) (Cherem *et al*., 2004; Cherem *et al.*, 2007).

Cerdocyon thous Linnaeus, 1766 is one of the most known species, being the first canid described in brazilian literature (Bisbal & Ojasti, 1980). It's geographic distribution ranges through Uruguay, northern Argentina, Bolívia, Venezuela, as well as Guiana, Suriname and Brazil, being found in almost all biomes, excepting the low areas of the Amazon basin (Heleno *et al*., 2011). On the other hand, *L. gymnocercus* prefers environments like open grasslands, andean tropical forests, woodland, marsh, swamps, pastures and farm land.

Angiostrongylus vasorum (Baillet, 1866) Kamensky 1905 is a nematode of the Strogylida order, Metastrongyloidea superfamily, that infects the pulmonary artery and right heart of many carnivore species such as *Canis familiaris Linnaeus 1758* (dog), *Canis lupus* Linnaeus, 1758 (wolf), *C. thous* (crab eating fox), *Vulpes vulpes* Linnaeus, 1758 (red fox), *Vulpes zerda* Zimmerman 1780 (desert fox), *Meles meles* Linnaeus, 1758 (European badger) and experimentally some species of rodents like the *Arvicanthis niloticus* Desmarest, 1822 and *Nile rat* (Bourque *et al*., 2005). In feline carnivores (Morgan *et al.*, 2008) and mustelidae like *Lutra lutra* Linnaeus, 1758 (otter) and *Mustela putorius* Linnaeus, 1758 (ferret) there was also evidence of these parasites (Koch & Willesen, 2009). Although human infection has not been confirmed, some researchers do not discard the zoonotic potential (Eckert & Lammler, 1972).

The transmission cycle of the parasite occurs with the ingestion of the third larval stage (L_3) in aquatic gastropods such as *Biomphalaria glabrata* Say, 1818 and terrestrial ones like *Arion* spp. Férussac, 1819, *Achatina fulica* Férussac,1821*, Subulina octona Bruguière, 1789, Bradybaena similis* Férussac,1821*, Laevicaulis salte* Férussac,1822*, Prosoples javanicum* (Bessa *et al*., 2000; Koch & Willesen, 2009; Oliveira *et al*., 2010; Patel *et al*., 2014) and *Omalonix matheroni* (Potiez & Michaud, 1838), where experimental observation found the larval development of *A. vasorum* to be faster in this mollusk compared to other observed intermediate hosts (Mozzer *et al*., 2011).

It has been demonstrated in dogs that the infection may occur by the ingestion of infected paratenic

hosts like toads and small mammals. Experimentally infected birds may also act as paratenic hosts (Mozzer & Lima, 2015).

Normally, the infection is mild and along with respiratory manifestations it may evolve to serious complications like neurological, cardiac and gastrointestinal disorders (Morgan & Shaw, 2010). Primary clinical signs are almost exclusively related to respiratory dysfunction that go from cough, exercise intolerance, dispnea and cardiac insufficiency. Non specific clinical signs, like vomit, diarrhea, anorexia and death have also been described (Gredal *et al*., 2011, Morgan & Shaw, 2010). Cat infection by *A. abstrusus* (Railliet, 1898) tends to be insidious, even in cases that evolve to clinical symptoms, fatal infection is relatively rare in this group (Traversa *et al*., 2010).

The infections are considered endemic, mainly on the European continent (France, Denmark, Italy, Spain Switzerland, England and Ireland), as well as in countries like Uganda, Turkey, Russia, Brazil, Colombia and Canada (Bourque *et al*., 2002). The nematode has also been described in non endemic countries like Australia and the USA (Jefferies *et al*., 2009).

MATERIAL AND METHODS

Between 2011 and 2013, seven species of canid were found run over on the mountain roads of the State of Santa Catarina, south Brazil (Fig.1). Three specimens of *C. thous* (two males and a female), and four female *L. gymnocercus*, one of them alive and another initially alive died of rangeliosis, a hemaprotozoa that infects canids. All other animals were killled from the trauma caused by the collision. The animals were referred by government agencies in the environmental area to the Laboratory of Zoology and Parasitology of the University Planalto Catarinense (UNIPLAC) for analysis. Parasitological exams were done, with the spontaneous flotation method (Hoffman *et al*., 1934) and simple flotation with a saturated solution of sodium chloride at 1,182 density (Willis-Molay).

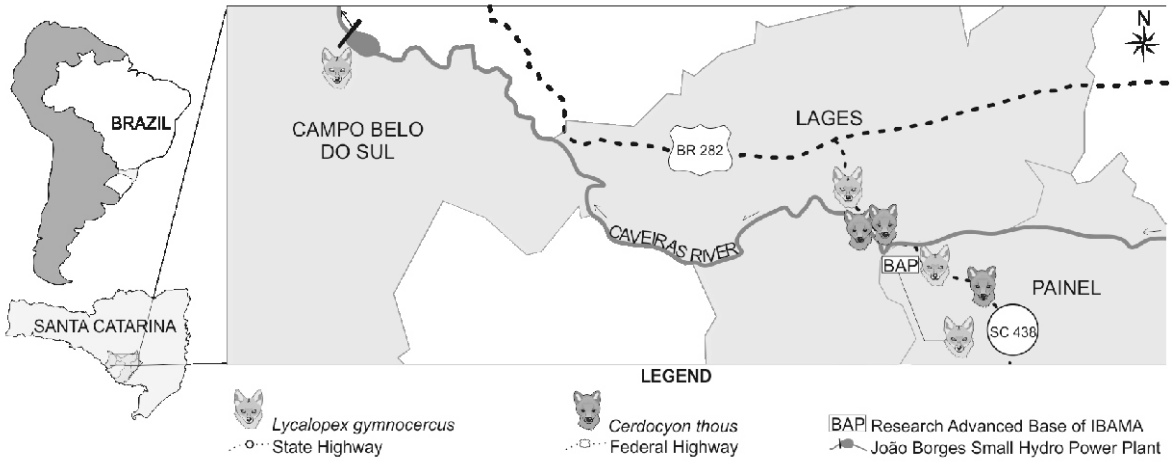

Figure 1. Location of canids in the mountain region in Santa Catarina state, Southern Brazil.

Ethic aspects: The authors declare that all the ethical aspects of the country and international ones were fulfilled.

RESULTS

In the spontaneous sedimentation method the presence of larvae of approximately 350µm long

with a dorsal terminal spine (400X) were observed, compatible with first stage larvae (L_1) of *A. vasorum* (Fig. 2), as described by Patterson *et al.* (2009).

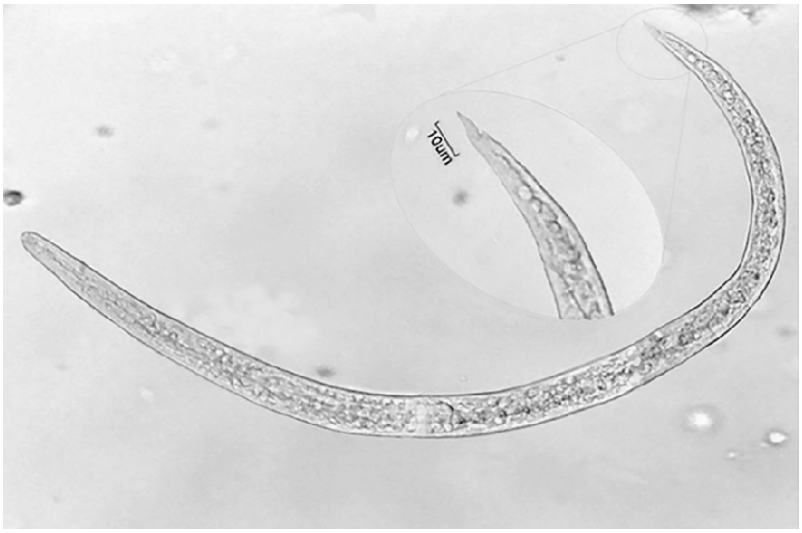

Figure 2. Larva of the first stage (L_1) of *Angiostrongylus vasorum* in fecal samples the *Lycalopex gymnocercus* (Vis. 100X). Detail: terminal spine (400X).

The larval stage was only diagnosed in a young live animal captured close to the town of Lages, Santa Catarina. The animal was also submitted to laboratory exams, the CBC presented 42% eosinophils (reference in the species is of 3-12%), this may be due to parasitic infection.

DISCUSSION

The event of the parasite in tropical, subtropical and temperate regions may be due to its ability to adapt to new hosts (Barçante, 2004; Magi *et al*., 2009). *A. vasorum* has been described in endemic areas as well as in regions previously described as free (Cesare *et al*., 2014; Simin *et al*., 2014).

Eosinophilia, regenerative anemia, thrombocytopenia, with or without clotting anomalies, may occur in canids infected with *A. vasorum* (Cury *et al*., 2005, Moermans *et al*., 2011). In dogs experimentally infected with *A. vasorum*, with high parasite load, only a slight hematological alteration was observed without eosinophilia (Schnyder *et al*., 2010). Parasitic eosinophilia is the result of contact between the parasite and hosts cells. The more complex the parasites cycle, with somatic migrations, higher the eosinophile count, when the parasite is limited to the digestive tube the eosinophile count tends to be lower (Chauffaille, 2010).

Mozzer *et al*. (2011) describes that one of the main abiotic factor for the development of *A. vasorum* larvae in gastropods is the temperature. Low temperatures (18° to 20° C) delay the larvae development meanwhile high temperatures accelerate the process. For Ferdushy & Hasan (2010), as well as corroborating that low temperatures are important for the survival maintenance of larvae, the air relative humidity seems to have no significant influence in larval viability.

Low temperatures was observed in the Santa Catarina mountains in winter, an average of 12.6°C (EPAGRI, 2013), and this climatic condition may favor the parasite development as observed in

European countries where parasitosis is endemic. The survival of *A. vasorum* L_1 is highly influenced by temperature (Ferdushy & Hasan, 2010) and *"In vitro"* the survival of L_3 *A. vasorum* larvae is higher at low temperatures, and high temperatures are associated to larger larvae mortality rates (Dias & Lima, 2012).

In Brazilian wild canids, *A., vasorum* was diagnosed *Lycalopex vetulus* in the State of Minas Gerais and *C. thous* in the States of Rio de Janeiro and Rio Grande do Sul (Duarte *et al*., 2007).

Canine angiostrongilosis is an emerging disease which probably has an expansion due climate factors, the presence of wild canids in urban areas (facilitating parasite propagation), as well as to employment of more precise diagnostic methods (Capogna *et al*., 2012).

Also, areas occupied by humans allow the interactions of wild and domestic animals, which may favor the infection of domestic dogs. Eleni *et al.* (2014), in Italy, defined that the cross infection between wild and domestic animals are important for the spreading of this parasite.

The great variety of definite hosts may be important for the distribution of the parasite in new, non-endemic areas. The potential of new, non-described, definite hosts may not be excluded while the parasite is introduced to new geographical areas (Koch & Willesen, 2009).

For parasites transmitted by gastropods the dissemination depends on the geographical distribution of the intermediate hosts, and these depend on environmental conditions for their development. Therefore environmental variability plays its role on the incidence of parasite infection (Tomlinson *et al*., 2006). When the environment is depleted, carnivores seek to vary their diet and, since mollusks belong to one of the largest filo of invertebrate in numbers of species, they may easily be found in nature, and become an alternative for animals with food restriction.

Traversa *et al.* (2010) states that more studies are necessary to explain the relation of climate variation and parasite distribution, such as intermediate hosts, levels of larval development, as well as the transition patterns, in endemic and non endemic areas, observing if temperature variation and other abiotic factors may explain the dissemination of *A. vasorum.*

As far as diagnose is concerned the main problem is that parasitosis symptoms are not specific and may be confused with other pathologies. The fact that some infected animals are asymptomatic makes it even harder to have a definite clinical diagnosis (Barçante, 2004). Along with this, the main diagnosis tool for this parasite, the Baermann technique for larvae detection, is not normally requested by veterinarians (Cesare *et al*., 2014).

Clinical diagnosis of angiostrongilosis is difficult. Animals don't always exhibit clinical signs and in its general form the infection may be confused with other pathologies. The parasite infection may be a problem in areas where the parasite is endemic and *L. gymnocercus* considered an interesting species for conservation.

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