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Review

Onchocercosis: A newly recognized disease in dogs

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Abstract

In the past 15 years, onchocercosis has been reported with increasing frequency in dogs in Europe and the United States, and 64 cases have been described so far. According to some authors, the *Onchocerca* sp. responsible for canine cases spills over from domestic or wild ungulates into dogs. However, canine *Onchocerca* does not match any of the descriptions for species of *Onchocerca* reported from domesticated and wild animals in Europe or North America. The nucleotide sequences of canine *Onchocerca* are also unique within the genus. Moreover, patent *Onchocerca* infections can be seen only in accidental hosts closely related to the natural hosts. In canine onchocercosis cases, high microfilarial load could be observed indicating that canids might be the definitive hosts of the parasite. Therefore, others suggested that *Onchocerca lupi* Rodonaja, 1967 originally described from a wolf (*Canis lupus*) can be responsible for these infections, which is a typical example for host switch and site shift, the dominant modes of speciation of the genus *Onchocerca*. The morphology, molecular characteristics, phylogeny, life cycle, host specificity, geographical distribution of *Onchocerca* sp. infecting dogs, as well as the clinical signs, pathology, laboratory diagnosis, therapy and possible zoonotic significance of canine onchocercosis are reviewed. Research into human onchocercosis has been hampered by the lack of analogous models. As infections in dogs may provide a practical experimental system, further studies should be encouraged to try to establish experimental *Onchocerca* infections in dogs.

Keywords: *Onchocerca lupi*; Dog; Wolf; Canids; Eye disease; Dermatitis; Zoonoses; Animal model

Contents

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1. Introduction

Onchocerca lupi as a distinct species was originally described in the periocular tissues of a Caucasian wolf (*Canis lupus*) in Gruziya (Rodonaja, 1967). In the past 15 years, onchocercosis has been reported with increasing frequency in dogs. Eight cases have been reported from south-western United States (Arizona, California, Utah) (Orihel et al., 1991; Gardiner et al., 1993; Eberhard et al., 2000; Gionfriddo et al., 2005; Zarfoss et al., 2005), and altogether 56 cases have been diagnosed in southern and central Europe (Germany, Greece, Hungary, Portugal, Switzerland) (Széll et al., 2001a,b; Egyed et al., 2002a; Komnenou et al., 2002, 2003; Hermosilla et al., 2005; Schäffer et al., 2006; Sréter-Lancz et al., 2007). According to some authors, canine onchocercosis is an aberrant infection by *Onchocerca lienalis* of cattle in an accidental host with ectopic location (Orihel et al., 1991; Gardiner et al., 1993; Eberhard et al., 2000; Zarfoss et al., 2005). Others suggested that a previously unrecognized species of *Onchocerca* is responsible for canine onchocercosis, which spills over from wild ungulates into canines with regularity (Komnenou et al., 2002). However, canine *Onchocerca* sp. only matches the description for species of *O. lupi* reported from domesticated and wild animals in Europe or North America (Egyed et al., 2001), and the nucleotide sequences of canine *Onchocerca* are also unique within the genus (Egyed et al., 2001, 2002b; Sréter-Lancz et al., 2007). Moreover, the host range of all *Onchocerca* spp. is very narrow (Rommel et al., 2000), and patent *Onchocerca* infection can be seen only in accidental hosts closely related to the natural host (e.g., in chimpanzees infected with *Onchocerca volvulus* of man) (Eberhard et al., 1995; Orihel and Eberhard, 1998). However, in canine onchocercosis cases, mature males, gravid females and high microfilarial load could be observed (Orihel et al., 1991; Gardiner et al., 1993; Eberhard et al., 2000; Széll et al., 2001a,b; Egyed et al., 2001; Komnenou et al., 2002, 2003; Gionfriddo et al., 2005; Hermosilla et al., 2005; Zarfoss et al., 2005; Schäffer et al., 2006) indicating that dogs or closely related canids, for example, wolves, might be the definitive hosts of this parasite. Therefore, other authors came to the conclusion that most likely *O. lupi* originally described from a wolf is responsible for canine onchocercosis (Széll et al., 2001b; Egyed et al., 2001, 2002b; Hermosilla et al., 2005; Schäffer et al., 2006; Sréter-Lancz et al., 2007; Krueger et al., 2007; Uni et al., 2007). The origin of the genus *Onchocerca* was referred to the Miocene radiation of the cervids and bovids, which form the majority of hosts (Bain, 2002). In the genus *Onchocerca*, it is clear that co-speciation between hosts and parasites is not the dominant mode of speciation. The results showed evidence of sympatric speciation both through host switch and site shift (Bain et al., 1977, 1993; Bain and Nasher, 1981; Bain, 2002; Chabaud and Bain, 1994; Morales-Hojas et al., 2006; Krueger et al., 2007). The case of *O. volvulus* of man, *Onchocerca dewittei* of wild boar, *Onchocerca ramachandrini* of warthog and *Onchocerca fasciata* of camel can be considered as typical examples for host switch. *Onchocerca gutturosa* and *O. lienalis* infecting cattle are the best examples for site shift. *O. lupi* of dogs can be another example for both modes of speciation. Herein we summarise the current knowledge on canine onchocercosis.

2. Morphology

Male worms are white, fragile and slender, measuring 43–50 mm in length by 0.1–0.2 mm in diameter (Table 1). The anterior end is rounded; the cuticle is 4–5 μm thick and bears faint transverse striations (Rodonaja, 1967; Egyed et al., 2001). The caudal papillae are large and fleshy. The left spicule is slightly curved, tubular and tapered and 160–203 μm long, and the right spicule is 75–94 μm long, curved, tubular, broad and heavily cuticularised at its proximal end but narrowing distally to a knobbed end (Demiaszkiewicz et al., 1991; Egyed et al., 2001; Komnenou et al., 2002).

As it is difficult if not impossible to remove complete female worms from the nodules, the total length of females is unknown but the longest fragments were 100–165 mm (Rodonaja, 1967; Komnenou et al., 2002). Several enzyme treatments were tested for the release of complete female worms, but none of them was successful (Egyed et al., 2001). Females are white, fragile, long and slender, measuring 0.2–0.4 mm in maximum diameter (Table 1). The anterior end is rounded; the vulva is located 638–1000 μm from the anterior end (Demiaszkiewicz et al., 1991; Komnenou et al., 2002). The tail is rounded with transverse striations of the cuticle