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Research paper

Season-long control of flea and tick infestations in a population of cats in the Aeolian archipelago using a collar containing 10% imidacloprid and 4.5% flumethrin

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ABSTRACT

Cats that have outdoor access are highly exposed to ticks, fleas, mites and flying insects, though the risk to become infested by arthropods is less perceived in cats than in dogs. This has resulted in fewer treatment and prevention options being available for cats than for dogs. A collar containing a combination of 10% imidacloprid and 4.5% flumethrin (Seresto®, Bayer Animal Health) is available for cats and licensed with claims against ticks and fleas for 7–8 months. Following the assessment of the efficacy of the collar against *Leishmania infantum* infection in privately owned cats living in the Aeolian archipelago, herein we report the efficacy of the collar in the treatment and prevention of tick and flea infestations in the same population of cats over a period of one year of observation. At the inclusion day (Study Day 0, SD 0), cats were visited and examined for ectoparasites (*i.e.*, flea combing and tick thumb counts) and allocated to group 1 (G1; n = 104; cats treated with Seresto® collar) or group 2 (G2; n = 100; untreated controls) and further checked at SDs 210, 270 and 360 (study closure). At SD 0, G1 and G2 had a comparable percentage of cats infested by fleas (45.2% and 49.0%; $\chi^2 = 0.164$; $P = 0.6859$) and ticks (6.7% and 14.0%; $\chi^2 = 2.946$; $P = 0.0861$). The number of cats infested by fleas was reduced in G1, being 8.3%, 0% and 3.8% on SDs 210, 270 and 360, respectively, resulting in efficacies against fleas of 79.4%, 100% and 93.6% on SDs 210, 270 and 360. None of the cats in G1 was found infested by ticks after the application of the collar, whereas in G2 ticks were observed on 15.7%, 4.8%, 17.5% of the cats at the different follow up visits, leading to an overall efficacy against ticks of 100%. A total of 375 ectoparasites were collected from cats, being 249 fleas (six *Ctenocephalides canis*, 240 *Ctenocephalides felis* and three *Nosopsyllus fasciatus*) and 126 ticks (87 *Ixodes ventalloi* and 39 *Rhipicephalus pusillus*). Field data gathered herein confirm a high efficacy of the collar in the prevention of tick and flea infestations on cats. This is of great importance both for the primary role of fleas and ticks as blood feeding parasites and, more importantly, because of their role as vectors of pathogens causing diseases of veterinary and medical importance.

1. Introduction

Until recently, ectoparasites of cats have received less attention than those of dogs. Fleas and ear mites are often considered by vet practitioners as the most important, if not the only, threat for cats (Beugnet et al., 2014). Nonetheless, in many instances cats live in the same household together with dogs, roam in the same environments and thus are also at risk of ectoparasite infestation. Unsurprisingly, stray cats are generally more exposed to ectoparasites than owned ones (Beugnet et al., 2014). According to a study conducted in seven European countries, 50.7% of the cats examined were positive for at least one parasite species and 14.0% of them were co-infested with at least an external and an internal parasite (Beugnet et al., 2014). Ixodid ticks (Ixodida, Ixodidae) are much less investigated in cats than in dogs, though studies on ticks and tick-borne diseases of cats have increased in the past few years (Beugnet and Marié, 2009). In Europe, cats may be

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parasitized by different tick species (Otranto and Dantas-Torres, 2010), including *Dermacentor reticulatus, Ixodes hexagonus*, *Ixodes ricinus*, *Ixodes ventalloi*, *Rhipicephalus pusillus*, and *Rhipicephalus turanicus* (Ogden et al., 2000; Stanneck et al., 2012; Claerebout et al., 2013; Geurden et al., 2017; Latrofa et al., 2017). The abovementioned tick species have been reported in cats from different Italian regions (Manilla, 1998). Nonetheless, there is limited information regarding the clinical significance of these ticks and their transmitted pathogens for cats. Moreover, the role of cats as transporters of infected tick to humans and their dwellings is poorly understood. On the other hand, what is well-known is that some of these ticks may carry pathogens, including viruses, bacteria and protozoa of public health significance (de la Fuente et al., 2008; Dantas-Torres et al., 2012; Otranto et al., 2014).

In spite of the availability of many effective ectoparasiticides for dogs, only a relatively small number of active compounds have been licensed in cats (*e.g.*, diazinon, fipronil, flumethrin, fluralaner, imidacloprid, nitenpyram, sarolaner, selamectin, and spinosad). Recently, a collar containing a combination of 10% imidacloprid and 4.5% flumethrin (Seresto®, Bayer Animal Health), hereafter referred to as "collar", has been registered for treatment and prevention of flea and tick infestations in cats, presenting both repellent (anti-feeding) and killing activities (Stanneck et al., 2012). Flumethrin is the only pyrethroid that is safe in cats (Linnett, 2008). Recent studies have demonstrated the efficacy of this collar for the prevention of vector-borne pathogen transmission in both dogs and cats (Fourie et al., 2012, 2013; Lappin et al., 2013; Otranto et al., 2013; Reichard et al., 2013; Brianti et al., 2014, 2016). In a recent study, we assessed the efficacy of the collar for preventing *Leishmania infantum* infection in a cohort of privately owned cats with regular outdoors access living in the Aeolian archipelago (Brianti et al., 2017), where ticks and transmitted pathogens are endemic (Pennisi et al., 2015; Persichetti et al., 2016; Latrofa et al., 2017; Otranto et al., 2017). Herein, we assessed the efficacy of this collar in the treatment and prevention of tick and flea infestations in the aforementioned population of cats during one year observation period.

2. Materials and methods

2.1. Ethical statement

The study complied with Good Clinical Practice (VICH GL9 GCP) and its protocol and procedures were approved by the Italian Ministry of Health (Authorization no. 0006088-10/03/2015-DGSAF-COD_UO-P). Animals were enrolled in the study after the signature of an informed consent by their owners.

2.2. Study site and design

The study was carried out on the two main islands of the Aeolian archipelago (Tyrrhenian Sea, Sicily, Italy), namely Lipari (38°28′N, 14°56′E) and Vulcano (38°24′N, 14°57′E). Data on ectoparasites were collected under the framework of another investigation aimed at assessing the efficacy of the collar in the prevention of *L. infantum* infection in cats (Brianti et al., 2017). On March 2015, at the inclusion day (Study Day 0, SD 0) cats were visited and examined for ectoparasites (*i.e.*, flea combing and tick thumb) and allocated to group 1 (G1; Seresto® collar) or group 2 (G2; untreated controls) following a "per household" random allocation plan designed to avoid contacts between cats wearing the collar and untreated. A total of 204 cats, aging from 6 months to 15 years and belonging to 80 owners, were assigned to G1 (n = 104) or G2 (n = 100). Animals of the G1 group were treated with the collar according to the package leaflet, while those in G2 were left untreated and served as negative controls. Animals were examined again for ectoparasites at SDs 210, 270 and 360 (study closure, April 2016) following the same procedures of SD 0. On SD 210 collars were replaced according to leaflet instruction. In case of accidental collar loss, a new collar was applied within a maximum of 2 days. At each visit all ticks and up to five fleas were collected from infested animals, stored in vials containing 70% ethanol, and identified to species level with the aid of morphological keys (Berlinguer, 1964; Manilla, 1998). Animals were also considered infested if flea faeces were detected at the scheduled examination. During the study cats remained with their owners and were managed as per normal routine without any containment measure or restriction. Treatments with products active against ectoparasites were not allowed in animals of the G2 group. However, in case of severe flea infestation, rescue treatments (Advantage® for cats, Bayer Animal Health) were admitted on untreated animals on a welfare basis.

2.3. Data management and statistical analyses

The percentages of cats infested by ectoparasites in G1 and G2 at the enrolment day at follow-up visits were compared using the chi-square test (χ^2) calculated on contingency tables. The efficacy of the treatment was calculated using the formula: efficacy = (% of cats positive in G2–% of cats positive in G1/% of cats positive in G2) x 100. The software used was WinEpi (available online at http://www.winepi.net/uk/index.htm) and the statistical significance threshold was set at $P < 0.05$.

3. Results

At the enrolment, G1 and G2 had a comparable percentage of cats infested by fleas (45.2% and 49.0%; $\chi^2 = 0.164$; $P = 0.6859$) and ticks (6.7% and 14.0%; $\chi^2 = 2.946$; $P = 0.0861$). During the course of the study, the percentage of cats infested by fleas reduced in G1, being 8.3% ($\chi^2 = 30.369$; df = 1; $P = 0.0001$), 0% ($\chi^2 = 50.102$; df = 1; $P = 0.0001$), and 3.8% ($\chi^2 = 37.235$; df = 1; $P = 0.0001$), on SDs 210, 270 and 360, respectively while no significant variations in the frequencies of flea infestation were observed in G2 ($\chi^2 = 6.949$; df = 3; $P = 0.0735$) (Table 1). This resulted in efficacies against fleas of 79.4%, 100% and 93.6% on SDs 210, 270 and 360, respectively.

Table 1
Number and percentages of infested cats from treated (G1) or untreated (G2) groups, before (SD 0) and after treatment (SD 210-SD 360) with Seresto® collar[a].

Study Day (SD)	SD 0		SD 210		SD 270		SD 360	
Groups (number)	G1 (n = 104)	G2 (n = 100)	G1 (n = 83)	G2 (n = 83)	G1 (n = 83)	G2 (n = 83)	G1 (n = 79)	G2 (n = 80)
Flea infestation	47 (45.2%)	49 (49.0%)	7 (8.3%)[b]	34 (41.0%)[b]	0[c]	44 (53.0%)[c]	3 (3.8%)[d]	46 (57.5%)[d]
Tick infestation	7 (6.7%)	14 (14.0%)	0[e]	13 (15.7%)[e]	0	4 (4.8%)	0[f]	14 (17.5%)[f]

[a] Significant differences are marked with equal letters on the same line.
[b] ($\chi^2 = 24.495$; df = 1;$P < 0.0001$).
[c] ($\chi^2 = 57.178$; df = 1; $P < 0.0001$).
[d] ($\chi^2 = 51.278$, df = 1,$P < 0.0001$).
[e] ($\chi^2 = 12.018$, df = 1, $P = 0.0005$).
[f] ($\chi^2 = 13.059$, df = 1, $P = < 0.0003$).