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Evaluation of the efficacy of selamectin spot-on in cats infested with *Aelurostrongylus abstrusus* (Strongylida, Filariodidae) in a Central Italy cat shelter

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ABSTRACT

In recent years *Aelurostrongylus abstrusus* has often been reported in Italy. This lungworm is very common in cat colonies due to its route of transmission. Deciding a therapeutic approach can be difficult in such colonies, because there is no certainty whether oral medicines administered with food, or with what dose, will be taken. In this field study, stool samples were taken from 42 cats and analysed for *A. abstrusus* L1 larvae with Baermann technique. Ten cats testing positive were treated with a spot-on formulation of selamectin 45 mg. Clinical examinations and laboratory tests, repeated four times in two months, demonstrated the success of the treatment in 9 of the 10 cats. Improvements in respiratory signs and general clinical condition were reported after treatment.

1. Introduction

The lungworm *Aelurostrongylus abstrusus* (Nematoda, Strongylida) is the most common lung parasite in cats (Bowman and Lynn, 1995). It has been reported in numerous areas of the world (Aiello and Mays, 1998; Soulsby, 1988; Urquhart, 1998), including Europe. Prevalence in Europe ranges from 1% in Spain (Miro et al., 2004) to 17% in Portugal (Puente et al., 2008), 17.3% in central Italy and 18.5% in southern Italy (Traversa et al., 2008a).

Adult forms usually do not exceed 10 mm in length and are found in the cardiorespiratory system in infested cats, mainly in the respiratory bronchioles, alveolar ducts and pulmonary alveoli. Adult females lay embryonated eggs which hatch in alveolar ducts and alveoli. Larvae (L1) are mobile and migrate to upper airways, aided by mucociliary clearance mechanisms and consequent coughing (Traversa et al., 2008b), then they pass to the pharynx, where are swallowed and released in the faeces. The life cycle of *A. abstrusus* is indirect, involving various species of slugs and snails as intermediate hosts. It takes about two months in the intermediate host to develop into L2 and finally L3 stage, that is infective. However, an important role in transmission to the final host is played by various feline prey species, such as rodents, frogs and toads, lizards, birds and snakes, which act as paratenic hosts infected by swallowing parasitised slugs or snails (Scott, 1972). Once swallowed by the final host, the larvae migrate through the blood/lymphatic system to the lungs and reach adult parasitic stage and sexual maturity in about four weeks (Bourdeau, 1993).

In cats, lungworm disease may be asymptomatic, subclinical or clinical. When clinical signs are present, severity is very variable. Some cases can prove rapidly fatal. This variability probably depends on both the number of parasites and host factors such as age, nutritional condition, immune response, concomitant diseases. The most common signs are coughing, weight loss, tachypnoea, and dyspnoea. In more severe cases of massive infestations, there may be: open-mouthed abdominal breathing attributable to interstitial bronchial pneumonia, violent coughing, frequent sneezing, and severe nasal discharge,

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sometimes mucopurulent, accompanied by hydrothorax (Ribeiro and Lima, 2001). The high incidence of this disease in cat colonies and populations of wild cats is related to the lungworm's life cycle, requiring intermediate hosts, usually present in open spaces (Grandi et al., 2005). Administration of oral medicines can be difficult and often not effective, due to insufficient dosage ingested with food. This makes particularly important the use of an easy-to-administer treatment requiring a minimal number of administrations.

In this field study the efficacy of a spot-on formulation of selamectin in *A. abstrusus* infestations was tested in a cat colony in Teramo (Abruzzo Region, Central Italy).

2. Materials and methods

2.1. Study area

The study was conducted over a 65-days period on cats housed in a purpose-built cat shelter owned by the Istituto Zooprofilattico Sperimentale dell'Abruzzo e del Molise "G. Caporale" (ICT), located in the municipality of Teramo (Abruzzo, Italy, 42°39′31″ N, 13°41′49″ E). The animals had previously lived in semi-closed premises placed in the same municipality, on the property of a private citizen.

The municipality of Teramo is mostly hilly, mean height ranging from 200 to 400 m above sea level, near calcareous and arenaceous mountains rising over 2000 m. Two rivers flow through the municipality area. Climate is temperate sub-litoraneous according to Koppen classification, with an average annual temperature of 12.9 °C (January 5.6 °C, July 20.6 °C) and a rainfall of 760 mm (ARSSA, 2009). Natural vegetation is mostly composed by pubescent oak woods (*Quercus pubescent*).

3. Animals

Forty-two cats were enrolled in the study, sheltered from April to June 2010 at the ICT. No general or veterinary details were available on the period prior to their transfer from a private cat shelter. On arrival, almost all the cats showed signs of severe malnutrition. Many suffered from large areas of alopecia, mucopurulent blepharoconjunctivitis and strong gastrointestinal and respiratory signs, with mild to severe coughing, sneezing, mucopurulent nasal discharge, open-mouthed abdominal breathing and dyspnoea.

The premise where the cats were housed consisted of an open area of 11.5 m × 7.85 m, enclosed by a wire mesh fence, on a floor of gravel and sand. A roofed shelter of 3.76 m × 3 m with a concrete floor was located on one side.

Individual animals were identified through a subcutaneous microchip associated with an electronic numerical code.

3.1. Sampling and laboratory tests

Stool samples were taken from all 42 cats and analysed for *A. abstrusus* larvae using Baermann's qualitative method (Traversa et al., 2010; Traversa and Guglielmini, 2008; Conboy, 2009). L1 larvae were identified through their typical notched, S-shaped caudal end (Sloss et al., 1994).

During the period of study, Baermann's method was repeated every two weeks (four times overall) in subjects testing positive for *A. abstrusus*.

3.2. Clinical examinations

Animals testing positive for *A. abstrusus* underwent clinical examination at the time of the first administration of selamectin and upon each stool sampling thereafter. Particular attention was paid to nutritional condition (Body Condition Score [BCS] 1–9) and respiratory signs.

4. Treatment

Subjects testing positive were treated with two spot-on administrations of selamectin 45 mg (Stronghold®, Pfizer Italia s.r.l.) 23 days apart, applied directly to the skin at the base of the neck in front of shoulder blades.

4.1. Statistical analysis

The efficacy of selamectin 45 mg spot-on (Stronghold®), was estimated by calculating the beta distribution with a confidence interval of 95%, using Excel® 2007 (Microsoft Corporation®, USA).

5. Results

The results of the faecal and clinical examinations in relation to the two treatments (Day 4 and Day 28) are reported in Table 1. At Day 0 (first test), 10 of the 42 cats (23%) tested positive for *A. abstrusus*.

Ten days after the first administration of selamectin spot-on (second test: Day 14) on the 10 positive cats, 9 of these tested negative (90% of treated subjects), while 23 days after the first administration (third test: Day 27) all cats tested negative. The fourth faecal examination, carried out 15 days after the second administration (fourth test: Day 43) proved negative for 9 of the 10 cats (90%), while one cat which had tested negative at the second and third tests retested positive. At the fifth test, 37 days after the second treatment (Day 65), this cat was again negative along with all other cats.

The analysis of clinical data following the two treatments (Day 43) revealed marked improvements in respiratory signs and general clinical condition: seven animals (70%) did not showed any sign, while the other three cats revealed only slight nasal discharge. At the last examination (Day 65) all subjects presented good Body Condition Score (4 or 5) and no respiratory signs.

Statistical analysis of these data revealed that the efficacy of selamectin 45 mg spot-on (Stronghold®) is between 59% and 98% (Fig. 1).

6. Discussion

The few literature reports on use of selamectin for the treatment of lungworm disease in cats refer to small caseloads (Fisher and Shanks, 2008; Reinhardt et al., 2004; Dryden, 2009). Off-label use of other spot-on treatments has proved effective against this parasite (Traversa et al.,

Table 1
Results of faecal and clinical examinations pre- and post-treatment.

Microchip	Day 0			Day 4	Day 14			Day 27			Day 28	Day 43			Day 65		
	Test 1				Test 2			Test 3				Test 4			Test 5		
	Faecal examination	BCS	Respiratory signs		Faecal examination	BCS	Respiratory signs	Faecal examination	BCS	Respiratory signs		Faecal examination	BCS	Respiratory signs	Faecal examination	BCS	Respiratory signs
380260040040882	+	4	Copious mucopurulent nasal discharge	Treatment 1	0	4	Slight nasal discharge	0	4	Slight nasal discharge	Treatment 2	0	4	Slight nasal discharge	0	5	Absent
380260040041268	+	4	Copious mucopurulent nasal discharge		0	4	Nasal discharge	0	4	Nasal discharge		0	4	Slight nasal discharge	0	5	Absent
380260040041315	+	3	Copious mucopurulent nasal discharge		0	4	Nasal discharge	0	4	Nasal discharge		0	4	Absent	0	4	Absent
380260040041455	+	3	Copious mucopurulent nasal discharge		0	4	Nasal discharge	0	4	Nasal discharge		0	4	Absent	0	4	Absent
380260040041580	+	3	Nasal discharge		0	3	Nasal discharge	0	3	Nasal discharge		0	3	Absent	0	4	Absent
380260040041634	+	3	Nasal discharge		0	4	Absent	0	4	Absent		0	4	Absent	0	4	Absent
380260040041720	+	3	Absent		0	4	Absent	0	4	Absent		0	4	ABSENT	0	4	Absent
380260040045945	+	3	Absent		+	3	Absent	0	3	Absent		0	3	ABSENT	0	4	Absent
380260040045946	+	2	Absent		0	3	Absent	0	3	Absent		0	3	ABSENT	0	4	Absent
380260040046674	+	3	Absent		0	4	Absent	0	4	Absent		+	4	Slight nasal discharge	0	5	Absent

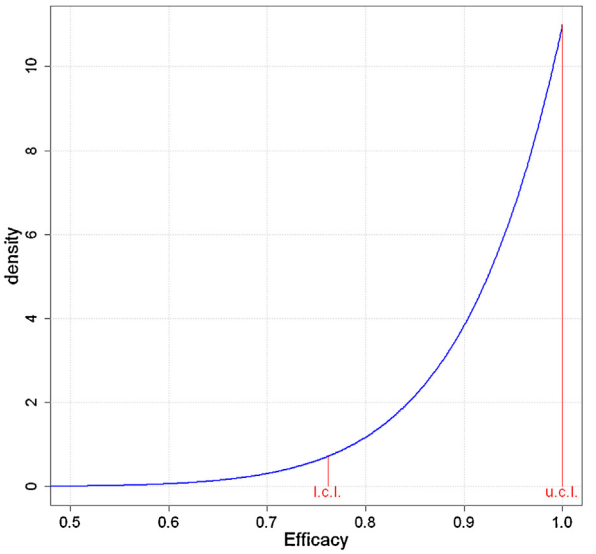

Fig. 1. Efficacy of selamectin 45 mg spot-on in the sample after two treatments (l.c.l.: lower confidence limit; u.c.l.: upper confidence limit).

2009a, 2009b), but to date there has been no information on the use of selamectin spot-on treatments in field studies. In this study, prevalence at first faecal examination was 23%, higher than that previously reported for central Italy (17.3%) and southern Italy (18.5%) (Traversa et al., 2008a).

Selamectin 45 mg spot-on was chosen due to the safety of its mode of administration and its therapeutic and preventive efficacy against other external and internal parasitic diseases, including flea infestations, mange, heartworm disease, and scabies (Bishop et al., 2000; Ritzhaupt et al., 2000; Dryden and Payne, 2005; Boy et al., 2000). Moreover, spot-on formulation makes administration easy, even to struggling animals, and provides certainty of the dose applied. In contrast, orally administered products do not assure that the dose actually received by the animal is sufficient, especially in the case of cats living in colonies or in semi-liberty.

In evaluating the results of this field study, the way in which *A. abstrusus* larvae are passed into the faeces and the diagnostic methods used should be borne in mind. As with most parasites, faecal elimination may be intermittent. Tests must therefore be repeated in the event of any negative results and evaluated in relation to clinical examinations, in order to reveal the presence of any specific signs. In contrast, a positive result always points to the presence of the parasite. For this reason, following an initial positive result and the first administration of selamectin 45 mg spot-on (Stronghold®), the faecal examination was repeated four times.

Results indicate the product's significant efficacy up to the end of the study period (61 days after the first administration and 37 days after the second), with 100% of animals testing negative on the last faecal examination (Table 1). Product's efficacy was greatest at tests carried out more than 15 days after treatment (the third and fifth tests, which were both negative for all animals examined), probably due to the gradual, prolonged absorption of the spot-on treatment. One animal found positive at the second test (10 days after the first treatment) and then negative at subsequent tests seems to confirm this theory.

The positive fourth test result in a cat previously testing negative could be linked with intermittent elimination of L1 larvae in the faeces or its reinfestation shortly after the second treatment, before the spot-on mode of administration enabled the product to reach its maximum efficacy. However, although unlikely in two consecutive examinations, the possibility of previous false negatives due to the method used should not be excluded. In fact, even though the qualitative Bearmann method is still considered the gold standard for the study of *A. abstrusus* naturally infected animals (Traversa and Guglielmini, 2008), its sensitivity is less than 100%. Nonetheless, reinfestation seems more likely, given the conditions in which the cats were housed (open shelters which could thus potentially be reached by both intermediate hosts (slugs and snails) and paratenic hosts (lizards, birds, frogs and toads, snakes, and rodents). Reinfestation also seems possible given the appearance of a slight nasal discharge (previously absent) in the animal testing positive at the fourth test. In any case, the long-term efficacy of selamectin spot-on caused the parasite to be eliminated by the fifth test without the need of other treatments.

7. Conclusions

This study confirmed the presence in Italy of lungworm disease in cats, supporting previous findings (Traversa et al., 2008b). The mode of transmission of this parasite means that it mostly affects cats with outside access or living in colonies. The severity of signs differs among individuals and in some cases can be extremely serious, especially in the presence of other infectious diseases. The choice of treatment must therefore take into consideration a number of factors, especially the efficacy of the product and its spectrum of action. In fact, using a product which acts on both internal and external parasites minimises the number of medicines that have to be administered. This is particularly important in shelters and colonies where cats are often not used to direct contact with humans and can therefore be difficult to capture and immobilise, even for a few seconds. The administration method is also important. Administration in food is not advisable in cat colonies, as it is impossible to be sure that each animal has received the product, and at what dose. Forced administration by mouth is both labour-intensive and stressful for the animal.

In this field study Selamectin 45 mg spot-on (Stronghold®) was found to have a high efficacy. Its broad spectrum of activity makes it useful against not only *A. abstrusus* but also the external parasites commonly found in all cats living outside. This reduces the number of captures of individual cats necessary for administration of treatments. Spot-on administration is also extremely practical in cat kennels, being without doubt more convenient, simple, and effective than oral or parenteral administration. Further field studies would be useful to verify the dynamics of spot-on absorption of selamectin

and confirm its efficacy, evident in any case in this study, for the treatment of lungworm disease in cats.

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