



# Association between infestation by *Lynxacarus radovskyi* (Acari: Lystrophoridae) and the occurrence of Feline Eosinophilic Granuloma Complex

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**Abstract** *Lynxacarus radovskyi* are mites commonly found within domestic feline hair stems. The infested animal presents an opaque fur with a “salt and pepper” aspect. The contamination may occur by direct contact with other infected animals or by fomites, and the main diagnostic tool is the direct examination of the fur. The Feline Eosinophilic Granuloma Complex (FEGC) is a dermatological pattern of an immune answer against many types of injuries in felines, mainly during allergic reactions, and the treatment of choice are corticosteroids. The objective of this work was to document the linxcariosis cases at the Veterinary Hospital Professor Ricardo Alexandre Hippler—University of Vila Velha. Furthermore, the work also meant to research the association between the parasite contagion and the occurrence of FEGC injuries, which commonly occurred. Between April 2017 and August 2018, there were 8 reported cases of felines infested with *L. radovskyi*. The diagnoses were made with Acetate tape impression or by direct fur examination. Seven out of the eight cats presented with at least one characteristic injury of the FEGC. In all of them the chosen treatment was moxidectin or *spot-on* imidacloprid plus corticotherapy on the cats with FEGC, which were effective.

**Keywords** Ectoparasite · Mite · Cat · Moxidectin · Imidacloprid · FEGC

## Introduction

*Lynxacarus radovskyi* is a mite commonly found infesting the fur of domestic cats. It belongs to the Lystrophoridae family, measures approximately 0.5 mm in length, has a flattened and elongated body and parasites the stems of the hairs (Aguiar et al. 2009). Its life cycle is little known, but occurs entirely in the coat of the host, where eggs, larvae, nymphs and adults can be found (Saridomichelakis 2008).

The first case to be reported occurred in Hawaii in the United States, by Tenório in 1974. *Lynxacarus radovskyi* is most commonly found in tropical and sub-tropical climate regions (Craig et al. 1993; Aguiar et al. 2009), as almost the entire Brazilian territory (according to data from INMET-National Institute of Meteorology). Linxcariosis has already been considered rare (Heath and Mariadas 1999; Faustino et al. 2004; Payne et al. 2005; Aguiar et al. 2009; Maruyama et al. 2016), however, has become common in free-living cats, according to the study of Ketzis et al. (2016). In Brazil, an increasing number of cases have been observed (Pereira 1996; Romeiro et al. 2007; Rocha et al. 2008), which can be explained by the large amount of wandering and semi-domiciled felines, facilitating the dissemination (Faustino et al. 2004). It is not highly contagious, but transmission occurs through direct contact between cats or by fomites (Craig et al. 1993; Miller et al. 2016).

The feline infested by the mite commonly appears to be dirty, giving the coat a “salt and pepper” look. In addition, unkempt hair, easily epilable, alopecia and variable

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pruritus (Faustino et al. 2004). Other clinical signs are reported, such as excoriations, deposition of furfuromicaceous scales, nibbling and avulsion of the hairs by the feline, which, in turn, can lead to the emesis and formation of tricobezoars (Larsson and Lucas 2016).

The main method of diagnosis, besides a good anamnesis and physical evaluation, is given by the direct examination of the hairs in the microscope. One can also use tools like the Wood lamp, magnifying lens of an otoscope and direct examination of the hairs with a magnifying glass (Larsson and Lucas 2016). Examination by tape acetate is easier to be performed and has high sensitivity (Ketzis et al. 2016). Currently, in practice, the USB digital microscope has been widely used, giving good visualization of the parasite.

One of the most common forms of treatment is the application of fipronil-based products (Clare et al. 2004). Shampoos, powders and sprays based on pyrethrin and tetraethyl-tiuran, plus imidacloprid, selamectin and even avermectins can also be used (Craig et al. 1993; Serra-Freire et al. 2002; Faustino et al. 2004; Payne et al. 2005). The use of oral afloxolaner and moxidectin associated with *spot-on* imidacloprid has shown excellent results. In a study with 30 felines, 100% efficacy of both eradication treatments was observed in 28 days (Han et al. 2016).

Feline Eosinophilic Granuloma Complex (FEGC) is a response pattern in viral, bacterial, parasitic, autoimmune, idiopathic and allergic diseases in the domestic feline (Larsson and Lucas 2016).

Etiopathogenesis of FEGC is certainly not defined, but it is known to be very common in hypersensitivity disorders present in allergic dermatopathies (Mazzoti and Roza 2016), such as food hypersensitivity, allergy to environmental antigens (atopic dermatitis) or to ectoparasites (Larsson and Lucas 2016). The presence of ectoparasites

triggers a late hypersensitivity reaction, mediated by Th2 lymphocytes, probably by the deposition of arthropodian antigens on the skin (Colombini et al. 2001).

The FEGC groups three types of lesions: eosinophilic plaque (EP), eosinophilic ulcer (EU) and eosinophilic granuloma (EG), which, although have a differentiated histology, have common characteristics, thus, they belongs to the same group (Fondati et al. 2001).

The aim of this study was to perform an analysis of the cases of linxacariosis in cats attended from April 2017 to August 2018 at the dermatology department of the small animal clinic of a veterinary university hospital in the municipality of Vila Velha, Espírito Santo, Brazil, and the frequent association of this infestation with the feline eosinophilic granuloma complex observed in these animals.

### Materials and methods

In the period from April 2017 to August 2018, at the Veterinary Hospital “Prof. Ricardo Alexandre Hippler” from the Vila Velha University, eight felines were diagnosed with linxacariosis. In all of them, the diagnostic technique used was the direct microscopic examination of the hairs, by avulsion with hemostatic forceps or by an acetate tape decal. The cases have been confirmed by visualization of the ectoparasite *L. radovskyi*.

The cases were described and arranged in a table, by order of time, separated by sex, age, body score, degree of pruritus, presentation of other signs, FEGC lesions and Feline Immunodeficiency virus (FIV)/Feline Leukemia Virus (FeLV) infection status (Table 1). In all cases, the treatment used for linxacariosis was the association of

**Table 1** Felines attended at the dermatology service of the clinic from the university veterinary hospital in Vila Velha—ES, ordered in a temporal order of attendance and relevant characteristics of the cases

Feline	Sex	Age	Body score	Pruritus	Other signs	FEGC	FIV/FeLV status
Feline 1	M	5 years	7/9	++ (+)/+++	alopecia	EG	Negative
Feline 2	F	10 months	6/9	+++ /+++	alopecia; opaque coat	EG	Positive
Feline 3	F	10 months	5/9	+++ /+++	Alopecia;	EG	Positive
Feline 4	F	4 years	6/9	+(+)/+++	Gingivitis; “salt and pepper” aspect	EP	Negative
Feline 5	F	8 months	5/9	+++ /+++	Alopecia; “salt and pepper” aspect	EU and EG	Not tested
Feline 6	M	1 year and 6 months	7/9	+ /+++	“Salt and pepper” aspect; furfuromicaceous scales	EG	Negative
Feline 7	M	2 years and 6 months	7/9	++ (+)/+++	Bilateral symmetrical alopecia; “salt and pepper” aspect	EP	Negative
Feline 8	M	6 months	5/9	+ /+++	Opaque coat with “salt and pepper” aspect	–	Positive

Imidacloprid and Moxidectin spot on and for the FEGC lesions corticosteroid therapy was performed.

## Results and discussion

In the present study, eight cats were diagnosed with linxacariosis, and from the epidemiological data, historical and clinical signs, we observed the profile of these patients (Table 1). Among the animals treated, there was no difference between the number of males and females affected, with four animals of each sex. Most of the affected felines were young (62.5%) of up to 1 year and 6 months and only 37.5% were older than 2 years. Among the eight reported cases, four had frequent access to the street (feline 2, feline 3, feline 5, feline 8) and from them, two were positive for FeLV, one for FIV/FeLV and another one was not tested, demonstrating that, in this case, the prevalence of animals affected by FEGC lesions in felines with some viral infection was 75%. All animals had a body score above 5/9.

Among the clinical signs reported, pruritus was the most frequent (100%), and the intensity was directly related to the degree of infestation of linxacariosis. In addition, the cats with the highest number of mites per field were the ones that most itched themselves. Other signs reported were alopecia (62.5%), “salt and pepper” appearance (62.5%), opaque and disheveled hair (25%) and fur-foromicaceous desquamation (12.5%). FEGC lesions were present in seven (87.5%) of the cases and, among the patients, EG was the most frequently reported lesion (57.14%), followed by eosinophilic plaque (28.58%) and, in one animal (14.28%), two lesions were present (EU and EG). This latter animal, curiously, presented the highest parasitic load in relation to the others.

For diagnosis, a complete anamnesis was essential, with the main questions based on pruritus, if the animal has access to the street and/or contactants and beginning of the signs. In addition, the physical examination was of fundamental importance, where the following aspects were evaluated: the appearance of the coat, whether or not there were manifestations of pruritus and lesions. The animals were submitted to basic dermatological tests, such as direct examination of the hairs and/or examination by acetate adhesive tape. The positive animals were those in which the presence of the mite was observed. According to Ketzis et al. (2016) report, the acetate adhesive tape examination was easy to perform and showed to be quite effective for the ectoparasite visualization.

The treatment used in 100% of cases was based on Moxidectin associated with *spot-on* Imidacloprid, repeated after 28 days. The dose was adequate for the animal weight (commercially available prescriptions are Advocate® for

cats up to 4 kg and 4–8 kg). This protocol is effective and safe, according to Han et al. (2016), which confirmed the efficacy of Moxidectin (1.4 mg/kg) in combination with *spot-on* Imidacloprid against oral use of Fluralaner (Bravecto®, 46.6 mg/kg) in cats. In this study, 100% efficacy was demonstrated in both protocols after 2 weeks of treatment. Environment cleaning was also indicated, due to the possibility of the presence of mites at it, mites that could re-infest the patients. The research of Han et al. (2016), cited above, confirms the importance of environmental control, since it states that tested cats that were highly infested had relapse after 42 days of the end of drug half-lives. In cases where there was more than one feline at the same place (felines 2, 3, 4, 5 and 7), the indication was to treat them all, since direct contact between them is the most effective transmission mechanism for *L. radovskyi* (Craig et al. 1993; Miller et al. 2016).

For animals with FEGC lesions, the use of prednisolone (2 mg/kg) orally was indicated, every 24 h for at least 10 days, with gradual dose reduction. According to Medleau and Hnilica (2003) and Rhodes (2005), this is the treatment of choice for FEGC. In only a feline (feline 4), methylprednisolone acetate (4 mg/kg) was injected intramuscularly, single dose, repeated after 15 days. The use of this drug was due to the impossibility of oral administration of drugs to the patient, as it was a very wary animal. In all cats, treatment was effective, with overall cure of FEGC signals, and none presented major adverse reactions. Among the reported reactions, moderate polyphagia was the most frequent (in 4 felines), which was not considered as bad by any tutor. Polyuria and mild magnitude polydipsia were observed in only two cats (feline 1 and feline 4), one of which was the patient who received methylprednisolone. One of the felines frequently presents a recurrence of EG (feline 7), requiring further investigation, such as the presence of other ectoparasites and endoparasites, viral infections or reaction to environmental antigens (atopic dermatitis) and re-infection with other felines that live at the same environment and due to fomites (Larsson and Lucas 2016).

We concluded, in the present study, that *L. radovskyi* infestation is closely related to the appearance of FEGC lesions as a response pattern, and mite infestation may be suspected when FEGC is present, especially associated with other findings such as pruritus, appearance of “salt and pepper” and opaque coat.

Direct examination of hair or examination by the tape acetate, associated to the good anamnesis and physical examination, were effective for the visualization of the parasite, thus, were considered good methods of diagnosis.

It can also be concluded that the acaricidal treatment carried out in the present study proved to be effective for the negativation of the direct examination of hair and of the

acetate tape, as well as the steroidal anti-inflammatory drugs were efficient for the resolution of FEGC. It is important to emphasize that the fact of diagnosing and treating the underlying cause, the parasitosis itself, was determinant for the regression of the lesions.

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#### Compliance with ethical standards

**Conflict of interest** The authors declare that they have no conflict of interest.

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