

Epidemiological, clinical and laboratory profile of dermatopathies of household dogs and cats in a semi-arid region of Northeast Brazil

Perfil epidemiológico, clínico e laboratorial das dermatopatias de cães e gatos domiciliados em área semiárida do Nordeste do Brasil

Perfil epidemiológico, clínico y de laboratorio de las dermatopatías en perros y gatos domiciliados en una zona semiárida del Noreste de Brasil

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Abstract

The present study aims to determine the epidemiological, clinical and laboratorial profile of the dermatopathies that affect dogs and cats living in a semi-arid area in the Northeast of Brazil. Seventy-eight dogs and cats consulted at the Veterinary Hospital with dermatological complaints were included in this study. Skin lesions were characterized with respect to morphology, appearance, and distribution, an epidemiological questionnaire was applied, and samples were collected for complementary examination. The diagnosis was confirmed by parasitological and microbiological tests. There was a predominance of the canine species (93.6%), of young animals (46.3%), and of animals of undefined breeds (61.5%). It was observed that 29.5% of the affections were of fungal aetiology, 14.1% were bacterial, 3.9% were scabies. In 5.1% of the cases there were associations between different pathogens, and in 47.4% the laboratory examination was negative for the pathogens investigated. The most frequent clinical manifestations included alopecia (74.4%), pruritus (61.6%) and erythema (43.6%), distributed mainly in the dorsal-ventral region (36.1%) or even disseminated (43.1%). With respect to One Health, 51.3% (40/78) of the owners reported that they did not know what "zoonoses" were. Dermatopathies have been shown to be important disorders, especially the mycotic and bacterial diseases. Atypical cases of infections motivated by pathogens little described in the literature as etiologic agents of dermatopathies in dogs and cats were observed.

Keywords: Veterinary dermatology; Fungi; Bacteria; Mite; One Health.

Resumo

O presente trabalho objetivou determinar o perfil epidemiológico, clínico e laboratorial das dermatopatias que acometem os cães e gatos domiciliados em área semiárida do Nordeste do Brasil. Setenta e oito cães e gatos atendidos no Hospital Veterinário com queixas dermatológicas foram incluídos neste estudo. As lesões de pele foram caracterizadas quanto à morfologia, aspecto e distribuição, foi aplicado um questionário epidemiológico, e colhidas amostras para exame complementar. O diagnóstico confirmado em testes parasitológicos e microbiológicos. Houve predominância da espécie canina (93,6%), de animais jovens (46,3%) e sem raça definida (61,5%). Observou-se que 29,5% das afecções eram de etiologia fúngica, 14,1% bacteriana, 3,9% de sarnas. Em 5,1% dos casos havia associações entre diferentes patógenos e em 47,4% o exame laboratorial foi negativo para os patógenos pesquisados. As manifestações clínicas mais frequentes incluíram alopecia (74,4%), prurido (61,6%) e eritema (43,6%), distribuídas principalmente na região dorso-ventral (36,1%) ou ainda disseminada (43,1%). Sobre Saúde Única, 51,3% (40/78) dos tutores informaram que não sabiam o que eram “zoonoses”. Dermatopatias demonstraram-se como importantes afecções, sobretudo as doenças micóticas e bacterianas. Foram observados casos atípicos de infecções motivadas por patógenos pouco descritos na literatura como agentes etiológicos de dermatopatias em cães e gatos.

Palavras-chave: Dermatologia veterinária; Fungos; Bactérias; Sarnas; Saúde Única.

Resumen

El presente estudio tuvo como objetivo determinar el perfil epidemiológico, clínico y de laboratorio de las dermatopatías que afectan a perros y gatos domiciliados en una zona semiárida del noreste de Brasil. En este estudio se incluyeron setenta y ocho perros y gatos tratados en el Hospital Veterinario con quejas dermatológicas. Las lesiones cutáneas se caracterizaron en términos de morfología, apariencia y distribución, se aplicó un cuestionario epidemiológico y se recolectaron muestras para su posterior examen. Diagnóstico confirmado en pruebas parasitológicas y microbiológicas. Hubo predominio de la especie canina (93,6%), de animales jóvenes (46,3%) y de raza no definida (61,5%). Se observó que el 29,5% de las afecciones fueron de etiología fúngica, 14,1% bacterianas, 3,9% sarna. En el 5,1% de los casos hubo asociaciones entre diferentes patógenos y en el 47,4% la prueba de laboratorio fue negativa para los patógenos estudiados. Las manifestaciones clínicas más frecuentes incluyeron alopecia (74,4%), prurito (61,6%) y eritema (43,6%), distribuidos principalmente en la región dorsoventral (36,1%) o incluso diseminados (43,1%). En cuanto a Unica Salud, el 51,3% (40/78) de los tutores informaron que no sabían qué eran las “zoonosis”. Se demostró que las dermatopatías son afecciones importantes, especialmente enfermedades micóticas y bacterianas. Se observaron casos atípicos de infecciones causadas por patógenos poco descritos en la literatura como agentes etiológicos de dermatopatías en perros y gatos.

Palabras clave: Dermatología veterinaria; Hongos; Bacterias; Sarna; Salud Única.

1. Introduction

There are indications that 20 to 70% of veterinary consultations are directly related to skin diseases, and the easy visibility of these conditions can drive the owners to seek veterinary care (Gasparetto et al., 2013). Similarly, dermatological diseases appear to have a high impact on the quality of life of affected animals and their owners (Madureira; Blum, 2017), besides the importance in public health due to the possibility of transmission of zoonotic and antimicrobial resistant pathogens, especially in the case of bacteria (Somayaji et al., 2016; Andrade; Rossi, 2019; Lagowski et al., 2019).

Dermatopathies are basically classified into three groups from the aetiological origin, these being bacterial, fungal, and parasitic dermatitis. The main bacteria involved comprise those belonging to the genera *Staphylococcus* and *Streptococcus* (Matos et al., 2012). In problems involving parasites, the most commonly identified mites are *Demodex canis* and *Sarcoptes scabiei*, causing demodectic mange and sarcoptic mange, respectively (Franco-Amorim et al., 2017). In respect to fungi, the dermatophytosis stands out, originated mainly by the species *Microsporum canis*, *Microsporum gypseum*, and *Trichophyton mentagrophytes*, and there is also the importance of commensal fungi, such as *Malassezia sp.* (Andrade; Rossi, 2019). This variable aetiology motivates distinct clinical manifestations that can present themselves in a localized or disseminated manner, with a changeable aspect, a fact that is possibly associated with the possibility of pathogen co-infection (Matos et al., 2012). Due to this wide variability in macroscopic lesions and etiologic agents involved, the diagnosis is considered difficult, posing a great challenge to the veterinary clinician (Franco-Amorim et al., 2010).

The correct diagnosis is essential for an adequate therapeutic conduct, avoiding the use of medication in an inappropriate manner and reducing negative repercussions, such as the increase of the treatment costs, bacterial and fungal

resistance, as well as aggravation of the patient's health, especially the debilitated ones (Gomes et al., 2012). Therefore, the knowledge of the aetiology culminates as an indispensable data for the veterinary clinical medicine, with the need for more information about the occurrence of skin diseases in different areas of the national territory (Cardoso et al. 2011; Gasparetto et al, 2013). Obtaining such data contributes to the prevention of diseases in other animals and also in humans, since these data vary according to the geographic area (Gasparetto et al, 2013). Thus, the objective of this study is to determine the epidemiological, clinical and laboratorial profile of dermatopathies that affect dogs and cats domiciled in a semi-arid area in the Northeast of Brazil.

2. Materials and methods

Ethical approval

This work was approved by the Ethics Committee on Animal Use (CEUA) of the Federal University of Western Bahia (UFOB), under license number 0017/2019.

Study location and sampling

Between the period from May 2018 to December 2019, the dogs and cats consulted at the University Veterinary Hospital (HVU) of the UFOB, Barra Multidisciplinary Centre, with presumptive diagnosis of dermatological disorders, were included in this study, regardless of gender, age, and breed. During veterinary clinical consultation, the lesions were characterized regarding the morphology, appearance, and distribution, in addition, an epidemiological questionnaire was applied in order to obtain general data on the sanitary and clinical-epidemiological history of the patient and knowledge of the owners about responsible ownership and animal welfare.

Sample Collection

Samples were collected from different areas of epithelial lesions using sterile scalpel blades for the purpose of scarification of the lesions, collection of crusts, hairs and lesion borders (Hnilica; Patterson, 2016), subsequently, they were sent to the Clinical Analyses and Veterinary Microbiology Laboratories of the same institution for processing.

Mite Survey

The skin scrapings were performed superficially and deeply, in addition to the collection of hair. Two drops of 10% potassium hydroxide (KOH) were added to these samples in order to digest the organic material and facilitate the visualization of parasitic structures. After 30 minutes the reading of the slide was carried out using an optical microscope with objectives of 10X and 40X, and the identification of the mites was based on structural characteristics (Hnilica; Patterson, 2016).

Mycological culture

The samples were seeded on Sabouraud Dextrose Agar with the addition of chloramphenicol, then, incubated in an oven for up to 15 days, with temperatures between 25 and 30°C, and the growth was monitored daily. The identification of the fungal species was carried out by evaluating the macroscopic morphological characteristics of the colonies (growth time, pigment production, appearance, morphology, verse and reverse), associated with microscopic characteristics such as hyphae staining, shape, arrangement, and spore formation (Lacaz et al., 2002; Oliveira et al., 2014). For this microscopic evaluation, the micro cultivation technique was used, with PDA - Potato Dextrose Agar (Anvisa, 2013).

Bacterial culture

Samples were streaked by depletion into Petri dishes containing 5% sheep blood agar and MacConkey agar media. They were then incubated at 37°C in aerobiosis, with consecutive readings at 24 and 72 hours. The identification of the species was performed from the macroscopic and microscopic characteristics of the colonies, in addition to biochemical tests (Murray et al, 1999), and the definitive confirmation was performed by the Matrix Associated Laser Desorption-Ionization - Time method (Barcelos et al., 2019).

Statistical Analysis

Information regarding the patients (age, breed, gender, type of bathing, access to the street) were used to determine the association with the risk of dermatopathies, by either Yates Chi-Square or Fisher's Exact Test (Thrusfield, 2006). The magnitude of the association was determined by calculating the Odds Ratio (OR) and analyses using EpiInfo™ 7.2.1.0 software (CDC, Atlanta, GA, USA), with the level of statistical significance at 5%.

3. Results

During the study period at the HVU-UFOB, a total of 354 dogs and cats were consulted, of which 78 were included in the study as they had dermatopathies, i.e., a portion of 22% (78/354) of all the veterinary consultations. The canine species made up 93.6% (73/78) of the patients and only 6.4% (5/78) belonged to the feline species. Among the canines, 56.2% (41/73) were male and 43.8% (32/73) were female, while in the feline species 60% (3/5) were male and 40% (2/5) were female, and there was no statistical correlation with the occurrence of dermatological problems ($p = 0.392$). As for age 46.3% (19/41) of the animals with dermatological problems were up to two years old, 41.5% (17/41) between two and seven years old, and 12.2% (5/41) older than seven years old.

In general, 61.5% (48/78) of the animals included in this study presented themselves as without a defined breed (WDB) and among the animals with defined breeds, it was observed that 23.3% (7/30) belonged to the Shih-tzu breed, 16.7% (5/30) to the Pinscher breed, 13.3% (4/30) to the Boxer breed, 10% (3/30) to the Pit Bull breed, 10% (3/30) to the Poodle breed, 6.7% (2/30) Dachshund breed. 0% (3/30) to the Poodle breed, 6.7% (2/30) to the Dachshund breed. The Rottweiler, Dobermann, Chihuahua, English Bulldog, Belgian Shepherd, and American Staffordshire Terrier breeds were equally distributed, accounting for 3.3% (1/30) each. Among the felines, 100% were WDB. Statistically the breed standard of the patients did not influence the presence of dermatopathies ($p=0.8092$).

Although all patients had clinical signs suggestive of dermatopathies, it was observed that 47.4% (37/78) had a negative laboratory diagnosis for bacterial, mycotic or parasitic disease. In contrast, 52.6% (41/78) of the patients tested positive for different aetiological agents (Table 1).

Table 1. Laboratory diagnosis for infectious causes correlated to canine and feline species. Analysis performed through 78 biological samples from animals seen at the University Veterinary Hospital (HVU) of the Federal University of Western Bahia (UFOB), Barra-BA Multidisciplinary Centre.

	Canine		Feline		TOTAL	
	N	%	N	%	N	%
Fungi	21	28.8	2	40	23	29.5
Bacteria	11	15.1	-	-	11	14.1
Scabies	3	4.1	-	-	3	3.9
Associations*	4	5.5	-	-	4	5.1
Negatives	34	46.6	3	60	37	47.4
TOTAL	73	100	5	100	78	100

* Associations between two or more pathogens of different species. Source: Authors.

The aetiological agents isolated from the dermatopathy cases were distributed between fungi, bacteria and mites, the latter being represented entirely by the *Demodex canis* mite (Table 2).

Given this scenario, there were cases of co-infection, with one dog presenting the association between two distinct fungal species, *Trichophyton rubrum* and *Microsporum canis*. A dog presenting with an association of *Staphylococcus pseudintermedius* and *Malassezia sp.* In two dogs there was an association between fungi, bacteria and mites: the first patient had coinfection by *Demodex canis*, *Malassezia sp.* and *Staphylococcus pseudintermedius*, and the second with coinfection by *Microsporum gypseum*, *Demodex canis*, *Staphylococcus simulans*, and *Klebsiella pneumoniae* (Table 2).

A portion of 7.7% (6/78) of the animals showed no macroscopically visible lesions, and the rest showed clinical signs characteristic of dermatological problems (Tables 3 and 4). Regarding the presence of ectoparasites, it was observed that 56.4% (44/78) of the animals included in this study had infestation by fleas and/or ticks, with no statistical significance as a predisposing factor to dermatological disorders ($p > 0.05$). In the patients positive for infectious and parasitic agents, 56.1% (23/41) had infestation by fleas and/or ticks, and in the animals that presented skin problems due to other causes, this percentage was 56.7% (21/37).

Table 2. Frequency of pathogens causing dermatological disorders in dogs and cats treated at the University Veterinary Hospital (HVU) of the Federal University of Western Bahia (UFOB), Barra-BA Multidisciplinary Centre.

	Etiological agent	N	%
Fungi	<i>Blastomyces dermatidis</i>	6	21.4
	<i>Microsporium gypseum</i>	5	17.8
	<i>Trichophyton rubrum</i>	4	14.3
	<i>Microsporium canis</i>	4	14.3
	<i>Epidermophyton floccosum</i>	3	10.7
	<i>Trichophyton mentagrophytes</i>	2	7.1
	<i>Malassezia</i> sp.	2	7.1
	<i>Trichophyton verrucosum</i>	1	3.6
	<i>Rhizopus</i> sp.	1	3.6
TOTAL		28	100
Bacteria	<i>Staphylococcus pseudintermedius</i>	10	66.7
	<i>Klebsiella pneumoniae</i>	2	13.4
	<i>Staphylococcus simulans</i>	1	6.7
	<i>Staphylococcus schleiferi</i>	1	6.7
	<i>Escherichia coli</i>	1	6.7
TOTAL		15	100
Mites	<i>Demodex canis</i>	3	100
TOTAL		3	100

Source: Authors.

Table 3. Anatomical distribution of macroscopic dermatological lesions in dogs and cats treated at the University Veterinary Hospital (HVU) of the Federal University of Western Bahia (UFOB), Barra-BA Multidisciplinary Centre, according to the laboratory diagnosis.

Injury site	Infectious		Other causes		TOTAL	
	N	%	N	%	N	%
Head and neck	4	9.8	3	9.7	7	9.7
Limbs and/or paws	4	9.8	4	12.9	8	11.1
Dorsal-ventral	11	26.8	15	48.4	26	36.1
Disseminated	22	53.7	9	29.1	31	43.1
TOTAL	41	100	31	100	72	100

Source: Authors.

It was found that 65.4% (51/78) of the animals had free access to the interior of their owners' homes, especially in the case of animals positive for infectious and/or parasitic agents in 63.4% (26/41). From the analysis of the information on responsible ownership, it was found that 53.7% (22/41) of the animals positive for infectious dermatopathies and 35.1% (13/37) of the negative animals had free access to the street. In relation to the environment where these animals lived, it was noticed that in the category of animals with infectious diseases, 65.8% (27/41) had contact with sand, while 34.2% (14/41) lived exclusively in places with cemented and/or ceramic floors. In animals with dermatological affections due to non-

infectious causes it was observed that 62.2% (23/37) had contact with sand and 37.8% (14/37) had contact only with cemented and/or ceramic floors.

Table 4. Macroscopic characteristics of dermatological lesions of dogs and cats treated at the University Veterinary Hospital (HVU) of the Federal University of Western Bahia (UFOB), Barra-BA Multidisciplinary Centre, according to the laboratory diagnosis.

Appearance of the lesion	Infectious								Other causes		TOTAL	
	Fungi		Bacteria		Scabies		Association*		N	%	N	%
	N	%	N	%	N	%	N	%				
Alopecia	19	79.2	7	63.6	3	100	3	75	26	70.3	58	74.4
Pruritus	17	70.8	7	63.6	2	66.7	4	100	18	48.7	48	61.6
Erythema	12	50	6	54.5	3	100	2	50	11	29.7	34	43.6
Pustule	4	16.7	2	18.2	-	-	1	25	4	10.8	11	14.1
Seborrhoea	3	12.5	-	-	1	33.4	2	50	6	16.2	12	15.4
Scabs	13	54.2	8	71.7	1	33.4	2	50	15	40.5	39	50
Hyperkeratosis	4	16.7	1	9.1	-	-	1	25	4	10.8	10	12.8
Nail alteration	-	-	-	-	-	-	-	-	1	2.7	1	1.3
Hyperpigmentation	-	-	1	9.1	-	-	-	-	1	2.7	2	2.6
Dry lesion	17	70.8	5	45.5	2	66.7	2	50	8	21.6	34	43.6
Humid lesion	-	-	2	18.2	-	-	-	-	1	2.7	3	3.8

Source: Authors.

Regarding the owners' knowledge of One Health, 51.3% (40/78) of those reported that they did not know what "zoonoses" were. Among the owners with animals positive for some pathogen, it was observed that 19.5% (8/41) of them reported lesions similar to those of their animals, during the same period of time. In this same group it was found that in 87.5% (7/8) of the cases the isolated agent was of fungal origin and 12.5% (1/8) of bacterial origin. In 8.1% (3/37) of the animals negative in the laboratory examination the report of a lesion similar to the animal in a simultaneous period also occurred.

4. Discussion

Clinical-epidemiological data about skin disorders in dogs and cats vary according to the geographic area (Gasparetto et al., 2013; Cardoso, 2011), which demonstrates the indispensable occurrence of studies of this veterinary specialty in different locations, basing the relevance of this study, which is pioneering in the Western Bahia region. The veterinary dermatologic casuistry has shown to be growing in recent years, with a variable frequency, with values of 11.5% (Neves et al., 2011), 11.53% (Afonso et al., 2018), and 21.34% (Khurana et al., 2016) of veterinary consultations. However, in the region where the present study was conducted, there is a noteworthy socioeconomic characteristic of a poor population associated with the low offer of veterinary technical assistance. In addition, the dry climate, high temperatures, and the significant number of stray animals may be factors that contributed to the high prevalence of dermatological disorders in the region analysed.

Most of the patients in this study belong to the canine species, with a smaller portion of felines presenting with dermatological disorders, a profile that has been demonstrated in some works (Palumbo et al, 2010; Neves et al., 2011) [17,20].

Although cats have a lower frequency of dermatological problems, some studies show the importance of this animal as an important source of subclinical or asymptomatic infection for humans and other animals (Nitta et al, 2016; Moosavi et al., 2019).

As for the age range, the most affected were generally young (Khurana et al, 2016), which may be attributed to the immunological immaturity presented by this group (Cardoso et al, 2011), similar to what happens with elderly and debilitated animals. Regarding the inherent predisposition for gender, other works confirm the absence of a relationship between the occurrence of dermatopathies and the gender of the patient (Cardoso et al, 2011; Neves et al., 2011).

Animals with defined breeds are often the most affected by dermatological disorders (Palumbo et al., 2010; Neves et al, 2011; Gasparetto et al., 2013; Afonso et al., 2018). Although in this study the opposite occurred, this information is not enough to ensure that WDB animals are more predisposed to dermatological diseases, but that this may be attributed to a cultural characteristic of the region studied, in which there is a predominance in the rearing of these animals.

The percentage of fungal dermatoses was similar to that found in a study, where these accounted for 61.9% of the total cases (Neves et al., 2011). However, other studies reveal distinct patterns, with a higher occurrence of parasitic dermatitis, followed by immunological, bacterial and fungal dermatitis (Gasparetto et al., 2013), respectively, or in researches where there is a higher frequency of bacterial dermatopathies, followed by parasitic and finally fungal (Cardoso et al., 2011). The results found in the literature collide with each other, which may be related to the climatic variability of the different regions (Cardoso et al., 2011; Khurana et al., 2019). It is believed that the high temperatures in the region, the availability of water resources associated with the extensive presence of stray animals, are important factors for the maintenance of fungal agents, justifying the high percentage of mycotic dermatopathies in the studied region.

In fungal dermatopathies the clinical signs of alopecia, pruritus, dry-looking lesions and crusts were found to be prevalent in most patients, distributed in a widespread manner and in the dorsal-ventral region, corresponding to the classic form of lesions caused by dermatophytes (Gomes et al., 2012), which was the most isolated fungal group in the present work. In an equivalent manner, another work showed that in 71% of dermatophytosis cases pruritus was present in varying degrees of intensity, alopecia in 66.6%, and crusting in 31.6% (Palumbo et al., 2010). Alopecia and crusts being the most important clinical signs for the manifestation of dermatophytosis (Neves et al., 2011).

The clinical and epidemiological importance of *M. canis* and *M. gypseum* is a widespread fact in the literature (Andrade; Rossi, 2019). In a research, the species *M. canis* and *M. gypseum* are highlighted as responsible for all cases of dermatophytosis (Gomes et al., 2012). The high occurrence of these zoophilic and geophilic pathogens, respectively, configure the expected results, as both are commonly isolated from humans and animals, and are considered the most common zoonotic agents (Andrade; Rossi, 2019). In the Barra region, there is a tendency to raise animals in a semi-domiciled manner, which favours the maintenance of pathogens in the environment and in animals, and may contribute to cases of direct and indirect transmission of such diseases.

Infection by *T. rubrum* in veterinary patients is considered atypical (Lagowski et al., 2019), however, its relevance in veterinary medicine is documented in some studies (Reis et al., 2020), and the possibility of transmission from man to animal has been contemplated (Kushida et al., 1975). It is important to emphasize the clinical presentation of the affection caused by this pathogen, with a pustular dermatophytosis being reported (Reis et al., 2020), similar to the results of the present study, where it was observed that a high percentage of patients with *T. rubrum* presented pustules, generating a clinical presentation easily confused with bacterial or even autoimmune diseases.

Among the other non-dermatophyte fungal species there was a significant amount of *B. dermatidis*, which is an environmental dimorphic fungus, which has pathogenic potential, causing mainly respiratory conditions, and dermatological

manifestations are rare (Bosco et al., 2016). In this particular case, most of the patients identified with *B. dermatidis* were living together in a crowded situation, which may characterize an outbreak of the disease (Bosco et al., 2016).

An interesting result was the occurrence of *T. verrucosum* among the isolated species, as this is a zoophilic dermatophyte commonly isolated in ruminants, and its occurrence in human beings has been reported (Jiang et al., 2019). In this case the patient was a young feline, raised in a home environment without direct contact with bovines, however, the animal's owner reported owning a small property in the rural area, which he visited constantly, this may have conferred the maintenance of the fungus on clothing and accessories, providing indirect contact and development of the fungal infection in the feline. Another possibility is direct transmission from the owner to the animal, as the owner reported having similar lesions to the animal in the same interval of time.

Bacterial dermatopathies were the second leading cause in this study, where *S. pseudintermedius* was mostly responsible for such cases. This species is of great veterinary clinical importance, accounting for up to 90% of canine pyodermitis (Sá et al., 2018), an important zoonotic pathogen on the rise, precisely due to the growing closeness between humans and companion animals (Somayaji et al., 2016). This high occurrence is related to the fact that *S. pseudintermedius* is commensal in the skin of healthy animals, and opportunistically causes disorders (Sá et al., 2018). However, there are reports of a low percentage of isolation of this species (6.97%) (Rafatpanah, 2020), once again exemplifying the variety of etiologic agents according to geographic area.

It is highlighted in this study the isolation of *K. pneumoniae* causing dermatological disorders. Bacteria of this genus are often associated with severe nosocomial infections, with resistance or even multidrug resistance to antimicrobials. *K. oxytoca* has been documented to cause disseminated dermatitis in dogs (Aquino; Herzig, 2018). In cases of canine pyodermitis in the form of mixed infections, isolation of 12.12% *K. pneumoniae* has been demonstrated (Shah et al., 2017), constituting a secondary infection. In the present study, one of the patients with *K. pneumoniae* had coinfection with *M. gypseum*, *D. canis*, and *S. simulans*, which are pathogens described as primary cause of infection, thus suggesting the occurrence of this species in an associated manner. In this case the primary infection could have generated a favourable microenvironment for the establishment of the opportunistic pathogen.

In bacterial dermatopathies the most frequent clinical sign was the occurrence of crusts, followed by alopecia, pruritus and erythema, which is compatible with the expected clinical picture (Sá et al., 2018). Another previous work illustrated that the main sites of cutaneous infection caused by bacteria comprised of the torso, head and limb region (Rafatpanah et al., 2020), a different profile from the results found. A study of experimental canine pyoderma infection showed that initial signs included erythematous papules, evolving into pustules, crusts, and epidermal collarettes, where the intensity of the lesions is directly related to the degree of impairment of the cutaneous barrier (Baumer et al., 2017), therefore changes in the lesion patterns are justifiable, according to the stage of the disease's progression.

The association of pathogens in dermatological conditions is usually related to more severe cases, and is considered by some authors as rare, since they are little described in the literature (Matos et al., 2012). In one case there was an association between *M. gypseum*, *D. canis*, *S. simulans* and *K. pneumoniae*, thus representing a fungal, parasitic and bacterial infection, similar to a report available in the literature (Lockwood et al., 2017), which demonstrated the importance of the basic diagnosis associated with prudent therapy as a prophylactic form of more serious cases such as the one described. Interestingly, in half of the cases in which the association between pathogens was observed, there was the use of drug therapy without veterinary guidance, which may probably have influenced the complication of the animal's clinical condition. Dermatopathies with association of pathogens presented a wide variety of lesions, generating a nonspecific clinical profile, severe and easily confused with possible differential diagnoses (Matos et al., 2012).

Several studies portray the importance of parasitic dermatopathies in the small animal clinic (Gasparetto et al., 2013), with the *D. canis* mite as the most prevalent etiological agent of dermatological disorders, contrary to the result found. As already commented, the variety and frequency of dermatological problems are associated with the study region and local climatic conditions (Khurana et al., 2016), demonstrating the need for clinical epidemiological studies in different geographic areas. Clinical manifestations of disseminated canine demodicosis, similar to the cases in this study, represented a percentage of 80% (24/30) of the animals in another work (Filgueira et al. 2019). It is emphasized that this is the most severe form of the disease, in which genetic and immunosuppression factors can increase the severity, complicating the patient's prognosis.

Infestation by ticks and fleas was not a statistically significant factor in the establishment of dermatopathies, despite its significant percentage. Ectoparasites cause pruritic affections, microtrauma and abrasions on the skin, generating a compromise of the cutaneous barrier, which can be sufficient for the installation of pathogens, generating pyodermitis conditions (Baumer et al., 2017), or allergic dermatitis, such as allergic dermatitis due to flea bites.

In the present study, the portion of patients that had negative microbiological and parasitological results, even when presenting signs of skin problems, may be associated with other possible causes that were not the subject of this study. Clinical dermatological manifestations occur without necessarily the presence of the investigated pathogens, as is the case of immunological, endocrine, nutritional, psychogenic, congenital dermatopathies, among others, thus revealing an even greater challenge for the veterinary clinician (Cardoso et al., 2011; Gasparetto et al., 2013; Khurana et al., 2016; Afonso et al., 2018).

In the context of responsible ownership, it is worth pointing out that free access to the street can predispose to health problems, as these animals have eventual contact with stray animals, favouring the transmission of infectious and contagious diseases. As for the living environment, in the group of dermatopathic animals positive for fungi, bacteria and/or mites, there was a high percentage of animals that lived in environments with sand, which the authors of this study believe favours the occurrence of dermatological disorders, since this environment is a natural habitat for some pathogens and also for environmental allergens.

The increase of the proximity between humans and animals is a widespread fact worldwide. In the present study the frequency of animals living inside the house proved to be high, including in the group of animals that tested positive for fungus, scabies, and/or bacteria. In another research 69.8% (90/129) of the owners kept their animals inside their homes, and in 57.4% (74/129) this contact was even closer, with the sharing of spaces of predominantly human use (bed and sofas), which may facilitate the zoonotic transmission of pathogens (Carobeli et al., 2019).

The significant number of owners who admitted that they didn't know what "zoonoses" were, reveals the need for investment in health education addressing topics of importance to One Health. Regarding the possibility of transmission of these diseases, a relevant percentage of the owners of animals which were positive for pathogens stated that they were presenting lesions concomitantly with their animals, and this fact was observed in cases of mycotic and bacterial dermatitis, which are important potentially zoonotic pathogens (Somayaji et al., 2016; Andrade; Rossi, 2019).

Dermatopathies have repercussions on the health and well-being of animals and their owner. This, plays the fundamental role in recognizing the problem (Madureira; Brum, 2017). In this sense, according to the concept of unique health, idealized initially by Calvin Schwabe, which advocates the integration between human and animal health, especially in the transmission of zoonotic agents (Schwabe, 1984; Destoumieux-Garzón et al., 2018), the study on the etiology and epidemiology of skin conditions in animals, as described in this study, is an important strategy for understanding the general panorama of infection in animals, being an initial stimulus for the conception of other related studies, as well as a tool for veterinary clinicians to diagnosis, and prevent the occurrence of the disease in other animals and also in humans.

5. Conclusion

In conclusion, in the present study dermatopathies have shown to be important ailments of domiciled dogs and cats, especially the mycotic and bacterial diseases, representative percentages of 29.5% and 14.1%, respectively. Atypical cases of dermatological infections motivated by pathogens little described in the literature as aetiological agents of dermatopathies in dogs and cats were observed, revealing a distinct pattern from other geographic areas. The region studied presents particular geographic, economic, and social characteristics, which can contribute to the occurrence of infectious and contagious diseases in domestic animals and also in humans, lacking further studies and interventions in the One Health field.

References

- Afonso, M. V. R., Cardoso, J. P. & Barreto, S. M. P. (2018). Diagnóstico dermatopatológico em cães. *Rev. Ciên. Vet. Saúde. Públ.*, 5(2): 98-108.
- Andrade, V. & Rossi, G. A. M. (2019). Dermatofitose em animais de companhia e sua importância para a Saúde Pública – Revisão de Literatura. *Rev. Bras. Hig. San. Anim.*, 13(1):142– 155.
- Aquino, S. & Herzig, K. (2018). *Klebsiella oxytoca* multirresistente como agente de dermatite disseminada em cão. *Acta Scientiae.Vet.* 46:324, 2018.
- Barcelos, M. M., Martins, L., Grenfell, R. C., Juliano, L., Anderson, K. L., Santos, M. V & Gonçalves, J. L. (2019). Comparison of standard and on-plate extraction protocols for identification of mastitis-causing bacteria by MALDI-TOF MS. *Braz. J. Microbiol.*, (50): 849 – 857.
- Baumer, W., Bizikova, P., Jacob, M. & Linder, K. E. (2017). Establishing a canine superficial pyoderma model. *Journal. App. Microb.*, 122(2):331-337.
- Brasil. Agência Nacional de Vigilância Sanitária. (2013). Microbiologia Clínica para o Controle de Infecção Relacionada à Assistência à Saúde. Módulo 8: Detecção e identificação de fungos de importância médica. Brasília: Anvisa, 30-31.
- Cardoso, M. J. L., Machado, L. H. A., Melussi, M., Zamarian, T. P., Carnielli, C. M. & José Júnior, C. M. F. (2011) Dermatopatias em cães: 257 casos. *Arch. Vet. Sci.*, 16(2):66-74.
- Carobeli, L. R., Diniz, B. V., Carvalho, N. M. M., Chinen, L. Y., Tanoye, J. L., Svidzinski, T. I. E., Veiga, F. F. & Negri, M. (2019). Fatores de virulência de fungos relacionados a zoonoses isolados em ambiente de banho e tosa de um *pet shop*. *Rev. Saúde. Meio. Amb.*, 9(2):49-65.
- Destoumieux-Garzón, D., Mavingui, P., Boetsch, G., Boissier, J., Darriet, F., Duboz, P., Voituren, Y. (2018). The one health concept: 10 years old and a long road ahead. *Frontiers in veterinary science*, 5, 14.
- Filgueira, R. K. R. B., Leite, M. C., Freitas, M. V. M., Rodrigues, M. C. & Melo Evangelista, L. S. (2019). Demodicose em cães atendidos em um hospital veterinário universitário. *Ciência Anim.*, 29(3):11-21.
- Franco-Amorim, E. F., Santos, A. C. G., Reis, H. R. C. & Guerra, R. M. S. N. (2010). Diagnóstico laboratorial e aspectos clínicos das infestações por artrópodes parasitos e fungos em cães. *Pesq. Foc.*, 18(1):69-81.
- Gasparetto, N. D., Trevisan, Y. P. A., Almeida, N. B., Neves, R. C. S. M., Almeida, A. B. P. F., Dutra, V., Colodel, E. M. & Sousa, V. R. F. (2013). Prevalência das doenças de pele não neoplásicas em cães no município de Cuiabá, Mato Grosso. *Pesq. Vet. Bras.*, 33(3):359-362.
- Gomes, A. R., Madrid, I. M., Matos, C. B., Telles, A. J., Waller, S. B., Nobre, M. O. & Meireles, M. C. A. (2012). Dermatopatias Fúngicas: aspectos clínicos, diagnósticos e terapêuticos. *Acta Vet. Bras.*, 6(4):272-284.
- Hnilica, K. A. & Patterson, A. P. (2016). Diagnostic Techniques. In: Hnilica, K. A. and Patterson, A. P. *Small animal dermatology: a color atlas and therapeutic guide*. 4th ed. *Elsevier Health Sciences*, St. Louis, Missouri. pp. 30-44.
- Jiang Y., Zhan P., Al-Hatmi A. M. S., Shi G., Wei, Y., Ende, A. H. G. G., Meis, J. F., Lu, H. & Hoog, G. S. (2019). Extensive tinea capitis and corporis in a child caused by *Trichophyton verrucosum*. *Jour. Med. Myc.*, 29(1):62-66.
- Khurana, R., Kumar, T., Agnihotri, D. & Sindhu, N. (2016). Dermatological disorders in canines- a detailed epidemiological study. *Haryana Vet*, 55(1):97-99.
- Kushida, T. & Watanabe, S. (1975). Canine ringworm caused by *Trichophyton rubrum*: probable transmission from man to animal. *Sabouraudia*, 13(1):30-32.
- Lacaz, C. S., Porto, E., Martins, J. E. C., Heins-Vaccari, E. M. & Melo, N. T. (2002). Tratado de micologia médica. (9a ed.), Sarvier, 1103-1104.
- Lagowski, D., Gnat, S., Nowakiewicz, A., Osinska, M. & Zieba, P. (2019). The prevalence of symptomatic dermatophytoses in dogs and cats and the pathomechanism of dermatophyte infections. *Adv. Microbiol.* 58: 165-176.
- Lockwood, S. L., Mount, R., Lewis II, T. P. & Schick, A. E. (2017). Concurrent development of generalised demodicosis, dermatophytosis and meticillin-resistant *Staphylococcus pseudintermedius* secondary to inappropriate treatment of atopic dermatitis in an adult dog. *Vet. Rec. Case. Rep.*, 5(1):1-7.
- Madureira, R., Brum, J. S. (2017). Diagnóstico dermatológico em pequenos animais: o que pode influenciar? *Archives of Veterinary Science*, 22(4).
- Matos, C. B., Madrid, I. M., Santin, R., Azambuja, R. H., Schuch, I., Meireles, M. C. A. & Cleff, M. B. (2012). Dermatite multifatorial em um canino. *Arg. Bras. Med. Vet. Zootec.* 64:1478-1482.

- Bosco, S. M. G., Bagagli, E., Baumgardner, D. J. (2016) Blastomicose. In: Megid, J., Ribeiro, M. G., Paes, A. C. Doenças infecciosas em animais de produção e companhia. Roca, Rio de Janeiro, Brazil, 861–868.
- Megid J., Ribeiro M. G. & Paes A. C. 2016. Doenças Infecciosas em Animais de Produção e de Companhia. 1296. Editora ROCA.
- Moosavi, A., Ghazvini, R. D., Ahmadikia, K., Hashemi, S. J., Geramishoar, M., Mohebal, M., Yekaninejad, M. S., Bakhshi, H. & Khodabakhsh, M. (2019). The frequency of fungi isolated from the skin and hair of asymptomatic cats in rural area of Meshkin-shahr-Iran. *Journ. Med. Myc.* 19(1):14-18.
- Murray, P. R., Baron, E. J., Pfaller, M. A., Tenover, F. C. & Tenover, R. H. (1999). Manual of Clinical Microbiology. American Society for Microbiology. 7^{ed}. Washington. D. C., pp. 325-337.
- Neves, R. C. S. M., Cruz, F. A. C. S., Lima, S. M., Torres, M. M., Dutra, V. & Sousa, V. R. F. (2011). Retrospectiva das dermatofitoses em cães e gatos atendidos no Hospital Veterinário da Universidade Federal de Mato Grosso, nos anos de 2006 a 2008. *Ciência Rural*, 41(8):1405-1410.
- Nitta, C. Y., Daniel, A. G. T., Taborda, C. P., Santana, A. E. & Larsson, C. E. (2016). Isolation of dermatophytes from the hair coat of healthy persian cats without skin lesions from commercial catteries located in São Paulo Metropolitan Area, Brazil. *Acta. Sci. Vet.*, 44:1-7.
- Oliveira, J. C. (2014). Diagnóstico Micológico por Imagens. 11-92.
- Palumbo, M. I. P., Machado, L. H. A., Paes, A. C., Mangia, S. H. & Motta, R. G. (2010). Estudo epidemiológico das dermatofitoses em cães e gatos atendidos no serviço de dermatologia da Faculdade de Medicina Veterinária e Zootecnia da UNESP–Botucatu. *Ciências Agrárias*, 31(2):459-468.
- Rafatpanah, S. H., Rad, M., Movassaghi, A. R. & Khoshnegah, J. (2020). Clinical, bacteriological and histopathological aspects of firsttime pyoderma in a population of Iranian domestic dogs: a retrospective study. *Iran. Journal. Vet. Research.*, 21(2):130-135.
- Reis, L. B., Sperb, A. D. M., Teixeira, J., Andrade, R. L. F. S., Coelho, R. A. & Borges, L. V. (2020). Pustular dermatophysosis in a feline by *Tricophyton rubrum*: case report. *Pub. Vet.*, 14(1):1-5.
- Sá, I. S., Almeida, L. F., Souza, C. P., Batista, R. M. O., Lima, D. A. S. D., Pereira, E. A., Benvenuto, M. E. M., Machado, F. C. F., Farias, M. P. O., Silva Filho, M. L. & Machado Junior, A. A. N. M. (2018). Piodermite canina: Revisão de literatura e estudo da prevalência de casos no Hospital Veterinário Universitário da UFPI, Bom Jesus – Brasil. *Pub. Vet.*, 12(6):1-5.
- Schwabe C. *Medicina Veterinária e Saúde Humana*. Baltimore: Williams & Wilkins (1984). 713 p.
- Shah, B., Mathakiya, R., Rao, N. & Nauriyal, D. S. (2017). Organisms recovered from cases of canine pyoderma and their antibiogram pattern. *Jour. Anim. Reseach.*, 7(6):1067-1073.
- Somayaji, R., Rubin, J. E., Priyantha, M. A. R. & Church, D. (2016). Exploring *Staphylococcus pseudintermedius*: an emerging zoonotic pathogen? *Fut. Mycrob.* 11:1371-1374.
- Thrusfield, M. (2004). Epidemiologia Veterinária. (2a ed.), Roca, 555-556.