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ORIGINAL RESEARCH

Is signalment associated with clinicopathological findings in dogs with leishmaniosis?

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Abstract

Background: Canine leishmaniosis (CanL) is a common infectious disease. Age, sex and breed might influence the type of clinical and pathological manifestations that dogs develop. The main objective of this retrospective cross-sectional study was to determine if an association between age, sex, breed and size and the clinical findings of CanL exists.

Material and methods: Dogs with a diagnosis of leishmaniosis were enrolled ($n = 123$). Clinical information, including signalment, clinical signs and laboratory abnormalities, was retrieved from medical records from different veterinary facilities from Catalonia.

Results: Young dogs developed less frequently systemic signs ($p = 0.0046$), renal ($p = 0.0019$) and haematologic ($p = 0.0275$) abnormalities, while dermatologic signs were more common in young and adult dogs compared with old ones ($p = 0.0451$). Young dogs showed proteinuria less often than adult and old dogs ($p = 0.0029$). Young dogs did not present renal azotemia, while old dogs showed occasionally renal azotemia ($p = 0.0478$). Young dogs were mainly classified as mild-moderate LeishVet clinical stages of the disease, and very rarely as severe-very severe LeishVet clinical stages, compared with adult and old dogs ($p = 0.0457$). Purebred dogs significantly developed ulcerative dermatitis more frequently than crossbred dogs ($p = 0.0460$).

Conclusion: This study describes that age is associated with differences in clinicopathological findings of CanL.

INTRODUCTION

Canine leishmaniosis (CanL) is a vector-borne disease caused by *Leishmania infantum*. Dogs are the main reservoir host of the parasite, which can also infect humans. This protozoan requires a phlebotomy sand fly vector, which transmits the promastigote form, and a mammal, where the intracellular amastigote form develops and replicates, to complete its cycle.[1]

Canine leishmaniosis is endemic in more than 70 countries all over the world,[2] especially where the ecological and climate conditions are more appropriate for the vector. In Europe, the endemic regions are those beside the Mediterranean Sea, even though the prevalence of leishmaniosis has increased in non-endemic countries due to the large number of dogs travelling from Southern Europe and the presence of the vector in latitudes where it did not traditionally exist.[3] In endemic areas, the prevalence of the disease is frequently lower than 10%, while subclinical infection is much higher.[2]

When dogs are infected by *L. infantum*, the immune system can respond against the parasite with a cellular response that induces macrophages anti-*Leishmania* activity which appears to be protective for the animal, or with a humoral non-protective response based on the production of non-protective antibodies.[4] The type of predominant individual immune response is crucial in the presentation of the disease and determinates the clinical signs and clinicopathological abnormalities in each dog. Clinical manifestations can range from a mild papular dermatitis associated with a low humoral response and a predominance of parasite-specific cellular immunity, to a severe disease characterized by renal damage associated with the glomerulonephritis caused by immunocomplex depositions due to a massive humoral response and high parasite load.[5]

Clinical signs can be widely different and are usually non-specific. Therefore, leishmaniosis can be included in a large number of differential diagnoses.[5] Cutaneous manifestations are among the most

frequent clinical sign found in sick dogs' physical examination and include non-pruritic desquamative dermatitis, ulcerative dermatitis, muco-cutaneous nodular dermatitis and papular dermatitis.[6–8] Common extra-cutaneous signs also include lymphadenomegaly, anorexia, weight lost or lethargy among others.[5] Ocular disease is reported to occur in almost 25% of affected dogs, which can present signs such as blepharitis, keratoconjunctivitis, anterior uveitis and keratoconjunctivitis sicca (KCS).[9] Vascular and neurological disorders can occasionally appear in sick animals.[1,10,11]

Typical laboratory findings are hyperglobulinaemia, hypoalbuminaemia, mild to moderate non-regenerative anaemia and mild to severe proteinuria among others extensively reviewed elsewhere.[12] Even renal disease is the main cause of mortality in dogs due to leishmaniosis,[1] renal azotaemia is not a common clinicopathologic finding because it appears when the damage is extensive enough to incapacitate renal function.[2]

Different factors determinate the susceptibility of a dog for this infection and development of the disease such as age, sex, nutrition, host genetics, coinfections or concomitant disease, immunosuppressive conditions, cytokine environment, parasitic burden, virulence of *Leishmania* strain, previous infections and method of transmission.[5,13] A bimodal age distribution is seen in dogs with clinical leishmaniosis, with a first peak found around 3 years old and a second peak observed in dogs older than 8 years.[14] This distribution can be explained by the fact that more susceptible dogs manifest the disease at an early age, while other dogs are more resistant initially but develop clinical leishmaniosis lately when the immune system declines or present a concomitant morbidity.[15] There is no agreement about sexual predisposition to develop clinical leishmaniosis. Some studies have reported that males are more affected by the disease,[15,16] although some others did not observe differences between sex.[17] However, sex seems to be a major determinant of the clinical evolution, and immune response in hamsters infected with *Leishmani*a spp., as male animals have an inherent risk of increased disease severity.[18] Some breeds seem to have more tendency to be affected by the disease like boxer, cocker spaniel, German shepherd and Doberman,[16,19] while others like poodle or Yorkshire terrier seem to be less frequent affected by leishmaniosis.[15] Dogs with short hair and living outdoors seem to present the disease more frequently.[16,19] The Ibizan hound rarely develop the disease due to a predominant cellular immune response against *L. infantum*.[20]

Age, sex and breed might influence the type of clinical manifestation that dogs develop as well as the outcome of infection. Although previous studies have reported that certain characteristics of the dogs signalment may be risk factors for CanL presentation, it has not been studied whether signalment can influence the type of clinical and pathological alterations observed in patients suffering from the disease. Since the clinicopathological abnormalities of CanL can be widely different, it would be useful for clinicians to know if there is any specific clinical abnormality according to signalment in order to prioritize CanL in their differential diagnosis. Therefore, the objective of this retrospective study was to determine if an association between age, sex, breed and size and the clinical and pathological presentation of CanL exists.

MATERIAL AND METHODS

Clinical data

A total of 123 privately owned dogs with a diagnosis of leishmaniosis made between 2000 and 2017 were retrospectively included in the present study. A signed informed consent was obtained from tutors. Clinical information including signalment, clinical signs and laboratory abnormalities was retrieved from medical records from different veterinary facilities from Catalonia: *Fundació Hospital Clínic Veterinari* (Bellaterra, Barcelona), *Hospital Ars Veterinària* (Barcelona) and *Hospital Mediterrani Veterinaris* (Reus, Tarragona). The diagnosis of leishmaniosis was based on the presence of compatible clinical signs and/or clinicopathological abnormalities and the results of the diagnostic techniques performed: serology for the detection of *Leishmania* antibodies (ELISA or indirect immunofluorescence), and/or identification of *Leishmania* amastigotes in cytology and/or histology with or without immunochemistry for *Leishmania*, and/or detection of *Leishmania* DNA with PCR.[21] Dogs with concomitant diseases were only included if clinical signs were controlled or were clinically not attributed to leishmaniosis. Moreover, laboratory test to rule out other vector-borne diseases were performed when deemed clinically necessary by the clinician.

The information obtained through the clinical history, physical examination and laboratory tests of each dog was used to fill out a database. According to their signalment and weight, dogs were grouped in the following categories: male or female; purebred or crossbred; young (younger than 3-year-old), adult (from 3- to 8-year-old) or old (older than 8-year-old); small sized (<10 kg), medium sized (10–20 kg) or large sized (20 kg). Clinical signs at the moment of the diagnosis were also recorded and grouped according the system affected: systemic clinical signs (i.e., low body condition, apathy, anorexia or hyporexia, weakness, fever, lymphadenomegaly, hepatomegaly, splenomegaly and epistaxis); dermatologic signs (i.e., desquamative dermatitis +/- alopecia, papular dermatitis, nodular dermatitis, ulcerative dermatitis and onychogryphosis); ophthalmologic signs (i.e., conjunctivitis, KCS, blepharitis, corneal edema and ocular mucosal discharge); musculoskeletal signs (i.e., lameness, articular pain and muscular atrophy); gastrointestinal signs (i.e., vomiting and diarrhea); and neurologic signs (i.e., ataxia and lumbar pain). According to laboratory

reference intervals, alterations in the complete blood count (CBC), biochemical profile, urinalysis and serum electrophoresis were recorded as follows: renal azotaemia, proteinuria, hyperproteinaemia, hypoalbuminaemia, hyperglobulinaemia, hyperbetaglobulinaemia, hypergammaglobulinaemia, anaemia and thrombocytopenia. In addition, values of creatinine, urea, urine protein creatinine ratio (UPC), urine-specific gravity, cholesterol, total protein, albumin, beta-globulin, gamma-globulin, alanine transferase, alkaline phosphatase, red blood cells, hemoglobin, neutrophils and platelets were also recorded. The different laboratory abnormalities observed in the dogs studied were grouped according to the system affected. Dogs that presented anaemia or/and thrombocytopenia were considered to have haematological alterations, dogs that presented proteinuria or/and renal azotaemia were considered to have renal alterations, and dogs that presented one or multiple alterations in serum proteins were included in the group of dysproteinaemia.

Clinical stage of the disease according to Leishvet clinical staging of CanL based on serological status, clinical signs and laboratory findings was also determined.[1] Disease severity was compared between dogs suffering from a mild or moderate Leishvet clinical stage (I-II) of the disease with those suffering a severe or very severe clinical stage (III-IV).

Statistical analysis

The statistical analysis was performed using the R program version R 3.6.2 GUI 1.70 (R Development Core Team).

Statistical $\chi 2$ test was used to compare the presence or absence of clinical signs and laboratory abnormalities and the severity of the disease according to sex, breed, age or size. Fisher´s exact probability test was applied when the expected values in any of the cells of a contingency table were below 5. Data analysis of quantitative variables was performed using Man-Whitney U-test to compare laboratory results between two groups (sex and breed) and Kruskal-Wallis when comparing three groups (age and size). Statistical significance was considered at $p < 0.05$.

RESULTS

Signalment and distribution of size

Results of breed, sex, age and distribution of size of dogs studied are listed in Table 1.

TABLE 1 Distribution of breed, sex, age and size of the dogs studied

Breed	**Number of dogs (%)**
Crossbred	43 (35.0%)
Purebred	80 (65.0%)
Labrador retriever	9 (7.3%)
Boxer	8 (6.5%)
Golden retriever	7 (5.7%)
German shepherd	6 (4.9%)
Dachshund	5 (4.1%)
French bulldog	5 (4.1%)
American bully	3 (2.4%)
American Stafford Terrier	3 (2.4%)
Greyhound	3 (2.4%)
West highland Terrier	3 (2.4%)
Other breeds	28 (22.8%)
Sex	**Number of dogs (%)**
Male	72 (58.5%)
Female	51 (41.5%)
Age (years)	**Number of dogs (%)**
<3	38 (30.9%)
3–8	60 (48.8%)
>8	25 (20.3%)
Size	**Number of dogs (%)**
Small (<10 kg)	17 (15.0%)
Medium (10–20 kg)	29 (25.7%)
Large (>20 kg)	67 (59.3%)

Clinical signs, laboratory abnormalities and clinical stage

The main type of clinical signs observed in the dogs included in the study were dermatologic signs (68.3%), followed by systemic signs (60.2%), being lymphadenomegaly the most frequent one (43.9%). Musculoskeletal, ophthalmologic, gastrointestinal and neurologic signs were less commonly observed (Table 2). Regarding laboratory abnormalities, alterations in the protein electrophoresis were the most frequent findings. The 89.1% of the dogs with protein electrophoresis evaluated ($n = 110$) presented one or multiple alterations. Polyclonal hypergammaglobulinaemia was the most common alteration noted (68.2%), closely followed by hyperproteinaemia (67.3%). CBC alterations were reported in 51.9% of the dogs evaluated ($n = 77$), and anaemia was the main alteration encountered (48.1%). In dogs in which biochemical profile and urinalysis was performed ($n = 104$), alterations on the renal parameters were less frequently found (25%) (Table 3). Most dogs studied were classified in the mild or moderate clinical stage of leishmaniosis (80.8%), while 19.2% of dogs were included in the severe or very severe stage of the disease (Table 4).

Clinical signs, laboratory abnormalities and clinical stage based on signalment and size

Young dogs developed less frequently systemic signs ($p = 0.0046$, $X^2 = 10.76$, $df = 2$), compared with the adult and old dogs, while dermatologic signs were more common in young and adult dogs ($p = 0.0451$,

TABLE 2 Distribution of the clinical signs of the dogs studied

Clinical signs	Number of dogs (%, 95% CI)
Dermatologic signs	**84 (68.3%, 60.1%–76.5%)**
Ulcerative dermatitis	43 (35.0%, 26.5%–43.4%)
Papular dermatitis	29 (23.6%, 16.1%–31.1%)
Desquamative dermatitis (+/- alopecia)	22 (17.9%, 11.1%–24.7%)
Nodular dermatitis	13 (10.6%, 5.1%–16.0%)
Onychogryphosis	2 (1.6%, 0.0%–3.9%)
Systemic signs	**74 (60.2%, 51.5%–68.8%)**
Lymphadenomegaly	54 (43.9%, 35.1%–52.7%)
Apathy-anorexia	24 (19.5%, 12.5%–26.5%)
Body condition < 4/9	13 (10.6%, 5.1%–16.0%)
Weakness	11 (8.9%, 3.9%–14.0%)
Epistaxis	5 (4.1%, 0.6%–7.6%)
Splenomegaly	5 (4.1%, 0.6%–7.6%)
Fever	3 (2.4%, 0.0%–5.2%)
Hepatomegaly	1 (0.8%, 0.0–2.4%)
Musculoskeletal signs	**17 (13.8%, 7.7%–19.9%)**
Lameness	14 (11.4%, 5.8%–17.0%)
Muscular atrophy	2 (1.6%, 0.0%–3.9%)
Articular pain	2 (1.6%, 0.0%–3.9%)
Ophthalmologic signs	**15 (12.2%, 6.4%–18.0%)**
Blepharitis	8 (6.5%, 2.2%–10.9%)
Keratoconjunctivitis sicca	3 (2.4%, 0.0%–5.2%)
Conjunctivitis	3 (2.4%, 0.0%–5.2%)
Mucosal discharge	1 (0.8%, 0.0%–2.4%)
Corneal edema	1 (0.8%, 0.0%–2.4 %)
Gastrointestinal signs	**13 (10.6%, 5.1%--16.0%)**
Vomiting	8 (6.5%, 2.2%–10.9%)
Diarrhea	8 (6.5%, 2.2%–10.9%)
Neurologic signs	**1 (0.8% 0%–2.4%)**

Abbreviation: CI, confidence interval.

TABLE 3 Distribution of the laboratory alterations of the dogs studied

Laboratory findings	Number of dogs (%, 95% CI)
Protein electrophoresis alterations ($n = 110$)	**98 (89.1%, 83.3%–94.9%)**
Polyclonal hypergammaglobulinaemia	75 (68.2%, 59.5%–76.9%)
Hyperproteinaemia	74 (67.3%, 58.5%–76%)
Hypoalbuminaemia	66 (60%, 50.9%–69.2%)
Polyclonal hyperbetaglobulinaemia	39 (35.5%, 26.5%–44.4%)
Haematologic alterations ($n = 77$)	**40 (51.9%, 40.8%–63.1%)**
Normocytic normochromic anaemia	37 (48.1%, 36.9%–59.2%)
Thrombocytopenia	17 (22.1%, 12.8%–31.4%)
Renal alterations ($n = 104$)	**26 (25.0%, 16.7%–33.3%)**
Proteinuria	21 (20.2%, 12.5%–27.9%)
Renal azotaemia	10 (9.6%, 4.0%–15.3%)

Abbreviation: CI, confidence interval.

TABLE 4 Distribution of the clinical stage of the dogs studied

Clinical stage ($n = 104$)	Number of dogs (%, 95% CI)
I-mild disease	11 (10.6%, 4.7%–16.5%)
II-moderate disease	73 (70.2%, 61.4%–79.0%)
III-severe disease	13 (12.5%, 6.1%–18.9%)
IV-very severe	7 (6.7%, 1.9%–11.6%)

Abbreviation: CI, confidence interval.

$X^2 = 6.199$, $df = 2$) (Figure 1). Renal ($p = 0.0019$, $X^2 = 12.58$, $df = 2$), and haematological ($p = 0.0275$, $X^2 = 7.182$, $df = 2$) abnormalities were less frequently found in young dogs compared with the adult and old ones (Figure 1). Young dogs were mainly classified in mild-moderate stages of the disease and very rarely in severe-very severe stages, compared with adult and old dogs ($p = 0.0457$, $X^2 = 6.172$, $df = 2$) (Figure 1). Regarding dermatologic signs, purebred dogs significantly developed ulcerative dermatitis more frequently than crossbred dogs ($p = 0.046$, $X^2 = 3.983$, $df = 1$). Concerning systemic signs, old dogs presented a lower body condition than young dogs ($p = 0.0175$, $X^2 = 8.090$, $df = 2$). Weakness was more commonly found in small sized dogs ($p = 0.0048$, $X^2 = 10.66$, $df = 2$) than in medium and large-sized dogs. According to laboratory abnormalities, young dogs showed proteinuria less often than older dogs ($p = 0.0029$, $X^2 = 11.67$, $df = 2$). Hyperbetaglobulinaemia was more frequently observed in medium and large sized dogs than in small sized dogs ($p = 0.0023$, $X^2 = 12.17$, df = 2). The only numerical haematological and biochemical parameters that were significant were UPC regarding age and platelet number regarding sex. The results are graphically displayed in Figures 2 and 3.

DISCUSSION

To the best knowledge of the authors, the results of this study seem to indicate, for the first time, that young dogs present less frequent clinicopathological findings than older dogs with leishmaniosis. They suffered less frequently systemic signs, renal and haematological alterations and were more prone to develop dermatologic signs. These results could suggest that some young dogs probably have a good immune response against *Leishmania* infection and develop cutaneous lesions at an early age with less systemic involvement. As reported previously, some skin manifestations, as papular dermatitis, appear to be associated with an effective cellular immune response and, consequently, with a favorable prognosis.[8,22–24] In addition, the observation of cutaneous lesions by the owners could accelerate the diagnosis of leishmaniosis in these patients, when organic damage is minor because they have not had enough time to developed lesions associated with chronic inflammation due to the presence of *Leishmania*. Instead, dogs with a non-protective humoral response and a high parasite load may develop a progressive and insidious systemic-organic dissemination of the infection

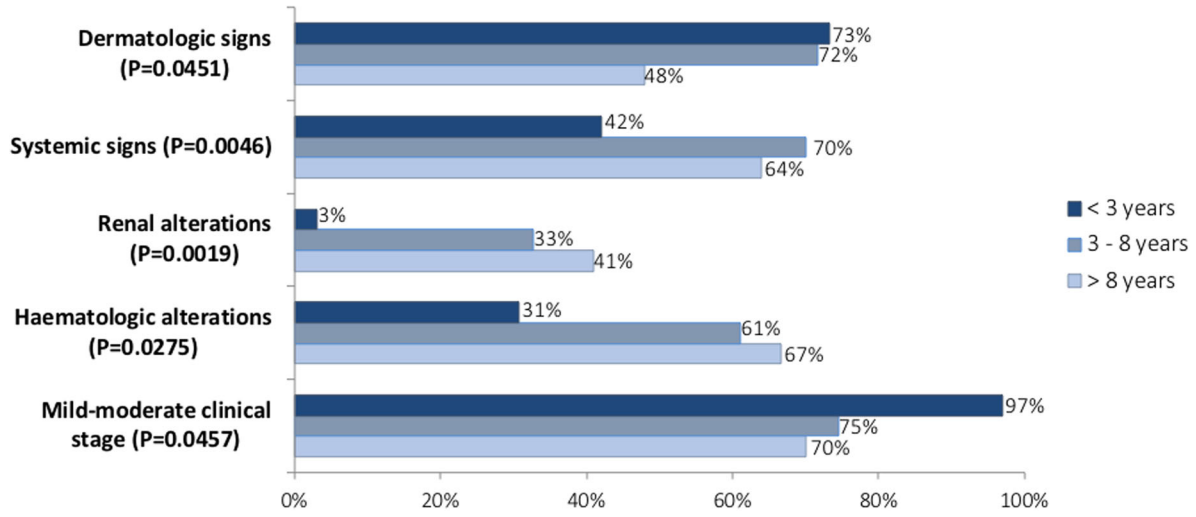

FIGURE 1 Significant results of the frequency of clinical signs, laboratory findings and clinical stage based on age

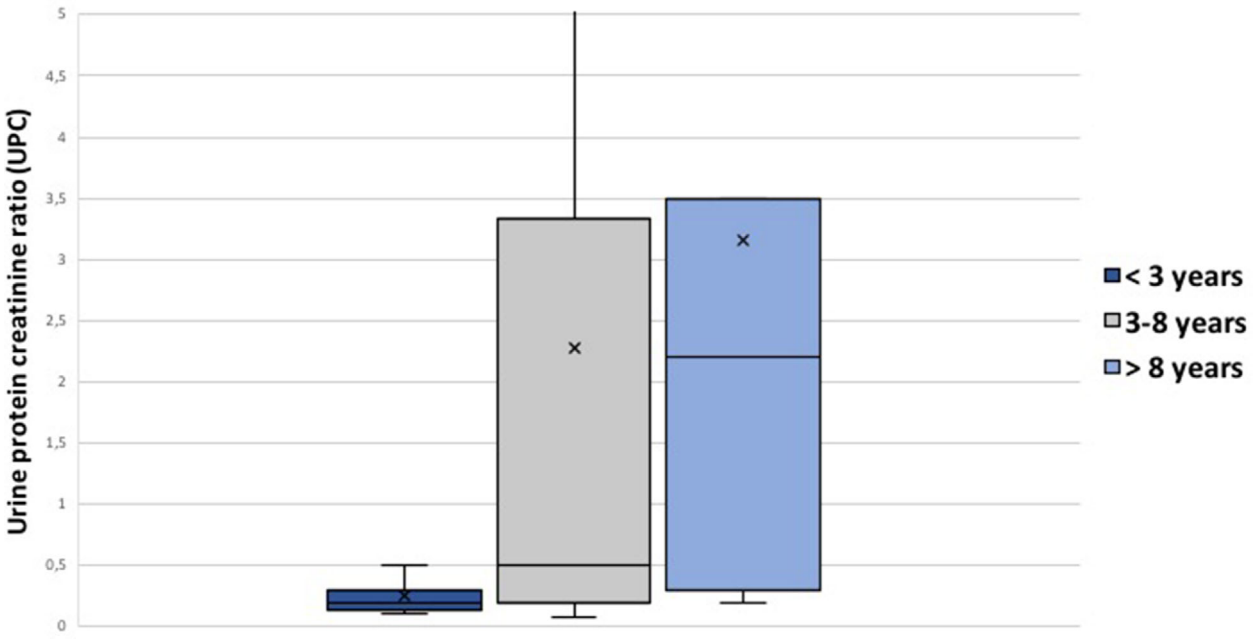

FIGURE 2 Urine protein creatinine ratio value according to age. Median value is indicated with a cross (x). Urinary protein creatinine ratio's mean in young dogs was 0.24 (95% CI = 0.08-0.42), while in adult and old dogs was 2.27 (95% CI = 0–5.72) and 3.15 (95% CI = 0–5.72), respectively (Kruskal-Wallis' test: $p = 0.0024$, $X^2 = 1.988$, $df = 2$)

and develop systemic clinical signs with aging. Consequently, they might have lesions associated with immunocomplexes deposition in glomeruli, among others,[5] that cause proteinuria and renal azotaemia. On the other hand, old dogs can suffer a chronic subclinical *L. infantum* infection since they were young, but when older, an impairment of immunological system or a concomitant disease might cause clinical disease development.[1] In fact, aging is negatively associated with all systems of the body, including the immunological system, leading to an increased susceptibility to different infectious diseases in older patients.[25–30] Both adaptative and innate immune response are affected, giving as a result an impairment of the skin immunological function with reduced activity of T-cells and macrophages.[27,28,30] Moreover, aging is also associated with low-grade inflammatory stage and an increased cellular oxidative damage, which is implicated in the pathogenesis of many age-related diseases and reduced response against pathogens.[25–28] Unsurprisingly, old dogs studied had a lower body condition than adult or young ones. This finding can be explained by the fact that old animals appear to have more tendency to develop systemic signs or it might be an inherent feature to their age. As seen in previous studies, the majority of the dogs of the study were between 3 and 8 years old at the moment of the diagnosis of CanL.[16,31]

In the present study, other clinical findings were associated with signalment. Regarding breed, purebred dogs suffered more frequently ulcerative dermatitis than crossbred dogs. Ulcerative lesions due to CanL can have a variable clinical presentation because can be result of different pathological mechanisms. The most frequent type of ulcerative dermatitis seen in dogs with leishmaniosis is the ulcerative dermatitis

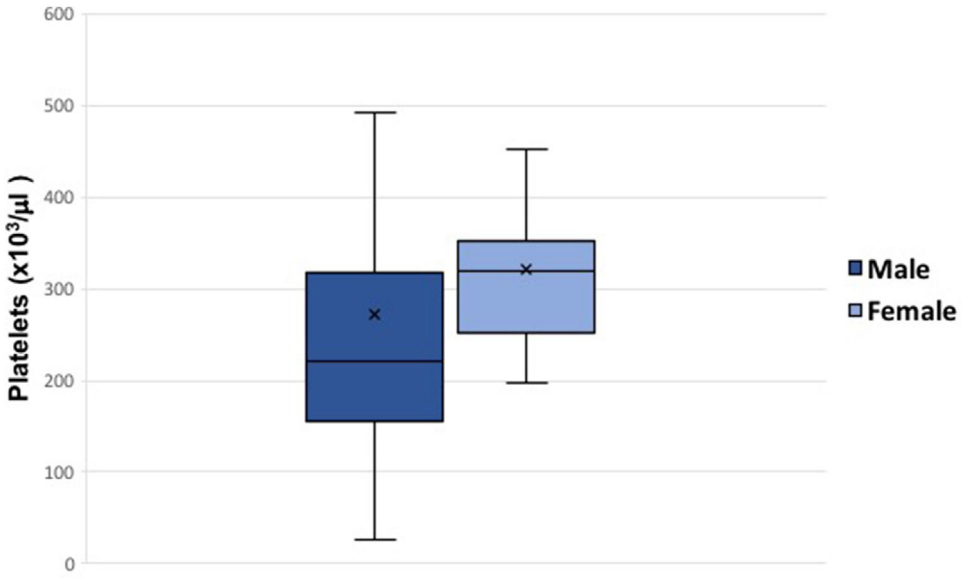

FIGURE 3 Platelets number according to age. Median value is indicated with a cross (x). Platelets' mean was 271.61 × 10^3/µl (95% CI = 64.01–479.21) in males and 320.52 × 10^3/µl (95% CI = 163.33–477.71) in females (Mann-Whitney test: $n_1 = 31$, $n_2 = 27$, $p = 0.0132$)

over the bony prominences, which is typically found in large-sized dogs.[7] Among all purebred studied, Labrador, boxer and German shepherd dogs were the most represented, being similar to other studies.[15,19] Therefore, the high percentage of ulcerative dermatitis in purebred dogs can be explained by the fact that the most represented breeds in the study are large-sized breeds that may be more predisposed to present ulcerative dermatitis over the bony prominences. Further studies are needed to determine a possible relationship between purebred dogs and ulcerative dermatitis. No other significant association between clinicopathological presentation of CanL and breed was found, probably due to the low number of purebred dogs enrolled that prevented to compare different breeds. However, several papers in veterinary literature describe breed-associated immune disturbances[29,32–34] or inherited defects[35] that predispose purebred dogs to develop diseases in one or more organs that can be also affected by *L. infantum* infection. Besides, in the present study, purebred dogs were more commonly affected by leishmaniosis than crossbred in accordance to other studies.[15,19]

According to sex, males were more represented than females, as previously reported,[15,16] and thrombocytopenia was more frequently found in males than females. Thrombocytopenia is not a common laboratory sign of CanL according to our study and others,[16,17] and the cause of this finding is uncertain. Male dogs might be more predisposed to disease due to intracellular pathogens such as *Leishmania*, *Babesia*, *Ehrlichia* and other rickettsial microorganisms as it seems to occur in humans and mice models.[18,36] The pathophysiology of thrombocytopenia due to CanL has not been as well described and investigated as other vector-borne disease like babesiosis or ehrlichiosis.[37,38] Unfortunately, diagnostic test for the detection of other pathogens were not always performed in each case and was only carried out at clinician discretion based on problem list and differential diagnosis. Therefore, co-infections, that could also cause thrombocytopenia, were not ruled out in the majority of cases. Moreover, co-infections might lead dogs towards disease progression and clinical presentation.[39–41] Therefore, it would be interesting to perform tests for the diagnosis of other concomitant vector-borne disease in patients with CanL.

Concerning size, we also found significant results that so far do not seem to be of clinical relevance. Even so, large breed dogs were more frequently affected by CanL as previously reported.[15,19]

This study also adds clinicopathological descriptive information of CanL. Clinical signs and laboratory alterations were similar to the ones described in previous studies. Although, in those previous studies patients did not present neurological disorders, and the prevalence of renal abnormalities was higher than in the present study.[16,42] It is likely that nowadays there is an increase in clinical awareness of this disease and that CanL is frequently included as differential diagnosis in endemic areas in Spain. Therefore, clinicians might do earlier diagnosis than 20 years ago, and clinical signs and laboratory abnormalities at the moment of diagnosis might be less severe. In addition, there is limited information regarding the clinical staging that dogs have in endemic areas of CanL. In the present study, most dogs included were classified in a moderate clinical stage of the disease as recently described.[43]

The main limitations of this study included low number of dogs enrolled and the retrospective nature of the study, which hinders to have homogeneous clinical data. Moreover, the combined effect of the different variables evaluated in the study had not been properly investigated. Considering that age distribution can change according to breed and size, it had been preferable to establish different age

categories based on breeds and sizes. Some of the clinicopathological abnormalities found at the time of the diagnosis could be caused by coinfections. Ophthalmologic and neurologic signs might be under diagnosed because a specialist did not commonly perform a complete ophthalmologic and/or neurologic examination to dogs included in the study. Furthermore, cutaneous lesions might not be always properly defined due to the fact that not all dogs were evaluated by a specialist dermatologist. Moreover, it would be interesting to include treatment protocols and outcome of dogs in the future. Finally, we believe that further studies with a larger number of dogs will be of benefit for a more robust study and to better define the relationship between age, breed, sex and size and the clinicopathological presentation of CanL.

CONCLUSIONS

Clinicopathological findings described in the present study are similar to previous studies, and leishmaniosis is more prevalent in males, pure breeds, dogs from 3 to 8 years old and large size dogs. Moderate clinical stage is commonly found in CanL. This study describes for the first time that age appears to be associated with differences in clinicopathological findings of CanL. Young dogs present less severe disease and are less prone to present systemic alterations than adult-old dogs, while dermatologic signs are more frequently found in young and adult dogs.

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CONFLICT OF INTEREST

The authors declare that there is no conflict of interest that could be perceived as prejudicing the impartiality of the research reported.

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