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Characterization of Acute Infections by Leptospira Spp. in 53 Dogs Admitted to a Biological Isolation and Containment Unit

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ABSTRACT

Leptospirosis is caused by spirochetes of the genus Leptospira spp., responsible for a serious systemic infection. A retrospective study was performed to identify risk factors, prognostic indicators and variables affecting the length of stay in acutely infected dogs with Leptospira spp, admitted to the Biological Containment and Isolation Unit of the Veterinary Teaching Hospital, Faculty of Veterinary Medicine, University of Lisbon.

Leptospirosis was confirmed through IgM serology in 53 dogs with clinical suspicion. Risk factors associated with the occurrence of acute leptospirosis were the dog's age group and winter. Being neutered females, dogs over 8 years old and summer were protective factors. There was a worse prognosis in hypothermic dogs, oligoanuric and with increased urea and/or high creatinine levels. The presence of neutrophilia significantly affected the length of stay.

Leptospirosis is one of the leading infectious causes for dogs' hospitalization with acute presentations often fatal. Yet 52.0% of the infected dogs were unvaccinated and 24.0% had the leptospirosis vaccination overdue. Vaccination compliance, early diagnosis and prompt treatment are critical. It´s a "One Health" threat and effective prevention programs are necessary to reduce the burden of this neglected disease, linking public health, animal health and environmental health.

Keywords
Canine leptospirosis, Kidney failure, Liver failure, Doxycycline, Zoonosis

Introduction

Leptospirosis is a zoonosis caused by pathogenic spirochetes of the genus Leptospira, responsible for a systemic infection. Leptospira spp. are thin, flexible, motile, spiral-shaped that have a hook-shaped end, which differentiates it from other spirochetes (Schuller et al 2015, Sykes 2014). In dogs, leptospirosis is caused by two pathogenic species, Leptospira interrogans and Leptospira kirscheneri (Sykes 2014).

Leptospirosis is transmitted between susceptible hosts by direct contact, or more often by indirect contact. In some studies, risk factors associated with canine leptospirosis include exposure to environmental water sources, adult non-neutered males, large dogs and hunting or working dogs (Sykes 2014, Adin & Cowgill 2000, Ward, Glickman & Guptill 2002, Ward et al 2004). However, other research groups found similar seroprevalences in small and large

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breeds, in dogs of all age groups and both genders, suggesting that dogs of any age and breed are at risk of infection (Gautam et al 2010, Rentko et al 1992, Stokes et al 2007).

Leptospirosis is more frequent in areas of the world with high annual rainfall and a warm climate, but the presence of infected reservoir hosts, greatly shapes the geographical distribution of cases and outbreaks (Sykes 2014). Small rodents are the most important maintenance hosts transmitting the disease to dogs, humans, and livestock species (Schuller et al 2015, Levett 2001).

In cases of acute leptospirosis, the incubation period is approximately 7 days, depending on the amount of bacteria the dog was exposed, virulence of the strain and quality of the immune system's response (Greenlee et al 2005). The clinical signs vary from subclinical or mild clinical disease as low-grade fever to severe kidney, liver, and pulmonary disease (Goldstein 2010).

There are plenty diagnostic methods available detecting the bacteria or specific antibodies (Reagan & Sykes 2019). The first group includes the direct visualization of Leptospira by culture, dark-field microscopy or detection of the spirochetes DNA by PCR, more useful in early stages of disease when the bacteria are present in high concentrations in the blood and urine, and before antibiotic treatment (Reagan & Sykes 2019). The second group includes tests that detect antibodies against Leptospira spp. The gold standard is the microscopic agglutination test (MAT) (Reagan & Sykes 2019). Detection of antibodies by MAT or by enzyme-linked immunosorbent assays (ELISA) and detection of leptospiral DNA by PCR are currently the most frequent methods of laboratory diagnosis (Schuller 2017).

The use of penicillin or doxycycline is recommended in the initial phase of treatment. It must start as soon as possible, even before obtaining laboratory confirmation of the diagnosis (Sykes 2014). When antibiotic therapy only starts four to seven days after the onset of the disease, recovery is more difficult to occur (Sykes et al 2011).

Dogs with azotemia, increased serum troponin-I concentration, increased C-reactive protein/haptoglobin ratio, increased urinary protein/creatinine ratio and de-creased serum albumin concentration, are at higher risk of death than dogs without these changes (Adin & Cowgill 2000, Rentko et al 1992, Birnbaum et al 1998, Mastrorilli et al 2007).

Leptospira vaccines are considered non-core (Day et al 2016). Vaccination should be restricted to use in geographical areas where a risk of exposure has been established or for dogs whose lifestyle places them at risk, such as, sheepdogs and hunting dogs, dogs swimming or drinking from environmental water sources, dogs living in urban or suburban settings with rodents or other synanthropic wildlife species (Day et al 2016, Sykes 2014). Vaccination with 4-serovar vaccines is recommended, from 8 weeks of age, with primary vaccination of two doses, 2-4 weeks apart, and annual revaccinations (Kohn et al 2010).

The main objectives of this study are to characterize leptospirosis infections in dogs admitted to the Biological Isolation and Containment Unit (BCIU) of the Veterinary Teaching Hospital (VTH) of the Faculty of Veterinary Medicine, University of Lisbon (FMV-ULisboa), in the period from 2013 to 2019, and to identify risk factors and possible prognostic indicators.

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Materials and Methods

The working population consisted of 148 dogs with clinical signs compatible with leptospirosis, hospitalized at BCIU, from December 2013 to December 2019.

BCIU is a high-level isolation facility with a specialized team of veterinarians providing intensive care services to critically ill companion animals with suspected or confirmed infectious diseases, admitted to the VTH or referred by veterinarians of all Portugal.

Inclusion criteria: cases with clinical presentation compatible with canine leptospirosis, based upon epidemiological and clinical criteria, in which leptospirosis was confirmed or ruled out thought an IgM detection-based semi-quantitative indirect immunofluorescence (IIF) in blood serum samples. As a result, of applying this inclusion criteria, 17 dogs with compatible leptospirosis clinical signs but lacking conclusive test were excluded from the study.

The medical records of the dogs were retrieved from the information systems Qvet® and Guruvet®, used at the VTH plus the BCIU database, built in Microsoft® Office Excel 365 for Windows®.

Twenty-three environmental and animal variables were collected: parish; county; number of cohabiting animals; total monthly precipitation; genre; castration; breed; age; weight; dog lifestyle; vaccine status; type of vaccine; referenced cases; admission date; length of stay; clinical condition; diagnosis; laboratory test; changes in physical examination; complementary diagnostic tests; treatment; outcome; follow-up.

Age was divided into 3 categories: young dogs (≤ 1 year), adult dogs (2-7 years), senior dogs (≥ 8 years). Dog size was distributed in 5 categories: very small dogs (≤ 4kg), small dogs (> 4 and <11 kg), medium-sized dogs (≥ 11 and <26kg), large dogs (≥ 26 and ≤ 45kg) and giant dogs (> 45 kg).

Relevant clinical signs were collected, including those presented by the dog on the day of consultation at VTH, and during hospitalization at BCIU. The data of the physical examination of the dogs admitted in second opinion and referral consultations were obtained from the referring vet complemented, with the data recorded on the day of admission at VTH and during hospitalization in BICU. Laboratory tests were performed whenever possible, on the day of admission and during hospitalization, reference levels are given between brackets.

Complete blood count: erythrocytes (5.5-8.5x10^3/µL), haematocrit (37-55%), leukocytes (6-17x10^3/µL), neutrophils (3000-11500/µL), lymphocytes (1000-4800/µL), monocytes (150-1350/µL), eosinophils (100-1250/µL), and platelets (200-500/µL). Biochemical profile: albumin, (2.2-3.5g/dl) total proteins (5.0-7.5g/dl), blood glucose (59-157mg/dl), ALT (0-130U/L), AST (0-43U/L), ALP (0-200U/L), urea (12.0-56.0mg/dl) and creatinine (0.6-1.6mg/dl). Urinalysis: glucose (negative), bilirubin (negative), erythrocytes (0-5/hpf), protein (negative), leukocytes (0-5/hpf), urinary casts (negative) and urinary density (1012-1050). Oligoanuria was considered whenever urinary production was below 1 ml/kg/h (Langston 2017), in a closed urine collection system. Electrolyte im-balance: phosphorus (mg/dl), chlorine (109-122mml/l), sodium (144-160mml/l) and potassium (3,5-5,8mml/l). Abdominal ultrasound and thoracic radiography were performed in-house and exam report stored in hospital information systems, changes were analysed and extracted to the database.

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Blood samples were collected from dogs and sent to an external laboratory, DNAtech©, where the Leptospira IgM-indirect immunofluorescence assay (IFA) was performed. IgM antibodies become detectable during the first week of illness (Levett 2001). IFA is based on a genus-specific antigen and so can be expected to detect antibodies against all the common Leptospira serovars (Burr, Lunn & Yam 2009). The test can be set up and completed within a few hours of sample receipt, being therefore very useful to confirm recent infections (Miller et al 2011). However, IFA does not provide information on the infecting serogroup.

Therapy records include given antibiotics, steroidal and non-steroidal anti-inflammatory drugs, cytoprotective agents, diuretics, antiplatelet agents and blood transfusions during the dog's hospitalization stay.

Based upon the guidelines for the vaccination of dogs compiled by the Vaccination Guidelines Group of the World Small Animal Veterinary Association, dogs that received two doses of the vaccine against leptospirosis, 2 to 4 weeks apart, from 8 weeks of age, followed by annual revaccinations, were considered immunized (Day et al 2016).

Statistical Analysis

Exploratory and descriptive analysis were carried out in Microsoft® Office Excel 365 for Windows®. Inferential statistics was performed in R for Windows®, version 4.0.2. Values of $p<0.05$ were considered statistically significant for all analysis. The Pearson's chi-square test was performed to assess categorical variables. When the expected frequencies were below 5, Fisher's exact test was used. The final statistical model included all variables whose univariate analysis had a significance of 0.2 (Hosmer & Lemeshow 2000). The odds ratio were computed using a logistic regression model.

Kaplan-Meier curves were constructed to identify variables influencing the recovery time, and the log-rank test was used to compare them.

To evaluate numerical variables, the sample's normality was initially tested using the Shapiro-Wilk test, considering p values>0.05 with normal distribution and used in these cases, the parametric t-test for two independent samples. If the assumption of a normal distribution was not fulfilled, the non-parametric Wilcoxon signed rank test was applied.

Results

Between December 2013 and December 2019, 148 dogs were admitted at BCIU with clinical presentations compatible with leptospirosis. Fifty-three (35.8%) dogs tested positive on the Leptospira IgM ELISA and the remaining 95 (64.2%) tested negative.

Twenty-seven (50.9%) of the infected dogs were males and 26 (49.1%) females. Only 10 (18.9%) animals were neutered. An association was found between being a neutered female and the occurrence of leptospirosis. This condition was a protective factor ($p=0.012$; OR=0.26; 95% CI=0.086-0.714).

No significant statistical association was found between gender ($p=0.9409$) and neutered male dogs ($p=0.737$) and the occurrence of leptospirosis. The same for gender of infected dogs and clinical outcome ($p=0.339$).

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Out of the 53 infected dogs, 9 (17.0%) were young (≤1 year), 28 (52.8%) adults (2 to 7 years) and 16 (30.2%) seniors (≥ 8 years). An association was found between age and the occurrence of leptospirosis (p=0.004). Belonging to the senior group was a protective factor against leptospirosis occurrence (p= 0.002; OR=0.31; 95%CI=0.141-0.645) in comparison with adult dogs.

The average age of infected dogs was 5.5±3.2 years, the median 6.0 years, ranging from 2.4 months to 15.0 years, while for dogs with a negative diagnosis of leptospirosis the average age was 7.9±4.0 years, the median 8.0 years, ranging from 6.0 months to 15.0 years. The difference between the medians of both groups was statistically significant (p=0.0002). There was no statistically significant association between age and clinical outcome (p=0.069).

Data regarding dog size was available for 48 infected animals. Three (6.3%) were very small, 5 (10.4%) small, 23 (47.9%) medium, 15 (31.3%) large and 2 (4.2%) giants. The average weight of the infected dogs was 21.2±11.2 kg, the median 20.1 kg, ranging from 2.8kg to 53.0 kg. There was no statistically significant association between dog size and clinical outcome (p=0.89).

Thirty-three (62.3%) of the infected dogs were breed dogs and 20 (37.7%) mongrel dogs (N=53). There was no statistically significant association between breed and the occurrence of leptospirosis (p=0.422) or between breed and clinical outcome (p=0.374).

Data regarding dog lifestyle was available for 48 infected animals. Twenty-four (50.0%) dogs had a mixed lifestyle, living indoors but with free access to the outside, 23 (47.9%) lived mostly outdoors, and 1 dog (2.1%) lived indoors, with occasional and supervised access to the outside. No significant statistical association was identified between dog lifestyle and the occurrence of leptospirosis (p= 0.069).

Within the 53 infected dogs, 27 (50.9%) did not cohabit with any animal, 21 (39.6%) cohabited with at least 1 animal and the information was missing for the remaining 5 dogs (9.4%). There was no statistically significant association, between cohabitation with other pets and leptospirosis occurrence (p= 0.946).

Vaccination status was available only for 25 infected dogs. Thirteen of these dogs (n=13; 52.0%) were not vaccinated against leptospirosis and six (24.0%) had the leptospirosis vaccination overdue. Only six dogs (24%) were properly vaccinated against canine leptospirosis. However, no statistically significant association was identified between the vaccination status for leptospirosis and the occurrence of the disease (p=0.053).

The average length of stay in the BCIU was 5.0±2.8 days; the median was 5.0 days, ranging from 1 to 12 days. The median hospitalization stay (Figure 1) in surviving dogs was 6.0 days, comparing to 3.0 days in non-surviving dogs. This difference is statistically significant (p=0.003).

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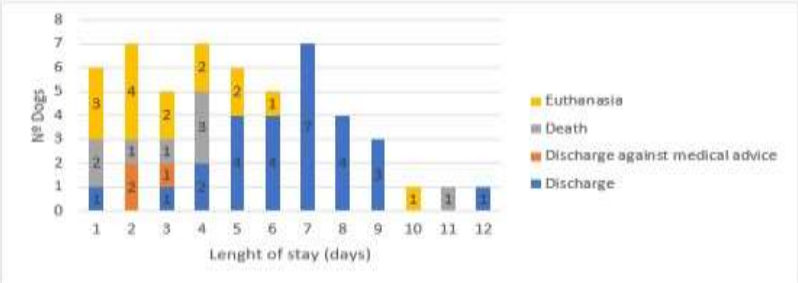

Figure 1. Length of stay (in days), and clinical outcome of infected dogs (n=53).

Regarding blood analysis, only neutrophilia influenced the length of stay ($p < 0.05$). Dogs with neutrophilia were more likely to not be discharged on the scheduled day than other infected dogs (Figure 2).

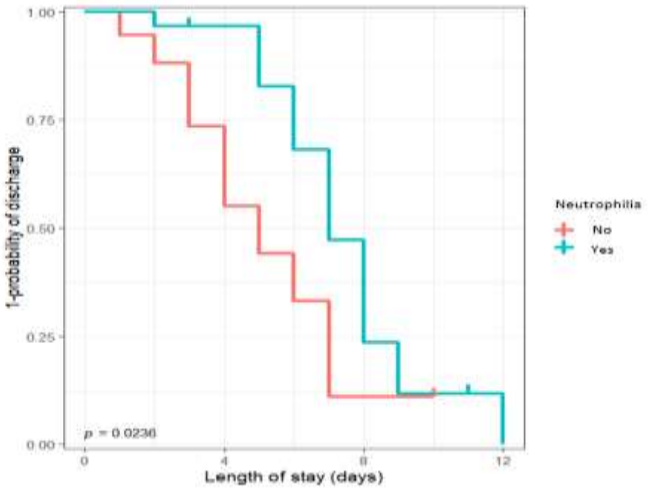

Figure 2. - Kaplan-Meier curves for the number of days until discharge. 32 infected dogs with neutrophilia and 15 infected dogs without neutrophilia.

An annual variation of 0 to 3 cases per month was observed, with leptospirosis cases being diagnosed in all years of the study period (Figure 3). March and October were the months with most hospitalizations due to leptospirosis and no positive cases were recorded in August. The probability of dogs being admitted at BCIU with leptospirosis in summer was 0.20 times lower than in the winter (p= 0.011; OR=0.20; 95% CI=0.052-0.639).

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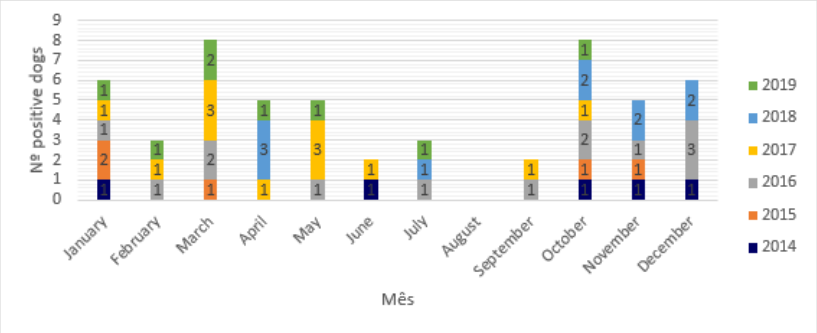

Figure 3. - Monthly and annual frequency of leptospirosis cases during the 6-year study period (n=53).

Most frequent clinical signs were vomiting (n=39; 73.6%), anorexia (n=26; 49.1%), diarrhea (n=21; 39.6%), hematuria (n=21; 39.6%), dehydration (n=18; 34.0%) and jaundice (n=17; 32.1%). An association was found between the presence of hypothermia and oligoanuria with clinical outcome ($p<0.05$). Dogs with hypothermia had a 6.5 times higher probability of death compared to dogs without hypothermia ($p= 0.010$; OR=6.5; 95% CI=1.714-32.709).

The main changes in blood count were leukocytosis with neutrophilia (32/48; 66.7%), eosinopenia (23/44; 52.3%), thrombocytopenia (20/39; 51.3%), monocytosis (18/46; 39.1%) and anemia (20/52; 38.5%). The majority of biochemical profiles revealed an increase in urea (34/49; 69.4%) and creatinine (34/50; 68.0%), increase in AST (9/9; 100%), ALT (27/47; 57.4%), ALP (18/43; 41.9%) and hyperbilirubinemia (9/11; 81.8%). Regarding electrolyte imbalance, most dogs had hyponatremia (10/19; 52.6%), hypokalemia (6/30; 20.0%) and hypochloremia (12/19; 63.2%). An association was found between the increase in creatinine and clinical outcome as dogs with increased creatinine levels had a 4.29 times higher probability of death in comparison to the other infected dogs ($p= 0.031$; OR=4.29; 95% CI=1.215-17.95). The median creatinine value for surviving dogs was 2 mg/dl and 3.9 mg/dl for non-surviving dogs ($p=0.008$). The median of urea values was 98 mg/dl for surviving dogs and 174 mg/dl for dogs that died. Again statistically significant ($p=0.02$).

The main changes in urinalysis were proteinuria (18/19; 94.7%), hematuria (13/19; 73.7%), glycosuria (7/19; 36.8%), bilirubinuria (6/19; 31, 6.0%), pyuria (5/19; 26.32%) and isostenuria (3/19; 15.8%).

Thirty-five dogs underwent abdominal ultrasound. Most frequent findings were hepatomegaly (16/35; 45.7%), liver hypoechogenicity (14/35; 40.0%), hyperechogenic renal cortex (8/35; 22.9%), splenomegaly (9/35; 25.7%), biliary sludge (8/35; 22.9%) and loss of the cortico-medullary transition (5/35; 14.3%).

Eighteen dogs underwent thoracic radiography. Unstructured interstitial pattern (5/18; 27.8%) and interstitial-alveolar pattern (2/18; 11.1%) were the most common patterns observed.

The main drugs used to treat dogs suffering from acute leptospirosis were ampicillin (n=38; 71.7%), doxycycline (n=36; 67.9%) and amoxicillin with clavulanic acid (n=16; 30.2%). Significant associations were found between the treatment with ampicillin, doxycycline, and clinical outcome ($p <0.05$). The OR of dogs that underwent treatment with doxycycline and

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ampicillin in relation to dogs that were not given these drugs, was respectively 0.02 (p=0.0004; 95% CI=0.001-0.123) and 0.21 (p=0.021; 95% CI=0.051-0.749), being protective factors as expected.

Out of the 53 infected dogs, 27 (50.9%) were discharged, 15 (28.3%) were euthanized, 8 (15.1%) died during hospitalization, and 3 (5.7%) were discharged against medical advice. The survival rate of infected dogs was 52.8%.

Discussions

In the present study, medical records of 148 dog patients admitted at BCIU with acute clinical presentations compatible with leptospirosis, were retrospectively reviewed. Fifty-three (35.8%) clinically suspected dogs were considered infected after positive IFA testing and remission of symptoms with first-choice antibiotics.

Gender was not identified as a risk factor for the occurrence of leptospirosis (p=0.9409). In fact, the proportion of infected males was similar to the infected females (50.9% vs. 49.1%), as was found in other studies (Gautam et al 2010, Stokes et al 2007, Birnbaum et al 1998, Knöpfler et al 2017). However, other researchers argue that intact males are at high risk of being infected due to risky behaviors such as smelling the urine of other dogs when marking their territories (Adin & Cowgill 2000, Ward, Glickman & Guptill 2002, Ward et al 2004, Levett 2001). Male castration was also not identified as a risk factor (p=0.7368). However, this result must be carefully analyzed because the proportion of neutered males was underrepresented. In contrary, neutered females were 0.26 times less likely to be infected with leptospirosis than intact females (p=0.012; OR=0.26; 95% CI=0.086-0.714), suggesting that neutering may be a protective factor. Probably because they exhibit less risky behavior, such as smelling the urine of other dogs or running away from home during estrus (Ward, Glickman & Guptill 2002, Ward et al 2004).

A higher frequency of leptospirosis in medium and large dogs was found in comparison with small dogs. This finding is in agreement with other studies (Adin & Cowgill 2000, Major, Schweighauser & Francey 2014). and may be explained because large dogs tend to spend more time outdoors and are therefore more exposed to rodent urine or contaminated water sources (Adin & Cowgill 2000, Ward, Glickman & Guptill 2002).

Median age of 6.0 years was similar to previous studies (Major, Schweighauser & Francey 2014, 20]. Most of the infected dogs were adults (52.8%). This result also matches other studies (Ward et al 2004, Duarte 2015, Ward 2002). On the contrary belonging to the age group senior (≥ 8 years old) was a protective factor, as senior dogs were 0.31 times less likely to become infected than adult dogs (p=0.002; OR=0.31; 95% CI=0.141-0.645). Gautam et al. (2010) and Major et al. (2014) explain this tendency because senior dogs spend more time indoors, therefore being less exposed to contaminated environments.

Lifestyle (p=0.069) was not identified as a risk factor despite most infected dogs had a mixed (50.0%) or outdoor (47.9%) lifestyle. These high frequencies of mixed/outdoor lifestyles were also found in other studies made in Portugal reporting high incidence of canine leptospirosis

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in dogs with mixed/outdoor lifestyles, either in rural or urban living environments (Cruz 2016, Lança 2011).

Although there was a higher frequency of leptospirosis in non-vaccinated dogs than in vaccinated dogs (52.0% vs. 24.0%), this difference was not statistically significant (p=0.053). Acute cases of leptospirosis in properly vaccinated dogs may signal infection with serovars not contained in the vaccines (Levett 2001, Adler & Klaasen 2015). Two recent studies carried out in Germany by Geisen et al. (2007) and Knöpfler et al. (2017) reported that respectively, 60% and 80% of dogs infected with leptospirosis, were vaccinated with a bivalent vaccine (serovars *Canicola* and *Icterohaemorrhagiae*) in the last twelve months. This is worrying because currently available vaccines in Europe may not protect against Leptospira serovars causing clinical disease.

Throughout the 6-year study period, the frequency of dogs hospitalized at BCIU was higher in winter, the rainiest season (IPMA 2020). This temporal distribution of leptospirosis cases is described in many studies (Sykes 2014, Adin & Cowgill 2000, Duarte 2015). Furthermore heavy rainfall in Iberian Peninsula often leads to discharge from Spanish dams increasing the flow of Portuguese rivers, namely the Tagus River, causing floods and sewage system outflow that may spread *Leptospira* spp. in the usual places where dogs walk or work, as reported in other countries (Cann et al 2013). On the contrary, summer was as a protective factor against the occurrence of canine leptospirosis (p=0.011; OR=0.2; CI=0.052-0.639). The reduced rainfall in this season (IPMA 2020) mitigates the transmission of waterborne diseases such as leptospirosis (Goldstein et al 2012).

Age (p=0.07), gender (p=0.339), size (p=0.890) and breed (p=0.374) did not significantly affect the clinical outcome.

There was a significant association between oliguria and non-survival (p=0.0005). Knöpfler et al. (2017) reported oliguria, jaundice and increased capillary repletion time as significantly associated with the death of infected dogs.

Regarding the biochemical profiles, only high levels of creatinine significantly influenced the clinical outcome, triggering almost an increase of 4 times on the probability of death (p=0.031; OR=4.3; 95% CI=1.215-17.950). A statistically significant result was obtained when comparing the median levels of creatinine (p=0.008) and urea (p=0.02) between surviving and non-surviving dogs. Hence, a poor prognosis should be given in dogs acutely infected with severe azotemia. There is robust scientific evidence of this association (Adin & Cowgill 2000, Rentko et al 1992, Birnbaum et al 1998, Mastrorilli et al 2007, Knöpfler et al 2017).

The median length of stay for surviving dogs was 6.0 days, while for non-survivors was 3.0 days, a 3-day statistically significant difference (p=0.003). Most deaths and euthanasia occurred between the first and fourth day of hospitalization. These results reflect the acute nature of the disease episodes investigated. According to BCIU *standard operating procedures for canine leptospirosis*, dogs must tolerate a treatment with oral doxycycline for at least 48 hours, in order to eliminate leptospiruria (Truccolo et al 2002) before being discharged. This procedure increases the length of stay of survivors and the cost of

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hospitalization, but it is an essential measure because leptospirosis is a serious animal health problem and a concerning re-emerging zoonosis [30].

While other authors report the return to normal platelet counts, serum urea and creatinine levels, and liver enzyme activity in 10 to 14 days, when treatment is successful [30], in our study these parameters did not significantly affect the probability of discharge. Although we found a significant association between the presence of neutrophilia and increasing delay in discharge ($p=0.024$).

As expected, treatment with doxycycline ($p=0.0004$) and ampicillin ($p=0.021$) significantly contributed to the survival of the infected dogs. These results reinforce the therapeutic approach of administering ampicillin in dogs clinically suspected of leptospirosis, even before establishing a definitive diagnosis, as in the initial phase of acute episodes most dogs do not tolerate oral doxycycline and ampicillin eliminates leptospiremia and leptospiruria (Schuller et al 2015, Sykes 2014, Sykes et al 2011, Truccolo et al 2002).

The survival rate of acute canine leptospirosis was 52.8%, within the survival rates reported by other studies performed in European countries, ranging from 52% to 68% (Knöpfler et al 2017, Major, Schweighauser & Francey 2014, Geisen et al 2007, Kohn et al 2010). However, Adin and Cowgill (2000) reported a survival rate of 83.3% in thirty-six dogs naturally infected with leptospirosis in California. In this study, treatment with hemodialysis made a difference by improving prognosis for dogs with severe azotemia. Renal replacement therapy with intermittent hemodialysis or continuous renal replacement therapy are not yet available at BCIU and this lack may explain the differences in survival rate observed as well as late referral of infected dogs.

The definitive diagnosis of canine leptospirosis was a weakness of this study. Dogs were considered infected if presenting clinical signs compatible with leptospirosis and a positive indirect immunofluorescence assay. The remission of signs and clinical cure with subsequent medical discharge reinforced the assertiveness of the initial diagnosis. Future investigations should resort to a better confirmatory test namely PCR or MAT to provide information on infecting serogroups.

Conclusion

Canine leptospirosis is, behind canine parvovirosis the second most frequent dog infectious disease leading to hospitalization at BCIU. Most cases were referred by practitioners concerned with the occupational risk of infection when handling infected dogs, especially in the stages of leptospiremia and leptospiruria.

Being an adult dog and winter were risk factors for leptospirosis acute infection; on contrary, senior age, neutered female, and summer were found to be protective factors during the 6-year investigated period.

Leptospirosis is a challenging disease for veterinarians providing intensive care to critically ill dogs. Hypothermia, oligoanuria, and increased creatinine or urea levels, significantly worsen the patient prognosis. Immediate administration of ampicillin in dogs clinically suspected of leptospirosis was crucial to achieve a survival rate of 52.8%.

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Only 24.0% of the dogs were properly vaccinated against leptospirosis. Fifty-two percent were not vaccinated and 24.0% had the leptospirosis vaccination overdue. There is an urgent need to improve dog vaccination rates against leptospirosis, especially in endemic geographical areas where a risk of exposure is predictable and communicated to dog owners. Leptospirosis is a "One Health" threat and effective prevention programs are necessary to reduce the burden of this neglected disease, linking public health, animal health and environmental health.

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