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Epidemiology of *Canine parvovirus* Enteritis in Dogs of the Metropolitan City of Yaounde, Cameroon

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Abstract: *Canine Parvovirus* Enteritis (CPE) has remained the most significant and important cause of mortality in young dogs in Cameroon. This retrospective study provides information on the current epidemiological profile and the management aspects of the disease through collation and analyses of data from clinical records of hospitalized dogs from 2008-2019 in the city of Yaounde and also by an administered structured questionnaire. The study revealed an overall prevalence of 11.43% of the disease in the study area with a mortality rate of 59.98%. Age, vaccination status, duration of treatment and disease outcome, were observed to be significantly associated with the disease ($p<0.05$). The male dogs (61.77%) and local breeds (37.9%) were most affected. The disease progressed in a saw-tooth fashion yearly with highest incidence recorded in 2015 (14.16%). Seasonally, the highest incidences of the disease were recorded in the dry season, particularly in the months of November (11.5%), December (9.03%) and January (10.62%). The majority of clinicians identified the disease on the basis of clinical signs and no supplementary examination was associated. The study identified shortcomings in the management of the disease but also the imperative need to enlighten dog owners about the importance of vaccination against the disease.

INTRODUCTION

Canine Parvovirus (CPV) is a highly contagious viral disease of dogs and wild canids and of great concern to pet owners, practising veterinarians and scientists due to its high morbidity and mortality rates. The disease affects dogs of all ages[1] but thanks to the development of vaccine and the development of acquired immunity in dogs that survived the infection, most adults have become resistant. Thus, nowadays, the disease mainly affects young dogs between 6 weeks and 6 months of age[2] of which it stands as the major causes of mortality and morbidity[3].

The disease is caused by *Canine Parvovirus* type 2 (CPV-2), a pathogen that is now circulating enzootically in dog population's worldwide[4]. This virus has a great capacity to mutate. In 40 years of existence, the original strain has undergone several mutations giving rise to 3

subtypes: CPV-2a, b, c. The latter are distinguished by an increase in their virulence and the ability to rapidly recover[5]. In addition to being resistant in the external environment, *Canine parvovirus* is characterized by a speed and ease of spread that is responsible for its worldwide distribution[2].

In Cameroon, there are many households that harbour crossed-breed of dogs. In addition, 38% of households in the city of Yaounde own at least one dog used either as a pet (24%) or as a guard animal (64%)[6]. Furthermore, there have been several reported cases of morbidity and mortality of CPE in dogs but there is fewness of information on the epidemiological profile and management aspects of the disease.

Thus, this study was initiated with the aim to determine the epidemiological profile of *Canine parvovirus* enteritis and to evaluate its management by Veterinarians of the city of Yaoundé. More specifically, it was about:

- Determine the prevalence and mortality rate of the disease
- Determine the susceptibility of dogs to the disease according to intrinsic (age, breed, sex) and extrinsic factors (vaccination status, duration of treatment, seasonality, outcome of the disease)
- Ascertain the prowess of clinicians in the management of *Canine parvovirus* enteritis through the administration of a structured questionnaire

MATERIALS AND METHODS

Ethical approval: The research was implemented at the Department of Microbiology, Immunology and Infectious Diseases of the School of Veterinary Medicine and Sciences of the University of Ngaoundere, Cameroon.

Period and study area: The study took place from July to December, 2019 in the city of Yaounde which is the political capital of Cameroon. The choice of this city is justified by the fact that it is a large urban center where a multitude of dogs can be found. In addition, out of the 58 veterinary clinics established in private practice in Cameroon, 29% of them exercise their function in the city of Yaounde[7]. Figure 1 show the location of the veterinary clinics in Yaounde that were exploited in this study.

Type of study and data collection: It is a retrospective cross-sectional descriptive study with prospective collection of data. In order to achieve the objectives, the sources of information presented in the consultation registers of the twelve veterinary clinics of the city were carefully exploited and only the records of dogs diagnosed with parvovirus were considered. Selection of cases was based on history, clinical signs and postmortem findings features of CPE recorded. Information on the date of consultation, the age of the dog, its sex, breed, clinical diagnosis established, vaccination status, number of days of hospitalisation and outcome of the disease were

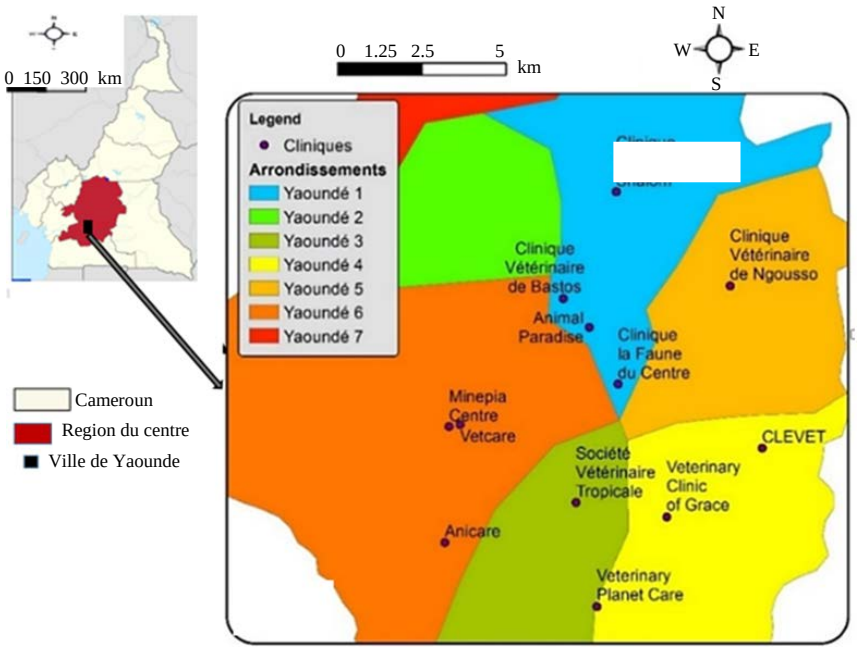

Fig. 1: Location of veterinary clinics in the city of Yaounde, Cameroon

collected. The vaccination status was categorised into vaccinated and unvaccinated. Similarly, the treatment outcomes of the cases following medical intervention were classified as either "recovered or dead".

In addition, a structured questionnaire designed using sphinx plus version 4.0 software was administered to Veterinarians in the city of Yaounde to ascertain their prowess in the management of *Canine parvovirus* enteritis.

Data analysis: The data obtained were entered into the Microsoft Excel in 2016 and sphinx plus programs for descriptive analysis of variables. Test of association between CPE and the different study variables were measured by Chi-squared analysis at 95% confidence limit ($p<0.05$).

RESULTS

Prevalence rates: The 565 cases of *Canine parvovirus* were reported out of 4943 dogs presented with various health challenges at the different veterinary clinics in Yaounde from 2008-2019, given a prevalence of 11.43% for the 11 years retropective study. The disease was observed to be present throughout the year. Figure 2 shows the yearly distribution of the *Canine parvovirus* cases. The distribution shows a non-constant (sawtooth) increasing trend of the disease from 2008-2019 with the highest percentage of occurrence (14.16%) recorded in 2015. The monthly statistics of the occurrence of the disease is shown in Fig. 3 and the highest number of cases in order of importance was observed in November, followed by January and December in the proportions of 11.5, 10.62 and 9.03%, respectively.

Among the parvovirus diagnosed dogs in this study, the male dogs were more affected (61.77%, 349) than the females (38.23%, 216) (Fig. 4).

Mortality rate: Of the 565 dogs recorded as suffering from *Canine parvovirus* enteritis, 305 of them died as a result of the disease, given a mortality rate of 53.98%.

Intrinsic risk factors associated with the occurrence of the disease: The age distribution of dogs presented with CPE shows a higher occurrence in dogs younger than six months of age (87.4%) than those older than one year (3%) (Fig. 5) and the observed breed prevalence of CPE showed the highest occurrence in Basenji (local breed), followed by German Shepherds and Rottweilers, its occurrence is low in Labrador and joker and least in Pitbull (Fig. 6).

Extrinsic risk factors associated with the occurrence of the disease: In this study, 78.23% (442) of the dogs diagnosed with CPE were not vaccinated against the disease, 19.29% (109) had history of prior vaccination while 2.5% (14) had doubtful vaccination history.

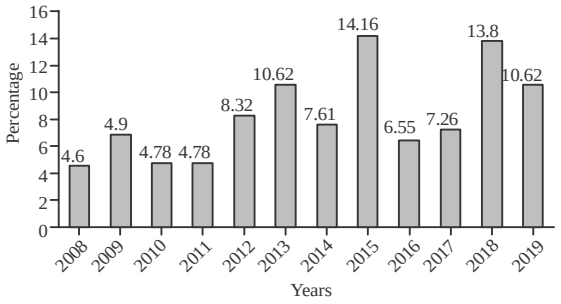

Fig. 2: Yearly distribution of parvovirosis cases

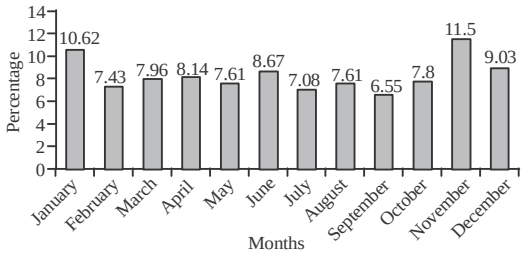

Fig. 3: Monthly distribution of *Canine parvovirus* cases

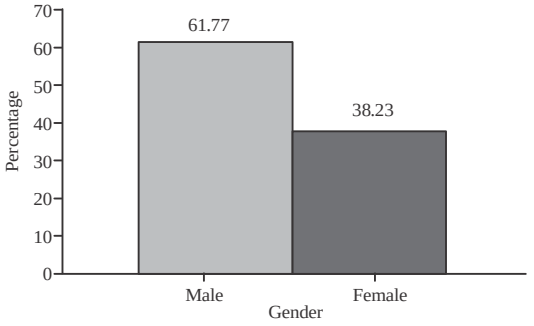

Fig. 4: Distribution of parvovirosis cases in relation to sex

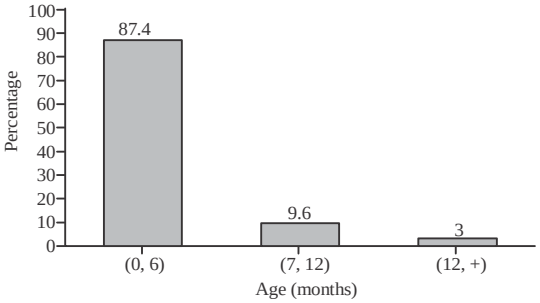

Fig. 5: Distribution of parvovirosis cases in relation to age

Table 1: Influence of risk factors on disease outcome

Variables	Outcome of disease (%)		
	Recovered	Dead	p-values
Age			
(0-6)	214 (37.9)	280 (49.5)	0.0027
(7-12)	36 (6.4)	18 (3.2)	
(12-.+)	10 (1.8)	7 (1.2)	
Sex			
Female	90 (15.9)	126 (22.3)	0.102
Male	170 (30.1)	179 (31.7)	
Vaccination status			
Vaccinated	45 (8)	64 (11.3)	0.03
Unvaccinnated	204 (36.1)	238 (42.1)	
Unknown	11 (1.6)	3 (0.5)	
Duration of treatment (days)			
(1-3)	104 (18.4)	206 (36.5)	2.433^{e}-10
(4-5)	101 (17.9)	71 (12.6)	
(6+)	55 (9.7)	28 (4.9)	
Breed			
German shepherd dog	64	80	0.37
Bichon	7	4	
Boer-bull	1	3	
Cane corso	17	19	
Caniche	13	10	
Cross breed	17	16	
Dalmatien	1	1	
Doberman	2	0	
Dogue allemand	4	4	
Joker	0	1	
Labrador	1	0	
Basenji	104	110	
Pittbull	1	2	
Rottweiler	28	55	

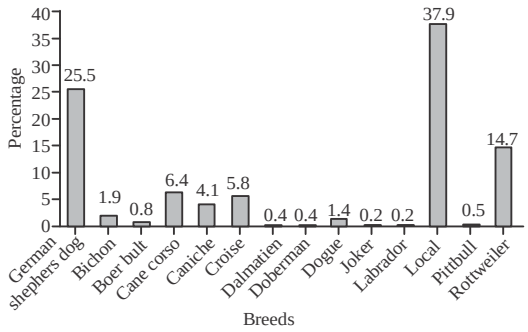

Fig. 6: Distribution of parvovirosis cases in relation to breeds

The influence of risk factors on disease outcome is summarised in Table 1. About 53.98% of the dogs admitted in the clinics for parvovirus died while 46.02% of the dogs recovered. Significant differences between age, vaccination status, duration of treatment and disease outcome ($p<0.05$) were observed. Thus, animals aged 0-6 months died (49.5%) more than those that recovered (37.9%). Those that did not receive a vaccine had the highest mortality rate (42.1%). Similarly, the mortality rate was higher (36.5%) among those who were treated for 1-3 days. However, there were no significant differences between breed, sex and disease outcome.

Table 2: Identification of the veterinary structures

Variables	Modalities	Frequency	Percentage
Gender	Male	8	66.67
	Female	4	33.33
Ages group (year)	(20-30)	1	8.33
	(30-40)	3	25.00
	(40-50)	4	33.30
	(50-60)	4	33.30
	>60	0	0.00
Duration of practice (year)	5	3	25.00
	(5-10)	4	33.33
	(10-15)	3	25.00
	>15	2	16.66

Of the twelve veterinary clinics surveyed in this study, 8 (66.67%) of them were managed by male veterinarians and the majority (66.6%) of the veterinarians were between 40 and 60 years of age. Most of the veterinarians (33.33%) has been in practice for 5-10 years. Table 2 shows the detail characteristics of the veterinary structures.

The KAP study revealed that all the clinicians knew and had already encountered cases of parvovirus in their practice. All of them identified the disease on the basis of clinical signs such as diarrhea and vomiting in association with bad odour or blood. However, only one clinician (8.33%) uses a diagnostic test for confirmation of the etiological agent and none of them do any further examination for parvovirus. In addition, only one facility has a laboratory but 9 (75%) of the veterinarians plan to open one soon. For the majority of clinicians (11/12 or 91.67%) the prognosis for parvovirus is reserved. The signs suggesting recovery are, in order of importance, the return of appetite and cessation of diarrhoea (11/12 practitioners or 91.67%), followed by cessation of vomiting and return to activities (9/12 or 75%).

DISCUSSION

Prevalence and mortality rates: This study reveals a prevalence of *Canine parvovirus* enteritis of 11.43%. This prevalence is lower than those obtained by Ogbu *et al*.[7] in Jos, Nigeria and McRee *et al*.[8] in Zimbabwe who reported a prevalence of 17.14 and 84.89%, respectively. On the other hand, this prevalence is lower than that obtained by Terzungwe *et al*.[9] in Makurdi, Nigeria who obtained a prevalence of 5.7%. These differences could be due to the different methods and techniques used for the diagnosis of the disease.

A mortality rate of CPE 53.98% was recorded in this study. This result is higher than that obtained by Shima[10] in Delta state of Nigeria who reported a mortality rate of 15.7%. This difference could be justified by the fact that dog owners bring their dogs to the clinics in an already advanced state of the disease. Being a rapidly evolving disease that requires rapid management in order to improve the outcome, an aggressive and in-depth treatment is require for a favourable outcome.

Susceptibility of dogs according to intrinsic and extrinsic factors: The majority of animals affected by parvovirus in this study were between 1 and 6 months of age (87.4%) and those over 12 months of age were in the minority (3%). These results corroborate those reported in Ukraine by Terzungwe *et al*.[11] who found 68.3% in dogs <6 months of age and 31.7% in dogs over 6 months of age and Shima[10] in Nigeria reported similar results (60.3% in dogs <6 months of age and 27% in dogs over 6 months of age). Indeed, this age group has been reported by several authors to be the most susceptible to *Canine parvovirus* infection[12, 13]. This would be due to the high mitotic activity that prevails in the intestines of these youngsters at this age as the virus has a tropism for dividing cells. As for adult dogs, the low rate would be due to a natural immunity developed following a previous infection.

The local breed (37.9%) was the most represented in this study, followed by German Shepherds (25.5%) and Rottweilers (14.7%). These results are comparable to those obtained by Terzungwe *et al*.[9] who also reported a higher percentage of local breed (44.9%) in Nigeria. However, disparate results were obtained in Pakistan by Umar *et al*.[14] (40% German Shepherd, 31.8% Labrador and 13.6% Pointer) and in France by Savary[15] (25.9% of crossbreeds, 16.3% of Rottweilers and 6.8% of Labradors). From the above, we can deduce that *Canine parvovirus* can affect dogs of all breeds. However, Rottweilers and related breeds, Labradors, German Shepherds are described as being predisposed to contracting this disease[16] although the reasons for this susceptibility are still unknown. Furthermore, the over-representation of local breeds could be explained by the fact that they are the most numerous breeds in the different study localities.

With regard to gender, males (61.77%) were found to more infected than females (38.23%) in this study. This result is similar to those reported by Terzungwe *et al*.[9] and Shima[10] but differs from that of Umar *et al*.[14] who found that females were more susceptible to parvovirus than males. However, Castro *et al*.[17] noted that the disease is not sexually predifferentiated. A study conducted by Bouli *et al*.[6] on canine demography in Cameroon showed that 74% of the dogs surveyed were male. This over-representation of males could be due to a preference of males for the guarding role they perform.

This study also revealed that unvaccinated animals (78.23%) were more susceptible to the disease than those that received the vaccine (19.29%). Similar results were obtained by Terzungwe *et al*.[11] in Ukraine (73.0% unvaccinated and 27% vaccinated) and Savary[15] in France (53.4% unvaccinated and 27.9% vaccinated). These results are in agreement with the finding of Dogonyaro[18] who states that the best way to protect animals is through vaccination. The high rate of non-vaccinated animals could be due to ignorance on the part of owners about the disease and the importance of vaccination, as well as the high cost of vaccination. In cases where vaccinated dogs have contracted the disease, there would be a problem of vaccine failure. This failure could result either from a poor injection procedure (protocol not followed or inappropriate) or from poor preservation of the vaccine following a break in the cold chain or interference between the vaccine and maternal antibodies which remains the major cause of vaccination failure in puppies[19].

The local breed has the highest death rate, followed by German Shepherds and Rottweilers. This state of affairs can be understood by the fact that the local breed was already more represented than the others. In addition, the local breed was not valued (cheaper on the market) and neglected by the owners because of its easy access and therefore easily replaceable in case of death. This result differs from that obtained by Gombac *et al*.[20] in Slovenia where the highest death rate was recorded among crossbreeds (23.8%), followed by German Shepherds (16.7%) and Rottweilers (10.5%). However, several authors note the fragility of Rottweilers which is due to an innate immunodeficiency[16].

This study also reveals that in puppies aged 1-6 months, the mortality rate is higher than the survival rate. This may be explained by the vulnerability of this class to the virus. In puppies of this age, the cells in the intestinal crypts are in the process of dividing, making the disease aggressive and fatal. However, the mortality rate is low in adults. Indeed, the mitotic activity of intestinal cells declines with age. Cases of death in adults could be due to a strong invasion by intestinal parasites and other viral or bacterial agents that contribute to immune system depression.

Similarly, poor hygiene and poor maintenance would weaken the immune system of animals. Gombac *et al*.[20] reported similar results (66.7% of deaths in the young under 6 months of age compared to 6.7% in dogs over 1 year of age) in Slovenia. With regard to vaccination status, the high death rate in unvaccinated individuals is thought to be due to the fact that they had no immunity to this endemic disease. Animals treated for >3 days had a high cure rate. Indeed, after >4 days of treatment, the outcome of the disease can be good.

The study also showed that the disease was present in all months of the year. This shows that the disease is endemic in the city of Yaounde. Moreover, the months of November (11.5%), December (9.03%) and January

(10.62%) had the highest rates. These months correspond to the dry season. Umar *et al*.[14] in Pakistan obtained a high prevalence in summer (corresponding to a hot period, 62%) compared to winter (cold period, 38%). In contrast, Terzungwe *et al*.[9] report high incidence in January (22.5%), June (15.7%) and July (12.4%), with high incidence in the wet season (51.7% vs. 48.3% in the dry season). Similarly, Savary[15] in France has the highest proportion of parvovirus in the cold season (winter: 49.6%). These different seasonal and monthly trends could be attributed to the different climates of the various geographical locations. This also reflects the resistance of the virus to temperature variations. The virus is present in both the cold and warm seasons.

In addition to the above, this study also shows that *Canine parvovirus* had been reported in the clinics since 2008 and was evolving in a sawtooth pattern. However, peaks were recorded in 2009 (6.9%), 2013 (10.62%), 2015 (14.16%) and 2018 (13.8%) with increasing proportions each time until 2015. These results show that the virus has been present for a very long time but also that prevention and treatment measures for this disease have been inadequate. However, the increase in the number of cases could also be linked to the gradual establishment of veterinary clinics that also diagnose this virus in space of time. A study by Terzungwe *et al*.[9] over a period of 7 years, on the contrary, showed a regression in incidence over time.

Management of parvovirus: On the subject of management, the study shows that men are predominantly represented as practising practitioners in the veterinary clinics of the city of Yaounde. This observation had already been noted in Senegal by Tine[21]. Indeed, this masculinisation of the profession could be understood due to the fact that most clinicians are in full-time practice. This requires great availability and a lot of physical effort that women cannot always naturally produce. This is all the more so since in the majority of African societies, women, in addition to the activities they could carry out, have mainly household responsibilities. In Europe, however, this profession is evolving towards a feminisation direction thanks to the possibility of access to part-time work[21].

With regard to the length of practice, only 2 clinicians (16.67%) had been practising for >15 years. This shows that the establishment of private veterinary clinics is recent in Cameroon.

As for the knowledge and diagnosis of *Canine parvovirus*, all the clinicians stated that they had already encountered cases of *Canine parvovirus* in their structure. They rely in particular on the expression of symptoms (nauseating haemorrhagic diarrhoea, vomiting) to establish the diagnosis. However, only one clinician has a laboratory within his structure and makes a confirmatory diagnosis (rapid test). The clinical signs of *Canine parvovirus* are pathognomonic[22] and the young age of the most affected animals is a good indicator in the clinical diagnosis. Moreover, confirmation of the virus does not influence management since it is symptomatic. However, Laperrousaz[23] insists on the need for clinicians to use a rapid diagnostic test to confirm their diagnosis. This is because the disease begins with non-specific warning signs. It is a rapidly progressive and usually fatal condition. Early diagnosis allows for rapid management and improvement of the outcome of the disease. No additional examination in relation to this virus is carried out by all the clinicians surveyed. This could be due to the cost of establishing a confirmatory diagnosis (the rapid diagnostic test cost 15 euro per test) or additional examinations. But also to the lack of local structures (laboratory) of veterinary specificities allowing to carry out these analyses and the incapacity of the veterinary clientele to support the expenses related to the various examinations. Tine[21] reveals that in Senegal, clinicians face the same challenges but they generally use human testing laboratories.

For most clinicians, the prognosis of parvovirus remains reserved because despite aggressive management of this disease, the dog has a 50% chance of dying[24]. Moreover, in veterinary clinics in Yaounde, management remains limited to visible symptoms since no additional examination is done to explore the complications of the disease.

The return of appetite, cessation of diarrhoea and bleeding are for most clinicians markers of recovery. Indeed, a study conducted by Mohr *et al*.[25] shows an improvement in the condition of feeding dogs. Similarly, Chevalier[26] in a study on the importance of food intake shows that voluntary food intake by a sick puppy during the first 48 h following admission appears to be a positive prognostic factor on the outcome of hospitalization. In addition, cessation of diarrhea and bleeding indicates recovery of the intestinal mucosa.

CONCLUSION

In conclusion, *Canine parvovirus* enteritis is endemic in the metropolitan city of Yaounde and the occurrence of the disease can be influence by intrinsic and extrinsic factors that include age, sex, breed, vaccination status, treatment and seasonal variations. These findings will serve as valuable tools to assist veterinarians, dog owners and policy makers in the animal health sector in taking adequate measures that will curtail the spread and high mortality rate brought about by this disease.

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