2018, Scienceline Publication
World's Veterinary Journal
World Vet J, 8(3): 48-54, September 25, 2018
ISSN 2322-4568

The Epidemiology of Canine Parvovirus Enteritis in Dogs of Makurdi, Benue State, Nigeria

Tion Matthew Terzungwe[1*], Apaa Ternenge Thaddaeus[1], Saganuwan Alhaji Saganuwan[2], Nwankwo Henry Chukwuebuka[2], Tughgba Terzungwe[3], Anumtyo Theresa Mwuese[4], Amine Aondowase Andrew[3], Nguetyo Samuel Aondonenge[4], Igoh Ann Faith[4], Akpehe-Ishor Washima[4]

[1]*Department of Veterinary Medicine, College of Veterinary Medicine, University of Agriculture, Makurdi, Benue State, Nigeria.*
[2]*Department of Veterinary Physiology, Pharmacology and Biochemistry, College of Veterinary Medicine, University of Agriculture, Makurdi, Benue State, Nigeria.*
[3]*Department of Veterinary Surgery and Theriogenology, College of Veterinary Medicine, University of Agriculture, Makurdi, Benue State, Nigeria.*
[4]*College of Veterinary Medicine, University of Agriculture, Makurdi, Benue State, Nigeria.*

[*]Corresponding author's Email: tions_doc@yahoo.co.uk

ABSTRACT

Since its emergence, canine parvovirus enteritis has remained the most significant and important cause of enteritis in puppies between six weeks and six months of age. The aim of this study was to carry out a retrospective study in order to assess the effect of certain factors on the prevalence of the disease in diagnosed cases presented to the veterinary teaching hospital Annex, university of agriculture Makurdi from 2010 to 2016. The overall prevalence of the diagnosed cases of canine parvoviral enteritis has been at 5.7% for the past seven years. Age, sex, breed, vaccination status was showed to have been associated with the infection. Puppies of up to five months of age, males, breeds such as the Nigerian local breed, Alsatian, Caucasian, Rottweiler and Russian shepherd dogs and unvaccinated dogs are prone to this disease. Furthermore, this study revealed that early presentation and an aggressive support management of these cases had brought about a high recovery outcome of 85.4%. The distribution of the disease according to the season showed the highest incidence of cases occurred in 2012 (25.8%) and had descended down to (9%) by 2016 with most cases witnessed around January (22.5%) in dry season and June (15.7%) in wet season. The need for educating both veterinarians and dog owners about core vaccinations in dogs is paramount.

Key words: Canine parvoviral enteritis, Dogs, Makurdi, Prevalence

ORGINAL ARTICLE
pii: S232245681800005-8
Received: 04 Aug 2018
Accepted: 09 Sept 2018

INTRODUCTION

The use of dogs as companion to humans cannot be overemphasized. Dogs are used as trackers, instrument of war, and healers of both the physical and emotional problems of humans (Carmichael, 2003). The population of dogs in Nigeria is estimated to be around 4.5million (Bourn et al., 1994) and infectious diseases such as parvovirosis could reduce their population. The affection humans develop towards pets continues to deepen in this twenty-first century (Daodu et al., 2017).

Canine parvovirus type 2 (CPV-2) is a highly contagious and often fatal viral disease that infects the gastrointestinal tract of dogs (Touihri et al., 2009). CPV is a small, non-enveloped with spherical capsid, consisting of three proteins and a linear, single-strand DNA virus of the family Parvoviridae (Maclachan and Dubovi, 2010). CPV-2 infection does not have predilection for sex, age or breeds of dogs (Castro et al., 2007; Gombac et al., 2008). CPV-2 affects dogs between the ages of six weeks and six months. It seldom affects older dogs, because of their natural immunity (McCaw and Hoskins, 2006; Prittie, 2004). But some breeds such as Rottweiler, Doberman pinscher, American Pit-bull terrier, Labrador retriever and German shepherd dog are at an increased risk of infection (Smith-Carr et al., 1997; Houston et al., 1996).

Certain factors that predispose puppies to CPV-2 infection are lack of protective immunity, intestinal parasites and overcrowding, poor sanitary, and stressful environmental conditions (Smith-Carr et al., 1997; Hoskins, 1997). CPV-2 can be transmitted from infected to susceptible dogs mainly through direct transmission (faecal-oral route), or indirect transmission where dogs can also become infected through exposure to fomites such as shoes, clothing, the hands of humans, food bowls and other utensils (Carmichael, 1994; Smith-Carr et al., 1997; Hoskins, 1997; Decaro et al., 2005b, Nivy et al., 2011). CPV-2 can also be transmitted via house flies, flesh flies and blow/bottle flies (Bagshaw et al., 2014).

To cite this paper: Tion MT, Apaa TT, Saganuwan AS, Nwankwo HC, Tughgba T, Anumtyo TM, Amine AA, Nguetyo SA, Igoh, AF and Akpehe-Ishor W (2018). The Epidemiology of Canine Parvovirus Enteritis in Dogs of Makurdi, Benue State, Nigeria. *World Vet. J.* 8(3): 48-54.
Journal homepage: www.wvj.science-line.com

CPV-2 has mutated twice in the early 1970s to mid 1980s given rise to two antigenic variants namely; CPV-2a and CPV-2b (Parker et al., 2001). In 2000, a third antigenic mutant named CPV-2c emerged from Italy (Buonavoglia et al., 2001). All the three antigenic variants have been distributed in different parts of the world (Bingga et al., 2014; Touihri et al., 2009; Wilson et al., 2014).

The emergence of CPV-2 infection in Nigeria can be traced back to the mid 1980s (Ezeokoli et al., 1985). Chollom et al. (2013) discovered CPV-2 with the use of conventional polymerase chain reaction (PCR). Case reports, seroprevalence, treatment regimen, immunity following CPV vaccination and risk factors affecting the disease in Nigeria have been reported (Eghafona et al., 2007; Ezeibe Maduike et al., 2010; Nwoha, 2011; Shima et al., 2015). CPV-2a strain has been reported in Nigeria (Dogonyaro et al., 2013; Apaa et al., 2016). The virus is often shed in the faeces of infected dogs within 4-5 days of exposure before clinical signs develop and then throughout the period of illness, and for 10days after clinical recovery (Cynthia and Scott, 2010).

CPV-2 infection manifests as an acute haemorrhagic enteritis and myocarditis. Dogs with enteritis show depression, loss of appetite, lethargy, vomiting, high fever and severe mucoid or bloody and foul smelly diarrhea (Lamm and Rezabek, 2008; Prittie, 2004). Presently, myocarditis though seen can develop in puppies less than eight weeks old dog born to unvaccinated bitches (Hoskins, 1997).

Definitive diagnosis is done by the detection of CPV-2 in the faeces of affected dogs, serology, and necropsy and histopathology (Pollock and Carmichael, 1988). Other methods of detection include electron microscopy, viral isolation, fecal hemagglutination, latex agglutination, counter-immunoelectrophoresis, immunochromatography, PCR (Macintire and Smith-Carr, 1997; Pollock and Carmichael, 1988; Desario et al., 2005; JinSik et al., 2006) which is more sensitive and reliable than traditional techniques (Desario et al., 2005).

CPV infection can be managed by aggressive symptomatic and supportive therapy (Prittie, 2004; Brown and Otto, 2008) involving fluid therapy, antibiotic, antiemetic, nutritional support, antiviral treatments and pain management (Mylonakis et al., 2016). Prevention is by vaccination of dogs with either attenuated or modified live vaccines (Martella et al., 2005). But maternally derived antibodies protect neonates as well (10 days) and it interferes with vaccines. Thus, causing vaccine failures (Pollock and Carmichael, 1982).

In Makurdi metropolis, there have been several reported cases of morbidity and mortality of CPV in dogs but there is paucity of information on prevalence, morbidity and mortality rates of the disease. Hence epidemiology of canine parvovirus infection was studied at Veterinary Teaching Hospital (VTH) of the University of Agriculture Makurdi (UAM).

MATERIALS AND METHODS

Study area

This study was conducted in Makurdi metropolis, Benue State, Nigeria. Makurdi, the capital of Benue state lies between latitude 70 15'- 70 45'N and longitude 80 15'- 8 0 40'E. It has a population of about 500,797 (The World Gazetter, 2007), it lies in the Guinea savannah vegetative belt and on the bank of the river Benue which is the second largest river in Nigeria. The river divides the town into North and South banks and the town covers an area of 16 km^2 (Omudu and Amuta, 2007). It has a tropical climate with a temperature ranging between 21.70 -24.70^{0}C (minimum) and 29.70-33.70^{0}C (maximum). The climate of Makurdi town is the tropical wet and dry type, Koppen's Aw classification, with double maxima (Ayoade, 1983). The rainy season lasts from April to October, with five months of dry season (November to March). Annual rainfall in Makurdi town is consistently high, with an average annual total of approximately 1173 mm (Abah, 2012).

Data collection

Data of 1571 treated cases of CPVE in dogs presented at the VTH Annex, UAM from 2010 to 2016 were assessed. History, clinical signs and therapeutic regimens of CPV were reviewed. The presented signs were foul smelly haemorrhagic diarrhoea, emaciation, vomiting and lethargy. The vaccination history, treatment outcome, sex, breeds and age of dogs were recorded. The status of the vaccination history was categorized as vaccinated, unvaccinated and unknown. Similarly, the treatment outcomes of the cases following medical intervention were classified as either "recovered or dead". The suspected cases were confirmed using SensPERT® canine parvovirus antigen test kits (VetALL, Korea).

Statistical analysis

The data collected were analysed using Microsoft Office Excel (2007) for descriptive analysis of variables such as age, sex, and vaccination history and treatment outcome.

To cite this paper: Tion MT, Apaa TT, Saganuwan AS, Nwankwo HC, Tughgba T, Anumtyo TM, Amine AA, Nguetyo SA, Igoh, AF and Akpehe-Ishor W (2018). The Epidemiology of Canine Parvovirus Enteritis in Dogs of Makurdi, Benue State, Nigeria. *World Vet. J.* 8(3): 48-54.
Journal homepage: www.wvj.science-line.com

Ethical approval

This study was certified and approved and was performed according to the ethics of committee of the college of veterinary medicine, University of Agriculture, Makurdi, Nigeria.

RESULTS

Of the 1571 dogs that were brought to the VTH Annex, UAM, Makurdi, for over a period of seven years (2010 - 2016), 89 (5.7%) were diagnosed of CPV enteritis. Table 1 shows the analysis of diagnosed CPVE cases according to age, sex, vaccination status, treatment outcome and season where as the analysis of diagnosed CPVE cases by breed of dogs, month and year have been presented in diagrams 1-3. The local Nigerian breed had the highest frequency of cases 40 (44.9%), followed by Alsatian 18 (20.2%), Caucasian 7 (7.9%), Rottweiler, Russian shepherd 6 (6.7%), Mixed 4 (4.5%), Bull mastiff, Neapolitan mastiff 3 (3.4) and Pit-bull and Chihuahua 1(1.1%) (Diagram 1). The highest incidence of cases was recorded more in the month of January 22 (22.5%), June 14 (15.7%), March and July 11 (12.4%), February 8 (9%), May 7 (7.9%), April, October 4 (4.5%), December 3 (3.4%), September 2 (2.3%) and November 1 (1.1%) respectively (diagram 2) while the peak incidence of cases were recorded in the year 2012, 23 (25.8%), 2013, 16 (18%), 2014, 15 (16.9%), 2011, 11 (12.4%), 2015, 9 (10.1%), 2016, 8 (9%) and 2010, 7 (7.9%) respectively (Diagram 3).

Table 1. Analysis of diagnosed canine parvoviral enteritis cases base on age, sex, vaccination status treatment outcome and season, presented to the veterinary teaching hospital, university of agriculture, Makurdi from 2010 to 2016

Groups	Number of diagnosed cases of canine parvovirus enteritis	
	Frequency	Percentage (%)
Age (Months)		
0-5	71	79.8
6-12	12	13.5
>1 year	6	6.7
Sex		
Male	54	60.7
Female	35	39.3
Vaccination status		
Vaccinated	25	28.1
Unvaccinated	42	47.2
Unknown	22	24.7
Treatment outcome		
Recovered	76	85.4
Dead	13	14.6
Season		
Dry (Nov- March)	43	48.3
Wet (April- October)	46	51.7

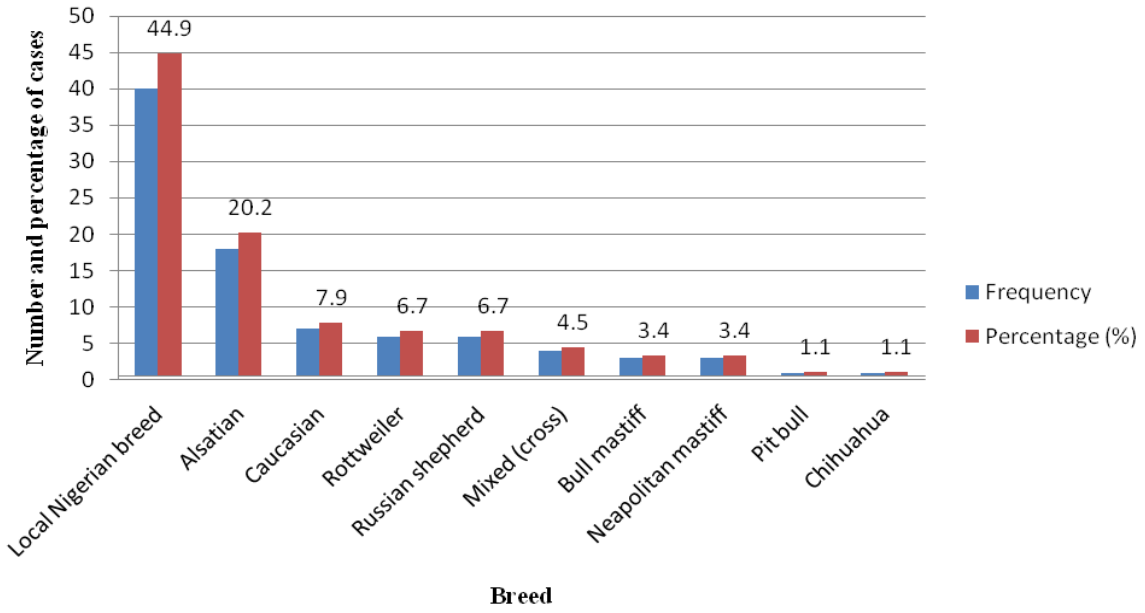

Diagram 1. The distribution of diagnosed canine parvoviral enteritis cases base on breed in university of agriculture Makurdi, Nigeria during 2010-2016.

To cite this paper: Tion MT, Apaa TT, Saganuwan AS, Nwankwo HC, Tughgba T, Anumtyo TM, Amine AA, Nguetyo SA, Igoh, AF and Akpehe-Ishor W (2018). The Epidemiology of Canine Parvovirus Enteritis in Dogs of Makurdi, Benue State, Nigeria. *World Vet. J.* 8(3): 48-54.
Journal homepage: www.wvj.science-line.com

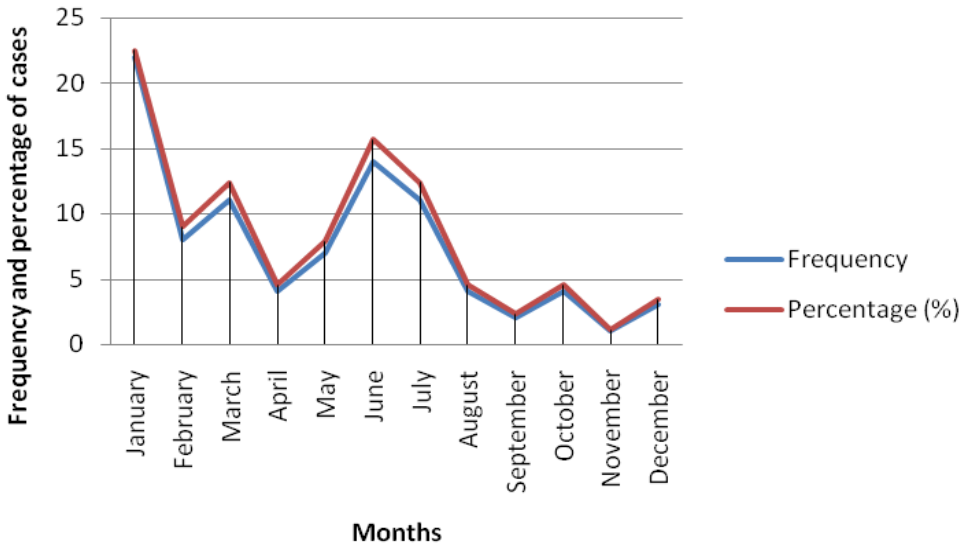

Diagram 2. The distribution of diagnosed canine parvoviral enteritis cases base on months in university of agriculture Makurdi, Nigeria during 2010-2016.

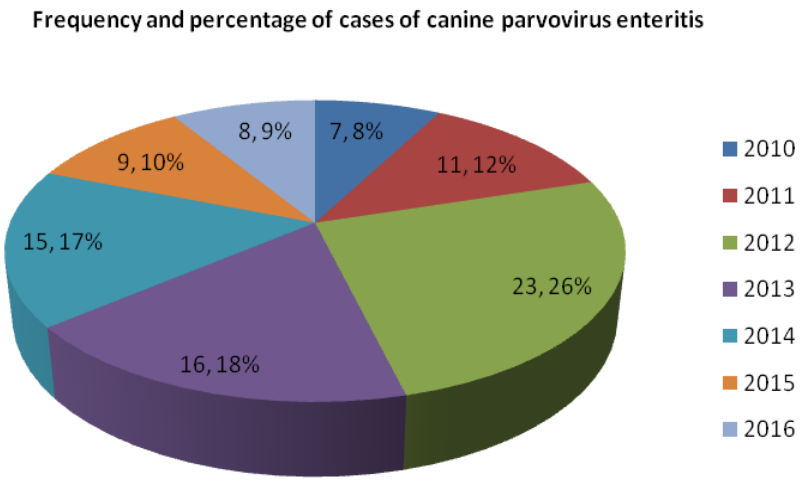

Diagram 3. The distribution of diagnosed canine parvoviral enteritis cases in Nigeria by years at the veterinary teaching hospital (2010-2016).

DISCUSSION

The study has shown that CPVE has been endemic in Makurdi metropolis for years with a 5.7 % prevalence rate (89/1571). Although, the prevalence rate in this study appears to be much lower compared to the values reported in Ilorin 6.4% (105/1645) (Daodu and Ajiboye, 2018), Effurun/Warri 13.4% (204/1527) (Shima et al., 2015), Jos North/South 17.4% (12/70) (Ogbu et al., 2016), Tunisia 32.1 % (54/168) (Tagorti, 2018), Nigeria and south Africa 96.7% (30/31), 98.2% (106/108) (Dogonyaro et al., 2013) and Zimbabwe 84.9% (191/225) (Mcree et al., 2014) but it was higher than the report from Vom 2.8% (87/3075) (Mohammed et al., 2005). The low prevalence may be due to low patronage of the VTH by dog owners, poor record keeping of medical cases and/or lack of proper diagnostic techniques/equipment then. Therefore, this report is a well representation of the cases of CPVE in Makurdi since the VTH is the major veterinary hospital where cases are handled in Makurdi metropolis.

The fact that the group (0-5 months) had a higher incidence rate of 79.8% (71/89), 6-12 months, 13.5% (12/89) and > 12 months, 6.7% (6/89) agrees with the reports from Effurun/Warri 60.3% (0-5 month), 27% (6-11 months) and 12.7% (12 months and above) (Shima et al., 2015), Argentina 86% (1-5 months) and 14% (6 months and above) (Calderon et al., 2011), United States of America 59% (less than 6 months) and 41% (more than 6 months) (Glickman et al., 1985), Slovenia 67.6% (1-5 months), 25.7% (6-12 months) and 6.8% (more than 12 months) (Gombac et al., 2008), India with 40.75% for (0-6 months), 24.19% for (7-12 months) and 10% for (12 months and above) (Basava, 2012). It has already

To cite this paper: Tion MT, Apaa TT, Saganuwan AS, Nwankwo HC, Tughgba T, Anumtyo TM, Amine AA, Nguetyo SA, Igoh, AF and Akpehe-Ishor W (2018). The Epidemiology of Canine Parvovirus Enteritis in Dogs of Makurdi, Benue State, Nigeria. *World Vet. J.* 8(3): 48-54.
Journal homepage: www.wvj.science-line.com

been reported that CPVE primarily affects puppies that are between the age of 6 weeks to 6 months (Marcovich et al., 2012; Mccaw and Hoskins, 2006; Prittie, 2004).

Local Nigerian breeds 44.9%, Alsatians 20.2%, Caucasians 7.9%, Russian shepherd and Rottweiler 6.7%, mixed breed 4.5%, Neapolitan mastiff and Bull mastiff 3.4% each and the least Pit-bull and Chihuahua 1.1% each. The reasons for breeds of dog being susceptible to this dreaded disease remain unknown. Although, there have been earlier reports that Doberman Pinscher, Rottweiler and German Shepherd puppies are under greater risk of developing CPV enteritis than other breeds (Glickman et al., 1985; Houston et al., 1996; Castro et al., 2007; Shima et al., 2015). Our findings disagree with the report that Alsatians, Rottweilers and Doberman pinschers appears to be more at risk (Gombac et al., 2008; Castro et al., 2007). Basava (2012) reported that, the Spitz breed had the highest prevalence (43.75%), followed by Doberman (42.85%), Pomeranian (37.5%), Alsatian (31.03%), Mongrel (28.71%) and Pug, Mastiff, Golden retriever, Labrador (27.77%). Dogs with highest incidence of cases of CPVE were the males (60.7%) as against females with (39.3%). This result agrees with the reported values in males (83.33%) and females (16.7%) respectively (Castro et. al., 2007; Basava, 2012) but disagrees with the finding of Umar et al. (2015) who reported that female (58.5%) were more at risk than the males (41.5%). In Nigeria, male dogs are preferred to females by owners as security with exception of the few that breed them.

The prognosis of CPVE is as low as 9.1% in the absence of treatment, and 64% or higher with treatment (Otto et. al., 1997). In the present study, the prognosis after treatment is 85.4%. This finding corroborates with the reports of Prittie (2004) and Macintire and Smith-Carr (1997) indicating that CPVE could be treated symptomatically. But unvaccinated dogs (47.2%) had the highest prevalence, followed by vaccinated dogs (28.1%) and dogs with unknown vaccination status (24.7%). This also agrees with the result of Basava (2012) who reported (35.4%) for unvaccinated and vaccinated dogs (16%) respectively. The lower prevalence rate of CPVE in vaccinated dogs indicated that current vaccine offer protection (Cavalli et al., 2001).

Monthly prevalence of CPVE in January (22.5%), June (15.7%), March and July (12.4%), February (9%), May (7.9%), April and October (4.5%), December (3.4%), September (2.3%) and November (1.1%) show that cases are seen in the dry season (48.36) and more in the wet season (51.7%), respectively. Shima et al. (2015) reported highest prevalence in January (17.2%) and lowest in April (2.0%). In contrast, Basava (2012) reported highest prevalence in July (48.97%) and the lowest in March (20%) and Houston et al. (1996) also reported that dogs are most likely to be admitted between July to September in Canada. Meanwhile, in the last seven years, the disease had its highest prevalence in 2012 (25.8%) followed by 2013 (18%), 2014 (16.1%), 2011 (12.4%), 2015 (10.1%), 2016 (8%) and 2010 (7.9%) respectively. This was due to lack of awareness on the preventive measures of the disease and poor regimen management.

CONCLUSION

CPVE is endemic in Makurdi metropolis and could be affected by age, sex, breed, vaccination status, treatment (management) and seasonal variations. Vaccination and therapy of the affected dogs could improve the well-being and longevity of the dogs. This result will serve as recorded information to veterinarians, dog owners and breeders in and around Makurdi in giving adequate care and taking preventive measures generally but particularly during the high prevalence period of CPVE.

DECLARATIONS

Author's contribution

ATM, AAA, NSA, IAF, AIW collated the data. NHC and TT analysed the data. TMT, ATT and SAS designed the work while TMT and SAS reviewed the manuscript.

Consent to publish

The author(s) grant(s) the publisher the sole and exclusive license of the full copyright in the contribution. Consequently, the publisher shall have the exclusive right throughout the world to publish and sell the contribution in all languages, in whole or in part, including, without limitation, any abridgement and substantial part thereof, in book form and in any other form including, without limitation, mechanical, digital, electronic and visual reproduction, electronic storage and retrieval systems, including internet and intranet delivery and all other forms of electronic publication now known or hereinafter invented.

Competing interests

The authors have declared that no competing interest exists.

To cite this paper: Tion MT, Apaa TT, Saganuwan AS, Nwankwo HC, Tughgba T, Anumtyo TM, Amine AA, Nguetyo SA, Igoh, AF and Akpehe-Ishor W (2018). The Epidemiology of Canine Parvovirus Enteritis in Dogs of Makurdi, Benue State, Nigeria. *World Vet. J.* 8(3): 48-54.
Journal homepage: www.wvj.science-line.com

REFERENCES

Apaa TT, Daly JM, and Tarlinton RE (2016). Canine parvovirus (CPV-2) variants circulating in Nigerian dogs. Veterinary Record Open 2016;3: e000198. Doi:10.1136/ vetreco-2016-000198.

Ayoade JO (1983). Introduction to climatology for the tropics. Ibadan: Spectrum Books. pp. 179-184. Doi:http://dx.doi.org/10.1144/GSL.JGS.1907.063.01-04.19

Bagshaw C, Isdell AE, Thiruvaiyaru DS, Brisbin JR IL and Sanchez S (2014). Molecular detection of canine parvovirus in flies (Diptera) at open and closed canine facilities in the eastern United States. Preventive Veterinary Medicine, 114: 276-284. Doi:https://doi.org/10.1016/j.prevetmed.2014.02.005.

Basava RK (2012). Clinico-epidemiological studies on canine parvoviral infection in and around Tirupati. M. Sc. Thesis, Department of Veterinary Epidemiology and Preventive Medicine, Sri Venkateswara Veterinary University, Tirupati, India, pp 1-71.

Bingga G, Liu Z, Zhang J, Zhu Y, Lin L, Ding S and Guo P (2014). High resolution melting curve analysis as a new tool for rapid identification of canine parvovirus type 2 strains. Molecular and cellular probes. Doi:https://doi.org/10.1016/j.mcp.2014.08.001.

Bourn D, Wint W, Blench R and Woolley E (1994). Nigerian Livestock Resources Survey. World Animal Review, 78: 49-58.

Brown AJ and Otto CM (2008). Fluid therapy in vomiting and diarrhea. Veterinary Clinics of North America: Small Animal Practice. 38(3):653–75. Doi: 10.1016/j.cvsm.2008.01.008.

Buonavoglia C, Martella V, Pratelli A, Tempesta M, Cavalli A, Buonavoglia D, Bozzo G, Elia G, Decaro N and Carmichael L (2001). Evidence for evolution of canine parvovirus type 2 in Italy. Journal of General Virology, 82: 3021-3025. Doi: 10.1099/0022-1317-82-12-3021.

Calderón MG, Romanuttia C, D'Antuonoa A, Kellerb L, Mattiona N and La Torre J (2011). Evolution of canine parvovirus in Argentina between years 2003 and 2010: CPV2c has become the predominant variant affecting the domestic dog population. Virus Research. 157:106-110. Doi:https://doi.org/10.1016/j.virusres.2011.02.015.

Carmichael LE (1994). Canine parvovirus type-2: An evolving pathogen of dogs. Annals of Veterinary Medicine. 135(4): 590-464.

Carmichael LE (2003). Canine infectious Diseases - A personal perspective. An oral presentation given on August 16th 2003, at the International Symposium: "Reunion Mundial de Lideres en la Educacion Veterinaria" that commemorate the 150th anniversary of veterinary education in the College of Veterinary Medicine, National Autonomous University of Mexico, Mexico City, D.F. Baker Institute for Animal Health Cornell University, Ithaca, New York (USA).

Castro TX, Miranda SC, Labarthe NV, Silva LE and Cubel Garcia RCN (2007). Clinical and Epidemiological Aspects of Canine Parvovirus (CPV) Enteritis in the State of Rio de Janeiro: 1995-2004. Arquivo Brasileiro de Medicina Veterinariae Zootecnia, 59: 333-339. Doi:http://dx.doi.org/10.1590/S0102- 09352007000200010.

Cavalli A, Bozzo G, Decaro N, Tinelli A, Aliberti A and Buonavoglia D (2001). Characterization of a canine parvovirus strain isolated from an adult dog. New Microbiology, 24: 239-242.

Chollom S, Fyaktu E, Okwori A, Agada G, Hashimu G, Akele R, Voumangai E, Dashe T and Egah D (2013). Molecular detection of canine parvovirus in Jos, Nigeria. Journal of Veterinary Medicine and Animal Health, 5: 57-59. DOI:10.5897/JVMAH12.033.

Cynthia MK and Scott L (2010). The Mercks Veterinary Manual, Tenth edition. Merck and Co Inc, White House Station, N. J. USA.

Daodu, O.B., Amosun, E.A. and Oluwayelu, D.O. (2017). Antibiotic resistance profiling and microbiota of the upper respiratory tract of apparently healthy dogs in Ibadan, South west Nigeria. African Journal of Infectious Disease,11 (1): 1-11 Doi::10.21010/ajid. v11n1.

Decaro N, Elia G, Martella V, Desario C, Campolo M, Trani LD, Tarsitano E, Tempesta M and Buonavoglia C (2005b). A real-time PCR assay 62 for rapid detection and quantitation of canine parvovirus type 2 in the faeces of dogs. Veterinary microbiology, 105: 19-28. DOI: 10.1016/j.vetmic.2004.09.018.

Desario C, Decaro N, Campolo M, Cavalli A, Cirone F, Elia G, Martella V, Lorusso E, Camero M and Buonavoglia C (2005). Canine parvovirus infection: which diagnostic test for virus? J. Virol. Methods, 126(1): 179–185. DOI: 10.1016/j.jviromet.2005.02.006.

Dogonyaro BB, Bosman AM, Sibeko KP, Venter EH and Van Vuuren M (2013). Genetic analysis of the VP2-encoding gene of canine parvovirus strains from Africa. Veterinary microbiology, 165: 460-465. Doi:https://doi.org/10.1016/j.vetmic.2013.04.022

Eghafona N, Jacob J and Yah S (2007). Evaluation of post-vaccination immunity to canine distemper and parvoviruses in Benin City, Nigeria. African Journal of Biotechnology 6: 1898-1904. Doi: http://dx.doi.org/10.5897/AJB2007.000-2286

Ezeibe MC, Nwaogu IC, Nwigwe AN, Okorafor ON and Eze JI (2010). Aluminium-magnesium silicate inhibits parvovirus and cures infected dogs. Health, 2: 1215. Doi:10.4236/health.2010.210179

Ezeokoli CD, Umoh JU, Adeyanju JB and Abdullahi SU (1985). Parvovirus enteritis in Nigerian dogs. Journal of Small Animal Practice, 26: 669 - 673. Doi:https://doi.org/10.1111/j.1748-5827.1985.tb02194.x.

Glickman LT, Domanski LM, Patronek GJ and Visintainer F (1985). Breed-related risk factors for canine parvovirus enteritis. Journal of American Veterinary Medical Association, 187(6): 589–594.

Gombac M, Svara T, Tadic M and PogacNik M (2008). Retrospective Study of Canine Parvovirosis in Slovenia: Case Report. Slovenia Veterinary Research, 45: 73-78.

Hoskins JD (1997). Update on canine parvoviral enteritis. Veterinary Medicine, 92(8):694–709.

Houston DM, Ribble CS and Head LL (1996). Risk factors associated with parvovirus enteritis in dogs: 283 cases (1982-1991). Journal of the American Veterinary Medical Association, 208(4):542–546.

Oh JS, Ha GW, Cho YS, Kim MJ, An DJ, Hwang KK, Lim YK, Park BK, Kang B and Song DS (2006). One-step immunochromatography assay kit for detecting antibodies to canine parvovirus. Clinical and Vaccine Immunology, 13(4):520–4. Doi: 10.1128/CVI.13.4.520-524.2006.

Lamm CG and Rezabek GB (2008). Parvovirus infection in domestic companion animals. Veterinary Clinics of North America: Small Animal Practice, 38(4): 837–50. Doi: 10.1016/j.cvsm.2008.03.008.

Macintire DK and Smith-Carr S (1997). Canine parvovirus. Part II. Clinical signs, diagnosis, and treatment. Compendium on Continuing Education for the Practising Veterinarian, 19(3):291–302.

MacLachlan NJ and Dubovi EJ (2011). Rabies. In: Fenner's Veterinary Virology.4th edition, pp 327-336.

Marcovich JE, Stucker KM, Carr AH, Harbison CE, Scarlett JM and Parrish CR (2012). Effects of canine parvovirus strain variations on diagnostic test results and clinical management of enteritis in dogs. Journal of the American Veterinary Medical Association, 241(1):66–72. Doi:10.2460/javma.241.1.66.

Martella V, Cavalli A, Decaro N, Elia G, Desario C, Campolo M, Bozzo G, Tarsitano E and Buonavoglia C (2005). Immunogenicity of an intranasally administered modified live canine parvovirus type 2b vaccine in pups with maternally derived antibodies. Clinical and Diagnostic Laboratory Immunology, 12(10): 1243–1245. Doi:10.1128/CDLI.12.10.1243-1245.2005.

McCaw DL, Hoskins JD (2006). Canine viral enteritis. In: Green CE, editor. Infectious Diseases of the Dog and Cat. 4th ed. St Louis, MO: Saunders; pp 63–73.

Mcree A, Wilkes RP, Dawson J, Parry R, Foggin C, Adams, H., Odoi A and Kennedy AM (2014). Serological Detection of Infection with Canine Distemper Virus, Canine Parvovirus and Canine Adenovirus in Communal Dogs from Zimbabwe. Journal of the South African Veterinary Association, 85(1), Art. #1110, 2 p. Doi:http://dx.doi.org/10.4102/jsava.v85i1.1110.

Mohammed JG, Ogbe AO, Zwandor NJ and Umoh JU (2005). Risk factors associated with canine parvovirus enteritis in Vom and environs. Animal Research International. 2(3): 366 – 368. http://dx.doi.org/10.4314/ari.v2i3.40870

Muzyczka N, Berns KI (2001). Parvoviridae: The Viruses and Their Replication. In: Knipe DM, Howley PM, Griffen DE, Lamb RA, Martin MA, Roizman B and Straus ES (Eds.), Fields Virology. 4th ed. Lippincott Williams & Wilkins, Philadephia, PA, pp. 2327–2359.

Mylonakis ME, Kalli I and Rallis TS (2016). Canine parvoviral enteritis: an update on the clinical diagnosis, treatment, and prevention. Veterinary Medicine: Research and Reports, 7: 91—100. Doi: https://doi.org/10.2147/VMRR.S80971.

Nivy R, Hahn S, Perl S, Karnieli A, Karnieli O and Aroch I (2011). A Fatal Outbreak of Parvovirus Infection: First Detection of Canine Parvovirus Type 2c in Israel with Secondary Escherichia coli Septicemia and Meningoencephalitis. This year we celebrate 250 years of veterinary medicine. The world's first veterinary school was established in Lyon, France in 1761 by Claude Bourgelat who managed to persuade King Louis XV of France of the need to train specialists, 66: 3.

Nwoha RIO (2011). Parvoviral Enteritis in a Dog: Case Report and Review of the Literature. Continental Journal of Veterinary Science, 5: 6-10.

Ogbu KI, Chukwudi IC, Ijomanta OJ, Agwu OE and Chinonye CN (2016). Prevalence of Canine Parvovirus in Jos North and South Local GovernmentAreas of Plateau State. British Microbiology Research Journal, 13(2): 1-5. DOI: 10.9734/BMRJ/2016/22813.

Omudu EA and Amuta EU (2007). Parasitology and urban livestock farming in Nigeria: Prevalence of ova in faecal and soil samples and animals ectoparasites in Makurdi. Journal of the South African Veterinary Association, 78: 40-45.

Otto CM, Drobatz KJ, Soter C (1997). Endotoxemia and tumor necrosis factor activity in dogs with naturally occurring parvoviral enteritis. Journal of Veterinary Internal Medicine, 11(2): 65–70.

Parker JSL, Murphy WJ, Wang D, O'Brein SJ and Parrish CR (2001). Canine and feline parvoviruses can use human and feline transferrin receptors to bind, enter and infect cells. Journal of Virology, 75: 3896-902. DOI: 10.1128/JVI.75.8.3896-3902.2001.

Pollock RVH and Carmichael LE (1982). Maternally Derived Immunity to Canine Parvovirus Infection: Transfer, Decline and Interference with Vaccination. Journal of the American Veterinary Medical Association, 180(1): 37-42.

Pollock RVH and Carmichael LE (1988). Canine viral enteritis. In: Barlough JE, editor. Manual of small animal infectious diseases. New York: Churchill Livingston, pp 101–7.

Prittie J (2004). Canine parvoviral enteritis: a review of diagnosis, management, and prevention. Journal of Veterinary Emergency and Critical Care, 14(3):167-176. Doi: https://doi.org/10.1111/j.1534-6935.2004.04020.x

Shima F, Apaa, T and Mosugu JT (2015). Epidemiology of Canine Parvovirus Enteritis among Hospitalized Dogs in Effurun/Warri Metropolitan Region of Delta State, Nigeria. Open Access Library Journal, 2: 1-7. Doi:http://dx.doi.org/10.4236/oalib.1101208.

Smith-Carr S, Macintire DK, Swango LJ (1997). Canine parvovirus. Part I. Pathogenesis and vaccination. Compendium on Continuing Education for the Practising Veterinarian.19(2):125–133.

Tagorti G (2018). Prevalence of canine parvovirus infection in Grand Tunis, Tunisia. Journal of Advanced Veterinary and Animal Research. 5(1):93-97. Doi: http://doi.org/10.5455/javar.2018.e251.

The World Gazetter (2007). Accessed via: http:// mikes.railhistory.railfan.net.

Touihri L, Bouzid I, Daoud R, Desario C, El Goulli AF, Decaro N, Ghorbel A, Buonavoglia C and Bahloul C (2009). Molecular characterization of canine parvovirus-2 variants circulating in Tunisia. Virus genes, 38: 249-258.https://doi.org/10.1007/s11262-008-0314-1.

Umar S, Ali A, Younus M, Maan MK, Ali S, Khan WA and Irfan M. (2015). Prevalence of Canine Parvovirus Infection at Different Pet Clinics in Lahore, Pakistan. Pakistan journal of zoology. 47(3):657-663.

Wilson S, Illambas J, Siedek E, Stirling C, Thomas A, Plevova E, Sture G and Salt J (2014). Vaccination of dogs with canine parvovirus type 2b (CPV- 2b) induces neutralising antibody responses to CPV-2a and CPV-2c. Vaccine, 32: 5420- 5424. DOI: 10.1016/j.vaccine.2014.07.102.

To cite this paper: Tion MT, Apaa TT, Saganuwan AS, Nwankwo HC, Tughgba T, Anumtyo TM, Amine AA, Nguetyo SA, Igoh, AF and Akpehe-Ishor W (2018). The Epidemiology of Canine Parvovirus Enteritis in Dogs of Makurdi, Benue State, Nigeria. *World Vet. J.* 8(3): 48-54.
Journal homepage: www.wvj.science-line.com