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Prevalence of Canine Parvovirus Infection in Khartoum State, Sudan

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Authors' contributions

This work was carried out in collaboration among all authors. Authors MZMA and MFAA designed the study, performed the statistical analysis and wrote the protocol and the first draft of the manuscript. Authors EAAA and WIM managed the analyses of the study, managed the literature searches and approved the final manuscript. All authors read and approved the final manuscript.

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Original Research Article

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ABSTRACT

This study was extended for 2 years and covered different seasons of the years 2021 and 2022. The study was aiming at investigating the prevalence of Canine Parvovirus infection among dogs. A total of 599 dogs from different breeds, ages and different localities of Khartoum State were investigated for the presence of Canine Parvovirus infection. According to the results of Canine Parvovirus Ag Rapid Kit for the detection of Canine Parvovirus, the prevalence of Canine Parvovirus in Khartoum State was 7%. Male and female dogs were susceptible for Parvovirus infection with the prevalence of 3.8% and 3.2% respectively. Young ages were more susceptible for the infection. According to ANOVA analysis, the mean infection in winter is higher than that in autumn or summer but there was no statistical significant difference (p-value= 0.289) in Canine Parvovirus infection among the three seasons. According to ANOVA analysis, there was no statistical significant difference (p-value= 0.514) among dog's breeds in Canine Parvovirus infection. Eighty one percent of Canine Parvovirus cases respond for the treatment trials with excessive fluid therapy, anti-inflammatories and antibiotics. This is the first study concerning investigation of

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Canine Parvovirus infection in Khartoum State. The Canine Parvovirus infection is more likely to occur at an early stage of life; therefore, it is recommended for owners of puppies less than 16 weeks to avoid contact with dogs at high risk for canine parvovirus infection or during recovery stage. Vaccination and Deworming programs against different diseases are recommended for dogs.

Keywords: Canine; khartoum state; parvovirus; sudan; viral infection.

1. INTRODUCTION

"Canine parvovirus (CPV) is a highly contagious virus that can affect all dogs, but unvaccinated dogs and puppies younger than four months old are the most at risk. Dogs that are ill from canine parvovirus infection are often said to have "parvo". The virus is a small belonging to the Parvoviridae family and Parvovirus genus under the Parvovirinae sub family" [1]. "A species jump which may have involved intermediate passage in other carnivores such as mink or raccoons" [2]. "CPV-2 possesses a single-stranded DNA genome of about 5,200 nucleotides in length ,enclosed in a 26-nm-diameter icosahedral capsid made up of a combination of two proteins,VP1 and VP2" [3,4]. "CPV infection became Panzootic since 1980 and caused severe and fatal illness in many dogs" [5]. "It has high morbidity and mortality in dogs being more severe in pups. CPV have undergone a series of evolutionary selections in nature, resulting in global distribution of new variants that have replaced the original CPV-2. Currently, the three major antigenic variants of CPV-2 which are 2a, 2b and 2c are known to be distributed among the dog population worldwide" [6]. "During acute phase of infection dogs may excrete virion particles up to 109/gram of feces" [7]. "Moreover, CPV-2 virion particles are very stable in environment which facilitates its transmission through fecal-oral route. Fecal samples diagnosed positive for CPV-2 were passaged in concanavalin A (Con A) activated peripheral blood mononuclear cells (PBMC) of dog" [8]. "CPV-2c, was discovered in Italy in 2000 [9], displaying an exceptional ability to rapidly spread through the canine population in that country [6], as well as in other European countries [10], Asia [11] and America" [1,12,13]. "Although the first reports seemed to account for a low pathogenicity of CPV-c, experimental data and field observations now indicate a more severe clinical course and higher mortality rates associated with CPV-2c infection, as well as its ability to infect and cause disease in adult dogs, even if repeatedly vaccinated" [14].

This study was aiming at investigating Canine Parvovirus infection in Khartoum State, Sudan.

2. MATERIALS AND METHODS

2.1 Area of the Study

The study was conducted in Khartoum State during the years 2020, 2021 and 2022.

2.2 Samples

2.2.1 Source of samples

In this study 599 dogs of different ages and breeds were investigated for presence of Canine Parvovirus infection. Faecal samples were collected during this investigation from all animals.

2.2.2 Breeds of dogs

The investigated dogs were belonged to German shepherd, Local, Lulu, cross, Perro de Presa Canario, Rottweiler, Royal black, Rood dog, Golden Retriever, Malinois, Griffon, Caucasian, Alabi, American bulldog, Saluki, Balboa and Husky breeds of dogs.

2.2.3 Ages of dogs

The age of the investigated dogs was ranged between 40 days and 20 months.

2.2.4 Sampling procedure

A total of 599 Faecal samples were collected from different Localities of Khartoum State. Faecal samples were collected directly from rectums of the dogs by using swabs. Faecal samples were transported in iceboxes to the Veterinary Laboratory in college of Veterinary Medicine University of Bahri.

2.3 Detection of Canine Parvovirus (CPV)

2.3.1 VDRG® CPV Rapid kit for detection of Canine Parvovirus (MEDIAN DIAGNOSTIC, Korea) [15]

Test Procedure:

1. Fecal samples were collected from dogs' rectums using the sample collection swabs.

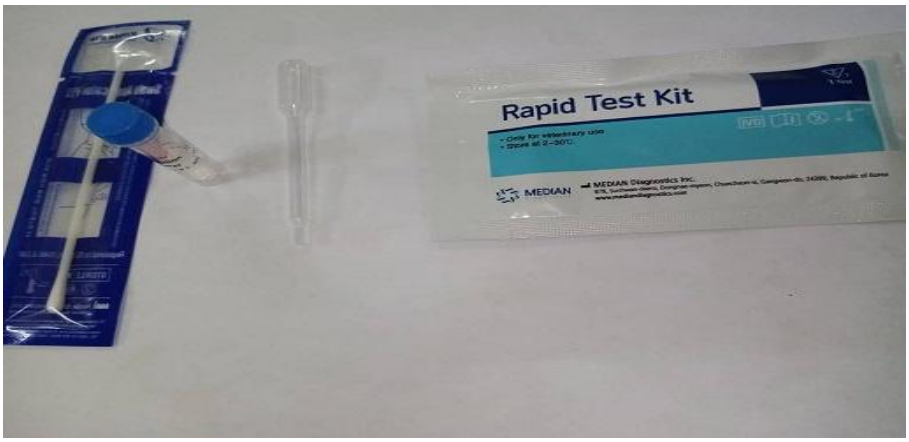

Fig. 1. Rapid Test Kit for detection of Canine Parvovirus (CPV)

2. Sample were put into the container that contained sample dilution buffer and the solution was stirred well with a swab in order to extract the virus from the fecal sample thoroughly.
3. The tube was placed upright until the large particles went down (20sec).
4. The supernatant of sample solution was taken using dropper, and then 4 drops were added into the sample hole on the test device.
5. Results were read after 10 minutes (Fig. 1).

2.4 Treatment Trial for Canine Parvovirus Cases

Excessive fluid therapy, anti-inflammatories and antibiotics were used for treatment of Canine Parvovirus cases [10].

3. RESULTS

3.1 Prevalence of Canine Parvovirus in Khartoum State

Among 599 dogs of different breed, sex and age, 42 (7.0%) were positive for CPV test. Male dogs represented 3.8% and females represented 3.2% of the positively tested dogs. The age of the infected dogs ranged in between 40 days and 13 months (Table 1, Figs. 2, 3 and 4).

3.2 Prevalence of Canine Parvovirus in autumn

The prevalence of Canine parvovirus during the autumn was 2.5%. Male dogs represented 1.5% and females represented 1.0% of the positively tested dogs (Table 2).

3.3 Prevalence of Canine Parvovirus in Winter

The prevalence of Canine parvovirus during the winter was 8.0%. Male dogs represented 3.5% and females represented 4.5% of the positively tested dogs (Table 3).

3.4 Prevalence of Canine Parvovirus in Summer

The prevalence of Canine parvovirus during the summer was 3.8%. Male dogs represented 2.5% and females represented 1.3% of the positively tested dogs (Table 4).

According to ANOVA analysis, the mean infection in winter is higher than that in autumn or summer but there was no statistical significant difference (p-value= 0.289) in Canine Parvovirus infection among the three seasons.

3.5 Prevalence of Canine Parvovirus in different dog's breeds

Among 42 dogs of different breeds, the prevalence of Canine Parvovirus was 33.3% in local, 31.0% in German shepherd, 14.2% in cross, 9.5% in Lulu, 2.4% in Perro de Presa Canario, Caucasian, Alabi, American bulldog and Balboa breeds (Fig. 5).

According to ANOVA analysis, there was no statistical significant difference (p-value= 0.514) among dog's breeds in Canine Parvovirus infection.

3.6 Treatment trial for Canine Parvovirus cases

Eighty one percent of Canine Parvovirus cases respond for the treatment trials (Fig. 6).

Table 1. Prevalence of Canine Parvovirus infection in Khartoum State

Breed	Infected Male	Healthy Male	Infected Female	Healthy Female	Total
German shepherd	6	159	7	174	**346**
Local	7	39	7	38	**91**
Lulu	2	16	2	25	**45**
Cross	4	19	2	17	**42**
Perro de Presa Canario	1	9	0	9	**19**
Rottweiler	0	5	0	6	**11**
Royal black	0	7	0	1	**8**
Rood dog	0	0	0	7	**7**
Golden Retriever	0	1	0	5	**6**
Malinois	0	4	0	2	**6**
Griffon	0	4	0	1	**5**
Caucasian	1	0	0	3	**4**
Alabi	0	1	0	2	**3**
American bulldog	1	0	1	0	**2**
Saluki	0	2	0	0	**2**
Balboa	0	1	0	0	**1**
Husky	1	0	0	0	**1**
Total	**23 (3.8%)**	**267 (44.6%)**	**19 (3.2%)**	**290 (48.4%)**	**599 (100%)**

Table 2. Prevalence of Canine Parvovirus infection in Khartoum State in autumn

Breed	Infected Male	Healthy Male	Infected Female	Healthy Female	Total
German shepherd	2	63	0	70	**135**
Local	1	14	1	10	**26**
Lulu	1	4	1	3	**9**
Rottweiler	0	4	0	5	**9**
Saluki	0	4	0	5	**6**
Cross	0	4	0	2	**6**
Griffon	0	4	0	0	**4**
Malinois	0	3	0	1	**4**
Alabi	0	1	0	2	**3**
Perro de Presa Canario	0	0	0	2	**2**
Caucasian	0	1	0	1	**2**
Balboa	1	0	0	0	**1**
American bulldog	0	0	1	0	**1**
Total	**4 (1.5%)**	**102 (49.0%)**	**3 (1.0%)**	**101 (48.5%)**	**208 (100%)**

Table 3. Prevalence of Canine Parvovirus infection in Khartoum State in winter

Breed	Infected Male	Healthy Male	Infected Female	Healthy Female	Total
German shepherd	4	61	6	62	**133**
Local	0	17	0	11	**28**
Cross	3	6	2	6	**17**
Lulu	0	4	1	5	**10**
Rood dog	0	0	0	6	**6**
Perro de Presa Canario	0	0	0	2	**2**
Caucasian	0	0	0	2	**2**
Saluki	0	1	0	0	**1**
Griffon	0	0	0	1	**1**
Golden Retriever	0	1	0	0	**1**
Malinois	0	1	0	0	**1**
Total	**7 (3.5%)**	**91 (45.0%)**	**9 (4.5%)**	**95 (47.0%)**	**202 (100%)**

Table 4. Prevalence of Canine Parvovirus infection in Khartoum State in summer

Breed	Infected Male	Healthy Male	Infected Female	Healthy Female	Total
German shepherd	0	35	1	42	78
Lulu	1	8	0	17	26
Cross	1	9	0	9	19
Perro de Presa Canario	1	8	0	5	14
Royal black	0	7	0	1	8
Golden Retriever	0	0	0	6	6
Local	0	1	1	1	3
Rottweiler	0	1	0	1	2
American bulldog	0	2	0	0	2
Rood dog	0	0	0	1	1
Malinois	0	0	0	1	1
Husky	1	0	0	0	1
Total	**4 (2.5%)**	**71 (44.1%)**	**2 (1.3%)**	**84 (52.1%)**	**161 (100%)**

Fig. 2. German shepherd dog infected with Canine Parvovirus

Fig. 3. Positive CPV test for detection of Canine Parvovirus

Fig. 4. Negative CPV test for detection of Canine Parvovirus

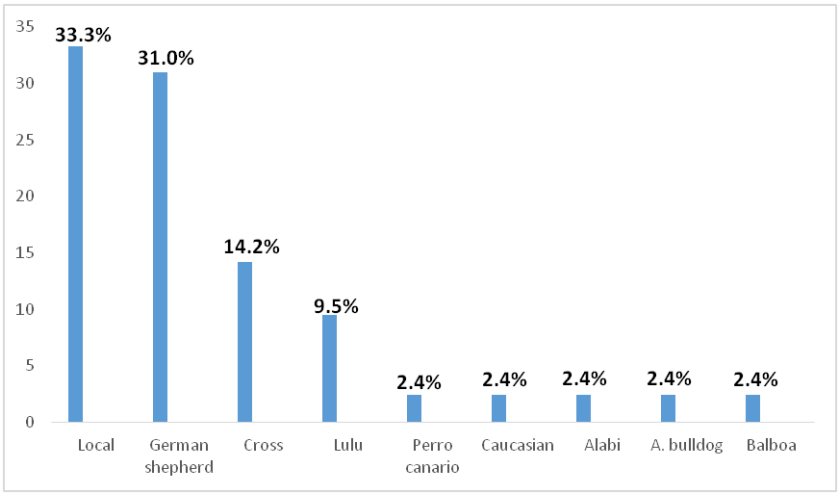

Fig. 5. Prevalence of Canine Parvovirus in different dog's breeds

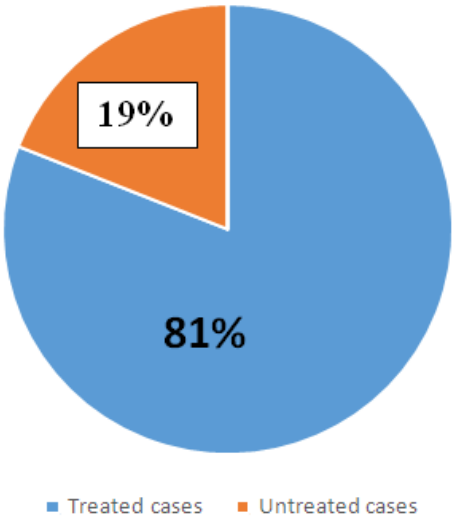

Fig. 6. Treated cases of Canine Parvovirus

4. DISCUSSION

Canine parvovirus (CPV) is a contagious virus mainly affecting dogs. CPV is highly contagious and is spread from dog to dog by direct or indirect contact with their feces. Vaccines can prevent this infection, but mortality can reach 91% in untreated dogs. In the present study the prevalence of Canine Parvovirus infection in Khartoum State was found to be 7.0%. The similar percentage was reported by Wazir et al. [16] in India. Ali et al. [17] reported higher prevalence (40%) of CPV in Egypt. Also Archana Shukla et al. [18] and Roy et al. [19], reported higher prevalence of 45.30% and 65.04% respectively in India. These variations observed in the prevalence were difficult to explain due to the different study areas and differences in the methods of sample analysis. In this study the age of the infected dogs with CPV ranged in between 40 days and 13 months. Al-Hosary [20] reported "a prevalence of CPV infection in 3 to 6 months old dogs in Egypt". Mukhopadhyay et al. [21], Dongre et al. [22] and Khare et al. [23] stated that, "the age wise prevalence of CPV infection revealed maximum prevalence in the dogs of 0-3 months of age i.e. 11.9%, followed by 3-6 months of age i.e. 7.09%, 6-12 months of age i.e. 5.31% and above 12 months of age i.e. 1.11%". Shanshan et al. [24], Zhuo et al. [25] and Wu et al. [26] reported that "in 1 month old dog, the prevalence varies from 5.40% to 9.93%; for 2 months old, it varies from 10.11 to 38.40%; for 3 months old, it varies from 11.26 to 23.08%; for 4 months old, it varies from 8.21 to 16.38%; between 5 months and 1 year, it varies from 2.55

to 7.65%; from 1 to 2 years, it varies from 0.00 to 18.03%, and over 2 years old, it varies from 0.00 to 11.20%. The higher prevalence in the dogs of 0 to 3 months of age may be attributed to the higher susceptibility of enterocytes to the viral tropism". Houston et al. [27] stated that "during weaning, enterocytes of the intestinal crypts have a higher mitotic index because of the changes in bacterial flora and diet, and were therefore more susceptible". "Thus, the higher prevalence of CPV infection in young dogs (0 to 3 months) was probably because of the close affinity of the virus with rapidly dividing cells of the intestine, which decline with the advancement of age" [28, 23]. In this study the prevalence of CPV in male dogs was 3.8% and 3.2% in females. Peter et al. [29] stated that male and female dogs are equally susceptible for the disease. The findings is different than Shanshan et al. [24], Kang [30] and Cao et al. [31] who reported that the prevalence of CPV in male dogs varies between 15.29 and 69.20%, whereas that of female dogs varies between 16.80 and 47.7%. In this study the prevalence of Canine Parvovirus was 33.3% in local breed, 31.0% in German shepherd, 14.2% in cross breed, 9.5% in Lulu, 2.4% in Perro de Presa Canario, Caucasian, Alabi, American bulldog and Balboa breeds. According to ANOVA analysis, the mean infection in winter is higher than that in autumn or summer but there was no statistical significant difference (p-value= 0.289) in Canine Parvovirus infection among the three seasons. The high prevalence of CPV in local dogs was also reported by Archana Shukla et al. [18] and Wazir et al. [16] in India. Also Al-Hosary [20] and Khare et al. [23] in Egypt reported "a higher prevalence of CPV in German shepherds breed of dogs". "The higher prevalence in these breeds might be due to the higher population density of this breed making their proximity to spread the infection or poor vaccination schedule being followed by the owners of the non-descript breeds due to the lack of awareness among them. No specific comment can be made on breed susceptibility as the population density of the breed varies from one geographical area to another" [18, 23]. The prevalence was higher in non-vaccinated dogs compared to the vaccinated ones. The finding was in agreement with Godsall et al. [32] where "unvaccinated puppies aged between six weeks and six months were at greatest risk of developing CPV infection. The higher prevalence of CPV infection in non-vaccinated dogs might be due to a lack of protective immunity. In vaccinated dogs, CPV infection might occur due to incomplete or ineffective primary vaccination course, or a failure of vaccination. In this study the prevalence of Canine Parvovirus during the autumn was 2.5%, 8.0% during the winter and 3.8% during the summer". According to ANOVA analysis, there was no statistical significant difference (p-value= 0.514) among dog's breeds in Canine Parvovirus infection. Higher prevalence during different seasons was reported by Shanshan et al. [24], Wang et al. [33] and Li et al. [34], who reported that in summer, prevalence vary from 7.70 to 52.22%; in the autumn vary from 5.48 to 33.06%, and in the winter vary from 14.80 to 33.04%. In the present study 81% of Canine Parvovirus cases respond for the treatment trials. In Switzerland Kevin Horecka et al. [35] reported a survival rate of 86.6% and in UAS Kathryn et al. [36] reported a survival rate of 75% for Canine Parvovirus cases.

5. CONCLUSION AND RECOMMENDATIONS

The prevalence of canine Parvovirus in Khartoum State was 7%. Male and female dogs had the same risk of infection with the virus. Young ages were more susceptible for the infection with the virus. According to ANOVA analysis, the mean infection in winter is higher than that in autumn or summer but there was no statistical significant difference (p-value= 0.289) in Canine Parvovirus infection among the three seasons. According to ANOVA analysis, there was no statistical significant difference (p-value= 0.514) among dog's breeds in Canine Parvovirus infection. Most cases were treatable. The canine parvovirus infection is more likely to occur at an early stage of life; therefore, it is recommended for owners of puppies less than 16 weeks to avoid contact with dogs at high risk for canine parvovirus infection or during recovery stage. All dogs must be vaccinated against different diseases and complete the vaccine schedules. Diseased dogs must be treated early for good prognosis. Diseased dogs must be separated from healthy dogs to prevent spread of infection. Hygiene must be doing during infection (sanitizing of fomite, food and water dishes.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Hong C, Decaro N, Desario C, Tanner P, Pardo MC, Sanchez S, Buonavoglia C,

Saliki JT. Occurrence of canine parvovirus type 2c in the United States. J. Vet. Diagn. Invest. 2007;(19):535-539.
2. Truyen U, Everman JF, Vieler E, Parrish CR. Evolution of canine parvovirus involved loss and gain of feline host range. Virology. 1996;(215):186-189.
3. Agbandje MCR, Parrish, Rossmann MG. The recognition of parvovirus capsids by antibodies. Semin. Virol. 1995;(6):219-231.
4. Reed APE, Jones V, Miller TJ. Nucleotide sequence and genome organization of canine parvovirus. J. Virol. 1998;(62):266-276.
5. Pollock RVH, Parrish CR. In Comparative pathobiology of Viral Diseases. CRC Press, Florida.1985;(1):145-177.
6. Decaro N, Martella V, Desario C, Bellaciccio AL, Camero M, Manna L, d'Aloja D, Buonavoglia C. First detection of canine parvovirus type 2c in pups with haemorrhagic enteritis in Spain. J. Vet. Med. Infect. Dis. Vet. Public Health. 2006;(53):468-472.
7. Carmichael LE, Binn LN. (1981). New enteric diseases in the dog. Adv. Vet. Sci. Comp. Med. 1981;(25):1-37.
8. Harder TC, Kenter M, Vos H, Siebelink K, Huisman W, Van Amerongen G, Barrett T, Apple MJG, Osterhausa DME and Gen J. Complement-Mediated Neutralization of Canine Distemper and Canine Parvovirus In Vitro. Virol. 2002;(77):397.
9. Buonavoglia C, Martella V, Pratelli A, Tempesta M, Cavalli A, Buonavoglia D, Bozzo G, Elia G, Decaro N, Carmichael LE. (2001). Evidence for evolution of canine parvovirus type-2 in Italy. J. Gen. Virol. 2001;(82)3021-3025.
10. Decaro N, Desario C, Addie DD, Martella V, Vieira MJ, Elia G, Zicola A, Davis C, Thompson G, Thiry E, Truyen U, Buonavoglia C. Molecular epidemiology of canine parvovirus, Europe. Emerg. Infect. Dis. 2007;(13):1222-1224.
11. Nakamura M, Tohya Y, Miyazawa T, Mochizuki M, Phung HT, Nguyen NH, Huynh LM, Nguyen LT, Nguyen PN, Nguyen PV, Nguyen NP, Akashi H. A novel antigenic variant of canine parvovirus from a Vietnames dog. Arch. Virol. 2004;(149):2261-2269.
12. Kapil S, Cooper E, Lamm C, Murray B, Rezabek G, Johnston L, Campbell G, Johnson B. Canine parvovirus types 2c and 2b circulating in North American Dogs in 2006 and 2007. J. Clin. Microbiol. 2007;4044-4047.
13. Perez R, Francia L, Romeo V, Maya L, Lopez I, Hernandez M. First detection of canine parvovirus type 2c in South America. Vet. Microbiol. 2007;(124): 147-152.
14. Decaro N, Desario C, Elia G, Martella V, Mari V, Lavazza A, Nardi M, Buonavoglia C. Evidence for immunization failure in vaccinated adult dogs infected with canine parvovirus type 2c. New microbiol. 2008; (31):125-130.
15. Touihri L, Bouzid I, Daoud R, Desario C, El-Goulli AF, Decaro N, Ghorbel A, Buonavoglia C, Bahloul C. Molecular characterization of canine parvovirus-2 variants circulating in Tunisia. Virus. Genes. 2009;38(2):249–258.
16. Wazir VS, Gupta SK, Kafil Hussain, Singh VP. Prevalence of Canine Parvovirus infection in dogs of Jammu. District of Jammu and Kashmir. Veterinary. Practitioner. 2013;14(2):296-297.
17. Ali A. Abdel-Rhman, Farouk A. El Balkemy, Nasser, Z. Abouzeid, Samir M. Edries. Canine Parvo Enteritis Infection in Egypt: Isolation, Molecular Characterization and Sequencing. Adv. Anim. Vet. Sci. 2019;7(2): 117-122.
18. Archana Shukla PC, Gupta DK, Kumar B. Epidemiology on Canine Parvovirus infection. Indian J. Vet. Res. 2010;18(2): 42-44.
19. Roy S, Ahmed SU, Alam S, Chowdhury QMMK, Rahman MS, Popy FY, Sharma B, Basit MSI, Ahmed J. Prevalence of canine parvoviral enteritis in pet dogs at Dhaka city of Bangladesh. Int. J. Biol. Res. 2018;6(1): 14–17.
20. AL-Hosary A. Detection and Molecular Characterization of Parvovirus Serotypes in Egypt. Journal of Advanced Veterinary Research. 2018;(8):79 - 83.
21. Mukhopadhyay HK, Amsaveni S, Matta SL, Antony PX, Thanislass J, Pillai RM. Development and evaluation of loop-mediated isothermal amplification assay for rapid and sensitive detection of canine Parvovirus DNA directiy in faecal specimens. Appli. Microbiol. 2012;55(3): 202-209.
22. Dongre J, Mehta HK, Maheswari P. Rapid diagnosis and clinical management of Canine Parvovirus infection. Intas. Polivet. 2013;14(1):155-156.

23. Khare DS, Gupta DK, Shukla PC, Das G, Amita Tiwari, Meena NS, Ravi Khare. Prevalence of Canine Parvovirus infection in dogs in Jabalpur (M.P.). J. Entomol. Zool. Studies. 2019;7(3):1495-1498.
24. Shanshan Q, Jianjun Zhao, Donghua Guo, Dongbo Sun. (2020). A Mini-Review on the Epidemiology of Canine Parvovirus in China. Front Vet Sci.2020; (7):5.
25. Zhuo GR, Di HS, Lu W, Liu JD, Zhang H, Wang CF. Epidemiological investigation and treatment effect of canine parvovirus disease in Taizhou, Jiangsu province. Jiangsu Agric Sci. 2015;(43):216–9.
26. Wu FS, Yuan KC, Wang QF. Investigation and analysis on canine parvovirus in Shanghai. Modern. Anim. Husbandry. 2018;(2): 50–2.
27. Houston DM, Ribble CS, Head LL. Risk factors associated with parvovirus Enteritis in Dogs: 283 cases. J. Am. Vet. Assoc. 1996;(208): 542-546.
28. Banja BK, Sahoo N, Panda HK, Ray SK, Das PK. Epizootiological status of Canine viral haemorrhagic gastroenteritis in Bhubanneswar city. Indian Vet. J. 2002;(79):850-851.
29. Peter D, Constble Kenneth W, Hinchclif Stanley, Done H, Walter G. Veterinary Medicine, A textbook of the diseases of cattle, sheep, pigs, and goat. 11th ed. Philadelphia. U.S.A. 2017.
30. Kang YL. Epidemiological investigation of canine parvovirus disease in Qingdao City. Shandong. J. Anim. Sci. Vet. Med. 2016; (37):40–1.
31. Cao L, Zhang JM, Gao LY. Epidemiological investigation of canine parvovirus diseased Dogs in Jiuquan City. J. Anim. Sci. Vet. Med. 2017;(36): 91–3.
32. Godsall SA, Simon, Russell Clegg, Jenny Stavisky, Radford, Gina L. Pinchbeck. (2010). Epidemiology of canine parvovirus and coronavirus in dogs presented with severe diarrhoea to PDSA Pet Aid hospitals. Vet. Reco. 2010;(167):196-201.
33. Wang XB, Ji XQ, Long DD. Epidemiological investigation of canine parvovirus in Zunyi City. Guizhou. J. Anim. Husbandry. Vet. Med. 2018;(42): 42–4.
34. Li J, Li Z, Wang YH, Cheng X. (2018). Diagnosis and comprehensive prevention of canine parvovirus disease. Modern Anim Husbandry Sci Technol. 2018; (44):118.
35. Kevin Horecka, Steve Porter E, Susan Amirian, Ellen Jefferson. A decade of Treatment of Canine Parvovirus in an Animal Shelter: A Retrospective Study. Animals (Basel).2020;10(6): 939.
36. Kathryn J, Sarpong, Jennifer M. Lukowski, Cassandra G. Knapp. Evaluation of mortality rate and predictors of outcome in dogs receiving outpatient treatment for parvoviral enteritis. J. Am. Vet. Med. Assoc. 2017;251(9):1035-1041.

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