

Hematological Parameters of Dogs Infected With Canine Parvovirus Enteritis in Sumy Ukraine

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Abstract- Canine parvovirus enteritis is highly contagious acute enteritis associated with high morbidity and mortality, with very low survival rates in untreated dogs. It is caused by canine parvovirus type 2. It generally affects dogs up to 6 months old. All breeds of dogs are affected although Rottweiler, Doberman pinscher, American Pit-bull terrier, Labrador retriever and German shepherd are at increased risk of infection. Blood is regarded as fluid that aid in the assessment of the health status of animals. Hematology of infected dogs can help in giving an idea about the severity of infection, guide in deciding the treatment protocol and prognosis of the disease. Twenty-nine dogs with clinical signs consistent with canine parvovirus presented at Health Veterinary Clinic in Sumy, Ukraine were analyzed. They were diagnosed using rapid in-clinic enzyme immunoassay test kits (SensPERT[®], VetAll Laboratories, Kyunggi-Do, Korea). Data indicated that 31.0% (9/29) of the puppies had received at least 1 dose of multivalent vaccine which included Biocan[®], Vanguard 5 plus[®] and Novibac[®]. Temperature and Hematology were collected on the day of admission. 2mL of blood were collected from the cephalic vein of each dog into a test tube containing ethylenediaminetetraacetic acid. The Hematological parameters (RBC, HGB, PCV, WBC, NEU, MON, EOS, LYM and PLT) were determined by using automated blood counter. The most common hematological finding in all dogs was anemia, thrombocytopenia, pancytopenia (leucopenia, neutropenia and lymphopenia), leucocytosis, neutrophilia, eosinophilia, lymphocytosis and monocytosis. All the hematological abnormalities witnessed in this study are consistent with CPVE. This is an indication that different dogs will present different cell mediated immune responses during the course of the disease.

Index Terms- Canine parvovirus enteritis, Hematological parameters, Dogs, Sumy.

I. INTRODUCTION

Canine parvovirus enteritis (CPVE) is a highly contagious viral disease that affects the gastrointestinal tract of dogs [1]. All dog breeds are affected but Rottweiler, Doberman pinscher, American Pit-bull terrier, Labrador retriever and German shepherd are at increased risk of infection [2],[3]. Puppies between 6 weeks and 6 months old are highly susceptible to this disease [4], [5] because of the derived

maternal antibody that are not adequate to protect them from the disease and as such will also prevent vaccine response resulting in vulnerability of puppies and placing them at great risk of infection [6]. The typical signs include vomiting and diarrhea that can range from mucoid to hemorrhagic [5], [7]. Canine parvovirus type 2 (CPV-2) has a predilection for rapidly dividing cells of the gastrointestinal tract, lymphoid tissue, and bone marrow, resulting to hemorrhagic diarrhea, vomiting, marked leucopenia, and immunosuppression [8]-[11].

Blood is one of the important body fluid used in accessing the health status of animals; the starting point of diagnosing diseases is by evaluating the blood parameters [12], [13]. Blood is an important index of physiological and pathological changes in an organism [14]. Hematological parameters have been extensively used in veterinary medicine for evaluation of clinical status, nutritional balance, deficit condition, treatment monitoring and prognostics in individual animal as well as populations [15].

Hematological parameters are not sufficiently specific to identify the cause of enteric disease, but they can provide clinically important information to establish a list of differential diagnoses, to assess the patient's response to treatment, and to suggest a prognosis [16], [17]. During the infection, there is reduced white blood cell count with a transient lymphopaenia being the most consistent finding [16], [18]. A lack of cytopenia, specifically normal total leukocyte and lymphocyte counts, had a positive predictive value of 100% for survival 24 hours post admission. The puppies that recover have an increase in the lymphocyte count 24 hours after admission [16]. This study was aimed at evaluating the hematological parameters of canine parvovirus enteritis in dogs from Sumy Oblast in Ukraine.

II. MATERIALS AND METHODS

Twenty-nine (29) diarrheic dogs presented at Health Veterinary Clinic in Sumy, Ukraine were analyzed. They were diagnosed using rapid in-clinic enzyme immunoassay test kits (SensPERT[®], VetAll Laboratories, Kyunggi-Do, Korea). Data obtained from the medical records of the dogs indicated that 31.0% (9/29) of the puppies had received at least 1 dose of multivalent vaccine which included Biocan[®], Vanguard 5 plus[®] and Novibac[®]. Data of temperature and Hematology were collected on the day of admission.

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Complete history of the animal including age, breed, sex, and vaccination status was taken from the owner. Two milliliter (2mL) of blood were collected from the cephalic vein of each dog using a 21 gauge needle into a test tube containing ethylenediaminetetraacetic acid (EDTA) to obtain uncoagulated blood. The Hematological parameters (RBC, HGB, PCV, WBC, NEU, MON, EOS, LYM and PLT) were determined by using automated blood counter (Beckman Coulter, Coulter diff Ac.T, USA).

Results

The mean values and standard error of means (Mean±SEM) of hematological indices of 29 dogs infected with CPVE are presented in different tables according to different factors (Table 1-4). The commonly observed clinical signs in the dogs consistent with canine parvovirus enteritis were anorexia, diarrhoea (mucoid or hemorrhagic), vomiting, dehydration and depression. The mean temperature value for the dogs was 38.6±0.15°C with minimum as 34.0 °C and maximum as 41.0 °C respectively. The Hematological values for dogs in different age groups is presented in Table 1, different sexes (Table 2), different breeds (Table 3) and vaccination status of dogs i.e. vaccinated and unvaccinated dogs (Table 4). The Hematological alterations in 29 dogs with canine parvovirus enteritis and different clinical signs graded according to individual observation are presented in Table 5. Majority of the dogs affected were <6 months old females, exotic that were unvaccinated. Data on hematology is adapted in part from multiple sources, including [19], [20].

Table 1: Hematology values of dogs in different age groups

Hematology	<6 mo (n=23)	>6 mo (n=6)	P-value
RBC (X10 ¹² /L)	5.82±0.29	7.99±0.37	0.002*
HGB (g/L)	12.46±0.68	17.05±0.73	0.122
PCV (%)	36.45±1.25	44.80±1.67	0.005*
WBC (X10 ⁹ /L)	9.94±1.20	7.45±2.33	0.348
NEU- Bands (%)	7.83±0.65	8.22±1.30	0.881
NEU-Segmented (%)	55.87±3.34	51.83±7.58	0.589
MON (%)	12.87±1.58	21.67±6.88	0.064
EOS (%)	3.57±0.87	4.83±2.96	0.571
LYM (%)	23.61±5.94	8.33±1.61	0.205
PLT (X10 ⁹ /L)	368.44±18.32	299.83±34.24	0.098

Mo= Months, RBC= Red Blood Cells, HGB= Hemoglobin, WBC= White Blood Cells, NEU= Neutrophils, MON= Monocytes, EOS= Eosinophils, LYM= Lymphocytes, PLT= Platelets.

* There is a significant difference at the 0.05 level.

Table 2: Hematology values of dogs in different sex

Hematology	Males (n=14)	Females (n=15)	P-value
RBC (X10 ¹² /L)	6.29±0.35	6.25±0.47	0.948
HGB (g/L)	13.55±0.82	13.28±1.04	0.910
PCV (%)	38.24±1.52	38.06±1.93	0.941
WBC (X10 ⁹ /L)	11.04±1.61	7.93±1.35	0.150
NEU- Bands (%)	7.67±1.76	8.35±1.31	0.761
NEU-Segmented (%)	58.64±3.49	51.67±4.83	0.251
MON (%)	12.93±2.31	16.33±3.09	0.369
EOS (%)	4.00±1.26	3.67±1.31	0.854
LYM (%)	24.36±9.78	16.80±2.42	0.439
PLT (X10 ⁹ /L)	380.07±22.88	330.13±23.31	0.136

RBC= Red Blood Cells, HGB= Hemoglobin, WBC= White Blood Cells, NEU= Neutrophils, MON= Monocytes, EOS= Eosinophils, LYM= Lymphocytes, PLT= Platelets.

* There is a significant difference at the 0.05 level.

Table 3: Hematology values of dog Breeds infected with canine parvovirus infection

Hematology	Local (n=6)	Exotic (n=23)	P-value
RBC (X10 ¹² /L)	5.79±0.64	6.40±0.33	0.382
HGB (g/L)	12.40±1.44	16.49±2.61	0.167
PCV (%)	35.72±3.26	38.81±1.29	0.291
WBC (X10 ⁹ /L)	9.70±1.83	9.36±1.27	0.897
NEU- Bands (%)	7.39±0.83	11.00±3.93	0.161
NEU-Segmented (%)	63.17±4.23	52.91±3.56	0.172
MON (%)	12.17±1.22	15.35±2.42	0.496
EOS (%)	2.33±0.80	4.22±1.10	0.400
LYM (%)	14.50±2.75	22.00±6.05	0.533
PLT(X10 ⁹ /L)	358.00±37.41	353.26±19.14	0.908

RBC= Red Blood Cells, HGB= Hemoglobin, WBC= White Blood Cells, NEU= Neutrophils, MON= Monocytes, EOS= Eosinophils, LYM= Lymphocytes, PLT= Platelets.

* There is a significant difference at the 0.05 level.

Table 4: Hematology values of vaccinated and unvaccinated dog infected with canine parvovirus infection

Hematology	Vaccinated (n=9)	Unvaccinated (n=20)	P-value
RBC (X10 ¹² /L)	6.90±0.56	5.99±0.33	0.133

HGB (g/L)	14.82±1.21	12.78±0.76	0.428
PCV (%)	40.23±2.58	37.00±1.33	0.243
WBC (X10⁹/L)	9.51±2.59	9.39±1.08	0.958
NEU- Bands (%)	9.64±1.74	6.73±1.12	0.164
NEU- Segmented (%)	49.78±6.11	57.40±3.41	0.245
MON (%)	21.33±5.42	11.70±0.98	0.020
EOS (%)	4.89±2.02	3.35±0.95	0.433
LYM (%)	14.56±3.71	23.10±6.80	0.418
PLT(X10⁹/L)	340.11±29.13	360.60±20.76	0.570

RBC= Red Blood Cells, HGB= Hemoglobin, WBC= White Blood Cells, NEU= Neutrophils, MON= Monocytes, EOS= Eosinophils, LYM= Lymphocytes, PLT= Platelets.

* There is a significant difference at the 0.05 level.

Table 5: Hematological alterations in 29 dogs with canine parvovirus enteritis

Hematology	Number of dogs with alterations/number of dogs examined
Anaemia	6/29 (20.7%)
Leucopenia	9/29 (31.0%)
Leucocytosis	8/29 (27.6%)
Neutropenia	16/29 (55.5%)
Neutrophilia	5/29 (17.2%)
Eosinopenia	8/29 (27.6%)
Eosinophilia	1/29 (3.5%)
Lymphopenia	8/29 (27.6%)
Lymphocytosis	1/29 (3.5%)
Monocytosis	19/29 (65.5%)
Thrombocytopenia	1/29 (3.5%)

III. DISCUSSION

Acute enteritis has no predilection for any age, breed or sex of dogs, although, puppies between 6 weeks and 6 months of age are more susceptible [5], [8]. Initially, clinical signs are nonspecific but later becomes typical including fever, anorexia, depression, lethargy, vomiting and diarrhea that can range from mucoid to hemorrhagic [5], [7].

From this study, table 1 revealed neutropenia and monocytosis in dogs <6 months (55.87±3.34; 12.87±1.58) and >6 months (51.83±7.58; 21.67±6.88) old although, lymphocytosis was observed in <6 months (23.61±5.94). This findings agrees with the report that neutropenia is observed in the acute phase of the disease while monocytosis and lymphocytosis are encountered after the hyperplasia of cell lines of the bone marrow [21]. A statistical significant difference (P<0.005) was observed in RBC and PCV among age. This implies that young dogs of <6 months old are more at risk of manifestation of the disease than >6 months old. This upholds the findings that

dogs between 6 weeks and 6 months old are more affected by the disease [5], [8].

The distribution among sex showed neutropenia in female (51.67±4.83) dogs, monocytosis in both males (12.93±2.31) and female (16.33±3.09) dogs but lymphocytosis was seen in male (24.36±9.78) dogs only (Table 2). There was neutropenia and moderate lymphocytosis in exotic (52.91±3.56; 22.00±6.05) dogs. Monocytosis was present in both local (12.17±1.22) and exotic (15.35±2.42) dogs (Table 3). In Table 4, Neutropenia and monocytosis were common to both vaccinated (49.78±6.11; 21.33±5.42) and unvaccinated (57.40±3.41; 11.70±0.98) dogs with moderate lymphocytosis in unvaccinated (23.10±6.80) dogs. The consistent findings here include neutropenia, monocytosis and lymphocytosis which uphold the result of [17] (2010). This shows that different dogs will present different cell mediated immune responses during the course of the disease.

The abnormalities observed in Hematology of the 29 dogs with CPVE shown in table 5 revealed the amount of alterations recorded that are consistent and contrast with CPVE. Anemia was seen in 20.7% (6/29), thrombocytopenia 3.5% (1/29), pancytopenia {leucopenia 31.0% (9/29), neutropenia 55.5% (16/29) and lymphopenia 3.5% (1/29)}, leucocytosis 27.6% (8/29), neutrophilia 17.2% (5/29), eosinophilia 3.5% (1/29), lymphocytosis 3.5% (1/29) and monocytosis 65.5% (19/29). This agrees with the findings that anemia, thrombocytopenia or thrombocytosis, pancytopenia, neutrophilic leucocytosis, and monocytosis may occur in CPVE [16], [17], [22]. [23] (2013) reported that leucopenia, lymphopenia, and thrombocytopenia are more frequent among dogs infected with CPVE. Low PCVs witnessed in most cases of CPVE are due to a combination of intestinal hemorrhage and rehydration therapy [8], [24].

A marked depletion of the cell lines (granulocytes, erythroid, and megakaryocytes) is seen because of the effect of the virus on the bone marrow during acute phase of the disease, it is followed by hyperplasia of the cell lines and neutrophilia in peripheral blood during convalescence [21] and these changes are nonspecific and could reflect the effect of endotoxaemia [25]. The severe changes to cell lines do not affect the pluripotent cells [26].

During CPVE, there is increased plasma granulocyte colony-stimulating factor (G-CSF) concentration after the onset of neutropenia that decreases to undetectable levels once the neutropenia has resolved [27]. The hematological changes arise from the destruction of hematopoietic progenitor cells of the various leukocyte types in the bone marrow and other lymphoproliferative organs such as the thymus, lymph nodes, and spleen resulting to inadequate supply of leukocytes in the gastrointestinal tract [16].

IV. CONCLUSION

All the hematological abnormalities witnessed in this study are consistent with CPVE although, a statistical difference observed in the RBC and PCV of dogs of <6

months and >6months old indicate that age is the major determinant that has effect on CPVE in dogs. Different dogs will present different cell mediated immune responses during the course of the disease.

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REFERENCES

- [1] L. Touihri, I. Bouzid, R. Daoud, C. Desario, A. F. El Goulli, N. Decaro, A. Ghorbel, C. Buonavoglia, and C. Bahloul, Molecular Characterization of Canine Parvovirus-2 Variants Circulating in Tunisia. *Virus Genes*, 2009, 38, pp. 249-258. <http://dx.doi.org/10.1007/s11262-008-0314-1>
- [2] S. Smith-Carr, D. K. Macintire, and L. J. Swango, Canine parvovirus. Part I. Pathogenesis and vaccination. *Compendium on Continuing Education for the Practising Veterinarian*, 1997, 19(2): pp. 125-133.
- [3] M. Houston, C. S. Ribble, and L. L. Head, Risk factors associated with parvovirus enteritis in dogs: 283 cases (1982-1991). *Journal of the American Veterinary Medical Association*, 1996, 208(4): pp. 542-546.
- [4] D. L. McCaw, and J. D. Hoskins Canine viral enteritis. In: Green CE, editor. *Infectious Diseases of the Dog and Cat*. 4th ed. St Louis, MO: Saunders, 2006, pp 63-73.
- [5] J. Prittie, Canine parvoviral enteritis: a review of diagnosis, management and prevention. *J. Vet. Emerg. Crit. Care*, 2004, 14(3):pp. 167-76.
- [6] Foster and Smith (2011) Parvovirus: Serious Diarrhea in Puppies & Dogs. www.peteducation.com/article.cfm?c=2+2102&aid=467
- [7] C. G. Lamm, and G. B. Rezabek, Parvovirus infection in domestic companion animals. *Vet. Clin. North Am. Sm. Anim. Pract.*, 2008, 38(4): pp. 837-50.
- [8] J. D. Hoskins, Update on canine parvoviral enteritis. *Vet Med*; 1997, 92, pp. 694-709.
- [9] K. S. Latimer, Leukocytes in health and disease. In: Ettinger SJ, Feldman EC, eds. *Textbook of Veterinary Internal Medicine*, 4th ed. Philadelphia, PA: WB Saunders Company, 1995, pp. 1892-1929.
- [10] C. M. Otto, K. J. Drobatz, C. Soter, Endotoxemia and tumor necrosis factor activity in dogs with naturally occurring parvoviral enteritis. *J. Vet. Intern. Med.*, 1997, 11, pp. 65-70.
- [11] R. V. H. Pollock, and M. J. Coyne, Canine parvovirus. *Vet. Clin. North Am. Small Anim. Pract.* 1993, 23, pp. 555-568.
- [12] A. A. Ariyibi, M. O. Oyeyemi, R. A. Ajadi, A Comparative Study of Some Hematology and Biochemical Parameters of Clinically Healthy Isatian and Local Dogs. *African Journal of Biomedical Research*, 2002, 5, pp. 145- 147.
- [13] B. R. Breechler, A. E. Jolles, and V. O. Ezenwa, Evaluation of Hematologic Values in Free-Ranging African Buffalo (*Syncerus caffer*). *Journal of Wildlife Diseases*. 2009. 45 (1): pp. 57-66.
- [14] B. M. Bush, Interpretation of Laboratory Results for small animal. Clinician Blackwell scientific Publication, London. 1991.
- [15] A. Talebi, S. Asri-Rezaei, R. Rozeh-Chai, R. Sahraei, Comparative Studies on Hematological Values of Broiler Strains (Ross, Cobb, Arboracres and Arian). *Int. J. Poult Sci.*, 2005, 4 (8): pp. 573- 579.
- [16] A. Goddard, A. L. Leisewitz, M. M. Christopher, Prognostic usefulness of blood leukocyte changes in canine parvoviral enteritis. *J. Vet. Intern. Med.* 2008, 22(2): pp. 309-316.
- [17] I. Kalli, L. S. Leontides, M. E. Mylonakis, K. Adamama-Moraitou, T. Rallis, and A. F. Koutinas, Factors affecting the occurrence, duration of hospitalization and final outcome in canine parvovirus infection. *Res. Vet. Sci.*, 2010, 89(2): pp. 174-178.
- [18] M. Ling, J. M. Norris, M. Kelman, M. P. Ward, Risk factors for death from canine parvoviral-related disease in Australia. *Veterinary Microbiology*, 2012, 158, pp. 280-90.
- [19] K. S. Latimer, Duncan & Prasse's Veterinary Laboratory Medicine: Clinical Pathology, 5th ed., Wiley-Blackwell, 2011.
- [20] D. J. Weiss, and K. J. Wardrop, Schalm's Veterinary Hematology, 6th Ed., Wiley-Blackwell, 2010.
- [21] D. K. Macintire, and S. Smith-Carr, Canine parvovirus. Part II. Clinical signs, diagnosis and treatment. *Comp. Contin. Edu. Prac. Vet.*, 1997, 19(3): pp. 291-302.
- [22] J. E. Sykes, Canine parvovirus infections and other viral enteritides. In: Sykes JE, editor. *Canine and Feline Infectious Diseases*. 1st ed. St Louis, MO: Elsevier, 2014, pp. 141-151.
- [23] T. X. Castro, S. C. Miranda, N. V. Labarthe, L. E. Silva, and R. C. N. Cubel Garcia, Clinical and Epidemiological Aspects of Canine Parvovirus (CPV) Enteritis in the State of Rio de Janeiro: 1995-2004. *Arquivo Brasileiro de Medicina Veterinariae Zootecnia*, 2007, 59, pp. 333-339. <http://dx.doi.org/10.1590/S0102-09352007000200010>.
- [24] R. M. Jacobs, M. G. Weiser, R. L. Hall, J. J. Kowalski, Clinicopathologic features of canine parvoviral enteritis. *J. Am. Anim. Hosp. Assoc* 1980, 16, pp. 809-814.
- [25] T. R. Boosinger, A. H. Rebar, D. B. DeNicola, G. D. Boon, Bone marrow alterations associated with canine parvoviral enteritis. *Vet. Pathol.*, 1982, 19(5):558-61.
- [26] L. Macartney, I. A. McCandlish, H. Thompson, and H. J. Cornwell, Canine parvovirus enteritis 1: clinical, Hematological and pathological features of experimental infection. *Vet Rec.*, 1984, 115(9): pp. 201-10.
- [27] L. A. Cohn, J. M. Rewerts, D. McCaw, G. D. Boon, C. Wagner-Mann, and C. D. Lothrop Jr, Plasma granulocyte colony-stimulating factor concentrations in neutropenic, parvoviral enteritis-infected puppies. *J. Vet. Intern. Med.*, 1999, 13(6): pp. 581-6.



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2. Nongo, N. N., **Tion, M. T.**, Apaa, T. T., and Ogunro, B. N. (2015). A case of Canine Trypanosomosis with Epistaxis in A two-year old Alsatian Dog. *IOSR journal of Agriculture and Veterinary Science*, 8(2); 68-72.
3. Shima, F.K., **Tion, M. T.**, Mosugu, J. I., and Apaa, T. T. (2015). Retrospective study of disease incidence and other clinical

conditions diagnosed in owned dogs in Delta State, Nigeria.
Journal of Advanced Veterinary and Animal Research, 2(4):
435-449.

4. **Tion, M. T.**, Ikurior, J. S., and Orbunde, K. D. (2016). The prevalence of Gastrointestinal Helminths (GIH) infection of dogs in Makurdi metropolis. *Imperial Journal of Interdisciplinary Research (IJIR)*, 2(8): 1042-1049.
5. **Tion, M. T.**, Wachida, N., and Gberindyer, J. S. (2017). Canine oral papillomatosis in a 4-month old Alsatian Dog. *Tropical Journal of Agricultural Research*, 1(1): 53-59.
6. Gberindyer, F.A., Abatan, M.O., Apaa, T.T., and **Tion, M. T.** (2017). Drugs prescription pattern in dogs diagnosed with parvovirus enteritis in some veterinary clinics in Nigeria. *Nigerian Veterinary Journal*. 38(3): 250-259.
7. Bosha, J. A., **Tion, M. T.** and Agbo, J. O. (2018). A case of cruelty in dog and its management. *GSC Biological and Pharmaceutical Sciences*. 3(3): 6-9.
8. **Tion, M.T.**, Fotina. H. and Saganuwan, S. A. (2018). Phytochemical Screening, Proximate Analysis, Median Lethal Dose (LD₅₀), Hematological and Biochemical Effects of Various Extracts of *Abrus precatorius* seeds in *Mus musculus*. *Journal of Advanced Veterinary and Animal Research*. 5(3): 354-360.

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