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Clinical and haemato-biochemical changes in dogs affected with canine parvovirus infection in Gadag, Karnataka

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Abstract

Canine parvovirus enteritis is an extremely contagious disease caused by CPV type-2 characterized by acute enteritis which causes significant morbidity and death, with very poor survival rates in untreated dogs. Young dogs less than 1 year old are highly susceptible, although all dog breeds are affected most often Rottweilers, Doberman pinschers, Labrador retrievers, and German shepherds are at a higher risk of infection. Hematology of infected dogs can assist to determine the severity of the illness, as well as advise treatment strategy and disease prognosis. Diagnosis was made using Rapid in-clinic enzyme immunoassay test kits (Anigen Rapid CPV Ag test kit Bionote® Korea) along with hematological evaluation.

Keywords: Canine parvovirus enteritis, hematological parameters, dogs, biochemical parameters

Introduction

Canine parvovirus enteritis is a highly infectious and fatal disease caused by parvovirus type 2 that mostly affects the digestive system and causes vomiting, diarrhoea, and fever (Rai *et al.*, 1994) [14]. The most prevalent symptom of the disease is anorexia, sadness, lethargy, acute foul-smelling enteritis and fever are among the initial clinical symptoms. In the latter stages vomiting and small bowel diarrhea vary from mucoid to hemorrhagic. Acute parvoviral enteritis can affect dogs of any breed, age, or gender, however pups from 6 weeks to 6 months tend to be particularly vulnerable (Dongre *et al.*, 2013) [15]. Lack of protective immunity, intestinal parasites, overcrowded, unclean, and stressful environmental factors all predispose puppies to parvoviral infection. Many nations, including India, have recorded CPV outbreaks. Balu and Thangaraj (1983) [11] in Madras were the first to report on the prevalence research in India.

The virus-induced destruction of rapidly proliferating cells, such as crypt intestinal epithelial cells, thymus, lymph nodes, and bone marrow precursor cells, is the main pathogenetic feature of CPV-2 infection (Decaro *et al.*, 2005) [4]. As a result, the intestinal mucosal barrier is disrupted, villous atrophy occurs, and malabsorption occurs, as well as profound leukopenia (primarily neutropenia and/or lymphopenia), resulting in profuse diarrhoea and vomiting, severe dehydration/hypovolemia, metabolic acidosis (or alkalosis). Bacterial translocation with subsequent coliform septicemia and endotoxemia, systemic inflammatory response syndrome (SIRS) (Skyes 2014) [15]. Co-morbid conditions may cause or worsen the disease (Goddard *et al.*, 2010) [7]. Clinically relevant CPV-2-induced myocarditis is currently an extremely uncommon unless infection occurs in gestation (Duffy *et al.*, 2010; Skyes 2014) [6, 15]. The purpose of this study was to determine the frequency of canine parvovirus-2 in and around Gadag, as well as to evaluate the clinical symptoms and haematological changes in dogs infected with canine parvovirus.

Materials and Method

Dogs presented at Veterinary College Hospital Gadag with the symptoms suggestive of PVGE and found positive with Rapid Immuno Assay were utilized in the current study. A total of Eighteen (18) dogs were found positive by rapid in-clinic enzyme immunoassay test kits (Anigen Rapid CPV Ag test kit Bionote® Korea). Data with respect to history (age, breed, sex, and vaccination) along with temperature and other physical examinations were collected on the day of admission and 2mL of blood sample was collected in EDTA coated vacutainers from each dog using a 21G and were subjected for hematological evaluation (RBC, HGB, PCV,

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WBC, NEU, MON, EOS, LYM and PLT) by using automated blood counter (Mindray BC-2800 Vet) and another 2mL of blood sample with clot activator was used to collect serum and same was subjected to evaluate the biochemical parameters like ALT, ALP, BUN, Cr, TP, Albumin, Total Bilirubin and Glucose using biochemical analyzer (Adiduo plus biochemistry analyzer). The hematological and biochemical data generated was compared within age, breed, gender and vaccination status to assess the changes associated with PVGE.

Statistical analysis

The data generated was statistically evaluated using the independent sample student T-test in (Prism 8.0 for Windows®)

Results and Discussion

The present study indicated vomiting, diarrhea, anorexia mild dehydration with decreased body temperature are the predominant clinical signs and the percentage of distribution of the same is indicated in Table 1. The epidemiological data with respect to breeds, gender, age and vaccination status was indicated in Table 2. The present study indicated nonvaccinated or partial vaccinated are highly susceptible and males are more susceptible in contrast to females.

Acute enteritis is the most prevalent CPV manifestation and is more common in pups up to 6 months of age. Anorexia, sadness, lethargy, and fever are among the initial clinical symptoms. Later symptoms include vomiting and small bowel diarrhoea that can range from mucoid to hemorrhagic in nature (Pritte 2004; Terzungwe, 2018) [10, 16].

The mean temperature value for the dogs was 100.2±0.30 oF with minimum as 96.8 oF and maximum as 101.8 oF respectively. The Hematological values for dogs in different age groups (Table 3), different sexes (Table 4 Fig.3), vaccination status of dogs i.e. vaccinated and unvaccinated dogs (Table 5 Fig.4) and different breeds (Table 6 Fig.1 and 2). The Biochemical values for dogs in different age groups (Table 7), different sexes (Table 8 Fig.3), vaccination status of dogs i.e. vaccinated and unvaccinated dogs (Table 9) and different breeds (Table 10 Fig.1 and 2). Majority of the dogs affected were <3 months old males, exotic that were unvaccinated.

The mean & SE at hematological parameter within the age group are presented in table 3. Dogs <3 months had slight neutropenia, lymphocytosis and monocytosis in dogs <3 months (68.41±0.85; 2.03±0.23) when compared to that of >3

months (71.59±1.20; 1.79±0.22). This observation is consistent with the fact that neutropenia is detected during the acute phase of the illness, whereas monocytosis and lymphocytosis are observed following the hyperplasia of bone marrow cell lines (Smith-Carr *et al.*, 1997) [14]. TEC and PCV levels were found to be lower in 3- month-old indicating of anemia and dehydration was seen in intestinal bleeding.

Similarly, the mean & SE of hematological parameter with the gender are presented in Table 4. It's evident that neutropenia, lymphocytosis and slight monocytopenia was observed among the male dogs in comparison with female dogs. However, the difference was non significant (NS). Female dogs tend to be more anemic in comparison with male counterpart.

Hematological parameter with respect to vaccinated, partial vaccinated and unvaccinated dogs are presented in Table 5. Neutropenia was seen in both vaccinated (74.43±1.25), partially vaccinated (69.39±0.92), and unvaccinated (69.28±1.38) dogs, with considerable lymphocytosis in the unvaccinated (25.71±1.38) dogs. The consistent findings here include neutropenia, monocytosis, and lymphocytosis, all of which support the outcome of (Kalli *et al.*, 2010; Tion, 2018) [8]. This demonstrates that individual dogs will have distinct cell-mediated immune responses throughout the course of the illness.

Table 1: Clinical Signs

Clinical signs	No. of dogs	Percent (%)
Anorexia	14	77.7
Body temperature		
a. Decreased	12	66.6
b. Normal	06	33.3
c. Increased	00	00
3.Vomition	16	88.8
Diarrhea		
a. Hemorrhagic	15	83.3
b. Non-hemorrhagic	03	16.6
Color of conjunctival mucus membrane		
a. Pink	08	44.4
b. Pale	10	55.5
Dehydration (%)		
Mild (4-6%)	02	11.1
Moderate (6-8%)	12	66.6
Severe (8-10%)	04	22.2
7. General body condition		
a. Good	12	66.6
b. Poor	06	33.3

Table 2: Epidemiological data of 18 dogs affected with CPV infection

Breeds	No	Male	Female	Vaccinated	Partial Vaccinated	Non Vaccinated	3 months below	3 months above
Dachshund	01	01	-	-	-	01	01	-
GSD	02	02	-	-	-	02	01	01
Labrador	01	01	-	01	-	-	-	01
Shiatzu	02	-	02	-	-	02	02	-
Pug	02	01	01	02	-	-	01	01
Boxer	01	-	01	-	-	01	-	01
Spitz	01	01	-	-	01	-	-	01
Dobermann	01	-	01	-	01	-	01	-
ND	07	05	02	-	05	02	02	05
Total	18	10	08	03	07	08	08	10

Table 3: Hematology values of CPV affected dogs in different age groups

Parameter	3 months below (n=8)	3 months above (n=10)	P value	Control (n=6)
RBC ($10^6/\mu\text{L}$)	4.34±0.21	4.56±0.29	0.999	6.0±0.19
WBC ($10^3/\mu\text{L}$)	5.65±0.26	6.04±0.51	0.87	11.32±0.86
Hb (g/dl)	8.27±0.43	9.97±0.89	0.843	14.22±0.48
PCV (%)	31.43±0.50	34.45±1.16	0.473	43.63±0.56
PLT ($10^5/\mu\text{L}$)	287.8±20.56	302.2±21.07	0.99	327.0±13.94
Neutrophil (%)	68.41±0.85	71.59±1.20	0.991	75.77±0.79
Lymphocyte (%)	25.23±1.31	23.15±1.36	0.92	20.90±0.89
Monocyte (%)	2.03±0.23	1.79±0.22	0.998	1.26±0.24
Eosinophil (%)	3.43±0.46	3.14±0.22	0.97	1.95±0.31

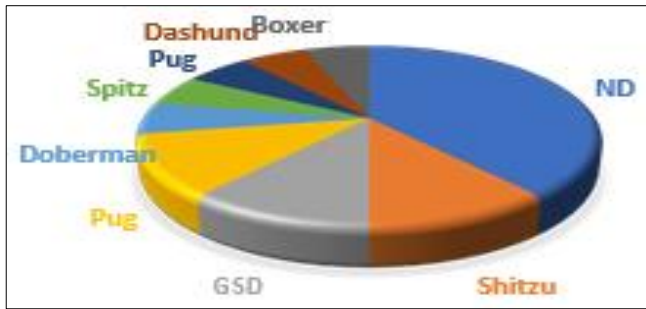


Fig 1: Pie chart showing prevalence of Breed affected with PVGE



Fig 5: Puppy affected with PVGE showing sign of bloody diarrhea

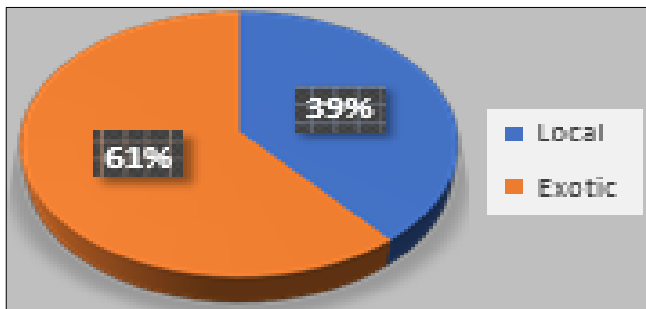


Fig 2: Pie chart showing prevalence of Breed affected with PVGE



Fig 6: Puppy affected with PVGE showing sign of dehydration

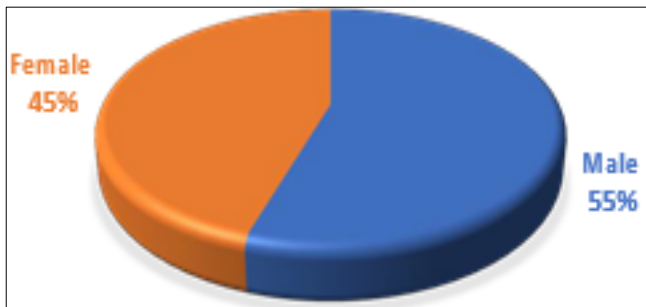


Fig 3: Pie chart showing prevalence of gender affected with PVGE

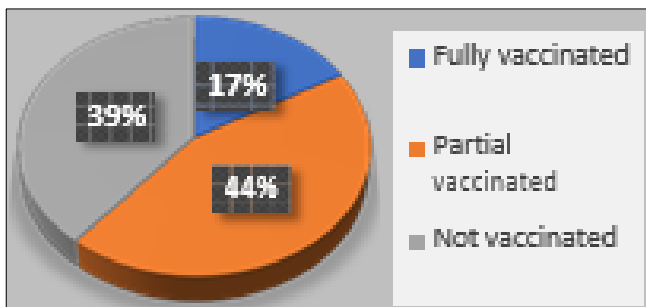


Fig 4: Pie chart showing prevalence of vaccination status of PVGE affected dog



Fig 7: Positive for PVGE in Rapid diagnosis kit

Table 4: Hematology values of CPV affected dogs in different sex

Parameter	Males (n=10)	Females (n=8)	P value	Control (n=6)
RBC (106/ μ L)	4.58 \pm 0.22	4.31 \pm 0.32	0.998	6.0 \pm 0.19
WBC (103/ μ L)	6.16 \pm 0.35	5.50 \pm 0.52	0.88	11.32 \pm 0.86
Hb (g/dl)	9.66 \pm 0.74	8.65 \pm 0.85	0.999	14.22 \pm 0.48
PCV (%)	34.07 \pm 1.15	31.90 \pm 0.69	0.844	43.63 \pm 0.56
PLT (105/ μ L)	290.4 \pm 15.36	302.5 \pm 27.60	0.78	327.0 \pm 13.94
Neutrophil (%)	68.68 \pm 0.82	72.05 \pm 1.37	0.999	75.77 \pm 0.79
Lymphocyte (%)	25.75 \pm 1.17	21.98 \pm 1.30	0.777	20.90 \pm 0.89
Monocyte (%)	1.74 \pm 0.19	2.05 \pm 0.27	0.83	1.26 \pm 0.24
Eosinophil (%)	3.17 \pm 0.17	3.42 \pm 0.50	0.98	1.95 \pm 0.31

Table 5: Hematology values of vaccinated, partial vaccinated and unvaccinated dog infected with canine parvovirus infection

Parameter	Vaccinated (n=3)	Partial vaccinated (n=7)	Not Vaccinated (n=8)	P value	Control (n=6)
RBC (106/ μ L)	4.45 \pm 0.30	4.83 \pm 0.19	3.63 \pm 0.42	0.405	6.0 \pm 0.19
WBC (103/ μ L)	5.43 \pm 1.65	6.62 \pm 0.41	5.36 \pm 0.39	0.91	11.32 \pm 0.86
Hb (g/dl)	8.75 \pm 0.82	10.26 \pm 0.71	8.01 \pm 1.92	0.949	14.22 \pm 0.48
PCV (%)	32.23 \pm 0.90	34.61 \pm 1.41	31.93 \pm 1.32	0.931	43.63 \pm 0.56
PLT (105/ μ L)	342.0 \pm 23.07	313.3 \pm 20.54	263.1 \pm 21.98	0.991	327.0 \pm 13.94
Neutrophil (%)	74.43 \pm 1.25	69.39 \pm 0.92	69.28 \pm 1.38	0.99	75.77 \pm 0.79
Lymphocyte (%)	18.60 \pm 1.15	24.54 \pm 1.13	25.71 \pm 1.38	0.978	20.90 \pm 0.89
Monocyte (%)	1.70 \pm 0.31	1.95 \pm 0.17	2.23 \pm 0.29	0.958	1.26 \pm 0.24
Eosinophil (%)	2.77 \pm 0.21	3.82 \pm 0.49	3.36 \pm 0.14	0.96	1.95 \pm 0.31

Table 6: Hematology values of dog Breeds infected with canine parvovirus infection

Parameter	Local (n=7)	Exotic (n=11)	P value	Control (n=6)
RBC (106/ μ L)	4.70 \pm 0.28	4.31 \pm 0.24	0.974	6.0 \pm 0.19
WBC (103/ μ L)	6.10 \pm 0.39	5.71 \pm 0.43	0.987	11.32 \pm 0.86
Hb (g/dl)	9.50 \pm 0.77	9.03 \pm 0.79	0.999	14.22 \pm 0.48
PCV (%)	33.83 \pm 1.41	32.65 \pm 0.83	0.996	43.63 \pm 0.56
PLT (105/ μ L)	315.1 \pm 19.32	283.5 \pm 20.13	0.998	327.0 \pm 13.94
Neutrophil (%)	69.24 \pm 1.07	70.77 \pm 1.20	0.999	75.77 \pm 0.79
Lymphocyte (%)	23.04 \pm 1.27	25.70 \pm 1.32	0.999	20.90 \pm 0.89
Monocyte (%)	1.65 \pm 0.27	2.03 \pm 0.19	0.10	1.26 \pm 0.24
Eosinophil (%)	3.10 \pm 0.32	3.40 \pm 0.33	0.87	1.95 \pm 0.31

Table 7: Biochemical values of CPV affected dogs in different age groups

Parameter	3 months below (n=8)	3 months above (n=10)	P value	Control (n=6)
Creatinine (mg/dl)	1.35 \pm 0.05	1.22 \pm 0.0	0.939	1.08 \pm 0.06
BUN (mg/dl)	31.63 \pm 2.12	28.70 \pm 2.33	0.991	24.67 \pm 1.89
ALT (IU/L)	179.3 \pm 15.20	161.7 \pm 10.41	0.984	94.50 \pm 4.15
ALP (IU/L)	269.3 \pm 19.12	244.4 \pm 27.12	0.998	120.5 \pm 15.20
Total Bilirubin (mg/dl)	0.25 \pm 0.07	0.45 \pm 0.04	0.375	0.36 \pm 0.04
Total Protein (g/dl)	6.74 \pm 0.08	6.63 \pm 0.11	0.996	6.88 \pm 0.06
Albumin (g/dl)	2.58 \pm 0.04	2.52 \pm 0.03	0.968	2.89 \pm 0.01
Glucose (mg/dl)	67.90 \pm 3.54	68.00 \pm 2.20	0.999	102.7 \pm 4.49

Table 8: Biochemical values of CPV affected dogs in different sex

Parameter	Males (n=10)	Females (n=8)	P value	Control (n=6)
Creatinine (mg/dl)	1.22 \pm 0.08	1.35 \pm 0.04	0.929	1.08 \pm 0.06
BUN (mg/dl)	28.70 \pm 2.42	31.63 \pm 1.95	0.991	24.67 \pm 1.89
ALT (IU/L)	186.0 \pm 11.57	148.9 \pm 10.25	0.461	94.50 \pm 4.15
ALP (IU/L)	262.4 \pm 22.26	247.0 \pm 28.00	0.999	120.5 \pm 15.20
Total Bilirubin (mg/dl)	0.35 \pm 0.06	0.38 \pm 0.06	0.999	0.36 \pm 0.04
Total Protein (g/dl)	6.83 \pm 0.05	6.51 \pm 0.05	0.425	6.88 \pm 0.06
Albumin (g/dl)	2.59 \pm 0.02	2.49 \pm 0.04	0.682	2.89 \pm 0.01
Glucose (mg/dl)	69.00 \pm 2.89	66.63 \pm 3.34	0.999	102.7 \pm 4.49

Table 9: Biochemical values of vaccinated, partial vaccinated and unvaccinated dog infected with canine parvovirus infection

Parameter	Not Vaccinated (n=8)	Partial vaccinated (n=7)	Vaccinated (n=3)	P value	Control (n=6)
Creatinine (mg/dl)	1.43 \pm 0.07	1.17 \pm 0.08	1.32 \pm 0.08	0.773	1.08 \pm 0.06
BUN (mg/dl)	30.38 \pm 2.57	27.79 \pm 2.26	35.33 \pm 3.18	0.734	24.67 \pm 1.89
ALT (IU/L)	177.3 \pm 15.89	164.0 \pm 10.56	161.7 \pm 26.96	0.999	94.50 \pm 4.15
ALP (IU/L)	268.9 \pm 31.88	244.9 \pm 23.85	253.0 \pm 46.31	0.999	120.5 \pm 15.20
Total Bilirubin (mg/dl)	0.23 \pm 0.05	0.42 \pm 0.06	0.56 \pm 0.08	0.201	0.36 \pm 0.04

Total Protein (g/dl)	6.58±0.12	6.87±0.05	6.51±0.21	0.711	6.88±0.06
Albumin (g/dl)	2.53±0.04	2.59±0.02	2.49±0.10	0.909	2.89±0.01
Glucose (mg/dl)	62.63±6.22	65.13±2.68	73.57±3.05	0.668	102.7±4.49

Table 10: Hematology values of dog Breeds infected with canine parvovirus infection

Parameter	Local (n=7)	Exotic (n=11)	P value	Control (n=6)
Creatinine (mg/dl)	1.23±0.06	1.31±0.07	0.998	1.08±0.06
BUN (mg/dl)	28.29±1.88	31.09±2.33	0.994	24.67±1.89
ALT (IU/L)	186.0±11.57	148.9±10.25	0.903	94.50±4.15
ALP (IU/L)	248.6±23.00	266.4±26.73	0.998	120.5±15.20
Total Bilirubin (mg/dl)	0.40±0.07	0.34±0.06	0.999	0.36±0.04
Total Protein (g/dl)	6.84±0.14	6.58±0.10	0.698	6.88±0.06
Albumin (g/dl)	2.57±0.04	2.53±0.04	0.997	2.89±0.01
Glucose (mg/dl)	69.57±3.48	66.91±2.80	0.999	102.7±4.49

Because of the virus's effect on the bone marrow during the acute phase of the disease, there is a marked depletion of the cell lines (granulocytes, erythroid, and megakaryocytes), which is followed by hyperplasia of the cell lines and neutrophilia in peripheral blood during convalescence (Smith-Carr, *et al.*, 1997) [14], and these changes are nonspecific and could reflect the effect of endotoxaemia (Boosinger *et al.*, 1982) [2]. The pluripotent cells are unaffected by the substantial modifications to cell lines (Macartney *et al.*, 1984) [11].

Table 7 from the current study demonstrated increased ALT and ALP in dogs ≤ 3 months old (186.0±11.57; 269.3±19.12) in comparison with dog ≥ 3 months old (161.7±10.41; 244.42±7.12). Also, glucose levels in ≤ 3 months old dogs (67.90±3.54) decreased in comparison to ≥ 3 months old. This means that young dogs more likely to develop the illness. This supports previous results that pups between the ages of 6 and 12 weeks are more susceptible to the illness (Hoskins, 1997; Pritte 2004; Terzungwe, 2018) [9, 10, 17].

Biochemical parameters within the gender of the affected dogs were presented in Table 8 elevated level of BUN, ALT, ALP and hypoglycemia was predominant in both genders. However, in male dogs' elevation of ALT and ALP was observed. In females' glucose levels were slightly reduced when compared to that of male dogs. The biochemical parameters among the altered vaccinated, partial vaccinated and unvaccinated (Table 9) and were as between local and exotic breed (Table 10) indicated elevated level of ALT, ALP, glucose and decreased level of BUN in local dogs and unvaccinated dogs. After the commencement of neutropenia, there is a rise in plasma granulocyte colony-stimulating factor (G-CSF) concentration, which drops to undetectable levels once the neutropenia has resolved during CPVE (Cohn *et al.*, 1999) [3]. Hematological changes result from the destruction of hematopoietic progenitor cells of various leukocyte types in the bone marrow and other lymphoproliferative organs such as the thymus, lymph nodes, and spleen, resulting in an insufficient supply of leukocytes in the gastrointestinal tract (Goddard *et al.*, 2008) [7] and hepatic hypoxia attributable to severe hypovolemia due to the breakdown of the gastrointestinal barrier might cause an increase in alkaline phosphatase and alanine transaminase.

Conclusion

All of the hematological abnormalities reported in this study are CPVE-related. The majority of the dogs affected were 3 months old males, exotics which were unvaccinated, and hematobiochemical alterations and different clinical signs graded according to individual observation were presented in

18 dogs with canine parvovirus enteritis and different clinical signs graded according to individual observation.

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Disclosure

The authors report no conflicts of interest in this study.

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