RESEARCH ARTICLE

Canine Parvovirus Infection: Clinical, Haemato-Biochemical and Oxidative Stress Profiles

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Abstract

The study covered 57 dogs presented with haemorrhagic gastroenteritis at Veterinary Clinical Complex, Jabalpur from May to October 2024 which were confirmed positive for canine parvovirus via PCR. The most frequently observed clinical manifestations in this study were inappetence, frothy vomition, bloody diarrhoea, dehydration and depression. The haematological alterations revealed decreased levels of haemoglobin, total erythrocyte count, total leukocyte count, packed cell volume, neutrophilia and lymphopenia in CPV affected dogs as compared to healthy dogs. The serum levels of alkaline phosphatase and alanine aminotransferase were elevated, while the total protein and albumin levels were decreased. Oxidative stress parameters, *viz.*, malondialdehyde was significantly higher, while reduced glutathione and catalase values were significantly lower in CPV affected dogs as compared to healthy controls.

Keywords: Bloody diarrhoea, CPV, Frothy Vomiting, Lymphopenia, Neutrophilia, Oxidative stress.

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Introduction

Among gastrointestinal disturbances, gastroenteritis is the most common disease encountered in all breeds and age groups of the canine population. It is characterized by inappetence progressing to anorexia, frothy vomiting, bloody diarrhoea and marked dehydration (Bhat *et al*., 2023). It is one of the leading causes of morbidity and mortality in dogs globally (Chauhan *et al*., 2024). Transmission primarily occurs through the faecal-oral route, as infected animals shed the virus in their faeces. Factors that predispose to parvoviral infection are lack of protective immunity, intestinal parasites, overcrowding, unsanitary and stressful environmental conditions (Parthiban *et al*., 2016). Oxidative stress arises from an imbalance between the production of reactive oxygen species (ROS) and the body's antioxidant defences. When ROS overwhelm the antioxidant system, they can damage cellular components, leading to inflammation and various diseases (Rubio *et al*., 2016). Maintaining a balance between oxidant and antioxidant agents is crucial for preventing oxidative stress and promoting overall health (Valko *et al*., 2007). The present study was an attempt to study the clinical, hemato-biochemical and oxidative stress parameter alterations in canine parvovirus infection.

Materials and Methods

The study was conducted on 57 dogs diagnosed with haemorrhagic gastroenteritis at the Veterinary Clinical Complex, College of Veterinary Science & Animal Husbandry, NDVSU, Jabalpur, from May to October 2024. A detailed clinical history of the affected dogs was recorded, regarding the duration of illness, appetite changes, frequency of vomiting and diarrhoea and their vaccination and deworming history. Approximately 3 mL blood sample was collected aseptically from the cephalic or saphenous vein of randomly selected 18 CPV affected and 6 healthy control dogs. Out of which, 1 mL was collected in vial containing EDTA for routine haematology and 2 mL in clot activator vacutainer vials for serum biochemical and oxidative stress parameter estimation.

The haematological parameters were assessed using automatic blood analyser (IDEXX Procyte Dx) including Hb, PCV, TEC, TLC and DLC. The serum biochemical parameters measured were ALT, ALP, total protein and albumin with HEM-5 plus semi-auto analyser using readymade kits (AST-Erba Mannheim, Transasia biochemical (India) Pvt Ltd). The oxidative stress parameters including malondialdehyde, reduced glutathione and catalase, were manually estimated spectrophotometrically using established methods described by Suleiman *et al*. (1996), Prins and Loos (1969) and Goth (1991).

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The data on haemato-biochemical and oxidative stress parameters were subjected to independent sample t-test assuming equal variances to determine the significance of differences between groups using IBM SPSS statistical software version 27.

Results and Discussion

Fifty-seven dogs with haemorrhagic gastroenteritis were thoroughly inspected and examined for the appearance of certain peculiar clinical ailments of parvovirus infection. All the CPV affected dogs showed vomition, *i.e.,* 100%, bloody diarrhoea was noted in 94.73% and anorexia in 89.47% of cases. Increased body temperature was noticed in 45.62% of dogs, while 33.33% and 21.05% had normal and sub-normal body temperature, respectively. Pale, congested and pink mucous membranes were noted in 43.86%, 38.60% and 17.54% dogs, respectively. However, the degree of dehydration varied as mild, moderate and severe in 22.81%, 59.65% and 22.81%, respectively (Table 1, Fig. 1-3).

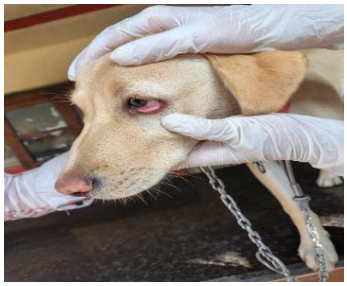

Fig. 1: Pale mucous membrane

Fig 2: Dull, depressed and dehydrated

Fig. 3: Bloody diarrhoea

Table 1: Clinical findings in dogs with parvovirus infection

Clinical findings		Frequency (n=57)	Per cent
Vomition		57	100
Bloody diarrhoea		54	94.73
Anorexia		51	89.47
Mucus membrane	Pink	15	26.31
	Pale	23	40.35
	Congested	19	33.34
Dehydration	Mild (4-6%)	13	22.81
	Moderate (6-8%)	34	59.65
	Severe (8-10%)	10	17.54
Rectal temperature	Sub normal	12	21.05
	Normal	19	33.33
	Increased	26	45.62

Alterations in haemato-biochemical and oxidative stress parameters of canine parvo viral gastroenteritis are represented in Table 2. Dogs found positive for CPV infection showed significant lower values of haemoglobin in comparison to apparently healthy control group. Similar findings were recorded by Khare *et al*. (2020) and Harizan *et al*. (2021) in CPV infected dogs, while Patel *et al*. (2022) observed increase in Hb in CPV infected dogs, which might be due to haemoconcentration as a result of dehydration. The low haemoglobin in parvoviral affected dogs might be attributed to virus's damage to the intestinal lining, leading to massive blood loss through severe diarrhoea.

TEC value was significantly lower in parvovirus infected dogs in comparison to apparently healthy control group. These findings were in accordance with Bhargavi *et al*. (2017), while Chethan (2020) reported significantly higher TEC values in parvovirus infected dogs on the day of presentation. The decrease in TEC in parvoviral enteritis is likely due to parvovirus induced destruction of the intestinal lining and villi capillaries, leading to massive bleeding and severe blood loss. Additionally low TEC values could be due to CPV's direct impact on the bone marrow, leading to reduced erythropoiesis (Khare *et al*., 2020).

Table 2: Haemato-biochemical and oxidative stress parameters in CPV infected dogs

Parameter	CPV affected dogs (n=18)	Apparently healthy dogs (n=6)	t- value
Hb (g/dL)	$9.77^{a} \pm 0.23$	$12.66^{b} \pm 0.29$	6.79^{*}
TEC (10^6/µL)	$4.65^{a} \pm 0.51$	$6.12^{b} \pm 0.37$	6.40^{*}
TLC (10^3/µL)	$9.68^{a} \pm 0.86$	$12.35^{b} \pm 0.80$	6.59^{*}
PCV (%)	$29.47^{a} \pm 0.77$	$40.18^{b} \pm 0.65$	30.28^{*}
Neutrophils (%)	$77.89^{a} \pm 1.84$	$65.67^{b} \pm 1.21$	15.07^{*}
Lymphocytes (%)	$12.61^{a} \pm 1.70$	$22.50^{b} \pm 1.51$	12.51^{*}
Monocytes (%)	$5.56^{a} \pm 0.51$	$5.33^{a} \pm 0.81$	0.79^{NS}
Eosinophils (%)	$3.61^{a} \pm 0.69$	$3.67^{a} \pm 0.81$	0.16^{NS}
TP (g/dL)	$4.72^{a} \pm 0.27$	$6.28^{b} \pm 0.31$	11.56^{*}
Albumin (g/dL)	$2.07^{a} \pm 0.47$	$3.34^{b} \pm 0.28$	6.12^{*}
ALT (U/L)	$111.91^{a} \pm 4.30$	$79.68^{b} \pm 3.82$	16.28^{*}
ALP (U/L)	$84.46^{a} \pm 1.84$	$68.87^{b} \pm 1.13$	19.32^{*}
MDA (nmol/mL)	$6.60^{a} \pm 0.88$	$3.44^{b} \pm 0.68$	7.96^{*}
GSH (nmol/mL)	$2.20^{a} \pm 0.52$	$3.35^{b} \pm 0.22$	5.11^{*}
Catalase (U/L)	$435.1^{a} \pm 30.81$	$648.6^{b} \pm 66.40$	10.86^{*}

*Significant at p≤0.05 level, NS- Non significant, Means followed by same superscript don't differ significantly.

In CPV positive dogs, TLC was found significantly lower as compared to the control group. These findings correlate with Mehta *et al*. (2020) and Patel *et al*. (2022). Reduction in TLC in CPV infected dogs could be attributed to the affinity of canine parvovirus for lymphocytes and lymphatic tissues, destroying haematopoietic progenitor cells of various leukocyte types in the bone marrow as well as in other lymphoproliferative organs such as the thymus, lymph nodes and spleen. This leads to insufficient compensation for the enormous demand for leukocytes.

Significantly lower PCV found in CPV positive dogs as compared to the control group, was in accordance with Saravanan *et al*. (2020) and Harizan *et al*. (2021). Alternatively, Kataria *et al*. (2020) reported non-significant increased PCV concentration in parvovirus infected dogs. The reduction in PCV in CPV infected dogs might be due to severe haemorrhagic enteritis leading to severe loss of blood.

In CPV positive dogs, the mean values of neutrophil count were significantly higher. These findings are in accordance with Panchsheel *et al*. (2024), while Zope *et al*. (2023) reported neutropenia in dogs infected with parvovirus. The present finding suggestive of increase in neutrophils, might potentially be due to the disruption of the mucosal barrier, which enables bacteria to enter the bloodstream, leading to sepsis and endotoxemia. This cascade of events activates and releases cytokines, promoting neutrophilia and intensifying the inflammatory response. Lymphopenia was observed in parvovirus affected dogs, which might be due to the virus replication in the lymphoid organs resulting in lymphocytolysis or endogenous release of high concentrations of cortisol. Non-significant variation was observed in monocytes and eosinophils in CPV affected dogs. These findings outcome parallels the findings of Patel *et al*. (2022).

Amongst biochemical parameters, the mean values of total proteins and albumin were significantly lower in CPV infected dogs. Similar findings were reported by Saravanan *et al*. (2020) and Khanduri *et al*. (2021). The low TP and albumin in parvoviral enteritis might be due to combination of inappetence/ anorexia, severe protein losing enteropathy through the damaged capillaries of the intestinal villi and less absorption of protein through the damaged intestinal villi (Kumar and Kumar, 2017). Additionally, low total protein could be due to decreased liver protein synthesis and malabsorption in parvovirus infection.

ALT value was significantly higher in CPV infected dogs, as observed by Harizan *et al*. (2021), while Saravanan *et al*. (2020) observed non-significant increase in ALT levels in parvovirus infected dogs. ALP value was significantly higher in CPV infected dogs. The results aligned with the findings of Kumar *et al*. (2020), while Rathore *et al*. (2024) reported non-significant reduction in ALP values in parvovirus infection in dogs. Significant increase in ALT and ALP might occur as a result of hepatic hypoxia secondary to severe hypovolemia or the absorption of toxic substances due to loss of the gut barrier or reactive hepatopathy in parvovirus infected dogs (Berghoff and Steiner, 2011). Additionally, elevated alkaline phosphatase activity can also be associated with young age.

Amongst oxidative stress parameters, the mean values of malondialdehyde were significantly higher in CPV infected dogs, as reported by Nath *et al*. (2023). The elevated MDA levels in this study suggest that parvovirus infection triggers oxidative stress, leading to increased lipid peroxidation. GSH concentrations were significantly lower in CPV infected dogs. Similar findings were reported by Kataria *et al*. (2020). GSH is used by glutathione peroxidase to detoxify hydrogen peroxide and other ROS. In CPV-infected dogs, the increased oxidative stress may lead to enhanced glutathione utilization, depleting GSH levels. Catalase activity was significantly lower in CPV infected dogs, as reported by Mekky *et al*. (2024). The reduction of catalase could be attributed to the increased production of ROS in CPV infected dogs, which can overwhelm the antioxidant defences, including catalase, which can directly inactivate catalase, leading to its degradation and reduced activity.

Conclusion

The dogs confirmed for parvovirus infection exhibited clinical symptoms, *viz.,* inappetence, froathy vomition, bloody diarrhoea, moderate dehydration, increased body temperature, pale mucus membrane. The haematological findings involving Hb, TEC, TLC, PCV and lymphocytes were significantly decreased and neutrophils significantly increased. Serum total protein, albumin was significantly decreased, and ALT, ALP were significantly increased in dogs with parvovirus infection. Malondialdehyde was significantly elevated, while reduced glutathione and catalase were lower in all canine parvovirus affected dogs.

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