

Prevalence and hematological parameters of Feline Panleukopenia virus (FPV) infection in cats in Ho Chi Minh City

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ARTICLE INFO	ABSTRACT
Research Paper Received: November 13, 2024 Revised: January 09, 2025 Accepted: February 10, 2025 Keywords Cat Feline panleukopenia virus Hematological parameters Ho Chi Minh City Leukopenia *Corresponding author Vo Phong Vu Anh Tuan Email: vpvatuan@ntt.edu.vn	Feline panleukopenia, caused by the Feline panleukopenia virus (FPV), a small DNA virus in the Parvoviridae family, is a highly contagious and often fatal disease affecting all feline species. This study was conducted from April to September 2024 at the K9 Veterinary Clinic system in Ho Chi Minh City. During this period, 47 FPV-positive cats were identified from 132 suspected cases, representing a prevalence rate of 35.61%. Age and the number of cats per household were significantly associated with FPV infection rates ($P < 0.05$). The FPV-positive cats exhibited alterations in specific hematological parameters, with a reduction in both white blood cell (WBC) count ($2.79 \times 10^9/L$) and neutrophil count ($1.77 \times 10^9/L$). The most commonly observed clinical signs in FPV-positive cats included vomiting, non-bloody diarrhea, poor skin turgor, lethargy, and anorexia. The results of the treatment indicated that 29 out of the 47 infected cats recovered, representing a success rate of 61.70%. In conclusion, feline panleukopenia remains a significant risk for cats, particularly in young or unvaccinated individuals. Early treatment of cats with leukopenia, combined with strict adherence to the treatment regimen, is essential to improve the recovery rate.

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1. Introduction

Feline leukopenia is caused by the Feline Panleukopenia virus (FPV), a small DNA virus belonging to the Parvoviridae family (Tuzio, 2021). The FPV has been demonstrated to infect all species within the Felidae family, causing

disease in both household and stray cats (Brussel, 2019). The FPV is highly resilient, with the capacity to survive for up to one year at room temperature in organic material. In feces, it can persist for 5 to 10 months or longer (Fischer et al., 2007). The disease has a high contagion rate

and a high mortality rate, particularly among kittens (Kabir et al., 2023). In newborn kittens, the disease progresses in an acute manner, resulting in the onset of neurological disorders such as ataxia and blindness. Kittens under 12 months of age frequently exhibit leukopenia and neutropenia as a consequence of infections of the bone marrow and lymphoid tissue, in addition to diarrhoea diarrhea resulting from the destruction of intestinal cells (Kiselev et al., 2021). Cats of all ages are susceptible to the disease, but the highest vulnerability is observed in kittens under 6 months of age (Nguyen et al., 2021). The most commonly reported symptoms in feline patients infected with the organism include vomiting, dehydration, and diarrhea (Barrs, 2019; Kabir et al., 2023).

The number of cats is increasing at a rapid rate, particularly due to the rising importation of foreign breeds. This exponential increase in the feline population is resulting in a proportional increase in the prevalence of feline diseases. A considerable number of studies have documented the high prevalence of FPV infection in cats. In Hanoi and surrounding areas, 34.93% of cats were found to be FPV-positive (Nguyen et al., 2021), and in Can Tho, the infection rate was 34.68% (Dang et al., 2023). In Ho Chi Minh City, the FPV infection rate reached 84.31% (Dinh et al., 2022). The elevated prevalence of FPV in cats can be attributed to a combination of inadequate vaccination coverage and constrained biosecurity measures. Additionally, research investigating a correlation between hematological parameters and FPV infection in cats remains limited in Vietnam. It is therefore imperative to study the prevalence, risk factors and haematological parameters to raise awareness, improve the efficacy of preventive measures, and facilitate the treatment of FPV.

2. Materials and Methods

2.1. Sample collection

The study was conducted between April and September 2024 at several K9 clinics in Ho Chi Minh City. One hundred and thirty two cats exhibiting clinical signs suggesting FPV infection, and with the information of their owners, were enrolled in the study. The cats suspected of having FPV exhibited (any stages of diseases) a range of clinical symptoms including high fever, lethargy, vomiting, generalized depression, loss of appetite, diarrhea, nasal discharge, and dehydration.

A comprehensive data set was assembled, face to face interviews with cat owners in order to collect data on potential risk factors for FPV, including breed, age, sex, lifestyle, housing, and history of clinic visits. The clinical symptoms were examined and collected by veterinarians using the appropriate diagnostic instruments.

2.2. Rapid diagnostic test kits

All cats exhibiting indications suspected of a potential FPV infection were subjected to the collection of either fecal (rectal swab) or vomit samples for rapid diagnostic testing via the FPV Ag test kit (Sensitivity: 95.6 % and Specificity: 98.1%; GenAction, Vietnam). For rectal swab, a cotton swab was inserted into the rectum about 1 - 2 inches past the anus and gently rotated the swab clockwise for 5 - 10 sec. Then, withdrew the swab without touching the skin and placed the swab and any adherent material into a swab container.

2.3. Blood sampling and hematological analysis

Two milliliters of blood were collected from the medial saphenous vein were collected in tubes

containing ethylene diamine tetra acetic acid (EDTA) for a complete blood count using the BC 5000VET hematology analyzer (19 parameters; Mindray company, China). The blood samples were used to estimate the following parameters: the White Blood Cell (WBC), Neutrophils (Neu), Lymphocytes (Lym), Monocytes (Mon), Eosinophils (Eos), Basophils (Bas), Red Blood Cell (RBC), Hemoglobin (HGB), Hematocrit (HCT), Mean Corpuscular Volume (MCV), Mean Corpuscular Hemoglobin (MCH), Mean

Corpuscular Hemoglobin Concentration (MCHC), and Platelets (PLT). There were 47 FPV-infected cats; however, only 15 cat owners agreed to test hematological parameters before and after treatment.

2.4. Treatment protocol

The FPV positive cats were treated in accordance with the standard protocol (Table 1) of the clinics.

Table 1. Treatment protocols for *Feline Panleukopenia* virus (FPV) infection in cats

Items	Drug administration route ¹
Secondary infection treatment: Broad-spectrum antibiotics (Sulfamethoxyridazole and Trimethoprim (Sept))	SC
Symptomatic treatment: reducing fever, alleviating vomiting (Cimetidine and Analgin - C)	SC
Supportive care, strengthened support (Catosal and B ₁₂ - ATP)	IV
Rehydration, electrolytes: (Ringer Lactate)	IV
Support for increasing leukocytes and enhancing immune system activity	IV or IM

¹SC: subcutaneous; IV: intravenous;IM: intramuscular.

A recovered cat is one that has a WBC count within the normal range (if the owners agreed to test hematological parameters after treatment), a normal appetite and defecation, behaves normally, and no longer exhibits clinical symptoms. An unrecovered cat does not show improvement in clinical symptoms, may worsen symptoms, or may die during the course of treatment.

2.5. Statistical analysis

The data were processed and calculated using Microsoft Excel, and the risk factors were

assessed using the Chi-square test with Minitab version 16.0.

3. Results and Discussion

3.1. The prevalence of FPV in cats

The results in Table 2 and Figure 1 demonstrated that 47 out of the 132 suspected cats were positive for FPV by using FPV Ag test kit, representing a prevalence of 35.61%. The non-specific symptoms of leukopenia in cats, coupled with the presentation of sick cats at various stages of the disease, can render clinical diagnostics

more challenging. The results of our study are consistent with those reported by Nguyen et al. (2021), who observed a 34.93% positivity rate for FPV in cats in Hanoi and surrounding areas. The

research conducted by Award et al. (2018) and Le et al. (2020) indicated higher FPV infection rates than those observed in our study, with figures of 40.19 and 40%, respectively.

Table 2. The proportion of Feline Panleukopenia virus (FPV)-infected cats

Items	Number of cats	Percentage (%)
FPV Negative	85	64.39
FPV positive	47	35.61
Total	132	100

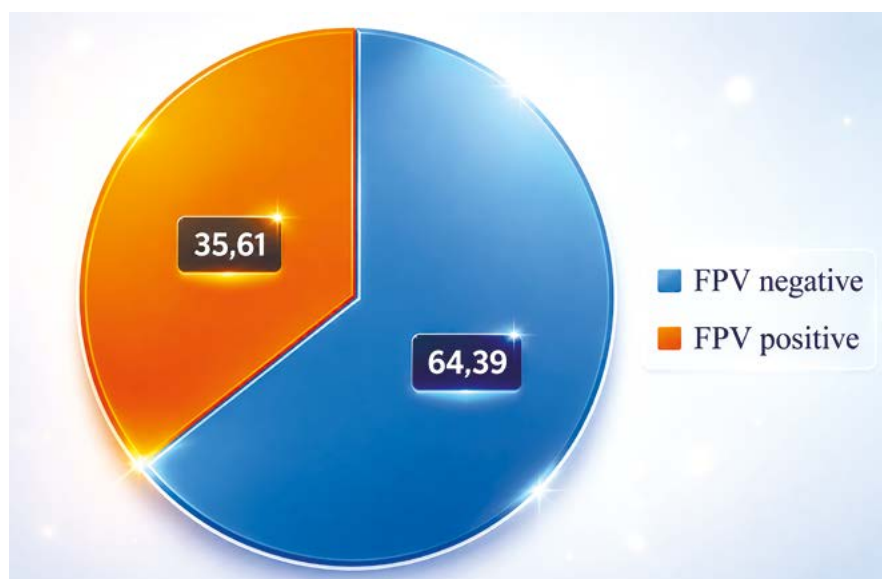


Figure 1. The proportion of *Feline Panleukopenia* virus (FPV)-infected cats.

3.2. The FPV-infected rate according to risk factors

The results presented in Table 3 indicate that the FPV positivity rate was 70.21% for domestic breeds and 29.79% for foreign breeds ($P > 0.05$). This finding is consistent with the findings of

Porporato et al. (2018), who reported that 99.4% of domestic cats and 0.6% of foreign breeds had panleukopenia. However, the report by Dinh et al. (2022) indicated a contrasting trend, with domestic breeds exhibiting a lower prevalence of 25.58%, compared to foreign breeds, which reached 74.42%.

Table 3. The prevalence of *Feline Panleukopenia* virus (FPV) infection according to risk factors

Items	Suspected cats	Infected Cats	
	132	47	Percentage (%)
Breed			
Domestic	80	33	70.21 ^a
Foreign	52	14	29.79 ^a
Gender			
Male	68	22	46.81 ^a
Female	64	25	53.19 ^a
Lifestyle			
Indoor	98	39	82.98 ^a
Outdoor	34	8	17.02 ^a
Housing			
Single-cat household	81	19	40.43 ^a
Multi-cat household	51	28	59.57 ^b
Visit to the hospital for other purposes			
Yes	37	12	25.53 ^a
No	95	35	74.47 ^a
Age			
0 to 6 months	66	29	61.70 ^a
6 to 12 months	41	15	31.92 ^a
> 12 months	25	3	6.38 ^b

^{a, b, c} Different letters in the same column indicate a significant difference ($P < 0.05$).

The data in Table 3 also indicated the FPV-infected rate between male cats (46.81%) and female cats (53.19%), suggesting that sex does not significantly affect the rate of feline panleukopenia ($P > 0.05$). The results of Awad et al. (2018) and Nguyen et al. (2021) also demonstrated comparable FPV infection rates between male and female cats. In contrast, the findings of Dinh et al. (2022) indicated a higher

prevalence of infection in male cats (76.74%) compared to female cats (23.26%).

The housing conditions (Table 3) demonstrated no statistically significant difference between the indoor group (infection rate of 82.98%) and the outdoor group (infection rate of 17.02%) ($P > 0.05$). This finding is consistent with the studies by Oğuzoğlu (2013) and Gülersoy et al. (2023), which reported infection rates of 69.23 and 88%

for indoor cats, respectively, 30.77 and 12% for outdoor cats. In contrast, Dinh et al. (2022) reported a higher infection rate among outdoor cats (76.74%) than indoor cats (23.26%).

The number of cats per household demonstrated a statistically significant difference between households with only one cat (infection rate of 40.43%) and those with two or more cats (59.57%) ($P < 0.05$). This discrepancy may be attributed to the elevated risk of disease transmission in households with multiple cats. These findings are consistent with those of Rehme et al. (2022) and Kabir et al. (2023), who observed that compared to households with only one cat, there is an elevated risk of infection in those with multiple cats.

Table 3 also indicated that 25.53% of infected cats had visited a veterinary clinic, in comparison to 74.47% of cats that had never been to a clinic. However, this difference is not statistically significant ($P > 0.05$). Consequently, the likelihood of transmission from veterinary clinics remains inconclusive. Conversely, Kabir et al. (2023) illustrated that cats attending clinics for diverse reasons exhibited a threefold elevation in infection risk compared to those that had never been brought to a clinic.

Additionally, age was identified as a risk factor for feline panleukopenia. As illustrated in Table 3, the highest infection rate was observed in cats under six months of age (61.70%), followed by those aged six to twelve months (31.92%) and cats over twelve months old (6.38%). Significant differences were identified between the groups of cats under six months and those over twelve months of age, as well as between the groups of cats aged six to twelve months and those over twelve months of age ($P < 0.05$). This trend may be attributed to the susceptibility of kittens to

feline panleukopenia as a result of the decline in maternally derived antibodies. Similarly, Khan et al. (2025) reported a comparable pattern, with a high infection rate in cats under six months (29.46%), followed by cats aged six to eighteen months (22.90%), and the lowest rate in cats over eighteen months (9.14%). Additionally, Le et al. (2020) observed the highest infection rate in cats under six months (55.56%) and the lowest in those over twelve months (5.00%), which is consistent with the findings of Nguyen et al. (2021). These findings indicate that cats under the age of six months are at an elevated risk of infection.

3.3. Hematological parameters in cats with *Feline Panleukopenia*

The results presented in Table 4 demonstrate the hematological parameters in cats that have been diagnosed with FPV. The white blood cell count exhibited a pronounced decline ($2.79 \times 10^9/L$ in comparison to the minimum threshold of $5.5 \times 10^9/L$), as did the neutrophil count ($1.77 \times 10^9/L$ in comparison to the minimum threshold of $3.12 \times 10^9/L$), whereas lymphocyte counts demonstrated a slight reduction ($0.65 \times 10^9/L$ in comparison to the minimum threshold of $0.73 \times 10^9/L$). The reduction in white blood cells results in immunosuppression, rendering FPV-infected cats more susceptible to secondary infections. It is therefore imperative that the treatment protocol includes antibiotics to prevent secondary infections and medications that can increase white blood cell count and boost the immune system in FPV-infected cats. Conversely, red blood cell counts were within the physiological range. A notable decline in platelet count was observed ($63.45 \times 10^9/L$ compared to the minimum threshold of $100 \times 10^9/L$), which elevates the risk of gastrointestinal

bleeding and necessitates the provision of additional hemostatic support. Additionally, studies conducted by Gülersoy et al. (2023) and Dishow et al. (2024) have reported reductions in analogous hematological parameters, which are consistent with the findings presented here. Similarly, research conducted by Nguyen et al. (2021) and Irgashev et al. (2023) demonstrated

a comparable trend. These studies collectively demonstrate a reduction in white blood cells, granulocytes, lymphocytes, and platelets. The presence of these subclinical symptoms is of significant diagnostic value, particularly in the development of treatment protocols for veterinary practitioners.

Table 4. Hematological parameters in cats with *Feline Panleukopenia*

Parameters	Normal values	Case group (n = 15) Range Mean ± SE
White blood cell (WBC), x 10 ⁹ /L	5.50 - 19.50	2.79 ± 1.07
Neutrophils (Neu), x 10 ⁹ /L	3.12 - 12.58	1.77 ± 0.91
Lymphocytes (Lym), x 10 ⁹ /L	0.73 - 7.86	0.65 ± 0.30
Monocytes (Mon), x 10 ⁹ /L	0.07 - 1.36	0.17 ± 0.10
Eosinophils (Eos), x 10 ⁹ /L	0.06 - 1.93	0.05 ± 0.02
Basophils (Bas), x 10 ⁹ /L	0.00 - 0.12	0.01 ± 0.01
Red blood cell (RBC), x 10 ¹² /L	4.6 - 10.2	7.24 ± 0.72
Hemoglobin (HGB), g/L	85 - 153	104.13 ± 9.95
Hematocrit (HCT), %	26 - 47	29.94 ± 2.68
Mean corpuscular volume (MCV), f/L	38 - 54	42.98 ± 1.83
Mean corpuscular hemoglobin (MCH), pg	11.8 - 18	14.45 ± 0.30
Mean corpuscular hemoglobin concentration (MCHC), g/L	290 - 360	343.60 ± 14.00
Platelets (PLT), x 10 ⁹ /L	100 - 518	63.45 ± 8.82

3.4. Clinical symptoms in FPV-infected cats

Clinical symptoms (Table 5) were frequently observed in FPV-positive cats, including foamy or yellow vomit, diarrhoea without blood, poor skin elasticity, loss of appetite, fatigue, and lethargy. Furthermore, studies by Awad et al.

(2018), Porporato et al. (2018), and Dishow et al. (2024) have also observed similar frequencies of these clinical signs. These symptoms serve as crucial indicators for cat owners and veterinarians to identify potential cases for monitoring and diagnostic purposes.

Table 5. Clinical symptoms in Feline Panleukopenia virus (FPV)-infected cats

Signs	Number of cats	Total FPV cats	Percentage (%)
Anorexia	39	47	82.98
Lethargy	41		87.23
Fever	28		59.57
Drooling	6		12.77
Dehydration	36		76.60
Pale mucous membrane	23		48.94
Diarrhea	43		91.49
Bloody diarrhea	8		17.02
Vomiting	45		95.74

3.5. Effectiveness of treatment in FPV-infected cats

The results presented in Table 6 demonstrate that the efficacy of the therapeutic intervention for cats with leukopenia is considerable, with a recovery rate of 61.70%. Currently, there is no specific treatment for feline panleukopenia (FPV). Consequently, the intervention is primarily based on supportive care and the treatment of symptoms. The survey results regarding treatment effectiveness are encouraging, mainly due to owners promptly

recognizing symptoms in their cats and bringing them to the clinic on time, administering the correct medications at the appropriate doses by the clinic's protocol, and closely implementing supportive measures. As Porporato et al. (2018) have demonstrated, the survival rate for cats with leukopenia is approximately 20.3%. In contrast, Dang et al. (2023) have reported a recovery rate of 34.88%. The cases of ineffective intervention are primarily attributable to owners detecting the disease at a late stage and failing to pursue treatment following the recommendations of the veterinary practitioner.

Table 6. Effectiveness of treatment in FPV-infected cats

Items	Number of cats	Percentage (%)
Recovered	29*	61.70
Unrecovered	18	38.30
Total	47	100.00

**Only 12 FPV-infected cats had their hematological parameters examined after treatment. The other (17) recovered cats were assessed based on clinical signs.*

4. Conclusions

The study revealed that 35.61% of cats tested positive for FPV. The number of cats per household and the age of the cats were found to be significantly associated with the occurrence of feline panleukopenia. The most commonly reported symptoms were loss of appetite, poor skin elasticity, diarrhoea, and vomiting. The FPV-positive cats exhibited a notable decline in white blood cell count, with a value of $2.76 \times 10^9/L$ for white blood cells and $1.87 \times 10^9/L$ for neutrophils. The application of supportive treatment resulted in a recovery rate of 61.70%.

Conflict of interest

The authors declare that there are no conflicts of interest regarding the publication of this manuscript.

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