RESEARCH ARTICLE

Comparative analysis of Western medicine and integrative medicine protocols in the clinical management of feline panleukopenia virus infection

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Feline panleukopenia virus infection is a highly pathogenic and contagious disease in felines, posing a serious threat to the health of cats. To optimize the treatment strategy for feline panleukopenia virus infection, a comparative analysis was conducted on the clinical effects of Western medicine treatment and integrative medicine treatment. A randomized controlled trial design was used to include 100 cats diagnosed with feline panleukopenia virus infection. The animals were divided equally into a Western medicine group and an integrative medicine group. A quantitative scoring system was established to monitor clinical symptoms such as vomiting and diarrhea, dynamically detect hematological and biochemical indicators, and regularly conduct polymerase chain reaction (PCR) for virus testing. Cats in the Western medicine group received standard clinical therapies including antiviral drugs, antibiotics, fluid therapy, antiemetics, and nutritional support, whereas the integrative medicine group received the same Western medicine treatment supplemented with Chinese herbal formulations and acupuncture-based supportive therapy. The results showed that the clinical symptom score of the integrative medicine group was below that of the Western medicine group on the 14th day ($P < 0.05$), and the cure rate was higher. The positive rate decreased to 5% on the 14th day in integrative medicine group, which was below that of the 10% of the Western medicine group ($P < 0.05$). In addition, the proportions of alanine aminotransferase abnormalities and total bilirubin in integrative medicine group were 11.43% and 14.00%, significantly lower than that of the 26.0% and 32.0% in the Western medicine group, respectively. The integrative medicine treatment demonstrated significant advantages in relieving clinical symptoms, improving cure rates, and clearing viruses, providing new ideas for the treatment of feline panleukopenia virus infection.

Keywords: Feline panleukopenia virus; hematological analysis; infection; integrative medicine treatment.

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Introduction

Feline panleukopenia virus (FPV) infection remains one of the most severe and highly contagious viral diseases affecting both domestic and wild feline populations. As a member of the parvovirus family, FPV preferentially targets rapidly dividing cells, especially those in bone marrow, intestinal mucosa, and lymphoid tissue, leading to acute leukopenia, severe gastrointestinal dysfunction, dehydration, and high mortality, especially in kittens [1]. With the increase in pet ownership and high mobility of the global cat population, FPV continues to pose

significant challenges to clinical management and disease control.

Karapinar *et al*. conducted molecular characterization analysis on the virus and explored genetic differences and found that FPV DNA was detected in 7 out of 19 fecal samples from cats with diarrhea and vomiting, and the positive samples had diverse genotypes [2]. Zhao *et al*. conducted relevant tests on the parvovirus genes in the feces of rescue cats in various parts of Japan and indicated that, among cats with diarrhea symptoms, the numbers of positive cases of FPV, FBoV-1, and FBoV-2 were significantly higher than that of asymptomatic cats, and the incidence of diarrhea symptoms in 1-2 month old kittens was also significantly higher than that in cats over 3 months old [3]. In recent years, significant progress has been made in diagnostic techniques, viral genetic characteristics, and understanding of the pathogenesis of FPV. Molecular detection methods such as polymerase chain reaction (PCR) have improved the accuracy of clinical diagnosis, and epidemiological studies have revealed changes in genotype diversity and transmission patterns in different regions. Currently, vaccination is the main preventive measure, but for cats that are not immunized or have failed immunization, effective clinical treatment is still necessary. At present, the treatment strategy for FPV mainly relies on Western medical methods including antiviral drugs, antibiotics, liquid therapy, and nutritional support. Although supportive therapy has improved survival rates in many cases, treatment failure still occurs due to severe immune suppression, secondary infections, or multiple organ dysfunction. In recent years, Chinese veterinary medicine has shown unique advantages in treating viral diseases such as the multi-target regulation of traditional Chinese medicine (TCM) and the neuro immune regulation of acupuncture and moxibustion. Studies have shown that some Chinese herbal ingredients can inhibit virus replication, promote lymphocyte proliferation, improve systemic immune function against viral infections, and enhance the body's disease resistance, while acupuncture and moxibustion can regulate gastrointestinal function. However, there is still a lack of systematic research on the integrated traditional Chinese and Western medicine treatment plan for FPV, especially in the comparative analysis of dynamic changes in viral load, immune recovery, and improvement of biochemical indicators to evaluate the combination of traditional Chinese and Western medicine in FPV clinical management [4].

This research conducted a randomized controlled trial to compare the clinical efficacy of Western medicine treatment and integrated Chinese and Western medicine treatment, aiming to provide a more scientific and effective strategy for treating feline parvovirus infection. This study combined traditional Chinese veterinary medicine with modern Western veterinary medicine, utilizing the advantages of both approaches to provide new ideas and methods for treating feline parvovirus infection, and has significant clinical application value.

Materials and methods

Research Object and Experimental Equipment

A total of 100 cats including domestic and stray cats diagnosed with FPV infection from a tertiary veterinary hospital in Zhengzhou, Henan, China between January 2020 and December 2022 were included in this study, which included 45 males and 55 females, aged 3 months to 10 years. The inclusion criteria were with typical clinical symptoms such as fever, vomiting, diarrhea, lethargy, loss of appetite, *etc*.; positive laboratory test results including fecal testing, blood routine showing leukopenia, PCR testing, *etc*.; having not been vaccinated against FPV or having an unclear vaccination history. The exclusion criteria were combined with other major diseases; having received similar treatment in the past and having incomplete medical records; pregnant or nursing cats to avoid potential effects on fetuses or kittens [5, 6]. The baseline characteristics of the enrolled cats were recorded to ensure

comparability between groups. The main breeds included British Shorthair, American Shorthair, Ragdoll, and other mixed breeds with similar distributions in both treatment groups. At admission, the major clinical symptoms included vomiting (80%), diarrhea (75%), listlessness (90%), and loss of appetite (85%), consistent with typical manifestations of FPV infection. The duration of illness ranged from 1 to 7 days with an average of 3 days. There were no statistically significant differences between the two groups in baseline variables such as sex, age category, breed composition, clinical symptoms, or immune status. Before treatment, clinical symptom scores were evaluated to ensure baseline comparability between groups. The Western medicine group (WMG) and the integrative medicine group (IMG) showed similar levels in vomiting, diarrhea, mental state, and appetite with mean scores of 2.2 to 2.3 for vomiting, 1.0 to 1.0 for diarrhea, 2.2 to 2.2 for mental state, and 2.1 to 2.1 for appetite without statistically significant. All procedures of this research were approved by the Ethics Committee of Henan University of Animal Husbandry and Economics (Zhengzhou, Henan, China).

Clinical symptom assessment

The clinical symptoms of cats before and after treatment were recorded and evaluated. The main observation indicators included vomiting, diarrhea, mental state, appetite, *etc*. [7]. The symptoms-based scoring system were vomiting frequency with 0 point for no vomiting, 1 point for 1 - 3 times per day, 2 points for 4 - 6 times per day, and 3 points for more than 6 times per day; diarrhea condition with 0 point for no diarrhea, 1 point for soft stool, 2 points for watery stool, and 3 points for bloody stool; mental state with 0 point for a good mental state, 1 point for a weak mental state, and 2 points for a loss of consciousness; appetite with 0 point for normal appetite, 1 point for decreased appetite, 2 points for anorexia. The improvement effect of treatment on clinical symptoms was evaluated by comparing symptom scores before and after treatment. In terms of hematological indicators testing, blood samples were collected from cats before and after treatment and analyzed using a Mindray BC-2800Vet automatic veterinary hematology analyzer (Mindray, Shenzhen, Guangdong, China) and a Hitachi 7080 biochemical analyzer (Hitachi, Tokyo, Japan) for routine blood tests and serum biochemical tests. The main detection indicators included white blood cell count, red blood cell count, platelet count, hemoglobin, serum amyloid A, alanine aminotransferase, aspartate aminotransferase, creatinine, urea nitrogen, *etc*. [8, 9]. The changes in hematological indicators before and after treatment were compared to evaluate the impact and recovery of treatment on the cat's bodily functions. The healing and mortality status of cats in the treatment group were recorded, and the cure rate and mortality rate were calculated. Healing criteria were that the clinical symptoms completely disappeared, blood routine and serum biochemical indicators returned to normal, and two consecutive cat parvovirus antigen tests were negative using the FPV antigen test kit (IDEXX Laboratories, Westbrook, ME, USA). The mortality was determined by counting the death of cats only caused by FPV infection during the treatment process.

Virus isolation and identification

The collected fecal samples were immediately placed in sterile test tubes containing virus transport solution and stored at 4°C. Samples were centrifuged using Eppendorf 5810R refrigerated centrifuge (Eppendorf, Hamburg, Germany) to remove impurities before inoculation. The clarified supernatant was then filtered through a 0.22 μm membrane (Millipore, Burlington, MA, USA) before 0.5 mL of filtered sample being inoculated onto a monolayer of F81 feline fibroblast cells (ATCC, Manassas, VA, USA) at a ratio of approximately 1:10 for virus isolation in Gibco Dulbecco's modified eagle medium (DMEM) (Thermo Fisher Scientific, Waltham, MA, USA) supplemented with 10% fetal bovine serum and 1% penicillin-streptomycin (Solarbio, Beijing, China). The culture was incubated at 37°C with 5% CO_2 in a Thermo Forma Series II humidified CO_2 incubator (Thermo Fisher Scientific,

Waltham, MA, USA). Cellular lesions were observed every 3 days. Cytopathic effects (CPE) including cell rounding, shrinkage, and detachment daily were monitored by using Olympus CKX53 inverted microscope (Olympus, Tokyo, Japan). If typical cellular lesions occurred, cells were freeze-thaw three times to release intracellular virions. The virus solution was collected for subsequent identification and analysis. The freeze-thawed lysates were centrifuged at 5,000 × g for 15 minutes to clarify the viral supernatant, which was then aliquoted and stored at -80°C [10, 11]. Viral DNA was extracted from either fecal or F81 cell culture samples using DP315 viral DNA extraction kit (Tiangen Biotech Co., Beijing, China) following manufacturer's instructions. PCR amplification was then performed in a Bio-Rad T100 thermocycler (Bio-Rad, Hercules, CA, USA) for viral confirmation using conserved sequence of the *VP2* gene of FPV with the primers of forward (5'-AGG TGG TTA GTT GGA GGA G-3') and reverse (5'-TCC AGT TGG TTA GGT GAT GA-3'). PCR reaction was set as 12.5 µL of 2× Taq Master Mix (Takara Taq™ Version 2.0, Takara Bio Inc., Shiga, Japan), 1 µL of each 10 µM primer, 2 µL of DNA template, and nuclease-free water to a final volume of 25 µL and was performed with 95°C for 5 min followed by 35 cycles of 95°C for 30 s, 55°C for 30 s, 72°C for 45 s, and a final extension at 72°C for 7 min. PCR products were electrophoresed on 1.5% agarose gels, stained with ethidium bromide, and visualized under a Gel Doc XR+ UV transilluminator (Bio-Rad Laboratories, Hercules, CA, USA) before DNA sequencing. The sequence analysis was performed by comparing obtained *VP2* gene sequence with the reference sequence in the National Center for Biotechnology Information (NCBI) database (https://www.ncbi.nlm.nih.gov) to determine the genotype and evolutionary relationship of the virus [12, 13].

Treatment strategies

After confirming FPV infection, cats were randomly assigned to the WMG or the IMG. Clinical symptoms, blood parameters, biochemical indices, and survival outcomes were monitored throughout the treatment period with data collected at baseline and at fixed intervals until recovery or death. The treatment of the WMG focused on maintaining stable vital signs and alleviating clinical symptoms, which included fluid replacement therapy, antibiotic and antiviral treatment, and targeted support. Fluid replacement therapy selected lactate Ringer's solution (Baxter Healthcare, Deerfield, IL, USA) or 0.9% sodium chloride for intravenous infusion at 40 - 80 mL/kg/day according to the dehydration and electrolyte imbalance of the affected cat. For cats with severe dehydration, a higher dose of fluid replacement was used within the first 24 hours. The infusion speed and dosage were adjusted according to clinical improvement in the later stage. Cefazolin sodium (Youcare Pharmaceutical Group, Beijing, China) was administered intravenously at 20 mg/kg every 12 hours for 5 - 7 days to prevent secondary bacterial infection. Recombinant feline interferon omega (Virbagen Omega, Virbac, Carros, France) was administered subcutaneously at 1 MU/kg once daily for three consecutive days as an antiviral agent. Targeted support provided corresponding symptomatic treatment drugs for symptoms such as fever, vomiting, and diarrhea and if necessary, combined with nutritional support treatment [14, 15]. Maropitant citrate (Cerenia, Zoetis Inc., Kalamazoo, MI, USA) was given subcutaneously at 1 mg/kg once daily to control vomiting. Vitamin B complex (Harbin Pharmaceutical Group, Harbin, Heilongjiang, China) was administered intramuscularly at 0.2 mL/kg once daily to provide nutritional support. The treatment continues until clinical symptoms improved and hematological and biochemical parameters stabilized. The IMG combined traditional Chinese medicine and acupuncture and moxibustion treatment with Western medicine treatment to improve the overall immune regulation ability and provide symptomatic support. Treatment methods included oral administration of traditional Chinese herbal formulas supplemented with conventional fluid therapy, antiviral and antibiotic treatment, as well as acupuncture and

moxibustion. The selected acupoints and treatment frequency were the same as those used by the Chinese veterinary team. The traditional Chinese medicine treatment was based on the theory of TCM syndrome differentiation and treatment [16]. Huanglian Jiedu Tang was used with modifications for cats with obvious symptoms of fever, vomiting, and diarrhea, while Si Jun Zi Tang was used with modifications for cats with weak constitution and loss of appetite. A modified Huangqi-Baizhu decoction was also used. All herbal materials were supplied by Beijing Tongrentang Pharmaceutical Group (Beijing, China) and prepared using Kangning K-80 traditional medicine decoction machine (Kangning Medical Instrument Co., Ltd., Guangzhou, Guangdong, China) to ensure extraction consistency. The dosage of traditional Chinese medicine formula was adjusted depending on the weight and condition of the cat, and the final extract was administered orally at 1 mL/kg twice daily. Acupuncture and moxibustion treatment selected appropriate acupoints and used filiform needle acupuncture method. Each treatment lasted 15 - 20 min with 2 - 3 times a week. The intensity and time of acupuncture and moxibustion were adjusted according to the cat's condition and reaction [17]. Electroacupuncture stimulation was delivered using Huatuo HY-300 small-animal electroacupuncture device (Suzhou Medical Supplies Factory Co., Ltd., Suzhou, Jiangsu, China) at the acupoints of Zusanli (ST36), Hegu (LI4), and Neiguan (PC6) with stimulation intensity maintained at 1 - 2 mA for 15 minutes once daily. The duration of integrative treatment was the same as WMG until clinical recovery criteria were met.

Statistical analysis

SPSS 26.0 (IBM, Armonk, New York, USA) was employed for statistical analysis. For clinical symptom scores and hematological indicator data, normality tests were first performed. If the data followed a normal distribution, one-way ANOVA was taken to compare the differences between different treatment plans. If the data was not normally distributed, non-parametric testing was used. For cure rate and mortality rate, the χ^2 test was used. The *P* value less than 0.05 was defined as statistically significant.

Results

No significant differences were observed between the two groups in baseline characteristics of gender, age, variety, clinical symptoms, and immune status, indicating a balanced grouping and good comparability.

Clinical symptom changes of treatment strategies for feline panleukopenia virus infection

The changes in clinical symptom scores during the treatment process between the WMG and IMG showed that, on the 3rd day, both groups had high scores, but the score of the IMG was 1.2, slightly lower than the score of 1.5 in the WMG. However, there was no statistically significant difference. As the treatment progressed, on the 14th day, the score of the IMG (0.4) was lower than that of the WMG (0.6) ($P < 0.05$) (Table 1).

Table 1. Changes in clinical symptom scores of each group with treatment time (Mean ± SD).

Post-treatment	WMG	IMG	*P value*
Day 3	1.5 ± 0.5	1.2 ± 0.4	> 0.05
Day 7	1.0 ± 0.3	0.8 ± 0.3	> 0.05
Day 10	0.8 ± 0.4	0.5 ± 0.3	< 0.05
Day 14	0.6 ± 0.3	0.4 ± 0.2	< 0.05

Hematological index

The dynamic changes in white blood cell count and red blood cell count were compared between the WMG and IMG. The results showed that, with the prolongation of treatment time, the white blood cell counts of both groups increased with WMG from about 4 to about 23 and IMG from about 3 to about 19 on the 3rd and 14th days (Figure 1a). The red blood cell in WMG showed a decreasing trend during the treatment period from about 8 on the 3rd day to about 6 on the 14th day, while IMG remained relatively

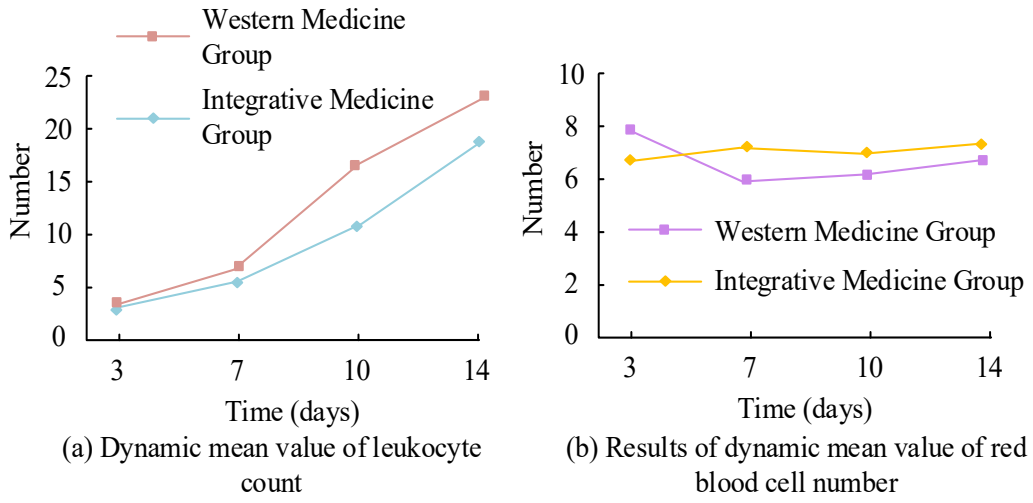

Figure 1. Changes in white blood cell and red blood cell count over the treatment time.

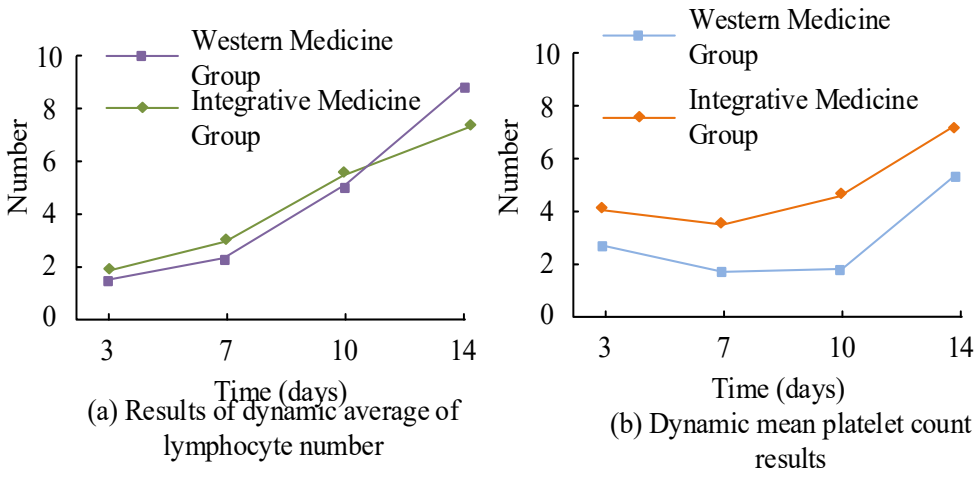

Figure 2. Changes in lymphocyte and platelet count over the treatment time.

stable (Figure 1b). The changes in lymphocyte count and platelet count demonstrated that, with the prolongation of treatment time, the lymphocyte counts of both groups increased, but the growth was more significant in IMG, especially on the 14th day of treatment with a lymphocyte count of 23, which was higher than that of the 18 in WMG (Figure 2a). The platelet counts in WMG decreased to a minimum of about 2 on the 7th day, and then gradually recovered. Both groups then remained at a relatively high level at about 7 on the 14th day with a faster recovery rate (Figure 2b).

Biochemical index

The key biochemical indicators before treatment demonstrated no statistically significant difference between the two groups, indicating that the health status of the two groups of cats was similar before treatment. During the treatment, in WMG, alanine transaminase (ALT) decreased from baseline 30 U/L to 20 U/L at the end of treatment, indicating an improvement in liver function, while blood urea nitrogen (BUN) decreased from 25 mg/dL to 20 mg/dL, reflecting an improvement in renal function. These changes might be attributed to specific drugs used in

Table 2. Biochemical indicator changes in WMG.

Biochemical parameter	Elevated cases	Normal cases	Decreased cases	Total abnormal cases	Abnormal sample percentage (%)
Alanine aminotransferase	8	37	5	13	26.0%*
Creatine kinase	7	38	5	12	24.0%*
Alkaline phosphatase	9	36	5	14	28.0%*
Total protein	6	40	4	10	20.00%
Blood urea nitrogen	10	35	5	15	30.0%*
Glucose	5	43	2	7	14.00%
Total bilirubin	11	34	5	16	32.0%**

Note: *: $P < 0.05$. **: $P < 0.001$.

Table 3. Biochemical indicator changes in IMG.

Biochemical parameter	Elevated cases	Normal cases	Decreased cases	Total abnormal cases	Abnormal sample percentage (%)
Alanine Aminotransferase	4	44	2	6	12.00%
Creatine Kinase	3	45	2	5	10.00%
Alkaline Phosphatase	5	43	2	7	14.00%
Total Protein	4	44	2	6	12.00%
Blood Urea Nitrogen	6	42	2	8	16.00%
Glucose	2	47	1	3	6.00%
Total Bilirubin	5	43	2	7	14.00%

Western medicine treatment such as antibiotics and antiviral drugs, which directly targeted infections and inflammation, thereby improving the biochemical indicators of cats. The impact of Western medicine treatment on the biochemical indicators showed that the proportion of cases with elevated ALT was higher than that of the normal reference proportion ($P < 0.05$). In addition, the proportion of abnormal total bilirubin was also relatively high (Table 2). The impact of traditional Chinese medicine treatment intervention on the metabolic status of cats showed that the proportion of abnormal indicators was relatively low compared to that in WMG (Table 3).

Changes in positive rate of feline panleukopenia virus infection before and after treatment

The changes in positive rates between WMG and IMG at different time points before and after treatment showed that, before treatment, the FPV positivity rates of both groups were 90% with no significant difference. After the 3rd day of treatment, the positive rate of WMG decreased to 60%, while IMG decreased to 40% ($P < 0.05$). On the 14th day, the positive rate of WMG was 10%, while IMG was only 5% ($P < 0.05$) (Table 4). On 3rd day, IMG exhibited faster initial viral load reduction, leading to an early change between the two groups. However, on the 7th day, both groups showed moderate and partially overlapping virus clearance rates, resulting in no statistically significant difference at this stage. On the 14th day, IMG achieved a higher proportion of complete viral negativity, while some cats in WMG still showed detectable viral antigens.

Discussion

FPV is highly contagious and lethal. It is transmitted through direct contact or environmental pollutants. After infection, it mainly attacks rapidly dividing cells. Clinical symptoms include high fever, vomiting, diarrhea, even bloody stools, dehydration, and mental

Table 4. Positive rates of feline panleukopenia virus infection.

Time point	WMG positive rate (%)	IMG positive rate (%)	*P* value
Pre-treatment	90	90	> 0.05
Post-treatment day 3	60	40	< 0.05
Post-treatment day 7	30	20	> 0.05
Post-treatment day 14	10	5	< 0.05

depression. The mortality rate of kittens infected can reach up to 90% [18, 19]. FPV infection presents complex clinical challenges due to its rapid progression, severe immune suppression, and high secondary complications. Although standard Western medicine therapies can stabilize many cases through antiviral therapy, fluid support, and infection control, changes in immune recovery, gastrointestinal recovery, and biochemical normalization are still common in clinical practice. These differences typically determine whether infected cats will fully recover, have a prolonged course of illness, or fail treatment [20, 21]. Therefore, evaluating the different treatment strategies that affect these key physiological processes is crucial for improving clinical management of FPV. This research conducted a comparative study on the therapeutic effects of Western medicine treatment and integrative medicine treatment on FPV infection. The clinical symptom score of IMG on the 14th day of treatment was below that of WMG in the later stage (P < 0.05). The integrative medicine treatment had a more lasting effect in relieving clinical symptoms, which might be related to the comprehensive regulatory role of traditional Chinese medicine that not only treated symptoms but also enhanced the overall function of cats and strengthens their immune system, thus exerting a synergistic effect during the treatment process. In terms of hematological indicators, the integrative medicine treatment showed an increase in white blood cell count and lymphocyte count. The results indicated that the integrative medicine treatment could more effectively activate the immune system of cats and enhance their resistance to viruses. The red blood cell counts in IMG remained relatively stable during the treatment process, while that in WMG showed a decreasing trend during the treatment period, which might be related to the blood nourishing effect of traditional Chinese medicine formulas. In terms of biochemical indicators, the proportion of abnormalities in IMG was below that in WMG (P < 0.05), which indicated that the integrative medicine treatment had a better protective effect on the liver function of cats. In terms of positive rate changes, the positive rate of IMG was below that of WMG after three days of treatment (P < 0.05). On the 14th day, the positive rate of IMG was only 5%, significantly lower than that of 10% in WMG (P < 0.05). By comparing the clinical effects of Western treatment and the integrative medicine treatment in FPV infection, the integrative medicine treatment not only showed a more lasting effect in relieving clinical symptoms, but also showed significant advantages in improving hematological indicators, regulating biochemical indicators, and virus clearance ability. However, the sample size used in the study was limited and confined to a single region, which might affect the generalizability. Future research should expand the sample size and cover more regions to enhance the broad applicability and delve into the specific mechanisms of veterinary treatment combined with traditional Chinese medicine, providing more scientific and effective strategies for the prevention and control of FPV infection.

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