大韓獸醫學會誌(2007) 第47卷 第4號
Korean J Vet Res(2007) 47(4) : 437~441

Feline panleukopenia virus infection in imported cats

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(Accepted: November 16, 2007)

Abstract : The cases of feline panleukopenia virus (FPLV) infection were diagnosed in three imported cats. All cats died within one week after mild emaciation, depression and anorexia. One cat showed yellowish watery diarrhea. At necropsy, all cats had segmental hemorrhage on the serosa and mucosa of the small intestine. Histopathologically, severe diffuse necro-hemorrhagic enteritis was observed in small intestine especially in jejunum and ileum. The crypts of Lieberkühn were dilated and contained necrotic epithelia. Severely damaged epithelia of crypts were transformed into bizarre shapes. Multifocal lympholysis and lymphoid depletion were found in Peyer's patches and other lymphoid tissues. Direct fluorescent antibody (FA) test revealed the characteristic FPLV antigen in the cytoplasms of crypt epithelial cells. Based on the clinical signs, characteristic pathologic findings and FA test, these cases were diagnosed as FPLV infection. In our best knowledge, this study is the first case report for FPLV infection in imported cats in Korea.

Key words : enteritis, FA test, FPLV, imported cats, small intestine

Introduction

Feline panleukopenia (FPL), also known as feline infectious enteritis or feline distemper, is a highly contagious generalized disease of cats caused by feline panleukopenia virus (FPLV) [1, 6]. FPLV is a parvovirus with single-stranded DNA that infects domestic and exotic species of *Felidae*, *Mustelidae* including mink and ferrets, and *Procyonidae*, including raccoon and coatimundi [8, 10]. The mortality rate ranges from 25 to 90% in the acute form [1, 11]. FPLV is most commonly transmitted to the susceptible animals by direct contact with infected cats and their secretions [3]. Cats shed virus in their urine and feces for a maximum of 6 weeks after recovery [3]. FPLV replication is initiated in the oropharynx and spreads systemically to lymphoid tissue, such as lymph node, Peyer's patch, spleen and thymus, epithelia in the intestinal crypts and stem cells of the bone marrow [3, 8, 10]. FPL infection is most severe in young, unvaccinated kittens between 6 and 24 weeks of age and is characterized by sudden onset of pronounced depression, anorexia and fever [11]. The central nervous system (CNS), optic nerve, and retina are only susceptible to injury during prenatal or early neonatal stage. Of the fetal CNS lesions, cerebellar hypoplasia and hydranencephaly due to intrauterine route have most commonly reported [1, 3, 5, 12].

According to seroepidemiological study of 240 stray cats from 5 different regions in Korea, about 65.8% cats had seropositivity against FPLV [4]. However there was no case report for FPLV infection in cat. The only case was reported in an 8-year-old male bengal tiger [13]. In recent years, the numbers of imported cats was gradually increased, but the studies for the FPL were not well documented in Korea. In this study, we report severe necrotic enteritis associated with FPLV infection in three imported cats.

Cases

Three cats were requested to the Pathology Division of National Veterinary Research and Quarantine Service with a clinical signs of mild emaciation, depression, and anorexia. One cat (cat 1) showed yellowish watery diarrhea before death. All cats died within one week after the

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onset of illness. Other clinical data could not be obtained in all cats. Owners purchased these cats from import traders one or two weeks before. These cats were imported from Russia (cat 1 and cat 3) and Uzbekistan (cat 2). Cat 3 was a 43-day-old female Siamese cat. And the others (cat 1 and cat 2) were 2-month-old males, a Persian cat and a Siamese cat. Representative tissue specimens were collected, fixed in 10% neutral phosphate-buffered formalin, routinely processed and stained with H&E stain for the light microscopic examination. Portions of the small intestines were taken aseptically for bacterial isolation by the VITEK system (Biomerieux Vitek, USA). In addition, for fluorescent antibody (FA) test, frozen sections prepared from the small intestines were fixed in cold acetone and stained directly with fluorescein isothiocyanate (FITC)-conjugated, anti-FPLV monoclonal antibody (VMRD, USA) according to the supplier's instructions.

At necropsy, all cats had typical segmental dilation and hemorrhage on the serosa and mucosa of the small intestine (Fig. 1). The mucosa of jejunum and ileum were covered with watery yellowish gray exudates. The content at the all levels of the intestine and the feces had watery, yellowish, and foul smelling. In severe case, the mucosa of jejunum was dark red in color with multifocal petechial or ecchymotic hemorrhage. The Mesenteric lymph nodes were enlarged.

Histopathologically, the principal lesions of all cats were severe villous atrophy and diffuse necrotizing enteritis in small intestine. Epithelial cells of the intestinal villi sloughed off and necrotic debris were presented in the lumen. Numerous Gram-negative small bacilli colonized in the tips of the intestinal villi (Fig. 2). Crypts were dilated and lined by cuboidal or more attenuated epithelial cells. Severely damaged crypts showed loss of epithelial cells and covered with various bizarre shape cells with swollen nuclei and abundant mucus exudates in the enlarged crypts (Fig. 2 & 3). Eosinophilic intranuclear inclusion bodies were noted within some of the degenerated cryptal epithelial cells in one cat. Multifocal lymphoplysis and lymphoid depletion were found in the follicles of the mesenteric lymph nodes, Peyer's patches in the ileum

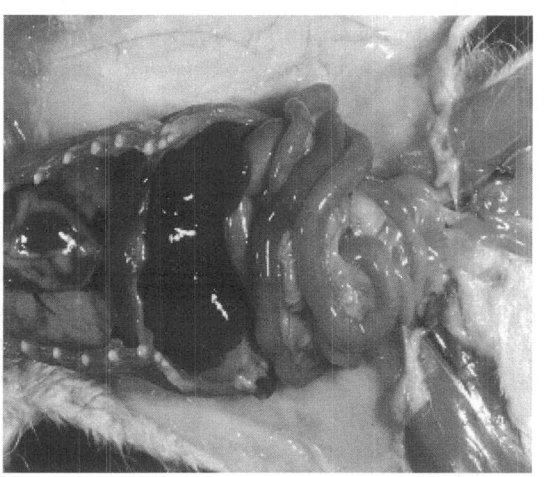

Fig. 1. Note severe segmental hemorrhage on the serosa of small intestine.

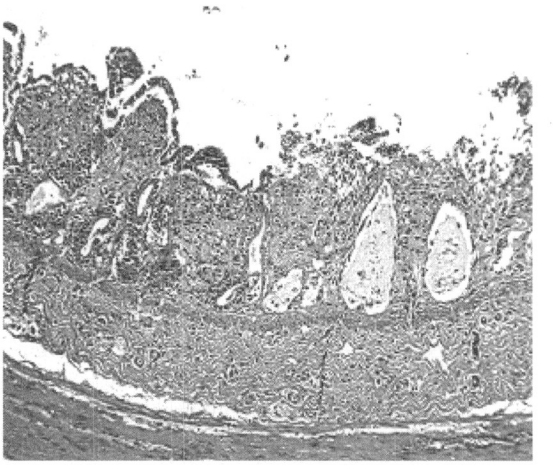

Fig. 2. Mucosa of the small intestine showed severe villous atrophy and dilation of cryptal lumens. Dilated crypts contained mucus exudates and necrotic cellular debris. H&E, ×100.

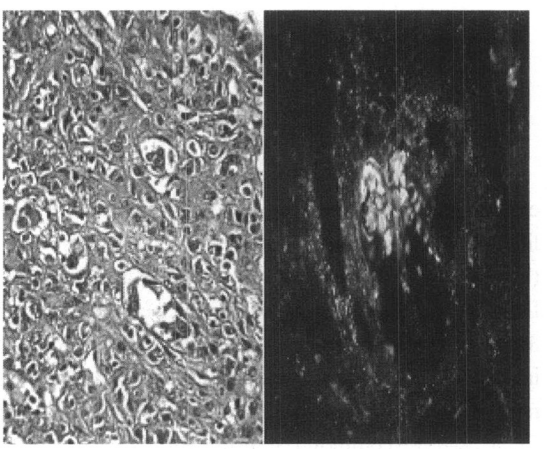

Fig. 3. Note desquamated bizarre shape epithelia in the lumen of crypt (left). H&E, ×400. These necrotic cells in crypt were strongly positive for FPLV (right). FA test, ×400.

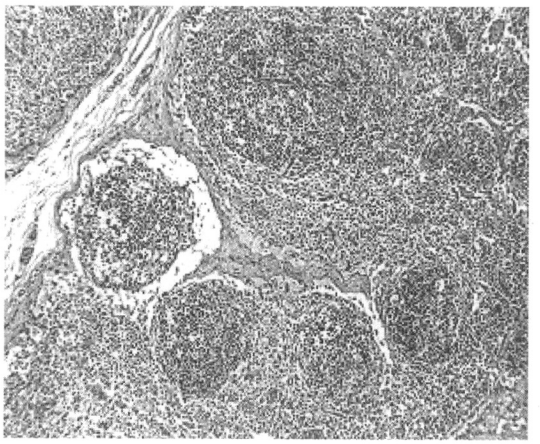

Fig 4. The lymphoid follicles in the mesenteric lymph node showed marked lymphoid depletion. H&E, ×100.

and other lymphoid tissues (Fig. 4). Lymphoid follicles were remarkable lysis of the follicular center cells and were occupied by a background of pale dendritic reticular cells. The result of direct FA test revealed the characteristic FPLV antigen in jejunum and ileum. FPLV-specific antigens were found in the crypt epithelia and Peyer's patches (Fig. 3).

No significant histopathologic changes were observed in the other internal organs. Non-pathogenic *Escherichia coli* was isolated from the small intestines of two cats. Diagnosis of FPLV infection was based on the histopathologic findings and confirmed by detection of FPLV-specific antigens in small intestines.

Discussion

FPL was the first disease of the cat recognized to be of viral origin in 1928 [6, 8]. The virus has world-wide distribution [10]. Most infected cats do not develop clinical disease. When it occurs, signs usually begin the late viremic phase, about 5-7 days after infection [1]. Fever, depression and anorexia are the most common findings. Vomiting is frequently bile-tinged and occurs unrelated to eating [3]. Diarrhea is seen with less frequency, but when it is present, bloody diarrhea is an especially bad sign. Untreated cats rapidly become dehydrated and die of hypovolemic shock within 24-96 h [10]. On abdominal palpation, the intestinal loops have a thickened, "rope-like" consistency, and discomfort is commonly noted [3]. Oral ulceration, bloody diarrhea, or icterus may be noted in complicated infections. Leukocytes counts during the height of infection (day 4 to 6 of infection) are usually between 50 and 3,000 cells/μl. However, leukopenia, from which the disease gets its name, is not pathognomonic for FPLV infection alone and may not occur in all cases of FPLV [3]. Although hematological tests could not be performed, these cases were similar to acute clinical signs in unvaccinated kittens, such as fever, anorexia and watery diarrhea before death.

Infection of the gastrointestinal epithelium is a secondary event, following dissemination of FPLV by circulating lymphocytes and cell-free viremia [1]. The intestinal lesions are milder in the colon, where epithelial mitotic rate are slower than in the small intestine. The jejunum and ileum are more affected than in the duodenum, which may reflect lower numbers of indigenous microorganisms in the proximal small bowel [3]. Damage to the intestinal villi results in diarrhea caused by malabsorption and increased permeability [3].

A diagnosis of FPLV infection may be made on the basis of the characteristic microscopic intestinal lesions [1]. In this study, three cats had the characteristic histopathologic lesions of FPL in the small intestine and mesenteric lymph node. FPLV has a selective effect on cells of high mitotic activity, such as replicating cells deep in the crypts of the intestinal mucosa [3, 10]. If cryptal damage is severe, the mucosa becomes thin and eroded or ulcerated [1]. However, regeneration of cryptal epithelium and partial or complete restoration of mucosa may be occur, if undamaged stem cells persist in most affected crypt [1]. Amphophilic intranuclear inclusions can be found in the crypt epithelium [7, 11], although they are transient and are frequently absent with routine formalin fixation. Hence Bouin's or Zenker's fixatives must be used for the detection of inclusions [3]. We successfully found viral inclusions in degenerated crypt epithelium of the small intestine in one cat.

Concurrent infections can increase the severity of FPLV infections. Dual infection with *Clostridium* (*C.*) *piliforme*, the causative agent of Tyzzer's disease, was found in kittens [7]. Histological lesions caused by *C. piliforme* are characterized by necrotizing enteritis or multifocal hepatic necrosis [7]. Feline salmonellosis may mimic feline panleukopenia with the presence of leukopenia and acute gastrointestinal illness. Co-infection with *Salmonella* sp. and FPLV has also been reported in a kitten from a private breeding cattery [2]. Fecal culture may be helpful under these concurrent infections with enteric bacteria [3]. Based on the bacterial culture, all three cases were

not complicated with other pathogenic bacteria.

Viral antigen can be detected in feces using enzyme-linked immunosorbent assay, hemagglutination test or electron microscopy [10, 11]. Polymerase chain reaction [7, 12] and FA test [1] has been used to identify FPLV in tissue samples. Using the direct FA test, we successfully detected the FPLV antigens in the tissue samples by specific anti-FPLV monoclonal antibodies. This method is fast and very useful in the diagnosis of FPLV infection.

In order to control the FPLV infection, vaccination is very effective and widely used in many countries. Because of rapid and effective immunity, modified live virus (MLV) vaccines can be used to immunize kittens at 9-10 weeks of age [11]. Vaccination should not be ended before 12 weeks of age because the presence of interfering maternal antibodies in younger kittens [10]. Pregnant queens and kittens whom are younger than 4 weeks of age should not used MLV vaccines because replicating virus may cause cerebellar hypoplasia in developing fetuses [3, 11]. Killed virus vaccines are somewhat slower in producing immunity than MLV vaccines. However, these vaccines are no danger of postvaccinal virus spread or clinical disease and may be given to febrile kittens when an effective immune response is doubtful [3]. Field trials for the trivalent inactivated vaccine including FPLV, feline viral rhinotracheitis virus and feline calicivirus were performed by other researchers in Korea [9]. Based on their paper, the trivalent inactivated vaccine seemed to be very effective, for the prevention of feline viral diseases.

Three cats in this study were imported from Russia and Uzbekistan in 2003. According to the data from Korean Customs Service, the importation of cats was greatly increased for 3 years from 2001 to 2003. About 4,000~5,000 cats were imported from Uzbekistan (56.9%), China (32.2%), and Russia (4.4%) in 2002 and 2003. However the importation was sharply decreased about 800 cats in 2004. In addition, the nations of exportation were changed into Uzbekistan (81%), China (9%), and USA (3%). The precise origin of FPLV in these cases was not known. We could not decide whether these cats were infected with FPLV before importation into Korea.

This study might be the first case report for FPLV infection in imported cats in Korea. The best quarantine strategy for imported cats and vaccination methods will be needed to prevent the transmission of this disease to domestic cats.

In conclusion, three imported cats showed mild emaciation, depression and anorexia. The prominent necropsy finding was segmental hemorrhage in the small intestine. Histopathologic examinations revealed diffuse necrotizing enteritis and lymphoid depletion in the small intestine. Direct FA test demonstrated the characteristic FPLV antigens in the crypt epithelial cells and the Peyer's patches of the jejunum and ileum. Based on the clinical signs, gross findings, histopathologic characteristics, and FA test, these cases were diagnosed as FPLV infection. In our best knowledge, this is the first report for FPLV infection for imported cats in Korea.

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