Efficacy of feline panleucopenia vaccine to prevent infection with an isolate of CPV2b obtained from a cat

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Abstract

Cats vaccinated against FPLV were protected against infection with a feline isolate of CPV2b. Nonvaccinated cats developed a lymphopenia and excreted virus which infected susceptible in-contact cats. © 1999 Elsevier Science B.V. All rights reserved.

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Phylogenetic analysis of canine parvovirus (CPV) Type 2 has strongly indicated that CPV infection in dogs originated from the transmission and infection of feline panleucopenia virus (FPLV), either directly or indirectly, from infected cats (Siegl et al., 1985) although other carnivores may be implicated (Truyen, 1999). FPLV differs from CPV2 by only a few amino acid, but these changes were sufficient to make the virus highly infectious for the canine (Appel et al., 1979) but not the for the cat (Truyen and Parrish, 1992). Since first isolated in the late 1970s (Appel et al., 1979), CPV Type 2 has evolved in the last 2 decades producing biotypes CPV2a and CPV2b (Parrish et al., 1985, 1991) which can be differentiated antigenically using monoclonal antibodies (mAbs). Recent studies, using mAbs and restriction enzyme analysis (REA), have indicated that CPV2 is no longer prevalent in cases of clinical disease in Europe and USA today (Greenwood et al., 1995). In the late 1970s-early 1980s, both live and inactivated FPLV vaccines were used to protect dogs against CPV disease due to shared antigens which stimulated cross protection but the protection they afforded was poor and of short duration. These were subsequently replaced by live attenuated CPV vaccines. Mochizuki et al. (1991) and Truyen et al. (1996) reported the isolation of CPV2a and CPV2b from
cat faeces suggesting this species was naturally infected. This study was designed to ascertain whether a vaccine (Nobivac Tricat, Intervet) that contains an attenuated FPLV, would protect cats against a challenge with a German isolate of CPV2b, characterised by both mAbs and REA, obtained from a naturally infected cat.

Fifteen SPF cats were vaccinated subcutaneously with one dose of Nobivac Tricat (Intervet). Twelve days postvaccination, all cats were starved for 24 h. Eight vaccinated cats and four nonvaccinated control cats were then challenged per os with CPV2b-strain 447 (10^{5.6} TCID_{50}), the remaining seven vaccinates and four nonvaccinated control cats challenged per os with pathogenic FPLV (strain 615-10^{5.0} TCID_{50}). All cats were deliberately overfed 24 h postchallenge to stimulate replication of intestinal crypt cells. 24 h postchallenge, two in-contact cats were placed in each of the rooms containing the vaccinated/CPV2b challenged and the nonvaccinated/CPV2b challenged cats, respectively, to determine the infectivity of the challenge virus by natural transmission. Rectal swabs, taken for virus isolation, were inoculated onto both A72 and CRFK cell lines, and blood smears prepared on specified days for evidence of lymphopenia/leucopenia. All animals were bled prevaccination, pre challenge and on various days postchallenge to measure haemagglutination inhibition antibody titres (HAI). At 7 days postinoculation, one control and two vaccinated CPV2b challenged cats were killed and their tissues examined for evidence of infection by viral isolation and polymerase chain reaction (PCR).

After challenge with FPLV and CPV2b, no overt clinical disease was observed in any vaccinated or nonvaccinated cat. All vaccinated cats developed antibodies against FPLV prior to challenge and, following challenge, showed no evidence of either a lymphopenia or leucopenia, irrespective of challenge virus. No significant increase in antibody titre was observed in any vaccinated cat confirming protection conferred by vaccination. Non-vaccinates, however, challenged with FPLV, developed a marked leucopenia with an accompanying, mild lymphopenia. In contrast, the CPV2b infected non vaccinates developed a pronounced lymphopenia, but only a relatively mild leucopenia.

The mean lymphocyte count in CPV2b infected controls reached its lowest level by Day 7, at which time moderately high antibody titres were detected (Fig. 1). In contact cats in this group showed a reduction in lymphocytes by Day 17, with an antibody response starting at 15 days postcontact, indicative of infection by natural transmission from the infected controls (Fig. 2). In contrast, the in contacts in the FPLV vaccinated/CPV2b challenged group showed no abnormal haematology and remained seronegative, indicating that virus did not spread from the vaccinated cats.

Postchallenge, no parvovirus (CPV2b or FPLV) was isolated from any of the vaccinated cats. FPLV and CPV2b viruses were isolated from 3/3 FPLV control cats and 3/4 of the CPV2b control cats, respectively, and a marked difference between groups was observed in the mean titre of virus isolated at peak excretion days (5–7), the FPLV cats shedding up to 2.76 log_{10} more virus over this period (Fig. 3). Samples of thymus, spleen, mesenteric lymph node, duodenum, jejunum, ileum and intestinal contents were taken from all CPV2b challenged cats postmortem. No virus was isolated from any tissue from the vaccinated cats. In the nonvaccinates, virus was isolated from thymus, duodenum, jejunum and ileum, the titre of virus being of similar titre on both cell lines confirming that it was canine parvovirus.
Fig. 1. Correlation between peripheral blood lymphocyte counts and antibody titres. Nonvaccinated – CPV2b challenged.

Fig. 2. Correlation between peripheral blood lymphocyte counts and antibody titres. Nonvaccinated – CPV2b challenged-in contacts.
Viral DNA was detected by PCR in the following tissues from the control cat inoculated with CPV2b: thymus, mesenteric lymph node, duodenum, jejunum, ileum and spleen. This DNA was shown by subsequent digestion with the restriction enzyme, HphI, to be from CPV2b. In the case of the FPLV vaccinated cats, trace amounts of residual vaccinal FPLV DNA were detected in thymus, mesenteric lymph node, jejunum ileum and spleen, suggesting the DNA persisted for 19 days postvaccination.

Histologically, a significant reduction of lymphocytes was observed in the thymus, the cortex being depleted and the medulla also showing pathological changes characteristic of CPV infection. Lymphocytic depletions were also observed in the mesenteric lymph node and splenic tissue.

This study has demonstrated that CPV2b can infect cats when experimentally inoculated by the oral route without causing overt clinical signs. Although the titre of the shed virus is markedly reduced compared to excreted FPLV, it is sufficient to infect susceptible in contact cats. A relative lymphopenia was observed in CPV2b infected cats, similar to that seen in CPV infected dogs. This is in contrast to FPLV infection which causes a characteristic leucopenia in cats. Cats vaccinated with FPLV vaccine were protected against the clinical manifestations of CPV2b infection, as well as infection, and did not excrete the virus. The results, together with those of others (Goto et al., 1984) suggest that it is probable that on passage through dogs during the last 20 years, the genetic changes in canine parvovirus enable infection of the feline species. Although the clinical pathology is not immediately apparent, it is possible that the lymphopenia produced could allow concomitant infections with other pathogens to have a more pronounced effect due to the resulting, but transient, immunosuppression which occurs following CPV2b infection.
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References


