BRITISH SMALL ANIMAL VETERINARY ASSOCIATION

49th ANNUAL CONGRESS

National Convention Centre,

Birmingham, England

20th – 23rd April, 2006

Conference Proceedings article from

A/Prof. Richard A. Squires BVSc, PhD

UPDATE ON CANINE AND FELINE PARVOVIRAL INFECTIONS: WHO IS INFECTING WHO?

RICHARD A. SQUIRES BVSc, PhD, DVR, DipACVIM, DipECVIM-CA, MRCVS.

IVABS, Massey University, Palmerston North, New Zealand 5301.

r.a.squires@massey.ac.nz

Canine parvovirus

In the northern hemisphere's summer of 1978, Canine parvovirus (CPV), the causative agent of canine parvoviral enteritis, appeared and spread rapidly all over the world. Serological surveys subsequently showed that dogs had not encountered CPV before 1974 in Europe. It is thought that CPV arose by mutation of a precursor parvovirus, probably one that had been circulating in Europe for some time among one or more carnivore species. An alternative and enticing suggestion was that CPV had arisen from a modified live feline panleucopenia vaccine virus; however this has not been supported by subsequent study. All CPV isolates clearly formed a single tight group, and were considered most likely to have been derived from a single, common ancestral virus. CPV is extremely closely related to feline panleucopenia virus (FPV) and has recently been described as a "host range variant of a feline virus". Although remarkably similar to FPV, the 1978 strain of CPV specifically infected members of *Canidae*, whereas FPV was known to infect and cause disease in felids, procyonids (raccoons), mink (*Mustela vison*) and possibly foxes (*Vulpes* spp.), but not dogs.

Regardless of its precise origin, CPV, like other parvoviruses, is highly resistant in the environment and was able to spread rapidly from continent to continent, probably carried on fomites with international travellers. Since dogs had no pre-existing immunity, the virus attacked and, in many instances, killed animals of all ages in a world-wide panzootic. Like many 'emerging' viruses, CPV evolved rapidly after entering its new host. The 1978 strain of CPV (originally termed CPV-2, to distinguish it from the first-discovered canine parvovirus, Canine minute virus) was rapidly and comprehensively replaced world-wide by two newer virus variants, termed CPV-2a and CPV-2b, which still circulate today. In naturally-infected Japanese dogs, CPV-2 was first detected in 1979, but by 1983 could no longer be found having been entirely replaced by CPV–2a and –2b. Unlike the original CPV–2, these newer variants are not restricted to infecting members of *Canidae*. Some sub-strains are able to infect cats *in vivo* while others cannot manage this, but can infect feline cells in tissue culture. In one study, CPV-2a and CPV-2b were isolated from about 10 to 20% of cats that had parvoviral enteritis in Japan, Germany and the USA. Some cats naturally infected with currently circulating strains of CPV have shown clinical signs indistinguishable from those caused by FPV, while others have remained quite unaffected by infection with the canine virus. As well as having an expanded host range, there is evidence that some of

the newer CPV–2a and –2b strains are more virulent in dogs than was the original CPV-2. Evolution of CPV–2a and –2b may have been driven by immune selective pressure, since each of these newer serotypes has lost at least one neutralising epitope compared with the original CPV-2.

The 'regained' ability of CPV to infect cats may have epizootiological consequences for both dogs and cats. From the point of view of susceptible dogs, CPV-excreting cats could potentially act as a source of virus additional to that provided by shedding dogs, although insufficient work has been done to quantify this risk. Given the fastidious toilet habits of cats, one might hypothesise that sub-clinically infected and shedding cats would pose less risk than those with diarrhoea. Long-haired cats, whose fur is more easily soiled by faeces, may pose a greater risk than short-haired cats. Of interest are two recent studies indicating that cats may become persistently infected by CPV, with virus circulating inside their peripheral blood mononuclear cells despite the presence of circulating virus neutralising antibodies. Persistent faecal shedding of virus from such sub-clinically infected cats has not, however, been demonstrated. Further work is needed to determine whether CPV-infected and shedding cats pose a health risk to unprotected puppies and adult dogs.

Feline panleucopenia virus

Feline panleucopenia (FP) is a viral disease characterised by fever, depression, anorexia, vomiting and diarrhoea. It has been recognised for about 100 years and is nowadays uncommonly diagnosed in pet cats in UK. In the past, FP was caused exclusively by FPV. However, a recent study showed that a disease identical to FP can be caused experimentally by CPV–2a and CPV–2b. CPV was isolated from a naturally infected 1.5 year-old pet cat in Japan that died of a disease indistinguishable from FP and also from cheetahs (*Acinonyx jubatus*) and a Siberian tiger (*Panthera tigris Altaica*) with diarrhoea. CPV, including a new variant referred to as CPV–2c by some researchers, has been found infecting Vietnamese and Taiwanese leopard cats (*Felis bengalensis*). This new variant virus caused disease when administered to experimental specific pathogen free (SPF) cats. Whether or not it is appropriate to refer to CPV-induced felid enteritis as FP is merely a semantic issue.

Given that CPV emerged fairly recently and continues to evolve, whereas FPV is at or close to evolutionary stasis, it is difficult to predict whether FP will remain an uncommon diagnosis in the coming years. Although FPV-containing vaccines have been shown to protect cats against CPV–2a and CPV–2b, antibody titres induced by one FPV vaccine were significantly lower against CPVs than against FPV. Conversely, cats experimentally vaccinated with CPV–2a developed high titres against CPV–2a and –2b but relatively low titres against FPV. Cheetahs (*Acinonyx jubatus*) that had been vaccinated with a killed FPV vaccine developed CPV–2b infection and gastrointestinal disease. Some

researchers have therefore suggested that new vaccines to protect cats against FP, incorporating CPV and FPV, or perhaps a feline-adapted strain of CPV that provides good cross-protection against both virus species, may need to be developed in the future.

The risks posed to susceptible kittens and adult cats by CPV-excreting dogs, including those excreting modified-live vaccine virus, have not been quantified. Immunosuppressed adult cats, for example those with feline leukaemia virus (FeLV)- or feline immunodeficiency virus (FIV)-associated AIDS, would be expected to be at greater risk than those with intact immune systems. It has already been shown that FIV and FeLV can each 'collaborate' with FPV to produce an FP-like illness in adult cats. The FIV-infected cats were in the primary stage of their retroviral infection, rather than the AIDS stage, when this happened. A modified live FPV vaccine strain was enough to cause severe FP-like disease in these cats.

Although 'classical' FP is nowadays uncommonly diagnosed, clinicians should not assume that FPV has disappeared. Familiar viruses are sometimes discovered to be causing new or unexpected diseases. In 1998, researchers reported detection of FPV in 13 'fading' pedigree kittens. These dying kittens came from households in which cats were regularly vaccinated against FPV. The authors surmised that disease occurred because these young kittens were exposed to large doses of FPV in their environment. In a separate study, FPV was implicated as a possible cause of feline cardiomyopathy. FPV DNA was found by PCR in the myocardium of 10/31 cats with cardiomyopathy but in 0/17 healthy control hearts. Histopathological examination revealed myocardial inflammation in 18/31 cats with cardiomyopathy but in 0/17 controls. Cases of hypertrophic, dilated and restrictive cardiomyopathy contained FPV DNA, showed myocardial inflammation, or both. The authors concluded that FPV and/or myocarditis might play a role in the pathogenesis of idiopathic feline cardiomyopathy.

Summary

Much has changed since CPV first emerged in 1978 and this small DNA virus continues to evolve at a surprisingly rapid rate. In future, it is possible that CPV may become as relevant to the health of cats as it is to dogs. FPV has been present in cats for at least a hundred years. Nevertheless, we have much to learn about this virus. In future it may be shown to play unexpected roles in diseases currently considered idiopathic.

Further Reading

Addie, DD; Toth, S; *et al.* Detection of feline parvovirus in dying pedigree kittens. Veterinary Record 1998; 142: 353-356.

Ikeda, Y; Nakamura, K; *et al.* Feline host range of canine parvovirus: recent emergence of new antigenic types in cats. Emerging Infectious Diseases 2002; 8: 341-346.

Parrish, CR. Host range relationships and the evolution of canine parvovirus. Veterinary Microbiology 1999; 69: 29-40.

Shackelton, LA; Parrish, CR; *et al.* High rate of viral evolution associated with the emergence of carnivore parvovirus. Proceedings of the National Academy of Sciences of the United States of America 2005; 102: 379-384.

Squires, RA. An update on aspects of viral gastrointestinal diseases of dogs and cats. New Zealand Veterinary Journal 2003; 51: 252-261.