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Feline Infectious Peritonitis - Updated Information
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One of the most poorly understood and enigmatic feline viruses is feline coronavirus - the virus responsible for feline infectious peritonitis (FIP). It is no exaggeration to say that this is one of the most feared diseases in catteries. Many catteries that remain operative for several years will have a brush with FIP. Despite the fact that this disease is a shared experience in the cat fancy, affected catteries are wrongly feared and ostracized. All breeders need to make efforts to understand this disease and how to control it.

Feline coronavirus operates differently from any other feline virus in several important ways:

a) Systemic antibodies have no protective function for the cat and may play a role in the disease FIP itself
b) Antibody titres have limited usefulness for diagnosis of FIP or prognosis
c) A vaccine is available, but there is no consensus on its efficacy or safety

First, some notes on terminology. ***FIP*** is the term for clinical disease associated with feline coronavirus infection. The common benign form of feline coronavirus is referred to as ***FECV*** (feline enteric coronavirus). When FECV has mutated into a disease-causing form, it is then referred to as ***FIPV*** (feline infectious peritonitis virus). Feline coronaviruses in general are referred to as ***FCoV***.

FECV is a very common, highly infectious feline virus. The majority of cats with FECV (about 90% or more) remain healthy. But in a small number of cases, FECV infection is the first step in a chain of events leading to FIP. This happens because coronaviruses are made of large numbers of nucleotides, the basic unit of genetic material, and they are very prone to mutations. As a virus reproduces itself, errors are made in copying these nucleotides. The more nucleotides, the more errors are possible. While most of these errors are harmless, some will have the effect of giving FECV the ability to cause disease. These mutant FECV strains are called FIPV.

Recent research has shown that mutant FECVs arise within an individual cat. Thus, we now know that the vast majority of cats do not "catch" FIP, but they develop it themselves from their own mutant FECV. Non-pathogenic FECV lives within the cells of the intestinal tract and may be shed into the feces. But FIPV (the mutant form of FECV) has developed the ability to live and replicate within cells of the immune system called macrophages. FIPV are able to spread throughout the cat's body, and are no longer localized in the intestinal tract and so are rarely shed into feces. Transmission of FIP from cat to cat is considered to be rare. This fact has caused leading FIP researchers to state

that cats who are ill with FIP are unlikely to be a risk to other cats and thus do not need to be isolated.

It has been estimated that in multi-cat households where FECV has been introduced, 80-90% of all the cats will be infected. In the general cat population, infection rates may reach 30-40%. Catteries are especially likely to be FECV positive. However, the incidence of cases of FIP is quite low in comparison to the number of cats infected with FECV. Generally, most catteries experience far less than 10% losses to FIP over the years. Rare instances have been documented where an apparent epidemic of FIP is associated with mortality rates of over 10% in a short period of time. One possible factor in these epidemics is the shedding of virulent virus, an uncommon situation. Usually, losses are sporadic and unpredictable. The peak ages for losses to FIP are from 6 months to 2 years old. Age-associated immunity to FIP appears to be possible. Transmission of FIP from a queen to her unborn kittens has not been shown to occur.

What are the factors that predispose a small percentage of cats with FECV to the development of FIP? Research is currently trying to find more answers to this question, but some facts are becoming clear. Dr. Janet Foley and Dr. Niels Pedersen of the University of California at Davis have identified three key risk factors: genetic susceptibility, the presence of chronic FECV shedders in the cattery, and cat-dense environments that favour the spread of FECV.

Drs. Foley and Pedersen identified a genetic predisposition to the development of FIP in 1996. They examined pedigree and health data from 10 generations of cats in several pedigreed catteries and found that the heritability of susceptibility to FIP could be very high (about 50%). It is likely a polygenetic trait rather than a simple dominant or recessive mode of inheritance. Inbreeding, by itself, is not a risk factor. Selecting for overall disease resistance is a helpful tool for breeders. The likely defect in immunity to FIP is in cell-mediated immunity. Therefore cats that are susceptible to FIP are also likely susceptible to some other infections as well, especially fungal and viral infections. This finding gives breeders the ability to achieve success in reducing the risk of FIP by using pedigree analysis to select breeding cats from family backgrounds that have strong resistance to FIP and other infectious diseases.

Research has shown that there are two main patterns that occur with FECV infection. Most cats (~70%) will become infected and recover, but will not be immune. They are susceptible to reinfection the next time they contact the virus. A small number of cats (~15%) become infected but do not recover. They become persistent shedders of FECV in the cattery and are the source of reinfection for the other cats although they may never become ill themselves. Therefore, the key to eliminating FECV (and thus the risk of FIP) in a cattery would be the identification and removal of chronic shedders. The traditional antibody titre for FECV cannot reliably be used to determine which cats are chronic shedders. The most effective and practical tool is PCR analysis of feces for the presence of FECV, a test that may not be widely available. Dr. Hans Lutz at the University of Zurich has shown that PCR on four fecal swabs taken at one-week intervals can determine the coronavirus shedding status of a cat.

In addition to selecting disease-resistant breeding stock, breeders can initiate husbandry practices that discourage the spread of FECV and development of FIP. Cat-dense environments favour the transmission of the highly contagious FECV. Dr. Diane Addie of the University of Glasgow, Scotland, recommends that the ideal way to house cats in catteries is individually. However, since this is not always possible, she recommends that they be kept in stable groups of no more than three or four. Kittens should remain in groups of similar ages and not be mixed with adults in the cattery. Any measures that reduce environmental and social stress in the cattery population will have a beneficial effect.

FECV is spread primarily by the fecal-oral route. The virus can persist in the environment in dried feces on cat litter for three to seven weeks, so scrupulous cleaning of cages and litter pans is important to reduce the amount of virus in the environment. Fortunately, FECV is susceptible to most common disinfectants and detergents. It is important to have adequate numbers of litter pans. Litter pans should be kept away from food bowls and spilled litter should be regularly vacuumed up from the floor.

Dr. Addie has also described a method for early weaning and isolation of kittens born to FECV positive queens. It involves rigorous barrier nursing techniques to prevent the spread of the highly contagious FECV, and so is not for every breeder or cattery. The procedure involves first isolating the pregnant queen in a separate area to have the kittens. When they are five to six weeks old (at the time when their maternal immunity to FECV is waning), the kittens are removed from the queen and isolated. Some of the difficulties with this method involve the strict infection control procedures needed (barrier nursing techniques) and possible difficulties in socializing kittens. It has been reported by breeders that some early-weaned kittens may have behavioural problems, such as inappropriate suckling on littermates. When properly practiced, not only can FECV-negative kittens be produced, but the kittens are often less prone to respiratory diseases and other common kitten ailments.

There are two forms of FIP. The effusive (or wet) form is characterized by accumulation of fluid in the chest or abdomen. This fluid is high in protein content and is often a yellow color. The non-effusive (or dry) form of FIP is characterized by inflammatory lesions called pyogranulomas that can be found in almost any organ of the body, including the nervous system. Signs of illness common to both effusive and non-effusive forms of FIP include loss of appetite, weight loss, lethargy, and a fluctuating fever that is not responsive to antibiotics. Cats with the effusive form may develop a swollen abdomen or difficulty breathing due to fluid accumulation.

As with so many aspects of FIP, diagnostic testing remains problematic. To date, there is no way to screen healthy cats for the risk of developing FIP. Antibody titres are poorly correlated with risk of FIP and should not be used to screen healthy cats for risk of FIP. As well as problems with interpretation of these antibody tests, there are problems with laboratory quality control. Finally, cats that have been vaccinated with some types of

vaccines may test positive on coronavirus antibody tests due to cross-reaction between components of the cell culture used to produce the vaccine and test system components.

There are newer DNA-based blood tests offered by a few labs that are purported to be FIP-specific. However, these tests are considered non-validated by experts as they have not been subjected to scientific scrutiny by researchers outside of the labs that offer them. In addition, there are no published studies that have identified a specific genetic difference between FECV and FIPV.

The fact remains that we have no screening test for FIP in well cats. Neither do we have a foolproof way to diagnose FIP in a sick cat. The gold standard remains a biopsy or findings at necropsy. Dr. Andrew Sparkes and his colleagues at the University of Bristol have suggested that combining several test results with clinical findings and antibody titre can help rule in or rule out FIP with some degree of certainty. It remains true, however, that a negative antibody titre does not rule out FIP. Neither does a positive antibody titre rule in FIP as a diagnosis.

Unfortunately, there is no known effective treatment for cats with FIP. Treatments are aimed at palliative care and patient comfort. Drugs that suppress the immune system response to FIPV (such as prednisone) may temporarily stabilize patients. Newer therapies, such as recombinant feline interferon, have shown some limited success in a small number of patients but require more investigation before they can be recommended. Sadly, patients eventually deteriorate to the point where humane euthanasia is chosen.

Probably one of the most controversial areas in any discussion of FIP is Primucell FIP®, the vaccine made by Pfizer Animal Health, available since 1991. The vaccine is a modified-live temperature-sensitive viral mutant licensed for intranasal use in cats at least 16 weeks of age. The manufacturer recommends annual revaccination although no duration of immunity studies are available. The vaccine stimulates local immunity and may also produce an antibody titre. Evaluation of the risks and benefits associated with this vaccine is a difficult venture and has engendered much controversy.

Since FIP is a severe and fatal disease, the safety of any vaccine is a paramount consideration. Dr. Fred Scott of the Cornell Feline Health Center concluded in a recently published paper, that the risks associated with the Primucell FIP® vaccine are minimal in most situations. He notes that the vaccine has been in use for many years with no increase in the incidence of FIP.

In catteries where FIP is endemic, studies have shown the vaccine had no effect on the incidence of disease. One reason may be that most kittens in catteries are infected between six and 10 weeks of age, long before the 16 weeks of age the vaccine is licensed for. Once a cat is infected with FCoV, the vaccine has no benefit.

For more information on FIP, see the following websites:

Companion Center for Animal Health, University of California, Davis:
http://www.vetmed.ucdavis.edu/CCAH/Prog-ID/ID-Facts_FIP.htm

Cornell Feline Health Center:
http://www.vet.cornell.edu/fhc/resources/brochure/fip.html

Dr. Diane Addie's feline coronavirus website:
http://catvirus.com

Dr. Alice Wolf's excellent article on FIP:
http://www.veterinarypartner.com/Content.plx?P=SRC&S=2&SourceID=19

The Cat Group's FAQ on FIP:
http://www.thecatgroup.org.uk/