

## **Feline Infectious Peritonitis (FIP) – What You Need To Know!**

Feline infectious peritonitis is a diagnosis cat owners know and fear. It is both heartbreaking and frustrating – it strikes the young, it is not treatable and is inevitably fatal, it is challenging to diagnose, and even more difficult to control. It's a complex disease that is still not completely understood.

### **So what do we know about FIP?**

We know that feline coronavirus infection is required for FIP. This virus is a common infectious agent, especially in multi-cat households and catteries. It is shed from infected cats in the feces, can persist in the environment for several days, and infects other cats via inhalation or ingestion. In the majority of infected cats, it causes little or no problem. This becomes part of the challenge in diagnosing FIP: detecting the virus in samples (blood, feces, tissue) from a cat, or finding even high levels of antibodies to the virus in the cat's blood (i.e. serology) doesn't offer much information. In fact, it is quite common for cats to be virus positive, even in blood, and to have high levels of antibody to the virus. It doesn't mean the cat has FIP, will develop FIP, or is protected against FIP.

We know that the majority of cats, even kittens, infected with feline coronavirus (FCoV) do not develop FIP. Most cats will clear the infection, and have no evidence of disease. Some cats remain chronically infected, shedding the virus in feces for months or longer; but even in these cases, it often has little effect on the cat. In a small percentage of infected cats, FIP develops.

Virus factors are important in FIP development. The normal target for FCoV is the intestines. In FIP, the virus is believed to mutate, or change in such a way that it then infects a type of white blood cell in the blood called monocytes and a type in the tissue called macrophages. In these cells, it replicates efficiently and eventually destroys the cell. It's unknown what changes in the virus to allow this alteration in target from intestines to cells of the immune system. Because of this, there is no test that can distinguish the harmless virus from the one causing FIP – there is NO FIP-specific test. Still, in cases where this type of virus change occurs, most cats will be able to eliminate or control the virus before any disease develops.

For FIP to develop, other things have to happen. The disease itself is due not so much to the virus itself, but to the cat's immune response to the virus. In those cats who develop FIP, antibodies to the virus are produced at high levels. But unlike cats who do not develop the disease, affected cats do NOT mount an effective antiviral response. An effective response requires more than antibodies, and for reasons still unknown some cats are not able to do this. The antibodies they do produce bind the virus as well as virus-infected cells, and cause significant damage not only to the virus and virus-infected cells but also to innocent bystanders nearby – uninfected cells that get "caught in the crossfire" of the immune response. Because the virus is not effectively eliminated, virus remains, the immune response continues, and the tissue damage snowballs. Eventually, the cumulative damage leads to organ failure and death.

So the disease itself is triggered by the virus, but is mediated by the immune response of the cat. The tissue damage occurs primarily in and around blood vessels. It may be widespread, affecting many blood vessels, leading to "leakiness" of the vessels themselves. This is the wet form of FIP, where fluid accumulates in the abdomen, chest, or both. In this form, the onset is relatively rapid, and the disease course short. Little can be done to help these animals. In other cases, the tissue damage is more restricted, occurring in single or only a couple of different tissues, such as the eye, kidney, liver, intestines, lung or nervous system. In these cases, referred to as the dry form (referring to the lack of fluid leakage), the onset is more insidious, and the disease course is longer. The clinical signs simply reflect which tissue is affected – e.g. evidence of eye infection, kidney failure, or diarrhea. Sometimes the clinical signs are vague – the so-called "ADR" cat – "ain't doing right." They exhibit weight loss, depression, decreased appetite, and lethargy. These animals can sometimes respond to symptomatic therapy for a time, but the disease is ultimately fatal in this form as well.

So why can't some cats mount an effective antiviral response, allowing virus to persist, and leading to this fatal disease? The short answer is we don't know. Much research is being done to decipher the reasons behind FIP development. We do know that predisposition to FIP development can be inherited, so there is likely a genetic component to disease development. This predisposition can sometimes be observed along familial lines, like a shared sire. What is behind this genetic predisposition also

remains unknown. But whatever the reason, in the majority of FIP cases, it takes a combination of the right virus and the right cat. This is likely the reason behind the relative low incidence of FIP, though FCoV infection is common.

To make matters worse, because we can't tell the harmless virus from the deadly virus and we can't identify the factors that lead to FIP development, and because the signs and symptoms are often vague, diagnosis can be very difficult. In most cases it takes a combination of things to reach a diagnosis of FIP, including ruling out other diseases. This combination includes characteristics of the cat (usually young purebred), history (from a multi-cat setting, perhaps history of a stressful event, like surgery, boarding, or adoption from a shelter), and symptoms including decreased appetite, weight loss, fever that may wax and wane, and lethargy. For the wet form, the fluid in the abdomen or chest is an important clue, and analysis of this fluid can be helpful. But for the dry form, the specific tissue(s) that are involved may not be obvious. Physical exam may reveal enlarged abdominal lymph nodes, kidney abnormalities, eye infection, or neurologic disease, depending on which tissue(s) is/are involved. Or it just may reveal a cat who doesn't feel well.

The veterinarian will have to do other tests to help make the diagnosis of FIP. These will include blood work at a minimum, as well as other disease-specific tests to rule out other diseases. But remember that there is NO single test that can diagnose FIP – no way to distinguish the harmless virus from the deadly one, no specific antibody level that means the cat has FIP, no one test that can confirm FIP. It takes analysis of various things – analysis of blood cells, organ function, fluid in the abdomen/chest, urine, even tissue samples from biopsy – to confirm the diagnosis of FIP.

Historically, treatment of FIP has involved suppression of the immune responses, since the lesions are caused by the cat's ineffective immune response. But for obvious reasons, immunosuppression to treat a disease involving a virus infection will not be curative. Research is ongoing to develop more appropriate therapy to promote an effective immune response, one that can successfully clear the virus without causing significant tissue damage. Hopefully, in the future, an effective treatment will be found.

Currently, control or prevention of FIP has two main goals – prevention of FCoV infection, and breeding of more resistant cats. The former is quite daunting, if not impossible, in most multi cat settings – virus infection is common, most infected cats show no signs, and prevention of exposure is extremely difficult. There is a vaccine against coronavirus, but its use is not widely recommended. While it can offer some protection to cats who have never been exposed to the virus, in situations where FIP is a significant problem (i.e. in those populations in which one would need effective protection), kittens are usually exposed at a very young age before vaccination is begun. Thus, vaccination at 16 weeks of age, as the manufacturer directs, is too late to do much good. However, vaccinating a seronegative cat before introduction into a seropositive population may be helpful.

Breeding of resistant cats is also challenging since we don't know what specific characteristics predispose a cat to FIP development. At most, if incidence of FIP occurrence in a breeding cattery increases, examination of breeding records of affected cats/kittens may reveal a common link and guide management decisions. But there is never a reason to euthanize a healthy cat simply because it has evidence of coronavirus infection nor because it has sired or borne a kitten that develops FIP.

For cat lovers and veterinarians alike, FIP remains a frustrating and heartbreaking disease. Advances in understanding the virus and the disease will hopefully lead to improved diagnostics, treatment, and prevention.