



VETERINARY HOSPITAL & HOTEL

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## Feline Leukemia Virus Diseases

Feline leukemia virus infection was, until recently, the most common fatal disease of cats. Because we can now protect cats with a leukemia virus vaccine, we are seeing fewer cases of the disease. However, it still remains a major cause of death in cats.

"Leukemia" means cancer of the white blood cells. This was the first disease associated with the feline leukemia virus (FeLV) and, thus, the source of its name. We often use the term "leukemia" rather loosely to include all of the diseases associated with the virus, even though most are not cancers of the blood. This virus causes many other fatal diseases, in addition to leukemia.

Feline leukemia virus is classed as a retrovirus. The retroviruses are of particular importance because they have the ability to integrate into the genetic material, or DNA, of the host. For this reason, some call the retroviruses "the ultimate genetic parasites." There are three subtypes of the virus and the diseases caused are dependent upon the particular subtype involved. The feline immunodeficiency virus, or feline AIDS virus, is another feline retrovirus. In humans, HIV is caused by a retrovirus.

### Contributing Factors

Cats who are greatest risk for contracting the feline leukemia virus are those who live in close, direct contact with an infected cat. Fighting is a known risk factor because the virus is shed in saliva. Kittens may contract the virus from the mother via the placenta.

### Prevalence

In the total population of cats, the incidence of FeLV is only about 1-2%. Free-roaming adult cats that are FeLV-negative have usually acquired age-related resistance to the virus. The incidence is much higher in "exposure households," or households where there is a FeLV-positive cat living among other cats. In this setting, 30% - 100% of the cats may be found to test positive.

### Clinical Signs

There are three major disease categories associated with the FeLV:

- 1) **Leukemia** is a cancer of the white blood cells.
- 2) **Lymphosarcoma** (also called Lymphoma) is a cancer of many different organs but it begins in lymphoid tissue, such as a lymph node. Almost any tissue may be affected; organs commonly involved include lymph nodes, intestinal tract, kidneys, liver, spinal cord, brain, bone marrow and blood. In young cats, lymphoma often manifests as a mass within in the thoracic cavity; this is called "mediastinal lymphoma."
- 3) **The Non-Cancerous Diseases** include a variety of somewhat unrelated diseases. Anemia, abortion, arthritis, and immune suppression are examples. When the immune system is suppressed, the cat becomes susceptible to many diseases it would ordinarily resist and mild diseases, such as respiratory infections, may become fatal.

### Causes/Transmission

The main means of transmitting the virus is through cat fights. Because large quantities of the FeLV are shed in cat saliva, puncture wounds associated with fighting result in injection of the virus into other cats. There are also large amounts of virus in respiratory secretions. Other less frequent routes of viral spread include sharing food and water bowls, cats grooming each other, and transmission from mother to kittens before birth.

## **Diagnosis**

The "leukemia test" is used to determine if a cat harbors the virus. Any of three different tests may be used to detect one particular virus protein in the cat. Some tests detect earlier stages of infection, whereas others are used to detect later (i.e., irreversible) stages of infection.

1. The blood ELISA test is performed on a blood sample and detects the FeLV at any stage of infection. This test turns positive within a few days of infection and, in some cases, may later turn negative if the cat's immune system eliminates the infection.
2. The IFA test is performed on a blood smear and turns positive only after the FeLV infection has progressed to a late stage of infection. Once positive, the IFA test usually means that the cat has a permanent infection. A cat that tests IFA positive is only rarely able to successfully eliminate the virus. The cat that is IFA positive is called "persistently positive" or "persistently viremic."
3. The tears/saliva ELISA test is performed on a sample of tears or saliva. It turns positive only in a late stage of infection; therefore, it may yield a false negative result in cats that are in the early stage of FeLV infection. It also has been associated with some false positive results due to inherent errors in the way the test is performed. Because of these problems, the tears and saliva tests are not used routinely.

## **The Cat that Tests Positive - Possible Outcomes of FeLV-infection**

When we are exposed to a virus, such as a flu virus, there are two possible outcomes. Either our immune system responds to the challenge and protects us, or it is unable to respond successfully and we develop the flu. A number of factors determine which outcome occurs and whether or not we will get sick:

1. The amount of the virus (Did someone sneeze directly in your face?)
2. The strain of the virus (Some strains are more potent than others.)
3. The status of our immune system (Are immune suppressing drugs being taken?)
4. Age (The very young and very old are more likely to become infected.)
5. The presence of other infections which might cause debilitation

The behavior of the feline leukemia virus in the cat's body cannot be predicted. Instead of the two possible outcomes described above (i.e., we get sick or we get well), there are four possible outcomes for cats with FeLV. Understanding these allows one to more fully comprehend some of the unusual situations that may arise in cats.

**OUTCOME 1: IMMUNITY** The cat mounts an immune response, eliminating the infection.

This is the most desired outcome because it means that the cat will not become persistently infected with the virus. During this period of virus challenge, the cat may actually develop a mild form of illness. Fever, poor appetite, lethargy, and swollen glands (lymph nodes) in the neck may develop and last for 3 to 10 days. Outcome 1 occurs about 40% of the time after a cat is challenged by the FeLV. Immunity to the virus is more likely to develop in the adult cat than in the kitten.

**OUTCOME 2: INFECTION** The cat's immune system is overwhelmed by the virus.

This is the least desired outcome because the cat is persistently infected with FeLV. All three of the FeLV tests will become positive and remain positive for the rest of the cat's life.

Although the cat may be sick for a few days initially (as described above), it usually recovers and appears normal for weeks, months, or years. Ultimately, most of these cats die of FeLV-related disease, but as many as 50% will still be healthy after 2-3 years and 15% after 4 years. Vaccination of these cats will not cause any problems, but doesn't help the cat, either.

Outcome 2 occurs about 30% of the time after a cat is challenged by FeLV. Although infection is more likely to occur in the kitten, many cats are persistently infected as adults. Although the main mode of viral transmission is through bite wounds (saliva), direct daily contact with a FeLV infected cat will often result in transmission of the virus. Non-infected exposed cats are at risk and should be vaccinated, although daily viral contact will result in vaccination failure of some cats.

**OUTCOME 3: LATENCY** The cat harbors the virus but we cannot easily detect it.

Unlike other viruses, the FeLV does not directly kill the cat's cells or make them become cancerous. Instead, it inserts a copy of its own genetic material (called DNA) into the cat's cells; these cells may later be transformed into cancer cells or cells which will no longer function normally. In Outcome 3, the genetic change in the cat's cells will remain undetected for an average of 2 1/2 years, during which time the cat will appear completely normal.

In the early stages of infection, the blood ELISA test will be positive, but it will turn negative about 2-4 weeks later. Following that, the blood ELISA and the IFA tests will remain consistently negative.

The prospect of latent infection presents us with a frustrating situation. Latency is estimated to occur about 30% of the time; it leaves the cat in a precarious situation. Some cats will ultimately reject the abnormal cells, and the state of latency will be terminated. In other cats these abnormal cells will result in the production of new FeLV which will result in Outcome 2. Outcome 2 generally leads to death due to a FeLV disease.

Latency is the state that explains the following situations:

1. Latently infected cats will test negative on all of the FeLV tests. If they are vaccinated, they will not be protected. They may develop a fatal FeLV-related disease later, especially following some form of stress or the administration of steroids. Stressors that may activate latent infections include pregnancy and nursing, overcrowding, movement to a new environment, territorial conflicts, poor nutrition, and other diseases. Steroids are used commonly in cats because they are very beneficial for many feline diseases
2. Lymphosarcoma is the form of cancer normally caused by the FeLV. Cats some forms of lymphosarcoma normally test positive with any FeLV test. Latently infected cats may have lymphosarcoma and test negative on the FeLV tests. It is also thought that some cats successfully eliminate the virus but not before malignant transformation of cells has already occurred. This may be another explanation for FeLV-negative cats with lymphosarcoma.
3. Latently infected pregnant cats may test FeLV negative (and even be vaccinated) but pass the FeLV to their kittens through nursing. These kittens often experience Outcome 2.

**OUTCOME 4: IMMUNE CARRIER** The cat becomes an immune carrier.

The FeLV becomes hidden in some of the cat's epithelial cells. Although the FeLV is multiplying, it is not able to get out of these cells because the cat is producing antibodies against the virus. The cat will appear normal in every way, except for its test results. The immune carrier will have a positive blood ELISA test and a negative IFA test.

This situation is unlikely to happen; it is estimated to occur 1-2% of the time. These cats may revert to an active FeLV infection (Outcome 2) or may develop a latent infection (Outcome 3). The main reason for understanding this situation is that it explains conflicting FeLV test results. Otherwise, there is not a specific test to detect it.

**Treatment**

**Leukemia.** Some forms of leukemia (blood cancer) are unresponsive to all available forms of cancer treatment. Other types of leukemias may respond to chemotherapy, though most of these have an average survival time of less than one year. Because the virus is not affected by treatment, the cat will always remain infected with FeLV. Also, relapse of leukemia is possible (and expected). These factors cause us to recommend treatment of leukemia in very few situations.

**Lymphosarcoma.** Lymphosarcoma is treatable, but not curable. Research has shown that cats with lymphoma who are FeLV-positive do not respond to treatment as well as FeLV-negative cats.

**Secondary infections.** Depending upon the type of infection involved and the general state of the cat's health, the prognosis may range from favorable to guarded. For example, bacterial infections may respond well to antibiotic therapy. Other types of infections, such as certain fungal infections, may not respond well because of the FeLV-induced weakness of the cat's immune system.

**The healthy FeLV-positive cat.** Healthy infected cats may remain apparently unaffected by the virus for several years. With good supportive care and prompt attention to all potential medical problems, these cats may live for a number of years. Bear in mind that these cats should be considered infectious and potentially dangerous to other cats. Such cats should be isolated from non-infected cats to prevent spread of infection. Many people find this undesirable or impossible and elect euthanasia to protect non-infected cats.

### **Prognosis**

The prognosis is dependent upon many factors. In general, 80% of all persistently positive cats (IFA positive) succumb within three years, most of these deaths occurring within the first six months of detection. The cat that is transiently positive may expect a normal lifespan, or may become ill if latent virus in the body is reactivated.

### **Transmission to Humans**

Extensive tests have been conducted for over 15 years to determine if the FeLV can be transmitted to humans. To date, no conclusive evidence has demonstrated any FeLV-related disease in humans or other animal species, including the dog. However, persons with compromised immune systems are of concern to many researchers. Newborn babies, persons on chemotherapy, AIDS patients or transplant recipients on anti-rejection drugs should probably not be unnecessarily exposed to this or any other virus.

### **Prevention**

A vaccine is available to protect cats from the FeLV. Although not 100% of cats are totally protected, the vaccine is strongly recommended for cats who are exposed to open populations of cats, (i.e., outdoor cats). We have seen a definite decline in the incidence of feline leukemia virus infection and related diseases since vaccine use became widespread. We strongly recommend it for cats at risk of exposure. If your cat stays indoors at all times and is not in contact with another cat that goes outdoors, the vaccine is generally not recommended. Many owners have concern that the vaccine will cause a cat to test positive for the virus, but this is not true. While the history of vaccination is important for us to know, it does not alter our ability to interpret the feline leukemia virus test.

### **Testing Prior to Vaccination**

Cats that are already infected with the FeLV will not be helped by the vaccine. (They will not be hurt by it, either). We recommend pre-vaccination testing for the FeLV in these particular situations:

- 1) Cats with a history of cat fights or fight wounds (i.e., abscesses)
- 2) Cats exposed to FeLV-infected cats
- 3) Cats from unknown backgrounds (particularly animal shelters, humane societies, or pet shops)
- 4) Routine health care, especially in multi-cat households

### **Injection Site Sarcomas**

In recent years, a disturbing phenomenon has been identified by veterinary researchers. A relationship has been found between feline leukemia virus vaccine (as well as rabies vaccine) and the development of very aggressive tumors at the injection site. The numbers of cats who have developed these tumors is very small compared to the total number of vaccinations given (1-3 per 10,000), but the outcome is devastating for cats that do get these cancers. Several veterinary schools are actively researching this problem. It remains unclear exactly why some cats develop tumors in response to vaccination; a genetic predisposition is thought to be part of the problem. At this time, feline specialists are recommending that leukemia vaccination be reserved for cats that are at risk for exposure to the virus. Strictly indoor cats generally do not need vaccination against FeLV. We can advise you about exceptions to the routine vaccination protocols.