Feline Infectious Peritonitis (FIP) in Cats & Kittens

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FIP is a viral disease of cats that can affect many systems of the body. It is a progressive disease and almost always fatal. It is found worldwide and affects not only domestic cats, but many wild ones as well, including cougars, bobcats, lynx, lions, and cheetahs.

What causes FIP?

FIP is caused by a virus. Cats can be infected with feline coronavirus (FCoV). There are two types of this virus which cannot be distinguished from each other in laboratory tests. One is avirulent (does not cause disease) or only mildly virulent and is called feline enteric coronavirus (FECV). Infection with this virus does not produce any signs other than maybe a very mild diarrhea. The other type is virulent (produces disease), is the cause of FIP, and is called feline infectious peritonitis virus (FIPV). It is believed that FIP occurs when FECV mutates to FIPV in the cat and starts to replicate in the cat's cells. What causes this mutation is unknown.

How common is FCoV infection and the development of FIP in cats?

Studies have shown that approximately 25-40% of household cats, and up to 95% of cats in multi-cat households and catteries are or have been infected with FCoV. The development of fatal FIP occurs in 1 in 5000 cats in households with one or two cats. In multi-cat households and catteries 5% of cats die from FIP.

How is the virus transmitted?

FCoV can be found in the saliva and feces of infected cats. Therefore, cat-to-cat contact and exposure to feces in litter boxes are the most common modes of infection. Contaminated food or water dishes, bedding, and personal clothing may also serve as sources of infection.

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FCoV may possibly be transmitted across the placenta. The significance of this is unknown.

FCoV can live in the environment 3-7 weeks. After 3 weeks, however, the number of virus particles present is probably too small to cause infection. Many disinfectants will kill the virus, including household bleach diluted 1:32 in water (1/2 cup of bleach per gallon of water).

How does the virus cause disease?

When a cat is exposed to FCoV, four things can happen, depending on a number of factors including age, health status, and strength of the cat's cellular immune system. The strain and dose of the virus can also influence the outcome.

Mammals' immune systems can be divided into two parts: the antibody-producing part, and the part in which cells kill invaders through direct contact or chemicals they produce. It is this second part of the immune system, the cellular immune system which plays a very important role in determining the result of exposure to FCoV.

1. If a cat's cellular immunity is very strong, the cat can usually fight off the infection.
2. If a cat's cellular immunity is moderately strong, the cat may be unable to kill all the virus, but is able to keep it in check. This results in a " latent" infection. If the cat is severely stressed or becomes ill from other diseases, the latent infection can be reactivated and the cat can develop FIP.
3. If a cat's cellular immunity is relatively weak, the virus continues to multiply slowly, FIPV becomes the predominant virus and FIP develops. In this form of disease, called "dry FIP" nodular lesions called granulomas slowly develop in one or multiple places in the body.
4. If the cellular immune system is very weak, the virus can multiply virtually uncontrolled. A "wet" form of FIP develops. In this form, large amounts of fluid accumulate in the chest and abdomen due to damage to blood vessels and subsequent leaking of fluid and protein into the surrounding tissues.

The damage to the body from FIPV is not so much due to the virus itself, but to the body's response to it. Complexes of FIPV and antibodies the cat produces against it are deposited on the walls of blood vessels. Macrophages, which are cells that eat cellular debris and foreign material, consume the virus and the virus replicates inside these cells. These macrophages are also deposited along blood vessels and in tissues. When they accumulate in large numbers they can form granulomas.

Which cats are more likely to develop FIP?

As you would imagine, the cats most likely to develop FIP are those with the weakest immune systems. This includes kittens, cats infected with feline leukemia virus (FeLV), and geriatric cats.

The largest number of FIP cases occurs in young cats. Kittens are often infected when they are 4

to 6 weeks old, when the antibody protection they received from their mothers through the milk is declining. Kittens usually start showing signs of FIP when they are between 3 months and 2 years of age. Most of the kittens with FIP die between 8 and 18 months of age.

When infections with feline leukemia virus (FeLV) were more common, infections with FeLV and FIPV were often seen together because FeLV suppressed the immune system. Now that FeLV is less common only 5% of cats with FIP are also infected with FeLV.

We rarely see FIP in cats between 3 and 10 years of age. However, starting at 10-12 years of age, the immune systems of these older cats apparently decline, making them more susceptible.

FIP has been shown to be more common in certain breeds and lines. It appears to be more common in Persians, for example. It is unclear whether these breeds are more susceptible because of their genetics or whether they are exposed to FCoV more often since many of them live or come from catteries.

What are the clinical signs of disease?

Although we separate FIP into 2 forms, wet and dry, there is really a gradient between the two forms, and we may often see signs of both forms.

Dry or Noneffusive Form: Dry FIP occurs in approximately ¼ of the cats with FIP. Generally, the signs of the dry form come on more slowly. Nonspecific signs such as chronic weight loss, fever, loss of appetite and lethargy appear. Other signs occur depending on which organs are damaged by the granulomas. Ten to twenty-five percent of cats will have neurological signs. When granulomas occur in the central nervous system we see paralysis, disorientation, loss of balance, tremors, convulsions, behavior changes and urinary incontinence. The liver and kidneys are often affected, and this is reflected in chemistry tests that evaluate these two organs. Granulomas can occur in the chest, as well. Sometimes the eye is the only organ affected. The pupil may appear irregular and the eye may appear discolored because of the inflammation that is present. Some cats with the dry form can live up to a year after first showing clinical signs.

Wet or Effusive Form: Early in the disease we can see similar signs to the dry form including weight loss, fever, loss of appetite, and lethargy. Anemia with resultant pale mucous membranes (e.g., gums) is often seen. Constipation and diarrhea can also occur. The wet form of the disease progresses rapidly and soon the cat may appear pot-bellied in appearance because of the fluid accumulation in the abdomen. Generally, the cat shows no signs of abdominal pain. Fluid may also accumulate in the chest causing respiratory difficulties. Most cats with the wet form of FIP die within 2 months of showing signs of disease.

What are the laboratory findings in FIP?

Chemistry Panels: Chemistry panels are used to assess the function of the liver and kidneys. If the kidney is involved, or the cat is dehydrated, we can see elevations in creatinine and BUN. These compounds are eliminated from the body by the kidneys. If they are elevated, the kidneys are not adequately filtering the blood. Liver enzymes including alanine transaminase and alkaline phosphatase are elevated when liver damage has occurred, and bilirubin will increase if the liver is not functioning normally.

One of the most common abnormalities is an increase in serum protein to levels over 7.8 g/dl. Most of the increase is caused by elevations in certain proteins called globulins (the other major serum protein is albumin). Spinal fluid also has an elevated protein level.

The abdominal fluid in cats with wet FIP is high in protein (5-12g/dl), yellow, viscous, froths when shaken, and may clot when exposed to air.

Complete Blood Count: A complete blood count may help to support a diagnosis of FIP. Many cats will have a mild to moderate anemia. Initially, the white blood cell count is low, but increases later in the disease. The increase is due to an increase in the type of white blood cells called neutrophils. These are scavenger-type cells. There is actually a decrease in the type of blood cells called lymphocytes. This can be important in determining the diagnosis.

FIP Testing: A test that detects antibody to FCoV is available. This test can NOT differentiate between FECV and FIPV. The test result is reported as a "titer." A titer of 1:100 means we still get a positive reaction after diluting the serum sample 1:100. It has been found that a high titer alone does not mean a cat has FIP. A high titer could mean:

- The cat was exposed to FCoV (either FECV or FIPV) and has eliminated the virus
- The cat was exposed to FCoV and is a carrier
- The cat was recently vaccinated against FIP
- The cat was exposed to FCoV and has developed FIP

A negative test could mean:

- The cat has not been exposed to FECV or FIPV

- The cat is infected with FIPV but is so early in the disease process antibody is not yet detectable
- The cat is infected with FIPV but can no longer make antibody
- The cat is infected with FIPV but all the antibody that is made is bound in complexes to FIPV and is not detected by the test
- The test was not sensitive enough to detect the antibody present

How is FIP diagnosed?

Because we can not rely totally on the antibody test for a diagnosis, we must combine the history, clinical signs, laboratory results, FCoV test result, and possibly radiographs to come to a "probable" diagnosis. The only way to be absolutely sure of an FIPV infection is to biopsy affected tissues and have them examined by a veterinary pathologist. As a result, most often the diagnosis is made after the cat has died, a postmortem examination has been performed and tissues have been examined.

In an attempt to try to make the best diagnosis we can while the cat is still alive, we can follow these criteria for a cat with clinical signs of FIP:

1. The cat has a low number of lymphocytes: $1.5x10^3$ cells/ l.
2. The cat has a positive FCoV test result (titer > 1:160).
3. The cat has elevated globulins in his blood > 5.1 gm/dl.

If the cat meets all three criteria, the probability the cat has FIP is 88.9%. If the cat does NOT meet all three criteria, the probability the cat does NOT have FIP is 98.8%.

In those cats who have fluid in the thorax or abdomen that can be analyzed:

- If the gamma globulin fraction in the fluid is greater than 32%, the chances that the cat has FIP are almost 100%.
- If the albumin fraction is greater than 48% or the ratio of albumin to globulin is greater than 0.81, it is almost 100% certain that the cat does NOT have FIP.

From this discussion, you can see that a certain diagnosis of FIP is not made very easily. Remember, the "gold standard" for diagnosis of FIP is through microscopic examinations of biopsies (a procedure called histopathology).

How is FIP treated?

There is no cure for FIP. A survivor of FIP is very rare. We can give the cat supportive care which will make her more comfortable and possibly extend her life for a short amount of time. Because the dry form of FIP progresses more slowly, cats with this form can sometimes live longer than those with the wet form. This is especially true if the eye is the only organ affected by granulomas. Cats who have an appetite, no neurological signs, and no anemia usually respond better to the supportive care.

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Supportive care includes:

- Periodic draining of abdominal or thoracic (chest) fluid in those with the wet form. If the fluid is drained too often, the cat loses large amounts of protein which can exacerbate the condition.
- Fluid therapy
- Quality nutrition
- Antibiotics for secondary bacterial infections
- Blood transfusions in cases of severe anemia

Cats with FIP are often treated with prednisone at an immunosuppressive dose of 2-4 mg/kg daily to decrease the virus-antibody complexes in the blood vessels. In cats with eye involvement, ophthalmic solutions containing corticosteroids, and injections of steroids into the inner side of the eyelid (conjunctival sac) can be used.

Research is ongoing to find other immunosuppressive drugs that may slow down the course of the disease. Attempts are also being made to find antiviral drugs that will kill or slow down the replication of the virus.

How is FIP prevented and controlled?

Managing a Cattery or Multi-cat Household:

- Litter boxes should be kept clean and located away from food and water dishes. The litter should be cleaned of feces daily and totally removed at least once weekly when the box is thoroughly cleaned and disinfected.
- Cats should be divided into families with 4-5 cats per group and kept separate from each other. These groups should also be divided according to age, with cats less than 4 months old separated from older cats.
- Newly acquired cats and any cats that are suspected of being infected should be separated from the other cats.
- Caretakers of the cats must use extreme care to make sure they are not bringing contaminated clothing, dishes, or other articles from one area to another. In general, kittens should be cared for first, and any suspect animals cared for last to minimize possible transmission to those most susceptible.
- Eliminating FeLV from all cats is important.
- Using the FIP test to identify potential carriers or immune animals is NOT possible.

Managing Litters:

- Pregnant and nursing queens should be kept separate from all other cats in the cattery (only one litter per room).
- If the queen is suspected of being a carrier, kittens should be weaned and removed from the queen at 4-6 weeks. They should also be kept separate from other cats in the cattery.
- Queens who repeatedly produce litters of kittens which eventually die of FIP should be removed from a breeding cattery.

Vaccination:

There is currently only one licensed FIP vaccine available. Primucell FIP, produced by Pfizer Animal Health, is a temperature-sensitive, modified-live virus vaccine that is given as an intranasal vaccine, and is licensed for use in cats at least 16 weeks of age. The vaccine appears to be safe; however, this vaccine has minimal if any effectiveness in preventing FIP, and it is not generally recommended by the American Association of Feline Practitioners Feline Vaccine Advisory Panel. Cat owners should consult their veterinarian to help them decide if their cat should be vaccinated.