Feline coronavirus & FIP

Feline coronavirus (FCoV) exists as two 'pathotypes': feline enteric coronavirus (FECV) and its mutated form feline infectious peritonitis virus (FIPV). Intestinal infection with the FECV form of FCoV is really common in cats, particularly in multicat households in which up to 90% of cats are seropositive (*i.e. they have antibodies against this virus*). FCoV also exists as two 'serotypes', with type 1 serotype being more common in the UK. Seroconversion occurs approximately 10 days after infection, with titres rising over the following weeks; however, these antibodies are unable to clear infection from the gut.

Following infection FECV has the potential to mutate into FIPV, which can then spread systemically. FIPV is not thought to be transmitted between cats in most cases. Although most infections with FECV (and FIPV!!) are self-limiting and cause no or only mild gastrointestinal signs, occasionally an inappropriate immune response to systemic FIPV infection (in up to 1-5% of infected cats) results in the fatal systemic disease of feline infectious peritonitis (FIP). Viral, host, and environmental factors are thought to contribute to the outcome of infection with FCoV.

Initial research describing specific mutations in the spike (S) protein of serotype 1 coronaviruses as specific markers of FIPV was extremely promising for the diagnosis of FIP. However, work subsequently performed and published by our research group showed that these mutations were markers of systemic FCoV infection, rather than of FIP, and could not confirm a diagnosis of FIP (most cats without FIP that had detectable virus in their tissues also had these mutations).

FAQs

How is FCoV spread?

FECV is shed in faeces and is spread between cats by the faecal-oral route, with litter trays being the main source of infection. Once shed, the virus is normally inactivated within 24-48 hours, but can survive up to 7 weeks in dried faeces allowing for indirect transmission via fomites. Around two thirds of cats in multicat households shed FCoV in their faeces; with levels higher in kittens compared to adults.

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Viral shedding starts soon after infection and can be transient over a few months, recurrent (attributed to cycles of infection, recovery, loss of immunity and then reinfection), or chronic over periods of months or years. Cats that shed FCoV chronically can act as a persistent source of infection to other cats in the household.

Can FCoV RT-qPCR help me diagnose FIP?

The Molecular Diagnostics Unit uses a sensitive reverse transcriptase - quantitative PCR (RT-qPCR) assay to detect and quantify levels of feline coronavirus within a sample, independent of pathotype or serotype. Reverse transcription is the process by which (viral) RNA is converted to DNA so that it can be detected in the qPCR.

FCoV RT-qPCR on faeces is NOT useful for the diagnosis of FIP. Using faeces this assay will predominantly be detecting FECV and therefore is only for use to detect coronavirus shedding in cats.

FCoV RT-qPCR on fluid or tissue IS useful for the diagnosis of FIP. Although the staining for viral proteins in tissue samples is the gold standard method of diagnosing cats with FIP, FCoV RT-qPCR is being increasingly used to detect the virus from fluid samples (abdominal, pleural, or pericardial effusions; cell suspensions; CSF; aqueous humour) or tissue samples taken from cats suspected of having FIP. Cats with FIP have significantly greater virus loads in their bodies (gut excluded) than cats without FIP; however, the presence of virus in samples alone does not absolutely confirm a diagnosis of FIP as some cats without FIP can have detectable virus in their bodies, albeit at low levels. However a positive result, particularly at a high levels (i.e. with a low CT value), would support a suspected diagnosis of FIP in a cat with appropriate clinical signs and supportive cytology / histology results.

RT-qPCR for FCoV forms part of the FIP profile we offer on pleural or peritoneal fluid to help you diagnose FIP. RT-qPCR for FCoV can also be performed on CSF samples, to support a diagnosis of FIP in neurological cases.

The MDU does not test for S protein mutations on fluid or tissue samples as this does not provide additional support in diagnosing FIP over the detection of virus by standard FCoV RT-qPCR assays.

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How do I control FCoV infection?

Mortality from FIP in a household tends to increase as the population of animals, especially kittens, increases, and when other concurrent diseases or infections are present. The number of cats housed together should be minimised, keeping cats in small stable groups of less than 6 per group whenever possible.

Control of FECV infection in cats is desirable in situations in which FIP has been a problem or, less commonly, if gastrointestinal signs (e.g. diarrhoea) are particularly prominent. Litter tray hygiene is very important as well as having adequate numbers of litter trays. The virus is readily destroyed by most household disinfectants and detergents.

Genetic resistance/susceptibility to FIP may also play a role in the incidence of FIP, particularly in breeding catteries; further breeding from the same parental pair that has resulted in kittens affected by FIP should be avoided. Although some laboratories have offered determination of FIP risk based on genetic variant checking, this is based on very limited and weak evidence.

Isolation of pregnant queens just before parturition, and subsequent early weaning of their kittens, has been recommended by some vets as a means to control coronavirus infection in breeding catteries. Normally kittens are protected from FCoV infection by maternal derived immunity (MDI) for the first 6 weeks of life, and are then infected with FCoV at around 9-10 weeks of age, when this protection wanes. Isolation and early weaning of kittens at around 4-6 weeks of age means that they are removed from sources of infection (i.e. the queen and other cats) before their immunity wanes, resulting in the production of ‘coronavirus-free’ kittens. However, the potential negative behavioural effects of early weaning on the kittens should be considered, as well as an appreciation of the amount of work (including financial cost) involved due to the segregation and strict quarantine required (it is best suited to smaller catteries). Additionally ‘coronavirus-free’ kittens will often then be rehomed into households or exposed to environments (e.g. shows; outdoor access; residential cattery) in which they are exposed to FECV, so it is unlikely that they will remain coronavirus-free for long. Although the older they are when they encounter FECV, the less likely they are to develop FIP as a result of infection.

How should I use the FCoV tests then?

Using faeces – The FCoV RT-qPCR assay will identify (FECV) coronavirus shedders. This has applications for breeding catteries to help with any coronavirus eradication or reduction

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programmes. The test, when repeated over time on an individual cat, can also be used to identify chronic shedders. Removal of chronic shedders from a household can help control FCoV infection in that household. In household that have previously experienced FIP, owners may want to test resident cats for evidence of coronavirus shedding before introducing a new cat into the household. Since cats can shed FCoV intermittently, 3+ faecal samples should be collected at 1-4 weekly intervals to maximise identification of shedding.

Using fluid / tissue samples – The FCoV RT-qPCR assay will identify and quantify the presence of coronavirus in these samples that do not normally have detectable virus within them. In association with clinical signs and clinical pathological changes on haematology, serum biochemistry, effusion analysis, aspirate cytology and/or histology. RT-qPCR for FCoV forms part of the FIP profile we offer on pleural or peritoneal fluid to help you diagnose FIP.

Interpretation of results

Chronic shedders will be RT-qPCR positive on faeces at 2 or more time points tested. Positive results over more than a 5 month period indicates that the cat is likely a chronic shedder. Cats with repeated negative faecal RT-qPCR results over an extended period can be considered non-shedders (as long as no intervening results are positive).

In cats with suspected FIP the higher the viral load (i.e. the lower the Ct) identified by RT-qPCR the more supportive the result is of a diagnosis of FIP. Virus can be detected infrequently in tissue samples and rarely in fluid samples from cats without FIP, and in these cases the cytology / histology was not supportive of pyogranulomatous inflammation as would be expected with FIP.

What sort of sample should I send?

FCoV RT-qPCR on faeces: a small volume (2-5mg) of fresh faeces. Please ensure that no cat litter is present. Samples should be kept refrigerated and sent directly to our laboratory, although refrigeration is not required for postage. To ensure the best results possible, samples should ideally be received in the laboratory within 3 days of sampling, although positive results have been obtained after lengthier delays.

FCoV RT-qPCR on fluid / tissue samples from cats with suspected FIP: a small volume of effusion / cell suspension / lavage (1 ml), CSF / aqueous humour (0.2 ml), or a small amount of fresh or frozen tissue (a needle-core ‘TruCut’ biopsy or larger is adequate, within 3 days of sampling).

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The FCoV RT-qPCR assay is duplexed with an internal amplification control PCR. This is extremely important for diagnostic PCRs, especially those performed on faeces, as this enables detection of any inhibitory substances, which could cause false negative FCoV RT-qPCR results.

PLEASE NOTE - We can only accept faecal samples for FCoV testing from Veterinary Surgeons. We cannot accept samples sent directly from owners or breeders.

More information can be found on the ABCD website: [Feline Infectious Peritonitis | (abcdcatsvets.org)]

Updated January 2022 by Dr Emi Barker