Minimizing Feline Coronavirus Transmission in Catteries: A Case Study of Controlled, Time-restricted Breeding of Virus-free Queens with Shedding Toms

Julia Jeremejeva[1], Aleksandr Dedjulja[2]
[1]*Institute of Veterinary Medicine and Animal Sciences, Estonian University of Life Sciences, F. R. Kreutzwaldi 62, 51006 Tartu, Estonia*
[2]*Evidensia Tartu Small Animal Clinic, Aleksandri 8B, 51004 Tartu, Estonia*

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Abstract. *Feline coronavirus (FCoV) is highly prevalent in multi-cat environments and may mutate to cause feline infectious peritonitis (FIP). This single-site retrospective case study analysed breeding and diagnostic data from a private cattery in Estonia (10 FCoV-free queens, 4 FCoV-shedding toms, and 29 kittens) to evaluate whether virus-free queens can be bred with shedding toms without subsequent infection in queens and offspring. Natural matings were conducted under strictly controlled conditions, limited to 90-minute sessions twice daily for three consecutive days, in a room without shared litter boxes, food, water, or enrichment. FCoV infection status was monitored using repeated faecal RT-PCR and serological testing before and after mating. All queens remained negative for FCoV on faecal RT-PCR and serology six months after breeding, and all kittens tested negative by faecal RT-PCR up to three months of age. No clinical or reproductive complications were observed. Within the limitations of a retrospective case study, these findings indicate that time-limited mating under strict environmental control was associated with no detectable FCoV transmission in this setting. This approach may be relevant for breeders and veterinarians managing FCoV-free breeding stock where virus-negative toms are not available.*

Introduction

Feline coronavirus (FCoV) is believed to be a highly contagious infectious disease in cats (Pedersen et al., 2008; Addie et al., 2023). According to a range of publications (Sharif et al., 2009; Oguzoglu et al., 2010; Andersen et al., 2018; McKay et al., 2020; Mūrniece et al., 2021; Zhou et al., 2021; Kokkinaki et al., 2023), the prevalence of FCoV in domestic cats can be up to 96% with the highest rates in breeding catteries and shelters with overcrowded cat populations (Klein-Richers et al., 2020; Felten et al., 2023).

Clinical outcomes range from subclinical infection to short self-limiting gastrointestinal disease (Pedersen et al., 1981; Pedersen et al., 2008; Addie, 2012) or chronic diarrhoea (Pedersen et al., 2014; Sung et al., 2022). The virus replicates in enterocytes of infected cats, leading to faecal shedding (Sherding, 2006). Kipar et al. (2006) reported that asymptomatic FCoV-infected cats can also be systemically infected, which may lead to transient viral presence in multiple organs (Stranieri et al., 2020). The predominant route is faecal–oral (Pedersen et al., 2008; Addie et al., 2023). FCoV transmission is facilitated by shared litter boxes and food bowls among infected and uninfected cats (Addie, 2000). FCoV can also be transmitted to healthy cats via contaminated fomites, such as human clothing and shoes (Sherding, 2006). The virus can persist in excreta in the environment for up to seven weeks (Scott, 1991; Addie, 2012). Studies by Kiss et al. (2000) and Stranieri et al. (2020) have also discussed the possibility of venereal transmissioon.

Experimentally infected cats can start shedding the virus with faeces as soon as the second day after infection (Meli et al., 2004). In naturally infected cats, viral shedding typically begins within the first week post-infection and can persist for 9 to 24 months (Addie and Jarrett, 2001). Some cats may become chronic shedders (Foley et al., 1997). Younger cats are more susceptible to infection (Almeida et al., 2019; Klein-Richers et al., 2020) and shed the virus in a higher viral load than older cats (Pedersen et al., 2008), contaminating the environment and contributing to FCoV spread in the population.

The high infectivity of the virus is significant due to the virus's capacity to mutate and cause the fatal disease, feline infectious peritonitis (FIP) (Vennema et al., 1998). FIP is a serious problem in veterinary medicine, causing death in up to 14% of FCoV infected cats (Addie et al., 1995) and 0.33–0.5% of all cats (Rohrbach et al., 2001; Pesteanu-Somogyi et al., 2006). The most important risk factor for the development of FIP in FCoV-infected cats is age. Most diseased cats are young, often under one year of age (Worthing et al., 2012; Pedersen et al., 2014; Kennedy et al., 2020). It has been shown that FIP is one of the major diseases causing mortality in kittens (Cave et al., 2002).

Corresponding author: julia.jeremejeva@emu.ee

Kittens born to a mother shedding the virus are protected from infection by maternal immunity, which normally lasts for the first 4–6 weeks of the kitten's life (Pedersen et al., 1981). Kittens that lose maternal immunity but, because of their very young age, still remain with a shedding mother, may become more susceptible to FCoV and have a higher risk of developing FIP (Pedersen et al., 1981; Pedersen et al., 2008). Therefore, it is important to keep breeding queens free from the virus to reduce morbidity and mortality associated with FIP in kittens and young cats and to prevent the transmission of FCoV.

Objectives

The aim of this retrospective case study was to document and evaluate whether strictly time-limited natural mating under controlled hygienic conditions in a clean, bowl- and litter box free room allows breeding of feline coronavirus–free queens with FCoV-shedding toms without subsequent infection of queens and their kittens.

Materials and methods

Data and results of routine testing of faecal samples and serological investigation of breeding cats performed by the breeder in one Estonian British Shorthair cattery, as part of the animals' health evaluation programme, were used in this study. Breeding data from 10 purebred British shorthair FCoV-free non-shedder queens with four purebred British Shorthair shedder toms and their 29 kittens were retrospectively enrolled in the study.

For breeding, each queen in heat was left with one of the toms in a room without litter boxes, food, water or any enrichment for 90 minutes, twice per day, for 3 consecutive days. Between sessions, queens were housed separately according to routine practice.

Ten individual monthly faecal samples were collected from each queen, comprising five pre-breeding and five post-breeding samples. Serological investigation of queens was conducted before breeding and 6 months after breeding. Individual sampling of faeces of breeding toms was done twice before breeding at one month apart. Litter-pooled kitten samples were collected monthly at 1–3 months of age.

Real-time polymerase chain reaction (RT-PCR) tests of faecal samples and serological testing for detection of anti-FCoV antibodies were performed at the accredited external laboratory LABOKLIN (Laboklin GmbH & Co. KG, Bad Kissingen, Germany). Results of serological investigations with a negative titre at dilution of <1:25 or <9 NTU, following the laboratory's reporting standards, were classified as negative.

To mitigate the limitation that faecal RT-PCR may fail to detect intermittent or low-level feline coronavirus shedding in infected cats, queens were monitored using repeated faecal RT-PCR testing over several consecutive months both before and after breeding, combined with serological testing, in accordance with established recommendations (Addie and Jarrett, 2001).

Cats that tested negative for FCoV in monthly faecal tests using RT-PCR over a five-month period, according to the recommendations of Addie and Jarrett (2001) and remained serologically negative for anti-FCoV antibodies at 6 months were classified as FCoV-free, non-shedding cats. Cats that showed shedding of the virus at least once during the observational period were defined as FCoV shedders.

Results

All 10 queens conceived and delivered (conception rate 100%). Mean litter size (±SD) was 2.9 ± 1.1 kittens per litter. No reproductive complications were observed during pregnancy or parturition, indicating that the implemented mating protocol did not negatively affect fertility or reproductive outcomes.

In total, 50 faecal RT-PCR tests were performed on samples from 10 queens before mating and 50 after mating, along with eight faecal RT-PCR tests from four toms and 30 pooled litter faecal samples from kittens from 10 litters. Additionally, 20 serological tests for the detection of anti-FCoV antibodies were performed in queens.

Across the defined observation period, no queen showed evidence of FCoV infection following mating. All queens remained negative on repeated faecal RT-PCR testing, and serological investigation conducted six months after breeding confirmed persistent seronegativity. Similarly, pooled litter samples from all 29 kittens tested negative for FCoV by faecal RT-PCR at monthly intervals up to three months of age. These findings indicate that, in this case study, controlled natural mating between FCoV-free queens and FCoV-shedding toms was not associated with detectable viral transmission to queens or offspring during the monitored period.

Discussion

It is known that certain breeds, such as British Shorthair, Cornish Rex, Birman, Burmese cats, Maine Coones, and Scottish Fold cats are more predisposed to FCoV infection (Bell et al., 2006; Taharaguchi et al., 2012). The exclusive inclusion of British Shorthair cats in this case study, therefore, represents a population with a recognised predisposition, thereby strengthening the relevance of the findings despite the limited sample size.

Most cats acquire FCoV infection early in life via the faecal–oral route, primarily through contact with contaminated litter boxes or the environment shared with shedding cats (Pedersen et al., 2008; Klein-Richers et al., 2020; Addie et al., 2023). Young cats not only become infected more readily but also shed higher viral loads, contributing disproportionately to

environmental contamination and population-level transmission (Pedersen et al., 2008). This is clinically significant because younger cats are at the highest risk of developing feline infectious peritonitis (FIP), a fatal outcome of FCoV mutation (Pedersen, 2009; Worthing et al., 2012; Pedersen et al., 2014; Kennedy et al., 2020). Preventing early-life infection, therefore, remains a central goal of FCoV management in breeding catteries.

Existing preventive strategies focus primarily on isolation of queens during pregnancy and early weaning of kittens into virus-free environments (Addie et al., 2004; Pedersen et al., 2008). While these measures can reduce the transmission risk, early weaning at 5–6 weeks of age has been associated with increased aggression, stereotypical behaviour, and long-term welfare concerns (Ahola et al., 2017; Martínez-Byer et al., 2023). Moreover, early weaning reduces but does not completely eliminate the risk of infection. In contrast, the approach documented in this case study allowed kittens to remain with virus-free queens beyond the maternal immunity period without detectable infection, offering a potentially more welfare-friendly alternative.

A major practical challenge for breeders is the high prevalence of FCoV in the general cat population, which makes it difficult to identify virus-negative toms for mating (Sharif et al., 2009; Oguzoglu et al., 2010; Andersen et al., 2018; McKay et al., 2020; Mūrniece et al., 2021; Zhou et al., 2021; Kokkinaki et al., 2023). Prolonged failure to mate queens has been associated with an increased risk of pyometra (Hollinshead and Krekeler, 2016), often forcing breeders to consider mating virus-free queens with known FCoV shedders. However, such matings are typically discouraged due to concerns regarding viral transmission.

The primary route of FCoV transmission is faecal–oral, most efficiently via shared litter boxes (Pedersen et al., 2008; Addie et al., 2023). During natural mating, however, direct contact between perineal and caudal body regions of the tom and queen raises theoretical concerns about transfer of small amounts of faecal material via the coat, followed by self-grooming. Despite this theoretical risk, no transmission was detected in the present case study, suggesting that strict time limitation of contact and elimination of shared litter boxes, food bowls, and water sources during mating substantially reduces transmission risk. Indirect transmission via contaminated environments or fomites has also been described (Sherding, 2006; Addie, 2012), and a minority of cats may shed FCoV via saliva (Addie and Jarrett, 2001). The mating protocol used in this case study deliberately excluded items likely to be contaminated with saliva or faeces, which may explain the absence of detectable transmission. While Felten et al. (2023) reported that hygiene measures alone were not significantly associated with shedding intensity at the population level, the present findings suggest that targeted, short-term environmental control during mating may still be effective in reducing individual transmission events.

Taken together, these results indicate that, within the limitations of a retrospective single-site case study, strictly controlled, time-limited natural mating can be associated with an absence of detectable FCoV transmission, even when toms are known shedders. These observations do not establish causality but provide practice-oriented evidence that may inform breeding management decisions and support the design of future prospective, controlled studies.

Conclusions

In this single-site retrospective case study, strictly time-limited natural mating in a clean, bowl- and litter box free room was associated with no detected transmission of feline coronavirus from shedding toms to virus-free queens or their kittens over short-term follow-up.

While the small sample size and observational design limit generalization, these findings provide practical, real-world evidence that controlled mating may be a feasible breeding management option for maintaining FCoV-free queens and preventing early-life infection in kittens. This approach may represent a welfare-friendly alternative to early weaning in selected cattery settings. This knowledge is very important for breeders with FCoV-free queens to prevent infection of kittens and spread of the virus in the population, and can be used to make guidelines for breeders to reduce the prevalence of or even eradicate FCoV from their cattery.

Future research should aim to build upon these observations through prospective, multi-site studies involving larger populations, predefined outcome measures, and longer follow-up periods for both queens and offspring..

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