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Viral infections; affect genital system in female cats

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ABSTRACT

Infertility in cats is a common reproductive disorder caused by genetic, environmental, and infectious factors. This review focuses on infertility caused by viral infections in cats. Previous studies have demonstrated that viruses such as Feline Immunodeficiency Virus (FIV), Feline Leukemia Virus (FeLV), Feline Panleukopenia Virus (FPLV), Feline Calicivirus (FCV), and Feline Herpesvirus (FeHV) contribute to infertility in cats by directly damaging reproductive organs or by weakening the immune system. Furthermore, the immunosuppression caused by these viruses makes cats more susceptible to secondary infections, which severely impacts reproductive health. This article highlights the critical importance of understanding, preventing, and managing infertility associated with viral infections in cats.

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Introduction

Infertility not only leads to significant economic losses in farm animals such as cows, sheep, and goats, but also poses a serious threat to the lineage of cats and dogs. Although the causes of infertility in dogs are well-known, there is a lack of extensive research on this topic in female cats (Evecen & Demir, 2017). This condition significantly impacts animal welfare and may present risks to both public and environmental health (Risvanli et al., 2009). Infertility can be defined as the loss or reduction of an animal's reproductive ability, manifesting as the inability to produce offspring after mating. Infertility in cats is a common problem that can occur in both female and male individuals and can arise due to various causes. The causes of infertility in cats include genetic factors, environmental influences, nutritional deficiencies, hormonal imbalances, and infections (Fontbonne et al., 2020; Lamm & Njaa, 2012; Tek & Beceriklisoy, 2020).

Viral infections represent a major contributing factor to infertility in cats. Viruses including Feline Immunodeficiency Virus, Feline Leukemia Virus, Feline Panleukopenia Virus, Feline Calicivirus, and Feline Herpesvirus may contribute to infertility by directly damaging reproductive organs or by compromising overall health (Fontbonne et al., 2020). These viruses can weaken the cat's immune system, making them more susceptible to secondary infections and severely impacting reproductive health (Tek & Beceriklisoy, 2020).

Viral diseases causing infertility

1. Feline leukemia virus

Feline leukemia virus (FeLV) is a Gammaretrovirus observed in domestic and wild felids, categorized into four subtypes (A, B, C, and T) based on the spectrum of host cells. Since this virus belongs to the Retrovirus family and is species-specific, it does not cause disease in species other than cats (Tek & Beceriklisoy, 2020). FeLV-type A is acquired from the environment, while FeLV-type B arises from the recombination between FeLV-A and endogenous retroviral sequences. FeLV-C results from a mutation in the env gene, and FeLV-T is characterized by T lymphotropism (Decaro et al., 2012).

The primary transmission occurs through saliva. Therefore, animals living in multi-cat households, shelters, and breeding farms are at high risk of FeLV

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infection due to sharing food and water bowls, close contact, and shared litter areas (Decaro et al., 2012).

FeLV includes various clinical forms caused directly or indirectly by virus replication in lymphoid tissues and bone marrow. The primary consequence of FeLV infection is immune suppression. Additionally, secondary infections caused by mild pathogens such as Mycoplasma hemofelis and other feline hemoplasmas, Cryptococcus spp., Toxoplasma gondii, feline coronavirus, and calicivirus can exacerbate the clinical course (Hartmann, 2011).

From a gynecologic perspective, queens infected with FeLV may exhibit reproductive disorders. It can lead to intrauterine infection, fetal resorption, abortion, and neonatal death. Fetal resorption may be responsible for what appears to be prolonged infertility. Abortion often occurs in the later stages of pregnancy and may be accompanied by bacterial endometritis (Hartmann, 2011). In a case report published by Axnér et al. (2008), it was noted that uterine pathologies, which could cause infertility, were observed in 4 out of 7 cats (57%) in which FeLV antigen was detected (Axnér et al., 2008).

Reproductive problems in cats diagnosed with FeLV can be mitigated by taking certain precautions, with regular vaccination being the most important measure. Kittens should receive the first dose of the vaccine at 8–10 weeks of age, followed by a second dose at 12 weeks, and yearly vaccinations should continue thereafter (Lutz et al., 2009).

2. Feline panleukopenia virus

Feline Panleukopenia Virus, together with canine parvovirus type 2 (CPV-2) and other parvoviruses, belongs to the Parvoviridae family's Parvovirus genus, specifically within the feline parvovirus group. This deoxyribonucleic acid (DNA) virus is shed in the feces of infected cats and is highly transmissible via the fecal-oral route. Following the onset of viremia, the virus shows a particular affinity for lymphoid organs, bone marrow, intestinal crypts, and the fetus in pregnant cats (Kilham et al., 1971). In a study performed in Turkey, positivity rates of 27.7% (5/18) and 16.6% (1/6) were determined in samples collected from the districts of Bolvadin and İscehisar, respectively (Gür & Avdatek, 2016).

The clinical course of the disease can vary significantly depending on the time of infection. Infections occurring postnatally in kittens aged 2 to 6 months often result in the classic form of feline panleukopenia, characterized by fever, loss of appetite, depression, hemorrhagic diarrhea, vomiting, and dehydration. Severe leukopenia, affecting all white blood cell (WBC) populations, is consistently observed, with WBC counts ranging between 50 and 3000 cells/µL (Binn et al., 1970). Intrauterine infections can lead to various gynecological disorders, depending on the stage of pregnancy at which the infection occurs. Early-stage uterine infections typically result in infertility, early fetal death, and resorption, while mid-pregnancy infections are more likely to cause abortion or fetal mummification. For example Cave et al. (2002), in their study conducted on 274 cats, reported that a significant proportion (25%) of abortions and neonatal deaths were caused by FPLV (Cave et al., 2002). Similarly, Oliveira et al. (2018), in their study on reproductive failures in 42 female cats, reported that infertility problems such as stillbirths and premature births were largely caused by FPLV (Oliveira et al., 2018). In late pregnancy, the virus shows affinity for fetal neural tissues, including the cerebrum, cerebellum, optic nerve, and retina (Csiza et al., 1971). Consequently, virus-induced lesions in the offspring may manifest as hydrocephalus, hydranencephaly, cerebellar hypoplasia, optic nerve atrophy, and retinopathy. In cats, since this part of the central nervous system develops during late pregnancy and the early neonatal period, the cerebellum is the most affected tissue. These lesions can also be observed in kittens infected within the first 10 days after birth (Sharp et al., 1999).

Accurate and early diagnosis is crucial for preventing FPLV, which causes all these reproductive issues. Vaccination against FPLV, confirmed via Polymerase Chain Reaction (PCR) testing, is one of the most effective prevention methods, particularly when administered to kittens in two doses starting at 8–9 weeks of age. Additionally, preventing direct contact between domestic cats and wild cats, environmental management, and regular vaccination schedules help reduce the incidence of FPLV (Truyen et al., 2009).

3. Feline immunodeficiency virus

Feline immunodeficiency virus (FIV) is a retrovirus belonging to the Lentivirus genus. It shares pathogenic features with human immunodeficiency virus (HIV). FIV is now recognized as an endemic pathogen in domestic cat populations worldwide, with prevalence rates reaching up to 28% in some countries. To date, at least five genetically distinct subtypes have been identified based on the sequence diversity of the env gene (Dunham & Graham, 2008; Hosie et al., 2009).

FIV transmission typically occurs through the transfer of free virus or virus-infected leukocytes via bite wounds. While transmission from infected female cats to their kittens is not very common, it can be experimentally achieved. Important routes of FIV transmission include vertical transmission, transplacental passage within the uterus, direct contact

with genital secretions during birth, or ingestion of infected colostrum or milk postpartum. Studies have detected high titres of the virus in the milk of infected cats, indicating an affinity of the virus for mammary epithelial tissues. Vertical transmission is more effective when pregnant female cats are infected during gestation. An increased rate of FIV infection with advancing pregnancy has been demonstrated. Fetuses from cats infected with FIV at 3 weeks of gestation were found not to be infected, but up to 60% of fetuses were virus-positive when the queens were infected later in pregnancy. This indicates that FIV infection in late pregnancy poses a significant risk for cats (Rogers & Hoover, 1998). For example, in a study by Weaver et al. (2005) on experimental FIV infection in cats, 15 out of 25 concepti (60%) were not viable, and FIV was isolated in 21 out of 22 fetuses (95%) (Weaver et al., 2005).

In hosts that acquire the pathogen through bites, clinical symptoms may appear months or even years later. The most commonly observed gynecological signs include: inhibition of fetal development, fetal mummification, abortion, stillbirths, shortened intervals between births, and congenital anomalies in the offspring (Hosie et al., 2009; Tek & Beceriklisoy, 2020).

Currently, there is no vaccine registered in Europe to protect against the effects of FIV. Therefore, rather than vaccination, it is recommended to prevent FIV transmission by adhering to general preventive measures such as avoiding the use of contaminated materials like needles and surgical instruments on multiple cats, and eliminating potential vectors like flies and insects that could transmit the virus to cats (Hosie et al., 2009).

4.Feline herpes virus

Feline herpesvirus 1 (FeHV-1) is a DNA virus belonging to the Alphaherpesvirinae subfamily. It primarily causes an upper respiratory tract infection, termed feline viral rhinotracheitis, in domestic cats. Both domestic and wild felids are at risk for herpesvirus infection. Infected cats may harbor the virus in a latent state, which can reactivate intermittently in response to stress, immunosuppression, or parturition (Gaskell et al., 2007; Karapinar et al., 2014).

The virus is transmitted through direct contact with acutely or latently infected cats, and indirectly in environments with high cat populations such as shelters and breeding catteries. The primary carriers of the virus are oronasal and conjunctival secretions. Newborn kittens typically become infected through contact with their mother's oronasal secretions. Intrauterine infections have been reported only under experimental conditions (Westermeyer et al., 2009). Herpesvirus-induced abortions in cats are much rarer compared to herpesvirus-induced abortions observed in dogs. When FeHV-1 DNA is isolated from the fetuses of cats that have aborted as a result of FeHV-1 infection, no definitive findings are observed. This suggests that the abortion may be indirectly caused by the immunosuppressive effects of the virus. Studies have shown that intravenous inoculations administered to pregnant cats in the late stages of gestation result in abortion, stillbirth, or generalized neonatal infections, whereas intranasal inoculation does not have a negative impact on pregnancy (Tek & Beceriklisoy, 2020). Additionally, following intravenous inoculation, herpesvirus has been isolated from the genital tract of the queens and the tissues of their aborted fetuses. This unnatural route of infection is the only one that causes necrotic lesions in the uterus, placenta, and vagina of the queens (Johnson, 1964).

The most important way to protect against FeHV-1, which causes serious problems, is through vaccination. Initial vaccinations at 9 and 12 weeks of age, followed by annual boosters, significantly reduce the risk of infection. In addition, infected animals can be treated with various antiviral drugs (Thiry et al., 2009).

5.Feline calicivirus

Feline Calicivirus (FCV) is an ribonucleic acid (RNA) virus belonging to the Vesivirus genus of the Caliciviridae family. It is a highly contagious pathogen commonly found in domestic cats, known for its resilience to environmental conditions and significant genetic variability. FCV infections pose serious problems, particularly in environments with large numbers of cats, such as shelters and breeding facilities. The most common clinical signs observed in cats infected with FCV are related to upper respiratory tract diseases, and it can lead to fatal lung infections, especially in young kittens (Hofmann-Lehmann et al., 2022).

While Feline Calicivirus (FCV) is primarily transmitted via oral and nasal secretions from infected cats, the virus can also be detected in their blood, urine, and feces. Transmission can occur through contact with these materials. Even after clinical recovery, cats may continue to shed the virus for durations ranging from 30 days to several years (Coyne et al., 2006). Studies reporting the rates related to FCV affecting the genital system of female cats are not available in the literature.

Similar to Herpesvirus, Calicivirus is believed to cause abortions due to immunosuppression as it adversely affects the overall health of the cat. Additionally, in contrast to Herpesvirus, experimental intranasal Calicivirus infections in pregnant cats have

shown that the virus can be transmitted to the fetuses, leading to severe abortions. For this reason, FCV vaccination is not recommended for pregnant cats, regardless of the route of administration (Hofmann-Lehmann et al., 2022; Tek & Beceriklisoy, 2020).

The most effective way to protect against FCV is through vaccination. All healthy cats should be vaccinated against FCV. Early vaccination should be considered for kittens from queens that have previously given birth to infected litters or for cats at risk of infection. Two vaccinations are recommended at 9 and 12 weeks of age, followed by a first booster one year later. In high-risk situations, a third kitten vaccination at 16 weeks is recommended. Booster vaccinations should be administered every 3 years; however, in high-risk situations, annual revaccination is advised (Radford et al., 2009).

Conclusion

This review addresses the various mechanisms by which viral infections can lead to infertility in cats. Viruses such as Feline Immunodeficiency Virus (FIV), Feline Leukemia Virus (FeLV), Feline Panleukopenia Virus (FPLV), Feline Calicivirus (FCV), and Feline Herpesvirus (FeHV) have been observed to have significant impacts on feline reproductive health. These viruses can cause direct damage to the reproductive organs, as well as indirectly lead to infertility by negatively affecting the overall health of the cats.

In cats infected with these viruses, serious reproductive issues such as immunosuppression, susceptibility to secondary infections, pregnancy losses, congenital anomalies, and neonatal mortality are observed. The effects of infection become more pronounced during pregnancy, negatively impacting fetal development and leading to outcomes such as abortion, mummification, and stillbirth.

In this context, the prevention and management of viral infections in cats are of paramount importance for preserving reproductive health. To prevent the spread of these viruses, appropriate vaccination protocols must be implemented, the risk of infection minimized, and infected cats excluded from breeding programs. Furthermore, the early diagnosis and treatment of viral infections play a critical role in safeguarding feline reproductive health. Future studies should focus on more thoroughly investigating the effects of these viruses on reproductive health and developing protective strategies.

Referances

Axnér, E., Ågren, E., Båverud, V., & Holst, B. S. (2008). Infertility in the cycling queen: Seven cases. *Journal of Feline Medicine and Surgery, 10*(6), 566-576.

Binn, L. N., Lazar, E. C., Eddy, G. A., & Kajima, M. (1970). Recovery and Characterization of a Minute Virus of Canines. *Infection and Immunity, 1*(5), 503-508.

Cave, T. A., Thompson, H., Reid, S. W. J., Hodgson, D. R., & Addie, D. D. (2002). Kitten mortality in the United Kingdom: a retrospective analysis of 274 histopathological examinations (1986 to 2000). *Veterinary Record, 1*51(17), 497-501.

Coyne, K. P., Dawson, S., Radford, A. D., Cripps, P. J., Porter, C. J., McCracken, C. M., & Gaskell, R. M. (2006). Long-term analysis of feline calicivirus prevalence and viral shedding patterns in naturally infected colonies of domestic cats. *Veterinary Microbiology, 118*(1–2), 12-25.

Csiza, C. K., De Lahunta, A., Scott, F. W., & Gillespie, J. H. (1971). Pathogenesis of feline panleukopenia virus in susceptible newborn kittens II. pathology and Immunofluorescence. *Infection and Immunity, 3*(6), 838-846.

Decaro, N., Carmichael, L. E., & Buonavoglia, C. (2012). Viral reproductive pathogens of dogs and cats. *Veterinary Clinics of North America - Small Animal Practice, 42*(3), 583-598.

Dunham, S. P., & Graham, E. (2008). Retroviral infections of small animals. *Veterinary Clinics of North America: Small Animal Practice, 38*(4), 879-901.

Evecen, M., & Demir, K. (2017). Erkek köpeklerde inferilite, tedavi yaklaşımları ve infertiliteye neden olan ilaçlar. *Turkiye Klinikleri Reproduction and Artificial Insemination-Special Topics, 3*(3), 181-188.

Fontbonne, A., Prochowska, S., & Niewiadomska, Z. (2020). Infertility in purebred cats – A review of the potential causes. *Theriogenology, 158*, 339-345.

Gaskell, R., Dawson, S., Radford, A., & Thiry, E. (2007). Feline herpesvirus. *Veterinary Research, 38*(2), 337-354.

Gür, S., & Avdatek, K. (2016). A serological investigation for feline panleukopenia virus in cats in Afyonkarahisar. *Kocatepe Veterinary Journal, 9*(3), 165-170.

Hartmann, K. (2011). Clinical aspects of feline immunodeficiency and feline leukemia virus infection. *Veterinary Immunology and Immunopathology, 143*(3-4), 190-201.

Hofmann-Lehmann, R., Hosie, M. J., Hartmann, K., Egberink, H., Truyen, U., Tasker, S., Belák, S., Boucraut-Baralon, C., Frymus, T., Lloret, A., Marsilio, F., Pennisi, M. G., Addie, D. D., Lutz, H., Thiry, E., Radford, A. D., & Möstl, K. (2022). Calicivirus Infection in Cats. *Viruses, 14*(5), 937.

Hosie, M. J., Addie, D., Belák, S., Boucraut-Baralon, C., Egberink, H., Frymus, T., Gruffydd-Jones, T., Hartmann, K., Lloret, A., Lutz, H., Marsilio, F., Pennisi, M. G., Radford, A. D., Thiry, E., Truyen, U., & Horzinek, M. C. (2009). Feline immunodeficiency. ABCD guidelines on prevention and management. *Journal of Feline Medicine and Surgery, 11* (7), 575-584.

Johnson, R. T. (1964). The Pathogenesis of Herpes Virus Encephalitis. II. A Cellular Basis for the Development of Resistance with Age. *Journal of Experimental Medicine,* 120(3), 359-374.

Karapinar, Z., Dinçer, E., Soydal Ataseven, V., & Karaca, M. (2014). Felid herpesvirus-1 infection in Van Cats with conjunctivitis. *Yüzüncü Yıl Üniversitesi Veteriner Fakültesi Dergisi, 25*(1), 15-17.

Kilham, L., Margolis, G., & Colby, E. D. (1971). Cerebellar ataxia and its congenital transmission in cats by feline panleukopenia virus. *Journal of the American Veterinary Medical Association, 158*(6), Suppl 2:888+.

Lamm, C. G., & Njaa, B. L. (2012). Clinical approach to abortion, atillbirth, and neonatal death in dogs and cats. *Veterinary Clinics of North America - Small Animal Practice, 42*(3), 501-513.

Lutz, H., Addie, D., Belák, S., Boucraut-Baralon, C., Egberink, H., Frymus, T., Gruffydd-Jones, T., Hartmann, K., Hosie, M. J., Lloret, A., Marsilio, F., Pennisi, M. G., Radford, A. D., Thiry, E., Truyen, U., & Horzinek, M. C. (2009). Feline leukaemia: ABCD guidelines on prevention and management. *Journal of Feline Medicine and Surgery, 11*(7), 565-574.

Oliveira, I. V. P. de M., Freire, D. A. de C., Ferreira, H. I. P., Moura, G. H. F., da Rocha, C. S., Calabuig, C. I. P., Kurissio, J. K., Junior, J. P. A., & Antunes, J. M. A. de P. (2018). Research on viral agents associated with feline reproductive problems reveals a high association with feline panleukopenia virus. *Veterinary and Animal Science, 6*, 75-80.

Radford, A. D., Addie, D., Belák, S., Boucraut-Baralon, C., Egberink, H., Frymus, T., Gruffydd-Jones, T., Hartmann, K., Hosie, M. J., Lloret, A., Lutz, H., Marsilio, F., Pennisi, M. G., Thiry, E., Truyen, U., & Horzinek, M. C. (2009). Feline calicivirus infection: ABCD guidelines on prevention and management. *Journal of Feline Medicine and Surgery,* 11(7), 556-564.

Risvanli, A., Bulut, H., Gaffar Zonturlu, A., Demiral, O., Saat, N., & Kilic Ass, A. (2009). The role of immunologic factors in abortions observed in sheep and goats. *International Journal of Applied Research in Veterinary Medicine, 7*(3), 91-96.

Rogers, A. B., & Hoover, E. A. (1998). Maternal-fetal feline immunodeficiency virus transmission: timing and tissue tropisms. *Journal of Infectious Diseases*, 178(4), 960-967.

Sharp, N. J. H., Davis, B. J., Guy, J. S., Cullen, J. M., Steingold, S. F., & Kornegay, J. N. (1999). Hydranencephaly and cerebellar hypoplasia in two kittens attributed to intrauterine parvovirus infection. *Journal of Comparative Pathology, 1*21(1), 39-53.

Tek, C., & Beceriklisoy, B. (2020). *İnfertilite. In M. Kaymaz, M. Findik, A. Rişvanli, & A. Koker (Eds.)*, Köpek ve kedilerde doğum ve jinekoloji (2nd ed., pp. 333–341). Medipress Yayınevi.

Thiry, E., Addie, D., Belák, S., Boucraut-Baralon, C., Egberink, H., Frymus, T., Gruffydd-Jones, T., Hartmann, K., Hosie, M. J., Lloret, A., Lutz, H., Marsilio, F., Pennisi, M. G., Radford, A. D., Truyen, U., & Horzinek, M. C. (2009). Feline herpesvirus infection: ABCD Guidelines on prevention and management. *Journal of Feline Medicine and Surgery, 11*(7), 547-555.

Truyen, U., Addie, D., Belák, S., Boucraut-Baralon, C., Egberink, H., Frymus, T., Gruffydd-Jones, T., Hartmann, K., Hosie, M. J., Lloret, A., Lutz, H., Marsilio, F., Pennisi, M. G., Radford, A. D., Thiry, E., & Horzinek, M. C. (2009). Feline panleukopenia: ABCD guidelines on prevention and management. *Journal of Feline Medicine and Surgery, 11*(7), 538-546.

Weaver, C. C., Burgess, S. C., Nelson, P. D., Wilkinson, M., Ryan, P. L., Nail, C. A., Kelly-Quagliana, K. A., May, M. L., Reeves, R. K., Boyle, C. R., & Coats, K. S. (2005). Placental immunopathology and pregnancy failure in the FIV-infected cat. *Placenta, 26*(2-3), 138–147.

Westermeyer, H. D., Thomasy, S. M., Kado-Fong, H., & Maggs, D. J. (2009). Assessment of viremia associated with experimental primary feline herpesvirus infection or presumed herpetic recrudescence in cats. *American Journal of Veterinary Research, 70*(1), 99-104.