The latest updates on FeLV - Everything you need to know and why you need to know it!

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1. Introduction

The following notes are a brief summary of an open access article available in the Australian Veterinary Journal - Feline leukaemia virus (FeLV) infection in domestic pet cats in Australia and New Zealand: Guidelines for diagnosis, prevention and management. Mark E. Westman, Sally J. Coggins, Moira van Dorsselaer, Jacqueline M. Norris, Richard A. Squires, Mary Thompson and Richard Malik.

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2. Summary

Progressive feline leukaemia virus (FeLV) infection dramatically shortens the lives of infected cats, causing acquired immunodeficiency, aplastic anaemia, lymphoma, leukaemia, and other myeloproliferative diseases. The potential impact of regressive FeLV infection on the development of FeLV related diseases is not yet fully understood and may contribute to overall disease morbidity and mortality in FeLV-infected cats. Despite a perceived general decline in incidence of progressive FeLV infection in Australia and other regions worldwide, FeLV remains a significant health threat and clinicians should have a thorough understanding of the complexities surrounding diagnosis, management and prevention of this disease.

Point-of-care (PoC) antigen testing using whole blood is the first step to detect progressive FeLV infection. Clinicians should be aware of the increased rate of false-positive results using such kits to detect diseases of low prevalence and therefore confirmatory FeLV PCR testing to detect proviral DNA is essential before a cat can be confirmed as FeLV-infected. Regressively infected cats should not be used as blood donors so all blood donor programs must include FeLV proviral PCR testing in their standard screening protocols.

No effective antiviral treatments currently exist for progressive or regressive FeLV infection, therefore veterinarians should advocate to minimise the exposure of cats to FeLV as a first-line strategy. The most reliable way to achieve this is for cats to be kept indoors, or with secured outdoor access (e.g. cat enclosures, secure gardens), with FeLV testing of any cohabitating cats. All animal holding facilities should aim to individually house adult cats to limit the spread of FeLV infection. For cats that cannot be kept indoors/enclosed, or cohabitate with known FeLV infected cats, vaccination can be considered. Two pentavalent vaccines containing inactivated whole-FeLV are currently available in Australia. At this time, we only endorse the use of the pentavalent vaccine in Australia in FeLV-endemic catteries or situations where there is a demonstrable and substantial risk of exposure. Research into potential antiretroviral therapy for FeLV infections in cats is needed.

3. Categories of FeLV infection

Progressive infections: Progressively infected cats are persistently viraemic, with viable virus shed in secretions and excreta of infected cats (especially saliva). Saliva from progressively infected cats contains on average five-times more FeLV per mL than plasma. Close, 'friendly' contact between cats (e.g., suckling, mutual grooming, nose-to-nose contact, sharing of food bowls/water bowls/toys) leads to much of the horizontal transmission of this virus. Infected queens regularly infect their kittens in utero or after parturition via grooming or infected milk. Given the high concentration of FeLV in saliva, deep bites acquired from fighting, for example in free-roaming cats, may also play a role in viral transmission although the epidemiology observed in Australia does not favour this mode of transmission. Blood transfusions are another potential pathway for FeLV transmission, as is the use of dental and surgical instruments that have not been appropriately sterilised between procedures.

'Age resistance' remains important in FeLV pathogenesis and epidemiology, however adult cats can and do become infected with FeLV. Progressively infected cats have poor immune responsiveness, resulting in permanent viraemia and provirus integration in host cells. These cats can readily transmit infection to FeLV-naïve cats and have the poorest prognosis, with reported mortality rates of up to 90% within 3 years of acquiring infection. Mortality is predominantly due to aplastic anaemia, lymphoma (most commonly mediastinal lymphoma), leukaemia, or other myeloproliferative diseases. In a recent FeLV treatment case series in Australia, a median survival time of 634 days for cats with progressive infections, and a poorer survival in young FeLV-infected cats compared to older FeLV-infected cats, was reported. For every 1-year increase in age at diagnosis, survival time increased by 88 days. Thus, younger cats fared considerably worse than older cats.

Regressive infections: Regressively infected cats are usually transiently viraemic for less than 4 months beyond their initial infection. These cats have a partially effective immune response that clears the viraemia but does not prevent lifelong infection due to proviral integration. Some cats bypass the viraemic stage and do not appear to demonstrate viraemic. Once viraemia has cleared, these cats are not contagious to FeLV-naïve cats and therefore pose no risk in group-housing situations. Regressively infected cats are capable of transmitting FeLV to other cats via blood transfusions and therefore should never be recruited as blood donors. The contribution of regressive infections to the development of FeLV related diseases remains uncertain.

Focal (localised, atypical) infections: Cats with focal infections, as their name suggests, have an immune response able to restrict viral replication to particular tissues such as the spleen, lymph nodes, small intestine, urinary tract, or mammary glands. Initially thought to occur rarely in the field, recent Australian and European studies have challenged this notion. Literature describing focal infections is limited, and some reported cases were not followed longitudinally; thus, clinical signs associated with focal infection at this stage are speculative and difficult to predict. Clinicians should be aware of this category but given sufficient time, and enough serial testing, most FeLV-infected cats will eventually be able to be classified as having either regressive or progressive infections.

Abortive infections: Abortively infected cats manage to completely eliminate FeLV after localised replication in the oropharyngeal lymph nodes. They are never infectious to other cats, cannot be identified with routine testing available in Australia, and have the same lifespan as FeLV-unexposed cats. Abortive infections occur in cats that mount an effective immune response that results in complete elimination of FeLV. FeLV-related disease does not develop, and life expectancy is identical to FeLV-uninfected cats. Clinicians in Australia should be aware of this category but at this stage we are unable to identify abortive infections without sending blood overseas for laboratory-based neutralising antibody (NAb) testing.

4. Prevalence of progressive FeLV infection in Australia

Australia is a large country and the prevalence of FeLV infection has been shown to vary between regions. It has been suggested that FeLV infection is more common in Western Australia (WA). Although systematic prevalence studies of infectious diseases such as FeLV were rare or non-existent prior to the 1990s, FeLV infection was considered common in Australia in the 1970s and early 1980s. Widespread screening of catteries and other feline populations in Australia for FeLV did not occur, but for whatever reasons, the prevalence of FeLV in the eastern Australian states was subsequently considered low to extremely low from the mid-1990s, before any FeLV vaccine was commercially available in Australia (Leucogen® FeLV, Virbac Animal Health, in 1998).

In a representative sample of 200 healthy pet cats collected in Sydney in 1994-1995, FeLV antigenaemia was uncommon (<2%). In the same study, samples submitted by city and country practitioners in New South Wales (NSW) to a private clinical pathology laboratory in Sydney yielded 1.4% (11/761) positivity using the same laboratory-based antigen test; approximately 88% of these samples were from 'sick' cats. This observation (~2% prevalence) was confirmed in 340 samples collected from pet cats in Sydney in 2002-2004 with PoC testing. Both studies were conducted before polymerase chain reaction (PCR) testing for FeLV was readily available for test confirmation and detection of regressive infections.

More recently, in a cohort of healthy pet cats aged two years-of-age or older with some level of outdoor access, a prevalence of 0.5% (2/440) progressive infections was found, using newer generation PoC antigen test kits and confirmed with semi-quantitative real-time (q)PCR testing. These cats lived in or near the cities of Adelaide, Melbourne, Canberra, Sydney and Brisbane. A small cluster of FeLV exposure in south-western Sydney, encompassing an area between Liverpool and Campbelltown, was identified. This study demonstrated that progressive FeLV infections still occur, albeit uncommonly, in pet cats in Australia.

Two large FeLV outbreaks in small Sydney-based rescue facilities have been documented over the past decade. Both rescue groups did not routinely test new arrivals for FeLV and practiced some level of group-housing. This created a 'perfect storm' for FeLV transmission, with lots of vulnerable, immunologically naïve kittens exposed to progressively infected cats. Following identification of index FeLV cases, testing was undertaken to help quickly identify all FeLV-infected cats for immediate management. In total, progressive infections were discovered in 21% (19/89) of cats. Sadly, some kittens were rehomed before the outbreak was detected and brought under control, meaning some unknowingly FeLV-infected kittens ended up in

private homes. This was an unfortunate reminder that veterinarians should always include in their history-taking a question about the origin of the animal, and whether the retroviral status of the animal is known.

The prevalence of FeLV infection in cats presenting with lymphoma in Australia has also declined over time. Of lymphoma samples collected at a veterinary teaching hospital in Sydney between 1967 and 1972 and examined for FeLV using electron microscopy, 9/11 (82%) cases were confirmed to be infected. Transmission experiments then showed that macerated tissue extracts from cats with lymphoma, when injected into normal healthy kittens, resulted in the rapid development of lymphoma in the challenged kittens. In a study of 60 cats with lymphoma seen in the same institution from 1984 to 1994 (i.e. approximately 20 years later), lymphoma appeared predominantly as a disease of older cats and only 2/22 cats (9%) tested positive to FeLV antigen with an ELISA. In a larger and more systematic study conducted from 1995 to 1998, only 2/107 cats (2%) with lymphoma had progressive FeLV infections on the basis of PoC testing using serum. This trend for decreasing incidence of FeLV-associated lymphoma has changed the typical feline lymphoma presentation from FeLV-infected younger cats with mediastinal lymphoma to FeLV-uninfected older cats with intestinal or extranodal lymphoma (solitary, non-lymphoid organ involvement, e.g. nasopharynx, central nervous system, kidneys, skin).

Nowadays, FeLV infection is rarely diagnosed in cats with lymphoma in Australia. In a recent study of abdominal lymphoma in Australian cats from 2017 to 2021, 0/34 (0%) cats tested positive for FeLV antigen. A retrospective study of lymphoma in Australian cats from 2000 to 2022 seen at two referral centres located in Melbourne and Sydney found 4.6% (13/284) cats tested positive for FeLV. The majority of FeLV testing performed was SNAP® PoC testing, with very few PCR tests performed (Peter Bennett, pers. comm.).

More FeLV testing needs to be done and reported in other cities and regional centres in Australia. The key point is this: progressively infected cats may only represent the 'tip of the iceberg' of pet cats that have been exposed to FeLV in Australia, and regressive and abortive infections also need to be considered to fully understand the risk of FeLV in a cat population and the overall viral dynamics.

5. Prevalence of progressive FeLV infection in New Zealand

Although published data are lacking, clinicians who practised in NZ in the 1970s and 1980s recollect seeing far more FeLV-related disease among NZ pet cats back then than more recently. Testing for FeLV in NZ was not available before 1980. On samples collected in 1978–1979, immunofluorescent antibody (IFA) testing performed in the USA found an overall prevalence of progressive FeLV infection of 11% (26/230). The prevalence of FeLV infection in multi-cat households was higher (16%) than in single-cat households (3%), and infection was found in a mixture of healthy and sick cats, including some with lymphoma. Soon afterwards, based on samples collected in 1980–1981, the prevalence of progressive FeLV infection in cats tested by a commercial PoC kit using blood was 4% (13/293). In 1982–1983, the prevalence of FeLV in NZ was 6.5% (30/465); the slightly higher prevalence reported was perhaps due to bias from more multi-cat households being tested.

In 2015, a cross-sectional survey of 112 veterinary practices found that 2.6% (56/2125) of PoC tests were positive for FeLV. At a first-opinion practice in Waimate, the overall FeLV positivity rate with SNAP® testing between 2010–2016 was 7% (41/572). Of these 41 FeLV-positive cats, two had confirmatory PCR testing performed, with 1 out of 2 cats (50%) testing PCR-positive. Cats entering the NZ SPCA shelter in Auckland in 2014 had a FeLV positivity rate with SNAP® testing of 1% (4/388); two of the four (50%) FeLV-positive cats were PCR-positive with confirmatory testing.

Anecdotally in NZ, pockets of FeLV infection have been reported in Taranaki, Queenstown, and Waikato (Natalie Lloyd, Zoetis Animal Health, pers. comm.). A feline medicine specialist based in Wellington reports diagnosing the occasional progressive FeLV infection in kittens and cats from rescue cases from the Wairarapa and Kapiti Coast and recently provided advice on a progressive FeLV infection in a Burmese kitten from a 'backyard breeder' (Pru Galloway, pers. comm.).

Studies in NZ to report the FeLV prevalence rate in cats presenting with lymphoma have not yet been performed.

6. FeLV testing

Feline leukaemia virus infection is typically simple to diagnose. Sometimes the challenge is that FeLV infection can induce a spectrum of possible outcomes, with the final result a balance between the cat's immune response (affected by breed, age, and drug therapy) and the infective dose and possibly the strain of the virus. To complicate the situation further, a cat's FeLV infection status will also be affected by the magnitude of initial challenge (viral inoculum), the age of the cat when first exposed, any concurrent disease(s) or other stressor(s) affecting the immune status of the cat, and the specific infecting virus isolate. As a consequence, FeLV-infected cats may have alternating test results that fluctuate between regressive and progressive infection status, especially early in the course of disease and with changing immune status (e.g., due to advancing age or developing co-morbidities). With repeated testing over time, a definitive outcome – either regressive or progressive infection – usually eventuates.

Progressive infections: Persistent p27 antigenaemia and proviral DNA PCR-positivity in blood (i.e., antigen-positive, provirus PCR-positive).

Regressive infection: Initial p27 antigenaemia and proviral DNA PCR-positivity in blood (i.e., antigen-positive, provirus PCR-positive); within 4 months of infection cats become p27 antigen-negative while remaining provirus PCR-positive.

Focal infections: Variable p27 antigenaemia and/or proviral DNA PCR-positivity in blood (i.e., results alternate between negative and positive over time). Sometimes defined as cats that test antigen-positive, provirus PCR-negative.

Abortive infections: Positive neutralising antibody (NAb) titres in the absence of p27 antigenaemia or FeLV provirus (i.e., antigen-negative and provirus PCR-negative, NAb-positive). NAb testing is currently not available to clinicians in Australia or NZ to identify abortive infections.

7. FeLV vaccination recommendations in Australia

Two FeLV vaccines are currently available in Australia. Fel-O-Vax® 5 is a pentavalent killed vaccine containing feline panleukopenia virus (FPV), feline calicivirus (FCV), feline herpesvirus type 1 (FHV-1), *Chlamydia felis* and FeLV antigens (initially manufactured by Fort Dodge, IA, USA, and later Boehringer Ingelheim Animal Health). Fevac® 5, a second pentavalent killed vaccine containing FeLV antigen, is also distributed in Australia (Zoetis Animal Health, Lyon, France). According to the manufacturer, FeLV vaccination in Australia initially requires two doses of one of these vaccines, and annual re-vaccination with a single dose of the same vaccine.

For a variety of reasons, including limited vaccine choice and perceived absence of justification, FeLV vaccination is not widely practiced in Australia, even in kittens and young cats. It is estimated only 2% of Australian pet cats are vaccinated against FeLV. More local prevalence data is required in Australia to allow clinicians to make evidence-based decisions about FeLV vaccination in their clinics and could readily be determined by individual practices to inform on vaccine-related decision-making.

We advise that cats should only be vaccinated against FeLV if a genuine risk of FeLV exposure has been demonstrated, for example living with progressively infected cats or FeLV-infected cats in which the status (i.e., progressive vs. regressive) has not yet been determined (and separation of cats is not possible). FeLV vaccination is not advised in areas without demonstrated FeLV infection, for cats housed strictly indoors, or in shelters practicing individual housing. In multiple cat households, when one cat is diagnosed with FeLV infection, all in-contact cats should immediately be separated, tested, and vaccinated against FeLV if they test negative, and vaccinated again 4 weeks later. Two weeks after completion of this primary course of FeLV vaccines, cats can be reunited.

8. FeLV vaccination recommendations in New Zealand

Two FeLV vaccines were registered in NZ but dwindling demand from veterinarians based on a perceived low FeLV prevalence resulted in both vaccines being removed from the market between 2015 and 2017. Consequently, no FeLV vaccine is currently available in NZ.

References

Please refer to the AVJ publication for references.