Prevalence of feline immunodeficiency virus in submissions of feline serum to a diagnostic laboratory in Atlantic Canada

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Abstract

The purpose of this project was to identify the prevalence of feline immunodeficiency virus (FIV) in the Atlantic region of Canada, and to determine possible associations between FIV serological status and breed, sex, and age. Feline serum samples (671) submitted to the Prince Edward Island Diagnostic Services — Atlantic Veterinary College laboratory between January 1, 1988 and July 30, 1989 were considered eligible for this study. The majority of samples originated from Prince Edward Island (607). Testing was performed in duplicate using commercial 96-well enzyme-linked immunosorbent assay test kits for FIV antibody. Results included a seropositive rate of 7.6% for all submissions. Mean age of FIV-seropositive cats was eight years. There was an increasing risk of FIV-seropositive status associated with age. Prevalence of FIV among intact males was significantly higher (odds ratio = 2.59) than other gender categories. The principal conclusion of this study was that FIV is present in cats of the Atlantic provinces, and that its associations and prevalence are consistent with those found in other North American epidemiological studies.

Résumé

La prévalence du virus immuno-déficient félin dans les sérums soumis à un laboratoire de diagnostic dans la région Atlantique canadienne

Les buts de cette étude étaient d'identifier la prévalence du virus immuno-déficient félin (VIF) dans la région Atlantique canadienne et de déterminer s'il y avait une association entre le statut sérologique du VIF et la race, le sexe et l'âge de l'animal. Cette étude compte 671 échantillons de sérum félin soumis au laboratoire du Prince Edward Island Diagnostic Services — Atlantic Veterinary College entre le 1er janvier 1988 et le 30 juillet 1989. La majorité des échantillons provenaient de l'Ile du Prince-Édouard (607). Les analyses ont été effectuées en duplicata par épreuve Elisa pour le dépistage d'anticorps VIF. Les résultats indiquent un taux de séropositivité de 7,6 %. L'âge moyen des chats séropositifs au VIF était de 8 ans et le risque d'un statut séropositif augmentait avec l'âge. La prévalence du VIF était plus élevée chez les mâles non castrés (ratio = 2,59) comparativement aux autres catégories. La principale conclusion de cette étude est que le VIF est présent dans la population féline des provinces de l'Atlantique et que ses associations et sa prévalence sont conformes à celles mentionnées dans d'autres études épidémiologiques en Amérique du Nord. *(Traduit par Dr Thérèse Lanthier)*

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Introduction

Seroepidemiological surveys report a worldwide prevalence of feline immunodeficiency virus (FIV) (1-4). The viral biology and clinical features of FIV have been reviewed well (4-9). It was our purpose to confirm the presence of FIV in the provinces of Prince Edward Island, Nova Scotia, New Brunswick, and Newfoundland. This study was carried out because regional veterinary practitioners require additional information on the prevalence of a relatively newly identified viral disease of cats (FIV), and the clinical need for serological testing in the regional domestic cat population (1,5,6).

Materials and methods

Study population

All feline serum samples submitted to the Prince Edward Island Diagnostic Services — Atlantic Veterinary College laboratory between January 1, 1988 and July 30, 1989 were considered eligible for this study. In the case of multiple serum samples submitted from a single individual, only the first sample was included. Samples included serum from cats with a variety of illnesses (sick) and from apparently healthy cats (e.g. elective surgeries). Multiple sources of samples submitted to this diagnostic laboratory, serving a large geographic region, resulted in a lack of consistency in the nomenclature used by participating veterinarians with regard to the reason for submission of serum. Demographic information recorded on the sample submission form, including laboratory reference number, name of cat, name of owner, referring clinic, age, breed, and gender, was entered into a database (dBASE III Plus, 1987, Ashton-Tate Corporation, Torrance, California, USA) with serological test results. Results of feline leukemia virus (FeLV) testing, if available, were also recorded.

Serological tests

A commercial feline T-lymphotrophic lentivirus antibody, indirect enzyme-linked immunosorbent

Table 1. Descriptive statistics on the relationship between seroprevalence of FIV and age, sex, breed, and FeLV seroprevalence

Variable	Number (%) of cats	
	FIV-infected	Total tested
Total population	51 (7.6)	671
Gender		
Intact males	15 (11.7)	128
Castrated males	19 (9.0)	212
Total males	34 (10.0)	340
Intact females	6 (4.5)	134
Spayed females	9 (5.4)	166
Total females	15 (5.0)	300
Age category		
<2 years	5 (3.0)	166
2-4 years	11 (6.5)	170
5-9 years	13 (9.5)	137
>9 years	20 (13.4)	149
Breed		
Domestic shorthair	34 (8.3)	409
Domestic longhair	13 (8.2)	158
Siamese	4 (8.0)	50
Other purebred	0 (0.0)	18
FeLV stauts		
FeLV-positive	5 (10.2)	49
FeLV-negative	16 (6.9)	231
Reason for sample submission		
Sick[a]	11 (11.1)	99
Healthy[b]	35 (8.2)	428
Undetermined[c]	8 (5.5)	144

[a]Serum submitted because of clinical sign or disease (e.g. diarrhea, vomiting, renal failure, liver disease)
[b]Serum submitted before elective surgery (e.g. neuter, declaw), vaccination, or for screening of an apparently normal cat
[c]No historical information provided

assay (ELISA)-96 well test kit (PETCK FTLV™, Idexx Corporation, Portland, Maine, USA) was used for determination of FIV status (10). Duplicate samples were coded, frozen at −20°C, and stored until tested separately. Samples were thawed and tests performed using the directions of the test kit manufacturer. Plates were read using an automated spectrophotometric ELISA plate reader (EL 310, Bio-Tek microplate autoreader, Burlington, Vermont, USA). Samples with duplicate positive results were considered to be FIV-positive. The manufacturer reports a sensitivity of 93% and a specificity of 98% for this test. If one sample test was negative and the duplicate positive, the case was not included in the study. This occurred in only two cases out of 673 pairs of samples tested (0.15%). Without additional testing by the Western blot technique, it is impossible to identify whether these were true positives or false positives (1,4,10,11).

Data analysis

Seroprevalence of FIV and its 95% confidence limits were calculated. The data were analyzed using Minitab (Minitab Release 7.1, 1989, Minitab Inc., State College, Pennsylvania, USA) and BMDP (BMDP Statistical Software, Inc., 1990, Los Angeles, California, USA) statistical software packages. Differences between FIV-positive and FIV-negative cats with regard to age were assessed using Student's *t*-test. Contingency table analyses using the Chi-square statistic were used to assess differences between seropositive and seronegative cats with regard to breed, sex, gender, reason for presentation (sick, healthy, undetermined), and FeLV infection status. Odds ratios (O.R.) and 95% confidence intervals (c.i.) were determined for these variables. All variables and their two-way interactions were entered into a logistic regression model and backwards elimination was used to remove variables not significant at $p = 0.15$ (12,13).

Results

A total of 671 cats were tested for FIV during the 19 months of the study (Table 1). Of these, 51 (7.6%), were identified as seropositive (95% c.i. 5.6%-9.6%).

Some data for serum submissions were incomplete on laboratory request forms. Gender was recorded for 640 cats, of which 20% were intact males, 33% were castrated males, 21% were intact females, and 26% were spayed females. The median age of cats (n = 622)

Table 2. Multiple logistic regression model

Variable	Coefficient	SEM	Odds ratio	
			Point est.	95% c.i.
All males	0.9512	0.3414	2.586	1.325–5.050
Intact[a] cats	0.61161	0.3366	1.843	0.953–3.566
Age[b]	0.12424	0.0307	1.132	1.066–1.203

[a]All intact cats regardless of sex
[b]Association with FIV-positive status for each additional year of age

at the time of testing was four years, with first and third quartiles being one and nine years, respectively. Age distribution was skewed to the right (mean age = 5.5 years). Of the 635 cats with breed information available, 64% were domestic shorthair, 25% were domestic longhair, 8% were Siamese, and 3% represented other pure breeds. Of 280 cats with FeLV test results available, 49 (17.5%) were seropositive for FeLV at the time of testing.

Simple associations between sex (male or female), neutering status, breed, age (categorized), FeLV status, and FIV are reported in Table 1. The mean age of FIV-positive cats (8.0 years) was significantly greater than the mean age of FIV-negative cats (5.3 years, $p = 0.0006$). The prevalence increased in each age group. In the 640 cats of known gender, males were more likely to be FIV-positive than females (10% and 5%, respectively, $p < 0.025$). The prevalence among intact males (11.7%) was higher than castrated males (9.0%), while the prevalence of FIV was slightly lower in intact females than in spayed females (4.5% vs. 5.4%). The effect of neutering or spaying was not statistically significant ($0.1 > p > 0.05$). The prevalence of FIV was close to 8% in domestic shorthair, domestic longhair, and Siamese cats. There were no cases among 18 other purebred cats. The association between breed and FIV status was not significant ($0.75 > p > 0.5$). The seroprevalence of FIV among 49 FeLV-positive cats was 10.2%, and, among 231 FeLV-seronegative cats, FIV prevalence was 6.9%. The difference was not statistically significant ($0.5 > p > 0.25$). Of the 671 serum samples submitted, 99 came from healthy cats, 428 came from sick cats, and the health of 144 cats could not be determined from the laboratory submission form. Prevalence of FIV among ill cats was 11.1%, slightly higher than the prevalence among healthy cats but this was not significant (8.8%, $0.75 > p > 0.5$). The prevalence of FIV among cats that were of unknown health status was 5.5%. This was not significantly different from either well or sick cats ($0.25 > p > 0.1$).

The logistic regression model (Table 2) supported the results of the univariate analyses. Male cats were more than twice as likely as female cats to be seropositive for FIV (O.R. = 2.59, 95% c.i. 1.324–5.505), and intact cats, regardless of sex, were (O.R. = 1.84) more likely than neutered or spayed cats to be seropositive, although this was not significant at the 0.05 level ($p = 0.07$, 95% c.i. 0.953–3.56). Age was a significant predictor variable ($p = 0.009$), with each additional year of life being associated with a risk 1.132 times greater than the previous year (95% c.i. 1.066–1.203).

Discussion

The presence of an antibody to FIV is currently assumed to imply lifelong active viremia due to the persistent nature of the virus in the host (1,4,6,9,14–19). Therefore, prevalence of infection correlates with a seropositive antibody, except for early incubational cases prior to production of antibody (1,14). Testing of samples submitted to a diagnostic laboratory also represents a selection bias. The number of submissions from individual provinces was inadequate for determination of prevalence by province. The power of testing subgroups for possible associations becomes reduced because the number of cats in each subgroup becomes too small to be meaningful. The freezing and thawing of sera has been reported not to affect the reproducibility of results for the FIV antibody assay (18). False positive and negative test results can occur due to undetermined factors. However, the indirect ELISA test used is reported to have a very good correlation to Western blot techniques which are considered highly sensitive (10,11).

A prevalence of 7.6% in our population of cats is consistent with other published reports from around the world (20). Seroprevalence of FIV is reported as being lower in healthy cats (1.2–12.0%) and higher in ill cats (10.2–28.0%) in North America (4,7,8,10,14–16,23). Our study showed that 11.1% of ill cats were FIV-positive, but this was not statistically significant ($p > 0.05$) when compared to healthy cats at 8.8%. This could relate to differences in the populations as described above or to sampling bias. There were not enough clinical signs or diseases recorded with submission forms to identify specific clinical signs or diseases which might be associated with FIV-positive status in Atlantic Canada. Other reports suggest that clinical signs associated with the chronic stage of FIV include nonregenerative anemias, neutropenia, lymphopenia, neoplasias, gingivitis and stomatitis, recurrent abscesses, enteritis, nonspecific neurological signs, and co-infections with FeLV, toxoplasmosis, demodectic mange, and other opportunistic secondary infections (4,8,18,19,20,22,23). These clinical associations continue to be debated since few cohort studies, with adequate numbers of cats in each group, have accompanied their reports (22,23).

Our results include a mean age of FIV-seropositive cats as eight years and that there is an increasing risk

associated with age. Prevalence is dependent on duration of antibody (assumed life-long) in the population, age of the cat (increasing risk of exposure and disease), and the rate of removal (death) of seropositive cats (4,18–20). It is difficult to tell how these contributed to the significant increase in prevalence associated with age in this cross-sectional study.

All male cats are at increased risk of FIV-positive status (O.R. = 2.59) compared to all females, regardless of neutering, in our study. This is consistent with the reports of others who also have found an increased incidence of FIV in male cats (3,4,15,16,18–20,23). The association of sex and FIV-positive status is hypothesized to be the result of increased risk of transmission that might occur with fighting and biting among free roaming, intact male cats. There is indication of further interaction between sex (male vs. female) and castration or spaying, with the effect of neutering being protective in males, but spayed female cats having slightly higher risk of FIV (Table 1). Again, the power of the testing of subgroups for associations becomes reduced because the numbers of cats in each subgroup becomes smaller. This may explain why sex/neuter status in the above interaction was not quite significant in the logistic regression model ($p = 0.07$).

In this study, FeLV status did not appear to be associated with seropositivity of FIV although the results were not statistically significant. This lack of association has been reported previously (4,8,17,23). Why it is not in agreement with results of studies from other geographic locations, such as Texas, which do report association of FIV and FeLV, is not known (19). It could be related to differences in regional populations of cats, opportunities for interaction between cats, prevalence of different viral strains of FIV and FeLV, and selection bias (19,21). The association of FIV and FeLV as reported by Cohen *et al* (19) does not mean that there is a cause and effect relationship (4,8,20,23).

Feline immunodeficiency virus is present in the Atlantic region of Canada. The epidemiological patterns are similar to those reported elsewhere in North America. We recommend that FIV be considered, by veterinarians in the Atlantic region of Canada, as a differential diagnosis for cats with clinical findings consistent with FIV. CVJ

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