NOTE *Virology*

Seroprevalence of Viral Infections in Domestic Cats in Costa Rice

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ABSTRACT. A cross-sectional survey of a convenient sample of domestic cats from Costa Rica's greater metropolitan area was carried out to determine the prevalence of antibodies against feline herpesvirus type 1 (FHV-1), feline parvovirus (FPV), feline immunodeficiency virus (FIV) and antigens of feline leukemia virus (FeLV). Blood samples were collected from at least 96 cats from June 1998 to December 2001; data related to the individual cats and household variables were obtained using a questionnaire. Antibodies against FHV-1 were found in 71.9% of the cats sampled, but only 25.0% of them had a history of previous vaccination. The prevalence of FPV was 92.8%, and all positive cats showed protective antibodies titres; however, only 16.5% of them were previously vaccinated. Antigens of FeLV were detected in 16.7% of the sampled cats; 11 (64.7%) of the 17 positive cats were older than 1 year at the time of testing. No differences were found between the percentage of seropositive males and females. Antibodies against FIV were detected in 8.8% of the samples tested; 8 (88.8%) of the seropositive cats were older than 1 year of age, and a greater proportion of seropositive males (66.6%) was found.

KEY WORDS: feline herpesvirus type 1, feline immunodeficiency virus, feline leukemia virus, feline parvovirus.

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Approximately 25% of the Costa Rican territory has some level of protection for its biological diversity. Six New World felids (*Leopardus tigrina, Leopardus wiedii, Leopardus pardalis, Herpailurus yaguaroundi, Panthera onca, Puma concolor*) are found in these protected areas. However, due to rapid population growth, the habitats of these wild felids are being fragmentized, and therefore contact between wild and domestic animals is possible. Epidemiological surveys of viral diseases in domestic cat populations have been conducted in developed countries [1, 6, 13, 15], with only a few reports in tropical countries [14, 16]; however, a worldwide distribution of these viruses is suspected [11]. The purpose of this study was to determine the prevalence of antibodies against feline herpesvirus type 1 (FHV-1), feline parvovirus (FPV), feline immunodeficiency virus (FIV) and antigens of feline leukemia virus (FeLV) in domestic cats from the greater metropolitan area of Costa Rica in order to assess the possible risk to endangered wild felid populations [3, 10, 16].

FHV-1 is an agent associated with upper respiratory tract diseases and causes rhinotracheitis [8]. FPV is highly contagious, inducing an acute disease characterized by leukopenia, fever, depression, dehydration and diarrhea in domestic cats [7]. Finally, FeLV is known to cause neoplastic diseases, and FIV can lead to immune suppression; both FeLV and FIV are associated with AIDS-like syndromes [9, 19].

At least 96 blood samples were collected from domestic cats from June 1998 through December 2001. This number was determined with Winepiscope 1.0 (95% confidence, 10% acceptable error) and was based on the assumption that the total number of cats in the greater metropolitan area of Costa Rica was proportional to 5% of the human population of that area. Selection of the animals for sampling was based on voluntary participation of the cats' owners attending veterinary clinics or home-to-home requests. Data were collected about the individual cats (age, gender), lifestyle habits (indoor or outdoor), household variables (single or multiple cat households) and information about previous vaccinations (the only vaccine available in the country at that time was Eclipse 3®, Fort Dodge, U.S.A.) that contained modified live feline parvovirus, herpesvirus-1 and calicivirus, using a questionnaire. Statistical analysis was carried out by calculation of both the absolute and relative frequencies (percentages). Additionally, multiple hypotheses testing for two proportions was performed to compare the percentages of seropositive cats between the types of virus taking the stratum of the variables into account and between the strata of each variable within the same type of virus using an alpha value of 0.05 as the threshold.

Antibodies against FHV-1 were detected by serum neutralization (SN) assay, as described previously [4], using 100–200 TCID50 of FHV-1-CR1 (field strain from Costa Rica isolated by Dolz *et al.* [5] from a cat with upper respiratory tract disease). To detect antibodies to FPV, a haemagglutination inhibition assay was carried out, as described previously [2], using as antigen feline parvovirus from the Eclipse 3® vaccine after formalin and heat inactivation. A commercial kit (Cite-Combo®, IDEXX Co., Portland, ME, U.S.A.) was used to detect FeLV antigen and antibodies against FIV, according to the manufacturer's instructions.

Antibodies to FHV-1 were detected in 69 (71.9%) out of 96 cat sera tested (Table 1). The antibody titres determined were between 1:2 and 1:1024, presenting a bimodal distribution (titre 1:4, 15.9%; titre 1:128, 23.2%). A higher pro-

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Table 1. Prevalence of antibodies against FHV-1, FPV and FIV and of antigens of FeLV in domestic cats in the metropolitan area in Costa Rica

Variable	Categories	No. of positive cats/No. of cats tested (positive %)			
		FHV-1	FPV	FeLV	FIV
Age	<1 year	26/36 (72.2)^{a1}	30/36 (83.3)^{a1}	0/28 (0.0)^{b1}	1/28 (3.6)^{b1}
	1–3 years	16/25 (64.0)^{a1}	27/27 (100.0)^{b2}	5/28 (17.9)^{c2}	5/28 (17.9)^{c2}
	> 4 years	17/19 (89.5)^{21}	9/10 (90.0)^{a1}	6/21 (28.9)^{b2}	3/21 (14.3)^{b2}
	ND*	10/16 (62.5)^{a1}	24/24 (100.0)^{b2}	6/25 (24.0)^{c2}	0/25 (0)^{d1}
Sex	Female	34/47 (72.3)^{a1}	35/40 (87.5)^{a1}	6/44 (13.6)^{b1}	3/44 (6.8)^{b1}
	Male	26/37 (70.3)^{a1}	40/42 (95.2)^{b1}	6/44 (13.6)^{c1}	6/44 (13.6)^{c1}
	ND	9/12 (75.0)^{a1}	15/15 (100.0)^{b2}	5/14 (35.7)^{c2}	0/14 (0)^{d2}
Cat lifestyle	Outdoor	24/37 (64.9)^{a1}	44/49 (89.8)^{b1}	6/41 (14.6)^{c1}	5/41 (12.2)^{c1}
	Indoor	27/37 (73.0)^{a1}	15/16 (93.8)^{b1}	1/27 (3.7)^{c2}	2/27 (7.4)^{c1}
	ND	18/22 (81.8)^{a1}	31/32 (96.9)^{b1}	10/34 (29.4)^{c1}	2/34 (5.9)^{d1}
Household	Multiple cat	47/62 (75.8)^{a1}	48/53 (90.6)^{b1}	2/59 (3.4)^{c2}	6/59 (10.2)^{c2}
	One cat	8/17 (47.1)^{21}	15/17 (88.2)^{b1}	5/16 (31.2)^{a2}	1/16 (6.2)^{c1}
	ND	14/17 (82.4)^{a1}	27/27 (100.0)^{21}	10/27 (37.0)^{c2}	2/27 (7.4)^{d1}
Vaccines	Vaccinated	24/33 (72.7)^{a1}	16/18 (88.9)^{b1}	0/0 (0)^{c1}	0/0 (0)^{c1}
	Unvaccinated	32/45 (71.1)^{a1}	48/52 (92.3)^{b1}	17/102 (16.7)^{c2}	9/102 (8.8%)^{c2}
	ND	13/18 (72.2)^{a1}	26/27 (96.3)^{b1}	0/0 (0)^{c2}	0/0 (0)^{c2}
	Total	69/96 (71.9)^{a}	90/97 (92.8)^{b}	17/102 (16.7)^{c}	9/102 (8.8)^{c}

*ND: Not determined. The letters (a-d) indicate statistical differences between different viruses, taking the stratum into account (horizontally), while the numbers (1–2) indicate statistical differences between strata within the same virus for each variable (vertically) using an alpha value of 0.05 as the threshold.

portion of cats older than 4 years of age was seropositive to FHV-1. No differences were observed between the number of seropositive males and females nor the indoor and outdoor cats; however, among the single cat households, a lower percentage of seropositive cats was determined (Table 1). Of the cats seropositive to FHV-1, only 24 (34.8%) had been reported as previously vaccinated; no differences were observed between the proportions of seropositive vaccinated and unvaccinated animals (Table 1).

Antibodies against FPV were detected in 90 (92.8%) out of the 97 sera tested (Table 1). The distribution of antibody titres (1:160–1:2560) was homogenous in 72 (80%) of the sera tested. All age categories showed similar proportions of cats seropositive to FPV, and differences were found in the 1 to 3 years age group. No differences were found between the percentage of seropositive animals within the variables of gender, indoor or outdoor cats and single or multiple cat households. Only 16 (17.8%) of the cats FPV-positive were reported as previously vaccinated; no differences were observed between seropositive vaccinated and unvaccinated animals (Table 1).

Antigens of FeLV were recognized in 17 (16.7%) of the 102 serum samples analysed, with no positive cats in the <1 year age group. No differences were found between the number of positive males and females, except within the variables of indoor or outdoor cats and single or multiple cat households. It is noteworthy that 5 seropositive animals lived in single cat households but were allowed to go outside. All 17 FeLV positive animals were not vaccinated, since the vaccine was not available in the country at that time (Table 1).

Antibodies against FIV were found in 9 (8.8%) of the 102 samples tested. Differences were found within the variables of age and gender, that is, a lower proportion of positive animals was found in the <1 year age group and a higher percentage of seropositive cats were males, respectively; none of the 9 cats positive for FIV were vaccinated (Table 1).

The results of the serological survey carried out in domestic cats from the greater metropolitan area of Costa Rica determined high prevalences for FHV-1 and FPV that were similar to those reported in Guatemala (72.3% and 50.0%, respectively), whereas the prevalences determined for FIV and FeLV were similar to those reported in the Czech Republic (5.8% FIV, 13.2% FeLV).

The results obtained in this study indicate that FHV-1 is widely distributed among the domestic cat population of Costa Rica, which is similar to the results of a study in Guatemala in accordance with the Guatemala's study [14] and in agreement with previous results obtained in Costa Rica [5], where nasal, ocular and oral swabs from 24 cats with upper respiratory tract disease were examined, and FHV-1 was isolated from 8 samples (33.3%) and feline calicivirus (FCV) was isolated from 2 samples (8.3%). High prevalences of FHV-1 were found in the all age categories, and only the group of animals living in single cat households showed a lower percentage of seropositives, confirming that this virus is possibly transmitted by direct contact between cats in Costa Rica [11]. Only 34.8% of the seropositive animals were reported as previously vaccinated, and no differences were found between the proportions of seropositive vaccinated and unvaccinated animals. This could be due to the wide distribution of FHV-1 in Costa Rica rather than to vaccination programs with a live modified vaccine.

The prevalence for FPV determined in domestic cats of

the metropolitan area of Costa Rica was in accordance with that reported for captive wild felids from Costa Rica (100%; unpublished data). Differences were found between the number of seropositive animals within the different age categories, but not within the variables of indoor or outdoor cats, single or multiple cat households and vaccinated or unvaccinated cats, suggesting natural exposure of cats to the relatively stable and resistant FPV at early ages in Costa Rica, which might be due to the high presence of the agent in the cat population, especially if we take into consideration that only 17.8% of the seropositive cats were reported as previously vaccinated. Another possible reason for this observation could be contact and natural exposure of domestic cats with canine parvovirus (CPV). CPV infection in dogs is very common in Costa Rica, and as described elsewhere, the canine agent shares several antigens with FPV that could cross-react in serological tests [17, 18].

The prevalences of FeLV and FIV determined for the domestic cats of Costa Rica are similar to those reported in Guatemala and Czech Republic [12, 14]. No differences were found in the prevalences of FeLV and FIV in Costa Rican domestic cats, and animals of different ages were infected with FeLV with no apparent gender preference; on the other hand, most of the animals positive to FIV were males, which is in accordance with the literature [6, 12, 13].

Our results revealed high prevalences for FHV-1 and FPV and the presence of FIV and FeLV in domestic cats in Costa Rica. A previous study demonstrated a high prevalence of FPV in captive wild felids of Costa Rica (unpublished data), indicating potential risks for populations of endangered wild felids, especially since most domestic cats in Costa Rica are allowed to go outdoors and are not vaccinated.

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