Ankara Üniv Vet Fak Derg, **57**, 271-274, 2010

Short Communication / *Kısa Bilimsel Çalışma*

Prevalence of feline coronavirus (FCoV) and feline leukemia virus (FeLV) in Turkish cats

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Summary: The aim of this study was to determine prevalence of Feline Coronavirus (FCoV) with concurrent Feline Leukemia Virus (FeLV) infections in that had no clinical signs living in different cities of Turkey. FCoV antibodies and FeLV antigens/antibodies were investigated in cats by using ELISA. The results showed that 37 (69.8%) of cats had FCoV antibodies and 2 (3.8%) of cats had FeLV antigens, 4 (7.5%) of cats had FeLV antibodies. Additionally, the FCoV antibodies were detected in all cats having FeLV antigen (n=2) and 75% of cats having FeLV antibody (n=4). The results of study showed the presence both of FCoV and FeLV of cats in association with different age, sex living conditions and environment in Turkey.

Key words: FCoV, FeLV, cat, Turkey.

Türkiye'de kedilerde feline coronavirus (FCoV) ve feline leukemia virus (FeLV) prevalansı

Özet: Bu araştırmada, Türkiye'nin farklı illerinden örneklenen ve klinik bulgu göstermeyen 53 kedide (20 sokak, 33 ev kedisi) Feline Corona Virus (FCoV) ve Feline Leukemia Virus (FeLV) enfeksiyonlarının birlikte varlığının tespit edilmesi amaçlanmıştır. FCoV antikorları ve FeLV antikor/antijen tespiti ELISA testi yardımıyla yapılmıştır. Kedilerden 37 adedinde FCoV antikorlarının varlığı ve 2 adedinde (%3.8) FeLV antijeni, 4 adedinde (%7.5) FeLV antikorları saptanmıştır. Ayrıca FeLV antijen pozitif olan kedilerin (n=2) tamamı (%100) ve antikor pozitif olan kedilerin (n=4) %75'i FCoV antikorları yönünden pozitif olarak tespit edilmiştir. Bu çalışma, Türkiye'deki farklı yaş, cinsiyet ve sosyal çevredeki kedilerde FeLV ve FCoV enfeksiyonlarının beraber varlığına dair sonuçları içermektedir.

Anahtar sözcükler: FCoV, FeLV, kedi, Türkiye.

The *Feline Coronaviruses* (FCoV) belongs to family of *Coronaviridae* which are positive sense enveloped RNA viruses. These viruses are common in domestic and wild life *felidae*, particularly in animal shelters in the world. Based on pathogenicity FCoV has been divided into two biotypes, termed *Feline Enteric Coronavirus* (FECV) and *Feline Infectious Peritonitis Virus* (FIPV), has been further divided in to type I and type II according to their serological relatedness (3). Although a virulent FCoV strains cause minor infections, their seroprevalences are high in cat populations. The mutations on FECV genome in some immunosuppressive events, differences of gender, age parameters and multiple household can lead to the development of virulent variants in the presence of FCoV antibodies in cats which may cause FIP (13).

Feline leukemia virus (FeLV) is a retrovirus which is responsible for causing tumor formation in haematopoietic organs with high morbidity in *felidae* (4). As FCoV infection, FeLV can be transmitted through saliva of infected cats and spreads rapidly among susceptible cat population. FeLV causes persistent and slow virus infection with immunsupression. Leukemia is also the major consequence of the disease and cats commonly die as a result of immunodeficiency. It is important for predisposing cats to other bacterial infection and viral infections especially FCoVs and FIVs (9, 11, 12).

In our previous study, we searched that FCoV infection of cats in different age, sex and breeding conditions in randomly sampling by using RT-PCR for the first time in Turkey (6). Following that the objective of the present study is to investigate the presence of concurrent FeLV and FCoV infections in cats living in different cities of Turkey and had no clinical signs for both infections.

A total of 53 blood serum samples were selected randomly from 20 of free living or stray cats (in two cities; Elazığ, n=9 and Kayseri, n=11) and from 33 indoor cats in two cities (İstanbul, n=3 and Ankara, n=30) in this study. The cats were at different age, sex, breeds but all were seen clinically healthy. The whole blood samples taken from the jugular vein and sera were separated and stored at -80°C until they were analysed. The samples were tested serologically and virologically. ELISA kits were used to detect FeLV p27 antigen, FeLV gp70 antibody and FCoV antibody (B.V. European Veterinary Laboratory, F1001-AG01, F1006-AB01, F1005-AB02, the Netherland), respectively. The kits were used as described by their manufacturer. Chi-square test was used to analyze the statistical significance of the results depend on the seropositivity rates for FCoV and FeLV in cats ($p<0.05$ was accepted as significant).

The analysis of the blood samples collected from 53 cats were found that 2 (3.8%) had FeLV antigen, 4 (7.5%) had antibodies against FeLV and 37 (69.8%) had antibodies against FCoV (Table 1). Both of FCoV and FeLV antibodies were detected in 3 of 53 (5.66%) cats. The differences of rates of FCoV and FeLV infections between indoor and outdoor cats were not statistically significant ($p>0.05$).

Table 1. The rates of FCoV antibody, FeLV antibody/antigen in cats.
Tablo 1. Kedilerde FCoV antikor ve FeLV antikor/ antijenlerinin oranları.

Remarks	Cats tested (n)	FCoV	FeLV	
		Ab+ (%)	Ab + (%)	Ag + (%)
Outdoor cats	20	14 (70.0)	1(5.0)	1(5.0)
Indoor cats	33	23 (69.7)	3(9.1)	1(3.0)
Total cats	53	37 (69.8)	4(7.5)	2(3.8)

The serological test results of FCoV and FeLV in cats were shown in Table 2 including their age and sex. The antibodies of FeLV were detected in 4 cats in different age (1-13 year) and sex (2 male and 2 female). Due to the low level of positivity rate for FeLV antibodies, no significant difference were observed in the detection rates of FCoV antibodies in cats related to sex and ages ($p>0.05$). The antibody positivity rates of FCoV and FeLV for indoor and outdoor cats related to ages were shown in Table 3.

According to the serological and virological surveys carried out in many countries of world including Turkey (5, 6, 7, 12, 14), FCoV and FeLV infections are widespread in wild and domestic *felidae*. In the present study, FCoV antibody positivity was detected 69.8% and

Table 2. Distribution of antibodies to FCoV and FeLV according to age and sex.
Tablo 2. Yaş ve cinsiyete göre FCoV ve FeLV antikorlarının dağılımları.

Age	Tested Cat No (♂+♀)	FCoV seropositive (%)			FeLV seropositive (%)		
		♀	♂	Total	♀	♂	Total
6 m-1 y	15 (8:7)	8 (88.8)**	5 (83.3)**	13 (86.6)	1 (11.1)	1 (16.6)	2 (13.3)
2 y	17 (9:8)	8 (72.7)*	5 (83.3)	13 (76.5)	-	-	-
3 y	16 (11:5)	6 (60.0)	4 (66.6)	10 (62.5)	-	-	-
5 y	1 (1:0)	-	-	-	-	-	-
6 y	2 (2:0)	-	-	-	-	-	-
7 y	1 (1:0)	-	1 (100)*	1 (100)	-	1 (100)**	1 (100)
13 y	1 (1:0)	-	-	-	1 (100)	-	1 (100)
Total	53 (33:20)	22 (66.6)	15 (75.0)	37 (69.8)	2 (6.1)	2 (10.0)	4 (7.5)

* It is detected as positive FeLV antigen.
** It is detected as positive for antibodies to FeLV and FCoV.

Table 3. Antibodies to FCoV and FeLV in indoor and outdoor cats according to age.
Tablo 3. Yaşa göre ev ve sokak kedilerinde FCoV ve FeLV antikorlarının dağılımları.

Age	Tested cats (n) (indoor:outdoor)	FCoV Ab positive (%)		FeLV Ab positive (%)	
		indoor	outdoor	indoor	outdoor
6m - 1y	15 (8:7)	7 (87.5)**	6 (85.7)**	1 (12.5)	1 (14.2)
2 y	17 (9:8)	7 (77.7)	6 (75.0)*	-	-
3 y	16 (11:5)	8 (72.7)	2 (40.0)	-	-
5 y	1 (1:0)	-	-	-	-
6 y	2 (2:0)	-	-	-	-
7 y	1 (1:0)	1 (100)*	-	1 (100)**	-
13 y	1 (1:0)	-	-	1 (100)	-
Total	53 (33:20)	23 (69.6)	14 (70.0)	3 (9.0)	1 (5.0)

* It is detected as positive FeLV antigen.
** It is detected as positive for antibodies to FeLV and FCoV.

this rate was found much higher than the other countries such as 18.3%, 24.3%, USA and UK, respectively (7, 10).

We found that the positivity rate for FeLV infection is 11.32% (6/53) in 53 cats, are higher than the results of other studies including U.S., Japan and Turkey found 2.3-3.3%, 2.9%, 5.8%, respectively (9, 10, 11, 12, 14). We thought that the reason of high proportion of FeLV infection positivity could be sampling from different geographic region and stray cats.

FCoV is mainly transmitted by fecal-oral route that is more frequent in younger cats than in adult cats (8, 13). Additionally, FeLV has been found commonly in younger colony cats (12). There was no significant difference in seroprevalence for FCoV and FeLV between cats younger one year in this study. Besides in the cats with the age groups less than 1 year were found as positive for FeLV antibody. The cats between 2 and 6 years old were not found as positive for FeLV antibodies. In the older cats the seropositivity rates have no significant importance but we found as positive a cat seven years old for both of antibody to both FCoV/FeLV and FeLV antigen. Although in the cats between 2 and 3 years old seropositivity rate of FCoV were found high (76.5%, 62.5%), seroconversion of FeLV could not detected in same age distance.

We found the seropositivity rate of FCoV in male and female cats were 75.0% and 66.6%, respectively, in our study, and but the statistical differences were not significant. Our results are on contrary with other studies reported 37.3% in male and 56.1% female cats in UK (7) and 25% in male and 35% in female in Swedish cats (8). The prevalence of FeLV infection was detected in female cats 6.1% and in male cats 10%. There has not been a strong agreement or conclusion among the researchers, in that some of them reported that female cats are susceptible to FeLV infection (11, 14), while others were not (5, 12). According to our results it is assumed that FCoV and FeLV infections could be occur often in male cats.

It was known that several factors affect the seroprevalence of FCoV, such as the differences in population, social interaction (multiple cat household), breed, age and geographical localisation (2, 8). In the present study, most of FCoV seropositive cats were between 6 month and 3 years old and seropositivity rate of outdoor and indoor cats is similar each other. We also detected the higher prevalence of FeLV in indoor cats and our results agreed with some studies (1), however some other studies (11) reported on contrary with these results. As some researchers (5) reported that FeLV positivity rates were also significantly higher in cats from multi-cat households, we were not able to compare our results with this fact due to the lack of the informations about the population density and socio-cultural features of indoor cats used in our study.

The present study was carried out to determine whether the presence of the both FCoV and FeLV infections of cats occurred either either by coincidentally or synergistically. In conclusion, we reported that the presence of FeLV and FCoV infections in cats had no clinical signs at different age, sex and social interaction in Turkey. However they are seen healthy, it should be noted that they may be have a potential risk for other healthy outdoor and indoor cats. Our results may be suggestive for future investigations that the researches collecting samples from cats showing clinical sings for FCoV should also investigate concurrent FeLV and FCoV infections.

Our preliminary results highlight the importance and necessity of the more and deliberate studies for investigating both FeLV and FCoV infections in larger cat populations throughout the world. This will provide a better understanding of the epidemiology and pathogenicity of these infections.

Acknowledgement

The authors wish to thank Prof.Dr Feray Alkan, from Department of Virology, Faculty of Veterinary Medicine, University of Ankara, for helpful critics on the manuscript**.**

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Geliş tarihi: 02.03.2009 / Kabul tarihi: 16.10.2009

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