Seroepidemiological Survey of Feline Retrovirus Infections in Cats in Taiwan in 1993 and 1994

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(Received 8 September 1994/Accepted 8 November 1994)

Abstract. In order to investigate the prevalence of infections with three feline retroviruses (FIV), feline leukemia virus (FeLV) and feline syncyial virus (FSV) in Taiwan, we collected a total of 75 blood samples from cats from veterinary hospitals, a breeding cattery and a homeless shelter in 1993 and 1994. We examined the presence of anti-FIV and FSV antibodies in FeLV-p27 antigen in these samples by the indirect immunofluorescence and enzyme-linked immunosorbent assays. All of the serum samples positive for FIV were obtained from healthy cats and the overall FIV positive rate was 4%. The overall positive rates of FSV and FeLV were 28% and 1.3%, respectively. From these results, together with previous seroepidemiological surveys by others, it was revealed that the prevalence of FIV and FeLV infections appeared to be lower in Taiwan than in the United States or Japan. In contrast, the prevalence of FSV infection in Taiwan was as high as that in Japan. - Key words: feline retrovirus infection, seroepidemiology, Taiwan.


Three retroviruses, i.e. feline leukemia virus (FeLV), feline immunodeficiency virus (FIV) and feline syncytial virus (FSV), are recognized to infect cats. FeLV, FIV and FSV belong to the genera oncovirus, lentivirus, and spumavirus, respectively. Infection with the respective viruses causes several diseases in cats. FeLV, which was first isolated in Scotland in 1964, causes leukemia, anemia, and immunodeficiency [9]. Seroepidemiological surveys conducted in the United Kingdom showed that the prevalence of FeLV was 4.5% and 17.5% in healthy and sick cats, respectively [6]. Infection rates in Europe, the United States and Canada, and Japan ranged from 4.5% to 11.5% [1–3, 7, 24]. FIV was first isolated in the United States in 1986 from a cat with an acquired immunodeficiency syndrome (AIDS)-like disease [22]. FIV infection in cats causes AIDS-related diseases including stomatitis, gingivitis, anemia, neurological dysfunctions and others [8, 29]. Seroepidemiological surveys conducted in several countries revealed that FIV is prevalent worldwide, and that the incidence of FIV infection in cats varied from 1% to 15% in healthy cats and from 3% to 44% in diseased cats [14]. In retrospective seroepidemiological surveys conducted in Japan and the United States, sera positive for FIV were found in samples collected in 1968 [3, 25], suggesting that FIV did not arise in recent years but existed in these countries as early as 1968. FSV has been isolated from normal and neoplastic tissues of cats [10, 11, 20]. Diseases tentatively associated with FSV infection include arthritis in old male cats [23] and urolithiasis [26]. However, it is difficult to make a specific association with disease because of the widespread asymptomatic infection in the cat population.

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Seroepidemiological survey conducted in Japan revealed that the infections rates of FSV were 13.7% by Mochizuki et al. [19] and 26.4% by Furuya et al. [3].

The existence of FIV and FeLV infections in the cat population of Taiwan was first indicated by serological findings in 3 and 7 out of 117 cats in 1990, respectively [12]. However, no advanced serological evidence of FIV and FeLV infections has been available up to now. Furthermore, there is no report on the prevalence of FSV infection in Taiwan. In this report, we performed a serological survey of the three retrovirus infections from a random sampling of domestic and homeless cats.

As shown in Table 1, for detection of antibodies to FIV and FSV, and of p27 antigen of FeLV, a total of 75 serum samples were obtained from three different areas in Taiwan in July and August 1993, and January 1994. The blood samples, from which sera were isolated, were collected by adding heparin for anticoagulation. Groups 1 and 2 were submitted by cat owners to hospitals A and B with complaints of various symptoms, but not particularly FIV symptoms. Group 3 comprised various age groups of cats from a breeding cattery. Group 4 consisted of two parts of various age groups of homeless cats from the same cat shelter.

The antibodies against FIV and FSV were detected by the indirect immunofluorescence assay (IFA) using smeared glass slides of cells from a feline T lymphoblastoid cell line (MYA-1 cells) [15] infected with FIV TM1 strain [16], and Crandell feline kidney (CRFK) cells infected with FSV Coleman strain [4], respectively. MYA-1 cells were maintained in RPMI 1640 medium supplemented with 10% fetal calf serum (FCS), antibiotics, 5 µM 2-mercaptoethanol, 2 µg/ml polybrene and 100 units/ml of recombinant human interleukin-2 as described previously [15]. CRFK cells were maintained in Dulbecco's modified Eagle's medium supplemented with 10% FCS and antibiotics. Anti-cat immunoglobulin G antibody conjugated with fluorescein isothiocyanate was used as a second antibody. Serum samples were screened.
Table 1. Source of cat serum and positive rate of FIV, FSV and FeLV infections in the cats of Taiwan in 1993 and 1994

<table>
<thead>
<tr>
<th>Group No.</th>
<th>Year</th>
<th>Area</th>
<th>Cat owner</th>
<th>Source</th>
<th>No. of cat</th>
<th>Age (years)</th>
<th>Physical condition</th>
<th>FSV</th>
<th>FIV</th>
<th>FeLV</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1993</td>
<td>Taichung</td>
<td>Domestic</td>
<td>Hospital A</td>
<td>32</td>
<td>1-4</td>
<td>Sick</td>
<td>7(21.9)</td>
<td>0(0)</td>
<td>0(0)</td>
</tr>
<tr>
<td>2</td>
<td>1993</td>
<td>Taichung</td>
<td>Domestic</td>
<td>Hospital B</td>
<td>13</td>
<td>2-5</td>
<td>Sick</td>
<td>0(0)</td>
<td>0(0)</td>
<td>0(0)</td>
</tr>
<tr>
<td>3</td>
<td>1993</td>
<td>Chia-Hua</td>
<td>Domestic</td>
<td>Breeding cattery</td>
<td>6</td>
<td>1-5</td>
<td>Sick</td>
<td>0(0)</td>
<td>0(0)</td>
<td>0(0)</td>
</tr>
<tr>
<td>4</td>
<td>1993-1994</td>
<td>Tam-Sui</td>
<td>Homeless</td>
<td>Shelter</td>
<td>24</td>
<td>2-6</td>
<td>Apparently healthy</td>
<td>14(58)</td>
<td>3(12.5)</td>
<td>3(12.5)</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>75</td>
<td></td>
<td></td>
<td>21(28)</td>
<td>3(4)</td>
<td>3(4)</td>
</tr>
</tbody>
</table>

a) Examined by clinical signs.
b) Nine serum samples were collected in 1993 and 15 serum samples were collected in 1994.

The higher positive rate of FIV and FSV infections in homeless cats, and low positive rate of FeLV infection might be also due to the different transmission modes of the respective viruses. FeLV infection is spread by intimate contact between persistently viremic and susceptible cats [5]. On the contrary, both FSV and FIV are inefficiently transmitted by contact alone and can be efficiently spread by bites [21, 30]. However, it was reported that FSV infection is commonly transmitted in utero [21], but FIV is not [30]. Therefore, it might be possible that FSV infection in Taiwan has been maintained by the in utero transmission mode. Cats which are discarded and roaming from home to home are commonly found in Taiwan recently, therefore, it is possible that the positive rate for both FIV and FSV will increase in the future in Taiwan due to biting. Meanwhile, in Taiwan there are some wild cats (Felis bengalenis) and Formosan gem-faced civets (Paguma larvata taivana) in mountain areas, and sometimes they have been raised by people. They might play a role in virus transmission or as a reservoir. In fact, it was reported that the Iriomote cat (Felis iriomotensis) in Iriomote island, which is located off the south-coast of Japan and near Taiwan, is infected with FSV but not with FIV and FeLV [18]. Further studies of serology and virus isolation from wild cats and Formosan gem-faced civets are important to gain understanding of the relative prevalence of these virus infections among wild cats, domestic cats and homeless cats.

Several isolates of FIV from geographically different countries have been molecularly cloned [17]. There is considerable genomic heterogeneity especially in env genes and long terminal repeats among FIV isolates, which can be divided into three or more subgroups on the basis of the heterogeneity [27, 28]. TM2 strain isolated in Japan was the most distant from the original U.S. isolate (Petaluma strain) [13]. Although the serological tests, including the IFA, could not differentiate the FIV isolates, the seroepidemiological study of FIV infection in Taiwan is an important step for virus isolation, because FIV can be isolated from seropositive cats. Further, it is of...
interest to determine whether FIV isolated in Taiwan belongs to the majority of Japanese type or not.

ACKNOWLEDGEMENTS. We are very grateful to Dr. Y. C. Lin (National Chung-Hsing University), Dr. D. J. Chen (National Veterinary Hospital) and Dr. W. Chi (BAO-AN Veterinary Clinic) for providing one part of the blood samples. We thank Dr. J. M. Gaskin (The University of Florida, Gainesville, U.S.A.) and Dr. M. Hattori (Kyoto University, Kyoto, Japan) for supplying the Coleman strain FSV and a human interleukin-2 producing cell line, respectively. We are also grateful to Dr. J. MacDonald (University of Glasgow, Glasgow, U.K.) for helping in the preparation of the manuscript. This work was supported in part by grants from the Ministry of Education, Science, and Culture, and from the Ministry of Health and Welfare of Japan.

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