Brief Communication

A Household Cluster of Feline Malignant Lymphoma

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Summary. During a 3½-year period, 3 histologically confirmed malignant lymphoma cases and 3 additional clinically diagnosed cases were observed among 34 cats kept for varying lengths of time in the same household. The 3 clinical diagnoses were supported by surgery and necropsy findings consistent with a diagnosis of malignant lymphoma. On the basis of existing incidence data, the occurrence of 3 to 6 cases in 34 cats is far higher than would be expected due to chance alone.

The pattern and occurrence of cases may best be explained by horizontal transmission of an infectious agent. There was a continuum of contact from the 1st to the 6th case. One case was not known to be related to any of the others. However, 5 of the 6 cases were related. Therefore, there was the possibility of inheritance of a genetic factor which affected susceptibility.

While cancer is ubiquitous in man and animals and not generally considered to be epidemic in occurrence, spatial and temporal aggregations of certain cancer forms, especially leukemia and lymphoma, have been observed (21). Occasionally in man, leukemia cases have been reported in related persons as well as nonrelated persons living in very close proximity (1, 9, 11, 15, 19). Multiple cases of lymphosarcoma in the same herds of cattle also have been observed (4, 6, 22).

Malignant lymphoma is often diagnosed in cats (5, 12); however, reports of aggregations in related cats or in those inhabiting the same household were not found. This paper describes what appears to be an unusually large aggregate of malignant lymphoma cases among cats in one household.

Of 34 cats that were owned and kept in the same household for various periods from February 1963 to July 1966, 6 died of malignant lymphoma. Chart 1 shows the number of animals in the household by month from January 1962, and when each malignant lymphoma case was present in the household. Chart 2 illustrates the related cats in the household since January 1962. In February 1963, at the time the first cat became ill, there were 13 cats in the household. During the next 3½ years, 14 cats (5 litters) were born in the household and 7 nonrelated cats entered the household. In addition to the 6 malignant lymphoma cases, 14 others died or left the household for various reasons since February 1963 (Table 1); as of September 1966, 14 cats were still alive in the household. Since January 1962 this household has been located at 3 different residences (Chart 1): Residence A, prior to May 1962; Residence B, from May 1962 to December 1966; and Residence C, from January 1, 1964, to the present. Residences A and B were located in a large metropolitan city. Both houses were wooden frame dwellings, 20 and 40 years old, respectively. Residence B had been used as a commercial cattery by a previous tenant. Approximately one month after the cattery vacated, the subject household moved into the residence. In both Residences A and B, the cats had free access to outside the house and its environs. At least 4 litters were conceived with stray male or female cats (Chart 2).

Residence C was a single-family wooden frame dwelling, 15 to 20 years old, located in a rural area. There was a completely fenced yard equipped with angle fencing to prevent animals from leaving. The cats had free access to the house, the garage, and the yard.

Food and feeding practices were not unusual. The cats were fed both dry and canned commercial cat foods of various brands, occasionally supplemented with a variety of foods normally used for human consumption.

Routine prophylactic immunization was limited to vaccination against feline panleukopenia and feline pneumonitis. Cats were neutered at different ages, with no consistent pattern. Illnesses other than neoplasia were chiefly recurrent upper respiratory disease and feline infectious anemia. Both diseases appeared soon after the move to Residence B and continued to occur in cats at Residence C through the fall of 1965. Flea infestations were a chronic problem.

The sole human occupant of the household at all residences, a 50-year-old Caucasian woman, was in good health. She had not been ill except for an episode of herpes zoster in April 1962, which lasted one month.

In review of all the veterinary records available on cats that died prior to our initial investigation (February 1965), 3 were diagnosed as having malignant lymphoma based upon the disease signs and the findings at surgery and/or necropsy described below. None of these earlier 3 cases (Cases 1–3) was histologically confirmed. Three animals died subsequent to our initial investigation; the presence of malignant lymphoma was confirmed histologically in each case (Cases 4–6).

Case 1. In February 1963, this 6-year-old castrated male, short-haired cat began losing weight. In July, a mass was discovered upon abdominal palpation. An exploratory laparotomy revealed whitish lesions on an enlarged liver and spleen. All of the mesenteric lymph nodes were greatly enlarged. The cat was euthanized.

Case 2. This intact female short-haired cat was 10 months of...
Household Cluster of Feline Malignant Lymphoma

Chart 1. The household cat population by month and the period of time in the household of malignant lymphoma cases. Cases in order of occurrence: 5y, Case 1 entered the household at 5 years of age; B, Cases 2-5 were born in the household; 2m, Case 6 entered at 2 months of age; O, onset of first signs of illness that could be attributed to malignant lymphoma; ML, malignant lymphoma, not confirmed histologically; ML, malignant lymphoma, confirmed histologically.

Chart 2. The related cats in the household, January 1962-July 1966. Numerals indicate age in years as of July 1966, or age at death; m, age in months; X, dead as of July 1966; ?, stray mates; *, left the household as kittens, the two 3-year-olds later returning to the household.

Age at death. Two siblings did not survive to weaning. She was undersized but apparently healthy from birth. In January 1965, the animal developed progressive respiratory distress and abdominal enlargement. Abdominal paracentesis revealed marked ascites. At exploratory laparotomy, whitish lesions were found involving the liver, spleen, and kidneys. The mesenteric lymph nodes were enlarged. Euthanasia was performed.

Case 3. This 22-month-old spayed female long-haired cat had been treated several times for recurring upper respiratory disease. In February 1965, she began to lose weight and polydipsia was noted. Her condition deteriorated rapidly; she was euthanized later that month. Necropsy revealed hepatosplenomegaly and visceral lymphadenopathy consistent with a diagnosis of malignant lymphoma. She was a littermate of Case 5.

Case 4. This intact female short-haired cat was 11 months of age at death. She became listless in February 1965 with a rapid pulse and pale mucous membranes. Treated for feline infectious anemia with tetracycline for 3 weeks, her condition progressively deteriorated and she was euthanized in March. Prior to euthanasia a blood sample was drawn. The packed cell volume was approximately 5%. *Haemobartonella felis*, the causative agent of feline infectious anemia, was present on the surface of some erythrocytes in a blood smear. The differential cell count was: 1.5% band neutrophils, 33.0% segmented neutrophils, 1.0%

The Reasons Cats Left the Household (February 1963–July 1966)

<table>
<thead>
<tr>
<th>Reasons</th>
<th>Number of cats</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>20</td>
</tr>
<tr>
<td>Died, malignant lymphoma</td>
<td>6</td>
</tr>
<tr>
<td>Died, other neoplasm*</td>
<td>1</td>
</tr>
<tr>
<td>Died, other disease</td>
<td>6</td>
</tr>
<tr>
<td>Killed, by dog or cars, or disappeared</td>
<td>4</td>
</tr>
<tr>
<td>Left as kittens</td>
<td>3a</td>
</tr>
</tbody>
</table>

* Sympathicoblastoma.

Two cats that later returned were not included.

TABLE 1

lymphoblasts, 8.0% prolymphocytes, 54.0% lymphocytes, 1.5% monocytes, 1.0% eosinophils. Six metarubricytes were counted per 100 nucleated cells.

At necropsy the mucous membranes were pale and the blood was light in color and thin in consistency. There was moderate peripheral lymphadenopathy. The anterior mediastinal lymph node, measuring 4.0 x 3.0 x 1.5 cm, was the only visceral lymph node enlarged. Upon cutting, it had a soft, even, uniform consistency, and the cut surface was white and homogenous. Other than pallor, no significant changes were seen in the various organs.

Upon microscopic examination some of the lymph nodes were infiltrated with immature lymphocytes to the extent of obliteration of the lymph follicles and the subcapsular sinuses; there was slight capsular invasion. In other nodes, edema, follicular hyperplasia, and reticuloendothelial hyperplasia were evident. Portal spaces of the liver (Fig. 1) and interstitial spaces of the kidneys also contained infiltrations of immature lymphocyte cells.

Case 5. At the time of death, April 1965, this spayed female short-haired cat was 24 months of age. She was treated in January for renal insufficiency. During the next 3 months she was periodically treated with antibiotics and fluids. The cat died with generalized lymphadenopathy. She was a littermate of Case 3.

At necropsy the sites of most extensive involvement were the pharangeal and mesenteric regions. Microscopically, the follicular pattern had persisted in some lymph nodes, but the subcapsular sinuses were obliterated and capsular invasion was evident. The architecture of mesenteric lymph nodes was completely obliterated, and the surrounding adipose tissue was extensively infiltrated by immature lymphocyte cells (Fig. 2).

Case 6. This spayed female short-haired cat was 3 years of age at death. An abscess below the left ear was treated in early May 1966. A routine blood sample on May 11 indicated a WBC of 3600 and a differential of 19.5% segmented neutrophils, 2.0% prolymphocytes, 75.5% lymphocytes, 2.0% monocytes, and 1.0% eosinophils. On June 29, this cat was presented with a second abscess on the neck and signs of anemia. The cat died suddenly on July 4.

Necropsy revealed sanguineous fluid in the left pleural cavity. A nodular layer of white homogenous tissue up to 1.0 cm thick had infiltrated the pericardium and pleura of the left lung. No other gross abnormalities were seen. The neoplastic tissue was comprised of masses of immature lymphocytic cells infiltrating fat and connective tissue (Fig. 3). No recognizable remnants of lymph nodes or thymus were found in the tissues acquired for histologic examination. Because of the location of this tumor, a diagnosis of aortic body tumor was considered. However, the cells of this neoplasm had a solid monotonous pattern rather than the peritheliomatous pattern typical of neoplasms of chemoreceptor origin. Also, the cells had less abundant eosinophilic cytoplasm, more dense nuclear chromatin, and more prominent nucleoli (Fig. 4) than the cells of aortic body tumors.

Discussion. Evidence has been presented that at least 3 and possibly 6 cases of malignant lymphoma have occurred in a household of cats among both related and nonrelated individuals. The incidence of malignant lymphoma in the cat population of a nearby county (Alameda County, California) is approximately 42 cases/100,000 cats (7). Thus the occurrence of 3 to 6 cases in 34 cats is far higher than expectation.

It is also unusual to have 34 different cats in the same household during a 34-year period. Most cat-owning households have only one cat; data from a household survey in Alameda County indicated that 16% of the cat-owning households had 2 cats and only 8% contained 3 or more, excluding nursing kittens (unpublished data, Epizootology Section, California Cancer Field Research Program, California State Department of Public Health, Berkeley, California). No interviewed households contained more than 9 cats. In the household described in this report, there was a minimum of 11 cats present at any time during the 34-year period.

<table>
<thead>
<tr>
<th>Month of birth</th>
<th>Total</th>
<th>1962</th>
<th>1963</th>
<th>1964</th>
<th>1965</th>
<th>Unknown</th>
<th>Total</th>
<th>No. of ML cases, all years</th>
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<tbody>
<tr>
<td>January–February</td>
<td>1</td>
<td>9</td>
<td>4</td>
<td>11</td>
<td>7</td>
<td>2</td>
<td>1</td>
<td>34</td>
</tr>
<tr>
<td>March–April</td>
<td>1</td>
<td>2</td>
<td>4</td>
<td>6</td>
<td>13</td>
<td>1</td>
<td>4</td>
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<td>May–June</td>
<td>3</td>
<td>13</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>July–August</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>4</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>8</td>
</tr>
<tr>
<td>September–October</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>November–December</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
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<td>1</td>
<td>1</td>
<td>4</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>5</td>
</tr>
</tbody>
</table>

The occurrence of cases in this household also supports a hypothesis of an infectious agent. There was a continuum of contact from the 1st to the 6th case (Chart 1). Also, there were many young and possibly more susceptible animals entering the household periodically. In 1963, when the 1st case occurred, 2 litters were born in the household with 6 other kittens entering the household from outside litters. Two cases occurred in one home-
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In addition to the malignant lymphomas, 2 other tumors were diagnosed in the household during this 3-year period. A sympathicoblastoma in the adrenal medulla of a 13-year-old spayed female long-haired cat was found on necropsy in September 1964. In May 1965, squamous cell carcinomas were removed from the tip of the right ear and from the lower eyelid of a 10-year-old castrated, male, white, short-haired cat. Both animals entered the household at young ages, 9 months and 6 weeks of age, respectively. As of September 1966, the latter cat was still alive.

Acknowledgments. The authors are indebted to the following veterinarians for making available clinical records of those cases which died prior to the initiation of this investigation: Dr. Hans A. Albertson, Cotati, California; Drs. Albert Chafets, Paul D. Clary III, and Norman T. Freid, all of San Francisco, California; and Dr. Seymour Roberts, Richmond, California.

REFERENCES


FIG. 1. Liver of Case 4. Infiltration of immature lymphocytic cells about a portal triad. Arrows indicate the numerous mitotic figures. H & E, X 330.

Fig. 3. Neoplasm from the pleural cavity of Case 6. Lymphocytic cells infiltrating what may have been the pericardium and the pericardial fat. H & E, X 260.

Fig. 4. Higher power of the neoplasm from the pleural cavity of Case 6. The neoplasm was made up of immature lymphocytic cells. Notice the lack of cellular orientation, and the mitotic figures. A large reticulum cell is present in the upper right (arrow). H & E, X 1000.
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