INTRODUCTION

In humans, renal cancer accounts for 2% of all malignant neoplasms (12), but little is known about etiology. Since the urinary system in dogs is histologically and functionally similar to that in humans and responds in a like fashion to known carcinogenic agents (8), it seems appropriate to investigate the distribution of spontaneous canine renal tumors and draw comparison with the lesion in humans.

MATERIALS AND METHODS

Data for this study came from medical abstracts submitted by hospitals and clinics of 13 North American veterinary universities participating in the Veterinary Medical Data Program. The Veterinary Medical Data Program is a data registry, sponsored by the National Cancer Institute, to which participants submit a standardized case abstract, systematically coded (38), about each clinical episode at their facility. As of June 1975, there were 1.4 million clinic visits documented in the registry; approximately 60% were about dogs.

The Veterinary Medical Data Program abstract contains descriptive information about the patient (i.e., identity number, age, breed, and sex), diagnoses, operations, and diagnostic procedures used during that visit. Also submitted are data about visits for physical examinations and routine vaccinations, but not drug therapy. One identity number is assigned to a patient regardless of the number of subsequent visits made to the medical facility. When the pedigree is not available, the determination of breed of the animal is based upon the phenotypic appearance. The relevant information collected about tumors includes site, cell type, and behavioral pattern.

RESULTS

Seventy-three dogs were identified with primary renal neoplasms; 67 involved the kidney, and 6 involved the renal pelvis. Adenocarcinoma was the most frequent cell type, followed by carcinoma not otherwise specified and embryonal nephroma (Table 1). Subsequent analyses of age, breed, and sex risk were limited to "renal carcinoma" encompassing the 34 cases of adenocarcinoma and carcinoma (not otherwise specified) of the renal parenchyma. Review of the medical histories of these dogs revealed a male with another primary tumor of the urogenital system, a transitional cell carcinoma of the bladder developing 2 months after the diagnosis of renal carcinoma.

$R$ values were calculated for breeds represented by 3 or more cases of renal carcinoma. Mixed breed (mongrel) dogs predominated with 12 cases, followed by 3 cases each among Labrador retrievers and miniature and toy poodles. None of these breed groups had a risk significantly different from that in all breeds combined (Table 2). Fourteen other breeds not qualifying for risk analysis were represented among dogs with renal carcinoma.

In both sexes, the risk for renal carcinoma increased with age (Chart 1). However, males had an overall risk 2.3 times that of females, based on 23 versus 11 cases, respectively (95% confidence interval = 1.05 to 4.94). The excess in males was primarily over 3 years of age (Chart 2).
Canine renal neoplasms by sex reported to the Veterinary Medical Data Program, March 1964 to July 1975

<table>
<thead>
<tr>
<th>Site/cell type</th>
<th>Total cases observed</th>
<th>Male</th>
<th>Female</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kidney</td>
<td>67</td>
<td>24</td>
<td>18</td>
</tr>
<tr>
<td>Adenocarcinoma</td>
<td>24</td>
<td>18</td>
<td>6</td>
</tr>
<tr>
<td>Carcinoma not otherwise specified</td>
<td>10</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Embryonal nephroma</td>
<td>8</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>Fibrosarcoma</td>
<td>7</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>Adenoma</td>
<td>4</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Sarcoma not otherwise specified</td>
<td>4</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Hemangiosarcoma</td>
<td>3</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Hemangioma</td>
<td>3</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Fibroma</td>
<td>2</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Lipoma</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Renal pelvis</td>
<td>6</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Squamous cell carcinoma</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Adenocarcinoma</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Carcinoma not otherwise specified</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Fibrosarcoma</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>

**Table 1**

Estimated relative risk (R) of canine renal carcinoma in dogs by breed

<table>
<thead>
<tr>
<th>Breed group</th>
<th>No. of cases observed</th>
<th>R</th>
<th>95% confidence interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mixed breed</td>
<td>12</td>
<td>1.5</td>
<td>0.87-3.80</td>
</tr>
<tr>
<td>Labrador retriever</td>
<td>3</td>
<td>2.7</td>
<td>0.70-9.72</td>
</tr>
<tr>
<td>Miniature and toy poodles</td>
<td>3</td>
<td>0.9</td>
<td>0.23-3.19</td>
</tr>
</tbody>
</table>

*When confidence interval includes 1, breed R is not significantly different from that in all breeds combined at the 0.05 level.

This series contained 6 females and 2 males with Wilms' tumor (Table 3). Review of the medical histories of these dogs failed to detect any congenital defects reported with Wilms' tumor in children (37).

In humans, tumors of the renal pelvis (25) and, possibly, renal carcinomas (3) have been linked with analgesic drug use. The medical histories of dogs with these lesions were reviewed for diseases routinely treated with salicylates. One of the 6 dogs with a neoplasm of the renal pelvis and 1 of the 34 dogs with renal carcinoma had a history of arthritis. No other conditions were identified.

**DISCUSSION**

Our findings, although based upon a well-defined hospital-clinic population of more than 250,000 dogs, are nevertheless subject to possible biases associated generally with retrospective studies and specifically with pet ownership. Although the Veterinary Medical Data Program includes medical episodes for non-disease visits and may therefore approximate the general population-at-risk, our results cannot be considered as incidence statistics. Estimates of relative risk in this study represent hospital-based prevalence values.

At least 110 canine renal carcinomas (4, 5, 7, 9, 10, 13-15, 22, 23, 27, 30, 31, 33, 40, 48), 22 Wilms' tumors (1, 5, 10, 16, 18, 24, 41, 43), and 70 other tumors of the kidney and renal pelvis have been reported (6, 11, 17, 35, 36, 45). However, reference populations for comparison were either lacking or not suitable for use, so that the reported variations in diagnosis by age, breed, and sex are uninformative.

The largest canine series reported, which describes the morphological characteristics of 31 cases of renal carcinoma, was based on material from the Armed Forces Institute of Pathology (5). The authors, in agreement with Willis (49), concluded that the canine lesion is histologically very similar to the human counterpart. Because of this similarity, a comparison of epidemiological features is especially relevant.

In our series, there was no evidence of familial (breed) predisposition among purebred dogs. A high proportion of the cases were in mongrel dogs which suggests that, as in humans (46, 50), genetic determinants of renal carcinoma are not conspicuous.

**Chart 1.** Estimated relative risk (R) of canine renal carcinoma by sex and age. Age interval of 4 to 6 years was used as standard reference (R = 1). R values for age intervals 0 to 3, 4 to 6, and 7 to 9 were plotted at the midpoint of each interval. Results for interval >10 years were plotted at 14 years.

**Chart 2.** Distribution of the male/female ratio of renal carcinoma in humans (12) and dogs from the Veterinary Medical Data Program by midpoint age intervals using the dog-years to human-years conversion formula (32).
Our analysis quantifies, for the first time, an excess risk of renal carcinoma in male dogs. This finding stands in contrast to the female predominance of canine bladder cancer, which may be related to the bitch’s tendency toward prolonged urine retention (21). The male predominance of canine renal carcinoma resembles that in humans (Chart 2). The canine male excess peaks in the 7- to 9-year age group. Using LeBeau’s conversion of dog years to human years (32), the mean of this age group approximates 49 years of age (12).

The primary causes of renal carcinoma in humans are unclear. A relationship to cigarette smoking has been suggested, but the evidence is inconclusive (3, 19, 29, 50). Occupational exposures to polycyclic hydrocarbons among coke oven workers in the steel industry and to cadmium have been implicated in some cases (29, 39). Worldwide trends indicate a correlation of renal carcinoma with consumption of coffee (44) and with animal fat and protein (2), but these hypotheses were not sustained by a case-control study (3).

The reason for the male predominance of human renal carcinoma is obscure. Environmental factors are suggested by the rising incidence reported among American men but not women (26) and call for further studies to evaluate the role of tobacco, nutrition, and occupational determinants. However, these factors cannot account for the male excess of kidney cancer in dogs (and similar trends in sex ratio with age) and suggest the influence of host susceptibility, including the endogenous production or metabolism of sex hormones. This possibility is consistent with the evidence for remission in some human patients with renal carcinoma using progestins (28, 42).

ACKNOWLEDGMENTS

We wish to thank Karen Beckwith for editorial and technical assistance and the veterinary university hospitals and clinics contributing data to this study: Colorado State University, University of California, University of Georgia, University of Guelph (Ontario), University of Illinois, Iowa State University, Kansas State University, Michigan State University, University of Minnesota, University of Missouri, Ohio State University, Purdue University (Lafayette, Ind.), and University of Saskatchewan.

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37. Pendergrass, T. W. Congenital Anomalies in Children with Wilms’ Tu-


Table 3

<table>
<thead>
<tr>
<th>Breed group</th>
<th>Sex</th>
<th>Age at diagnosis</th>
<th>Discharge status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mixed breed</td>
<td>Male</td>
<td>5 mos.</td>
<td>Euthanasia</td>
</tr>
<tr>
<td>Mixed breed</td>
<td>Female</td>
<td>1 yr</td>
<td>Alive</td>
</tr>
<tr>
<td>Mixed breed</td>
<td>Female</td>
<td>2-3 yr</td>
<td>Euthanasia</td>
</tr>
<tr>
<td>Mixed breed</td>
<td>Female</td>
<td>4-6 yr</td>
<td>Euthanasia</td>
</tr>
<tr>
<td>Mixed breed</td>
<td>Male</td>
<td>7.5 yr</td>
<td>Alive</td>
</tr>
<tr>
<td>German shepherd</td>
<td>Female</td>
<td>3 yr</td>
<td>Alive</td>
</tr>
<tr>
<td>Miniature poodle</td>
<td>Female</td>
<td>6 yr</td>
<td>Alive</td>
</tr>
<tr>
<td>Shetland sheepdog</td>
<td>Female</td>
<td>8 yr</td>
<td>Euthanasia</td>
</tr>
</tbody>
</table>

Table 3: Cases of embryonal nephroma reported in dogs
H. M. Hayes, Jr., and J. F. Fraumeni, Jr.


Epidemiological Features of Canine Renal Neoplasms

Howard M. Hayes, Jr. and Joseph F. Fraumeni, Jr.


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