J. Vet. Sci. (2007), **8**(3), 229–236

JOURNAL OF
Veterinary
Science

Retrospective study of canine cutaneous tumors in Korea

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Over the 42 month period from January 2003 to June 2006, a total of 2,952 canine biopsy specimens were received from the Veterinary Medical Teaching Hospital of Seoul National University and from veterinary practitioners across the nation. Out of these, 748 (25.34%) cases were diagnosed as canine cutaneous tumors in the Department of Veterinary Pathology, College of Veterinary Medicine, Seoul National University, Korea. Thirty-eight different types of cutaneous tumors were identified and categorized into epithelial and melanocytic tumors (56.95%), mesenchymal tumors (38.90%), and hematopoietic tumors (4.14%) located in the skin. Among these, 69.25% were benign and 30.74% were malignant. The top ten most frequently diagnosed cutaneous tumors were epidermal and follicular cysts (12.70%), lipoma (11.36%), mast cell tumors (8.82%), cutaneous histiocytoma (7.49%), basal cell tumors (6.82%), sebaceous gland adenoma (6.68%), sebaceous gland hyperplasia (5.08%), hepatoid gland adenoma (3.61%), apocrine adenocarcinoma (3.07%), and fibroma (2.81%), in order of prevalence. They comprised 68.45% of all cutaneous tumors. These top ten cutaneous tumors were distributed on the trunk (30.08%), head and neck (20.9%), extremities (19.14%), anal and perianal area (8.59%), and tail (3.91%). The age of the dogs with the ten most frequent tumors had a mean age of 8.3 years, with a range of 2 months to 19 years. When all types of tumors were considered together in the entire population, there was no difference in incidence according to sex.

Key words: benign, biopsy, cutaneous tumors, histopathology, malignant

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Introduction

The skin is continuously exposed to a wide variety of chemical and physical insults and other environmental factors, and therefore, is prone to neoplastic proliferation. In dogs, approximately 30% of all neoplasms are reported to arise in the skin [8,15]. The incidence of cutaneous tumors in dogs is estimated to be 728 cases every year per 100,000 dogs [8].

In the last five years of our experience, the number of canine cutaneous biopsy specimens sent to our laboratory has increased, and new protocols for the management and treatment of these neoplasms have been introduced and adjusted in recent years. Information on the prevalence and distribution of individual cutaneous tumors helps veterinary practitioners to diagnose them in time, determine an appropriate therapy, and anticipate an adequate prognosis. For example, a major advantage of standard surgical excision of skin tumors is completeness of surgery, which can only be determined by histopathology [17].

A basic prerequisite for proper diagnosis, appropriate therapy, and adequate prognosis is a valid classification of cutaneous neoplasms. Skin tumors are generally classified histologically according to the tissue of origin (epithelial cell and mesenchymal cell) and individual cells of origin (round cell and spindle cells) if sufficient differentiation is present. Tumors are further classified in terms of the degree of malignancy based on several histologic characteristics, such as the mitotic index and degree of cellular or nuclear atypia [17]. Therefore, to establish a uniformity and valid classification of cutaneous neoplasms, the World Health Organization (WHO) introduced a new classification of skin tumors in 1999 [12]. The need for retrospective analysis and reclassification of cutaneous tumors according to recent WHO classification is particularly important. Classification based on the recent WHO standards is a prerequisite for precise diagnosis, and may provide an appropriate therapeutic and prognostic approach to the problem.

Reports on the prevalence, tumor predilection sites, sex, breed, and age of the canine cutaneous tumors have been published previously [1,6,8-13,15]. The results of those studies were considerably variable, which could be attributed primarily to geographical location, prevalent environmental influences, and breed populations [1,8,10-12,14].

This study aims to determine the relative prevalence and distribution of several types of canine skin tumors in our bioptic samples, which were received and analyzed between January 2003 and June 2006. We anticipate that the result of this study will be valuable for veterinary practitioners in their practices. To our knowledge, this kind of information has not been published previously for the Korean canine population.

Materials and Methods

Study subjects

A total of 3,069 canine biopsy and necropsy specimens were submitted to the Department of Veterinary Pathology, College of Veterinary Medicine, Seoul National University for diagnosis during the designated period (January 2003 to June 2006). The samples were received from the Veterinary Medical Teaching Hospital of Seoul National University and veterinary practitioners across the nation. Of these, 2,952 were biopsy specimens. Among the biopsy specimens, 748 cases (25.34%) were diagnosed as cutaneous tumors and were included in this study.

Histopathologic examination

Histopathologic examination was performed on all 3,069 cases. For histopathologic examination, the tissues were fixed in 10% phosphate-buffered neutral formalin, routinely processed, paraffin embedded, and stained with hematoxylin and eosin (H&E). Replicate sections of particular cases were also stained with special stains such as Oil Red O, Giemsa, periodic acid-Schiff and toluidine blue whenever they were needed to confirm the diagnosis.

Histological classification of study subjects

The skin tumors found in our material were categorized in three groups according to the recent WHO classification, namely, epithelial and melanocytic tumors, mesenchymal tumors of the skin, and hematopoietic tumors located in the skin.

Immunohistochemistry

Replicate sections of particular cases were subjected to immunohistochemistry whenever it was needed to decipher the cellular origin by applying a routine avidin-biotin-complex (ABC) procedure (Vectastain; Vector Laboratories and Histostain Plus; Zymed Laboratories, USA). Commercially available antibodies such as cytokeratin (BioGenex, USA), vimentin (DakoCytomation, Denmark), desmin (BioGenex, USA), S-100 (DakoCytomation, Denmark), Melan A (DakoCytomation, Denmark), neuron-specific enolase (DakoCytomation, Denmark), and other related tumor markers were used in this study.

After deparaffinization, the sections were dipped in 3% hydrogen peroxide in methanol to block endogenous peroxidase activity. Sections were then subjected to microwave antigen retrieval in a 0.01 M citrate buffer (pH 6.0) for 10 min at 750 watts power. The sections were allowed to cool, and were then blocked with a blocking serum for 1 h. After incubating tissue specimens with the primary antibodies overnight at 4°C, immuno-reaction complexes were detected using the ABC procedure and visualized with 3, 3-diaminobenzidine tetrahydrochloride as the chromogen. The sections were counterstained with Mayer's hematoxylin and examined under a light microscope.

Results

During the 42 month study period, 748 (25.34%) cases were diagnosed as canine cutaneous tumors among a total of 2,952 canine biopsies. Thirty-eight different types of cutaneous tumors were identified. Among them, 21 different histological types were categorized into epithelial and melanocytic tumors (56.95%, 426/748), 15 were mesenchymal tumors (38.90%, 291/748), and 2 were hematopoietic tumors (4.14%, 31/748) located in the skin.

Among the top five tumors from the epithelial and melanocytic skin tumors group, epidermal and follicular cysts were most frequent at 22.30% (95/426), followed by basal cell tumors at 11.97% (51/426), sebaceous adenoma at 11.74% (50/426), sebaceous hyperplasia at 8.92% (38/426), and hepatoid gland adenoma at 6.34% (27/426), comprising a total of 61.27% (261/426) of all epithelial and melanocytic tumors. As a subgroup, sebaceous and modified sebaceous gland tumors were the most frequent at 27.70% (118/426), followed by cysts at 22.30% (95/426), tumors with adnexal differentiation at 13.38% (57/426), epithelial tumors without adnexal differentiation at 11.97% (51/426), tumor-like lesions at 8.92% (38/426), apocrine and modified apocrine gland tumors at 6.10% (26/426), and tumors of the epidermis at 5.40% (23/426). Melanocytic tumors comprised 4.23% (18/426) of all epithelial and melanocytic tumors (Table 1 & 3).

Similarly, among mesenchymal tumors of the skin, lipoma at 29.21% (85/291), mast cell tumors at 22.68% (66/291), cutaneous histiocytoma at 19.24% (56/291), fibroma at 7.22% (21/291), and hemangiopericytoma at 4.12% (12/291) were the top five cutaneous mesenchymal tumors in order, comprising a total of 82.47% (240/291) of all mesenchymal tumors of the skin (Table 2 & 3). In the case of hematopoietic tumors located in the skin, only plasmacytoma (54.84%; 17/31) and lymphoma (45.16%; 14/31) were observed in our study (Table 2). Representative photomicrographs of epithelial and melanocytic tumors and

Table 1. Incidence of cutaneous epithelial and melanocytic tumors diagnosed during the period from January 2003 to June 2006

Tumor type	Total number	% Epithelial
Epithelial tumors without adnexal differentiation:		
Basal cell tumor	51	11.97
Tumor with adnexal differentiation:		
Infundibular keratinizing acanthoma	21	4.93
Trichoblastoma	15	3.52
Trichoepithelioma	11	2.58
Pilomatricoma	7	1.64
Tricholemomma	2	0.47
Malignant trichoepithelioma	1	0.23
Tumor of the epidermis:		
Papilloma	16	3.76
Basosquamous carcinoma	1	0.23
Sebaceous and modified sebaceous gland tumors:		
Sebaceous adenoma	50	11.74
Meibomian adenoma	9	2.11
Meibomian epithelioma	13	3.05
Hepatoid gland adenoma	27	6.34
Hepatoid gland epithelioma	15	3.52
Hepatoid gland adenocarcinoma	1	0.23
Hepatoid gland carcinoma	4	0.93
Apocrine and modified apocrine gland tumors:		
Apocrine adenoma	3	0.70
Apocrine adenocarcinoma	23	5.40
Cysts:		
Epidermal and follicular cysts	95	22.30
Tumor-like lesions:		
Sebaceous gland hyperplasia	38	8.92
Melanocytic tumors:		
Melanoma	18	4.23
Total	426	100

mesenchymal tumors are presented in Fig. 1.

The ten most frequently diagnosed tumors in order of prevalence, comprising 68.45% (512/748) of all cutaneous tumors diagnosed during the study period, are summarized in Table 4. The site distributions of these ten frequent tumors were on the trunk (30.08%; 154/512), head and neck (20.90%; 107/512), extremities (19.14%; 98/512), anal and perianal area (8.59%; 44/512), and tail (3.91%; 20/512) (Table 5). When all types of tumors were considered together in the whole population (n = 646), there was no significant difference in incidence according to sex. However, among the top ten tumors, hepatoid gland adenoma and apocrine adenocarcinoma were more frequent among males and females, respectively. The age of the animals with the ten most frequent tumors ranged from 2 months to 19 years, with a mean of 8.3 years (Table 4). This finding is closer to the average age of 7.94 years in the whole population (n = 748).

Epidermal and follicular cysts accounted for 12.70% of all of the tumors observed, which was in line with the finding of another group [6]. The average age of the dogs affected with this tumor was 5.1 years, with a range of 4 months to 14 years. These tumors were most commonly located on the trunk (44.21%), extremities (18.95%), and head and neck (13.68%). Basal cell tumors accounted for 6.82% of the total number of tumors observed (n = 748), which is in line with the findings of other authors [10,11,15,17]. The average age of the dogs affected with this tumor was 7.8 years, with a range of 3 months to 12 years. These tumors were most commonly located on the head and neck (64.71%) and extremities (13.73%). Sebaceous adenoma and sebaceous hyperplasia accounted for 6.68% and 5.08% of all tumors, respectively. The average age of the dogs affected with sebaceous adenomas was 10.3 years, with a range of 4 months to 16 years, while sebaceous gland hyperplasia was observed in dogs at an average age of 8.6 years, within a

Table 2. Incidence of mesenchymal tumors of the skin and hematopoietic tumors located in the skin diagnosed during the period from January 2003 to June 2006

Tumor type	Total	% Mesenchymal	% in total population
Tumors of fibrous tissues:			
Fibroma	21	7.22	
Collagenous hamartoma	10	3.44	
Fibrosarcoma	9	3.09	
Tumors of adipose tissue:			
Lipoma	85	29.21	
Liposarcoma	6	2.06	
Tumors of smooth muscle:			
Leiomyoma	2	0.69	
Leiomyosarcoma	3	1.03	
Tumors of vascular tissues:			
Hemangioma	8	2.75	
Lymphangioma	1	0.34	
Tumors of peripheral nerves:			
Peripheral nerve sheath tumor	7	2.41	
Mast cell tumors	66	22.68	
Histiocytic tumors:			
Canine cutaneous histiocytoma	56	19.24	
Unclassified tumors:			
Canine hemangiopericytoma	12	4.12	
Malignant fibrous histiocytoma	1	0.34	
Transmissible venereal tumor	4	1.38	
Total	291	100	38.90
Hematopoietic tumors:			
Cutaneous plasmacytoma	17	54.84	
Cutaneous lymphoma	14	45.16	
Total	31	100	4.14

Table 3. Top five most frequently diagnosed epithelial and melanocytic tumors and mesenchymal tumors of the skin

Tumor type	Total number	% Epithelial (n = 426)	% in Total case (n = 748)
Epithelial and melanocytic:			
Epidermal and follicular cysts	95	22.30	12.70
Basal cell tumors	51	11.97	6.82
Sebaceous adenoma	50	11.74	6.68
Sebaceous hyperplasia	38	8.92	5.08
Hepatoid gland adenoma	27	6.34	3.61
Mesenchymal:		% Mesenchymal (n = 291)	% in Total case (n = 748)
Lipoma	85	29.21	11.36
Mast cell tumors	66	22.68	8.82
Cutaneous histiocytoma	56	19.24	7.48
Fibroma	21	7.22	2.81
Hemangiopericytoma	12	4.12	1.60

range of 1 to 15 years. While sebaceous adenoma was most commonly located on the head and neck (26.00%), trunk (22.00%), and extremities (20.00%), the outgrowths representing sebaceous gland hyperplasia were most frequently located on the head and neck (21.05%) and tail (21.05%). Hepatoid gland adenoma accounted for 3.61% of the total number of tumors in our case. The average age of the dogs affected with this tumor was 11.5 years, with a range of 5 years and 4

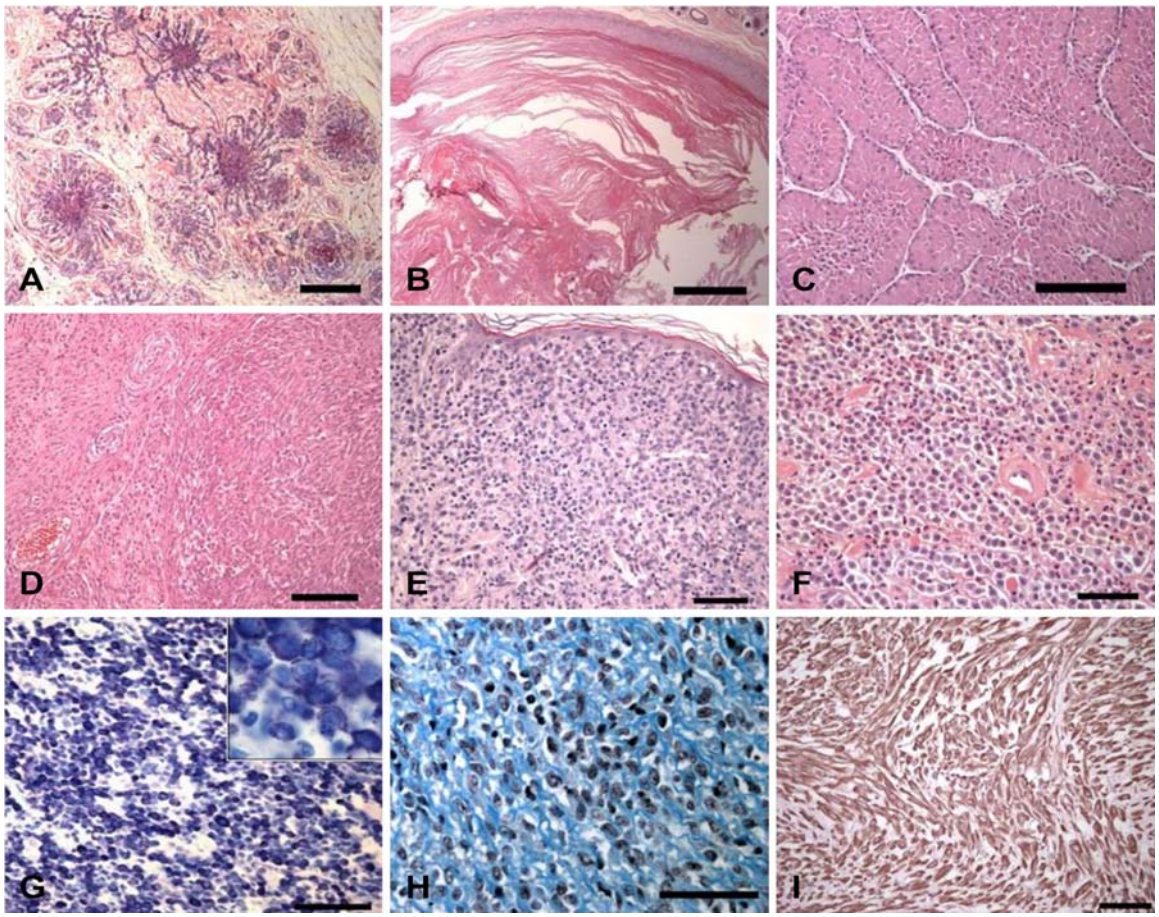

Fig. 1. Photomicrographs of cutaneous and mesenchymal tumors of canine. (A) Basal cell tumor, medusoid subtype. Note neoplastic cells aggregated in the center and cords stream outward in medusa pattern. H&E stain. bar = 200 μm. (B) Epidermal cyst. Note a wall of squamous epithelial cells containing keratinous content in its lumen. H&E stain. bar = 200 μm. (C) Hepatoid gland adenoma. Note well differentiated hepatoid cells arranged in anastomosing trabeculae. The individual neoplastic cells resemble hepatocytes. H&E stain. bar = 100 μm. (D) Hemangiopericytoma. Note neoplastic cells demonstrate the perivascular whorled pattern and storiform pattern. H&E stain. bar = 100 μm. (E) Cutaneous histiocytoma. Note compact sheet of neoplastic histiocytes replacing adnexa and infiltrating into the epidermis. H&E stain. bar = 80 μm. (F) Mast cell tumor. Note a dense sheet of neoplastic mast cells causing collagenolysis. Aggregates of eosinophils are also present. H&E stain. bar = 80 μm. (G) Mast cell tumor. Fine metachromatic granules are dispersed in the cytoplasm. Toluidine blue stain. bar = 20 μm. (H) Fibrosarcoma. Note abundant collagen bundles. Masson's trichrome stain. bar = 20 μm. (I) Peripheral nerve sheath tumor. Spindloid neoplastic cells arranged in interwoven bundles are positive for vimentin. Avidin-biotin peroxidase complex method. bar = 20 μm.

months to 19 years. These tumors were predominantly located in the anal and perianal area (96.30%) and tail (3.70%). These tumors were more frequently found in males (70.37%) than females (11.11%).

Melanocytic tumors accounted for 2.40% of all tumors and 4.23% of all epithelial and melanocytic tumors. The average age of dogs affected with this tumor was 8.2 years, with a range of 2 to 14 years. These tumors were most prevalent on the head and neck (83.33%) and extremities (11.11%).

Lipoma accounted for 11.36% of the total number of tumors diagnosed in our study. The average age of the dogs affected with this tumor was 7.1 years, with a range of 1 to 17 years. These tumors were predominantly located on the trunk (61.18%), and extremities (9.41%). Mast cell tumors accounted for 8.82% of all tumors. The average age of the dogs affected with this tumor was 7.4 years, with a range of 5 months to 16 years. These tumors were most commonly located on the extremities (40.91%), trunk (27.27%), and head and neck (18.18%). Cutaneous histiocytoma accounted for 7.49% of the total number of tumors in our study. The average age of the dogs affected with this tumor was 3.2 years, with a range of 2 months to 16 years. These tumors were predominantly located on the extremities (35.71%), head and neck (30.36%), trunk (19.64%), and tail (1.78%). Fibroma accounted for 2.81% of all tumors in our study. The average age of the dogs affected with this tumor was 9 years, with a range of 1 to 17 years. These tumors were most

Table 4. Top ten most frequently diagnosed canine cutaneous tumors from all cases (n = 748)

Tumor type	Total number	Avergage age (Year)	Range (Year)	
Epidermal and follicular cysts	95 (12.70%)	5.1	4 month	17
Lipoma	85 (11.37%)	7.1	1	17
Mast cell tumors	66 (8.82%)	7.4	5 month	16
Cutaneous histiocytoma	56 (7.49%)	3.2	2 month	16
Basal cell tumors	51 (6.82%)	7.8	3 month	12
Sebaceous gland adenoma	50 (6.68%)	10.3	4	16
Sebaceous gland hyperplasia	38 (5.08%)	8.6	1	15
Hepatoid gland adenoma	27 (3.61%)	11.5	5	19
Apocrine adenocarcinoma	23 (3.07%)	10.3	2	18
Fibroma	21 (2.81%)	9	1	17

Table 5. Number of tumors in different locations in ten common cutaneous tumors

Tumor type	Number of tumors in different locations				
	Head & neck	Extremities	Trunk	Anal & perianal	Tail
Epidermal and follicular cysts (n = 95)	13 (13.68%)	18 (18.95%)	42 (44.21%)		4 (4.21%)
Lipoma (n = 85)	2 (2.35%)	8 (9.41%)	52 (61.18%)	4 (4.71%)	1 (1.17%)
Mast cell tumors (n = 66)	12 (18.18%)	27 (40.91%)	18 (27.27%)	2 (3.03%)	3 (4.54%)
Cutaneous histiocytoma (n = 56)	17 (30.36%)	20 (35.71%)	11 (19.64%)		1 (1.78%)
Basal cell tumors (n = 51)	33 (64.71%)	7 (13.73%)	3 (5.88%)		1 (1.98%)
Sebaceous gland adenoma (n = 50)	13 (26.00%)	10 (20.00%)	11 (22.00%)	1 (2.00%)	
Sebaceous gland hyperplasia (n = 38)	8 (21.05%)	2 (5.26%)	2 (5.26%)	3 (7.89%)	8 (21.05%)
Hepatoid gland adenoma (n = 27)				26 (96.30%)	1 (3.70%)
Apocrine adenocarcinoma (n = 23)	6 (26.09%)	3 (13.04%)	10 (43.48%)		1 (4.34%)
Fibroma (n = 21)	3 (14.29%)	3 (14.29%)	5 (23.81%)	8 (38.10%)	

Table 6. A comparison of the prevalence of the five most common cutaneous tumors diagnosed in the present study with relevant data from previous surveys*

Neoplasm	% Prevalence					
	This study (n = 748)	Greece† (n = 174)	USA‡ (n = 984)	UK§ (n = 2,616)	Australia‖ (n = 1,000)	Australia¶ (n = 1,000)
Epidermal and follicular cysts	12.70	NR	NR	NR	NR	NR
Lipoma	11.36	5.7	8.6	8.5	6.0	5.0
Masts cell tumors	8.82	13.8	21.3	19.2	17.6	16.1
Cutaneous histiocytoma	7.49	5.7	2.5	6.0	7.8	14.0
Basal cell tumors	6.82	4.02	NR	4.1	12.0	5.5

NR = not reported.
*cited from Vail and Withrow [17] and Kaldrymidou *et al.* [8]; †Kaldrymidou *et al.* [8]; ‡Brodey [2]; §Bostock [1]; ‖Finnie and Bostock [3]; ¶Rothwell *et al.* [11].

commonly located on the anal and perianal area (38.10%), trunk (23.81%), head and neck (14.29%), and extremities (14.29%). Hemangiopericytoma accounted for 1.6% of all tumors. The average age of the dogs affected with this tumor was 9.9 years, with a range of 7 to 15 years. These tumors were most commonly located on the trunk (50%) and extremities (33.33%).

Discussion

A brief account of our findings for the top five tumors in epithelial and melanocytic tumors, mesenchymal tumors of the skin, and melanoma is presented below. The majority of the cutaneous tumors diagnosed in the present study were benign (69%; 518/748) in nature, and this finding was in

agreement with earlier reports [5,14,17].

In terms of the follicular and epidermal cysts, our findings showed relatively different frequencies compared to those reported in earlier investigations [6,7]. However, age distributions were not reported previously [15]. For basal cell tumors, our findings are similar to the findings of previous studies [11,15,17], and our observation of the mean age is close to that of a previous reports, 6-7 years [15]. For sebaceous adenoma and sebaceous hyperplasia, our results were in agreement with previous reports [7,14,17], and our data for mean age is similar to the findings of other authors [7,8,14,15]. Sebaceous gland hyperplasia has been reported to occur in older animals, with a mean age of 9.1 years [17]. Our observations on the locations of sebaceous gland hyperplasia showed some variation in terms of the frequency of their distribution compared to that found in previous reports [5,7]. Our findings on the occurrence of hepatoid gland adenoma with respect to age [5,14,15], sex [5,6,14-16], and location [5,6,14-16] were similar to the findings of earlier workers. Our findings on the prevalence of melanocytic tumors [7,13] and on age [5,16,17] are similar to those found in previous reports.

For lipoma, our findings on age and tumor location were in line with the findings of earlier authors [5-7,14,15]. Our findings on age and tumor location of mast cell tumors are similar to the earlier observations [4-7,14,15,17]. In cutaneous histiocytoma, our observations on age and tumor location are in agreement with the findings of earlier workers [5-7,14,15]. Our findings on prevalence [7], age, and tumor location [5-7,14,15] of fibroma are similar to the findings of earlier workers. In the case of hemangiopericytoma, our findings on prevalence [10], age [11,14-16], and tumor location [5,6,15] are in agreement with the findings of earlier workers.

The sex predilection of these cutaneous tumors was not significantly different (male 48.92% versus female 51.08%) in 646 total cases. However, at the individual tumor level amongst the top ten most frequently diagnosed tumors, males were more affected by hepatoid gland adenoma, while females were more affected by apocrine adenocarcinoma. Hepatoid gland tumors are associated with the androgen sex hormone; hence, these were reported more frequently in male dogs than in female dogs [8,12,15], but there has been no report to prove the etiology of apocrine adenocarcinoma. We could not draw valid conclusions on the sex predilection for the other tumors diagnosed in the present study due to non-specified sex data for the population.

The results of this study were also compared with those from the United States of America [2], the United Kingdom [1], Australia [3,11], and Greece [8]. Mast cell tumors, hepatoid gland adenoma, lipoma, and cutaneous histiocytoma were reported to be the four most common skin tumors occurring in surveys carried out in the USA, UK, Australia, and Greece. Our findings, except those for epidermal and follicular cysts, were consistent with the findings of the studies from the other countries.

The discrepancies between our data and the data obtained in previous studies in terms of the relative incidence of these frequently diagnosed tumors may be attributed mainly to differences in the diagnostic criteria, the classification system that various workers used, the geographical locations and environmental influences, and the study population and breed [5,8,12,15,17].

Our study revealed that the skin tumors of dogs that are prevalent in other parts of the world are also prevalent in dogs in Korea, but differ in the order of prevalence. Our observation on the ages of the dogs affected by various skin tumors and anatomical locations indicates that there is no significant variation in these important parameters among Korean dogs and dogs from other parts of the world. We could not examine or draw valid conclusions on the sex predilection for the top ten most frequently diagnosed tumors and breed predisposition in our overall population. This is partially due to a lack of information on the Korean dog population, and also partially due to inadequate information for biopsy specimens that were submitted for diagnosis to our laboratory.

It is important to provide detailed information and proper bioptic specimens when submitting samples for diagnosis. Clinical history and gross morphology are important and integral components of diagnosis. This should include the duration and rate of tumor growth, change in appearance over time, size, shape, color, consistency, tissue of origin such as epidermis, dermis, and subcutaneous, and the presence or absence of attachment with the underlying tissues [15-17].

It is essential to document the prevalence of various tumors in various geographic areas so that more definitive information may be accumulated for future use [15]. Documented knowledge on the type and incidence of tumors helps veterinary practitioners to determine an appropriate therapy and anticipate an adequate prognosis. After a careful clinical examination, consideration of documented information on age, sex, and breed type and the histopathological report, clinicians can diagnose tumors in a reasonable amount of time, determine and decide on an appropriate therapy, and anticipate an adequate prognosis for many patients.

This study was entirely based on clinical cases submitted for diagnosis from the Veterinary Medical Teaching Hospital of Seoul National University and veterinary practitioners across the nation. It was not based on random samples from a dog population, nor did we sample according to our own interest. Therefore, we anticipate that the results of our study will reflect the prevalence and distribution of various cutaneous tumors in the Korean dog population. Furthermore, this result would serve as an important reference in future investigations. We anticipate that the result of our study would be useful for veterinary practitioners and veterinary students across the nation. To our knowledge, this kind of

information has not been published previously for the Korean dog population.

Acknowledgments

This study was supported by the Brain Korea 21 Program for Veterinary Science.

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