Canine cutaneous neoplasms: prevalence and influence of age, sex and site on the presence and potential malignancy of cutaneous neoplasms in dogs from Zimbabwe

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ABSTRACT

Histopathological examination was performed on cutaneous biopsies from 900 dogs with skin lesions from Zimbabwe, collected from 1996 to 2000. Clinical data were collected from medical records. Sixty per cent (540/900) of the cases were tumours and 40 % (360/900) were non-neoplastic inflammatory or degenerative diseases. Thirty different histological types of tumour were diagnosed. The prevalence of epithelial, mesenchymal, lymphohistiocytic and melanocytic tumours was 39.4 %, 44.4 %, 7.4 % and 8.7 %, respectively. The 10 most common tumours, comprising 73.7 % of all cutaneous neoplasms, were mast cell tumours, squamous cell carcinomas, perianal gland adenomas, lymphomas, benign melanomas, haemangiosarcomas, sebaceous gland adenomas, fibrosarcomas, lipomas and malignant melanomas. The prevalence of various neoplasms, age of affected dogs and sites of occurrence were similar to surveys in other countries, except that in Zimbabwe there was a greater prevalence of lymphomas and of tumours associated with increased exposure to ultraviolet light (squamous cell carcinomas, haemangiosarcomas and melanomas). For all classes of tumours the sex of the dog did not have any significant influence on the likelihood of developing a tumour. For a dog diagnosed with a tumour located on the trunk, the tumour was significantly more likely to be an epithelial tumour than a non-epithelial tumour. The occurrence of melanocytic tumours on the trunk was significantly lower than at other sites. Lymphohistiocytic tumours were 10 times more likely to occur at multiple locations as opposed to single locations.

Key words: canine cutaneous neoplasms, malignancy, odds ratio, prevalence, Zimbabwe.

Mukaratirwa S, Chipunza J, Chitanga S, Chimonyo M, Bhebhe E **Canine cutaneous neoplasms: prevalence and influence of age, sex, and site on the presence and potential malignancy of cutaneous neoplasms in dogs from Zimbabwe**. *Journal of the South African Veterinary Association* (2005) 76(2): 59–62 (En.). Paraclinical Veterinary Studies, Faculty of Veterinary Science, University of Zimbabwe, PO Box MP 167, Mount Pleasant, Harare, Zimbabwe.

INTRODUCTION

The skin is the largest organ system of the body and the organ most commonly affected by neoplastic conditions in dogs[1,5]. Dorn *et al.*[6] showed the frequency of skin neoplasms in the United States to be about 450 new cases for 100 000 dogs yearly and this represents 1 in 3 of all dog tumours. Surveys on the prevalence, predilection sites, and effects of age, sex and breed of dog on the occurrence of these neoplasms have been published in Australia[7,8,14,17], the United Kingdom[2,3], the USA[4], Greece[12] and South Africa[1] . These surveys have shown regional variations in the occurrence and type of tumours that appear in dogs. Part of this variation may be due to environmental carcinogenic exposure of different dog populations and differences in breed popularity reflecting differences in genetic susceptibility. There is no information on the prevalence of various histopathological types of neoplasms and the influence of sex, age or breed on the prevalence of these neoplasms or on predilection sites in dogs found in Zimbabwe. The objectives of the present study were 1) to assess the prevalence, sex, age, breed and site distribution of various histopathological types of canine skin neoplasms in Zimbabwe, 2) to investigate the effect of age, sex, site distribution on the likelihood of developing cutaneous neoplasm, and 3) to investigate the effect of sex, age, type of tumour, and site distribution on potential malignancy

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Received: September 2004. Accepted: March 2005.

MATERIALS AND METHODS

Case materials

Cutaneous biopsies from 900 dogs submitted for histopathology at the Section of Diagnostic Pathology, Department of Paraclinical Veterinary Studies, University of Zimbabwe, from 1996 to 2000 were studied. Cases came from the University of Zimbabwe Teaching Hospital and from various private veterinary practitioners in Zimbabwe. All cases with a histopathological diagnosis of skin neoplasia were reviewed, excluding neoplasms of the mammary or ceruminous glands. All tissues had been fixed in 10 % neutral buffered formalin, embedded in paraffin wax, and sectioned and stained with haematoxylin and eosin. Special stains, such as toluidine blue, periodic acid-Schiff and alkaline Congo red, were used at the discretion of the case pathologist. These neoplasms were classified according to published criteria[9,16].

Statistical analysis

Initially, the histological type, prevalence, sex, age and site distribution of the neoplasms were described. The neoplasms were grouped into 4 broad classes, namely epithelial, mesenchymal, melanocytic and lymphohistiocytic. The location of the neoplasm on the body was grouped into 4 groups, namely trunk, limbs, multiple, and head and neck. The 10 most common types of neoplasms were determined using the PROC FREQ procedure of the Statistical Analysis System (SAS)[18]. The odds of developing a cutaneous neoplasm in a particular sex and breed were estimated using the PROC LOGISTIC procedure of SAS[18]. Logistic regression was performed in SAS[18] to evaluate the usefulness of age and sex of dogs in predicting the likelihood of any one of the 4 types of tumours encountered in this study, given that a dog had already been diagnosed with a tumour and the location of that tumour had been established. The association between tumour site and the tumour's potential for malignancy was determined using the chi-square test for association.

RESULTS

A total of 900 canine cutaneous biopsies were submitted during the study period. Of these cutaneous biopsies 540 (60 %)

Table 1: **Histogenetical classification, prevalence, sex and age distribution of cutaneous neoplasms in 540 dogs from Zimbabwe.**

Tumour type	Number of cases	Male:female ratio	Mean age (years)	Range age years)
Epithelial tumours (*n* = 213)		114:99		
Papilloma	12	7:5	6.2	1–10
Squamous cell carcinoma	83	54:39	9.8	1.5–15
Trichoblastoma	13	8:5	10.3	6–12
Trichoepithelioma	9	3:6	5.2	0.5–9
Sebaceous gland adenoma	23	10:13	9.2	5–14
Sebaceous gland carcinoma	3	2:1	11.3	10–12
Sweat gland adenoma	11	7:4	6.6	4–15
Sweat gland carcinoma	4	1:3	10	10–14
Perianal gland adenoma	39	20:19	8.4	5.5–14
Perianal gland carcinoma	6	5:1	10.8	8–13
Intracutaneous epithelioma	6	4:2	5	2–7
Pilomatrixoma	1	1:0	4	4
Sebaceous epithelioma	3	2:1	6.3	5–7
Mesenchymal tumours (*n* = 240)				
Fibrosarcoma	23	17:6	6.5	1.5–17
Myxoma	3	2:1		
Myxosarcoma	1	0:1	7	–
Schwanoma	4	1:3	4.75	9–10
Haemangioma	12	8:4	10.08	2–12
Haemangiosarcoma	25	17:8	4.78	3–10.5
Haemangiopericytoma	17	10:7	7.12	1–13
Lipoma	22	5:17	7.45	3–11
Liposarcoma	5	1:4	7.4	5–12
Mast cell tumour	110	90:20	5.38	0.5–14
Fibroma	12	4:8	5.67	3–16
Lymphangioma	1	1:0	8	8
Undifferentiated sarcoma	5	1:4	12.2	3–14
Lymphohistiocytic tumours (*n* = 40)				
Lymphoma	27	17:10	4.13	2.5–15
Histiocytoma	13	8:5	5.45	0.6–12
Melanocytic tumours (*n* = 47)				
Benign melanoma	27	13:14	8.05	3–13
Malignant melanoma	20	13:7	9.3	6–13

were diagnosed as neoplasms and 460 (40 %) as cases of non-neoplastic inflammatory or degenerative diseases. The prevalence, sex and age distribution of the various histopathological types of cutaneous neoplasms are presented in Table 1.

Histogenetical types and prevalence

Thirty different cutaneous neoplasms were recognised. Of these, 213 (39.4 %) were of epithelial origin (13 types), 240 (44.4 %) of mesenchymal origin (13 types), 40 (7.4 %) of lymphohistiocytic origin (2 types) and 47 (8.7 %) of melanocytic origin (2 types) (Table 2). Thirty-seven per cent of the tumours were malignant. Only the lymphohistiocytic tumours had a higher number of malignant tumours than benign tumours (Table 2). The 10 most common tumours, comprising 73.7 % of all cutaneous neoplasms diagnosed during the study, are shown in Table 3 and are compared with results from studies carried out in Greece, Australia, the UK and the USA. Mast cell tumours and squamous cell carcinoma were the 2 most common tumours, comprising about a third of all cutaneous neoplasms diagnosed during this period.

The mean age of dogs with neoplasia, according to the histopathological type, ranged from 0.5 to 17 years with an overall mean of 12.2 years (Table 1). Tumours of epithelial and melanocytic origin had a higher mean age of occurrence (8.8 and 8.6 years, respectively) than those of mesenchymal (6.1 years) and lymphohistiocytic (4.1 years) origin. The breed distribution of the most common breeds with cutaneous tumours is shown in Table 4. There was wide variation in the number of epithelial, mesenchymal, lymphohistiocytic and melanocytic tumours between breeds. For example, the terriers contributed 16.9 % of the total number of epithelial tumours and 12.5 % of the mesenchymal tumours, while Rottweilers contributed 0.5 % of the epithelial tumours and 5.0 % of the mesenchymal tumours.

Twenty-two per cent (120/540) of the neoplasms were located on the head and neck, 46.1 % (249/540) on the trunk and 24.3 % (131/540) on the limbs. Only 7.4 % (40/540) of the neoplasms were found at multiple sites (Table 5). Most of the lymphohistiocytic tumours (40 %) were found at multiple sites whereas none of the melanomas were found at multiple sites.

Table 2: **Benign and malignant skin tumours as a percentage of individual types of tumour in dogs from Zimbabwe.**

Tumour type	*n*	% Benign	% Malignant
Epithelial tumours	213	55	45
Mesenchymal tumours	240	75	25
Lymphohistiocytic tumour	40	33	67
Melanocytic tumours	47	57	43
Total	540	63	37

Effect of histogenetical origin of tumour and sex of dog on the tumour's potential for malignancy, and effect of sex of dog and location of neoplasm on the likelihood of developing epithelial tumours or non-epithelial tumours

Mesenchymal tumours were significantly ($P < 0.05$) less likely to be malignant compared with melanocytic tumours. The odds of malignancy did not significantly differ between epithelial or lymphohistiocytic tumours and melanocytic tumours (Table 6). The sex of dog had no effect on the likelihood of occurrence of both epithelial and non-epithelial tumours and neither did it have a significant effect on the likelihood of any tumour type becoming malignant. Development of both epithelial and non-epithelial tumours did not show site specificity.

Association between tumour site and the tumour's potential for malignancy

Tumours on the trunk and limbs were, respectively, 3 and 4 times more likely to be malignant compared with those occurring at multiple sites (odds ratios, 3.19 and 4.68, respectively) (Table 7). Tumours on the head and neck were 2.93 times more likely to be malignant compared with those on multiple locations. This effect was, however, not statistically significant.

DISCUSSION

Epidemiological studies of canine cutaneous neoplasms have been per-

Table 3: **Prevalence of the 10 most common skin tumours occurring in Zimbabwe and comparison with previous surveys.**

Tumour	% Prevalence					
	Zimbabwe	Greece[12]	Australia[7]	Australia[17]	UK[2]	USA[4]
Mast cell tumour	20.3	13.8	16.0	16.1	19.2	21.3
Squamous cell carcinoma	15.4	2.3	10.4	6.9	5.4	3.9
Perianal gland adenoma	7.2	9.8	ND*	5.0	9.8	18.3
Benign melanoma	5.0	1.1	3.9	1.8	ND	ND
Lymphoma	5.0	2.9	1.5	1.0	ND	ND
Haemangiosarcoma	4.6	2.9	4.5	4.3	ND	ND
Sebaceous gland adenoma	4.2	2.9	4.5	4.7	8.2	ND
Fibrosarcoma	4.2	4.2	6.3	6.6	7.4	5.9
Lipoma	4.1	5.7	ND	6.0	8.5	8.6
Malignant melanoma	3.7	0.6	3.6	3.5	ND	ND

*ND = not specified.

Table 4: **Prevalence of canine skin tumours correlated with breed in 9 selected dog breeds from Zimbabwe.**

Breed	% Epithelial tumours	% Mesenchymal tumours	% Lymphohistiocytic tumours	% Melanocytic tumours	% Total of all skin tumours
Mixed	21.60	31.67	36.17	22.50	27.41
Terriers	19.90	12.50	10.64	10.00	13.89
Labrador	6.57	7.92	2.13	5.00	6.67
German shepherd dog	8.45	3.75	8.51	5.00	6.11
Jack Russell	4.69	4.17	0.00	7.50	4.26
Ridgeback	1.88	7.50	0.00	0.00	4.07
Doberman	2.81	2.92	8.51	10.00	3.89
Rottweiler	0.47	5.00	6.38	5.00	3.33

Table 5: **Site distribution of various cutaneous neoplasms in dogs from Zimbabwe.**

Tumour type	% Head and neck	% Trunk	% Limbs	% Multiple sites
Epithelial (n = 213)	25.4	55.4	13.1	6.1
Mesenchymal (n = 240)	15.8	48.8	30.8	4.6
Lymphohistiocytic (n = 40)	17.5	15.0	27.5	40.0
Melanocytic (n = 47)	44.7	17.0	38.2	0
Total (n = 540)	22.2	46.1	24.3	7.4

formed in various geographical regions including the USA[4], Australia[7,8,14,17], the UK[2,3] , Greece[12] and South Africa[1]. The prevalence of various histological types of tumours varies among the reports published in these regions. In the present study, two-thirds of cutaneous biopsies submitted during the study period were neoplasms and of these 37.4 % were malignant. Similar results were obtained in the UK where 37.5 % of the tumours were malignant[3]. Therefore, of all the skin tumours, less than 40 % require chemotherapy, radiotherapy or immunotherapy after initial surgical excision.

Forty-four per cent of the canine skin tumours were of mesenchymal origin, 39.4 % of epithelial origin, 8.7 % of melanocytic origin, and 7.4 % of lymphohistiocytic origin. Prevalence of skin epithelial *versus* non-epithelial tumours in the dog varied in different studies[12,17]. In 1 such study, epithelial tumours constituted 48 % of all skin tumours and mesenchymal tumours constituted 40 %[12]. The observed differences may be a reflection of canine breed population and environmental influences.

Table 6: **Effect of histological origin on the tumour's potential for malignancy using melanocytic tumours as the reference point.**

Tumour type	Odds ratio	Chi-square value	*P*-value
Epithelial	0.85	0.21	0.65
Mesenchymal	0.26	14.49	0.0001
Lymphohistiocytic	0.67	0.74	0.39

Thirty histological types of tumour were diagnosed, but 10 types accounted for 69.6 % of all canine skin tumours. These 10 tumours, in order of prevalence in our study, were mast cell tumour, squamous cell carcinoma, perianal gland adenoma, lymphoma, benign melanoma, haemangiosarcoma, sebaceous gland adenoma, fibrosarcoma and lipoma. The prevalences of these tumours are compared in Table 2 with those from Greece[12],

Table 7: **Association between tumour site and the tumour's potential for malignancy using multiple sites as the reference point.**

Tumour site	Odds ratio	Chi-square value	*P*-value
Trunk	3.19	4.66	0.03
Head and neck	2.93	3.64	0.06
Limbs	4.68	7.49	0.006

Australia[7,17], the UK[2] and the USA[4]. Some of these tumours have been cited as the most common in other surveys, although the order of prevalence has varied between studies. It is not possible to compare the prevalences of the skin tumours with the South African study by Bastianello[1] because the total number of skin tumours and the organ location of most of the mesenchymal tumours could not be determined.

Mast cell tumour was the most common tumour (20.3 %) in this study and in all previous surveys[2,4,7,8,12,14,17]. Squamous cell carcinoma (the 2nd most common tumour in this study) was more common in Zimbabwe (15.4 %) than in other regions (2.3–5.4 %). A possible explanation may be the difference in environmental influences. Zimbabwe lies in the subtropics and most dogs are kept outdoors and therefore have greater exposure to sunlight. Other tumours, such as haemangiosarcomas and melanomas, that have been associated with increased exposure to UV light in humans and domestic animals[10,11,15] were also more common in our study than in other regions. However, a study in tropical Queensland found no increase in the number of UV light-associated tumours compared with other regions. The observed difference may be due to other environmental predisposing factors or a reflection of breed differences.

The mean age of dogs with tumours of epithelial, mesenchymal and melanocytic origin (Table 1) falls within the common range for the occurrence of most tumours in dogs, *i.e.* 6–14 years[19]. The mean age of dogs with lymphohistiocytic tumours (lymphomas and histiocytomas) was only 4.3 years. The common occurrence of histiocytomas in young dogs is well known[2,12,17]. However, the common occurrence of lymphomas in young dogs has not been noted. The aetiology of lymphomas in dogs has not been determined; in cats the cause is feline leukaemia virus.

A male predominance of 322:218 was observed in this study. In our study population, males may be over-represented because most dog owners in Zimbabwe prefer to keep male dogs. Thirty-three breeds, including mixed breed dogs, were represented in this study. There may be a predisposition for cutaneous tumours among some breeds, but, since canine population figures for Zimbabwe are not available, relative prevalence among different breeds could not be determined. However, we observed a variation in the prevalence of different histological types of cutaneous tumours according to breed (Table 4). For example, German shepherd dogs had more than twice as many epithelial (8.5 %) and lymphohistiocytic (8.5 %) tumours than mesenchymal tumours (3.8 %); a high number of melanocytic tumours were found in Dobermans (8.5 %); and none of the tumours in Ridgebacks were of lymphohistiocytic or melanocytic origin.

The distribution of the skin tumours in this study is consistent with the predilection sites reported in Greece[12]. The only difference from our study was that lymphohistiocytic tumours, which were much more common on the limbs of dogs in Greece, were much more common at multiple sites in our study. The observed difference is expected because of the presence of high numbers of lymphomas in the present study as these are usually located at multiple sites[13].

In the present study, tumours of the trunk and limbs were more likely to be malignant than those occurring at multiple sites. This is in contrast to a study in Greece[12], where the potential malignancy of a tumour was not associated with its location. This difference may be attributed to the fact that there is no established definitive criterion for histopathological differentiation of a benign tumour from a malignant neoplasm. Age and breed-orientated risk analyses could not be accomplished in this study because of the small number of dogs below 12 months of age and because of sparse breed data.

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