Journal of Veterinary Dentistry
1-10

DOI: 10.1177/08987564221146896
journals.sagepub.com/home/jov
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Histopathological Results of Mouth Lesions in Dogs and Cats from Colombia

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Abstract

Mouth-related neoplastic and non-neoplastic lesions are commonly found in dogs and cats, and their diagnosis and classification are important for treatment planning and prognosis. This retrospective study analyzed mouth-related lesions in dogs and cats between 2000-2019 from the animal pathology laboratory of the Universidad de Antioquia, Medellín, Colombia. A total of 640 mouth-related lesions affecting 572 dogs (89.4%) and 68 cats (10.6%) were reviewed. Lesions were classified as neoplastic or non-neoplastic. The average age for neoplastic lesions was 8.6 years in dogs and 6.4 years in cats, while for non-neoplastic lesions the average age was 7.7 years for dogs and 5 years for cats. Data was analyzed using descriptive statistical methods according to year and source of report, demographic information for the animal, location of the lesion, and diagnosis. Tissue origin and behavior were variables considered for neoplastic lesions. Melanoma was the most common neoplasia in dogs and squamous cell carcinoma was most common in cats. The most frequent non-neoplastic lesion in dogs was gingival hyperplasia, while in cats the inflammatory lesions showed a wide range of morphological diagnoses. This study described many pathological lesions affecting the oral cavity for both dogs and cats and provides useful epidemiological data for both pathologists and clinicians.

Keywords

neoplasia, oral lesion, stomatitis, tumor, tumor-like lesion

Introduction

Tumors and tumor-like lesions affecting the oral cavity represent a frequent reason for daily in-clinic consultation involving both dogs and cats. These lesions may cause pain, discomfort, and reluctance to eat.[1] Therefore, inspection of the oral cavity should be a standard procedure during clinical examination, followed by histopathological analysis if required, to determine the exact nature of any lesion found.[2]

Multiple studies have reported the frequency of oral tumors and tumor-like lesions in dogs and cats.[1-10] However, these studies generally do not include inflammatory disorders.[11] Information on the frequency of mouth-related lesions in dogs and cats in Latin America is scarce. To the best of our knowledge, this report is the first published on mouth-related lesions in dogs and cats from Colombia. This study retrospectively analyzed mouth-related pathological lesions in dogs and cats based on records collected between 2000-2019 from an animal pathology laboratory in Colombia.

Materials and Methods

Ethical Considerations

This study reports the analysis of the information obtained during regular histopathological diagnosis. The laboratory authorized the use of the records. Approval from an ethical committee on animal experimentation was not necessary.

Study Population, Histopathological Analysis, and Data Collection

A retrospective search of reports on mouth-related pathological lesions in dogs and cats was performed. Cases were examined by experienced veterinary pathologists at the animal pathology laboratory of Universidad de Antioquia, Medellín, Colombia. Routine histopathological examinations were included. Lesions were primarily classified into neoplastic and non-neoplastic. Data included the year of report (2000-2019), source of report (veterinary clinic and private veterinarian), demographic information of the animal (species, breed, age, and sex), location of the lesion (cheek, gingiva, palate, sublingual tissue, lip, tongue, and multiple locations), diagnosis, tissue origin (epithelial, melanocytic, mesenchymal, and round cell) and the behavior of neoplastic lesions (malignant or benign). The nomenclature of

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the mouth-related pathological lesions were classified based on previously reported studies.[12,13] The diagnosis of inflammatory lesions was defined according to the original diagnosis made by the veterinary pathologist.

Data Analysis

All data extracted from the records was manually entered into Excel worksheets[a] and then exported to Stata 16.0 v. 16.0[b] for statistical analysis. Descriptive statistics were computed for all the variables of interest, and they were presented as percentages resulting from the total number of mouth-related pathological lesions. Dogs and cats <1-year-old were excluded from the average age calculations, because the specific age was not included in the reports.

Results

A total of 640 mouth-related pathological lesions were obtained from reports collected during a 20-year period (2000-2019) in 632 animals. One report per animal was found, except for eight patients with two different pathological processes in different anatomical locations. Reported samples were submitted to the animal pathology laboratory by 141 different veterinary clinics and eight private veterinarians.

Mouth-related pathological lesions included 572 reports involving dogs (89.4%) and 68 cats (10.6%). The study population included 47 dog and four cat breeds, including crossbreds for both species. Information on breed was missing in four reports. Distribution of neoplastic and non-neoplastic mouth-related lesions as well as the average ages of presentation are shown in Table 1.

The distribution of neoplastic mouth-related lesions in dogs, according to the specific diagnosis (pathological term), behavior, frequency, anatomical location, and average age at presentation are shown in Table 2. Neoplasms represented the most frequent diagnosis in dogs, and 187/419 (44.6%) of the reports showed a benign neoplasm. The most common diagnosis among benign neoplasms corresponded to peripheral odontogenic fibroma (POF) (44.4%, 83/187) (Figure 1A). Affected breeds included Schnauzer, Boxer, and Labrador Retriever (15.7%, 13/83 for each breed), crossbreds (10.8%, 9/83), Poodle (9.6%, 8/83), Golden Retriever (6%, 5/83), and Beagle and Bulldog (3.6%, 3/83 for each breed), with no sex predilection. Ossification was present in nine cases (10.8%, 9/83) of POF.

Acanthomatous ameloblastoma (AA) (Figure 1B) represented 8.35% of all oral neoplasms (35/419). AA affected males in 62.9% of cases, compromising the gingiva and reaching the palate in two cases and the sublingual tissue in one case. Crossbred dogs were most affected by AA (17.1%, 6/35), followed by the Beagle, Boxer and Schnauzer (8.6%, 3/35 for each breed).

Papilloma (Figure 1C) affected 44 dogs and four of these were diagnosed with squamous papilloma. Twenty-three dogs were 1-year-old or younger (48.9%). The most affected breeds were crossbred (18.2%, 8/44), Golden Retriever (13.6%, 6/44), Beagle (11.4%, 5/44), and Pinscher (6.8%, 3/44). Twenty other dog breeds were reported to be affected by papilloma. No sex predilection was observed. Four dogs had lesions located on the tongue and cheek (4.5%, 2/44); gingiva, lip, and sublingual (2.3%, 1/44); and lip, cheek, and tongue (2.3%, 1/44).

Transmissible venereal tumor (TVT) was reported in four dogs, three of which were males. One Pinscher who was <1-year-old was affected by TVT, with lesions in both the gingiva and palate.

Malignant neoplasms were found in 232 (55.4%) dogs. Oral malignant melanoma (MM) (Figure 1D) was the most common malignant neoplasm found in this study (42.6%, 99/232). Crossbred dogs were most affected (19.2%, 19/99), followed by the Poodle (17.2%, 17/99). Gingiva and cheek were the most frequent locations for MM (5.1%, 5/99), and males were most affected 63.6% (63/99). The average age of the Poodle population affected was 13.2 years, and only three dogs were younger than 10 years of age. The melanocytoma, its benign counterpart, was reported in four cases and represented 4% of the melanocyte tumors. Melanocytomas were observed in dogs older than 5 years of age in all cases.

Squamous cell carcinoma (SCC) (Figure 1E) affected two <1-year-old dogs. The frequency in males was higher (68.3%, 28/41) as compared to females. The Poodle was the most frequently affected breed (22%, 9/41), followed by Labrador Retriever (12.2%, 5/41), and Boxer (9.8%, 4/41).

Fibrosarcoma (FS) (6.9%, 16/232), osteosarcoma (OS) (5.2%, 12/232), and hemangiosarcoma (HS) (4.7%, 11/232) were the most common sarcomas, and six cases were diagnosed

Table 1. Distribution of Neoplastic and Non-Neoplastic Mouth-Related Pathological Lesions in Dogs and Cats from 2000-2019.

Classification of Lesions	Dogs (Average Age at Presentation)		Cats (Average Age at Presentation)		Total
Neoplastic	419 (8.6 years)[a]		14 (6.4 years)[c]		433 (67.6%)
	Benign	Malignant	Benign	Malignant	
	187	232	1	13	
Non-neoplastic	153 (7.7 years)[b]		54 (5 years)[d]		207 (32.4%)
Total	572 (89.4%)		68 (10.6%)		640 (100%)

[a]15 cases in dogs <1-year-old. [b]3 cases in dogs <1-year-old. [c]15 cases in cats <1-year-old. [d]15 cases in cats <1-year-old.

Table 2. Distribution of Neoplastic Mouth-Related Pathological Lesions in Dogs in the Study from 2000-2019.

Benign										
Histopathological Diagnosis	Cheek	Lip	Palate	Tongue	Sublingual Tissue	Gingiva	Multiple Locations	NR	Total	Average Age at Presentation (in Years)
Peripheral odontogenic fibroma			3			77		3	83	7.6
Papilloma	1	13	2	3		5	4	16	44	3.8[a]
Acanthomatous ameloblastoma					1	29	1	4	35	7.4
Transmissible venereal tumor						3	1		4	11.5[a]
Melanocytoma		1				2		1	4	9.5
Squamous papilloma		1		1		1	1		4	4.5
Osteoma			1			1			2	9
Peripheral nerve sheath tumor						1		1	2	6
Angiokeratoma				1					1	6
Fibroleiomyoma						1			1	4
Cementifying fibroma						1			1	4
Hemangioma		1							1	<1
Leiomyoma		1							1	8
Neurofibroma	1								1	11
Plasmacytoma		1							1	6
Basal cell tumor						1			1	10
Granular cell tumor						1			1	6
Total	2	18	6	5	1	123	7	25	187	

Malignant										
Histopathological diagnosis	Cheek	Lip	Palate	Tongue	Sublingual Tissue	Gingiva	Multiple Locations	NR	Total	Average Age at Presentation (in Years)
Malignant melanoma	4	17	4	4	6	38	8	18	99	11.2[a]
Squamous cell carcinoma	1	6	3	4	2	21	1	3	41	9.4
Fibrosarcoma	3	2	2		1	6	1	1	16	8.7
Adenocarcinoma		1	3		1	3	2	2	12	6. 7
Osteosarcoma	1		5			3	2	1	12	9.9
Hemangiosarcoma			1	3		6	1		11	9
Mast cell tumor		9							9	7. 9
Undifferentiated sarcoma	1	2				3			6	10. 7
Acinic carcinoma		1	2					1	4	11. 7[a]
Lymphoma	1	2	1						4	7.8
Basal cell carcinoma						1	1		2	8
Chondrosarcoma	1					1			2	11
Undifferentiated carcinoma				1		1			2	9.5
Fibroleiomyosarcoma						1		1	2	6
Reactive histiocytosis		1		1					2	10.5
Leiomyosarcoma						1		1	2	12.5
Rhabdomyosarcoma				1			1		2	6.5
Histiocytic sarcoma		2							2	13
Malignant myoblastoma				1					1	5
Histiocytic undifferentiated malignant tumor							1		1	14
Total	12	43	21	15	10	85	18	28	232	

Multiple localization refers to several anatomical sites affected by the same process. NR: Not reported. [a]Dogs 1-year-old or younger were not considered in the average age calculations.

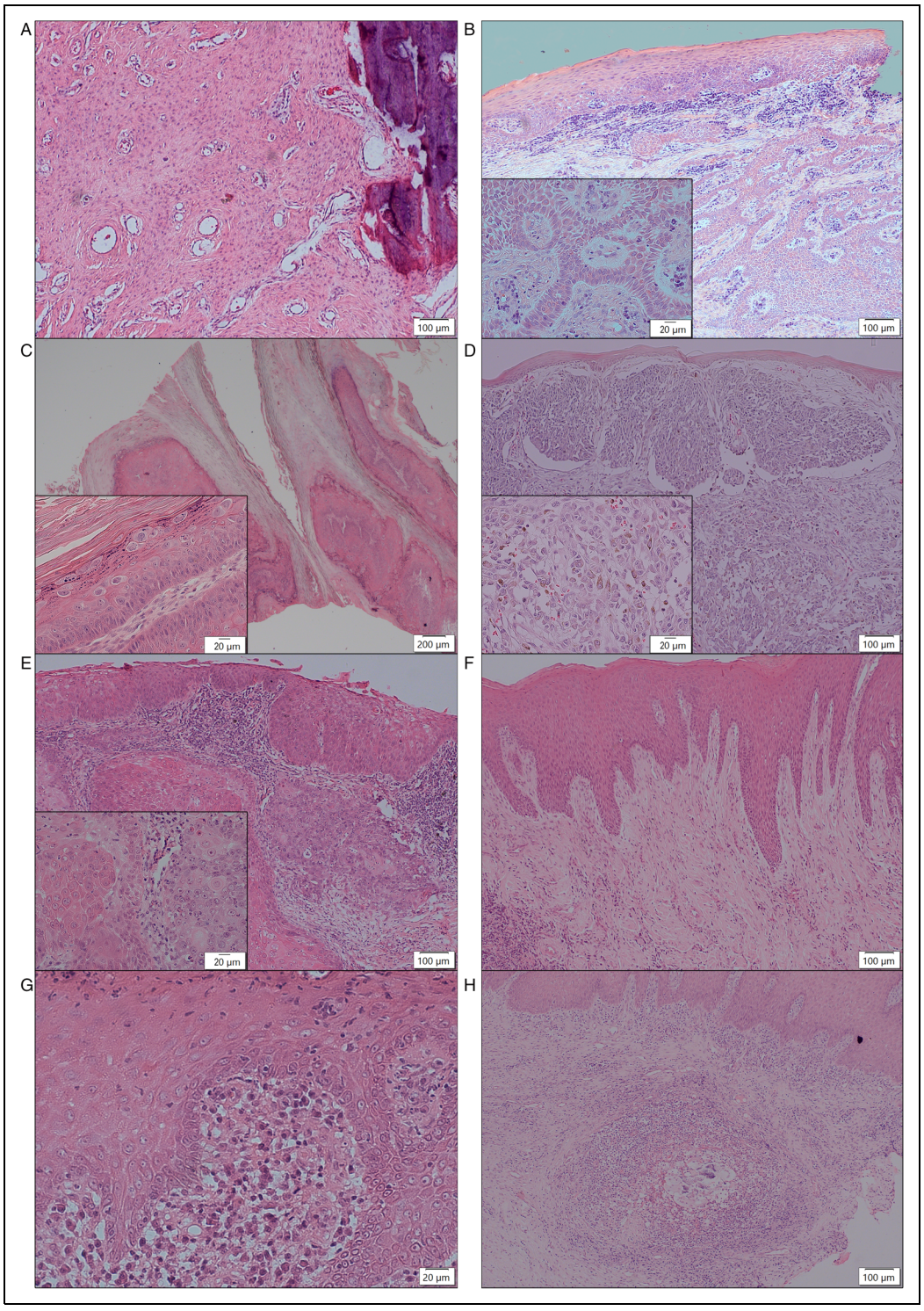

Figure 1. Histopathological features using hematoxylin and eosin-stain. (A) Peripheral odontogenic fibroma (100×). Dilated vascular spaces characteristic of the periodontal ligament are embedded in masses of collagenous tissue, with presence of calcium. (B) Acanthomatous ameloblastoma (100×). A trabecular anastomosing pattern, supported by dense mature fibrous stroma with a lymphocytic infiltrate (Insert - basilar epithelial cells palisaded). (C) Papilloma (40×). A thin core of dermal fibrous connective tissue with epidermal hyperplasia and orthokeratotic hyperkeratosis (Insert - enlarged keratohyaline granules and several koilocytes). (D) Melanoma (100×). Variable sized nests in the dermis, separated by a fibrovascular stroma (Insert - epithelioid and polyhedric cells show a moderate amount of melanin). (E) Squamous cell carcinoma (100×). Trabeculae and nests of neoplastic cells in the stroma are visible (Insert - dyskeratosis and intercellular junctions in neoplastic cells). (F) Gingival hyperplasia (100×). A predominantly hyperplastic gingival epithelium and a coarse dense collagen. (G) Lymphoplasmacytic gingivitis (100×). Submucosal lamina propria with a leukocyte infiltrate and a predominance of lymphocytes and plasma cells. (H) Granulomatous gingivitis (100×). The focal inflammatory process in the submucosal lamina propria reacting to a foreign body, with epithelioid macrophages infiltration.

Table 3. Distribution of Non-Neoplastic Mouth-Related Pathological Lesions in Dogs in the Study from 2000-2019.

Histopathological Diagnosis	Cheek	Lip	Palate	Tongue	Sublingual Tissue	Gingiva	Multiple Locations	NR	Total	Average Age at Presentation (in Years)
Gingival hyperplasia			4			95	3		102	7.9[a]
Chronic active gingivitis						7			7	7.6
Lymphoplasmacytic gingivitis						4			4	6
Calcinosis circumscriptive				1	1				2	1[a]
Chronic active stomatitis	3								3	7
Lymphoplasmacytic stomatitis							1	1	2	10.5
Proliferative stomatitis					1		1		2	9
Chronic gingivitis						1	1		2	9.5
Granulomatous gingivitis						2			2	1[a]
Eosinophilic granulomatous glossitis				2					2	4.5
Peripheral giant cell granuloma						2			2	6.5
Chronic active cheilitis		2							2	11[a]
Proliferative cheilitis		2							2	8.5
Angiomatosis		1							1	12
Chronic stomatitis	3								3	10
Eosinophilic granulomatous stomatitis			1						1	NR
Granulomatous stomatitis					1				1	6
Pyogranulomatous stomatitis								1	1	5
Ulcerative stomatitis								1	1	6
Necrotizing gingivitis						1			1	12
Subacute gingivitis						1			1	6
Chronic active glossitis					1				1	10
Granulomatous glossitis					1				1	4
Mucocele					1				1	13
Pyogranulomatous palatitis			1						1	4
Proliferative palatitis			1						1	6
Lymphoplasmacytic cheilitis		1							1	6
Necrotizing cheilitis		1							1	2
Pyogranulomatous cheilitis		1							1	13
Sialocele			1						1	3
Total	6	8	8	3	6	113	6	3	153	-

NR: Not reported. [a]Dogs 1-year-old or younger were not considered in the average calculations.

as undifferentiated sarcomas (1.44%). FS showed no sex predilection, and the most frequently affected breeds were Schnauzer and Poodle (18.8%, 3/16 for each breed). A 12-year-old Labrador Retriever was affected in both the gingiva and cheek. OS was most commonly found in females (75%, 9/12) and the most frequently affected breeds were Bulldog and Poodle (16.7%, 2/12 for each breed). HS affected two Chow-Chow males (18.2%) and four crossbred dogs (36.4%), and it was present in multiple locations in a 9-year-old crossbred female (ie gingiva, cheek, sublingual tissue). A male predilection was observed for HS (72.7%, 8/11), compared to female dogs.

Glandular lesions in dogs represented 3.1%, of which 88.9% were neoplasms, 12 of the 16 reports were classified as adenocarcinoma (6.0%, 12/232) and four as acinic carcinomas (1.7%, 4/232). No sex predilection was observed in both cases. Acinic carcinoma affected a <1-year-old Golden Retriever. Other affected breeds were the Beagle, Boxer, and Poodle. Alternatively, adenocarcinoma mainly affected Labrador Retrievers (25%, 3/12), Poodle (16.7%, 2/12), and crossbred dogs (33.3%, 4/12). Two <1-year-old dogs, a Labrador Retriever male, and a crossbred female, were affected by adenocarcinoma.

The distribution of the non-neoplastic findings in dogs, based on the pathology report diagnosis (pathological term), frequency, anatomical location, and average age at presentation is shown in Table 3. Among the non-neoplastic lesions, gingival lesions were the most frequent, with gingival hyperplasia

Table 4. Anatomic Distribution of Non-Neoplastic Mouth-Related Pathological Lesions in Cats in the Study from 2000-2019.

Histopathological Diagnosis	Cheek	Lip	Palate	Tongue	Gingiva	Gingiva, Palate	Gingiva, Tongue	Gingiva, Cheek	NR	Total	Average Age at Presentation (in Years)
Chronic active stomatitis	3		1				2	2	4	12	5.5
Gingival hyperplasia					10					10	5
Chronic active gingivitis					8					8	5.7[a]
Chronic active glossitis				3						3	4[a]
Granulation tissue					3					3	4.3
Chronic stomatitis						1			1	2	3.5
Lymphoplasmacytic gingivitis					2					2	5
Lymphoplasmacytic stomatitis									1	1	10
Suppurative stomatitis									1	1	6
Ulcerative stomatitis									1	1	2
Eosinophilic gingivitis					1					1	2
Granulomatous gingivitis					1					1	2
Eosinophilic glossitis				1						1	2
Proliferative palatitis			1							1	<1
Chronic active cheilitis		1								1	<1
Pyogranulomatous cheilitis		1								1	7
Sialadenitis					1					1	4
Total	3	2	2	4	26	1	2	2	8	50	-

NR: Not reported. [a]Cats 1-year-old or younger were not considered in the average calculations

(GH) (Figure 1F) being the most common diagnosis, mainly affecting Labrador Retrievers (13.7%, 14/102) and crossbred dogs (12.7%, 13/102). Most cases were reported in males (59.8%, 61/102). The palate was shown to be affected in seven reports. GH was more frequent in males (59.8%, 61/102), and mainly affecting Labrador Retrievers (13.7%, 14/102) and crossbred dogs (12.7%, 13/102). Gingivitis and stomatitis were also frequently diagnosed (Figure 1G). Gingival and palatal locations were noted in three dogs with GH.

Stomatitis was diagnosed in 18 dogs, showing lesions in cheeks, palate, and sublingual tissue with extension to gingiva, lip mucosa, and tongue. The average age at presentation was 7.9 years and the Poodle was the most affected breed (22.2%, 4/18).

Inflammatory lesions on the tongue represented 2.5% of the non-neoplastic lesions (4/153). These lesions were granulomatous (Figure 1H) in most of the cases, and in two of them they were accompanied by eosinophils. Eosinophilic granulomatous glossitis affected two Siberian Huskies, aged 1 and 8-years-old.

Other non-neoplastic proliferative lesions occurred infrequently, including angiomatosis (12-year-old female poodle), mucocele (13-year-old male Labrador Retriever), sialocele (3-year-old female crossbred), and peripheral giant cell granuloma (12-year-old male Beagle and 1-year-old male Golden Retriever).

Cats reported having 7.1% (1/14) benign tumors, which was a plasmacytoma in a 7-year-old crossbreed male. The specific location inside the mouth was not reported. The most frequent malignancy in cats was SCC (38.5%, 5/13), and it was most frequently reported in cats between 2 and 10-years-old. Anatomical locations were the gingiva, palate, lip, and one lesion affected both gingiva and lip. Other malignant neoplasms were reported once and included rhabdomyosarcoma, chondrosarcoma, FS, HS, mast cell tumor, lymphoma, MM, and anaplastic (undifferentiated) carcinoma.

Fifty-four cases of non-neoplastic lesions were reported in cats. The distribution of these findings, based on the specific diagnosis (pathological term), frequency, anatomical location, and average age at presentation are shown in Table 4.

Active stomatitis was the most frequent diagnosis in cats, and chronic behavior was the most reported (83.3%, 10/12). The average age at presentation was 5.5 years, and more commonly reported in males (58.3%, 7/12). Persian cats were shown to be affected in two reports and a Siamese cat in one report. The other nine reports involved crossbred cats.

GH affected two adult 7 and 8-year-old Persian cats (20%, 2/10). The other reports corresponded to crossbred cats (80%, 8/10). The average age at presentation was 5 years with no sex predilection.

Discussion

This study aimed to retrospectively analyze mouth-related pathological lesions in dogs and cats from records collected over 20

years at an animal pathology laboratory in Medellín, Colombia. Systematic observation of records supports scientific-based information for clinicians to obtain an accurate diagnosis so the patient can receive the appropriate treatment, improving the prognosis.[2,14]

Published reports evaluating both neoplastic and non-neoplastic lesions of the oral cavity in dogs and cats are scarce. In this study, crossbred dogs were overrepresented (14.9%), followed by the Poodle (11%), Labrador Retriever (10.1%), and Schnauzer (7.5%). Other authors have reported similar breeds in slightly different proportions, but always maintaining overrepresentation of crossbred dogs. One study reported a greater representation of crossbred dogs (18%), followed by the Labrador Retriever (8%), and Golden Retriever (5.7%).[11] A higher frequency in crossbreds (63.53%), followed by Labrador Retriever and Yorkshire Terrier (4.41% for each breed) has also been reported.[1] Similarly, the first study reported a breed tendency in cats, with the short-haired crossbred (60.3%), the long-haired crossbred (11%), the Siamese and the Ragdoll (7% for each breed) being the most frequently affected.[11] These results are in accord with the present study where the crossbred cats category was overrepresented (70.6%). However, to report whether the cat is short-haired or long-haired is not common in Colombia. Such findings may be due to breed tendencies in the studied populations in both dogs and cats, which could present a specific predisposition for the lesions of interest. However, to achieve such detailed information is not easy.

In the present study, MM was the most common malignancy in dogs, similar to other reports.[15,16] MM was the third most commonly diagnosed oral neoplasia (6.3%) representing 4.7% of all diagnosed oral lesions in one study.[11] The current study reported MM to represent 15.5% of all diagnoses, being slightly higher than that reported by the other study and the second lesion most frequently diagnosed after GH.[11] A separate study reported that the anatomical location of the MM was the mandibular gingiva (28.6%), followed by the maxillary gingiva (24.3%), lip (24.3%), tongue (14.3%), lip or buccal mucosa (5.7%), tonsils (1.4%), and hard palate (1.4%).[14] These results are similar to those reported here, where the gingiva was the most common location, followed by extension to other locations, mainly to the cheek.

Fibromatous, ossifying and acanthomatous epulides have been described and classified according to their histological characteristics,[12] although some authors have reported these as different neoplasms. Two studies reported AA as being the most frequent odontogenic neoplasm (53.9% and 45%, respectively).[6,17] These results are in contrast with the findings in this study, where POF was the most frequent neoplasm, representing 69.7% of the odontogenic neoplasms, which agrees with a previous report.[12] This study found that POF was the second most common mouth-related neoplasm, representing 19.8% of the total neoplasms. AA corresponded to 29.4% of the odontogenic tumors and 6.1% of all mouth related neoplasms. Similarly, it has been found that among 234 cases of oral neoplasms in dogs, POF represented 10.3% of the cases, being the sixth most frequent oral neoplasm in their study.[15]

One study found no breed predilection for POF,[6] which was in contrast to a separate study which found POF predilection related to crossbreds (18.9%), Maltese (16.8%), Shetland Sheepdog (14.1%), Shiba Inu (13.5%), and Shih-Tzu (9.7%).[18] A higher occurrence in the Schnauzer, Boxer, and Labrador Retriever (15.7% for each breed), followed by crossbreds and the poodle (10 and 9.6%, respectively) was observed in the present study. Alternatively, two studies reported a predisposition for AA in Golden Retrievers, which was not observed in this study.[6,17] In addition, a minor sex predilection for POF has been observed, where it occurred slightly more frequently in males than in females (66% and 64.6%, respectively).[6,18] The results of this study are in agreement with several authors who have reported no sex predilection for AA.[6,17,18] The average age at presentation for POF and AA in this study is in accord with previous reports, 8.1 and 8.3 years, respectively.[6,15]

Papilloma showed no sex predilection. Four dogs were affected in multiple locations including the tongue and cheek (4.5%), gingiva, lip, and sublingual (2.3%), and lip, cheek and tongue (2.3%). Similar to this study, others did not report sex predilection for papilloma,[19] and found that dogs with ages ranging from 6 months to 10 years, with an average of 3.1 years were most commonly affected by papilloma,[3] which is in agreement with this study, where 48.9% were <1-year old and the average age was 3.9 years. In addition, the literature reports that oral papilloma occurs in young dogs (approximately 1-year-old).[19]

As in the present study, one report found that SCC was the fourth most common oral neoplasm in dogs, occurring in 14.1% of cases,[15] while others reported SCC is the second most common oral neoplasia in dogs.[9,16] A sex predilection for SCC was observed in males in this study, which differs from a separate study,[9] which showed a slight sex predilection, 60.7% in females and in 39.3% males. However, other authors do not report sex predilection for SCC.[11] SCC was most frequently found on the gingiva (51.2%), a finding which is similar to a previous report,[9] which stated that 66.7% of SCCs originated in the gingiva. The age at presentation in this study were in accord with the literature, where dogs aged 8 to 10-years old are most affected by SCC.[9,15,20]

In this study, FS accounted for 3.8% of all oral neoplasms in dogs, which contrasts with others,[8] who reported a higher frequency (8%-25%) among all neoplasms of the oral cavity in dogs. One study[11] reported FS to be 6% of all pathological lesions diagnosed by biopsy in the oral cavity, and the second most diagnosed malignant neoplasm (9%). Such findings agree with the results of this study, where FS represented 6.9% of malignant neoplasms. In contrast, other studies reported a higher frequency in Golden Retrievers and Labrador Retrievers,[8,11,15] whist this study found that the Poodle and Schnauzer were the two more commonly affected breeds.

This study reported HS as the third most common mesenchymal neoplasm in dogs, the sixth most common malignant neoplasm, and the ninth neoplasm overall. Its occurrence is very

rare in the oral cavity in dogs, with a frequency of 1-2%, and it is commonly found in the tongue.[4,21] In this study, HS represented 2.6% of mouth-related neoplasms, but the most common anatomical location was the gingiva (54.5%), followed by the tongue (27.3%). Other studies have reported a greater prevalence of HS in the oral cavity, approximately 10%.[22] The age at presentation of HS was reported most frequently at 9 years of age, in contrast to two other studies which found a higher average age, 10.3 and 10.7 years, respectively.[4,23]

The literature reports that OS is the fourth most common non-odontogenic oral neoplasm in the dog, representing 9-12% of all oral neoplasms.[24] However, it only represented 2.9% of all oral neoplasms in this study, closest to another study,[11] who observed a frequency of 6.3%. This study showed a greater representation of OS in Bulldogs and Poodles, which differs from that reported by the literature, where a predilection for occurrence in crossbreds and Retrievers is highlighted.[11,24] Some studies have reported a sex predilection in females, similar to this study (75%).[24] The average age at presentation reported in the present study (9.9 years) is in agreement with the range (9 to 10-years-old) reported by other authors.[2,24]

Salivary gland lesions in dogs are rare, with an incidence of 0.2% being reported in the literature, 30% of which are neoplastic.[25,26] This contrasts with the results of this study, where salivary gland pathology had an incidence of 3.2%, 88.9% of which were neoplasms.

This study found AA comprised 2.9% of all oral neoplasms, in agreement with another study,[11] who found a frequency of 1.4%. Separately, it was found a breed predilection in Retrievers showing 25%, similar to the results of this study in which the Labrador Retriever was the purebred showing the greater proportion of AA (25%).[25]

There is scarce epidemiological information on acinic carcinoma in the literature. One study reported eleven cases, with an age range between 3 and 14 years.[27] The tumors originated in minor salivary glands from the lip, gingiva, and tongue. This report found four cases having an average age of 11.7 years and 50% of the lesions were located on the palate.

Angiokeratoma is a rare variant of hemangioma. This study found a case in the tongue of a 6-year-old German Shepherd. This neoplasm occurs mainly in the ocular conjunctiva, but it can occur in other mucous membranes or skin, as reported previously as being on the abdominal skin of a 6-year-old Pekingese.[28] Granular cell tumor is an uncommon neoplasm as well, mainly occurring on the tongue.[12] A case of this neoplasm on the gingiva, in a 6- year-old female Boston Terrier was described by this study.

SCC was the most common malignancy in cats, and this agrees with previous reports.[29] In this study, SCC represented 35.7% of oral neoplasms and 7.4% of all oral pathology. This contrasts with the literature, which reports that SCC is approximately 60-70% of feline oral tumors.[5,11] One study reported a breed predilection in domestic (crossbred) shorthair cats (75.5%),[29] similar to the findings of this study. Nevertheless, crossbreds were also overrepresented (80%), possibly due to the low frequency of ownership of purebred cats in Colombia. In this study, a sex predilection in males was revealed (100%), contrary to others,[11] who observed a slight predilection in female cats (60%). However, another study[29] reported no sex predilection. Two studies found the age at presentation to be 10.6 and 13.1 years, respectively,[11,29] which is in contrast with the results of this study which showed an average age of 4.8 years (range 2 to 10 years).

As previously reported,[11] only one report of FS was obtained in this study. There were less records for cats available compared to the data obtained for dogs. One study reported FS as the second most common oral neoplasm in cats,[2] but there are few reports regarding FS in cats.

This study found a gingiva-located case of HS in a 6-year-old female crossbred cat. HS is a rare neoplasm in cats, accounting for 1.5% to 2% of nonhematopoietic neoplasms in all tissues.[30]

MM is uncommon in cats.[2] A labial mucosa-located case of MM in a 10-year-old crossbred female cat was reported in this study, similar to another study,[11] who found this neoplasm in a 20-year-old male. Alternatively, others reported five cats with oral MM of which 80% were domestic short-hair and 20% Siamese, 80% were female, and the average age was 12 years.[31]

The most frequent non-neoplastic lesion in dogs was GH, while in cats, inflammatory lesions showed a wide range of morphological diagnoses. There are few studies that evaluate the epidemiology of non-neoplastic oral lesions in dogs and cats. In this study it was shown that non-neoplastic lesions represented 26.7% of lesions in dogs and 79.4% in cats. Similarly, others reported inflammatory lesions in dogs and cats, representing 28% and 51%, respectively, of all pathologic processes in the oral cavity.[11] As reported in the literature and in this study, non-neoplastic pathology is more prevalent in cats, while neoplastic pathology is more common in dogs. This may be due to the multiple pathogens, mainly viral, affecting the cats' oral cavity, which cause inflammatory processes.[13] In this study, GH was the most common non-neoplastic disease in dogs and the second most common in cats. GH is considered one of the most common non-neoplastic oral disorders in dogs and cats.[2] In dogs, it was found that the most common breeds affected were the Labrador Retriever and crossbred (13.7 and 12.7%, respectively). However, a separate study observed a breed predilection in the Boxer,[2] while another reported no such finding.[6] Different authors have reported an average age for presentation of GH of 9 years,[1,6] similar to the results obtained in this study which showed an average of 7.9 years. There was a slight predilection for GH in male dogs (59.8%), but one report found no sex predilection.[6] In cats, one study reported 20 cases of GH, which represented 18.69% of non-neoplastic lesions,[1] which agrees with the results obtained in this study (18.5%), however it differs on the average age at presentation (8 years old vs 5 years old).

One of the most common non-neoplastic lesions found by this study was active chronic inflammation. It has been reported that mixed stomatitis as being most common.[1] However, the

authors observed a prevalence of 1.51% and 0.93% in dogs and cats, respectively, and average ages of 8.5 and 6 years. In addition, the literature reports the presentation of ulcerative lesions as being a chronic process.[32] In this study, this type of lesion represented 1.9%, both in dogs and cats, of non-neoplastic processes, with an average age of 10.3 years in dogs and just one case in a 2-year-old cat. The previous study reported that ulcerative stomatitis represented 6.1% of the non-neoplastic lesions and found an average age for presentation of this lesion of 10 years.[1]

One study reported four cases of granulomatous process (three crossbred dogs and one Maltese), where the average age was 8.5 years and three of the cases were in the maxilla.[18] While a separate study reported just one case in dogs and cats (0.75 and 0.93% of non-neoplastic lesions).[1] Similar to the other authors, few cases of granulomatous process were found by this study, with only two cases in cats (3.7%) and six cases in dogs (3.9%).

Neoplastic processes are common in elderly patients, but inflammatory processes can occur at any age.[13] In dogs, a similar age was evidenced in neoplastic and inflammatory processes, but in cats, inflammatory processes occurred in younger patients. This may be due to common viral processes in cats, such as feline leukemia virus (FeLV), feline immunodeficiency virus (FIV), calicivirus, feline infectious peritonitis (FIP), herpes virus, and panleukopenia virus, which cause oral inflammation.[12,33]

The authors believe this report on mouth-related pathological lesions in dogs and cats represents the first to be published from Colombia. This report focused on epidemiological data such as frequency of presentation and anatomical location by species, breed, sex, and age of the oral biopsy samples sent to an animal pathology laboratory over 20 years. This study described many pathological processes affecting the oral cavity for both species, providing useful epidemiological data for both pathologists and clinicians, in the diagnosis of neoplastic and non-neoplastic diseases affecting both dogs and cats.

Materials

(a) Microsoft Corp., 2016, Redmond, WA, USA
(b) StataCorp., 2019, Texas, USA

Acknowledgements

The authors thank the animal pathology laboratory of Universidad de Antioquia, Medellín, Colombia for the records provided.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The author(s) received no financial support for the research, authorship, and/or publication of this article.

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References

1. Mikiewicz M, Paździor-Czapula K, Gesek M, Lemishevskyi V, Otrocka-Domagala I. Canine and feline oral cavity tumours and tumour-like lesions: a retrospective study of 486 cases (2015–2017). *J Comp Pathol*. 2009 Oct;172:80-87. doi: 10.1016/j.jcpa.2019.09.007.
2. Verhaert L. Oral proliferative lesions in the dog and cat oral proliferative lesions in the dog and cat. *EJCAP*. 2010;20(3):252-264. Available from: https://www.vin.com/apputil/content/defaultadv1.aspx?pId=8708&catId=18047&id=3843718.
3. Bianchi M, Wouters F, Boos GS, et al. Canine papillomatosis: a retrospective study of 24 cases. *Pesquisa Vet Bras*. 2012;32(7):653-657. doi: 10.1590/S0100-736X2012000700012.
4. Burton JH, Powers BE, Biller BJ. Clinical outcome in 20 cases of lingual hemangiosarcoma in dogs: 1996-2011. *Vet Comp Oncol*. 2012;12(3):198-204. doi: 10.1111/j.1476-5829.2012.00351.x.
5. Bilgic O, Duda L, Sánchez MD, Lewis JR. Feline oral squamous cell carcinoma: clinical manifestations and literature review. *J Vet Dent*. 2015;32(1):30-40. doi: 10.1177/089875641503200104.
6. Fiani N, Verstraete FJM, Kass PH, Cox DP. Clinicopathologic characterization of odontogenic tumors and focal fibrous hyperplasia in dogs: 152 cases (1995–2005). *J Am Vet Med Assoc*. 2011;238(4):495-500. doi: 10.2460/javma.238.4.495.
7. Gardner H, Fidel J, Haldorson G, Dernell W, Wheeler B. Canine oral fibrosarcomas: a retrospective analysis of 65 cases (1998-2010). *Vet Comp Oncol*. 2015;13(1):40-47. doi: 10.1111/vco.12017.
8. Martano M, Iussich S, Morello E, Buracco P. Canine oral fibrosarcoma: changes in prognosis over the last 30 years? *Vet J*. 2018 Nov;241:1-7. doi: 10.1016/j.tvjl.2018.09.005.
9. Nemec A, Murphy BG, Jordan RC, Kass PH. Oral papillary squamous cell carcinoma in twelve dogs. *J Comp Pathol*. 2014;150(2–3):155-161. doi: 10.1016/j.jcpa.2013.07.007.
10. Ramos-Vara JA, Beissenherz ME, Miller MA, et al. Retrospective study of 338 canine oral melanomas with clinical, histologic, and immunohistochemical review of 129 cases. *Vet Pathol*. 2000;37(6):597-608. doi: 10.1354/vp.37-6-597.
11. Wingo K. Histopathologic diagnoses from biopsies of the oral cavity in 403 dogs and 73 cats. *J Vet Dent*. 2018;35(1):7-17. doi: 10.1177/0898756418759760.
12. Munday J, Lorh C, Kiupel M. Tumors of the alimentary tract. In: Meuten DJ, ed. *Tumors of Domestic Animals*. Fifth ed. John Wiley & Sons, Inc; 2017:499-601. doi: 10.1002/9781119181200.
13. Usal FA, Plattner B, Hostetter J. Alimentary system. In: Grant M, ed. *Jubb, Kennedy & Palmer's Pathology of Domestic Animals*. Sixth edition. Elsevier; 2016:2-30. doi: 10.1016/B978-0-7020-2823-6.X5001-5.
14. Arzi B, Anderson JG, Verstraete FJM. Oral manifestations of systemic disorders in dogs and cats. *JVCS*. 2008;1(4):112-124. Available from: https://www.academia.edu/29543609/Oral_Manifestations_of_Systemic_Disorders_in_Dogs_and_Cats.

15. Sarowitz BN, Davis GJ, Kim S. Outcome and prognostic factors following curative-intent surgery for oral tumours in dogs: 234 cases (2004 to 2014). *J Small Anim Pract*. 2017;58(3):146-153. doi: 10.1111/jsap.12624.
16. Rodríguez F, Castro P, Ramírez GA. Collision tumour of squamous cell carcinoma and malignant melanoma in the oral cavity of a dog. *J Comp Pathol*. 2016;154(4):314-318. doi: 10.1016/j.jcpa.2016.03.004.
17. Goldschmidt SL, Bell CM, Hetzel S, Soukup J. Clinical characterization of canine acanthomatous ameloblastoma (CAA) in 263 dogs and the influence of postsurgical histopathological margin on local recurrence. *J Vet Dent*. 2017;34(4):241-247. doi: 10.1177/0898756417734312.
18. Yoshida K, Yanai T, Iwasaki T, et al. Clinicopathological study of K9 oral epulides. *J Vet Med Sci*. 1999;61(8):897-902. doi: 10.1292/jvms.61.897.
19. Yhee JY, Kwon BJ, Kim JH, et al. Characterization of canine oral papillomavirus by histopathological and genetic analysis in Korea. *J Vet Sci*. 2010;11(1):21-25. doi: 10.4142/jvs.2010.11.1.21.
20. Baines SJ, Shales C, White R. Oral non-tonsillar squamous cell carcinoma in young dogs. *Vet Rec*. 2013;172(2):52-53. doi: 10.1136/vr.f145.
21. Papadimitriou S. Gingival hemangiosarcoma of the left mandible in a dog. *J Vet Sci Med*. 2012;1(1):2-5. doi: 10.13188/2325-4645.1000006.
22. Dennis MM, Ehrhart N, Duncan CG, Barnes AB, Erhart EJ. Frequency of and risk factors association with lingual lesions in dogs: 1196 cases (1995-2204). *JAVMA*. 2006;228B(10):1533-1537. doi: 10.2460/javma.228.10.1533.
23. Schultheiss PC. A retrospective study of visceral and non-visceral hemangiosarcoma and hemangiomas in domestic animals. *J Vet Diagnostic Investig*. 2004;16(6):522-526. doi: 10.1177/104063870401600606.
24. Farcas N, Arzi B, Verstraete FJM. Oral and maxillofacial osteosarcoma in dogs: a review. *Vet Comp Oncol*. 2014;12(3):169-180. doi: 10.1111/j.1476-5829.2012.00352.x.
25. Hammer A, Getzy D, Ogilvie G, et al. Salivary gland neoplasia in the dog and cat: survival times and prognostic factors. *J Am Anim Hosp Assoc*. 2003;37(5):478-482. doi: 10.5326/15473317-37-5-478.
26. Sozmen M, Brown PJ, Eveson JW. Salivary gland basal cell adenocarcinoma: a report of cases in a cat and two dogs. *J Vet Med Ser A Physiol Pathol Clin Med*. 2003;50(8):399-401. doi: 10.1046/j.0931-184x.2003.00563.x.
27. Brunnert S, Altman N. Canine lingual acinic cell carcinoma (clear cell variant) of minor salivary gland. *Vet Pathol*. 1990 May;27:203-205. doi: 10.1177/030098589002700310.
28. Lim HK, Kim HJ, Lee HR, Han S. Angiokeratoma with lysosomal dilatation in keratinocytes in a dog: a case report. *Vet Med (Praha)*. 2014;59(9):453-456. doi: 10.17221/7686-VETMED.
29. Soltero-Rivera MM, Krick EL, Reiter AM, Brown DC, Lewis JR. Prevalence of regional and distant metastasis in cats with advanced oral squamous cell carcinoma: 49 cases (2005–2011). *J Feline Med Surg*. 2014;16(2):164-169. doi: 10.1177/1098612X13502975.
30. Johannes CM, Henry CJ, Turnquist SE, et al. Hemangiosarcoma in cats: 53 cases (1992-2002). *J Am Vet Med Assoc*. 2007;231(12):1851-1856. doi: 10.2460/javma.231.12.1851.
31. Patnaik AK, Mooney S. Feline melanoma: a comparative study of ocular, oral, and dermal neoplasms. *Vet Pathol*. 1998;25(2):105-112. doi: 10.1177/030098588802500201.
32. Anderson JG, Peralta S, Kol A, Kass PH, Murphy B. Clinical and histopathologic characterization of canine chronic ulcerative stomatitis. *Vet Pathol*. 2017;54(3):511-519. doi: 10.1177/0300985816688754.
33. Lyon KF. Gingivostomatitis. *Vet Clin North Am - Small Anim Pract*. 2005;35(4 SPEC. ISS.):891-911. doi: 10.1016/j.cvsm.2005.02.001.