

Characteristics of domestic dogs with neoplasms at a hospital in Mexico City

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[Características de cães domésticos com neoplasias em um hospital na Cidade do México]

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Cancer is a common pathology in domestic dogs worldwide. Due to the importance of this disease, the aim of this study is to provide information to identify the characteristics of dogs with neoplasms at a veterinary hospital located in Mexico City. Therefore, an analysis was conducted on data from clinical records that included cytopathological and histopathological reports from July 2020 to August 2021, with a total of 378 cases. Females (58.4%) were more common than males. Mixed-breed dogs were more prevalent, accounting for 18.5% of cases. Mast cell tumor was the most common neoplasm, accounting for 20.1% of cases. According to biological behavior and histological type, malignant tumors were the most frequent, as were round cell neoplasms. Cytology diagnosis from fine needle aspiration in malignant neoplasms was statistically significant. Conclusions. A report was obtained on the characteristics of the canine population with neoplasms, and fine needle aspiration cytology was found to be a reliable method for early cancer diagnosis.

Keywords: cancer; characteristics; frequency; neoplasms; dog

RESUMO

O câncer é uma patologia comum em cães domésticos em todo o mundo. Devido à importância dessa enfermidade, o objetivo deste estudo é fornecer informações para identificar as características de cães com neoplasias em um hospital veterinário localizado na Cidade do México. Para isso, foi realizada uma análise de dados de prontuários clínicos que incluíam laudos citopatológicos e histopatológicos no período de julho de 2020 a agosto de 2021, totalizando 378 casos. As fêmeas (58,4%) foram mais frequentes do que os machos. Cães sem raça definida foram os mais prevalentes, representando 18,5% dos casos. O mastocitoma foi a neoplasia mais comum, correspondendo a 20,1% dos casos. De acordo com o comportamento biológico e o tipo histológico, os tumores malignos foram os mais frequentes, assim como as neoplasias de células redondas. O diagnóstico citológico por punção aspirativa com agulha fina em neoplasias malignas apresentou significância estatística. O presente estudo permitiu caracterizar a população canina com neoplasias, demonstrando que a citologia por punção aspirativa com agulha fina é um método confiável para o diagnóstico precoce de câncer.

Palavras-chave: câncer, características, frequência, neoplasias, cão

INTRODUCTION

For decades, neoplasms have been considered one of the leading causes of mortality in dogs (*Canis lupus familiaris*), with senior and geriatric dogs being the most affected. Due to their high prevalence in companion animals, their study has become very important in veterinary medicine

worldwide, especially in the Field of Veterinary Oncology (Dobson, 2014).

In the literature, the high prevalence of neoplasms in the canine population has recently been the subject of study by several authors. Some of them mention that 1 in 10 dogs will develop some type of neoplasm during their lifetime, and others have pointed out that

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approximately 45% of dogs over 10 years of age die due to complications caused by cancer (Pinello *et al.*, 2022). Although there are no exact data on the prevalence of this pathology due to the diversity of populations and the disease itself, over the years there has been an increase in the number of cases of tumors diagnosed as neoplasms in clinical veterinary practice, due to the importance given to this species, especially by humans (Elgue *et al.*, 2012). One of the best-known veterinary tumor repositories cited as a source of data on dogs is the California Animal Neoplasms Registry (CANR), which has been used as a source of data on neoplasms in dogs (Fajardo *et al.*, 2013).

In Mexico, statistical studies have reported on factors preceding the occurrence of neoplasms in dogs; however, these studies were conducted at different times, on diverse canine populations, and across various regions of the country, resulting in varying outcomes (De La Cruz *et al.*, 2017). Consequently, certain purebred dog breeds have been identified as predisposed to specific types of neoplasms, including lymphomas. These breeds include Labrador Retrievers, Dobermans, and Boxers (Baioni *et al.*, 2017).

Veterinary oncology studies have also investigated the relationship between hormonal imbalances and the development of neoplasms in hormone-secreting organs in dogs, such as the testicles, ovaries, and mammary glands (Simon *et al.*, 2009). Other factors include diet and cyclooxygenase-2 expression (Nosalova *et al.*, 2024). Therefore, the objective of this study is to identify the characteristics of patients that may be associated with the presence of neoplasms in domestic dogs, to provide an updated overview of this pathology in the canine population in Mexico.

ETHICAL ASPECTS

This research was not submitted to the *Ethics Committee on Animal Use*. This is because it was a private hospital.

MATERIALS AND METHODS

A retrospective, descriptive, cross-sectional, observational study was conducted using a convenience sample from a Veterinary Oncology

Hospital in Mexico City. A total of 2,076 clinical records of canine patients from July 2020 and August 2021 were collected, and only 377 were diagnosed with neoplasms.

Patients were selected based on a definitive diagnosis of neoplasms. Information was obtained from clinical records and the cytopathological and/or histopathological results performed by a veterinary clinical pathologist.

Cases in which the clinical record did not present confirmatory pathological reports of neoplasms and/or did not have the required complete data, as well as those records that reported a diagnosis in progress, were excluded from the study.

To perform the data analysis, the intrinsic factors of each patient were taken as variables: sex, age (divided into four groups according to the classification made by Zheng *et al.*, 2022 in mammary gland tumors), breed, neuter status, classification of neoplasms, benign or malignant biological behavior according to the classification of Baioni *et al.* (2017) and the technique used for diagnosis.

In the case of mast cell tumors, all those that were high grade (grade II or III) were classified as malignant, and those that were low grade (grade I) were classified as benign, according to the classification of Kiupell and Patnaik, respectively (Śmiech *et al.*, 2018). Additionally, risk factors associated with the presence of neoplasms carrying a malignant prognosis were analyzed.

Frequencies and risk factors were analyzed using logistic regression with respect to the variables analyzed in patients diagnosed with neoplasia. It was performed using the SAS 2.0 statistical program.

RESULTS

During the period from July 2020 to August 2021, a total of 378 cases of neoplasms in dogs were documented. Breaking down the number of cases by sex, there were 222 (58.7%) females and 156 (41.6%) males. According to age, the cases were divided into four groups, with a total of 206 cases (54.6%) in the “over-9-year-old” group (Table 1), the most affected group being animals considered geriatric.

In addition, 21 breeds were reported. Mixed-breed dogs accounted for the highest number of patients with neoplasms, with a total of 181 cases (47.8%), followed by schnauzers with 34 (8.9%)

and pit bulls with 10 (6.9%) affected patients. Boxers, which are considered the most common breed in the presence of neoplasms, ranked 7th with 20 (5.3%) cases (Table 2).

Table 1. Characteristics of patients diagnosed with neoplasia

Age Group	Female	Male	Number of Cases
< 5 years	15 (43%)	20 (57%)	35 (9.2%)
5–8 years	83 (60%)	54 (40%)	137 (36.2%)
9–12 years	89 (57%)	67 (43%)	156 (41.2%)
> 12 years	35 (70%)	15 (30%)	50 (13.4%)
Total	222 (58.73%)	156 (41.27%)	378 (100%)

Table 2. Percents in breeds found in the study with the presence of neoplasms

Breed	Female %	Male %
Mixed Breed	12.70	6.08
Schnauzer	4.50	4.50
Pit Bull	2.65	4.23
Golden Retriever	3.70	2.91
Labrador Retriever	0.53	2.91
Poodle	3.70	1.59
Boxer	3.17	2.12
Beagle	2.65	1.06
French Bulldog	1.59	1.59
Cocker Spaniel	1.32	1.85
Pug	2.91	0.26
Chihuahua	1.59	1.32
Maltese	1.85	0.00
Yorkshire Terrier	1.06	0.79
Dachshund	1.06	0.53
Old English Sheepdog	0.53	0.79
Basset Hound	0.79	0.53
Scottish Terrier	1.06	0.26
German Shepherd	0.79	0.26
Bernese Mountain dog	0.79	0.26
Border Collie	0.53	0.53

Among benign cases, 8 (2.1%) dogs were neutered, while 24 (6.3%) were intact. Whereas malignant cases, 66 (17.4%) dogs were neutered, and 280 (74%) were intact.

On the other hand, based on histological type, mast cell tumor was the most common type, with 76 cases (20.1%), followed by lymphoma, with 58 cases (15.3%), and in third place were those directly affecting the mammary gland, with 42 cases (11.1%). A smaller number of squamous cell carcinomas were observed, with 37 (9.7%), and hemangiosarcomas, with 23 (6.0%). As a particular finding, mastocytoma was found to have a high frequency of localization in the thoracic and pelvic limbs (36 cases), representing 44.7% of the total number of mastocytomas by anatomical area.

Based on biological behavior, 347 (91.8%) cases were found to be malignant neoplasms and 32 (8.2%) were benign. The diagnoses were confirmed by cytopathology in 106 (27.5%) cases and by histopathology in 272 (72.5%) cases.

Therefore, logistic regression was performed to identify risk factors, where cytology diagnosis from fine needle aspiration in malignant tumors was the only variable that showed statistical significance ($p>0.05$). The variables of age, sex, race, and presence of sexual organs did not show statistical significance, but they did show findings at high frequencies (Table 3).

Table 3. Logistic regression data with the variables analyzed in dogs with neoplasms

Variable	Estimate	Standard Error	p-value	-95% CI	+95% CI	Odds Ratio (unit ch)	OR	-95% CI	OR+95% CI
Constant (B0)	-2.492	0.300	0.000	-3.082	-1.901	0.083	0.046	0.149	
Gender	0.184	0.381	0.629	-0.565	0.933	1.202	0.568	2.543	
Age	0.064	0.223	0.775	-0.375	0.502	1.066	0.688	1.652	
Breed	-0.017	0.430	0.969	-0.861	0.828	0.983	0.423	2.289	
Sterilized	0.347	0.431	0.421	-0.500	1.193	1.414	0.606	3.297	
Diagnostic Method	0.764	0.377	0.043	0.024	1.505	2.147	1.024	4.503	

DISCUSSION

In the present study, females were the most affected, a result that coincides with the findings in previous studies such as Dhein *et al.* (2024), Pinello *et al.* (2022), and Śmiech *et al.* (2023); in this study, the female sex is related to the presence of mammary gland tumors. It has been shown that breast cancer in humans and female dogs is linked to alterations in the number and function of immune cells, where they have the ability to exhibit phenotypic and functional characteristics, i.e., cancer cells use these signaling molecules to release themselves. Inflammation is related to cancer and plays an important role in mammary carcinogenesis, contributing to the acquisition of essential capabilities that allow cancer cells to survive, proliferate, and spread. This can be attributable, at least in part, to the presence of the cyclooxygenase-2 inflammation cells (Carvalho *et al.*, 2016).

Furthermore, the high frequency in elderly dogs has already been reported by other authors (Elgue *et al.*, (2012); Fajardo *et al.*, (2013); Torres *et al.* (2015); Vinueza *et al.*, (2017). Cancer has been observed to be a late-onset disease with considerable mortality, where the cells of older dogs have undergone more cell cycles and have been exposed to carcinogenic factors for longer than young dogs (Dobson, 2014; Elgue *et al.*, 2012); Duque- Velasco and Romero- Peñuela, 2022). Although not statistically significant in this study, dogs over 9 years of age were the most affected. Age has been shown to be one of the factors with the greatest predisposition to its onset. Most neoplasms experience a steady and irregular increase as the animal ages (Chang *et al.*, 2017). In the case of osteosarcomas and lymphomas, they can occur at early and advanced ages as a second development peak (Martínez and Pérez, 2007; Dobson, 2014).

As well for breed, prevalence of neoplasm in mixed breeds of 17% and 38% have been reported. Coinciding with the present study of 47.8% (Elgue *et al.*, 2012). Other authors have shown that regardless of longevity, pedigree dogs are susceptible to genetic mechanisms for developing cancer. Artificial selection of specific traits sets aside Darwin's natural selection. Therefore, even if the aim is to preserve

characteristics in pure breeds, there is also a risk of introducing undesirable genetic variants that cause diseases, including cancer. In addition, inbreeding exists in pure breeds, which favors the appearance of undesirable genetic findings (Doherty *et al.*, 2020). It has also been shown that mixed breeds live longer than purebred dogs, which involves longevity with the presence of neoplasms (Schwartz *et al.*, 2022). In our study, most of the individuals were mixed breed and not purebred, so the population size was limited to determine whether or not breed interferes with the presence of the disease.

Hart *et al.* (2020) mention that spayed female dogs are 2 to 4 times more likely to develop cancer than unsplayed female dogs, but this was associated with breeds predisposed to cancer, such as Golden Retrievers. However, Beaudu-Lange *et al.* (2021) indicate that late spaying is associated with a lower incidence of death from neoplasms in females, possibly due to the protective effect of estrogens against the development of non-mammary cancer. The same authors demonstrated that spayed dogs had a four times lower risk of dying from mammary cancer (OR = 0.23; 95% CI: 0.11-0.47; $p < 0.0001$) compared to intact dogs. A decrease in the presence of mammary tumors has been found in female dogs associated with hormonal stimulation and who were generally not spayed at such an early age. This is similar to our findings in this study.

According to the classification of neoplasia types, De la Cruz *et al.* (2017), Vinueza *et al.* (2017), and Santos *et al.* (2013) report that mammary gland tumors are the most common in clinical veterinary practice, while in the study by Bravo *et al.* (2010), squamous cell carcinoma was the most common. In this study, mast cell tumors were consistently observed, which is associated with the skin being exposed to high levels of environmental carcinogens, a predisposition that is reflected in the variety of cutaneous, subcutaneous, and adnexal neoplasms that occur most frequently in dogs, as reported by Ogilvie and Moore (2008). Nardi *et al.* (2022) mention that round cell tumors represent the third most common skin tumor subtype in domestic dogs, accounting for 11% of skin cancer cases.

De la Cruz *et al.* (2017) mentioned that malignant neoplasms were common, with a percentage of 64.9%. This study found similar results and a higher percentage. The lifetime prevalence of malignant tumors in dogs is approximately 29.7 per 1,000 dogs, more than double that of benign tumors (14.7 per 1,000). Furthermore, the prevalence increases with age and is higher in large to giant dogs (up to almost 3.7 times higher in very large dogs vs. small dogs (Schwartz *et al.*, 2022). The presence of malignant tumors is related to large mammals, giant breeds with tumors such as hemangiosarcomas or osteosarcomas in the appendicular bones [Schwartz *et al.*, 2022]. In this study, large and giant breeds with malignant tumors accounted for 8.1%, therefore, giant breeds were not observed as frequently as in other studies.

Regarding logistic regression statistical analysis, cytological diagnosis from fine needle aspiration showed an OR of 2.1 with p -value < 0.04 (95% CI 1.024:4.503) for the detection of malignant neoplasms. Simon *et al.*, 2009 found that cytological examination had a sensitivity of 88% and a specificity of 96% for detecting malignancy in breast tumors. Even if malignancy is confirmed and the cellular origin is determined by fine needle aspiration, cytology cannot definitively rule out malignancy, and a surgical biopsy and histopathology should be performed when malignancy is clinically suspected and not confirmed cytologically. These are complementary laboratory studies, where cytology contributes to early detection and histopathology contributes to an accurate and reliable diagnosis (Sontas *et al.*, 2012).

CONCLUSIONS

The comparative evaluation of this study shows that characteristics such as sex, age, mixed breed, and not being neutered were the most common factors associated with the presence of neoplasms in dogs at a veterinary hospital in Mexico City. The most common neoplasm was mast cell tumor, as well as the presence of malignant biological behaviour. Due to the results obtained and the lack of statistically significant relevance except for the type of diagnostic technique, there may be a greater guideline for future research interested in

studying the domestic canine population in Mexico.

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CONTRIBUTORS

M. Melo-Hernández: redaction and data collection, K.P. Pedroza-Zepeda: data collection and clinical cases, B. Domínguez-Mancera: statistics, E.J. Medina-Magariño: writing and design, A. Serrano-Solís: design, J.L. Bravo-Ramos: design and A. Olivares-Muñoz: writing, language, and design

DATA AVAILABILITY STATEMENT

The research data are available within the article itself.

REFERENCES

- BAIONI, E.; SCANZIANI, E.; VINCENTI, M.C. *et al.* Estimating canine cancer incidence: findings from a population-based tumour registry in northwestern Italy. *Vet. Res.*, v.13, p.203, 2017.
- BEAUDU-LANGE, C.; LARRAT, S.; LANGE, E. *et al.* Prevalence of reproductive disorders including mammary tumors and associated mortality in female dogs. *Vet. Sci.*, v. 8, p.184, 2021.
- BRAVO, D.; CRUZ, P.; OCHOA, J. Prevalencia de neoplasias en caninos en la Universidad de los Llanos, durante 2004 a 2007. *Rev. MVZ Córdoba.*, v.15, p.1925-1927, 2010.
- CARVALHO, M.I.; SILVA-CARVALHO, R.; PIRES, I. *et al.* A comparative approach of tumor-associated inflammation in mammary cancer between humans and dogs. *Biomed. Res. Int.*, v.2016, p.4917387, 2016.

- CHANG, G.; PERALES, R.; TABACCHI, L. Frecuencia de neoplasias en caninos de 0 a 5 años diagnosticadas en el laboratorio de histopatología veterinaria de la Universidad Nacional Mayor de San Marcos (2003-2014). *Rev. Investig. Vet. Perú.*, v.27, p.1071, 2017.
- DE LA CRUZ, N.; MONREAL, A.; CARVAJAL, V. et al. Frecuencia y caracterización de las principales neoplasias presentes en el perro doméstico en Tamaulipas, México. *Rev. Med. Vet.*, v.35, p.53-71, 2017.
- DHEIN, E.S.; HEIKKIÄ, U.; OEVERMANN, A. et al. Incidence rates of the most common canine tumors based on data from the Swiss Canine Cancer Registry (2008 to 2020). *PloS One.*, v.19, n.4, 2024.
- DOBSON, J. Introducción: cáncer en gatos y perros. En: DOBSON, J.; DUNCAN, X. (Eds.). *Manual de oncología en pequeños animales*. 3.ed. Barcelona: Lexus, 2014.
- DOHERTY, A.; LOPES, I.; FORD, C.T. et al. A scan for genes associated with cancer mortality and longevity in pedigree dog breeds. *Mamm. Genome*, v.31, p.215-227, 2020.
- DUQUE-VELASCO, M.; ROMERO PEÑUELA, M.H. Supervivencia en hembras caninas con neoplasia mamaria. *Rev. MVZ Córdoba*, v.27, p.e03, 2022.
- ELGUE, V.; PIAGGIO, J.; AMARAL, C.; PESSINA, P. Factores asociados a la presentación del tipo de cáncer en perros atendidos en el Hospital de la Facultad de Veterinaria de Uruguay. *Veterinaria*, v.187, p.25-30, 2012.
- FAJARDO, R.; ALPÍZAR, A.; PÉREZ, L. et al. Prevalencia de tumores en perros del municipio de Toluca, México, del 2002 al 2008. *Arch. Med. Vet.*, v.45, n.3, 2013.
- HART, B.L.; HART, L.A.; THIGPEN, A.P.; WILLITS, N.H. Assisting decision-making on age of neutering for 35 breeds of dogs: associated joint disorders, cancers, and urinary incontinence. *Front. Vet. Sci.*, v.7, p.388, 2020.
- MARTÍNEZ, E.; PÉREZ, C. Influencia de la edad en el desarrollo del cáncer. *Rev. Electron. Clín. Vet.*, v.2, p.1-4, 2007.
- NARDI, A.B.; SANTOS, H.R.; FONSECA-ALVES, C.E. et al. Diagnosis, prognosis and treatment of canine cutaneous and subcutaneous mast cell tumors. *Cells*, v.11, p.618, 2022.
- NOSALOVA, N.; HUNIADI, M.; HORŇÁKOVÁ, L. et al. Canine mammary tumors: classification, biomarkers, traditional and personalized therapies. *Int. J. Mol. Sci.*, v.25, P.2891, 2024.
- OGILVIE, G.; MOORE, A. *Manejo del paciente canino oncológico*. Buenos Aires: Intermédica, 2008. 904p.
- PINELLO, K.; AMORIM, I.; PIRES, I. et al. Vet-OncoNet: malignancy analysis of neoplasms in dogs and cats. *Vet. Sci.*, v.9, p.535, 2022.
- SANTOS, I.; CARDOSO, J.; OLIVEIRA, K.; LAISSE, C.; BESSA, S. Prevalência de neoplasias diagnosticadas em cães no Hospital Veterinário da Universidade Eduardo Mondlane, Moçambique. *Arq. Bras. Med. Vet.*, v.3, p.19, 2013.
- SCHWARTZ, S.M.; URFER, S.R.; WHITE, M. et al. Lifetime prevalence of malignant and benign tumours in companion dogs: cross-sectional analysis of Dog Aging Project baseline survey. *Vet. Comp. Oncol.*, v.20, p.797-804, 2022.
- SIMON, D.; SCHOENROCK, D.; NOLTE, I. et al. Cytologic examination of fine-needle aspirates from mammary gland tumors in the dog: diagnostic accuracy with comparison to histopathology and association with postoperative outcome. *Vet. Clin. Pathol.*, v.38, p.521-528, 2009.
- ŚMIECH, A.; BULAK, K.; ŁOPUSZYŃSKI, W.; PULA, A. Incidence and the risk of occurrence of benign and malignant canine skin tumours in Poland - a five-year retrospective study. *J. Vet. Res.*, v.67, p.437-446, 2023.
- ŚMIECH, A.; ŚLASKA, B.; ŁOPUSZYŃSKI, W. et al. Epidemiological assessment of the risk of canine mast cell tumours based on the Kiupel two-grade malignancy classification. *Acta Vet. Scand.*, v.60, p.70, 2018.

SONTAS, B.H.; YÜZBAŞIOĞLU-ÖZTÜRK, G.; TOYDEMİR, T.F. *et al.* Fine-needle aspiration biopsy of canine mammary gland tumours: a comparison between cytology and histopathology. *Reprod. Domest. Anim.*, v.47, p.125-130, 2012.

TORRES, M.; PERAZA, B.; FABRÉ, Y. *et al.* Frecuencia de presentación de neoplasias en caninos del municipio San Miguel del Padrón, La Habana, Cuba. *Rev. Salud Anim.*, v.37, p.39-46, 2015.

VINUEZA, R.; CABRERA, F.; DONOSO, L. *et al.* Frecuencia de neoplasias en perros en Quito, Ecuador. *Rev. Investig. Vet. Perú*, v.28, p.92-100, 2017.

ZHENG, HH.; DU, C.T.; YU, C. *et al.* Epidemiological investigation of canine mammary tumors in Mainland China Between 2017 and 2021. *Front. Vet. Sci.*, v.9, p.843390, 2022.

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