Global Journal of Medical Research: G
Veterinary Science and Veterinary Medicine
Volume 22 Issue 1 Version 1.0 Year 2022
Type: Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals
Online ISSN: 2249-4618 & Print ISSN: 0975-5888

Histological Origin and Anaplastic Behavior of Neoplasms Diagnosed in Canines in Guatemala (2015-2019)

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Abstract- The present study sought to statistically relate the histological origin and anaplastic behavior of neoplasms diagnosed in the Pathology Unit of the Faculty of Veterinary Medicine and Zootechnics of the University of San Carlos of Guatemala in the years 2015 to 2019, as well as associate race, age, sex and affected body system. A total of 1,162 canine samples were diagnosed, and a subsample of 289 cases was determined by systematic stratified random sampling of proportional allocation of each year. Regarding histological origin, 44% were epithelial neoplasms, 29% connective and derivatives, 12% other types, 4% endothelial, and 1% nervous. Concerning the anaplastic behavior, 51% of neoplasms were benign and 49% malignant. Likewise, it was determined that the neoplasms affected mostly females, pure breeds, canines of 7-10 years, and affected the integumentary system and soft tissues.

Keywords: *histological, anaplastic, neoplasms, canines.*

GJMR-G Classification: *DDC Code: 611.018 LCC Code: QM551*

Strictly as per the compliance and regulations of:

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Abstract- The present study sought to statistically relate the histological origin and anaplastic behavior of neoplasms diagnosed in the Pathology Unit of the Faculty of Veterinary Medicine and Zootechnics of the University of San Carlos of Guatemala in the years 2015 to 2019, as well as associate race, age, sex and affected body system. A total of 1,162 canine samples were diagnosed, and a subsample of 289 cases was determined by systematic stratified random sampling of proportional allocation of each year. Regarding histological origin, 44% were epithelial neoplasms, 29% connective and derivatives, 12% other types, 4% endothelial, and 1% nervous. Concerning the anaplastic behavior, 51% of neoplasms were benign and 49% malignant. Likewise, it was determined that the neoplasms affected mostly females, pure breeds, canines of 7-10 years, and affected the integumentary system and soft tissues. According to the value of the Cramér index (V = 0.525), it is concluded that there is a moderate level of association between the histological origin of a neoplasm and anaplastic behavior, with which it is inferred that the different histological origins have greater or lesser probability of developing certain tumor behavior.

Keywords: histological, anaplastic, neoplasms, canines.

I. Introduction

In recent decades, special interest in oncology has been observed in veterinary medicine. The presentation of neoplasms in wild animals is not common, due to the shorter life expectancy, which is why knowledge of oncology in non-domestic animals is scarce. Regarding domestic animals, the dog is of particular interest, since this species is more frequently affected by tumors, due to the fact that neoplasms are among the most common causes of death in dogs [5,9].

Previous studies point out the importance of comparative medical research in this species that share the environment intimately with humans, since it often presents similar risk factors for the development of spontaneous neoplasms that have similar biological behavior and equivalent histological characteristics to the neoplasms seen in the human being. In many aspects, neoplasms in canines can be compared with the biological differences associated with neoplasms in humans, in addition to their close relationship with them concerning housing, environment and diet[1,3,18,20].

On the other hand, authors indicate that the presence of tumors in canines can be explained by improvements in their health care, better nutrition, immunizations, parasite control, use of antibiotics, etc., which make companion animals live longer, and therefore they are exposed to carcinogens for a longer time and exceed an age in which the cells reach the stage of tumor promotion and progression. For this reason, neoplasms are diagnosed with great efficiency and treated more frequently compared to previous years[9,18].

There is abundant clinical information on diagnosis and therapies for the distinct types of neoplasms, and some studies on risk factors. In an ideal situation, all neoplasms occurring in each population should be microscopically confirmed, either by histopathology or cytology, to identify and enumerate all individuals in the population at risk. Veterinary oncology is a young and growing specialty, and it does not have the resources for studies and treatments that human cancer has. In many cases, the patient is euthanized as soon as there is a presumptive diagnosis of cancer, although it is known that many patients with an early and correct diagnosis can be treated successfully. Likewise, there is limited information on the frequency, prevalence, and incidence of the distinct types of cancer in the canine population in many countries of the world, and Guatemala is no exception[4,6,19].

Different authors assert that the general benefit of these epidemiological studies is not only aimed at better understanding the epidemiology of canine tumors, but also at detecting and understanding future environmental hazards in the development of these diseases when comparing the situation of dogs with humans. Most epidemiological studies of neoplasms in canines in recent years have used canine populations derived from reference university veterinary hospitals[15,20,22].

In Guatemala, the last study conducted on neoplasms diagnosed through biopsies and necropsies was from 2012 to 2014. Despite the interest in the subject, no new epidemiological research has updated it, so the behavior of the disease has likely changed over the years due to the concern of the owners, and

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because of detection methods and greater diagnostic efficiency in veterinary practice[10]. The present study seeks to contribute to the knowledge of canine neoplasms in the country, through the analysis of data from canine samples sent in the years 2015 to 2019 to the Pathology Unit at the Faculty of Veterinary Medicine and Zootechnics of the University of San Carlos of Guatemala, a reference center for veterinary histopathological diagnosis in the country; and its objective is to determine and statistically relate the histological origin and anaplastic behavior of diagnosed neoplasms, as well as to associate with the patient's race, age, sex and affected body system.

II. Resources and Techniques

A longitudinal study was conducted using canine biopsy and necropsy samples that turned out to be neoplasms sent to the veterinary histopathology and necropsy service provided by the Veterinary Pathology Unit at the Faculty of Veterinary Medicine and Zootechnics (FMVZ) of the University of San Carlos of Guatemala (USAC) in the period from 2015 to 2019. The diagnoses were made by experienced veterinary pathologists who performed a histopathological evaluation of samples stained with standard hematoxylin-eosin.

During that period, 1,162 patients were diagnosed with neoplasms. According to the total population, a probabilistic sample was calculated with the following equation when the size of the population is known:

$$n = \frac{N}{1 + \frac{d^2(N-1)}{z^2 s^2}} n = \frac{1162}{1 + \frac{(0.05)^2(1161)}{(1.96)^2(0.25)}} n = 289$$

n = size of the sample that you want to know
N = known population size
d = deviation or error that is willing to tolerate, expressed in proportion. In this case 5% or 0.05.
z = typical score corresponding to the confidence level; normally, z 95%, or 1.96, is used.
s^2= population variance in the variable to be measured. In this case we have that $s^2 = pq = (0.50)\ (0.50) = 0.25$

The calculated size of the sample (289) was subjected to a stratified random sampling of proportional allocation. Subsequently, the subsample corresponding to each year was subjected to a systematic random sampling with which the specimens that made up each specific sample of each year were identified. The investigation focused on the neoplasm in each canine, and if multiple neoplasms were found in one animal, they were all addressed separately. However, biologically identical neoplasms located in the same animal at different anatomical sites were considered a single neoplasm.

For data collection purposes, a form or instrument was used for each canine, in which the data corresponding to the histological origin of the neoplasm (connective tissue and derivatives, endothelial, hematopoietic or lymphoreticular, epithelial, nervous, and others) and the anaplastic behavior were recorded (benign or malignant) according to the records of the pathology unit.

Additionally, general data on sex (female or male), race (pure or mongrel), age (<1 year, 1-6 years, 7-10 years, or >10 years), as well as the patient's affected body system was recorded (integumentary system and soft tissues, gastrointestinal, respiratory, urogenital, hemolymphatic, endocrine, nervous, cardiovascular, mammary gland, musculoskeletal or multicentric). Given the symmetric relationship between the variables to be observed and measured, and the nominal or frequency data they provide, the type of research is correlational, with which Cramér's V coefficient was used to indicate the association index between said study variables or categorical fields.

This work was approved by the Postgraduate Bioethics Committee of the University of San Carlos of Guatemala on October 19, 2021 (Ref. EPVirtual. 190.2021).

III. Results

A total of 1,162 samples of neoplasms from canine biopsies and autopsies were diagnosed during the years 2015-2019 in the FMVZ-USAC Pathology Unit, of which a subsample of 289 cases of neoplasm was determined through a stratified random sampling systematic proportional allocation of each year.

Concerning the histological origin, 128 (44%) were epithelial-type neoplasms, 84 (29%) connective and derivatives, 35 (12%) other types of neoplasms, being mostly mixed type, 12 (4%) endothelial, and 2 (1%) of the nervous type (Table 1). About anaplastic behavior, 146 (51%) neoplasms were benign, and 43 (49%) were malignant (Table 2).

Females presented a higher frequency of neoplasms, with a distribution of 172 (60%) females, compared to 117 (40%) males. Regarding the histological origin, both in males and females, there was a higher frequency of epithelial-type neoplasms (44 and 45% respectively), followed by connective tissue and derivatives (27 and 30%), others (11 and 13%), hematopoietic or lymphoreticular (12 and 8%), endothelial (5 and 3%) and nervous tissue (1%). In relation to anaplastic behavior,

Table 1: Number of canines according to histological origin of neoplasms

Histological origin	N°	%
Connective and derivatives	84	29
Endothelial	12	4
Hematopoietic or lymphoreticular	28	10
Epithelial	128	44
Nervous	2	1
Others	35	12
Total	**289**	**100**

Table 2: Number of canines according to anaplastic behavior of neoplasms.

Benign		Malignant		Total	
N°	%	N°	%	N°	%
146	51	143	49	289	100

53 (36%) male canines and 93 (64%) females presented benign neoplasms, while 62 (43%) males and 81 (57%) females presented malignant neoplasms.

Purebred canines presented a higher frequency of neoplasms, being 225 (78%) cases, compared to 64 (22%) of mongrel canines. Regarding histological origin, 105 (47%) purebred dogs presented epithelial-type neoplasms, 63 (28%) connective and derivative types, 27 (12%) other types of neoplasms, and 19 (8%) hematopoietic or lymphoreticular type. In contrast, 23 (36%) mongrel canines presented epithelial-type neoplasms, 21 (33%) connective and derivative types, 9 (14%) hematopoietic and lymphoreticular types, and 8 (12%) other types of neoplasms. Concerning anaplastic behavior, 110 (75%) purebred canines and 36 (25%) mongrel canines presented benign neoplasms, while 115 (80%) purebred canines and 28 (20%) mongrel canines had malignant neoplasms. Commonly found purebreds were Poodle (12.9%), Schnauzer (11.1%), Boxer (8.4%), English Cocker Spaniel (7.6%), Labrador Retriever (7.1%), Siberian Husky (5.8%), Golden Retriever (5.3 %), Dachshund (3.6%), Basset Hound (3.1%) and Chihuahua (3.1%).

Concerning the age, canines between 7-10 years old presented the highest frequency, with 132 (46%) canines, followed by 78 (27%) dogs between 1-6 years, 74 (26%) canines over ten years, and 5 (1%) under one year old. Regarding the histological origin of neoplasms, canines under one year presented a higher frequency of neoplasms of epithelial origin (60%), followed by the endothelial type (20%) and other types (20%). Canines between 1-6 years old showed a higher frequency of neoplasms of connective origin and derivatives (40%), followed by epithelial neoplasms (31%), hematopoietic or lymphoreticular (11%), and others (10%). Canines between 7-10 years old showed a more significant number of cases of epithelial origin (42%), followed by neoplasms of connective origin and derivatives (29%), hematopoietic or lymphoreticular (13%), and others (11%). Very similar were the canines over ten years, where there was a higher percentage of neoplasms of epithelial type (61%), connective and derivatives (20%), other types of histological origin (15%), and hematopoietic or lymphoreticular (3%). Concerning the anaplastic behavior, benign neoplasms were shown in 70 (48%) canines between 7-10 years old, 42 (29%) canines between 1-6 years old, 30 (20%) canines over ten years old, and in 4 (3%) canines less than one year old while malignant neoplasms were present in 62 (43%) canines between 7-10 years, followed by 44 (31%) canines older than ten years, 36 (25%) canines between 1-6 years, and 1 (1%) canines less than one year old.

Regarding the affected body systems, there was a greater number of cases in the integumentary system and soft tissues (33%), followed by the mammary gland (18%), gastrointestinal system (13%), urogenital (12%), musculoskeletal (9 %), multicentric (7%), respiratory (3%), hemolymphatic (3%), cardiovascular (1%), and nervous (1%). (Figure 1).

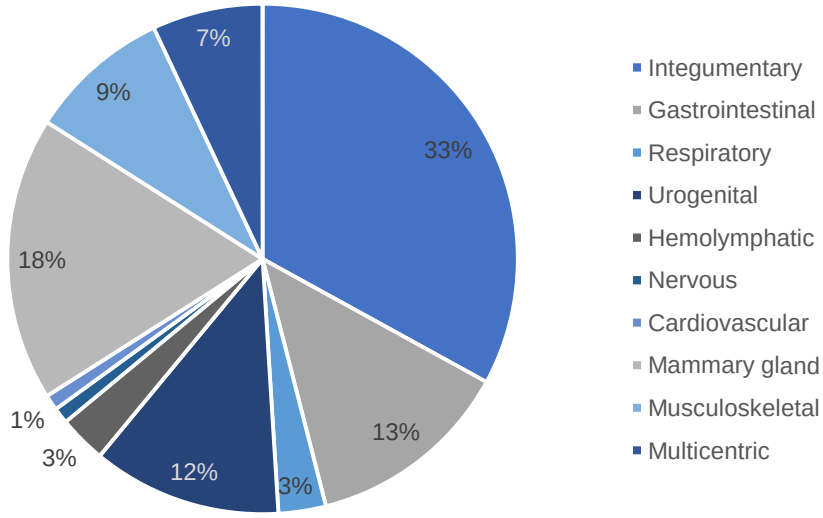

Figure 1: Distribution of canines according to the affected body system.

Concerning the anaplastic behavior according to the affected body systems, the benign neoplasms occurred in the integumentary system and soft tissues, mammary gland, urogenital, musculoskeletal, and gastrointestinal systems; while malignant neoplasms were shown in a higher percentage in the integumentary system and soft tissues, mammary gland, gastrointestinal system, multicentric and urogenital system.

Finally, Cramér's V coefficient was used to indicate the association index between the study variables, where the value was *V=0.525,* indicating a moderate level of association between the histological origin and the anaplastic behavior of the neoplasms in the observed canine sample (Table 3).

Table 3: Number of canines according to the histological origin and anaplastic behavior of neoplasms

Histological origin	Benign		Malignant		Total	
	N°	%	N°	%	N°	%
Connective and derivatives	68	47	16	11	84	29
Endothelial	10	7	2	1	12	4
Hematopoyetic or lymphoreticular	2	1	26	18	28	10
Epithelial	41	28	87	61	128	44
Nervous	2	1	0	0	2	1
Others	23	16	12	9	35	12
Total	**146**	**100**	**143**	**100**	**289**	**100**

IV. Discussion

The characterization of a population at risk is essential to understand the epidemiology of a disease. In recent decades there has been a growing interest in comparative oncology, due to the progressive understanding of environmental biological monitoring. In domestic animals such as dogs, there is a high manifestation of tumors, probably because they are allowed to reach old age, as well as their close relationship with humans regarding the environment and food. The analysis of neoplasms in a population based on their histological origin and anaplastic behavior, in addition to their association with characteristics of the patient's data, can contribute to accurate diagnoses, and early and more appropriate treatments in daily practice[9,17,19].

The results of this study reveal interesting aspects of the current epidemiology of neoplasms in canines in Guatemala. Compared to studies previously conducted from 2012 to 2014, where 183 biopsies and 113 autopsies with neoplasm cases were analyzed, the number of cases increased considerably in the years examined in this study, with a total of 1,162 cases as a whole[10].

According to the histological origin, the most common type of tumor was epithelial, followed by connective and derivatives, similar to what was found by Aco (2020) in Peru and Cevallos (2013) in Ecuador; and different from De la Cruz et al. (2017) in Mexico, Mayorga and Ruiz (2016) in Colombia, and Tordova (2016) in Bulgaria, who found a higher frequency of mesenchymal neoplasms (51.5-55%), followed by those of epithelial origin (41.3-45%). Epithelial tumors are usually the most common type in companion animals, primarily affecting the integument and soft tissues, followed by mammary neoplasms. Various authors with equivalent results regarding the affected body system consider that it is because the skin is the tissue most exposed to a wide variety of physical and chemical aggressions, and to various environmental factors that can trigger the development of neoplasms. Likewise, they are easier to recognize through clinical examination as it is the most visible organ, easily explored and accessible to obtain samples, unlike those that affect internal organs that require specific imaging studies, such as X-rays, ultrasound, computed tomography (CT) and magnetic resonance imaging (MRI)[8,14,16,22]. In second place are mammary gland tumors, which are influenced by sex, being less prevalent in males, and their development in females is due to hormonal factors and increases the probability of suffering from it if they are sterilized, starting from 0.05% if spayed before the first heat, up to 26% if spayed after the second heat, and if spayed later in life, the risk of developing mammary tumors is the same as for an intact female[8,21]. Other authors (Elgue et al, 2012; Tordova, 2006) differ with this, since they indicate that mammary tumors are the most frequent in canines, and skin neoplasms are in second place.

Regarding anaplastic behavior, there was a similar result for benign and malignant neoplasms, with benign neoplasms being slightly more frequent, mainly those of the connective type and derivatives, like Mayorga and Ruiz (2016) who demonstrated that benign neoplasms and of mesenchymal type were the most frequent. In most studies, benign neoplasms are usually twice as frequent as malignant ones. The close numerical proximity between benign and malignant neoplasms in this study could be due to the fact that benign neoplasms are generally slow-growing, do not represent a danger to the patient, are often missed or detected incidentally during clinical examination, and that owners are reluctant to allow surgical resection and/or histopathological examination, causing the condition to migrate towards malignancy. A very different result was evidenced by Aco (2020) in Peru, and De la Cruz et al. (2017) in Mexico, where most malignant neoplasms were presented[1,4,11,13].

Concerning sex, females presented a higher frequency of neoplasms than males, like results seen by many authors, who consider that gender may be a factor that influences the development of some neoplasms due to the presence of hormones that can stimulate the abnormal cell division and turn into tumors. For this reason, it is considered that hormonal overstimulation of some organs increases the probability of the appearance of neoplasms, as well as working together with other carcinogens that could induce a mutation and neoplastic transformation of tissues [4,8,14,23].

Regarding the breed, it was shown that the pure breeds presented a higher frequency of neoplasms, of a malignant nature. Authors who agree with these results have determined that there is a racial predisposition toward the malignant growth of neoplasms, and the reason for this natural predisposition is unknown; it is believed that in specific individuals there is inactivation of tumor suppressor genes or activation of inherited oncogenes, or mutant versions of normal genes, which provide morphological characteristics of the breed together with its other genetic traits[1,8,11,23]. When comparing dog breeds, neoplasms were found more frequently in poodles, schnauzers and boxers, similar to the results found by Juarez (2017), with the difference that they showed a major presence of neoplasms in canines of the schnauzer breed and in second place the poodles. The results could be influenced by the fact that they are the most popular breeds in Guatemala. However, it is essential to consider that owners tend to exaggerate or idealize the breed of their pets, so the quality of the breed data that depends primarily on owner reports should be questioned[19]. Different results were found by Elgue et al (2012) in Uruguay, and De la Cruz et al. (2017) in Mexico, which determined that mongrel canines had a higher presentation of neoplasms than purebreds.

Concerning the age of presentation, it was more frequent in canines between 7-10 years, like Fajardo et al. (2013), Torres et al. (2015), and Aco (2020). This is as a consequence that the tissues have been exposed for extended periods to risk factors, as well as decreased cell repair as the animals age and a reduced immune response that leads to greater vulnerability to activity of carcinogens. The fact that malignant tumors mainly occurred in the older age groups (7-10 years and >10 years), suggests that age could be a significant risk factor, since exposure to endogenous and exogenous risk factors, together with a weakened immune system, can trigger the development of malignant tumors[8,23].

According to the Cramér index value, it is concluded that there is a moderate level of association

between the histological origin of a neoplasm and anaplastic behavior. De la Cruz et al. (2017) in Mexico carried out a similar study where they evaluated the existence of a significant statistical association between the five most frequent tumors in the country, and the sex, race, and age of the patients in the development of neoplasms, to which they determined that there was no difference significant after evaluating the behavior of the neoplasm with race and sex, but with the age of the patients. Furthermore, Elgue et al. (2012) concluded through their study in Uruguay that sex, age, and race were factors associated with cancer. When analyzing this information, it is inferred that not only age is an important factor in the development of neoplasms and that senior age increases the risk of developing malignant neoplasms, as well as race and sex, but also the different histological origins of neoplasms are more or less likely to develop malignant tumor behavior, for example, according to the present study, neoplasms of epithelial and hematopoietic/ lymphoreticular origin are more likely to be malignant, while those of connective origin and derivatives are more likely to be benign[4,7].

V. Conclusion

Studies of neoplasms from the records of a reference veterinary diagnostic center allow a deep understanding of the epidemiology of the disease and point out the differences that may occur from one country to another, which can support a better diagnosis and treatment in daily practice. This study focused on determining and statistically relating the histological origin and anaplastic behavior of neoplasms diagnosed between 2015 and 2019, as well as with the sex, race, age, and affected body system of the patient, revealing interesting aspects about the current epidemiology of neoplasms in canines in Guatemala. With the results obtained, it was found that epithelial-type neoplasms, and of a benign nature, were more frequently presented. In addition, an important level of association between the histological origin and the anaplastic behavior of these neoplasms was evidenced, which represents an important epidemiological factor. Likewise, it was determined that neoplasms in the country mainly affect females in terms of gender, purebred canines, the age group between 7 and 10 years old, and that the disease affects to a greater extent the integumentary system and soft tissues. From all this, it is concluded that it is essential to expand this type of research to understand the behavior of the disease in domestic animals in the country, and to make a continuous effort to evaluate the risk factors and compare them with the risk factors in humans.

Acknowledgements

The authors thank the Pathology Unit of the Faculty of Veterinary Medicine and Zootechnics of the University of San Carlos of Guatemala for the assistance with accessing data from the medical records, and to José R. Monroy and Gabriela Vásquez for the assistance on the manuscript drafting.

No third-party funding or support was received in connection with this study, or the writing or publication of the manuscript. The authors declare that there were no conflicts of interests.

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Supplementary Material

Table 1: Sample size of each year

Year	PT	%	N
2015	106	9	26
2016	215	19	55
2017	269	23	67
2018	290	25	72
2019	282	24	69
Total	**1,162**	**100**	**289**

Table 2: Number of canines according to sex and histological origin of neoplasms

Histological origin	Male		Female		Total	
	N°	%	N°	%	N°	%
Connective and derivatives	32	27	52	30	84	29
Endothelial	6	5	6	3	12	4
Hematopoietic or lymphoreticular	14	12	14	8	28	10
Epithelial	51	44	77	45	128	44
Nervous	1	1	1	1	2	1
Others	13	11	22	13	35	12
Total	**117**	**100**	**172**	**100**	**289**	**100**

Table 3: Number of canines according to sex and anaplastic behavior of neoplasms

Sex	Benign		Malignant		Total	
	N°	%	N°	%	N°	%
Male	53	36	62	43	115	40
Female	93	64	81	57	174	60
Total	**146**	**100**	**143**	**100**	**289**	**100**

Table 4: Number of canines according to breed and histological origin of neoplasms

Histological origin	Purebred		Mongrel		Total	
	N°	%	N°	%	N°	%
Connective and derivatives	63	28	21	33	84	29
Endothelial	9	4	3	5	12	4
Hematopoyetic or lymphoreticular	19	8	9	14	28	10
Epithelial	105	47	23	36	128	44
Nervous	2	1	0	0	2	1
Others	27	12	8	12	35	12
Total	**225**	**100**	**64**	**100**	**289**	**100**

Table 5: Number of canines according to breed and anaplastic behavior of neoplasms

Breed	Benign		Malignant		Total	
	N°	%	N°	%	N°	%
Purebred	110	75	115	80	225	78
Mongrel	36	25	28	20	64	22
Total	**146**	**100**	**143**	**100**	**289**	**100**

Table 6: Number of canines according to age and histological origin of neoplasms

Histological origin	<1 year		1-6 years		7-10 years		>10 years		Total	
	N°	%	N°	%	N°	%	N°	%	N°	%
Connective and derivatives	0	0	31	40	38	29	15	20	84	29
Endothelial	1	20	6	8	5	4	0	0	12	4
Hematopoyetic or lymphoreticular	0	0	9	11	17	13	2	3	28	10
Epithelial	3	60	24	31	56	42	45	61	128	44
Nervous	0	0	0	0	1	1	1	1	2	1
Others	1	20	8	10	15	11	11	15	35	12
Total	**5**	**100**	**78**	**100**	**132**	**100**	**74**	**100**	**289**	**100**

Table 7: Number of canines according to age and anaplastic behavior of neoplasms

Age	Benign		Malignant		Total	
	N°	%	N°	%	N°	%
<1 year	4	3	1	1	5	2
1-6 years	42	29	36	25	78	27
7-10 years	70	48	62	43	132	46
>10 years	30	20	44	31	74	25
Total	**146**	**100**	**143**	**100**	**289**	**100**

Table 8: Number of canines according to the affected body system and anaplastic behavior of neoplasms

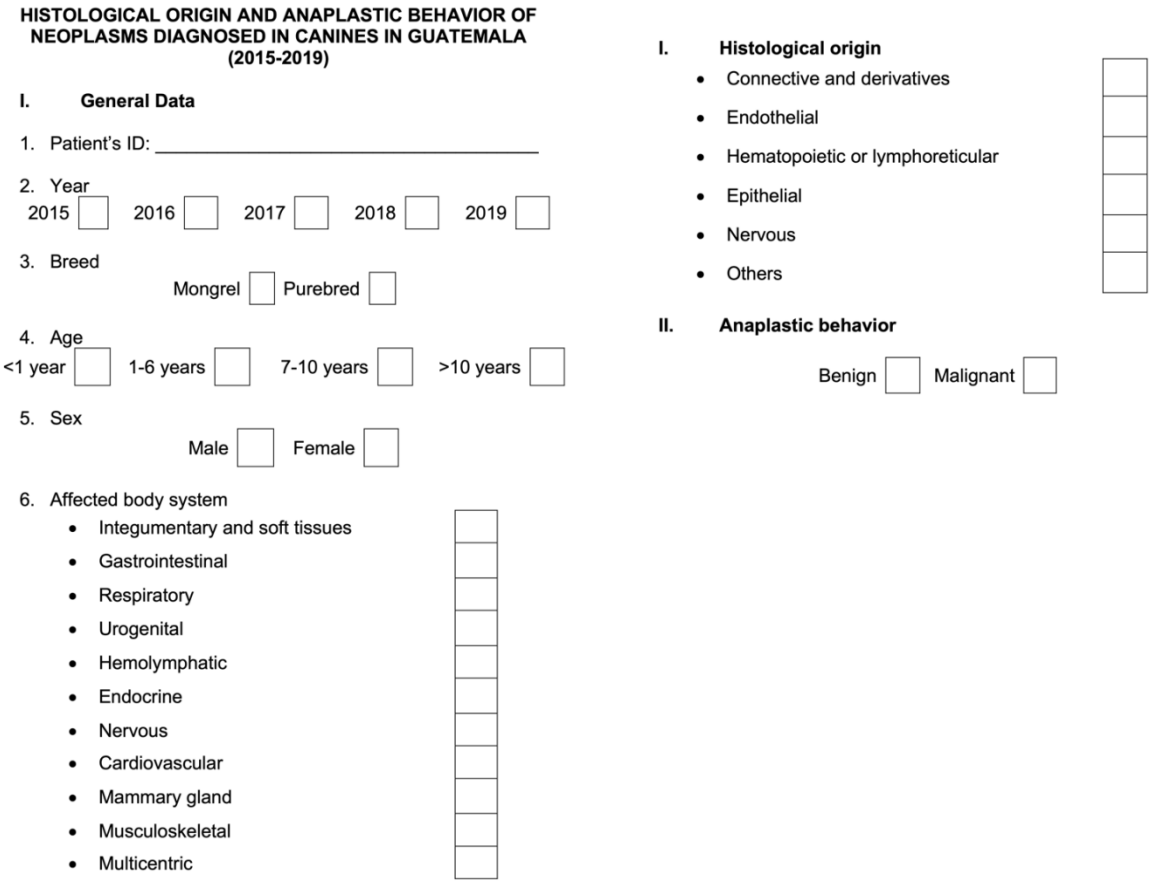
Affected body system	Benign		Malignant		Total	
	N°	%	N°	%	N°	%
Integumentary and soft tissues	56	38	40	28	96	33
Gastrointestinal	16	11	21	15	37	13
Respiratory	4	3	4	3	8	3
Urogenital	23	16	12	8	35	12
Hemolymphatic	0	0	8	5	8	3
Endocrine	0	0	0	0	0	0
Nervous	2	1	0	0	2	1
Cardiovascular	2	1	1	1	3	1
Mammary gland	26	18	27	19	53	18
Musculoskeletal	17	12	9	6	26	9
Multicentric	0	0	21	15	21	7
Total	**146**	**100**	**143**	**100**	**289**	**100**

Table 9: Contingency table for statistical analysis of Cramér's V association index

Histological origin	Anaplastic behavior		Total
	Benign	Malignant	
Connective and derivatives	68 (42.43)	16 (41.56)	84
Endothelial	10 (6.06)	2 (5.93)	12
Hematopoietic or lymphoreticular	2 (14.14)	26 (13.85)	28
Epithelial	41 (64.66)	87 (63.33)	128
Nervous	2 (1.01)	0 (0.98)	2
Others	23 (17.68)	12 (17.31)	35
Total	**146**	**143**	**289**

Table 10: Distribution of cases of neoplasms according to purebred canines

Breed	No.	%
Poodle	29	12.9
Schnauzer	25	11.1
Boxer	19	8.4
English Cocker Spaniel	17	7.6
Labrador Retriever	16	7.1
Husky	13	5.8
Golden Retriever	12	5.3
Dachshund	8	3.6
Chihuahua	7	3.1
Basset Hound	7	3.1
Pitbull	6	2.7
Shih Tzu	6	2.7
German shepherd	6	2.7
Beagle	5	2.2
Guatemalan dogo	4	1.8
Rottweiler	3	1.3
French bulldog	3	1.3
Sharpei	3	1.3
Bulldog	2	0.9
Fila brasileiro	2	0.9
Doberman	2	0.9
American Bully	2	0.9
Chowchow	2	0.9
Dalmatian	2	0.9
Great dane	2	0.9
Others	22	9.7
Total	**225**	**100**



HISTOLOGICAL ORIGIN AND ANAPLASTIC BEHAVIOR OF NEOPLASMS DIAGNOSED IN CANINES IN GUATEMALA (2015-2019)

I. General Data

1. Patient's ID: _____
2. Year
   2015 ☐ 2016 ☐ 2017 ☐ 2018 ☐ 2019 ☐
3. Breed
   Mongrel ☐ Purebred ☐
4. Age
   <1 year ☐ 1-6 years ☐ 7-10 years ☐ >10 years ☐
5. Sex
   Male ☐ Female ☐
6. Affected body system
   - Integumentary and soft tissues ☐
   - Gastrointestinal ☐
   - Respiratory ☐
   - Urogenital ☐
   - Hemolymphatic ☐
   - Endocrine ☐
   - Nervous ☐
   - Cardiovascular ☐
   - Mammary gland ☐
   - Musculoskeletal ☐
   - Multicentric ☐

I. Histological origin

- Connective and derivatives ☐
- Endothelial ☐
- Hematopoietic or lymphoreticular ☐
- Epithelial ☐
- Nervous ☐
- Others ☐

II. Anaplastic behavior

Benign ☐ Malignant ☐

Figure 1: Instrument used in data collection