Cartography of neoplasms in dogs from different regions of the city of São Paulo, SP, Brazil: a survey (2002-2003) of data from the Veterinary Hospital of the School of Veterinary Medicine and Animal Science of the University of São Paulo, Brazil

Cartografia das neoplasias em cães das diferentes regiões da cidade de São Paulo, SP, Brasil: *um levantamento (2002-2003) dos dados do Hospital Veterinário da Faculdade de Medicina Veterinária e Zootecnia da Universidade de São Paulo, Brasil*

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Abstract

Improvements in veterinary medicine have resulted in a significant benefit in the life of pets in the last 20 years, and increased pet life expectancy led to an increased prevalence of canine neoplasia. Cancer epidemiology and spatial analysis tools, although well developed for human oncology research, is just beginning to be explored in veterinary oncology. São Paulo city, capital of the state of São Paulo, Brazil, is divided into five regions: North, South, East, West and downtown. The Veterinary Hospital of the School of Veterinary Medicine and Animal Science, University of São Paulo (HOVET-SVMAS-USP), is located in the West region of São Paulo, Brazil, and admits cases of small and large animals. Canine mammary tumors are so numerous that they are not routinely treated at the HOVET. The aim of this work was to perform a cartographic study to describe the spatial distribution of prevalent cases of neoplasms in dogs from the HOVET. Of the 3,620 cases seen in 2002 and 2003, 380 cases (10.5%) were of dogs affected with benign and malignant neoplasms. No statistical difference was found for the 380 addresses distributed among the five regions of the city. These results showed that the HOVET receives canine patients from all regions of São Paulo and there is a homogeneous spatial distribution of neoplasms. Authors encourage additional broader studies, involving several veterinary hospitals, clinics or laboratories in order to obtain more accurate data on distribution of canine neoplasms in São Paulo, SP, Brazil.

Keywords: Neoplasms. Dogs. Geoprocessing. Cartography. Epidemiology.

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Resumo

Avanços na medicina veterinária resultaram em benefícios significativos na vida de animais de estimação nos últimos 20 anos, e o aumento da expectativa de vida para animais levou a uma maior prevalência de neoplasias em cães. A Epidemiologia do Câncer e as ferramentas de análise espacial, embora bem desenvolvidas na pesquisa oncológica humana, estão começando a serem exploradas na Oncologia Veterinária. A cidade de São Paulo, capital do estado de São Paulo, Brasil, é dividida em cinco regiões: Norte, Sul, Leste, Oeste e centro. O Hospital Veterinário da Faculdade de Medicina Veterinária e Zootecnia da Universidade de São Paulo (HOVET-SVMAS-USP) está localizado na região Oeste de São Paulo, Brasil, e admite casos de pequenos e grandes animais. Tumores mamários caninos são tão numerosos que não são tratados na rotina do HOVET. O objetivo deste trabalho foi realizar um estudo cartográfico para descrever a distribuição espacial dos casos prevalentes de neoplasias em cães a partir do HOVET. Dos 3.620 casos atendidos em 2002 e 2003, 380 (10,5%) casos eram de cães acometidos por tumores benignos e malignos. Não foi encontrada diferença estatística entre a distribuição dos 380 endereços entre as cinco regiões da cidade. Os resultados mostraram que o HOVET atende pacientes caninos de todas as regiões de São Paulo e que há uma distribuição espacial homogênea das neoplasias. Os autores incentivam estudos mais amplos, envolvendo vários hospitais veterinários, clínicas e laboratórios, a fim de obter dados mais precisos sobre a distribuição das neoplasias caninas em São Paulo, SP, Brasil.

Palavras-chave: Neoplasmas. Cães. Geoprocessamento. Cartografia. Epidemiologia.

Introduction

Improvements in veterinary medicine have resulted in a significant benefit in the life of pets in the last 20 years. Factors affecting this better quality of life included proper nutritional management, vaccinations and regular deworming, regular periodontal treatments and other management options currently practiced. The increase of pet life expectancy led to an increased prevalence of canine neoplasia (WITHROW, 2007). Various researchers found that the close relationship between dogs and humans could justify the use of dogs as sentinels for humans (SALDIVA; BÖHM, 1998; SCHALIE et al., 1999; BACKER et al., 2001; BETTINI et al., 2010; GAVAZZA et al., 2001; BERTONE-JOHNSON et al., 2008; BREEN; MODIANO, 2008; PONCE et al., 2010). The epidemiological data is variable in each country or region showing that the use of the Geographic Information System (GIS) is a new and important research tool in veterinary oncology, separating tumors according to the region or institution analyzed and using dogs as a sentinel of human diseases.

The Veterinary Hospital (HOVET) of the School of Veterinary Medicine and Animal Science, University of São Paulo, Brazil, provides medical-surgical, outpatient and hospital care to the community. It is located within the "Cidade Universitária", in the west region of the city of São Paulo. The HOVET admits cases of small and large animal neoplastic and non-neoplastic diseases. Because canine and feline mammary tumors are so prevalent, these tumors are not routinely treated at the HOVET.

The aim of this work was to perform a spatial epidemiological study of neoplasms in dogs from the HOVET, and to verify whether any region of the city of São Paulo eventually accounted for more cases of neoplasm admitted to the hospital.

Material and Methods

Cases

This is a retrospective study of cases of neoplasms of dogs from the HOVET - SVMAS-USP, diagnosed by histopathological examination, from January 1, 2002 to December 31, 2003. All cases of neoplasms (benign and malignant) in each region were divided by the total number of dogs from the Veterinary Hospital of the School of Veterinary Medicine and Animal Science, University of São Paulo (HOVET-SVMAS-USP) seen in the same time period. The veterinary hospital does not see cases of breast tumors, so these cases were excluded from the study. Records with incomplete data were excluded from analysis.

Epidemiological population data, Statistical and Spatial analysis

Epidemiological data were categorized by the following: medical record number, breed, zip code, address, type of diagnosis, sites of tumor, and histological classification. Data from each animal was added to a database in Microsoft Excel (2002). The zip codes were correlated with addresses by the program NBS - National Directory of Addresses, a database developed and marketed by Brazilian Post and Telegraph. Neoplasms were diagnosed according to the criteria of the World Health Organization (WHO). The relative proportion was determined by dividing the number of neoplasm cases in dogs from each region by the total number of cases from that region in the same period. Chi-square (x^2) was used to analyze the frequency of neoplasms by regions. With the data obtained by retrospective study, it was possible to map the cases of neoplasia of dogs in different regions of São Paulo, using the GIS (Geographic Information System). Address was localized by zip code through the ESRI® Arc MapTM 9.1 program.

Results

Of the 3,620 cases treated during the years 2002 to 2003 in the HOVET-SVMAS-USP, 380 (10.5%) were of dogs affected with benign and malignant neoplasms.

Dogs between six to 12 years of age were the most affected by neoplasms. There was no statistical significance between males (185 cases: 49%) and females (195 cases: 51%). The mixed breed was the most cataloged in this study at the HOVET - SVMAS-USP (285 cases: 75%).

The relative frequency of dog breeds (95 cases: 25%) most affected by neoplasia in descending order was: Boxer (41.60% with neoplasia and 58.40% without neoplasia), Doberman Pinscher (33.80% with neoplasia and 66.20% without neoplasia), German Shepherd (22.70% with neoplasia and 77.30% without neoplasia), Cocker Spaniel (22.30% with neoplasia and 77.70% without neoplasia), cross breed (22.00% with neoplasia and 78% without neoplasia), Poodle (17.80% with neoplasia and 82.20% without neoplasia), Rottweiler (16.80% with neoplasia and 83.20% without neoplasia) and Labrador Retriever (14.80% with neoplasia and 85.20% without neoplasia). Figure 1 shows canine tumor and non-tumor cases from all regions of São Paulo through points corresponding to each animal.

From the relative proportion of cases of neoplasms diagnosed in the HOVET -SVMAS-USP, 10% were from the downtown region (102 tumor cases/992 dogs from veterinary hospital from that region in the same period), 11% were from west region (108 tumor cases /1012 dogs from veterinary hospital that region in the same period), 10% were from the east region (43 tumor cases/411 dogs from veterinary hospital from that region in the same period),10% were from the north region (61 tumor cases/584 dogs from veterinary hospital from that region in the same period) and 10% were from the south region (64 tumors cases/640 dogs from veterinary hospital from that region in the same period), shown in figure 2. According to the Chi-square test, there was no significant statistical difference between the west and south region ($p = 0.7241$); west and downtown ($p = 0.8322$), west and north ($p = 0.9543$); west and east ($p = 0.8753$); south region and downtown ($p = 0.9201$); south and north ($p = 0.871$); south and east ($p = 0.992$); east and north ($p = 0.9923$); downtown and east ($p = 1.000$) and downtown and north ($p = 0.9865$). The denominator (subpopulation) is the total of dogs from the HOVET-SVMAS-USP/district.

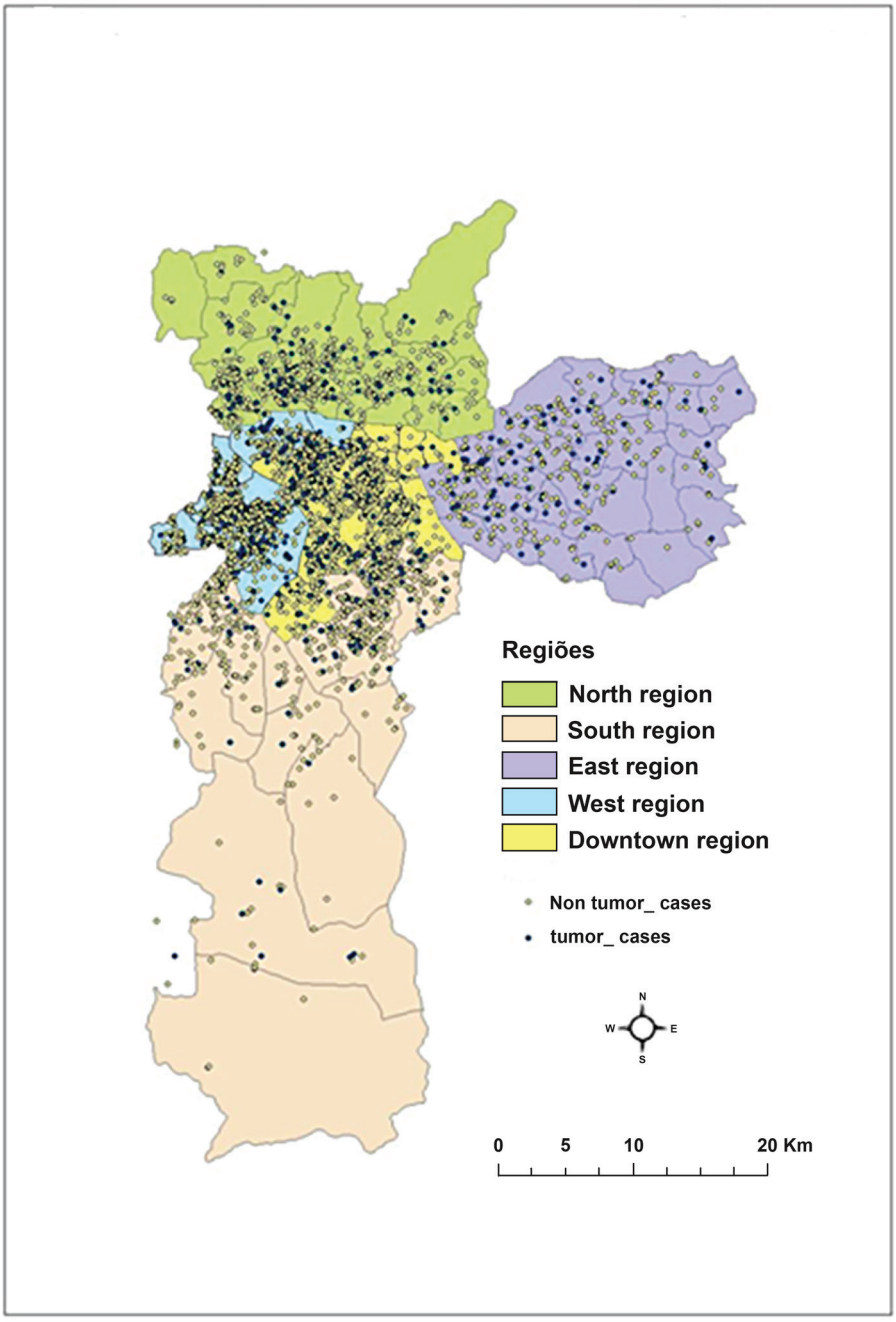
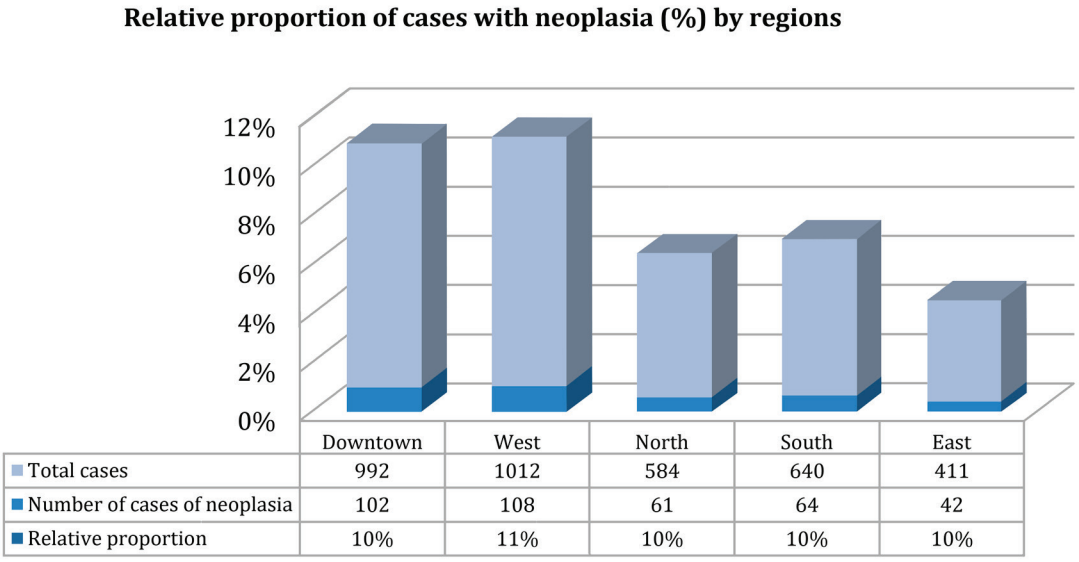


Figure 1 – Distribution of canine cases with tumor and non-tumor in the different regions of São Paulo, SP, Brazil (HOVET – SVMAS - USP, 2002-2003)
Source: (KIMURA, 2003)



	Downtown	West	North	South	East
Total cases	992	1012	584	640	411
Number of cases of neoplasia	102	108	61	64	42
Relative proportion	10%	11%	10%	10%	10%

Figure 2 – Relative proportion of canine cases with neoplasms (2002-2003). Data from Veterinary Hospital of SVMAS-USP, obtained according to the different regions of the city of São Paulo, SP, Brazil (HOVET – SVMAS - USP, 2002-2003)

Source: (KIMURA, 2003)

The histological type of neoplasm most frequently found was mast cell tumor (70 cases: 18%) followed by osteosarcoma (39 cases: 10%), lipoma (32 cases: 8%), transmissible venereal tumor (21 cases: 6%), sarcoma (19 cases: 5%), tumor of adnexal tissue (17 cases: 4%), undifferentiated carcinoma and malignant peripheral nerve sheath tumor (14 cases: 4%), perianal adenoma, basal cell carcinoma, melanoma and seminoma (12 cases: 3%), hemangioma (9 cases), lymphoma (8 cases), perianal carcinoma (7 cases), hemangiosarcoma (6 cases), and Leydig cell tumor (6 cases) correspond to 2% and other tumors that had values below 1% (Table 1). The highest relative frequency of breed diagnosed with mast cell tumor was Boxer (41.60% with neoplasia and 58.40% without neoplasia), followed by Doberman Pinscher (33.80% with neoplasia and 66.20% without neoplasia), German Shepherd (22.70% with neoplasia and 77.30% without neoplasia), Cocker Spaniel (22.30% with neoplasia and 77.7% without neoplasia) and mixed breed (22.00% with neoplasia and 78% without neoplasia).

Discussion

The aim of this study was to investigate the spatial distribution of neoplasms in canines seen at the HOVET-SVMAS-USP from 2002 to 2003. As canines are considered sentinels of environmental contaminations, we considered it important to verify if any of the regions of the city of São Paulo could present a higher incidence of cancers that could possibly be caused by environmental contaminations to which humans could also be exposed. Advancing age in dogs has been considered a higher risk to developing neoplasia (DE NARDO, 2003; WITHROW, 2007). In this study, the prevalence of neoplasia in dogs was higher from 6 to 12 years of age. Similar to our results, many retrospective studies related that tumors in dogs had an average age of nine years with an age range of approximately between four months and 12 years (KALDRYMIDOU et al., 2002; PIRES; TRAVASSOS; PIRES, 2003; ROSSETTO et al., 2009; MEIRELLES et al., 2010). There was no significant statistical difference between females and males, similar to the study of Rosseto et al. (2009).

Table 1 – Absolute number of histological types of neoplasms in dogs, according to the region (South, East, North and West) of the city of São Paulo, SP, Brazil – HOVET, SVMAS, USP – 2002-2003

Histological types of tumors	Absolute number of tumors according to the region						
Canine	**Downtown**	**East**	**North**	**West**	**South**	**Total**	**%**
Mast cell tumor	15	9	7	22	17	70	18
Osteosarcoma	6	4	9	13	7	39	10
Lipoma	11	3	4	12	2	32	8
Transmissible venereal tumor	7	1	5	5	3	21	6
Sarcoma	4	2	1	6	5	19	5
Tumor of Adnexal Tissue	6	3	3	3	2	17	4
Basal Cell Carcinoma	5	2	1	3	3	14	4
Undifferentiated Carcinoma	6	3	1	3	1	14	4
Malignant peripheral nerve sheath tumor	3	2	5	3	1	14	4
Perianal Adenoma	4	1	2	2	3	12	3
Malignant Melanoma	4	2	1	3	2	12	3
Seminoma	4	2	1	2	3	12	3
Hemangioma	3	0	1	4	1	9	2
Lymphoma	1	3	2	1	1	8	2
Perianal Carcinoma	0	0	3	2	2	7	2
Hemangiosarcoma	1	1	3	0	1	6	2
Leydig Cell Tumor	1	0	1	1	3	6	2
Apocrine Cyst	1	0	0	3	1	5	1
Fibrosarcoma	2	0	1	1	1	5	1
Liver Adenocarcinoma	1	1	1	1	0	4	1
Sebaceous Adenocarcinoma	0	0	0	4	0	4	1
Epidermoid Carcinoma	1	1	0	2	0	4	1
Hemangiopericytoma	1	1	1	1	0	4	1
Histiocytoma	2	0	0	1	1	4	1
Neurofibroma	2	0	0	0	2	4	1
Plasmocytoma	0	1	0	3	0	4	1
Sertolinoma	1	0	2	0	1	4	1
Complex Carcinoma	1	0	0	2	0	3	1
Simple Adenoma	1	1	0	0	0	2	1
Squamous Cell Carcinoma	1	0	0	1	0	2	1
Papillary Cystadenoma	1	0	1	0	0	2	1
Fibrous Histiocytoma	2	0	0	0	0	2	1
Fibroma	0	0	2	0	0	2	1
Liposarcoma	1	0	0	0	1	2	1
Basal Cell Tumor	1	0	0	1	0	2	1
Renal Adenocarcinoma	0	0	0	0	0	1	0.3
Complex Adenoma	0	0	0	1	0	1	0.3
Papilar Adenoma	0	0	0	1	0	1	0.3
Simple Carcinoma	0	0	1	0	0	1	0.3
Perianal Epithelioma	1	0	0	0	0	1	0.3
Fibrous Malignant Histiocytoma	0	0	1	0	0	1	0.3
Papilloma	0	0	1	0	0	1	0.3
Subungual Keratoacanthoma	0	0	0	1	0	1	0.3
Rhabdomyosarcoma	1	0	0	0	0	1	0.3
Total	**102**	**43**	**61**	**108**	**64**	**380**	**100**

The mast cell tumor was responsible for the higher prevalence, especially in Boxer breeds reported in many studies, and our results confirm these findings (FOX, 1998; GILSON; PAGE, 1998; SOUZA et al., 2006). Another epidemiological study of cases of neoplasia diagnosed by cytology, from the Universidade Estadual de Londrina (Brazil), between 1996 and 2006, confirmed the Boxer as a most-affected breed, followed by Poodle and German Shepherd (ROSSETTO et al., 2009).

The more common tumors in this study were similar to other results, differing from the order of tumors, showing that the most common tumors in dogs were epidermal and follicular cysts (95:12.70%), followed by lipoma (85:11.37%) and mast cell tumors (66:8.82%) in 748 (25%) cases diagnosed in the Department of Veterinary Pathology, College of Veterinary Medicine Seoul National University, Korea (SOUZA et al., 2006; PAKHRIN et al., 2007). In the present investigation study, although a higher absolute frequency of cases of neoplasms was verified in downtown and west regions in comparison to other regions, when the relative frequency was performed no statistical differences between the regions were obtained. There is no data published on cases of neoplasms in dogs by region in the city of São Paulo, showing the importance of this pioneering work in the city. Dogs seen at the HOVET-SVMAS-USP came from all regions (north, south, east, west and downtown) of São Paulo, even from administrative regions or districts far from the veterinary hospital. A map illustration can be a useful tool, coupled with other epidemiological features. In this case, if the number of cases increased, it is possible to draw an epidemiological profile in the regions and see what risk factors are involved in cancer clusters.

The use of Spatial Information Geographic (GIS) of neoplasia in companion animal epidemiology is an important tool only recently used in veterinary oncology. O'Brien et al. (2000), used locations of owners with dogs diagnosed with cancers to a clinic in Michigan by GIS to investigate the spatial and temporal distribution of canine cancers. In 2003, another study with lymphoma, mammary adenocarcinoma, melanoma and spindle cell sarcoma identified significant spatial clustering (FOX, 1998). Areas highly exposed to a solid waste incinerator with high dioxin emissions in the city of Besançon (France) had a risk 2.3 times greater for the highest exposure group to develop non-Hodgkin lymphoma compared with those living in areas of low exposure (FLORET et al., 2007). A study about geographic distribution of canine neoplasia in France related that waste incinerators, polluted sites, and radioactive waste may have implication with environmental factors in the development of non-Hodgkin lymphomas (PASTOR et al., 2009). However, there are only a few studies using GIS in companion animals, mainly in cancer epidemiology. Several articles of environmental exposures that increase risk of developing neoplasia in companion animals have been associated with urban air pollutants (REIF; BRUNS; LOWER, 1998; STAGNARO et al., 2001; MARCONATO et al., 2009; PASTOR et al., 2009). The case control study investigated environmental causes like exposure to domestic factors, possibly carcinogens (including tobacco) and local pollution, and the higher risk of developing tumors of the sinuses in dogs was observed. The occurrence of neoplasia in pets in specific geographic areas by environmental causes must be investigated. The dog is considered as a sentinel of humans and the GIS is an extremely important tool for investigating the oncology epidemiology for public health.

The present investigation found that the HOVET-SVMAS-USP receives cases from all regions of São Paulo city. No statistical differences in the prevalence of canine neoplasms were obtained, when the different regions of the city of São Paulo were considered. It must be emphasized that the investigation was performed with cases from only one veterinary hospital. Authors encourage further and broader

investigations involving several veterinary hospitals and/or clinics or laboratories, in order to obtain more accurate data on distribution of canine neoplasms in São Paulo.

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