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Retrospective Study of Neoplasms in Domestic Animals: a Survey Between 1993 and 2002 of the Service of Animal Pathology, Department of Pathology, School of Veterinary Medicine and Animal Science, University of Sao Paulo, Southeast Brazil

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Abstract

The incidence of neoplasia in animals is increasing, and cancer epidemiology can be considered an essential area in veterinary pathology and clinics. The aim of this study was to present a survey of neoplasia in domestic animals diagnosed at the Animal Pathology Service (Serviço de Patologia Animal – SPA), Department of Pathology, School of Veterinary Medicine and Animal Science of the University of São Paulo, Brazil. Biopsy and necropsy archival specimens of the SPA were surveyed and all cases with the main diagnosis of neoplasia from 1993 to 2002 were retrieved. Animal species, breed, age, gender, location, and the histological type of neoplasm were recorded and the findings analyzed and formatted to display the epidemiological features of the tumors. A total of 12.118 biopsy and necropsy specimens were processed by the diagnostic service during this period. Among them, 1.971 cases (16%) of neoplasia were found. Most cases of neoplasia were diagnosed in canines (92%, n=1.813), followed by felines (4%, n=82), equines (3%, n=61) and bovines (1%, n=15). Cross breed was the most commonly found breed among dogs (27%, n=492) and cats (40%, n=33). Holstein (47%, n=7) and Mangalarga (28%, n=17) were the most commonly affected breeds in bovines and equines, respectively. The gender incidence of tumors was not significantly different in any species. Dogs, cats and horses were more frequently affected by neoplasia at the age range of 6 to 10 years while cattle were affected at an age range of 1 to 10 years. The most diagnosed neoplasm in dogs was mammary carcinoma (13%, n=244) whereas squamous cell carcinoma was the most diagnosed neoplasm in cats (18%, n=14), cattle (53%, n=8), and horses (33%, n=5). Due to the absence of a veterinary cancer registry in Brazil, epidemiological studies may represent important sources of information on neoplasia in animals, and, additionally, may be a tool in the development of prevention methods in order to control cancer in domestic animals.

Key Words: neoplasia, diagnostic prevalence, epidemiology, domestic species

Introduction

Cancer epidemiology is an important field of cancer research and is a growing field in veterinary medicine and has been important to determine the statistical data of the disease by allowing the survey of the incidence of cases, tracing of breeds predispose to certain types of cancer, the study of the age group most affected

and the relationship of epidemiological data about the quality of life of animals in each study region.

In 2001, there was an estimated population of 73.9 million dogs and 90.5 million cats in the United States (USA) and 85% of these pets had veterinary care. More than 69 million homes bear one or more pets (2). In another study, only 2% of American pet owners consider their animals to be a "property," while 51% consider them as "companions" and 47% consider them as "members of the family" (3).

In a study conducted in Brazil, 52.6% of a total of 20.958 householders interviewed, owned a dog, with the average of 1.6 dogs per house (dog/inhabitant ratio was 1:4), and 12.6% owned a cat; with average of 1.8 cats per house (cat/inhabitant ratio was 1:16.4). Similarly, a recent study showed that in a total of 11.272 households in a metropolitan region of Sao Paulo, Brazil, 50% had a dog with the same average of 1.6 dogs per house (dog/inhabitant ratio was 1:4.3) (1,5).

The first described registry of neoplasms in dogs and in cats was performed in 1963 and in 1966 (Alameda and Contra Costa of California, respectively), and they showed an incidence of cancer of 1/100000 in dogs and 155/100000 in cats (9,10). Another study found that 715 of 63.504 dogs (1126/100000 dogs) and 56 of 11.909 cats (470/100000 cats) had neoplasia in the Tulsa Registry of Canine and feline Neoplasms in the United States (14).

The incidence of malignant neoplasia in dogs was similar to that in cats, and the incidence of benign neoplasia was 10 times higher in dogs than in cats for the period from April 1, 1972 through March 31, 1973 (14). Other study identified a 19 times increase of incidence of skin neoplasia in dogs: 25 cases (1964-1973); 48 cases (1974-1983); 161 cases (1984/1993) and 469 cases (1994/2003) (23). A total of 2,952 canine biopsy specimens were diagnosed with 748 (25.3%) of canine cutaneous tumors in the Service of Animal Pathology, College of Veterinary Medicine, Seoul National University, Korea (19). In a recent research of cutaneous neoplasms in dogs, 5.016 tissue samples were reported, including 1.017 (20.3%) from the Service of Animal Pathology, Universidade Federal do Rio Grande do Sul (UFRGS), Southern Brazil, over a 6 year period (2002 to 2007) (15).

The incidence of feline tumors was 1.078 cases from 6,748 cats at Azabu University Veterinary Teaching Hospital in Japan from April 1985 to March 2008 (22).The prevalence of cutaneous neoplasia was 88.4% in 673 dogs from the Service of Animal Pathology Laboratory of the Universidade Federal de Santa Maria (UFSM-RS) Southern Brazil, between 1964 and 2003 (23). Another author determined the prevalence of neoplasms from the Service of Animal Pathology Laboratory of Universidade Estadual de Londrina (UEL), Southern Brazil: from 3,378 cases of cytological examinations, 1,019 cases were diagnosed as neoplasms (21).

A retrospective study from the Regional Diagnostic Laboratory of the Faculdade de Veterinária da Universidade Federal de Pelotas, Southern Brazil, between 1978 and 2002 (19) on all lesions detected in production animals 175 neoplastic cases were identified including 98 cases in cows (2.22%), 9 cases in sheep (1.41%), 65 cases in horses (8.39%) and 3 cases in pigs (0.6%). Other study found 22 cases of neoplasia in a total of 1139 diagnoses in horses from 2007 to 2011 at the Large Animals Deparment of the Universidade Federal do Rio Grande do Sul, Brazil (7).

The aim of this work was to perform a retrospective study of neoplasms in domestic animals collected at the Service of Animal Pathology of the Faculdade de Medicina Veterinária e Zootecnia da Universidade de São Paulo (FMVZ-USP), Southeast Brazil, from 1993 to 2002.

Material and Methods

Samples

A total of 12.118 biopsy and necropsy specimens were retrieved and diagnosed according to the World Health Organization classification (28) from the Service of Animal Pathology of the School of Veterinary Medicine and Animal Science of the University of São Paulo between 1993 and 2002. Among these specimens, 1.971 cases of tumors in dogs, cats, cattle and horses were found. Age, gender, breed, histological type of tumor as well as the neoplasm location were recorded. The age distribution was divided into six groups: group 1 (> 1 year); group 2 (1 year to 5 years); group 3 (6 years to 10 years); group 4 (11 years to 15 years); group 5 (16 years to 20 years); group 6 (26 years to 30 years). No diagnoses were made within the 21-25-year range. All data that were not found were categorized as missing data.

Besides being separated by species, tumor types were separated in nine groups, according to the tissue or organ of origin: epithelial tumors, mesenchymal tumors, round cell tumors, testis tumors, melanocytic tumors, ovarian tumors, mesothelial tumors, brain tumors, and neuroendocrine tumors. The subtype known as haired skin adnexal tumor included infundibular keratinizing acanthoma, trichoblastoma, trichoepithelioma, pilomatricoma, tricholemomma, malignant trichoepithelioma, and follicular cysts.

Results

Neoplasms in dogs

In this retrospective study, dogs were more affected by neoplasms accounting for 92% of all cases of neoplasia.

The most affected breeds of dogs were: Cross breed (13% n=244), German shepherd (10%, n=174),

Poodle (8%, n=147) and Boxer (7%, n=122). Missing data represented 13% (n=244). Missing data are incomplete data or data that were not filled in correctly being excluded from analysis. The distribution of dog breeds is represented in Table 1.

Table 1 - Species breeds affected with tumors between 1993 and 2003 - Department of Pathology of the School of Veterinary Medicine and Animal Science of the University of São Paulo, Brazil.

Species	Breed	N.	%
Bovines	Holstein	7	47
	Mix Breed	6	40
	Simmental	1	7
	Missing Data	0	0
Bovine Total		14	100
Felines	Mix Breed	33	40
	Siamese	24	29
	Missing Data	18	22
	Persian	4	5
	Angora	2	2
	British	1	1
Feline Total		82	100
Canines	CROSS BREED	492	27
	Missing data	244	13
	PURE BREED		
	German Shepherd	174	10
	Poodle	147	8
	Boxer	122	7
	English Cocker Spaniel	97	5
	Doberman	75	4
	Husky Siberiano	55	3
	Fox Paulistinha	49	3
	Pinscher	37	2
	Rotweiller	32	2
	Fila Brasileiro	28	2
	Great Dane	27	1
	Akita	21	1
	Beagle	20	1
	Weimaraner	20	1
	Teckel	17	1
	Schnauzer	16	1
	Irish Setter	16	1
	Pekingese	15	1
	German Shepherd Belga	13	1
	Collie	12	1
	Basset	10	1
	Labrador	9	0,4
	Dalmatian	8	0,4
	Yorkshire	8	0,4
	Bichon Frise	6	0,3
	Afghan Hound	5	0,3
	Old English Sheepdog	4	0,2
	Pointer	4	0,2
	Shar Pei	4	0,2
	Lhasa Apso	4	0,2
	Maltese	3	0,2
	Bernese Mountain Dog	2	0,1
	Chihuahua	2	0,1
	Golden Retriever	2	0,1
	Pit bull	2	0,1
	Scottish Terrier	2	0,1
	Chow Chow	1	0,1
	English Buldog	1	0
	Spanish Galgo	1	0
	Mastiff	1	0,1
	Mastim	1	0,1
	Samoyeda	1	0,1
	English Springer Spaniel	1	0,1
	West higland white terrier	1	0,1
	Whippet	1	0,1
Canine Total		1813	100
Equines	Missing Data	19	31
	Mangalarga	17	28
	Mix Breed	11	18
	Thoroughbred	5	8
	Brasileiro de Hipismo	3	5
	Quarter Horse	3	5
	Appaloosa	2	3
	Arabian	1	2
Equine Total		61	100
TOTAL OF NEOPLASMS		**1971**	

The gender of animals bearing these tumors was 51% (n=917) female, 43% (n=773) male and in 7% (n=123) of cases the gender was not recorded (missing data).

Concerning the distribution of age of dogs with neoplasia, it was found that 1% (n=18) of cases were below 1 year (group 1); 14% (n=252) of dogs were aged between 1 and 5 years (group 2); 45% (n=812) of dogs were aged between 6 and 10 years (group 3); 25% (n=446) of dogs were aged between 11 and 15 years (group 4); 1%(n=18) of dogs were aged between 16 and 20 years (group 5). Note that 15% of cases did not have this data registered (n=270).

The most frequent neoplasms in dogs were: mammary adenocarcinoma (13%; n=242); cutaneous mast cell tumor (7%; n=126); squamous cell carcinoma (5%; n=86) being 62% skin tumors; 9% in the oral cavity, 4% in the bladder, oropharynx and eyelid; 3% in pinna and vagina and 1% in tongue and vulva); seminoma (4%, n=73), haired skin adnexal tumor (4%, n=73), hemangiosarcoma (4%, n=71), basal cell carcinoma (4%, n=67), mammary adenoma (3%, n=63), hemangioma (3%, n=63), osteosarcoma (3%, n=60), melanoma (3%, n=58), Leydig cell tumor (3%, n=57), lipoma (3%, n=54), fibrosarcoma (3%, n=52), Hematopoietic /lymphopoietic tumor (leukemia and lymphoma) (3%, n=51), hepatoid gland adenoma (2%, n=45), transmissible venereal tumor (2%, n=45), Sertoli cell tumor (2%, n=41), malignant peripheral nerve sheath tumor (2%, n=35). Other tumors had a percentage below 1%, and 3% (n=52) were missing data.

Histological tumor group more frequently found was composed of: 45% of epithelial tumors, 27% of

mesenchymal tumors, round cell tumors (Histiocytoma: 50% were cutaneous, 15% were missing data, 14% in the eyelid gland, 7% in the limbs, 7% in the mammary region, and 7% in the inguinal region); Leukemia was 100% located in the bone marrow; Lymphoma (23%) was located in lymph nodes, 23% in the spleen, 16% in the intestine, 14% in the skin and 2% in the kidney; Mast cell tumor 57% was located in the skin, 16% in the scrotum , 7% in a limb, 7% in missing data, 2% in the ear, and 1% in other regions); TVT (transmissible venereal tumor) with 42% was located in the vagina, 16% were nasal, 12% were missing data, 10% in the penis, 8% in the prepuce, 7% in the vulva and 5% in the scrotum; testicular tumors (germ cell or sex cord) (9%); melanocytic tumors (46%) were located in the skin, 13% in digits, 13% in the oral cavity, 9% were missing data, 9% in the eyelid gland, 7% in the eyes, and 2% in the third eyelid gland) (3%); ovarian tumors (germ cell and sex cord) (1%); brain tumors (meningiosarcoma, ependymoma, meningioma) (0.2%) and 0.2% of neuroendocrine tumors located in adrenal glands, carotid body and vagus nerve.

Among the four types of the epithelial tumor group, mammary carcinoma (13%) was the most frequent, followed by squamous cell carcinoma (5%) located in the skin (41%), 15% in the oral cavity, 7% in the nose, 7% in digits, 4% in the eyelid gland, 3% in tonsils, in the third eyelid gland, oropharynx, limb, ear, missing data and mammary, and 1% in vagina, perivulvar, perianal, eyes and bladder, haired skin adnexal tumor (4%), and basal cell carcinoma (4%). These are represented in Table 2.

Table 2 - Prevalence of the histological tumor types in dogs affected with neoplasia between 1993 and 2003 - Department of Pathology of the School of Veterinary Medicine and Animal Science of the University of São Paulo, Brazil.

Group	**Type of neoplasia**	**N.**	**%**
Brain	Meningiosarcoma	2	0,1
	Ependymoma	1	0,1
	Meningioma	1	0,1
Subtotal		**4**	**0,2**
Epithelial neoplasms	**Mammary gland**		
	Mammary adenocarcinoma	242	13
	Mammary adenoma	63	3
	Skin /lids		
	Tumor of adnexal tissue	73	4
	Basal cell carcinoma	67	4
	Hepatoid gland adenoma	45	2
	Sebaceous adenoma	24	1
	Sebaceous carcinoma	22	1
	Apocrine adenocarcinoma	22	1
	Hepatoid gland carcinoma	21	1
	Undifferentiated adenocarcinoma	17	1
	Papilloma	16	1
	Undifferentiated carcinoma	9	0,5
	Apocrine adenoma	8	0,4
	Sebaceous epithelioma	2	0,1
	Meibomian epithelioma	4	0,2
	Collagenous nevus	3	0,2
	Liver		
	Cholangiocarcinoma	13	1
	Hepatocellular adenoma	1	0,1
	Hepatocellular carcinoma	1	0,1
	Pancreas		
	Pancreatic adenocarcinoma	4	0,2
	Bladder		
	Transitional cell carcinoma	10	1
	Thyroid	4	0,2
	Thyroid carcinoma	4	0,2
	Prostate		
	Prostatic carcinoma	2	0,1
	Nasal		
	Nasal adenocarcinoma	2	0,1
	Adrenal gland		
	Adrenal adenocarcinoma	2	0,1
	Pituitary		
	Pituitary adenoma	1	0,1
Subtotal		**802**	**44**
Melanocytic	Melanoma	58	3
Subtotal		**58**	**3**
Mesenchymal	Angiosarcoma	71	4
	Angioma	63	3
	Osteosarcoma	60	3
	Lipoma	54	3
	Fibrosarcoma	52	3
	Malign peripheral nerve sheath tumor	35	2
	Fibroma	27	1
	Leiomyoma	16	1
	Liposarcoma	15	1
	Hemangiopericytoma	12	1
	Rhabdomiosarcoma	11	1
	Leiomyosarcoma	11	1
	Malignant Fibrous Histiocytoma	9	0,5
	Chondrosarcoma	7	0,4
	Chondroma	5	0,3
	Benign peripheral nerve sheath tumor	5	0,3
	Osteochondroma	4	0,2
	Undifferentiated sarcoma	4	0,2
	Mixosarcoma	2	0,1

Subtotal		**463**	**26**
Mesothelial	Mesothelioma	4	0,2
Subtotal		**4**	**0,2**
Missing data	*missing data*	52	3
Subtotal		**52**	**3**
Neuroendocrine	pheochromocytoma	2	0,1
	chemodectoma	1	0,1
	paraganglioma	1	0,1
Subtotal		**4**	**0,2**
	Teratoma	2	0,1
	Ovarian adenocarcinoma	2	0,1
	Ovarian adenoma	1	0,1
Subtotal		**17**	**1**
Round cell	**Skin/mucosa**		
	Mast cell tumor	126	7
	Cutaneous histiocytoma	14	1
	Transmissible venereal tumor	44	2
Hematopoietic/lymphopoietic	Lymphoma	51	3
	Leukemia	3	0,2
Subtotal		**238**	**13**
Testis	Seminoma	73	4
	Leydig cell tumor	57	3
	Sertoli cell tumor	41	2
Subtotal		**171**	**9**
Total		**1813**	**100**

Hemangiosarcoma (4%), 35% were located in the skin, 26% in the spleen, 12% in the limbs, 8% were missing data, 8% in the liver, 5% in abdominal site and 2% in digits, eyelid gland, femoral, heart, and inguinal region; Hemangioma (3%), 48% were located in the skin, 36% were splenic, 8% in the thoracic site, 2% in the liver, nasal, ocular, in the tail and abdominal site. Osteosarcoma (3%) with 35% was located in the femur, 30% in the tibia, 25% in the humerus, 4% were nasal and missing data and 2% were vertebral); and lipoma (3%), 37% were located in the limbs, 23% were lumbar, 16% were missing data, 13% were thoracic, 6% were abdominal and 4% were inguinal. Mesenchymal tumors are represented in Table 2.

Mast cell tumor (7%, n=126), hematopoietic /lymphopoietic tumor (7%, n=61), TVT (2%, n=44) and cutaneous histiocytoma (1%, n=14) were the top four round cell tumors retrieved in this survey. Boxers had a high prevalence of mast cell tumor (30%), followed by cross breed dogs (25%) reported in Table 3.

Table 3 – Distribution of breeds of dogs affected with mast cell neoplasia between 1993 and 2003 - Department of Pathology of the School of Veterinary Medicine and Animal Science of the University of São Paulo, Brazil.

Type	Breed	N.	%
Mast cell tumor	Boxer	38	30
	Cross breed	31	25
	Missing Data	16	13
	Doberman Pinscher	6	5
	Toy Pinscher	5	4
	Fila Brasileiro	5	4
	Poodle	4	3
	Teckel	3	2
	Brazilian Terrier	3	2
	Husky Siberiano	2	2
	English Cocker Spaniel	2	2
	German Shepherd	2	2
	Rotweiller	1	1
	Beagle	1	1
	Labrador	1	1
	Maltese	1	1
	Akita	1	1
	Great Dane	1	1
	Bernese Mountain Dog	1	1
	Basset	1	1
	Pekingese	1	1
TOTAL		**126**	**100**

The most frequent testicular neoplasms in dogs were: seminoma (4%, n=73), Leydig cell tumor (4%, n=57) and Sertoli cell tumor (2%, n=41).

The other groups (ovarian tumor, neuroendocrine tumor, brain tumor and mesothelial tumor) had scores below 0.3%.

Neoplasms in cats

The feline species accounted for 4% of cases of cancer collected by the study. The breeds of cats with neoplasia were: cross breed (40%, n=33), Siamese (29%, n=24), Persian (5%, n=4), Angora (2%, n=2), British Shorthair 1%, n=1) and Seal Point (1%, n=1). Missing data represented 22% of the cases (n=18).

Concerning gender, 56% (n=46) of tumor cases were found in females, 33% (n=27) in males, and 11% (9) of cases did not have the sex registered (missing data).

The distribution of age of cats with neoplasms was: 3% (n=2) of cases in cats below 1 year (group 1); 19% (n=15) of cases in cats between 1 and 5 years (group 2); 34% (n=27) of cases in cats between 6 and 10 years (group 3); 16% (n=13) of cases in cats between 11 and 15 years (group 4); 5% (n=4) of cases in cats between 16 and 20 years (group 5). Note that in 23% of cases sex was not registered (n=18).

The most frequent neoplasms in cats were: squamous cell carcinoma (17%; n=14), mammary carcinoma (12%; n=10), fibrosarcoma (12%; n=10), lymphoma (11%; n=9), haired skin adnexal tumor (5%;

n=4), mammary adenoma (5%; n=4), fibroma (5%; n=4), basal cell carcinoma (5%; n=4), apocrine adenocarcinoma (4%; n=3), and intestinal adenocarcinoma (2%; n=2). Other tumors had a percentage below 1%. Squamous cell carcinoma was located in the skin in 36% of cases, 29% in the ear, 21% in the eyelid gland, 7% in the oropharynx and 7% were missing data.

Histological group of tumors most frequently found in the survey were: epithelial tumors (53%), mesenchymal tumors (28%), round cell tumors (14%), hematopoietic /lymphopoietic tumors (10%), ovarian tumors (3%), melanocytic tumors (1%), and neuroendocrine tumors (1%).

Among the four tumors from the epithelial tumors group, squamous cell carcinomas (18%) were the most frequent, followed by mammary adenocarcinoma (10%), basal cell carcinoma (5%) and haired skin adnexal tumor (5%).

Fibrosarcoma (13%), fibroma (5%), osteochondroma (1%) and malignant fibrous histiocytoma (1%) were the top four mesenchymal tumors.

Lymphoma (11%), leukemia (1%) and plasma cell neoplasia (1%) were the top four round cell tumors recorded.

In the ovarian tumor group, granulosa cell tumor (1%) and ovarian carcinoma (1%) were found. The melanocytic tumor group accounted for 1% of melanoma and 1% of mesothelial tumor represented the mesothelial tumor group.

The histological types of neoplasms by groups in cats are represented in Table 4.

Table 4 - Prevalence of histological tumor types in cats affected with neoplasia between 1993 and 2003 - Department of Pathology of the School of Veterinary Medicine and Animal Science of the University of São Paulo, Brazil.

Group	Type of neoplasia	N.	%
Epithelial			
	Skin		
	Squamous cell carcinoma	14	17
	Basal cell carcinoma	4	5
	Tumor of adnexal tissue	4	5
	Apocrine adenocarcinoma	3	4
	Sebaceous adenoma	1	1
	Mammary gland		
	Mammary adenocarcinoma	10	12
	Mammary adenoma	4	5
	Bladder		
	Transitional cell carcinoma	2	2
	Intestine		
	Intestinal adenocarcinoma	2	2
	Liver		
	Cholangiocarcinoma	1	1
	Hepatocellular adenoma	1	1
	Hepatocellular carcinoma	1	1
	Pancreas		
	Pancreatic adenoma	1	1
Subtotal		**48**	**59**
Melanocytic	Melanoma	1	1
Subtotal		**1**	**1**
Mesenchymal	Fibrosarcoma	10	12
	Fibroma	4	5
	Leiomyoma	1	1
	Malignant fibrous histiocytoma	1	1
	Osteochondroma	1	1
	Angiosarcoma	1	1
	Hemangiopericytoma	1	1
Subtotal		**19**	**23**
Mesothelial	Mesothelioma	1	1
Subtotal		**1**	**1**
Ovarian	Ovarian adenocarcinoma	1	1
	Granulosa cell tumor	1	1
Subtotal		**2**	**2**
Round cell	**Skin**		
	Plasma cell neoplasia	1	1
Hematopoietic /lymphopoietic	Lymphoma	9	11
	Leukemia	1	1
Subtotal		**11**	**13**
Total		**82**	**100**

Neoplasms in cattle

Only 1% of cases of neoplasms collected at the Service of Animal Pathology of the School of Veterinary Medicine and Animal Science of the University of São Paulo were diagnosed in bovine. The bovine breeds with neoplasia were: Holstein (47%, n=7), Cross breed (40%, n=6), and Simmental (7%, n=1).

The gender of the animals bearing these tumors was 47% (n=7) females, 20% (n=3) males, and in 33% of cases (n=5) the information was not recorded (missing data).

The distribution of age of bovines bearing neoplasms was: 20% (n=1) of cases in bovine below 1 year of age (group 1); 40% (n=2) of cases in bovines between 1 and 5 years of age (group 2) and 40% (n=2) of cases in bovine between 6 and 10 years of age (group 3). Information on age of the animals was not found in 67% of cases (n=10) (missing data).

The most frequent neoplasms in bovines were: squamous cell carcinoma (53%; n=8), Leukemia (20%; n=3), hemangiosarcoma (13%; n=2), papilloma (7%; n=1) and lymphoma (7%; n=1).

Histological group of neoplasms more frequently found were epithelial tumors (60%), round cell tumors (27%) and mesenchymal tumors (13%).

Among the most-found epithelial tumors were the squamous cell carcinoma (2% located in the vulva, 4% in the hird eyelid gland and 2% were missing data) (53%) and papilloma (skin) (7%).

Leukemia (20%) and lymphoma (7%) were classified as round cell tumors.

Hemangiosarcoma (13%) was the only histological type within the mesenchymal tumor group found in this study.

The histological types of neoplasms by groups in bovines are represented in Table 5.

Table 5 - Prevalence of the histological types of tumors in cattle affected with neoplasia between 1993 and 2003 - Department of Pathology of the School of Veterinary Medicine and Animal Science of the University of São Paulo, Brazil.

Group	Type of neoplasia	N.	%
Epithelial	Squamous cell carcinoma	8	53
	Papilloma	1	7
Subtotal		**9**	**60**
Hematopoietic/ lymphopoietic	Leukemia	3	20
	Lymphoma	1	7
Subtotal		**4**	**27**
Mesenchymal	Hemangiosarcoma	2	13
Subtotal		**2**	**13**
Total		**15**	**100**

Neoplasms in horses

Only 4% of the neoplasms in this survey were present in the equine species. The most affected breeds were Mangalarga (28%, n=17), cross breed (18%, n=11), Thoroughbred (8%, n=5), Andaluz (8%, n=5), Quarter horse (5%, n=3), Brasileiro de hipismo (5%, n=3), Appaloosa (3%, n=2), and Arabian (2%, n=1). In 31% of the cases, (n=19), breeds were not recorded (missing data).

Regarding gender, 41% of the cases (n=26) were found in females, 39% of the cases (n=24) were found in males and in 20% (n=12) sex was not recorded (missing data).

The age distribution of equines with neoplasms was: 17% (n=8) of cases between 1 and 5 years of age (group 2); 49% (n=23) of cases between 6 and 10 years of age (group 3); 19% (n=9) of cases between 11 and 15 years of age (group 4); 9% (n=4) of cases between 16 and 20 years of age (group 5); 6% (n=3) of cases between 25 and 30 years of age (group 6). In 23% of the cases age was not registered (n=14) (missing data).

The most frequent neoplasms in equines were: squamous cell carcinoma (46%, n=28) with 26% in the skin, 19% in the eyes, 15% in third eyelid gland and eyelid gland, 7% in the mouth (?), 4% penis, prepuce, esophageal, distal limbs and 4% were missing data; sarcoid (10%, n=6), fibroma (8%; n=5), fibrosarcoma (5%, n=3), undifferentiated carcinoma (3%, n=2), hemangiosarcoma (3%, n=2), malignant peripheral nerve sheath tumor (3%, n=2). Other tumors had a percentage below 1%. 5% (n=3) were missing data.

Histological types found were: epithelial tumors represented 54% (n=33), mesenchymal tumors represented 39% (n=24) and melanocytic tumors (cutaneous) represented 2% (n=1) of the cases. 5% (n=3) were missing data. Among the most found tumors from the epithelial tumors types were squamous cell carcinoma (46%), undifferentiated carcinoma (3%), adrenal carcinoma (2%), papilloma (2%), and sebaceous carcinoma (2%).

Sarcoid (10%), fibroma (8%), fibrosarcoma (7%), hemangiosarcoma 3%, malignant peripheral nerve sheath tumor (3%), hemangioma (2%), benign peripheral nerve sheath tumor (2%), and undifferentiated sarcoma (2%), chondrosarcoma (2%) and osteosarcoma (2%) were the most diagnosed mesenchymal tumors.

Melanoma (2%) was the only histological type of the melanocytic tumor group found in this study. The histological types of neoplasms by groups in equines are represented in Table 6.

Table 6 - Prevalence of the histological types of tumors in horses affected with neoplasia between 1993 and 2003 - Department of Pathology of the School of Veterinary Medicine and Animal Science of the University of São Paulo, Brazil.

Group	Type of neoplasia	N.	%
Epithelial	Squamous cell carcinoma	28	46
	Undifferentiated carcinoma	2	3
	Adrenal carcinoma	1	2
	Papilloma	1	2
	Sebaceous carcinoma	1	2
Subtotal		**33**	**54**
Melanocytic	Melanoma	1	2
Subtotal		**1**	**2**
Mesenchymal	Sarcoid	6	10
	Fibroma	5	8
	Fibrosarcoma	4	7
	Hemangiosarcoma	2	3
	Malignant peripheral nerve sheath tumor	2	3
	Hemangioma	1	2
	Benign peripheral nerve sheath tumor	1	2
	Undifferentiated sarcoma	1	2
	Chondrosarcoma	1	2
	Osteosarcoma	1	2
Subtotal		**24**	**39**
Missing data	*Missing data*	3	5
Subtotal		**3**	**5**

Discussion

The Veterinary Hospital of the School of Veterinary Medicine and Animal Science of the University of São Paulo, Brazil, provides the community with medical-surgical, outpatient and hospital care being considered the largest Veterinary Hospital in South America. The School of Veterinary Medicine is divided into different specializations, one of which is pathology. The Service of Animal Pathology is responsible for performing necropsy and histopathology in animals of different species seen by the hospital and other institutions, public or private clinics. Most of the data collected by the Service of Animal Pathology diagnosed as neoplasia was found in the canine species in this study. The great volume of dogs can be explained by the urban location of the Veterinary Hospital and the high interest of

the owners to take care of their pets that are now regarded as part of the family.

Results regarding pure breeds affected by neoplasia in this study are almost similar to other already described although differ in the order of prevalence from Poodle, followed by Boxer, Cocker Spaniel and German Shepherd, respectively, cited by the authors (6,14,20). Comparing pure breeds and cross breeds affected by tumors, this study identified more prevalence in cross breeds like other authors (14,19). It is necessary to bear in mind that the variety and frequency of breeds registered in a service depends on the country or region surveyed. The gender predilection of tumors was not significantly different. However, at the individual tumor level, females were more affected by mammary tumors and males were more affected by seminoma. The risk of tumors with increasing age has been shown by many authors (3,24). One retrospective study sampled dogs affected with tumors from a range of 6 to 12-year-old (7). Another author reported that the average age in dogs was 7.94 years with a range of 2 months to 19 years (17). Similarly, one study found that canine tumors ranged from 4 months to 16 years with a median age of 9 years, while another observed the average age of 8.8 years with a range of 2 to 20 years in 1,869 canine tumors (10,14). Our results had the mean age close to the mentioned in those reports affecting mostly older animals. In general, epithelial tumors had more prevalence than mesenchymal and round cell tumors like in other survey in which 102 cases of canine tumors were diagnosed (epithelial neoplasms; mesenchymal neoplasms and round cell tumors, respectively (15). A total of 2,952 cases of canine cutaneous neoplasms in Korean dogs listed more epithelial tumors: epithelial and melanocytic, mesenchymal tumors and hematopoietic neoplasias, respectively (17). In contrast with other reports, there were found more round cell tumors than epithelial and mesenchymal neoplasms (20,21).

Cutaneous histiocytoma is the only tumor that occurs in dogs between 6 months and 3 years of age (7). In this study, this tumor occurred mainly in dogs under 5 years old. Mammary adenocarcinoma was the most frequently diagnosed neoplasia in dogs in this project. This finding is in accordance with the reported tumor registry of dogs and cats in two provinces in Northern Italy (26).

Similarly, another study resulted in more cases of dogs with mammary gland tumor, followed by mast cell tumor (7). This study was different from other studies in which mast cell tumor was the most frequent (14, 19, 22).

The second histological type more commonly found in dogs was mast cell tumor mainly in Boxers corroborating the findings of other authors. Studies have shown the Boxer breed to be genetically predisposed to have mast cell tumor (4,12). The testicular neoplasm most commonly found in this study was seminoma, followed by Leydig cell tumor and Sertoli cell tumor. This finding paralleled other study that observed seminoma, followed by Leydig cell tumor, and Sertoli cell tumor (13).

Most of the studies showed cross breeds are more affected by neoplasia in cats like this study (11,22). There was no significant difference between genders in contrast with other report that showed more female than male feline tumors diagnosed from Azabu in Japan (22). As in dogs, the sequence and frequency of cancer vary within regions or countries.

Regarding large animals, Holstein breed was the most affected by tumors in cattle; similar results were identified at the Regional Diagnostic Laboratory of the Faculdade de Veterinária da Universidade Federal de Pelotas, Brazil (1978-2002) showing the Holstein breed as the most affected by tumors, followed by Hereford and Crioulo breed in equine (20). Other study identified Cross bred horses, followed by Crioulo breed as the most affected by neoplasia (6). Lymphoma and squamous cell carcinoma were the most histological types diagnosed in bovines and Sarcoid in equines (19). Paint horses, Belgian draught, and Palomino breeds are well recognized to be at an increased risk of squamous cell carcinoma (24). These breeds are not raised in our region. Squamous cell carcinoma is very common in dogs, cats, cattle and horses (2,6,16,18,22,23). Other results showed the higher prevalence of some tumors like lymphoma and squamous cell carcinoma in cattle and sheep and sarcoid in horses (20).

Neoplasia may cause major damage to the cattle industry and is responsible for significant economic losses. Hereford and Holstein are the most affected breeds (20,27). Holstein, Hereford and Simental breeds have a racial predisposition to develop squamous cell tumor due to their unpigmented skin, particularly on the face (7). Percentage of the species diagnosed with squamous cell carcinoma was 36% of dogs, 33% of cats, 22% of bovines and 7% of equines, in a survey performed between 2002 and 2006 (23). Similarly, our finding showed a high incidence of squamous cell carcinoma in cats, equines and bovines, especially in the Holstein breed. In summary, this study showed a high prevalence of mammary gland tumor in dogs, of squamous cell carcinoma prevalence in cats, bovine and horses, probably due to environmental conditions in Brazil with a marked decrease of the ozone layer.

This retrospective study represents a thorough contribution to veterinary oncology and epidemiology. Only a few epidemiological studies in Brazil concern veterinary oncology. It is expected to add to a very neglected field of pathology, suggesting the implementation of complete records in Veterinary Hospitals and institutions in Brazil, avoiding the missing data, and favoring the use of standard data (tumor diagnosis and classification). Descriptive data of the tumors are important to investigate the characteristics of each region, the differences between breeds, age, and types of cancer, to support advanced research and

knowledge of the tumors consequently the risk factors involved. Therefore, there is a need for more published scientific papers with regional and institutional statistics, thus the information will allow to improve prevention and strategic methods to learn more about cancer in Brazil.

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