



**UNIVERSITY OF NAIROBI**  
**COLLEGE OF AGRICULTURE AND VETERINARY SCIENCES**  
**FACULTY OF VETERINARY MEDICINE**

**A RETROSPECTIVE STUDY OF NEOPLASM REPORTED AT  
NECROPSY IN DOGS AT THE UNIVERSITY OF NAIROBI.**

A Research Project Submitted in Partial Fulfillment of the Requirements for the Award of a  
Bachelor's Degree in Veterinary Medicine of university of Nairobi

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## **Declaration**

This project is my original work and has not wholly, or in part, been presented for a degree in any other institution or university.

Signed.....

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## **Dedication**

To my mother, Mrs. Syprose Ogolla, my siblings Ruth, Victor, Bernard, Beatrice, Evalyne and David.

And finally to my beautiful niece, Stacy.

In recognition and appreciation of the roles they have played and continue to play in my life.

You all inspire me in your own unique ways.

## **Acknowledgement**

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In the preparation of this report, I enjoyed the help and advice of colleagues and friends. I owe thanks to all of them.

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## **Abstract**

A ten year retrospective study was carried out at the department of veterinary pathology, microbiology and parasitology, University of Nairobi, to evaluate the prevalence of neoplasm reported in dogs at necropsy between the years 2004-2014. The study also determined the trend of their occurrence and assessed the predisposing factors based on breed, age and sex.

A total of 1802 post mortem and histopathology records of dogs brought for post mortem in this period were assessed and evaluated. Data from the 293 cases that had histopathology confirmed neoplasm diagnosis were coded and entered in Microsoft excel 2007 and then descriptive statistics including mean and frequencies used to determine the prevalence of neoplasm, trend of occurrence and predisposing factors.

From the results, the most frequently reported neoplasm were osteosarcoma 45(15%) and lymphosarcoma 36(12%) with the least reported being liposarcoma 2(0.6%). Most neoplasm were reported in the musculoskeletal system 91(31%) followed by lymphatic system 61(20.8%). Cross breeds were the most affected by neoplasm recording 29% followed by German shepherd at 28.7%. Dogs in the age group 5-10 years reported high number of neoplasm 66(22.5%) while those in the 15-20 years age group reported only a single case of neoplasm (0.3%).

The following conclusions were therefore reached, that; higher proportion of neoplasm are reported in the cross breeds and the German shepherds, osteosarcoma and lymphosarcoma are the frequently reported neoplasm and dogs in the 5-10 year age group are at higher risk of getting neoplasm.

## **Chapter 1;**

### **1.0 Introduction**

Cancer is a common problem in dogs affecting all breeds of dogs. While cardiovascular disease causes a greater number of death, cancer remains the number one disease in terms of arousing public fear (Gordon *et al.*,1987). However, some breeds of dogs are at a higher risk of getting certain types of cancer than others due to their genetic makeup . Several studies have indicated that there are age, breed, sex and diet predisposition of dogs to various types of cancers (Fleming *et al.*, 2005). A study by Cohen *et al.*, (1974) revealed that there has been a steady increase in cases of neoplasm in dogs in the last 10yrs. The researchers attributed this to emergence of better diagnostic facilities at veterinary schools and the willingness of dog owners in affluent societies to pay the necessary costs of diagnosis. Longevity, climatic and genetic changes were also incriminated in the same study to be contributing to the rise in canine cancers. Cancer in dogs has led to significant economical and emotional losses in terms of mortalities and veterinary costs incurred by dog owners in managing the conditions.

Common neoplasia in dogs includes; histiocytic sarcoma, osteosarcoma, haemangiosarcoma, mast cell tumor, lymphoma/leukemia, melanoma, mammary gland tumor. Others like brain tumor, prostate cancer and squamous cell carcinomas also do affect dogs occasionally (Bender *et al.*, 1982).Cancer remains an important disease in dogs and represents one of the major causes of canine death accounting for up to 27% of all deaths in purebred dogs in the United Kingdom (Michell,1999). In Sweden, a study revealed that frequent mortalities from cancers were reported in Bernese mountain dog, Irish wolfhound, flat coated retriever, Golden retriever and Rottweilers

which accounted for up to 20% of all deaths in dogs in the period of the study (Bonnett *et al.*, 2005).

In Kenya however, there are no systematic research which have been carried out to determine the occurrence of the various cancers in dogs. However, a few studies have reported isolated cases of dogs affected with osteosarcoma predisposed by *spirocerca lupi* (Brodey *et al.*, 1977).

There is therefore a need to carry out a research that will determine the occurrence of the various types of cancers in dogs, their trends and describe their predilections with regards to age, sex and breeds.

## **1.1 Justification**

There has been considerable interest in canine neoplasm over the years. Studies have recommended comparative medical research in (dog) since it shares so intimately man's environment and is subject to the same kinds of neoplasm seen in man (Mulligan *et al.*, 1949); (Howard *et al.*, 1965); (Prier, *et al.*, 1969).

In Kenya however there are no systematic research which have been carried out to determine the occurrence of the various cancers in dogs. Thus there are no reliable tumor registries and records on prevalence of neoplasm in dogs in the country. However, a few isolated cases of neoplasm have been reported as coincidental finding in dogs (Brodey *et al.*, 1977; Wandera *et al.*, 1976).

There is therefore a need to carry out a research that will determine the occurrence of the various types of cancers in dogs, their trends and describe their predilections with regards to; age, sex and breed.

The purpose of this project therefore, was to determine the occurrence of neoplasm in dogs in Nairobi brought for post mortem at the university of Nairobi, department of veterinary pathology, microbiology and parasitology. The information from this study will be useful to clinicians and diagnosticians in their work.

## **1.2 Objectives and hypothesis**

### **1.2 Overall Objectives**

Generally the project intended to determine the occurrence of the various types of cancers that were reported in dogs, their trends and frequencies.

#### **1.21 Specific objectives**

- 1.0 To determine the occurrence of neoplasm in dogs brought for post mortem at the university of Nairobi, department of Veterinary pathology, microbiology and parasitology .
- 2.0 To determine the trend of occurrence of neoplasm cases in dogs brought for post mortem at the University of Nairobi, department of Veterinary pathology, microbiology and parasitology.
- 3.0 To determine the associated risk factors to neoplasm in dogs brought for post mortem at the University of Nairobi, department of Veterinary pathology, microbiology and parasitology.

### **1.3 Hypotheses**

- There are no neoplasm in dogs brought for post mortem at the university of Nairobi, department of veterinary pathology, microbiology and parasitology.
- Neoplasm of dogs have increased over the last 10 years (2004-2014).

## **Chapter 2;**

### **2.0 Literature Review**

#### **2.1 Definition and mechanism of development of neoplasm**

Cancer refers to abnormal growth of cells. This may make the cancer cells to differ from the normal cells in that they are no longer responsive to all or some of the normal growth-controlling mechanism. A further complication may be that some tumor cells may not grow at all after the cells have been transformed from the normal cells (Rollins *et al.*, 2000). According to another study, the expression of neoplasm depends on age, degree of cell differentiation, growing, invasion and metastatic potential (Baltic *et al.*, 2002).

Carcinogenesis is a multistage process with the earliest stages being initiation and promotion both of which require exogenous exposures to carcinogenic chemicals. Initiation is an irreversible phenomenon (mutagenic) resulting from DNA damage produced by a metabolically activated genotoxic carcinogen while promotion is epigenetic in nature and is often reversible and is responsible for induction of initiated cells to start dividing out of control (Yuspa *et al.*, 1998). Most neoplasm are solid masses. However, few like leukemia do not form solid masses (WHO, 1980). Tumors can be divided into benign tumors, in situ tumors and malignant tumors (Rollins *et al.*, 2000).

## **2.2 Causes of neoplasm in dogs and predisposing factors**

Cancer is a genetic disease caused by changes to genes that control the way the cells function, especially how they grow and divide (Gordon *et al.*, 1987). A study done by ( Hayes *et al.*, 1975) showed that genetic changes that cause cancer can be inherited from parents but can also be acquired during an individual's lifetime as a result of errors that occur as cells divide or from damage to DNA caused by certain environmental exposures.

A study by Bruce *et al.*, (1957), revealed that causes of cancers are complex; and that cancer risk is related to exposure to carcinogenic agents, environmental carcinogens and predisposing host factors. The study grouped the causes into intrinsic and extrinsic causes of cancers.

### **2.21. extrinsic causes of cancer in dogs**

Three general classes of extrinsic agents (physical, viral and chemical) were shown to be carcinogenic in the study (Bruce *et al.*, 1957).

### **2.22Physical agents**

Sunlight (Lunna, 1984), radiations (Roentgen, 1942) are the common physical agents causing neoplasm in dogs . Other radiation induced neoplasm includes myelogenous leukemias in swine and dogs (Dougherty *et al.*, 1967).

Prolonged and continuous exposure to sunlight also induce skin cancers (carcinoma) especially in non pigmented glabrous skin in domestic animals (Forbes *et al.*, 1981). Furthermore, carcinogenic effect of U.V irradiation on the skin in animals from sunlight may also act in concert with infectious agents to induce neoplasm ( Forbes *et al.*, 1981).

### **2.23 Viral causes of neoplasia dog**

Experiments have shown that Tumor viruses (RNA and DNA containing tumor viruses ) are able to transform cells in culture from normal into malignant-like phenotype and also shown these to be capable of inducing tumors when inoculated into experimental animals (Bruce *et al.*, 1987). Ellerman and Bang in 1908 showed in their work that erythromyeloblastic leukemia in chickens could be transmitted by a cell free filtrate. Canine oral papilloma virus was demonstrated in a study done by Demonbreun *et al.*, (1932).

### **2.24 Chemical causes of cancers**

A variety of carcinogenic chemicals of natural or anthropogenic origin are known to induce cancers. These include consumables like tobacco, food, drugs, and cosmetics in the environment or biological contaminants(Mohr *et al.*, 1978). Other studies reported that chemicals such as asbestos, nitrosamines, aflatoxin, N-nitrosodiethylamine, aramite, cigarette smoke, O-aminoazotoluene, 2-acetylaminofluorene, coal tars also cause cancers such as mesothelioma in dogs (Glickman *et al.*,1983); ( Mohr *et al.*,1978).

### **2.25 Bacterial and parasite-induced carcinogenesis**

A study done by (Wandera, 1976) showed that neoplasms can arise as a consequence of chronic parasitic infection. Even though the study did not reveal the mechanism by which long term infection results in tumors, it however, suggested that chronic inflammation and stimulation of cell proliferation may play a role . In the same study, Wandera reported sarcomas of the oesophagus in dogs with long term infection with *Spirocerca lupi*.

Another study also linked biliary carcinoma in dogs and cats to infection with liver flukes (Hou, 1964).

### **2.3 Intrinsic causes of cancer**

As noted by Bruce *et al.*,(1987), intrinsic causes of cancer are more difficult to clearly define and may be a mixture between extrinsic and intrinsic factors. Bruce generally classified them under the broad categories of diet, hormonal stimulations, genetic make-up and aging mechanism.

#### **2.31 Diet and cancer**

The dietary role in these processes is related to ingestion of substances(ones listed in the chemical causes) which are initiating as well as directly carcinogenic compounds and establishment of a condition that modulates organ susceptibility and response to causative factors (Gori *et al.*,1977). In domestic animals particularly, another study recognized diet as an important factor in chronic disease, and as a management method that may potentially improve the results of cancer therapy (Miller *et al.*, 1983).

### **2.32 Host factors and breed predilection**

A study conducted by Harnden *et al.*, (1984) established that in most cases only a small percentage of the population exposed to environmental influences will develop cancer and that the probability of an initiating event to cause cancer is not the same for all individuals exposed to the same environmental stimulus and also found that the probability of an initiating event progressing to frank neoplasm is not the same for all individuals. Other experimental studies have also shown that after an initiation event, progression to a fully developed tumor will depend on age, sex, hormone balance, immune status exposure to promoters and other factors (Harnden *et al.*,1984).

Studies have specified breed predilections to certain types of cancers such as thyroid carcinoma (Hayes *et al.*,1976), urinary bladder carcinoma and neoplasm of chemoreceptor system (Hayes, 1976), testicular tumor (Hayes *et al* 1976), skin tumor (Forbes *et al.*,1981) and melanoma (Priester *et al.*,1980) have suggested a role of inheritance influencing risk for those specific neoplasm.

### **2.33 Familial tendencies**

Studies have shown that certain neoplasm aggregate excessively in families. Several familial neoplasm in animals, including high risk for lymphoma in a family of bull mastiff dogs in Great Britain (Onions, 1984) and familial aggregation of osteosarcoma in St. Bernard dogs (Bech-Nielsen *et al.*, 1978) have been demonstrated.

### **2.34 Sex predisposition/hormonal stimulation**

Several studies have shown sex predisposition to certain types of cancers such as lipoma in females (Brodey, 1970); (Priester, 1973), canine perianal gland tumors in males (Nielsen *et al.*,1964). Mammary gland tumor and prostate tumor were however, shown to be sex dependent in the two studies. Other studies have also shown compelling evidence on the effect of ovariohysterectomy in dogs that the action of hormones can increase the risk of mammary carcinoma (Schneider *et al.*, 1969). Exogenous estrogen and progesterone have also been shown to have capacity to cause hyperplastic and neoplastic lesions (Jabara, 1962); (Giles *et al.*, 1978); (Selman *et al.*, 1997).

### **2.35 Age predisposition to cancers**

Study by (Miller, 1980) showed that age can predispose dogs to certain types of neoplasms with some seen in young dogs and most in old dogs. Studies have also shown that dogs under 2 years of age are prone to cancers like cutaneous histiocytoma (Mulvihill *et al.*,1978) and hemolymphatic neoplasms (Theilen *et al.*,1978).

### **2.36 Multiple primary tumors**

Studies by (Gates, 1932); (Burgher, 1934); (Fulmer *et al.*,1985) concluded that a patient with one malignant neoplasm was more likely to develop a second malignant neoplasm that could be expected by chance alone or may be influenced by immunosuppressive effect of prior or concurrent therapies, malnutrition, familial history of cancer, viral infections, environmental

factors and radiation. The occurrence of a benign neoplasm in dog has also been shown to indicate a parallel predisposition to malignancy (Bender *et al.*, 1982).

### **2.37 Cytologic classification of canine cancers and types of cancers**

Tumors can be classified into malignant tumors, in situ tumors and benign tumors (Rollins *et al.*, 2000). Malignant tumors can be classified cytologically into three broad categories namely discrete cell tumors, carcinomas and sarcomas as was highlighted by Rebar *et al.*, (1977).

Discrete cell tumors as Rebar described, arise from cells that can function independently of other cells and may be cells that are found as individual cells in tissues and examples include malignancies of leukocytes, mast cell tumors, melanoma, lymphoma, lymphosarcoma and transmissible venereal tumor in dogs (Hess, 1977).

Carcinomas have cells that exfoliate in large numbers and the cells are frequently found in large groups as were described by Griffiths *et al.*, (1982). Their cells are round to oval, nucleus is usually eccentrically placed and the boundaries between cells are often not distinct. Examples of carcinomas includes mammary adenocarcinomas, pancreatic adenocarcinomas, gastric adenocarcinomas, salivary adenocarcinomas, prostatic adenocarcinomas, squamous cell carcinoma (oral and dermal), thyroid adenoma and adenocarcinoma, perianal gland adenoma and adenocarcinoma (O' Rourke *et al.*, 1980).

Most sarcomas as were described by (Rebar, 1977) cytologically appear as individual cells which are more or less spindle shaped. Another study also stated that aspirates of sarcomas and impression smears yielded few cells and as such, the necessity to scrape the tissue in order to

obtain adequate number of cells for examination was well elaborated (O'Rourke, 1983). Examples of these tumors are fibrosarcoma, liposarcoma, lymphangiosarcoma, fibroma, leiomyosarcoma, rhabdomyosarcomas, chondrosarcomas , hemangiosarcoma, myxosarcoma and osteosarcomas, histiocytic sarcoma.

In situ tumors usually develop in epithelium and are usually but not invariably small. The cells have the morphological appearance of cancer cells but remain in the epithelial layer but they do not invade the basement membrane and the supporting mesenchyme. On the other hand, benign tumors may arise in any tissue, grow locally and cause damage by local pressure or obstruction but are not spread to distant sites (Rollins *et al.*, 2000).

### **2.38 Classification of cancers using TNM-system**

Tumors can also be classified using the TNM-system of the WHO which is based on the assessment of; the extent of the primary tumor (T), the condition of the regional lymph nodes (N) and the absence or presence metastases (M) as was described by (Owen, 1980).

## **Chapter 3;**

### **3.0 Materials and methods**

This was a retrospective study based survey of post-mortem records with clinical and histopathological diagnosis of cancer available in the archives of the department of pathology, microbiology and parasitology, University of Nairobi. The data was collected from the database of the department of pathology of cancer diagnosis which were reported in dogs at necropsy with a histopathologically confirmed diagnosis of cancers in the period between January 1<sup>st</sup>, 2004 and December 31<sup>st</sup>, 2014. The post mortem reports of the patients were reviewed to determine the cancer classification, prevalence and frequencies.

#### **3.1 Data analysis**

The data was coded and entered in Microsoft excel 2007. Descriptive statistics including mean and frequencies was used to determine the prevalence of neoplasm in dogs, trend of their occurrence and predisposing factors with regards to age, breed and sex. The data was then presented using frequency tables and graphs to show the trends.

## Chapter 4;

### 4.0 RESULTS

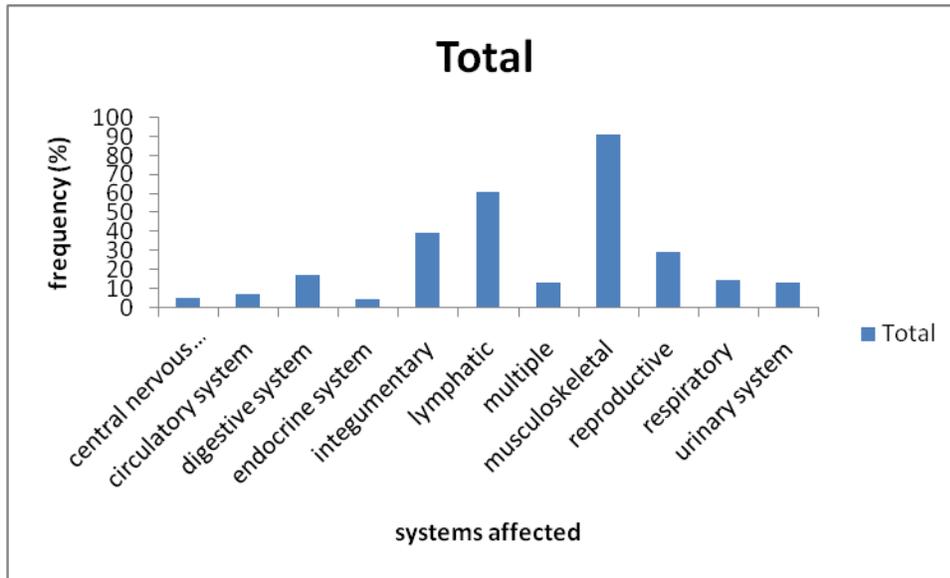
Several dogs were reported with neoplasm in the period 2004 to 2014. Out of 1802 cases of dogs that were brought for post mortem in this period, 293 (16%) cases were reported with neoplasm. Some breeds were reported with higher numbers of neoplasm compared to others. The cross breeds 86 (29%), German shepherds 84(28.7) and Rottweilers (23) reported the highest number of neoplasm with Greyhound and Collies reporting the least as shown in table 1.

**Table 1; Frequencies of neoplasm reported in different breeds of dogs between 2004 and 2014.**

Row Labels	Count of neoplasm
Alsatian	5
Boerboel	2
Boxer	3
Collie	1
Cross	86
Dachshund	8
Doberman	4
Great Dane	3
Greyhound	1
GSD	84
Japanese spitz	8
Labrador	20
Local	4
Machli	1
Mastiff	2
Pekingese	1
Retriever	1
Ridgeback	14
Rottweiler	23
Spaniel	8
St. Bernard	1
Terrier	12
Weimeraner	1
<b>Grand Total</b>	<b>293</b>

#### 4.1. Body systems affected by neoplasm

Body systems reported different frequencies of neoplasm with the musculoskeletal and lymphatic systems reporting the highest frequencies of 91 and 61 respectively. The endocrine system was the least affected reporting only 4 cases as shown in the figure 1.



**Figure 1: Frequencies of neoplasm reported in different body systems in dogs between 2004 and 2014.**

#### 4.2 Types of neoplasm reported in dogs

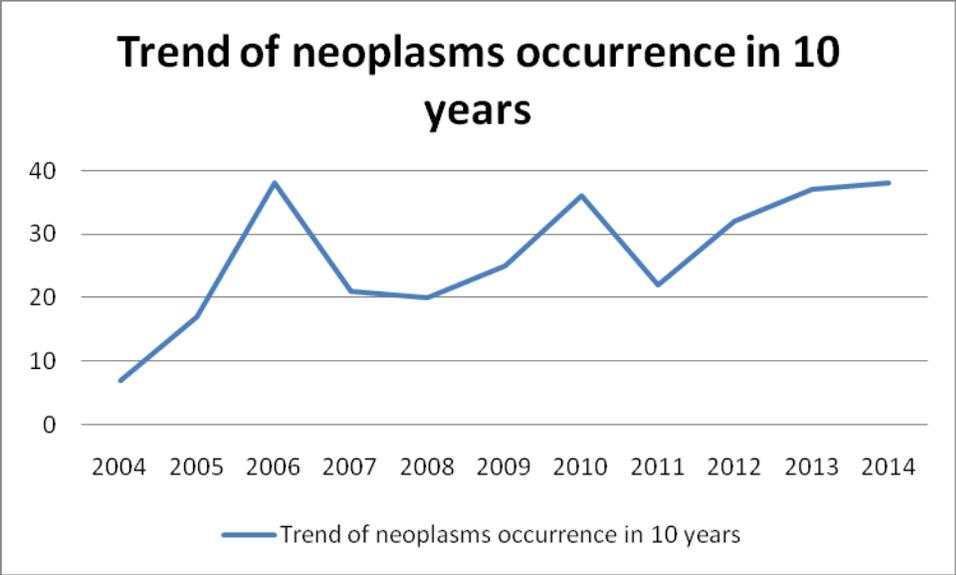
Osteosarcoma(45) and lymphosarcoma (36) were the most frequently reported neoplasm with liposarcoma and heart tumors being the least reported with only 2 cases of each reported over the study period as shown table 2.

**Table 2; Types of neoplasms that were reported in dogs between 2004 and 2014**

<b>Row Labels</b>	<b>Count of neoplasm</b>
brain tumor	5
Chondrosarcoma	6
Fibrosarcoma	12
heart tumor	2
Hemangiosarcoma	22
hepatocellular tumor	16
Histiosarcoma	3
kidney tumor	13
Leiomyosarcoma	5
Leukemia	3
Liposarcoma	10
Lymphosarcoma	38
mammary gland tumor	21
mast cell tumor	3
mixed multiple tumor	14
nasal carcinoma	3
Osteosarcoma	48
pancreatic tumor	1
perianal adenoma	2
prostatic adenocarcinoma	14
pulmonary adenocarcinoma	16
Rhabdomyosarcoma	7
sertoli cell tumors	1
skin tumor	9
squamous cell carcinoma	4
thyroid gland tumor	3
transmissible venereal tumor	12
<b>Grand Total</b>	<b>293</b>

#### 4.3 Neoplasm reported annually

There was a general increase in the number of neoplasm reported over the 10 year period and this was even better depicted with the steady rise in number of neoplasm reported between 2011 and 2014 as shown in the line graph (figure 2)



**Figure 2;frequencies of neoplasm reported annually in dogs between 2004 and 2014**

**4.4 Frequencies of neoplasm reported according to age between the year 2004 and 2014**

Most neoplasm were reported in more than 5years old and only few cases reported in those more than 12years old as shown in table 3 below. The unspecified adults group reported the highest number of neoplasm (160) followed by 5-10 years age group (66) and 15-20 age group reported only a single case.

<u>Age groups</u>	<u>Number reported</u>	<u>Percentage %</u>
0.0-5.0	37	12.6
5.1-10.0	66	22.5
10.1-15.o	29	9.9
15.1-20.0	1	0.3
Unspecified adults	160	54.6

**Table 3 Prevalence of neoplasm occurrence with according to age between the period 2004 and 2014.**

## Chapter 5

### 5.0 Discussion

The cross breeds reported the highest number of tumors (86) followed by German Shepherds (84), Rotweillers (23), Labrador (20), Ridgeback (14) and Terrier (12). The high number of neoplasm in the cross breed and German Shepherds may be attributed to the fact that a higher number of the two breeds were brought to the department for post mortem than any other breed and probably because they are the most kept dog breeds in Nairobi (Wandera, 1976).

Body systems reported different frequencies of neoplasm with the musculoskeletal and lymphatic systems reporting the highest frequencies of 91 and 61 respectively. The endocrine system was the least affected reporting only 4 cases. This was contrary to the results got by Gordon *et al.*, (1987) which revealed that lymphatic system is the most commonly affected system by neoplasm with lymphoma and lymphosarcoma representing 20% of all canine tumors.

More males (166) were reported with neoplasm than females (127) representing 57% and 43% respectively and this most probably occurred by chance as more males were brought for post mortem than females and not necessarily because males have higher risk of developing neoplasm relative to females. This was in line with studies done by Cohen *et al.*, (1974) and Schneider, (1976) to determine comparable variations in domestic animals of female versus male rates for specific tumors which did not show any significant difference in the rates and this was seen as a reflection of similarity of environmental exposures of both sexes in animals. However, sex

predisposition of males to perianal gland tumor and females to lipoma (and liposarcomas) came out clearly in the study as has been reported in other studies (Brodey, 1970;Priester, 1973).

In the period of this study (2004-2014), osteosarcoma (45) was the most frequently reported neoplasm in dogs that were brought for post mortem followed by lymphosarcoma (36) contrary to results got by Gordon *et al.*, (1987) in his study. Liposarcoma and heart tumors were the least reported neoplasm with 2 cases of each reported.

The high number of osteosarcoma reported may be attributed to the fact that it is mostly a neoplasm of large breed dogs (Hayes, 1976), and these large breeds constituted the highest proportion of dogs brought for post mortem. Furthermore, most of these large breed dogs received for post mortem were security dogs and frequent movements associated with them can predispose them to bone cancers.

Generally, there was an increase in number of neoplasm reported over the 10 year period. Even well elaborated was the steady rise in number of neoplasm reported between the year 2011 and 2014.

This may have been contributed to not necessarily by increase in incidence of neoplasm over the years but probably by rising awareness and interest of animal owners in knowing what killed their animals, their ability and willingness to pay for post mortem services and longevity of animals due to improved standards of living over the period of the study as was suggested by Wandera, (1976).

Most neoplasm were reported in dogs in the unspecified adults age group, followed by 5-10 years age group and only a single case reported in 15-20 years age group. It is important to note that specific ages for most of the dogs reported with neoplasm between 2004 and 2014 were not entered in the data base of the department where they were only put as 'adults'. I assumed 'adult' in this case was taken to mean 1 year and above after the dogs have attained puberty. Generally, more than 5years old reported the highest number of neoplasm and only few cases were reported in those more than 12years old which this was in agreement with a study done by Miller, (1980).The study did not establish the factors responsible for the decrease in number of neoplasm reported in more than 12 year olds. As to whether the decline was due to the possibility that only few dogs especially the large breeds attain this age before they die or most are euthanized at earlier age once diagnosed with neoplasm was not determined in this study and can only be given as suggestions.

## 5.1 Conclusions

**I would like to make the following conclusions, that;-**

1. A higher proportion of neoplasm are reported in cross breeds followed by German shepherds and Rottweilers. Least proportion is reported in collies of the dogs brought for necropsy at the university of Nairobi.
2. The musculoskeletal system and lymphatic system are the most commonly affected systems with neoplasm with endocrine system being the least affected.
3. Osteosarcoma is the most frequently reported tumor followed by lymphosarcoma in Nairobi area. Liposarcoma and heart neoplasm are the least reported.
4. The number of neoplasm reported in dogs has generally increased over the years with a steady increase between the year 2011 and 2014.
5. Neoplasm are mostly reported in dogs more than 5 years and less than 12 years old in Nairobi area.

## 5.2 Recommendations

I hereby make the following recommendations:-

- That the department of pathology, microbiology and parasitology improves the quality of its data base as in the course of this project, I established that most of the dog breeds were simply registered as “crosses” without indicating of which breeds. Most age entries were simply made as “adults” and in some cases the sex was not indicated which made it difficult to get comprehensive data from the department for research purposes. The department should improve in this area.
- That when a sample has been taken to the histopathology laboratory for confirmatory tests, they should be clearly labeled with the pathology case numbers to ease marching of the two results when carrying out research. This I realized had not been done in some cases.
- That further studies be done to determine the population of the different breeds of dogs in Nairobi area and also establish if the large dog breeds are at high risk of getting neoplasm relative to the small breeds.

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