



**UNIVERSITI PUTRA MALAYSIA**

**DISEASE PREVALENCE AND ASSOCIATED PATHOLOGICAL  
CHANGES IN SMALL ANIMLAS PRESENTED TO POST MORTEM  
LABORATORY, FACULTY OF VETERINARY MEDICINE, UPM FROM  
THE YEAR 2005 TO 2015**

**RATHIYMALER MANIAM**

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SMALL ANIMLAS PRESENTED TO POST MORTEM LABORATORY,  
FACULTY OF VETERINARY MEDICINE, UPM FROM THE YEAR 2005 TO  
2015**

**RATHIYMALER MANIAM**

A project paper submitted to the

Faculty of Veterinary Medicine, Universiti Putra Malaysia

in partial fulfillment of the requirement for the

**DEGREE OF VETERINARY MEDICINE**

Universiti Putra Malaysia

Serdang, Selangor Darul Ehsan

**MARCH 2016**

## CERTIFICATION

It is hereby certified that we have read this project paper entitled “Disease Prevalence and Associated Pathological Changes in Small Animals presented to Post Mortem Laboratory, Faculty Of Veterinary Medicine, UPM from the year 2005 to 2015”, by Rathiymaler Maniam and in our opinion it is satisfactory in terms of scope, quality, and presentation as partial fulfillment of the requirement for the course VPD 4999 – Project.

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**DEDICATIONS**

**GOD**

**MY FAMILY**

Father, Maniam Krishnan

Mother, Saroja Devi Mariappan

Brothers, Suriendran Maniam and

Sasiendren Maniam

**LECTURERS AND STAFF**

All lecturers and staff of Faculty of Veterinary Medicine,

University Putra Malaysia

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## LIST OF ABBREVIATION

CD= Canine Distemper

MGT = Mammary Gland Tumor

CPV= Canine Parvoviral Infection

MCT= Mast Cell Tumor

CLUTD= Canine Lower Urinary Tract Disease

FIP= Feline Infectious Peritonitis

FPL= Feline Panleukopenia

SCC= Squamous Cell Carcinoma

FURD= Feline Upper Respiratory Disease

FLUTD= Feline Lower Urinary Tract Disease

TCC= Transitional Cell Carcinoma

HRS= High Rise Syndrome

RTA= Road Traffic Accidents

GIT= Gastrointestinal tract

PM= Post mortem

**ABSTRAK**

Abstrak daripada kertas projek yang dikemukakan kepada Fakulti Perubatan Veterinar untuk memenuhi sebahagian daripada keperluan kursus VPD 4999 – Projek

**KAJIAN BEKENAAN KADAR PREVALENS PENYAKIT DAN PERUBAHAN  
PATHOLOGI DI KALANGAN KUCING DAN ANJING YANG  
DIKEMUKAKAN KE MAKMAL NEKROPSI FAKULTI PERUBATAN  
VETERINAR, UPM DARI TAHUN 2005 HINGGA 2015**

**Oleh**

**Rathiymler Maniam**

**2016**

**Penyelia : Prof. Dr. Zamri Saad**

**Penyelia Bersama: Dr. Annas Salleh**

Nekropsi adalah pemeriksaan atau pembedahan yang dilaksanakan ke atas bangkai haiwan untuk menentukan punca kematian. Punca kematian boleh ditentukan dengan menganalisis lesi matakasar, perubahan histopatologi dan hasil ujian makmal. bantuan Sejak kebelakangan ini, perliharaan haiwan kesayangan meningkat di kalangan para masyarakat Malaysia menyebabkan punca kematian haiwan kesayangan menjadi satu

aspek penting. Kajian berbalik ini melibatkan penganalisan data kes kucing dan anjing yang dikemukakan ke Makmal Nekropsi FPV, UPM untuk mencari penyakit yang kerap berlaku di kalangan anjing dan kucing disamping mengenal-pasti perubahan patologi yang berkaitan. Sebanyak 35 jenis penyakit anjing yang telah didiagnosis dan septisemia (10.2%), kanser kelenjar mamar (8.4%) dan distemper kanin (7.9%) [ $X^2$  (34 N=726) = 513.552,  $p < 0.001$ )] merupakan tiga penyakit yang paling kerap berlaku. Manakala, dikalangan kucing 27 jenis penyakit telah dikenalpasti dan penyakit yang paling kerap merupakan kecederaan trauma (19.5%), peritonitis berjangkit felin (15.1%) dan sporotrikosis (12%) [ $X^2$  (26 N=726) = 1568,  $p < 0.001$ ]]. Kajian juga menunjukkan bahawa setiap satu penyakit mempunyai perubahan patologi yang spesifik.

Kata Kunci: Perubahan nekropsi, penganalisan data, anjing, kucing, masalah kesihatan.

## ABSTRACT

An abstract of the project paper presented to the Faculty of Veterinary Medicine, UPM  
in partial requirement for the course of VPD 4999- Project

**DISEASE PREVALENCE AND ASSOCIATED PATHOLOGICAL CHANGES IN  
SMALL ANIMLAS PRESENTED TO POST MORTEM LABORATORY,  
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2015**

**By**

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**2016**

**Supervisor: Prof. Dr. Mohd. Zamri Saad**

**Co-supervisor: Dr. Annas Salleh**

Post mortem or necropsy is an autopsy on an animal to find its cause of death whenever it's possible. The cause of death can be determined using the gross lesions, histopathological changes and laboratory results. Gross changes are the abnormalities observed during post mortem while histopathology involves the abnormal changes in the tissues observed under the microscope. Since keeping pet has become a growing trend among Malaysians, indentifying the common problems leading to death of their furry

companion becomes a necessity. This retrospective study was conducted by analyzing data on cases among the small animals which includes cats and dogs presented to Post Mortem Laboratory, Faculty of Veterinary Medicine, UPM to find the most common diseases and to describe the respective lesion associated with the disease. There were a total of 37 diseases diagnosed among dogs. However, the most common diseases among dogs were septicemia (10.2%), mammary gland tumor (8.4%) and Canine Distemper (7.9%) [ $X^2$  (34 N=726) = 513.552,  $p < 0.001$ ]. In cats, a total of 27 diseases were diagnosed but the most common one were traumatic injuries (19.5%), Feline Infectious Peritonitis (15.1%) and Sporotrichosis (12%) [ $X^2$  (26 N=726) = 1568,  $p < 0.001$ ]. Each of the diseases has their specific gross pathology and histopathological lesion which are discussed below.

Keywords: Post mortem changes, analyzing records, cats, dogs, health problems.

## 1.0 INTRODUCTION

Post Mortem or necropsy is an examination done of the dead body of an animal to determine the cause of death whenever it's possible (Philips, 2014). Thus, post mortem is an examination done after death is extremely valuable because it provides an opportunity to examine everything, both inside and outside (Stahl, 2014). A necropsy is normally categorized into two sections, the gross pathology examination where the body of the animal is visually observed and manually examined during post mortem procedure. Meanwhile, the histopathology section involves examination of the affected organs or tissues under a microscope (Yousha, 2005). To determine the cause of death, both the gross and histopathological lesions together with the associated laboratory results and a complete medical history are required. However, not all necropsies will result in a confirmatory diagnosis but it may rule out certain differential diagnosis.

The Post Mortem Laboratory of Faculty of Veterinary Medicine, UPM was established in 1972 with major functions in providing services in post mortem examinations, biopsies, carcass disposal, tissues and organs fixation. This laboratory receives cases from all over Malaysia which includes the University Veterinary Hospitals, pet owners, zoos and any animal associated organizations.

This retrospective study revolves on the results of post mortem examination on the pet animals, particularly dogs and cats. Keeping pets such as dogs, cats, fish, reptiles and birds has become a growing trend around the world including Malaysia (Brough, 2014). Furthermore, according to the American Pet Products Association (APPA) most recent study, in the 2013-2014 APPA National Pet Owners Survey, it was estimates that 82.5

million or 68 percent of American households keep pets. Therefore, highlighting the cause of death of pet animals has become a necessity. On the other hand, identifying the common health problems can assist in preventive measure in the future (Center for Disease Control and Prevention, 2009).

There are limited studies conducted to identify the common health problems and their associated pathological changes among the small animals. Therefore, this study was designed to identify the common health problems based on pathological examinations among the local dogs and cats presented to Post Mortem Laboratory of Faculty of Veterinary Medicine. This study also describes the pathological changes associated with the common health problems observed in the cats and dogs for better understanding on health problems faced by the pets in Malaysia.

## 2.0 LITERATURE REVIEW

### 2.1 Post Mortem Study

There have been many studies that investigate the prevalence of diseases based on post mortem examinations. However, most of these studies were focused on specific diseases. Kagira and Kanyari, (2000) stated that disease prevalence study helps to enhance public health control measure and encourage veterinarians to do the preliminary diagnosis. Okusanya *et al.*, (2014) studied prevalence of pneumonia in dogs following post mortem examination while Watson *et al.*, (2010) focused on hepatic lesion in dogs using post mortem examinations. The prevalence of gastrointestinal disorder in veal calves has been carried out (Brscic *et al.*, 2011). These studies identified specific diseases among the animals presented to post mortem laboratory.

### 2.2 Septicemia

Septicemia is a condition where there is persistent presence of bacterial infection in the bloodstream that spread throughout the body leading to multiple organ failure and septic shock (Hoskins, 2008). Lamm *et al.*, 2010 did a retrospective study on *Streptococcus* infection in dogs and found that streptococcal septicemia is an important cause of abortion and neonatal death among dogs. Nevertheless, the clinical symptoms are more severe in cases involving Gram negative organism as they produces endotoxins and most of septicemia cases (Stearns-Kurosawa *et al.*, 2011). Furthermore, most septicemia cases originate from gastrointestinal tract where *E.coli* predominates. Septicemia causes decrease in blood pressure leading to vasodilatation and blood pooling in multiple organs, thus

causing reduce of blood circulation output and eventually causing septic shock and death (Koenig, 2011).

### **2.3 Mammary Gland Tumor**

Mammary gland tumor (MGT) is the highest tumor incidence in bitches and exhibiting commonly a malignant type (Brigette *et al.*, 2012). A study done in Ryan Veterinary Hospitals of University of Pennsylvania revealed that breeds, which are in risk for MGT includes toy and miniature Poodles, Spaniels and German Shepherds. Another study concludes that intact female dogs are 25% more risk than spayed bitches (Rutteman, 2011). The average age of dogs getting MGT is at 10.87 years (Brigette *et al.*, 2012) while the incidence of MGT increases slowly at the age of 4 years old and increase tremendously between 6 and 10 years old of age (Rutteman, 2011).

World Health Organization has classified MGT according to histological. The grading system is further used for prognosis and treatment purpose (Goldschmidt *et al.*, 2011). As gross lesion does not provide definitive diagnosis, thus histology examination may provide useful information (Rutteman, 2011). The classification mainly involves the malignant type, benign type and the dysplasia category. Most affected gland is the inguinal mammary and caudal abdominal mammary glands (Brigette *et al.*, 2012) with 25-50% of malignant tumor show lung metastasis due to its high growing capacity with invasive characteristics (Lockett, 2005). The most commonly occurring MGT is the malignant carcinoma thus all mammary gland masses remove surgically and sent for biopsy for identifications (Lockett, 2005; Brigette *et al.*, 2012).

## **2.4 Canine Distemper**

Canine Distemper is disease cause by mobilivirus, a single stranded RNA virus. This virus is shed in respiratory exudates, saliva, urine and conjunctival secretions (Lappin, 1997), affecting dogs and other carnivores worldwide for centuries (Amude et al., 2010). It remains as an important viral disease in dogs as it leads to highest fatality rate besides rabies.

Chung et al., 2011 reported that the common pathological findings in canine distemper are lymphoid depletion in lymphoid tissues, interstitial pneumonia, degenerative changes in epithelia or respiratory organs, urinary bladder and gastrointestinal tract as well as intracytoplasmic or intranuclear eosinophilic inclusion bodies in these epithelial cells.

## **2.6 Feline Infectious Peritonitis**

Foley et al., 1997 stated that feline infectious peritonitis (FIP) is caused by mutation of feline coronavirus (FCoV) an enveloped, positive stranded RNA virus. Normally, FCoV is associated with FIP and feline enteric corona virus (FECV), an infection that leads to self-limiting fever with gastrointestinal sign of diseases. On the other hand, FIP shows more of polysystemic signs (Lappin, 1997).

According to Carlson and Macintire, (2006), most infected cats with FCoV are exposed to the virus as kittens. Since there is no treatment for FIP, thus prevention measure should be taken (Barker and Tasker, 2014). Kittens in contact with adult cats other than their mothers have higher risk of developing FIP (Lappin, 1997). The virus has the ability to infect monocytes resulting in viremia and spread the infection throughout the body.

Younger cats frequently develop effusive FIP as they have poor cellular immunity (Pedersen, 2013).

Reverse transcriptase (RT) - Polymerase chain reaction (PCR) can be used to identify RNA of FCoV and is useful as diagnostic tool although normally the protein level of the effusion tells us that the cat highly infected with FIP (Baker and Tasker, 2014).

## 2.7 Sporotrichosis

Sporotrichosis is a fungal disease that occurs worldwide. It is caused by *Sporothrix schenckii*, the organism that has two unique phases that maintain high rate of the diseases. First, this fungus has the ability to change its phase to ascomycete teleomorph where it can survive in both living and decaying plant material. Secondly, once this fungus enters the blood stream of the host, it changes to yeast form thus accomplishing a systemic involvement in the host body (Welsh, 2003). The budding of the yeast cause unhealing of the wound as the yeast is present on the skin.

The multiple skin lesions in *Sporothrix*-infected cats can occur because of self-trauma, grooming and hematogenous dissemination of the spores from the lungs or perhaps from the initial skin lesion (Barros *et al*, 2011).

## 3.0 MATERIALS AND METHODS

### **3.1 Data Collection**

Case records at the Post Mortem Laboratory, Faculty of Veterinary Medicine, University Putra Malaysia between 2005 and 2015 were selected. These include the records of necropsy, biopsy and disposal. From these, only records on small animals particularly dogs and cats were selected to further identify and analyse the common health problems.

Cases without a confirmatory diagnosis were classified as miscellaneous. Details on each cases such as identity, age, history, clinical health history that lead to death, the gross lesion, histological changes and associated laboratory results were recorded using Microsoft Excel version 2007. Within the study period, there were a total of 762 cases on dogs and 866 cases on involving cats that were selected and analysed.

### **3.2 Data Analyzing**

The transferred records from Microsoft Excel were furthered transferred to Statistical Packages for the Social Sciences (SPSS) version 22. Pearson Chi-Square test was used to determine the occurrence rate of all the diseases and to identify significance of prevalence between the three most common diseases compared to the rest diseases among both dogs and cats. Chi-square is a statistical test that tests for the existence of a relationship between two variables (Garczynski, 2007). Chi-square is also suitable for non-parametric data or nominal data when only frequencies or numbers of data without the mean or scores were available (Nova Southeastern University, 2004). This test was done at 95% confidence intervals level.

### **3.3 Histopathology**

#### **3.3.1 Paraffin Block Selection**

Once the three most common diseases in dogs and cats were identified, three representative cases for each of the three common diseases of dogs and three common diseases of cats were randomly selected before their paraffin blocks were collected from Histopathology Laboratory storage area.

#### **3.3.2 Tissue Sectioning**

The selected paraffin blocks were inserted into the microtome and were sectioned 4 µm using microtome (Reichert-Jung 2045 Multicut Rotary Microtome, Canada). The tissue section of the samples were then placed on warm water bath at 42<sup>0</sup>C before they were fished onto the glass slides and left to be air dried overnight.

#### **3.3.3 Tissue Staining and Mounting**

Harris' Haematoxylin and Eosin (H&E) staining procedure was used in this study. First the slide were submerged into Xylene for 5 minutes, followed by 100% alcohol for 5 minutes and then in 70% alcohol for 5 minutes. The slides were rinse using tap water. Next, the slides were submerged into Haematoxylin solution for 5 minutes and then rinsed for 3-5 times before they were dipped into 1% acid alcohol for 3 seconds. The slides were rinsed under the running tap water for 5 minutes then submerged in Eosin for 1 minute. Next the slides were sprayed with 95% alcohol then rinse in running tap water for 5-10 seconds. The slides were sprayed with 95% alcohol, cleaned using gauze and air dried. Finally, the slides were dipped in xylene for three times and mounted with Distryene Plasticizer Xylene (DPX)

mounting medium to preserve the H&E stain. This procedure was performed in fume hood.

The glass slides that have been mounted with DPX were left overnight to dry.

### **3.3.4 Histopathology Slides Examination**

The dried histology slides were then ready for viewing. It was observed using Olympus CX31 upright microscope attached with Olympus U-CAM3 and Hpx2301 monitor. The associated histopathological changes were identified for each disease. On the other hand, the gross lesions were noted following analyses of records.

## **4.0 RESULTS**

### **4.1 Common Diseases among Dogs**

There were 762 dog cases between 2005 and 2015 while 35 common health problems were identified. The 35 common health problems were septicemia, mammary gland tumor, canine distemper, squamous cell carcinoma, hemangioma, trauma, lipoma, mast cell tumor, poisoning, fibroma, canine parvoviral infection, lymphosarcoma, osteosarcoma, pneumonia, basal cell tumor, sebaceous gland tumor, dermatitis, melanoma, hip dysplasia, infectious canine hepatitis, canine lower urinary tract disease, lymphoma, liver failure, renal failure, sertoli cell tumor, seminoma, cystic endometrial hyperplasia, pyometra, congestive heart failure, dirofilariasis, heat stroke, multiple organ failure, erlichiosis, otitis externa, and leptospirosis. The total number of cases for each disease is shown in Table 4.1.

The most common health problems among presented to Post mortem Laboratory between 2005 and 2015 were septicemia with (10.2 %), mammary gland tumor (8.4%) and canine distemper infection of (7.9%). The three most common diseases of dogs were significantly ( $p < 0.001$ ) more frequently diagnosed than the remaining 32 diseases. Figure 4.1 shows the prevalence of the 35 diseases among dogs presented to Post mortem laboratory, FPV, UPM.

<b>Num.</b>	<b>Disease type</b>	<b>Total number of cases</b>
<b>1</b>	Septicemia	78
<b>2</b>	Mammary gland tumor	64

3	Canine Distemper	60
4	Squamous cell carcinoma	52
5	Hemangiosarcoma/Hemangioma	36
6	Trauma	34
7	Lipoma	29
8	Mast cell tumor	29
9	Poisoning	27
10	Fibroma/Fibrosarcoma	26
11	Canine parvoviral infection	25
12	Lymphosarcoma	24
13	Osteosarcoma	24
14	Pneumonia	22
15	Basal cell tumor	21
16	Sebaceous gland tumor	21
17	Dermatitis	19
18	Melanoma	17
19	Hip dysplasia	17
20	Infectious canine hepatitis	14
21	Canine lower urinary tract disease	13
22	Lymphoma	12
23	Liver failure	12
24	Seminoma	12
25	Cystic endometrial hyperplasia	11
26	Renal failure	11
27	Sertoli cell tumor	11
28	Pyometra	8
29	Congestive heart failure	8
30	Dirofilariasis	6
31	Heat stress/Heat stroke	6
32	Multiple organ failure	4
33	Erlichiosis	3
34	Otitis externa	3
35	Leptospirosis	3
<b>Total</b>		<b>762</b>

Table 4.1: The list of health problems and total number of cases for each health problem observed among dogs presented to the Post mortem Laboratory, FPV, UPM between 2005 and 2015.

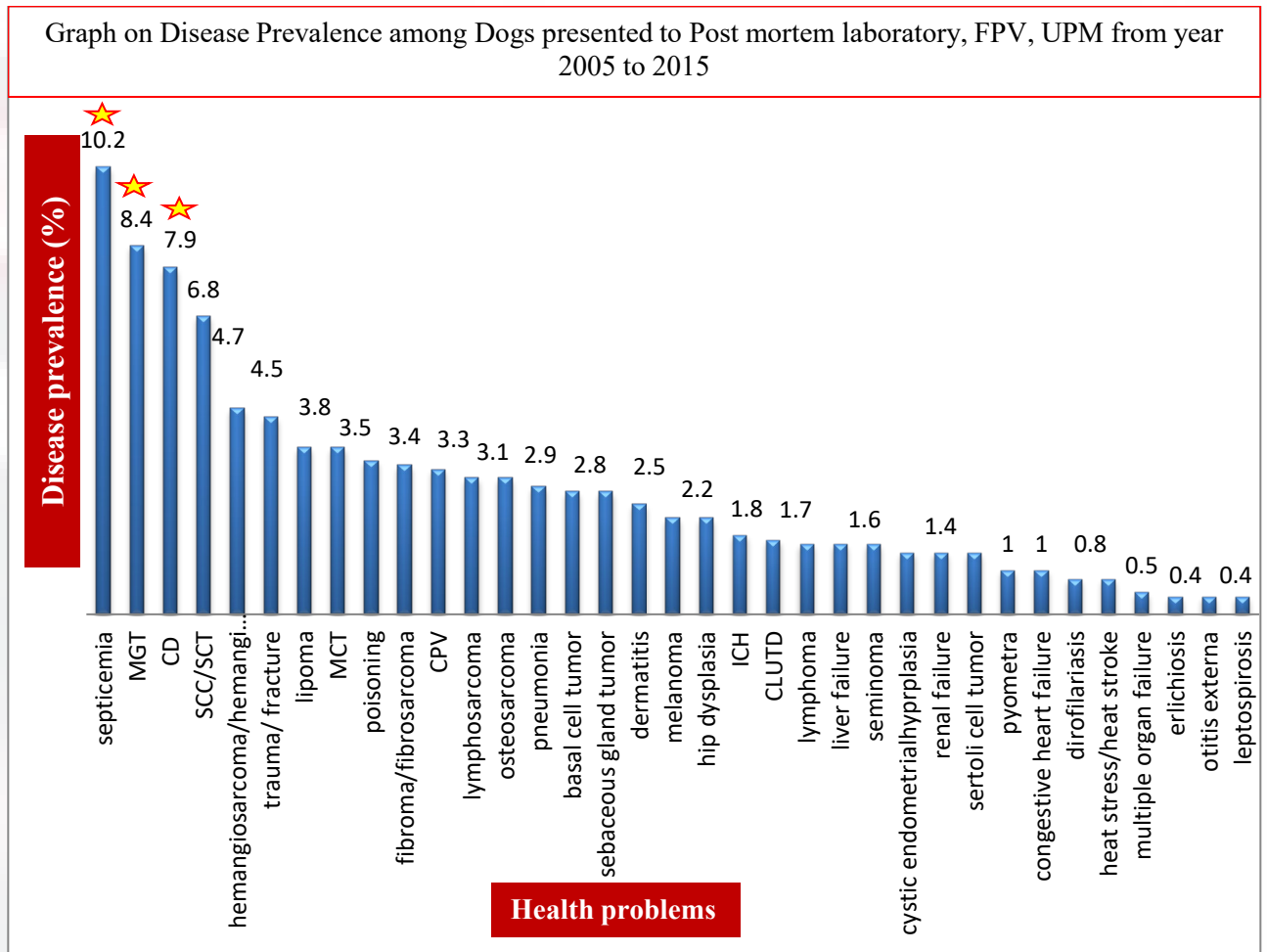


Figure 4.1: Prevalence of disease and health problems among dogs presented to the Post mortem laboratory, FPV, UPM between 2005 and 2015. ★ Chi-square test,  $X^2(34, N=762) = 513.552$ ,  $p < 0.001$ .

#### 4.1.1 Septicemia

Septicemia was the most common problem among dogs (10.2%). When further classified according to the causative agent, it was revealed that Gram-negative bacteria were the most common cause of septicemia (66%) followed by a mixture of Gram-positive and Gram-negative (15%) while Gram-positive bacteria were involved in only 1% of septicemia cases

of dogs (Table 4.2). The involvement of Gram-negative bacteria in septicemia was significantly ( $p < 0.001$ ) higher than other types of bacteria (Figure 4.2).

Septicemia Classification	Total number of cases
Gram negative	51
Gram positive	1
Mixed	12
Unclassified	14
<b>Total</b>	<b>78</b>

Table 4.2: Total cases of septicemia according to the type of bacterial agent that causes septicemia.

Chi-square test shows that gram negative bacteria causes septicemia significantly higher than other type of bacteria group classification ( $p < 0.001$ ). Figure 4.2 shows the pie chart on percentage of each bacterial category causing septicemia.

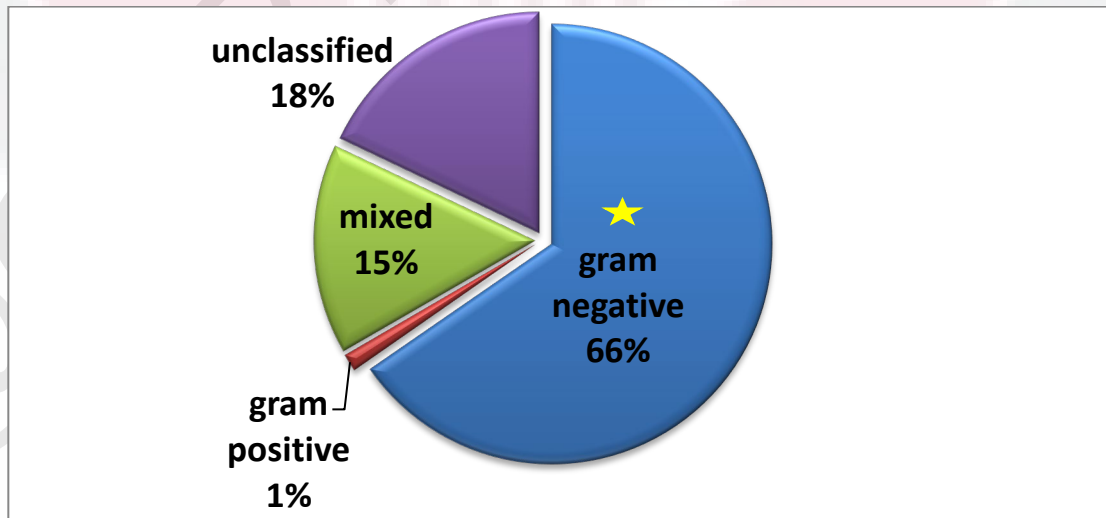


Figure 4.2: Pie chart on percentage of each bacterial category causing septicemia. ★  
Chi – square test  $X^2(3, N=78) = 97.1, p < 0.001$

The most common gross lesion that was observed in cases of septicemia was the congestion of multiple organs which include spleen (Fig.4.3), liver (Fig.4.4), lungs (Fig 4.5), kidney and gastrointestinal tract (Figs. 4.6 and Fig. 4.7). Besides, lesion such as hemorrhagic spleen and hemorrhagic serosal and mucosal layer of small intestines with inflammatory cell infiltration were also reported.

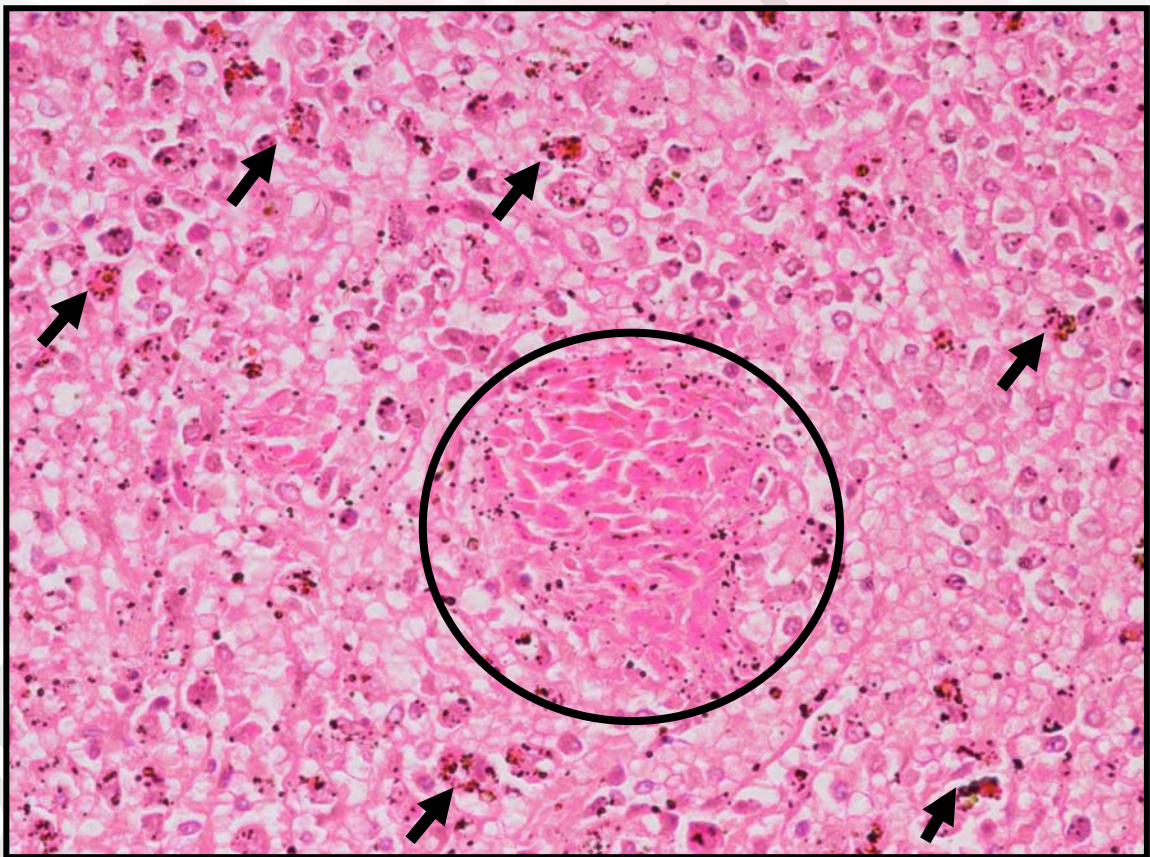


Figure 4.3: Histopathological of spleen showing congestion (circle) with presence of hemosiderin (arrow) indicating hemorrhages in the spleen. HE x100

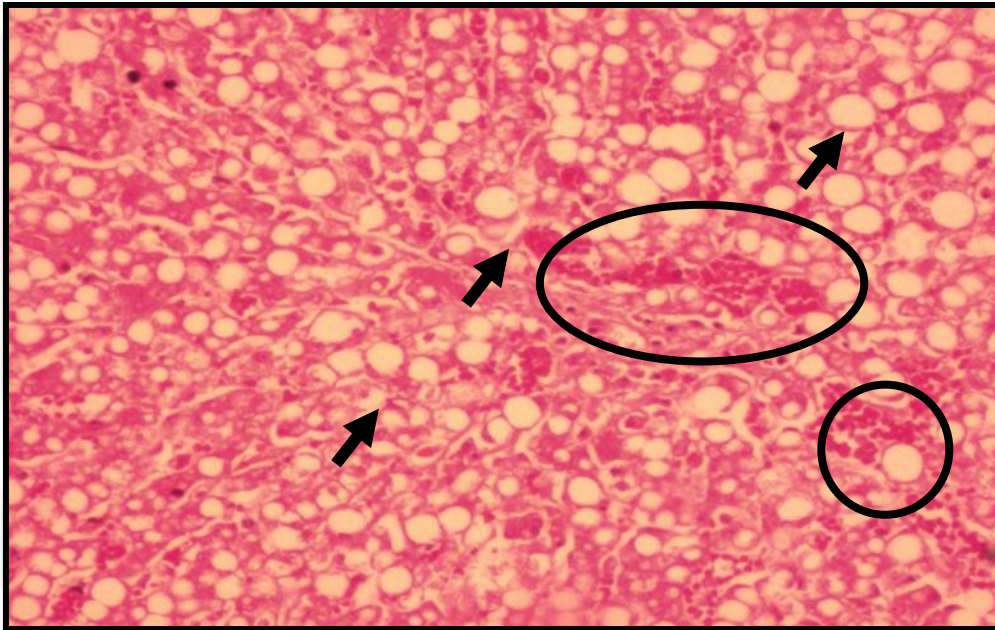
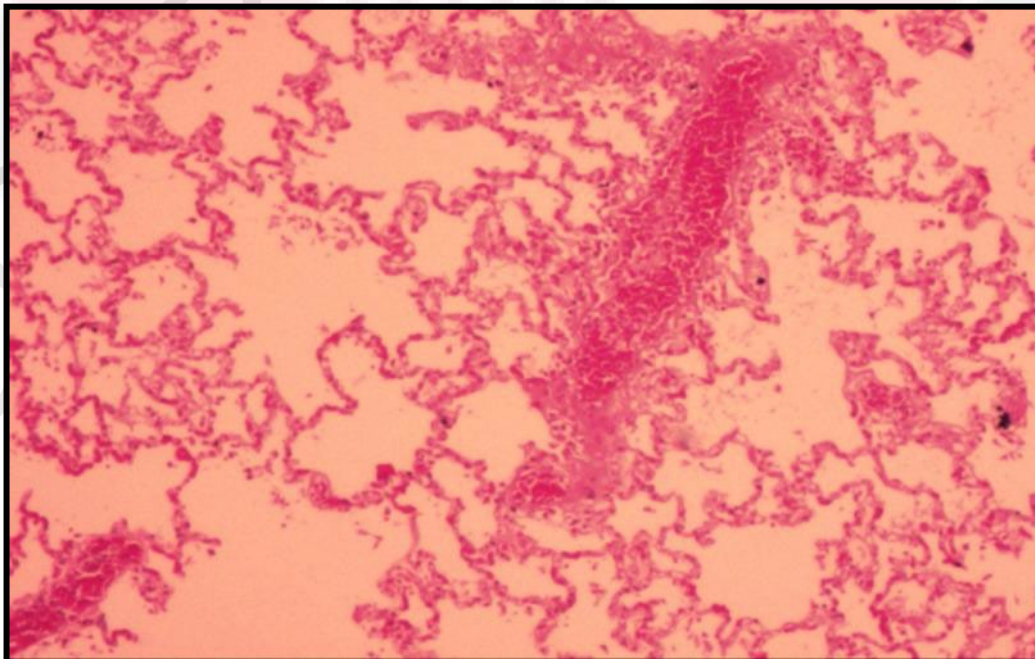


Figure 4.4: Histopathological of liver showing congestion (circle) with fatty liver degeneration (arrow). HE x100



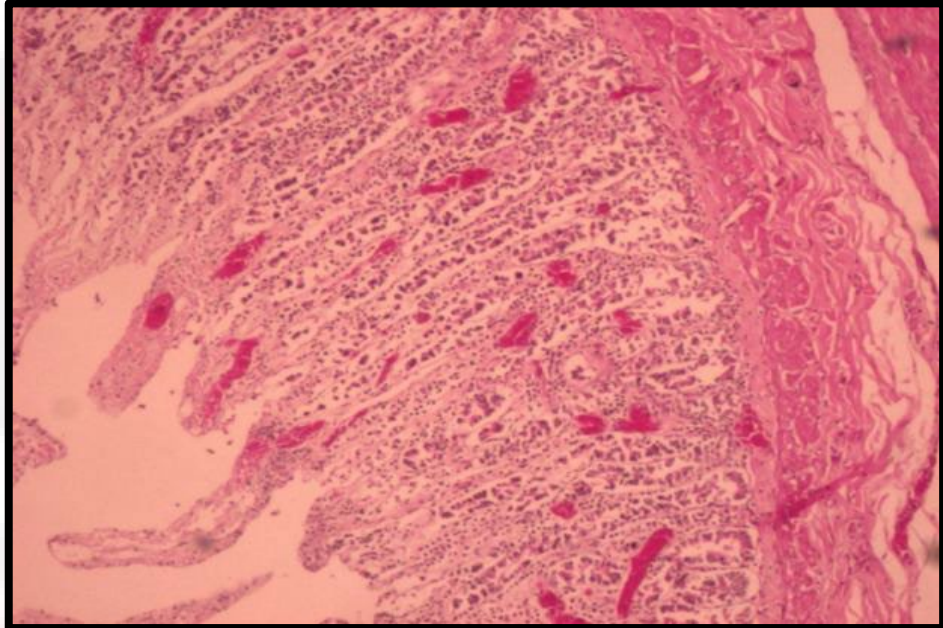


Figure 4.5:

Histopathological of lungs showing congestion of the major blood vessel (circle) and interstitial capillaries. HE x100

Figure 4.6: Histopathological section of small intestine showing congestion of mucosal layer. HE x4

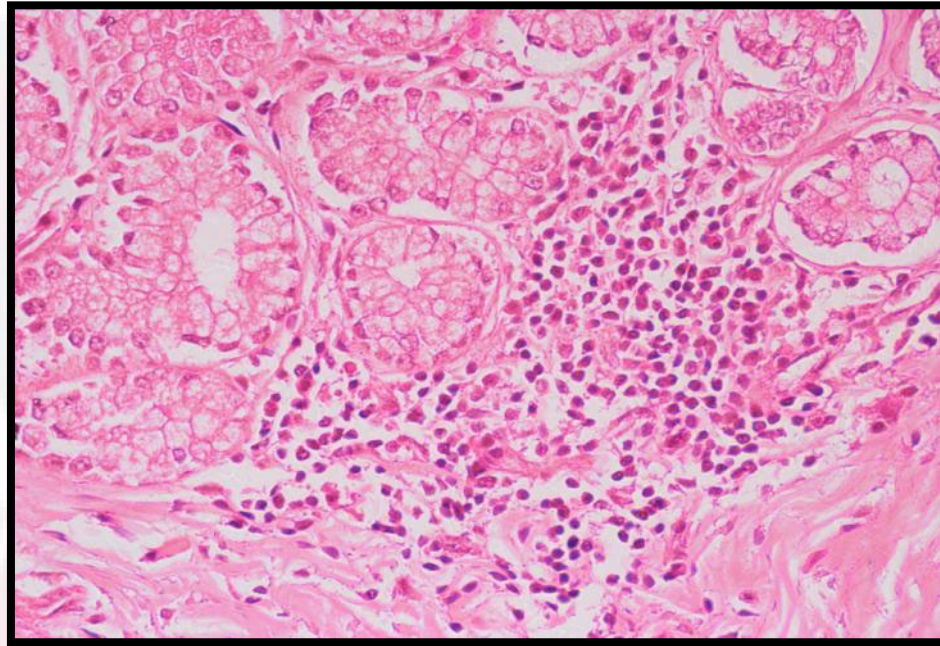


Figure 4.7: Histopathological of a gastric mucosa showing presence of inflammatory cell infiltration. HE x40

#### 4.1.2 Mammary Gland Tumor

The second most common disease among dogs was the mammary gland tumor (8.4%). The table 4.3 shows the occurrence of the different type of mammary gland tumor.

<b>Mammary Gland Tumor</b>	<b>Number of Cases</b>
Mammary gland carcinoma	37
Mammary gland adenoma	3
Mammary gland adenosarcoma	1
Unclassified	23
<b>Total</b>	<b>64</b>

Table 4.3: Total number of cases of the different types of mammary gland tumor classified.

Mammary gland carcinoma occurs significantly ( $p < 0.001$ ) higher than other type of mammary gland tumor among the female dogs. Figure 4.8 shows the percentages of each type of mammary gland tumor.

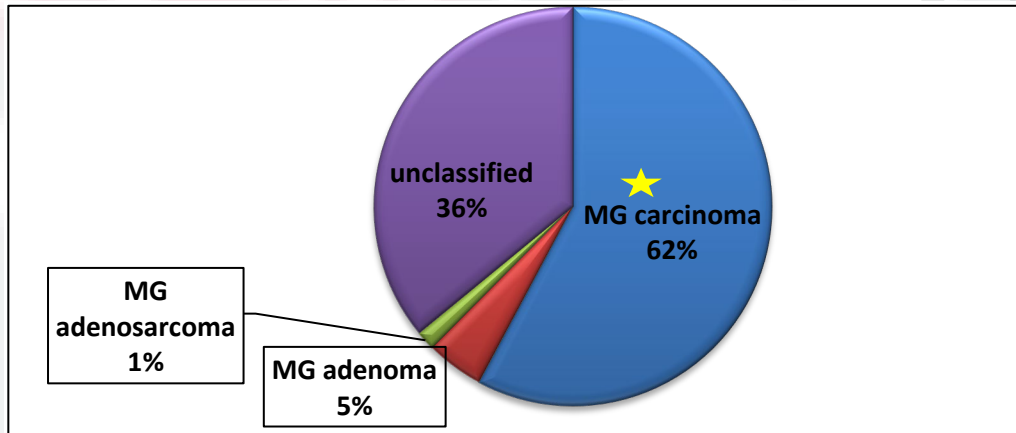
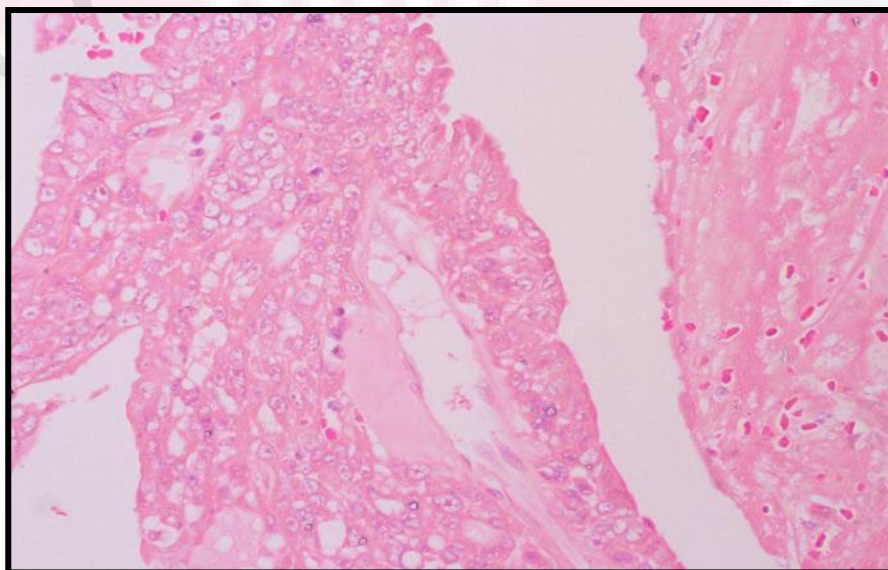


Figure 4.8: Pie chart on percentage of each mammary gland tumor. ★ Chi-square test,  $X^2(3, N=64) = 73.6, p < 0.001$

The most common gross lesion in mammary gland tumor was presence of growth or mass at the mammary gland region or ventral abdomen region. Histological



examination revealed either mammary gland carcinoma (Figs 4.9 and 4.10) or mammary gland adenoma (Figs 4.11 and 4.12)

Figure 4.9: Biopsy on mammary gland carcinoma mass. There is loss of tubular structures of the mammary duct tubules. HE x10X

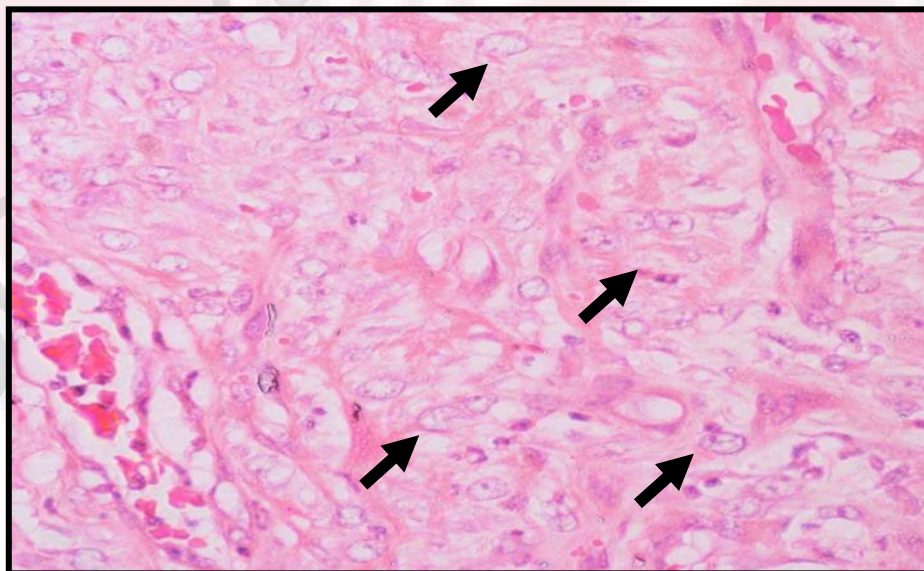


Figure 4.10: Pleomorphic cells in case of mammary gland carcinoma (arrow). HE x40

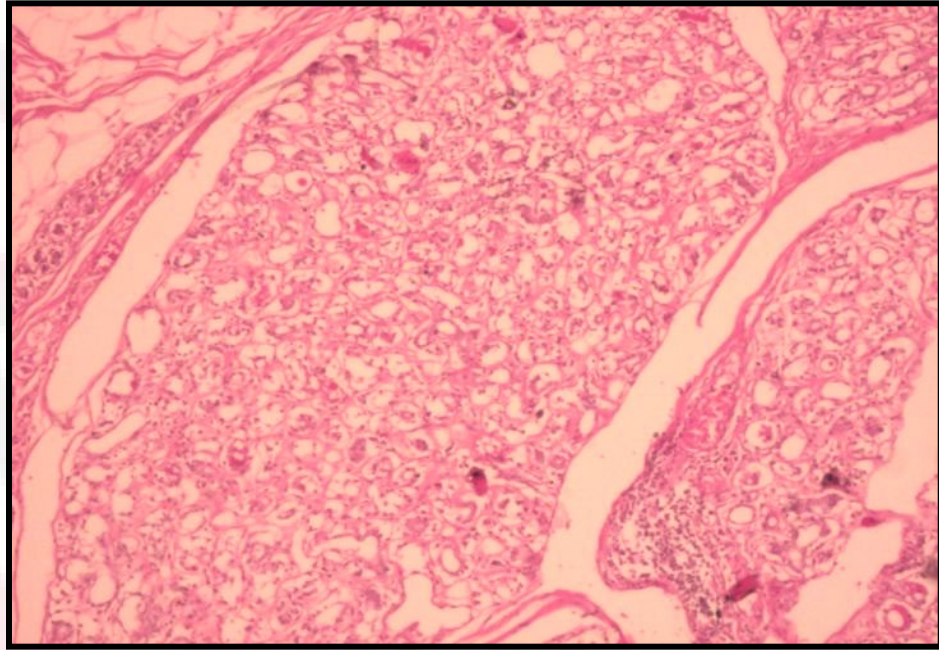


Figure 4.11: Biopsy of mammary gland adenoma showing generalized degeneration of the mammary gland. HE x4

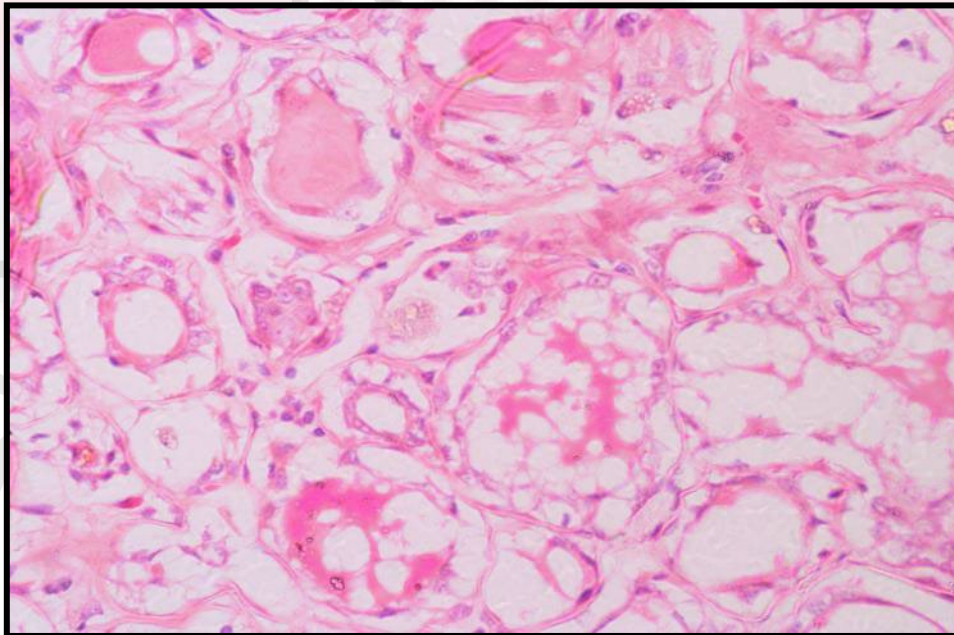


Figure 4.12: Loss of myoepithelium cells surrounding the mammary gland tubules in higher magnification (circle). HE x40

### 4.1.3 Canine Distemper

Canine distemper was the third most common disease among the dogs with 7.9% prevalence. The common gross lesions observed during post mortem were congested brain with malacia and edema (Fig. 4.13). Moreover, the lungs appeared to be congested and edematous (Fig. 4.14) while in gastrointestinal tract showed petechial hemorrhages on the mucosal layer.

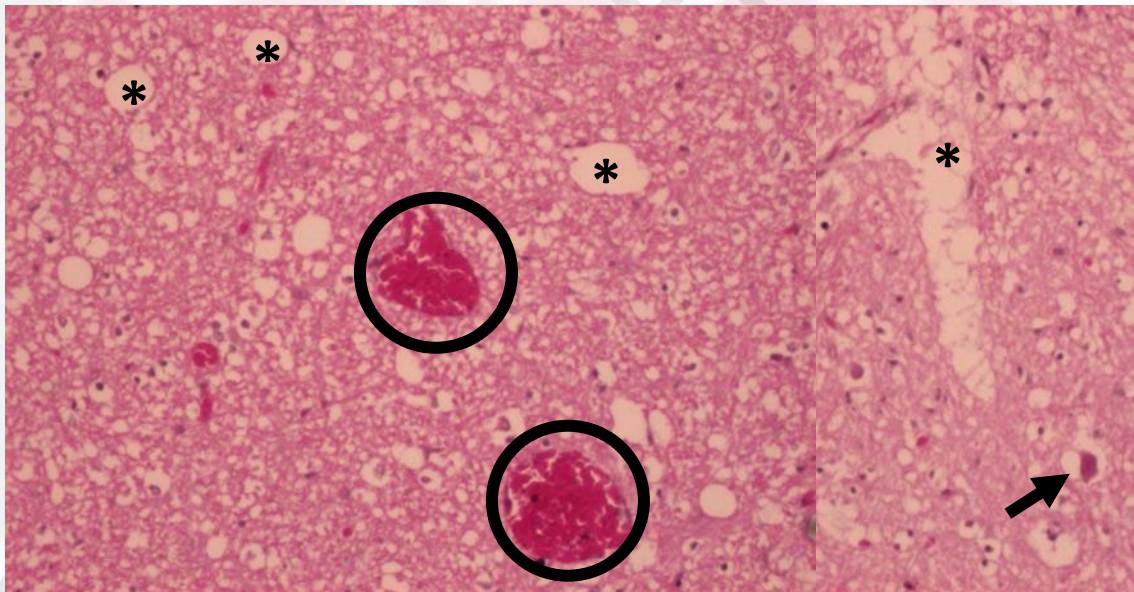


Figure 4.13: Histopathological section of brain showing congestion (circle), spongiosis \* ( ) and edema (arrow). HE x10

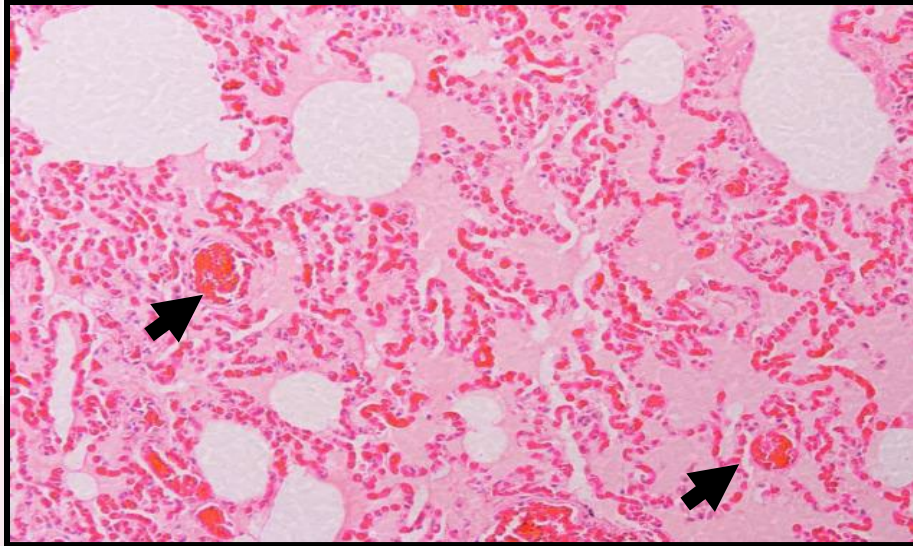


Figure 4.14: Histological section of the lung showing thickening of interalveolar space due to congestion (arrows). Note the presence of protein-rich oedema fluid in the alveoli. HE x10

#### 4.2 Common Diseases among Cats

There were a total of 866 cases involving cats that were handled between 2005 and 2015. Eventually, 27 common health problems were diagnosed and the three most common problems occur at highest were traumatic injuries, feline infectious peritonitis and sporotrichosis. (Table 4.4; Fig. 4.15)

<b>Num</b>	<b>Common Health Problems</b>	<b>Total Number of Cases</b>
1	Traumatic injury	169
2	Feline infectious peritonitis	131
3	Sporotrichosis	104
4	Feline panleukopenia	87
5	Septicemia	57
6	Respiratory failure	57
7	Renal failure	38
8	Feline Lower Urinary Tract Disease	35
9	Squamous Cell Carcinoma	23
10	Lymphoma/Lymphosarcoma	23
11	Poisoning/Toxicity	22
12	Feline Upper Respiratory Disease	21
13	Mammary gland tumor	20
14	Hemangioma	11
15	Fibroma/Fibrosarcoma	9
16	Endometritis/Pyometra	8
17	Enteritis/Gastritis	8
18	Liver failure	8
19	Leiomyoma/leiomyosarcoma	6
20	Sebaceous gland tumor	6
21	Multiple organ failure	5
22	Osteosarcoma	5
23	Dermatitis	3
24	Basal cell tumor	3
25	Transitional Cell Carcinoma	3
26	Melanoma	2
27	Ear polyp	2
	<b>Total</b>	<b>866</b>

Table 4.4: The list of health problems and total number of cases according to each health problem observed among cats presented to Post mortem laboratory, FPV, UPM between 2005 and 2015.

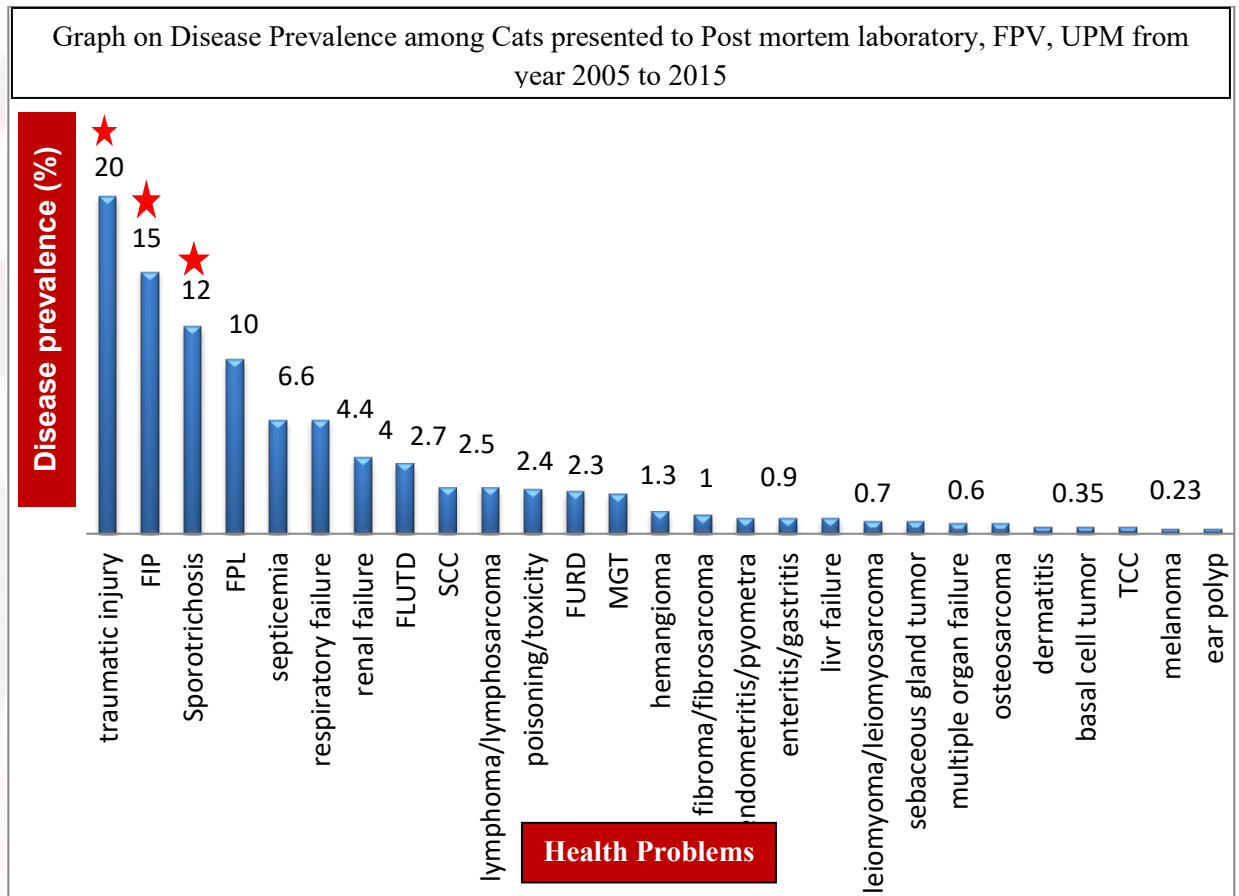


Figure 4.15: Graph on disease prevalence among cats presented to post mortem laboratory, FPV, UPM between 2005 and 2015. ★ Chi-square test,  $X^2(26, N=866) = 1150.1, p < 0.001$ .

The graph shows the prevalence of traumatic injuries (20%), feline infectious peritonitis (15%) and sporotrichosis (12%), which were ( $p < 0.001$ ) higher compared to the other 24 health problems.

#### 4.2.1 Traumatic Injuries

The prevalence of traumatic injuries among cats was 20% and road traffic accidents appeared to be the most common (57%) cause of traumatic injuries, followed by high rise syndrome (23%), blunt object trauma (9%), bite wound/ fight (6%) and fighting (5%) (Fig. 4.16).

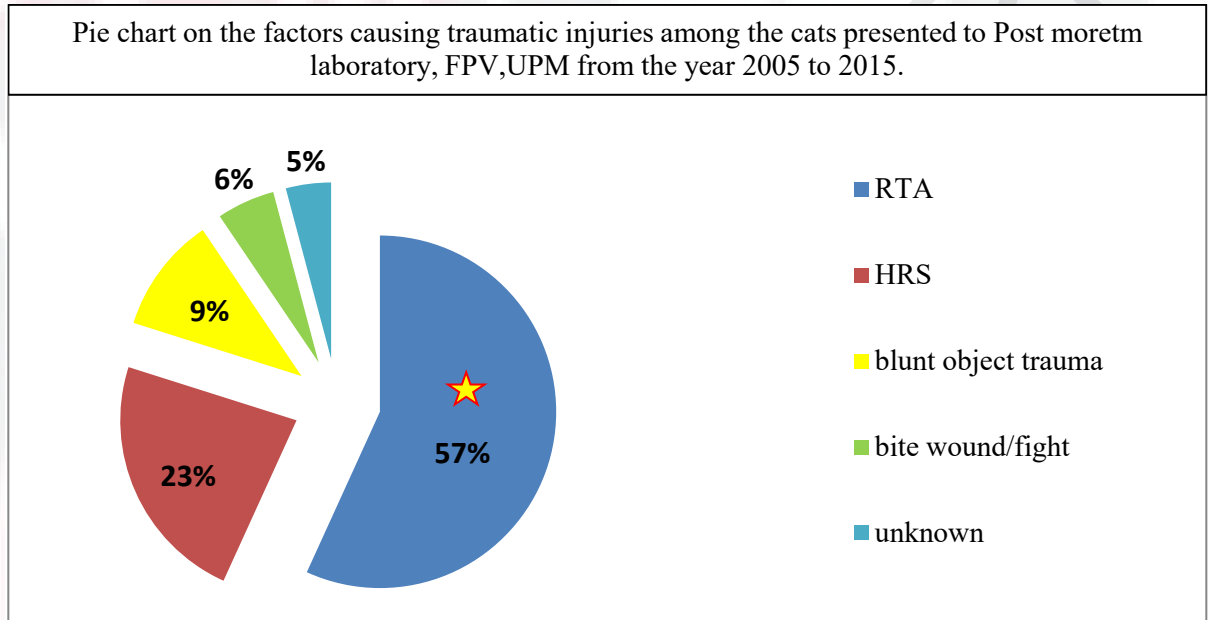


Figure 4.16: Pie chart on the factors causing traumatic injuries among the presented cats to post mortem laboratory. ★Chi-square test,  $X^2(4, N=169) = 200.8, p<0.001$

Cases of Traumatic Injury	Number of Cases
RTA	96
HRS	39
Blunt object trauma	15
Bite wound/Fight wound	10
Unknown	9
<b>Total</b>	<b>169</b>

Table 4.5: Total number of cases according to each causes of traumatic injuries experienced by the cat presented to Post mortem laboratory between 2005 and 2015

The most common gross lesion in traumatic injuries were spinal injury with transected spinal, head trauma with brain hemorrhages, multiple fracture, herniation, hemoabdomen or hemothorax as well as subcutaneous hemorrhages.

#### 4.2.2 Feline Infectious Peritonitis

Second most common health problem was FIP with 15% prevalence. Figure 4.17 shows the percentages of each type of FIP.

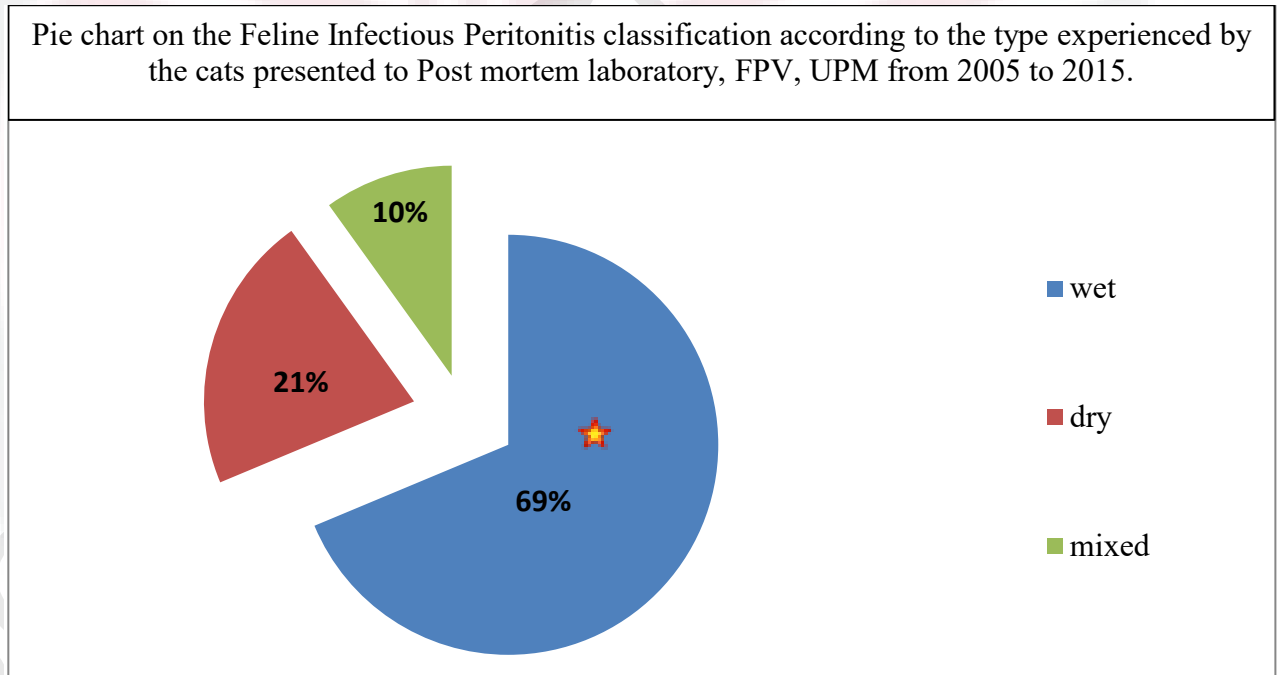


Figure 4.17: Pie chart on each types of feline infectious peritonitis. ★ Chi-square test,  $X^2(2, N= 131) = 114.5, p<0.001$

Type Of Feline Infectious Peritonitis	Number of Cases
<b>Effusive (wet)</b>	90
<b>Non-Effusive (dry)</b>	28
<b>Mixed</b>	13

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Total	131
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Table 4.6: Total number of cases for each type of FIP among the cats presented to Post mortem laboratory between 2005 and 2015.

The effusive form of FIP shows ascites, pleural effusion and thickening of small intestinal wall with hemorrhagic mucosa. The lung showed vasculitis (Fig. 4.18) and focal necrosis (Fig. 4.19)

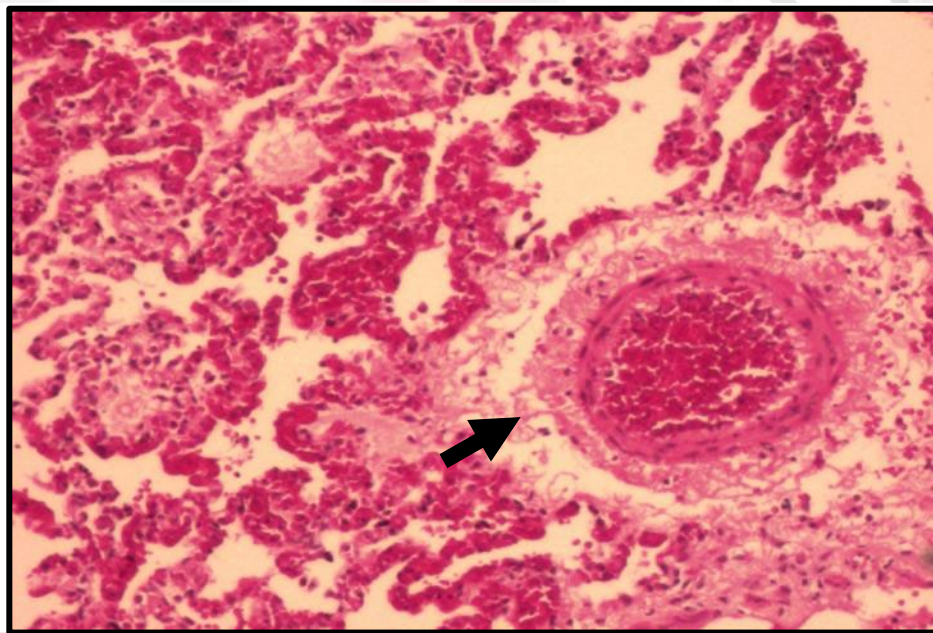


Figure 4.18: Histology section of FIP affected lung showing vasculitis (arrow) and congested interalveolar septa. HE x40X.

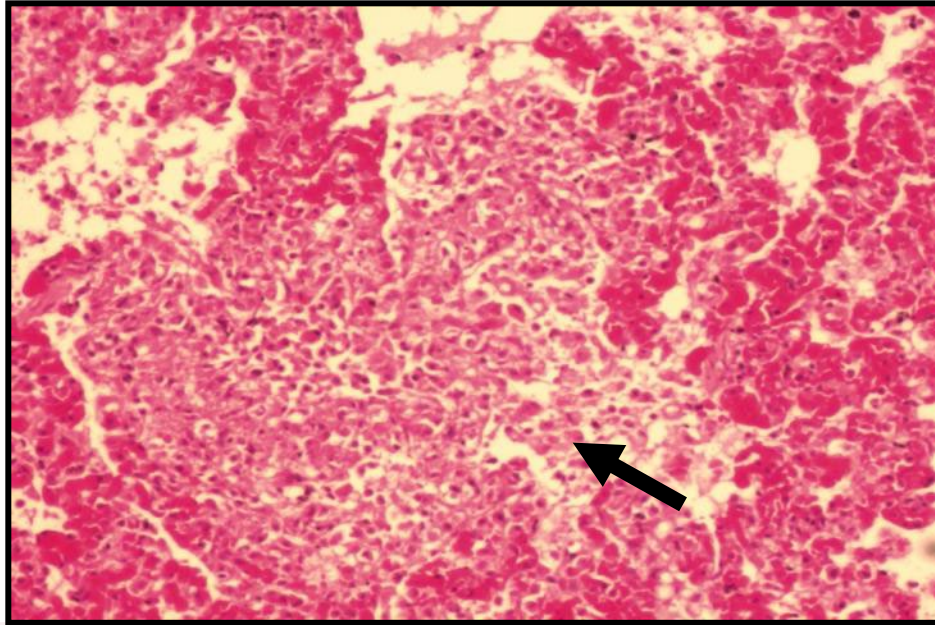


Figure 4.19: Histology section of FIP affected lung showing necrotic foci at the parenchyma (arrow). HE x40X.

The dry form of FIP showed pyogranuloma in their lungs and liver. The affected liver was firm with fibrins tag, congested and inflamed brain (Fig. 4.20) and hydropericardium.

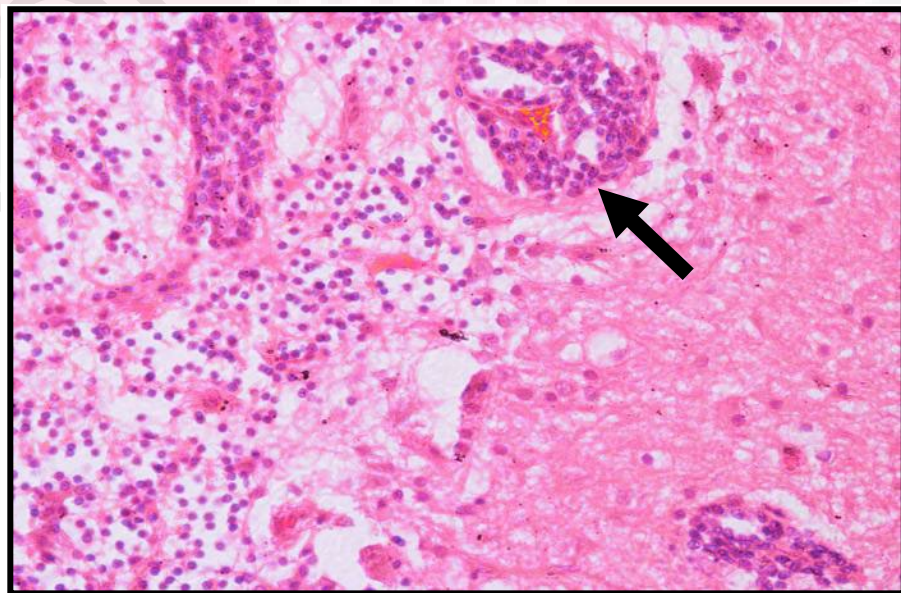


Figure 4.20: Histopathological section of the brain showing numerous infiltrations of inflammatory cells and vasculitis (arrow). HE x40

Mixed form of FIP involves the combination of both effusive and non-effusive form.

The commonly lesion seen were ascites and multifocal diffuse pyogranuloma in multiple organs (Figs. 4.21 and 4.22)

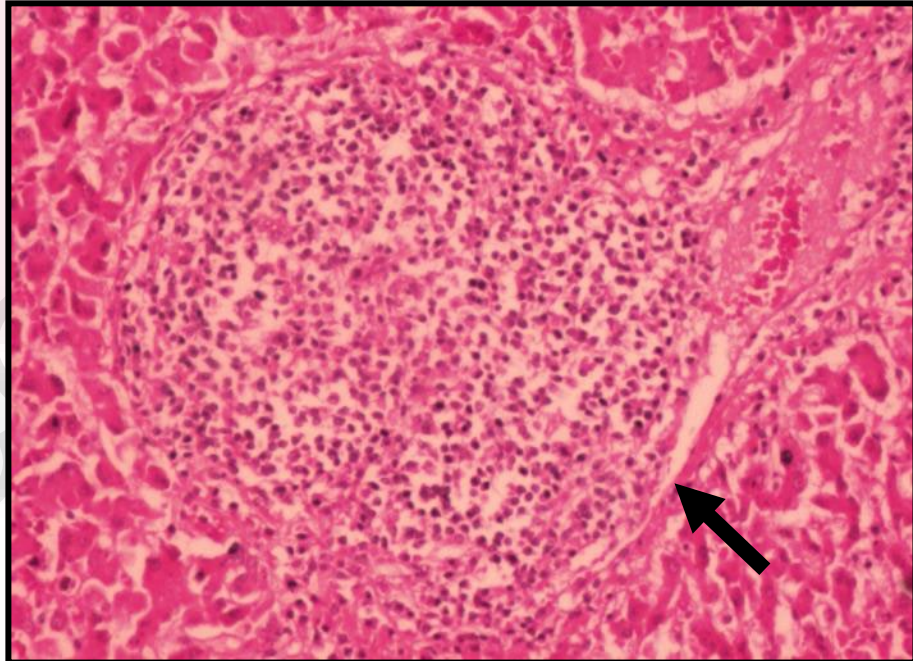


Figure 4.21: Histology section of liver showing pyogranuloma with accumulation of inflammatory cells (arrow). HE x40X.

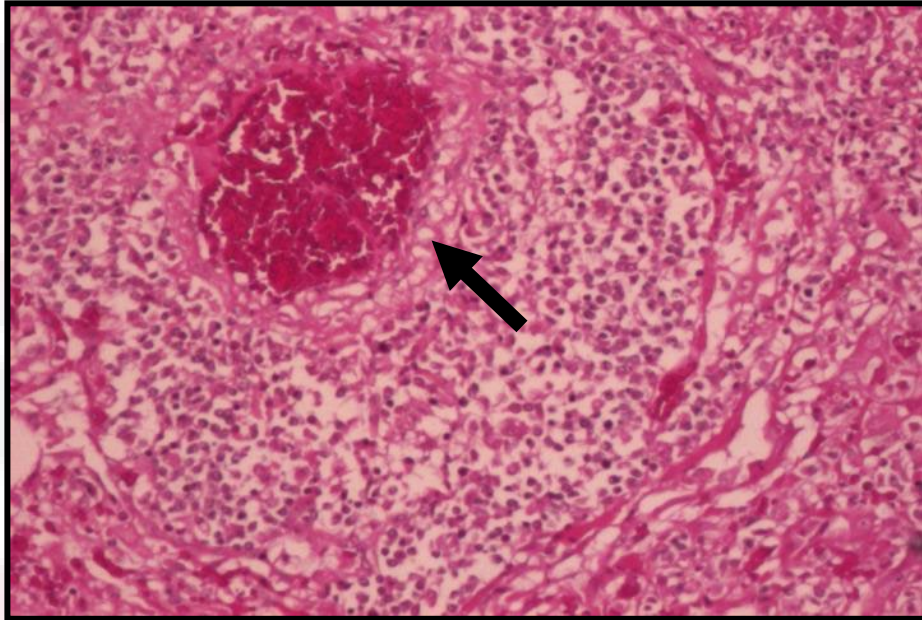


Figure 4.22: Histopathological section of lung with vasculitis (arrow). HE x40X

### 4.2.3 Sporotrichosis

Sporotrichosis is the third most common health problems among these cats with 12% prevalence. The most common lesion observed in the affected cats was the non-healing wounds. Histologically, there were spores found either freely or within the macrophages at the area of the non-healing wounds (Fig. 4.23)

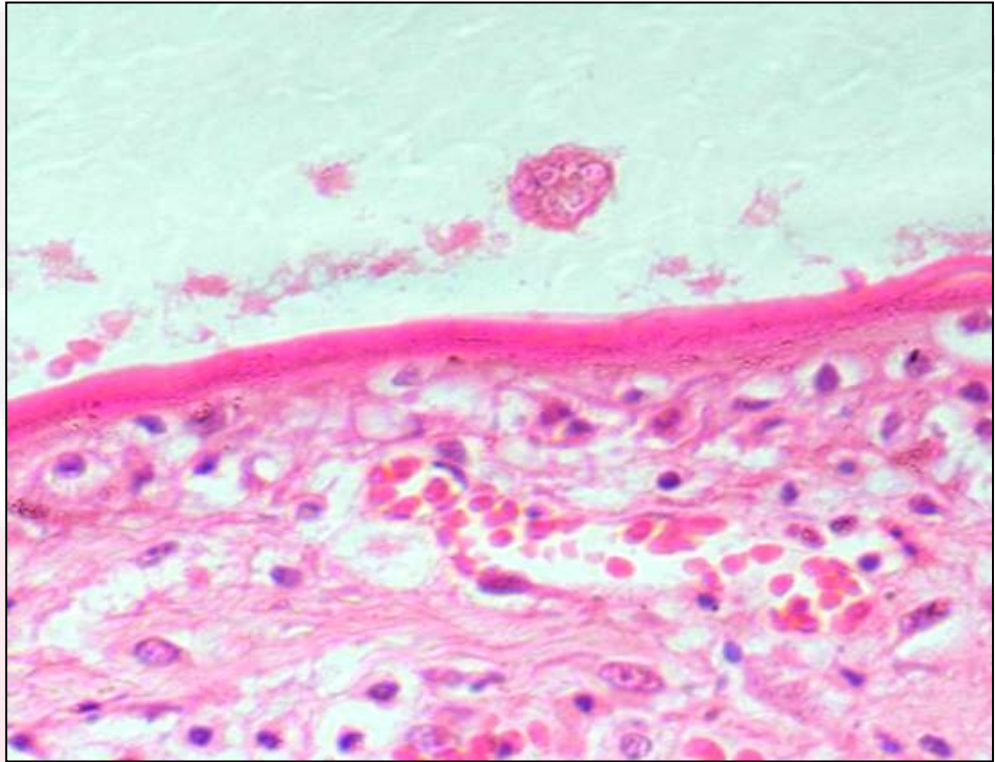


Figure 4.24: Histology section of the non-healing wound showing spores of *Sporotrix schenckii* (arrow) within a macrophage. HE x40.

## 5.0 DISCUSSION

Septicemia is the most common health problem among the dogs that were presented to the post mortem laboratory. This is in agreement with Koenig (2011) who concluded that septicemia caused high mortality in dogs at about 50% through multiple organ dysfunctions. Similarly, Ramachandran (2014) also concluded that bacterial septicemia causes high mortality rate. Bacteriology culture test revealed frequent involvement of Gram-negative bacteria, similar to those reported by Hoskins (2008). This is because Gram-negative produces dangerous endotoxins that cause dilation of blood vessels in multiple organs which eventually cause septic shock. (Hoskins, 2008)

Interestingly, most cases of septicemia reported in this study showed numerous inflammatory cells either in the stomach or small intestine mucosa, indicating that most septicemic cases in dogs originates from the gastro-intestinal tract. This has also been reported earlier (Hoskins, 2008). Pet owners can only prevent septicemia by giving antibiotics to prevent the multiplications of the bacteria and must be aware of the pets temperature, appetite and behavior.

As reported by Brigette *at el.* (2012) mammary gland tumor (MGT) is the most common tumor in female dogs compared to other types of tumor. This study concludes that most MGT cases involved un-spayed female dogs of the age above 4 years old.

Rutteman (2011) also reported high frequency of MGT among un-spayed dogs at 25% higher risk compared to the spayed dogs. Similarly, dogs older than 4 years old have higher risk and this risk increase tremendously in dogs of age higher than 6 years old. (Rutteman, 2011).

Mammary gland adenocarcinoma has the highest occurrence with 62% followed by adenoma type with 5% and adenosarcoma type with 1 %. The unclassified 36% were all malignant type but unclassified to specific type of tumor according to WHO 1999 histology classifications. In this study, it was obvious that malignant type predominates compared to benign types (Lockett, 2005; Brigitte et al., 2012).

Canine distemper (CD) occurs highly in dogs that have improper vaccinations (Frolich, 2002). Pet owners should be aware that vaccination could help to protect their dogs. Many cases involve dogs less than 1 year old while Lappin, 1997 observed CD mostly in puppies of age 3 to 6 months old. Chung *et al.* (2011) recommended that main histopathology lesion in CD is the lymphoid depletion in spleen. This is because the characteristic of the virus which affect the lymphoid organs thus in *utero* infected puppies will always show thymic atrophy (Lappin, 1997). This unfortunately is not a common practice in Post mortem laboratory, UPM. Nevertheless, Greene and Appel (2006) concluded that most CD show acute noninflammatory lesion in the brain with spongy vacuolation predominates. This is similar to the observation in this study. Hyperkeratosis of nose and digits is most commonly seen in dogs with central nervous system (CNS) sign. (Lappin, 1997; Greene and Appel, 2006) which were also reported in this study.

Traumatic injuries (20%) are the most common causes of death among cats in this study and are also one of the frequently observed health problems among dogs (4.5%). Rochlitz *et al.* (2004) observed high incidence of traumatic injuries among the non-neutered and outdoor cats due to their roaming tendency. Road traffic accidents (RTA) are the major reason that leads to traumatic injuries cases. Earlier, Rochlitz *et al.* (2001) found that RTA as common cause of injuries and death among cats in United Kingdom while a study done by University Teaching Hospital, USA found that 16% to 29% of emergency cases brought to their veterinary clinics belongs to RTA (Kolata,1980). Thus, RTA is a worldwide problem.

Feline infectious peritonitis (FIP) occurs whenever there is presence of feline enteric coronavirus (FECV) and Foley et al, 1997 said that FECV is endemic in multi-cat house hold as well as worldwide. This may be the reason behind of steadily increasing incidence of FIP and leading causes of death among the cats. Feline infectious peritonitis can be divided into effusive or non effusive form (Lappin, 1997) and in rare cases of mixed form of FIP. This is in agreement with our study found only that 10 % of mixed form in the last 11 years.

The effusive form is the most common type of FIP and developed following a poor cellular immunity of the affected cats. Therefore, this type usually observed in cats younger than 2 years old with developing immune system (Pedersen, 2013). In fact, Lappin (1997) suggested much younger cats of less than 1 year old. However, this study agrees with these two statements, as most of the cats presented were younger than 2 years old.

The non-effusive is characterized by pyogranulomatous inflammation in multiple organs and spreads to the brain (Carlson and Macintire, 2006). The most common histology lesion found in these cats is vasculitis in the brain with numerous infiltrations of inflammatory cells. This type also said to be occurring in older cats (Pedersen, 2008) as this type slowly develop in FIP seropositive cats.

Cats are highly susceptible to sporotrichosis compared to other species of animals (Welsh, 2003). This infectious disease always causes systemic infection in cats which makes it difficult to treat and eventually cause death in cats (Barros *et al.*, 2011). The organism is ubiquitous as they can survive in both living and decaying plant material as well as soil. Thus, it makes sporotrichosis an important zoonotic disease and cats can get this from environment by inhaling and wound abrasion, and transmit to others via bites and scratches.

## **6.0 CONCLUSION**

The most common health problems among dogs were septicemia, mammary gland tumor and canine distemper infection. These three problems occur significantly higher than other 32 diseases classified among dogs. ( $p < 0.001$ ). Septicemia was commonly associated with Gram-negative bacteria leading to death in dogs. On the other hand, traumatic injuries, feline infectious peritonitis and sporotrichosis occur significantly higher than the other 24 diseases identified among cats presented to Post mortem laboratory. Traumatic injuries due to road traffic accidents cause highest mortality cases in these cats.

In a nut shell, pet owners should be aware of these most common diseases and prevention measure should be taken to avoid the increasing trend of these diseases.

## **7.0 RECOMMENDATION**

A further study should be done to identify the significance of each lesion found associated to each common disease found. This can help to justify the significance occurrence of lesion specify to each disease that occurs commonly among the pets in Malaysia. Thus, it helps us to identify the most suitable differential diagnosis when a case is presented during necropsy.

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## 9.0 APPENDICES

HEALTH PROBLEMS IN CATS	Total	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Traumatic injury	169	14	9	16	17	19	16	24	7	17	19	11
FIP	131	5	6	8	9	12	14	15	23	11	21	7
Sporotrichosis	104	2	3	1	12	7	5	9	11	12	19	23
FPL	87	4	5	6	12	13	12	11	10	7	4	3
Septicemia	57	2	5	4	2	2	8	7	6	8	7	6
Respiratory failure	57	6	7	8	3	5	6	7	10	2	1	2
Renal failure	38	3	2	3	6	5	2	3	4	2	3	5
FLUTD	35	3	4	2	1	5	3	2	2	4	5	4
SCC	23	2	2	6	1	1	3	4	1	1	0	2
Lymphoma	23	3	2	4	1	1	2	0	1	4	3	2
Poisoning/toxicity	22	1	3	1	4	2	5	0	0	2	3	1
FURD	21	1	2	3	1	4	1	0	5	1	2	1
MGT	20	0	1	2	1	1	4	2	1	4	1	3
Hemangioma	11	2	1	1	1	0	1	2	1	2	0	0
Fibroma/fibrosarcoma	9	0	0	1	1	0	1	1	2	1	1	1
Endometritis/pyometra	8	0	1	1	1	2	1	0	0	1	0	1
Enteritis/gastritis	8	0	1	1	1	0	1	1	1	0	2	0
Liver failure	8	1	1	1	0	1	2	1	0	0	1	0
Leiomyoma	6	0	0	1	0	1	0	1	1	1	1	0
Sebaceous gland tumor	6	2	0	0	1	1	0	0	1	0	1	0
Multiple organ failure	5	0	1	0	0	0	2	0	1	0	1	0
Osteosarcoma	5	1	0	0	2	0	0	0	1	0	1	0
Dermatitis	3	0	1	0	0	0	0	0	0	1	1	0
Basal cell tumor	3	1	0	0	0	1	1	0	0	0	0	0
TCC	3	0	0	0	0	1	0	0	1	0	1	0
Melanoma	2	1	0	0	0	0	0	0	1	0	0	0
Ear polyp	2	0	0	0	0	0	1	0	0	0	1	0
<b>Total</b>	<b>866</b>	<b>54</b>	<b>57</b>	<b>70</b>	<b>77</b>	<b>84</b>	<b>91</b>	<b>90</b>	<b>91</b>	<b>81</b>	<b>99</b>	<b>72</b>

Table 4.7: Total number of cases according to common health problems among cats presented to Post mortem laboratory for each year respectively



HEALTH PROBLEMS IN DOGS	TOTAL	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
septicemia	74	4	6	8	4	8	1	7	8	9	10	13
CD	58	2	3	1	4	1	8	8	6	12	9	6
MGT	64	0	6	4	6	1	6	4	9	14	14	0
pneumonia	19	3	2	1	2	2	3	3	1	1	2	2
melanoma	17	0	1	1	3	2	2	2	2	2	2	0
CPV	24	1	2	2	0	1	5	2	1	5	2	4
lymphosarcoma	21	3	2	3	2	3	4	1	5	0	0	1
hemangiosarcoma	33	3	2	7	4	3	4	2	4	0	5	2
lymphoma	8	4	0	1	0	0	1	1	1	2	1	1
multiple organ failure	4	0	0	0	0	0	1	0	0	2	1	0
Lipoma	27	2	1	2	1	3	0	5	6	3	4	2
pyometra	6	2	0	0	0	3	0	0	0	1	2	0
cystic endometrial hyperplasia	8	3	1	0	1	1	3	0	2	0	0	0
basal cell tumor	21	0	2	5	3	5	1	0	1	2	2	0
dirofilariasis	5	1	0	0	0	2	1	1	0	1	0	0
congestive heart failure	6	2	0	0	0	0	2	0	2	2	0	0
renal failure	11	0	1	1	1	1	0	0	2	2	2	1
liver failure	12	0	1	2	3	1	0	1	0	2	1	1
dermatitis	14	5	6	1	0	1	2	0	0	4	0	0
SCC/SCT	49	3	4	2	9	4	5	8	7	5	4	1
MCT	27	2	2	3	0	2	2	6	3	6	2	1
sebaceous gland tumor	19	2	1	3	2	7	1	3	0	2	0	0
seminoma	12	0	2	2	0	1	0	1	4	2	0	0
sertoli cell tumor	11	0	1	0	4	0	0	0	5	0	1	0
osteosarcoma	23	1	5	2	0	2	1	1	5	2	5	0
erlichiosis	2	1	0	0	0	0	0	1	0	1	0	0
fibroma/fibrosarcoma	23	3	1	0	0	4	2	3	4	4	5	0
poisoning	26	1	0	3	2	1	1	2	0	5	10	2
CLUTD	10	3	2	0	0	0	3	0	0	3	1	1
ICH	14	0	3	0	0	4	1	3	3	0	0	0
otitis externa	3	0	1	0	1	0	0	1	0	0	0	0
hip dysplasia	17	0	0	1	1	3	1	0	0	4	5	2
heat stress/heat stroke	6	0	0	0	0	0	0	0	2	3	0	1
leptospirosis	3	0	0	0	0	0	0	1	0	0	2	0
trauma/ fracture	32	2	3	1	1	3	1	5	8	2	6	2
	709	53	61	56	54	69	62	72	91	103	98	43

Table 4.8: Total number of cases according to each common health problems among dogs presented to Post mortem laboratory for each year respectively