



# Occurrence of canine mammary and skin/ subcutaneous neoplasms in and around Thrissur district of Kerala during 2017-2020: A review of 265 cases<sup>#</sup>

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## Abstract

The study was conducted in 265 clinical cases of mammary and skin/ subcutaneous neoplasms in dogs presented to University Veterinary Hospitals Mannuthy and Kakkalai during a period of 36 months from October 2017 to September 2020. Mammary neoplasms were found more in females (51.7 per cent) than in males whereas skin and subcutaneous neoplasms were found more in male dogs (48.3 per cent). The maximum occurrence of neoplasms was recorded in the age group of eight to twelve years (38.5 per cent) whereas least occurrence was noticed in the age group up to four years (9 per cent). Labrador and Rottweiler breeds were found more affected with neoplasms (38 per cent each) with highest occurrence of mammary neoplasms in inguinal mammary glands (35.03 per cent) and highest occurrence of skin/ subcutaneous neoplasms on sites involving trunk region (14.06 per cent cases). Eighty-three per cent of the neoplasm cases in the present study were pet dogs with a greater number of dogs maintained in outdoor kennels and 17 per cent of neoplasm was found in free-roaming dogs rescued from streets. Out of total 265 dogs, 37.73 per cent dogs were found to be having commercial dog food as their main feed and 32 per cent dogs were fed with a mixed diet of homemade food and commercial dog food. Among the cases, 14.71 per cent dogs had a previous history of cancer surgery.

**Keywords:** Mammary, skin and subcutaneous neoplasms, dogs.

Running title: Occurrence of canine mammary and skin/ subcutaneous neoplasms

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In the past few decades, an uprise in the cancer incidence in the companion animals were recorded. More than 50 per cent older dog population develops cancer with one-fourth of the reported populations eventually dying of it. (Lewis *et al.*, 2018). The leading cause of death in dogs is still identified as cancer and proves to be a constant focus of research in veterinary medicine. University Veterinary Hospitals of Mannuthy and Kokkalai of Kerala Veterinary and Animal Sciences University serves as referral hospitals of the state and a large number of cases of neoplasms were reported in the past decade. The present study was envisaged to document trends in occurrence of neoplasms in dogs over the past three years in and around Thrissur District of Kerala, India.

### Materials and methods

Occurrence of mammary and skin/subcutaneous neoplasms presented to University Veterinary Hospitals Mannuthy and Kokkalai during a period of 36 months from October 2017 to September 2020 were studied. Signalment and anamnesis including the information on age, breed, sex, body weight, general body condition of the animals, general information on lifestyle/ history of illness, home and environment factors, nutritional information and previous history of concurrent illness were recorded. The data collected were analysed to find out the trends in the occurrence of neoplasms.

### Results and discussion

A total of 265 cases of superficial neoplasms were reported among the 14140 clinical cases screened during a period of three years at University Veterinary Hospitals Mannuthy and Kokkalai. Out of 265 cases, 137 cases were canine mammary neoplasms (51.7 per cent) and 128 cases were skin/subcutaneous neoplasms (48.3 per cent). The increased number of mammary neoplasms than skin/subcutaneous neoplasms were in accordance with Aleksić-Kovačević *et al.* (2005) and Choi *et al.* 2016 who reported mammary neoplasms as the main type of neoplasms in dogs. However, these observations were not in agreement with the findings of Gupta *et al.* (2012) and Karnik *et al.* (2020) who reported

cutaneous tumours as the most commonly occurring neoplasms in dogs followed by canine mammary neoplasms.

### Age

The maximum occurrence of neoplasms were recorded in the age group of eight to twelve years (38.5 per cent) followed by four to eight years (29.1 per cent) and more than twelve years (20.38 per cent), whereas least occurrence (12.08 per cent) were reported in the age group up to four years. The trend of minimum incidence below four years scaling to an increase in four to eight years followed by peak incidence at 11 years and decrease thereafter at age of 12 years was recorded by Dhami *et al.* (2010) and Vascellari *et al.* (2016).

### Breed

Breed wise occurrence of neoplasm was seen slightly more in Labrador retrievers (38/265, 14.34 per cent) and Rottweilers (38/265, 14.34 per cent) followed by German shepherds 36 / 265, (13.58 per cent), non-descript /crossbreed (34 / 265, 12.83 per cent), Dachshund (33/265,12.45 per cent), Spitz (28/265, 10.57 per cent), Doberman pinschers (23/265 ,8.68 per cent), Chinese Pug (22/265, 8.30), Great Dane (2/265, 0.75 per cent), Pitbull terriers (2/265, 0.75 per cent) Lhasa Apso (2/265, 0.75 per cent) Golden Retrievers (2/265, 0.75 per cent) ,Neapolitan mastiff (1/ 265, 0.38 per cent), Basset hound (1/ 265, 0.38 per cent), Weimaraner (1/ 265, 0.38 per cent), Jack Russel Terrier (1/ 265, 0.38 per cent) and Beagle (1/ 265, 0.38 per cent) (Fig.1).

Pure breeds were more affected (87.16 per cent) than non-descript breeds (12.83 per cent) in the current study and this was accordance with Vascellari *et al.* (2016) and Hemanth *et al.* (2015). These findings are contradictory to the observation of Dayananda *et al.* (2009). It could be concluded that even though specific breed predisposition to neoplasms was not established in the majority of cancer types, the increased breed wise occurrence in Labrador retriever, Rottweiler and German shepherd dog breeds could be attributed to breed preference among local populations.

### **Gender**

Neoplasms were seen more in females (168/ 265, 63.4 per cent) than in males (97/ 265, 36.6 per cent). This was in accordance with Karnik *et al.* (2020). Even though canine mammary neoplasms were seen more in female dogs (130/137 cases, 94.89 per cent), male dogs were also reported with mammary neoplasm (7/137 cases, 5.11 per cent). Similar findings were documented by Dhami *et al.* (2010) and Patel *et al.* (2019). The occurrence of skin and subcutaneous neoplasms was seen more in males in the present study. This result was found in agreement with the observations recorded by Aleksić-Kovačević *et al.* (2005) and Dayananda *et al.* (2009).

### **Gland wise occurrence of mammary neoplasm**

Gland -wise occurrence of mammary neoplasms in dogs are depicted in Fig. 2. Out of 137 mammary neoplasm cases, inguinal mammary glands accounted for a maximum of total mammary neoplasm (35.03 per cent) followed by cranial abdominal glands (23.36 per cent), caudal abdominal glands (16.79 per cent), and caudo-thoracic glands (10.22 per cent) cranio-thoracic (8.03 per cent), respectively. This was in accordance with Ginn *et al.* (2007) and Panchkhande *et al.* (2019). A similar pattern of ascending involvement from cranial thoracic to inguinal glands was reported by Dhami *et al.* (2010).

### **Region wise occurrence of skin/ subcutaneous neoplasm**

Region wise distribution of skin/ subcutaneous neoplasms in dogs are depicted in Fig.3. Out of 128 cases of skin/ subcutaneous neoplasms, 18 cases were found to be involving trunk region, 13 croup and loin region of the body, 13 cases in the forehead, 12 cases in the hindlimb, 10 cases in the forelimb manus, 11 cases on tail base, nine cases in the thigh region, eight cases each on the perianal and digit and neck regions, seven cases in the axilla and four cases each on the lip region, shoulder region and para preputial /penis. In the present study, trunk region was found to be having a maximum number of skin and subcutaneous

neoplasms which was in accordance with Mukaratirwa *et al.* (2005) who observed larger incidence of skin and subcutaneous tumours located on the trunk which were more likely diagnosed as epithelial tumour than non-epithelial tumours and attributed increased incidence of neoplasms in the trunk region due to the larger exposure area for carcinogens.

### **Bodyweight**

Out of 265 dogs, 105 dogs (39.62 per cent) were found emaciated whereas 62 cases were found to be obese (23.4 per cent) and 98 dogs (36.98 per cent) were found to be in the normal body condition. This was in accordance with Philibert *et al.* (2003) who documented that fat content influences the development and biological behaviour of canine mammary gland neoplasms. Neoplasms were seen more (39.62 per cent) in dogs which were emaciated than the dogs with normal body weight (36.98 per cent of animals) in the present study. The reason for emaciation in the majority of animals with neoplasm may be due to cancer cachexia of malignant neoplasms as documented by Arnold *et al.* (2001).

### **Rearing pattern**

Out of 265 cases of neoplasms, 220 (83 per cent) cases were owned by people and 45/265 dogs (17 per cent) were dogs with free-roaming lifestyle rescued from streets by animal welfare organizations. Out of 220 owned dogs, 150 dogs (68.19 per cent) were maintained in outdoor kennels / chained with an average 6-8 hours free-roaming time inside the compound and 56 dogs (25.45 per cent) were strictly maintained indoors and 14 dogs (6.36 per cent) in the study were community dogs with free roaming lifestyle.

### **Environment**

In the present study 137/220 dogs (17 per cent) of the owners reported that they reside near a farm, or any other agricultural/ horticultural /industrial area Among the owned dogs, 45 out of 220 dog owners (20.45 per cent) reported that they regularly used rodenticides, herbicides or pesticides in their house/premises. The increased occurrence of neoplasms in the

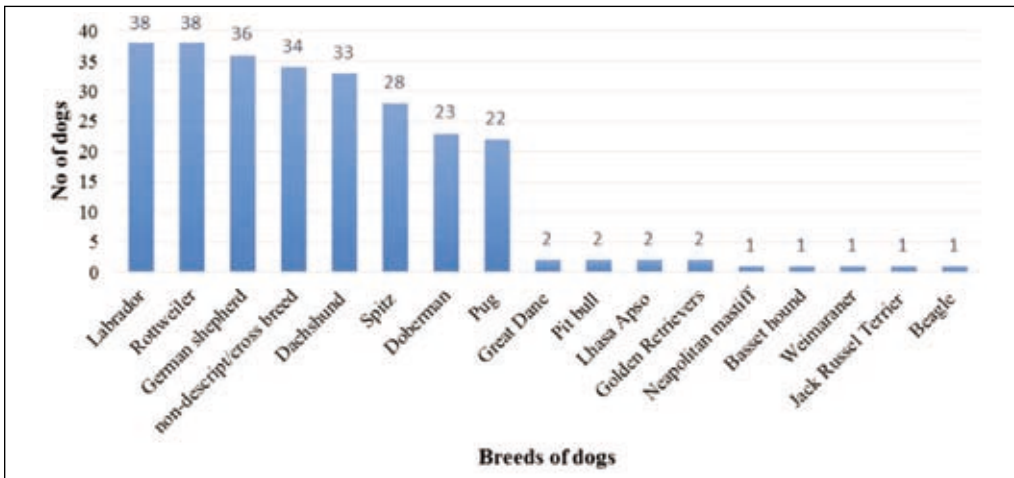


Fig. 1. Graph showing breed-wise occurrence of neoplasms in dogs (n=265)

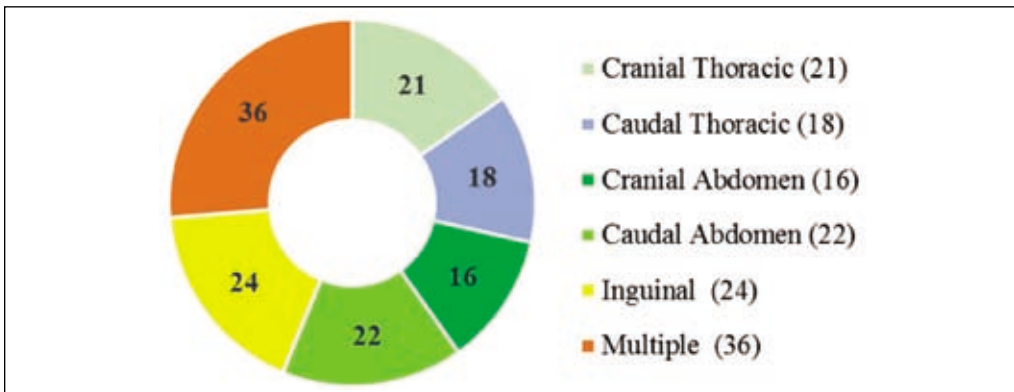


Fig. 2. Gland-wise occurrence of mammary neoplasms in dogs (n=137)

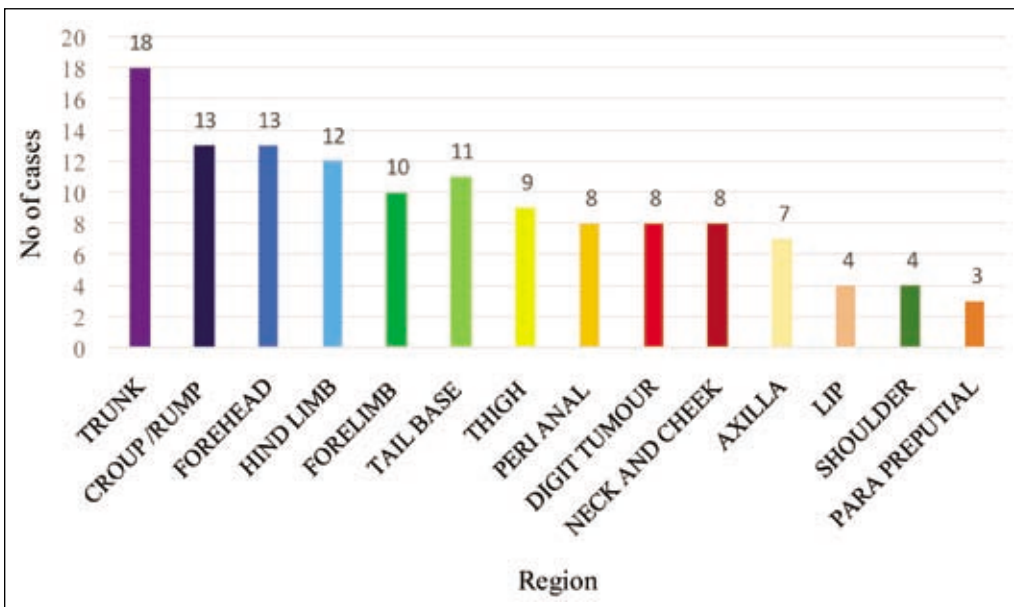


Fig. 3. Region-wise distribution of skin/ subcutaneous neoplasms in dogs (n=128)

dogs could be attributed to increased exposure to environmental carcinogens as documented by Reif *et al.* (1998) and ultraviolet rays as reported by Guzman *et al.* (2003). The increased incidence of neoplasms in the outdoor dogs may also be attributed to the illegally burned household waste and automobile exhausts as reported by Comba *et al.* (2006). In the present study 7.72 per cent, owners reported cigarette smoking or the presence of smokers at home. This was in accordance with Reif *et al.* (1992) who reported a weak relationship between passive smoking and the risk of developing lung cancer in dogs.

### Diet

Out of total 265 dogs, 100 (37.73 per cent) dogs were found to be having commercial dog food as their main feed, 66 dogs (24.9 per cent) were reported to be maintained on exclusively home food, 85 (32 per cent) dogs were fed with a mixed diet of homemade food and commercial dog food and 14 dogs (5.28 per cent) were free-roaming dogs with scavenging eating habits.

Feeding practices finds itself a vast area contributing to cancer. Even though the current study cannot rule out the potential effect of commercial pet foods on cancer, an increased occurrence of neoplasms among the dogs solely fed with commercial in the present study. Dobson *et al.* (2008) detected carcinogenic property of simple triazine compounds mainly melamine and cyanuric acid in commercial pet foods. Further studies are needed to emphasise the findings of an increased incidence of neoplasms in dogs maintained with commercial pet foods. In the present study least occurrence was reported in the animals fed with homemade food alone. Neoplasms were also detected on dogs with scavenging eating habits in the present study. This could be attributed to the ingestion of carcinogenic contaminants as reported by Gavazza *et al.* (2001).

### Previous history of neoplasms

Among the cases, 39 dogs had a previous history of cancer surgery, of which 20 cases were mammary neoplasms and 19 cases were skin and subcutaneous neoplasms. These

observations were in accordance with Neeman and Ben-Eliyahu (2013) who reported that surgical trauma could initiate specific factors that can influence the cancer recurrence and surgery-induced vascular endothelial growth factor (VEGF) which could potentiate cancer stem cells (Ceelen *et al.*, 2014).

### Conclusion

The present study recorded the occurrence of 265 cases of mammary tissue and skin / subcutaneous neoplasms in and around Thrissur district of Kerala from October 2017 to September 2020. ). Most of the of the neoplasm cases (eighty-three per cent) in the present study were pet dogs with a greater number of dogs maintained in outdoor kennels and the remaining cases of neoplasm was found in free-roaming dogs rescued from streets.

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### Conflicts of interest

There were no conflicts of interest reported by the authors.

### References

- Aleksić-Kovačević, S., Kukolj, V., Marinković, D. and Knežević, M. 2005. Retrospective study of canine epithelial and melanocytic tumors. *Acta. Vet-Beograd.* **55**: 319-326.
- Arnold, S. M., Lieberman, F. S. and Foon, K. A. 2005. Paraneoplastic syndromes. In: DeVita, V.T., Jr, Hellman, S. and Rosenberg, S.A. (eds.), *Cancer: Principles and Practice of Oncology*. (7<sup>th</sup> Ed.). Philadelphia, PA: Lippincott Williams & Wilkins, pp. 176-185
- Carlo, G. L., Cole, P., Miller, A. B., Munro, I. C., Solomon, K. R., Squire, R.A. 1992. Review of a study reporting an association between 2, 4 - dichlorophenoxyacetic

- acid and canine malignant lymphoma: report of an expert panel. *Regul. Toxicol. Pharmacol.* **16**: 245-252.
- Ceelen, W., Pattyn, P. and Mareel, M. 2014. Surgery wound healing, and metastasis: recent insights and clinical implications. *Crit. Rev. Oncol. Hematol.* **1**: 16-26.
- Cesario, L., Garrett, L. D., Barger, A. M., O'Brien, R. T. and Fan, T. M. 2016. Diagnosis and ultrasonographic appearance of hepatic metastasis in six cases of canine appendicular osteosarcoma (2005–2013). *Aust. Vet. J.* **94**: 160-165.
- Choi, J. W., Yoon, H. Y. and Jeong, S. W. 2016. Clinical outcomes of surgically managed spontaneous tumors in 114 client-owned dogs. *Immune. Network.* **16**: 116-125.
- Comba, P., Bianchi, F., Fazzo, L., Martina, L., Menegozzo, M., Minichilli, F., Mitis, F., Musmeci, L., Pizzuti, R., Santoro, M. and Trinca, S. 2006. Cancer mortality in an area of Campania (Italy) characterized by multiple toxic dumping sites. *Ann. N. Y. Acad. Sci.* **1076**: 449-461.
- Dobson, R. L., Motlagh, S., Quijano, M., Cambron, R. T., Baker, T. R., Pullen, A. M., Regg, B. T., Bigalow-Kern, A. S., Vennard, T., Fix, A. and Reimschuessel, R. 2008. Identification and characterization of toxicity of contaminants in pet food leading to an outbreak of renal toxicity in cats and dogs. *Toxicol. Sci.* **106**: 251-262.
- Dayananda, T. S., Suguna, R., Byregowda, S. M., Satyanarayana, M. L., Jayachandra, K. C. and Shilpa, V. T. 2009. Prevalence of skin and subcutaneous tissue neoplasms in dogs. *Indian Vet. J.* **86**: 671-673.
- Ginn, P. E., Mansell, E. K., Rakich, P. M. 2007. Skin and appendages. In: Maxie, M. G. (eds.), *Jubb, Kennedy, and Palmer's Pathology of Domestic Animals*. (5<sup>th</sup> Ed.). Elsevier Saunders, New York, pp.777-780.
- Gupta, K., Sood, N. K., Uppal, S. K., Mohindroo, J., Mahajan, S., Raghunath, M. and Singh, K. 2012. Epidemiological studies on canine mammary tumour and its relevance for breast cancer studies. *IOSR. J. Pharm.* **2**: 322-333.
- Hemanth, I., Kumar, R., Varshney, K. C., Nair, M. G., Ramesh Kumar, B., Sivakumar, M. and Thanislass, J. 2015. Epidemiological and clinical studies on canine mammary tumours. *Ind. J. Vet. Res.* **24**: 11-14.
- Karnik, M., Anjankumar, K. R., Jeevan, K., Gowda, Y., Rakshith, K., Shettar, M., Azeemullah, H. R., Yashas, R. K., Rajashekaraiah, R., Mahesh, V. and Rao, S. 2020. Incidence and Histopathological Studies on Tumours of Dog in Bengaluru, India. *Int. J. Curr. Microbiol. Appl. Sci.* **9**: 747-752.
- Lewis, T. W., Wiles, B. M., Llewellyn-Zaidi, A. M., Evans, K. M. and O'Neill, D. G. 2018. Longevity and mortality in Kennel Club registered dog breeds in the UK in 2014. *Canine Genetics and Epidemiology.* **5**: 10.
- Mukaratirwa, S., Chipunza, J., Chitanga, S., Chimonyo, M. and Bhebhe, E. 2005. Canine cutaneous neoplasms: prevalence and influence of age, sex, and site on the presence and potential malignancy of cutaneous neoplasms in dogs from Zimbabwe. *J. S. Afr. Vet. Assoc.* **76**: 59–62.
- Neeman, E. and Ben-Eliyahu, S. 2013. Surgery and stress promote cancer metastasis: new outlooks on perioperative mediating mechanisms and immune involvement. *Brain, behavior, and immunity.* **30**: S32-S40.
- Panchkhande, N., Dewangan, R., Kalim, M. O., Sharda, R., Ratre, H. K., Sahu, D., Sidar, S. and Yadav, S. K. 2019. Incidence of mammary tumour and venereal granuloma in canine in Durg District Chhattisgarh. *Int. J. Curr. Microbiol. Appl. Sci.* **8**: 2368-2381.

- Patel, M.P., Ghodasara, D.J., Raval, S.H. and Joshi, B.P., 2019. Incidence, Gross Morphology, Histopathology and Immunohistochemistry of Canine Mammary Tumors. *Indian J. Vet. Sci. Biotechnol.* **14**: 40-44.
- Philibert, J.C., Snyder, P.W., Glickman, N., Glickman, L.T., Knapp, D.W. and Waters, D.J. 2003. Influence of host factors on survival in dogs with malignant mammary gland tumors. *J. Vet. Intern. Med.* **17**: 102-106.
- Reif, J.S., Dunn, K., Ogilvie, G.K. and Harris, C.K. 1992. Passive smoking and canine lung cancer risk. *Am. J. Epidemiol.* **135**: 234-239.
- Reif, J.S., Bruns, C. and Lower, K.S. 1998. Cancer of the nasal cavity and paranasal sinuses and exposure to environmental tobacco smoke in pet dogs. *Am. J. Epidemiol.* **147**: 488-492.
- Sorenmo, K.U., Shofer, F.S. and Goldschmidt, M.H. 2000. Effect of spaying and timing of spaying on the survival of dogs with mammary carcinoma. *J. Vet. Intern. Med.* **14**: 266-270.
- Dhami, M. A., Tank, P. H., Karle, A. S., Vedpathak, H. S. and Bhatia, A. S. 2010. Epidemiology of canine mammary gland tumours in Gujarat. *Vet. World.* **3**: 282.
- Guzman, E., Langowski, J.L. and Owen-Schaub, L. 2003. Mad dogs, Englishmen and apoptosis: the role of cell death in UV-induced skin cancer. *Apoptosis.* **8**: 315-325.
- Vascellari, M., Capello, K., Carminato, A., Zanardello, C., Baioni, E. and Mutinelli, F. 2016. Incidence of mammary tumors in the canine population living in the Veneto region (Northeastern Italy): Risk factors and similarities to human breast cancer. *Prev. Vet. Med.* **126**: 183-189. ■