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Mammary Tumors in dogs: Age, Breed, Gender, Rearing, and Diet Factors

S. Sruthi[1], K.S. Prasanna[1*], A.J.George[2], I.S Sajitha, S.N. Sudheesh[3], P.P. Varuna[4] and R. Bharathi[1]

Department of Veterinary Pathology, College of Veterinary and Animal Sciences, KVASU, Mannuthy

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Abstract

Mammary neoplasms, are the second most common canine cancer type that pose a significant health concern for the dogs. This research explores the prevalence and identifies various risk factors associated with their occurrence. Among 45 confirmed cases, mammary tumors were most common in dogs aged 8 to 12 years. Female dogs were more susceptible, attributed to estrogen's effect on mammary glands. The highest occurrence of mammary tumors was identified in Labrador Retrievers and Crossbred dogs. The highest incidence of CMTs was noted in the inguinal mammary gland. Following this, the caudal abdominal gland, cranial thoracic mammary gland, while the caudal thoracic glands accounted the least number of cases. In the current study, there was higher incidence of neoplasms in underweight dogs and in owned dogs reared in outdoors. This study provides insights into the epidemiology of mammary tumors in dogs, with respect to age, gender, breed, environmental exposures, and dietary practices as significant.

Key words: Tumor, risk factors, age.

Mammary neoplasms, or breast tumors, are the second most common type of cancer in dogs after skin tumors (Rezia *et al.,* 2009). The incidence of mammary tumors in intact female dogs is with an estimated occurrence rate of approximately 71 %. Within the spectrum of neoplastic conditions in female canines, mammary tumors comprise approximately 50% of reported cases, and a substantial 82% of these tumors are localized within the female reproductive organs (Karnik, *et al.,* 2020). It is pertinent to note that in at least 50% of cases, multiple masses are observed, with a predilection for their occurrence in the caudal mammary glands, as documented by Wey *et al.* (2000). Dogs, in their natural state, spontaneously develop these tumors.

Mammary tumors in dogs manifest a broad spectrum of sizes, ranging from minuscule millimeter-sized nodules to sizable centimeter-scale masses, with a notable propensity for clustering primarily in the caudal mammary glands. Moreover, factors such as advancing age, progesterone treatment, early-life obesity, and dietary choices parallel toobserved in humans and are associated with an augmented risk of mammary tumors in canines. As such, dogs represent a valuable model for the preclinical evaluation of novel pharmaceuticals and preventive interventions before their application in human clinical trials, thereby facilitating a deeper understanding of the disease epidemiology and factors responsible for the disease (Gupta *et al.,* 2012).

Materials and Methods

Samples

Excision biopsy samples of mammary tumour suspected growths from dogs presented to University Veterinary Hospitals, Mannuthy and Kokkalai were collected for the study

**Corresponding author* : Email : prasanna@kvasu.ac.in
[1] Department of Veterinary Pathology, College of Veterinary and Animal Sciences, KVASU, Mannuthy
[2] Department of Veterinary Pathology, College of Veterinary and Animal Sciences, KVASU, Mannuthy
[3]Department of Veterinary Surgery and Radiology, College of Veterinary and Animal Sciences, KVASU, Mannuthy
[4]Department of Veterinary Biochemistry, College of Veterinary and Animal Sciences, KVASU, Mannuthy

during the period for one-year from February 2022 to February 2023. Animal details like age, breed, sex, weight, rearing conditions, feeding pattern were collected. Portion of mammary gland affected also noted on physical examination. Tumour tissues fixed in 10 per cent neutral buffered formalin were processed by routine paraffin embedding method (Spencer and Bancroft, 2013). Paraffin embedded blocks was sectioned at four micrometre thickness using a rotary microtome and were stained by routine Haematoxylin and Eosin staining procedure

Occurrence of canine mammary tumours

The age-wise, breed-wise, sex-wise occurrence of canine mammary tumours were studied based on the clinical history of the animals. Weight of the animals, rearing conditions, feeding pattern and portion of mammary gland were analyzed to correlate the occurrence of canine mammary tumours.

Results and Discussion

This study investigated the age distribution of Canine Mammary Tumours (CMTs) in a total of 45 cases. The mean age for the occurrence of CMTs was determined to be 8.5±0.040 years. The age range of affected dogs spanned from 4 to 13 years. Susceptibility to CMTs was analysed across various age categories, revealing distinct patterns. The age range for the occurrence of CMTs in this study ranged from a minimum of 4 years to a maximum of 13 years, demonstrating the broad age spectrum within which these tumours manifest. The age category of 8 to 12 years showed the highest susceptibility to CMTs representing 34.1 per cent of the observed cases. This observation was in concordance with the study of Ariyarathna *et al.* (2018). A significant susceptibility was observed in dogs older than 12 years, constituting 50 per cent of the total cases. Statistically significant increase in susceptibility was observed with the occurencence of CMTs and increase in age ($P<0.01$).

In contrast, the age range of two to four years exhibited a relatively low susceptibility to CMTs, accounting for only 6.82 per cent of cases. The age group encompassing animals less than two years of age demonstrated the least occurrence of CMTs in this study. A prominent factor that plays a significant role in this is the influence of hormones. Many mammary tumors in dogs are known to be influenced by hormones, particularly oestrogen (Sorenmo *et al.,* 2000). Young dogs typically have lower levels of sex hormones, including estrogen, before they reach sexual maturity. These hormones are known to play a critical role in the initiation and progression of mammary tumors. Therefore, the reduced exposure to hormones in younger dogs can account for the decreased incidence of CMTs in this age group.

The highest occurrence of CMTs was identified in Labrador Retrievers and Crossbred dogs. The lowest incidence was recorded in Golden Retrievers. The results was in accordance to the previous studies (Karnik *et al.*, *loc. cit.*; Senthil *et al.*, 2020). The increased occurrence of CMTs in Labrador Retrievers and Crossbred dogs is probably linked to genetic elements that affect the likelihood of developing mammary cancer. Crossbred dogs, with their wide array of genetic origins, might display differing degrees

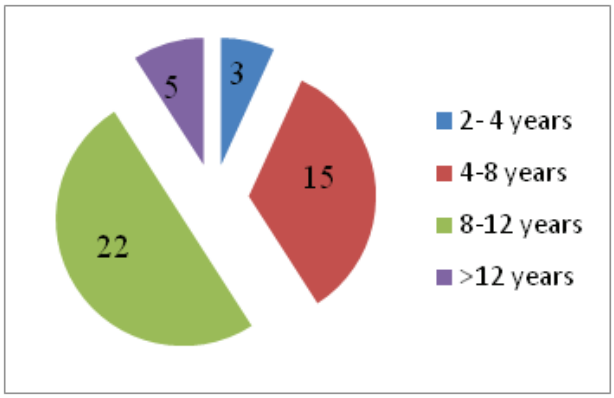

Fig. 1. Age wise occurrence of CMTs (n = 45)

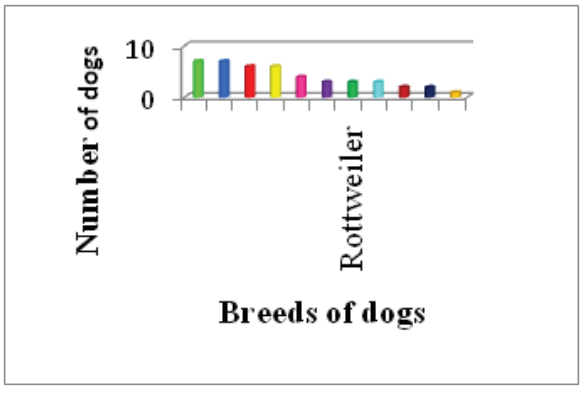

Fig. 2. Breed wise occurrence of neoplasms (n = 45)

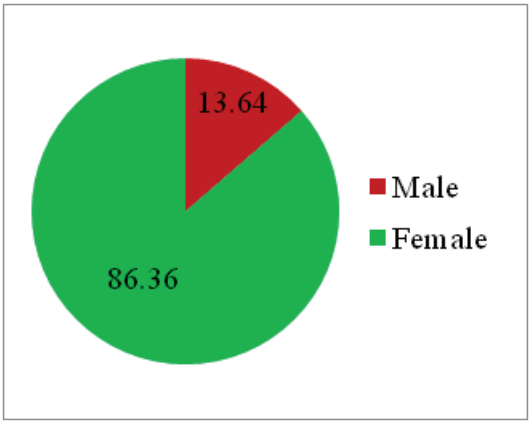

Fig. 3. Gender wise occurrence of neoplasms in dogs (n = 45)

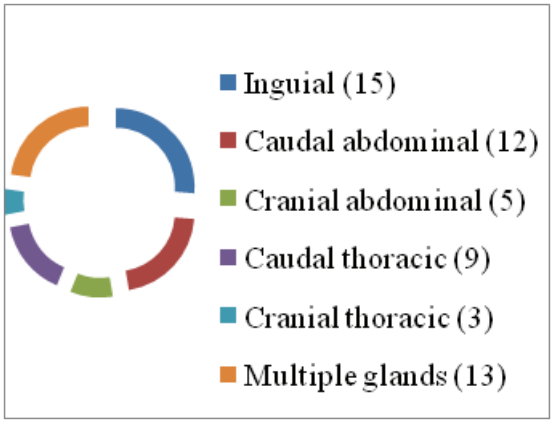

Fig. 4. Gland wise occurrence of CMTs (n = 45)

of vulnerability to CMTs, depending upon the specific breeds contributing to their genetic composition.

The occurrence of CMTs exhibited a notable gender-based disparity within the study population with highest in female dogs. Specifically, 86.67 per cent of the cases (39 out of 45) were observed in female dogs, while male dogs accounted for 13.33 per cent of the cases (6 out of 45) (Fig.3). Dhami *et al.* (2010) observed similar findings in their studies. Extended exposure to progesterone during pregnancy and pseudo pregnancy has been associated with an increased likelihood of mammary tumor occurrence. Female dogs typically possess more extensive mammary tissue that contains receptors for oestrogen. These receptors render mammary tissue more susceptible to the effects of oestrogen and progesterone, both of which can stimulate the growth of mammary tumors (Misdorp, 2002). Circulating levels of Progesterone (P4), estrone sulphate (E1SO4), androstenedione (A4), dehydroepiandrosterone (DHEA), and 17-estradiol (E2) were higher in female dogs with CMTs compared to begin tumours, dysplasias and normal mammary gland (Pena *et al.*, 2003). Some earlier reports of male dog mammary neoplasia linked the tumours to hormonal disorders, especially when they were associated with testicular neoplasms (Raflo and Diamond 1980). Testicular neoplasia or other abnormalities of the testicles were not documented in the past for any of the dogs in our investigation for which a comprehensive history was available. Furthermore, there was no history of sex hormone treatment, diabetes, or obesity.

In the current study, there was a higher incidence of neoplasms in underweight dogs compared to those with a normal body weight (Table I). The prevalent reason for the majority of animals being underweight could be attributed to cancer cachexia associated with malignant neoplasms, as reported by Arnold *et al.* (2011).

The highest incidence of CMTs was noted in the inguinal mammary gland. Following this, the caudal abdominal gland, cranial thoracic mammary gland, while the caudal thoracic glands accounted for least number of cases. Baba and Catoi (2007) and Nithya *et al.* (2018) got similar findings as the posterior glands are commonly affected with CMTS. Panchkhande *et al.* (2019) also reported that highest incidence of CMTs occur in the inguinal glands. Dhami *et al.* (2010) also documented a comparable pattern of increasing involvement, starting from the cranial thoracic glands and extending down to the inguinal glands. Female dogs typically possess eight to 10 pairs of mammary glands that are positioned along their abdomen and chest.

This arrangement of mammary glands can influence the probability of tumor development in various anatomical regions. Impact of estrogen and progesterone, have a significant role in the initiation of mammary tumors. The mammary glands located in the inguinal and abdominal areas are more susceptible to hormonal fluctuations and, consequently, are more prone to hormone-related tumors due to

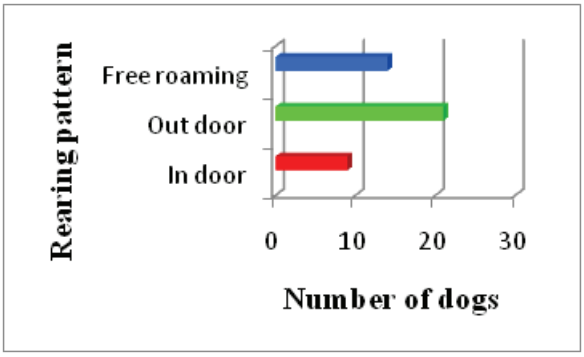

Fig 5. Rearing pattern of dogs affected with CMTs (n= 45)

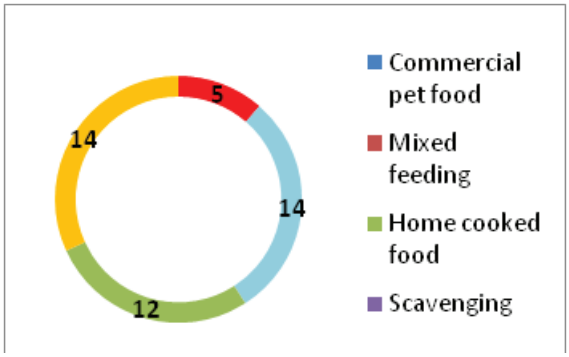

Fig 6. Feeding pattern of dogs affected with CMTs (n = 45)

their proximity to the ovaries. The inguinal mammary gland is especially vulnerable to hormonal effects because it tends to be active during pregnancy and lactation, periods when hormonal fluctuations are more prominent (Sorenmo *et al.,* 2003). A statistically significant increase in susceptibility of the occurrence of CMTs from ascending to descending pairs of mammary glands were observed (P<0.01).

The higher prevalence of neoplasms in owned dogs reared in outdoors might be associated with elevated exposure to environmental carcinogens. This exposure includes factors such as ultraviolet rays, as noted by Guzman *et al.* (2003), as well as the improper burning of household waste and exposure to automobile exhaust, as reported by Sasco (2008).

Table. Body weight of the dogs affected with CMTs (n = 45)

Body weight range (kg)	<15	15-20	<25
Number of dogs	18	16	11

While the current study could not definitively determine the potential impact of foods on cancer, it did observe a higher incidence of neoplasms in dogs that free roaming. This observation could be attributed to the potential presence of environmental carcinogens that may have contaminated the food.

In the entire group of 45 dogs analyzed in this study, it was found that only 5 dogs had a confirmed history of previously diagnosed CMTs at some point in their medical records. These findings align with Neeman and Ben-Eliyahu (2013), who noted that surgical trauma can trigger specific factors that have the potential to affect cancer recurrence. Additionally, Ceelen *et al.* (2014) reported that surgery-induced vascular endothelial growth factor (VEGF) may enhance the regrowth of cancer stem cells.

Summary

The observations from the present study highlights the multifaceted nature of canine mammary carcinoma, with factors such as age, gender, breed, environmental exposures, dietary habits, and histopathological characteristics playing important roles in its occurrence and development. Further research is needed to establish causal relationships between certain factors and CMT and to explore potential preventive measures and treatments.

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