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Prevalence and pathological features of canine mammary tumors

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Abstract
The present study examined 50 spontaneous canine mammary tumors to assess their distribution based on age, breed, and glandular involvement, along with their gross, cytological, and histopathological features. Mammary tumors were most frequently observed in middle-aged female dogs, with a mean age of eight years and a peak incidence between six and eight years. Labrador Retrievers were the most commonly affected breed, followed by non-descriptive breeds, Golden Retrievers, and Dachshunds. All affected dogs were females, predominantly intact, indicating a strong hormonal influence in tumor development. The caudal abdominal and inguinal glands, especially on the left mammary chain, were the most frequently involved sites. Grossly, the tumors varied from well-circumscribed solitary nodules to large, multifocal, ulcerated, or cystic masses. Malignant tumors accounted for 70% of the total cases, while benign and hyperplastic lesions comprised the remainder. Cytological evaluation of malignant tumors revealed high cellularity, marked pleomorphism, and a high nuclear-to-cytoplasmic ratio, whereas benign tumors exhibited cellular uniformity and low mitotic activity. Histopathologically, tubular carcinoma was the most prevalent malignant subtype, followed by complex and cystic papillary carcinomas, while simple adenomas were the most common benign lesions. The observed histological patterns were consistent with established classifications of canine mammary neoplasia, validating the use of cytology as a reliable diagnostic tool. Overall, the findings emphasize that spontaneous mammary tumors are common in intact, middle-aged female dogs, with the caudal mammary glands being the most affected sites, highlighting the importance of early cytological screening and histopathological evaluation for accurate diagnosis and management of canine mammary neoplasia.

Keywords: Canine mammary tumors, cytology, histopathology, neoplasia, breed predisposition, hormonal influence

Introduction
Cancer is a major life-threatening disease affecting both humans and animals, with dogs being particularly susceptible to neoplasms, which are a significant cause of morbidity and mortality (Roshni *et al.*, 2013) [20]. Among canine tumors, mammary gland tumors (MGTs) are the most frequently diagnosed in intact females, second only to skin tumors in overall incidence (Sorenmo, 2003; Goldschmidt *et al.*, 2011) [25, 10]. These tumors arise from abnormal cellular proliferation due to genetic, hormonal, or environmental disruptions, with risk factors including breed, reproductive status, hormonal influences, nutrition, and exposure to carcinogens (Dhami *et al.*, 2010; Roshni *et al.*, 2013; Vascellari *et al.*, 2016 and Senthil *et al.*, 2018) [7, 20, 26, 23]. Epidemiologically, MGT prevalence ranges from 23.6% to 70% of all neoplasms in female dogs, with malignancy rates between 50% and 96% (Merlo *et al.*, 2008; Vascellari *et al.*, 2016; Santos *et al.*, 2020; Egenvall *et al.*, 2020; Goldschmidt *et al.*, 2011; John *et al.*, 2022 and Devraj, 2024) [14, 26, 21, 9, 10, 11, 6]. The disease predominantly affects middle-aged to older bitches, particularly between 8 and 12 years, and shows breed predisposition in Spitz, German Shepherds, Dachshunds, and Labradors, with females being almost exclusively affected (Dhami *et al.*, 2010; Canadas *et al.*, 2019; Raposo-Ferreira *et al.*, 2021; Vascellari *et al.*, 2016; John *et al.*, 2022; Rokad *et al.*, 2023 and Zheng *et al.*, 2022) [7, 3, 17, 26, 11, 19, 27]. Early spaying significantly reduces risk, whereas intact bitches have a higher incidence, highlighting the hormonal influence on tumor development (Schneider *et al.*, 1969; Senthil *et al.*, 2018; Zheng *et al.*, 2022 and Devraj, 2024) [22, 23, 27, 6].

Mammary tumors most frequently occur in the caudal abdominal and inguinal glands, likely due to greater size, secretory activity, and hormonal sensitivity (Meuten, 2016; Dolka *et al.*, 2018; and Santos *et al.*, 2020) [15, 8, 21]. Grossly, they range from small nodules to large ulcerated masses, sometimes invading adjacent tissues (Goldschmidt *et al.*, 2011; Devarathnam *et al.*, 2021 and Devraj, 2024) [10, 5, 6]. Cytological and histopathological examinations are critical for accurate diagnosis and classification, with simple carcinomas being most common, followed by complex and mixed types (Raposo-Ferreira *et al.*, 2021; Nadhiya *et al.*, 2020 and Devarathnam *et al.*, 2021) [17, 16, 5]. Given their high prevalence, diverse biological behavior, and clinical significance, canine mammary gland tumors remain a major concern in veterinary oncology. Understanding their occurrence, morphology, and associated risk factors is essential for improving diagnosis, prognosis, and therapeutic management in affected dogs.

Materials and Methods

The study was carried out at the Department of Veterinary Pathology, Veterinary college, Hebbal, Bengaluru. A total of 50 cases of spontaneously occurring mammary gland tumors submitted to Department of Veterinary Pathology over a period of nine months from Veterinary College Hospital, Bengaluru and from constituent hospitals of KVAFSU for diagnosis were collected. Clinical data such as breed, age, sex, reproductive status, site of occurrence and number of glands affected were recorded. For cytology the sample were collected through fine needle aspiration and subjected for Giemsa staining and Field's staining. For histopathology representative tissue samples obtained after surgical excision were fixed in 10 percent neutral buffered formalin immediately and processed by routine paraffin embedding technique.

Ethical approval

The study protocol was reviewed and approved by Institutional Animal Ethics Committee (IAEC), Veterinary College, Hebbal, Bengaluru. All of the investigated samples were obtained for diagnostic purposes as part of routine and standard care. Procedures were designed to avoid or minimise discomfort, distress and pain. IAEC approval number: VCH/IAEC/2025/37.

Results

Occurrence of mammary gland tumors

In this study, 50 spontaneous mammary gland tumor cases were examined, involving 108 glands—28 with multiple and 22 with single gland involvement. The largest tumor from each case was analyzed, revealing 13 benign (26%), 35 malignant (70%), and 2 hyperplastic (4%) tumors.

Age

The age of occurrence of mammary gland tumors ranged from 1 to 15 years, with a mean age of 8 years. The highest incidence (32%) was recorded in the 6-to-8-year age 54 group, followed by 26 Percent in 4 to 6 years, 20 Percent in 8 to 10 years, 10 Percent in 10 to 12 years, 8 Percent in 12 to 14 years, 2 Percent in 14 to 15 years, and 2 Percent in 0 to 2 years (Table-1).

Breed

Breed-wise analysis of mammary tumor incidence revealed the highest occurrence in Labrador Retrievers (38%), followed by non-descriptive breeds (20%), Golden Retrievers (10%), Dachshunds (8%), German Shepherds (6%), Pomeranians (6%), and Shih Tzu (4%). Mudhol, Great Dane, Cocker Spaniel, and Beagle each constituted 2 Percent of the cases (Table-2).

Sex and reproductive status

In the present study, mammary tumors were recorded exclusively in female dogs, of which 43 were intact and 7 were neutered (Table-3).

Gland wise occurrence

In this study, the left mammary gland chain was more frequently affected (62 tumors, 57.98%) than the right chain (46 tumors, 42.57%). Tumor distribution was highest in the caudal abdominal glands (36.11%), followed by the inguinal (27.63%), cranial abdominal (18.50%), caudal thoracic (13.88%), and cranial thoracic glands (5.55%) (Table 4). Regardless of the chain, caudal glands showed the highest susceptibility (36.11% and 27.63%), while cranial thoracic glands were least affected (5.55%), with moderate involvement of cranial abdominal (18.5%) and caudal thoracic glands (13.88%).

Gross pathology

Grossly, mammary tumors varied in size (2-20 cm) and shape. They appeared as single firm well-defined masses (Fig-01), single firm ulcerative masses (Fig-02), multiple nodular firm masses (Fig-03), or single ulcerative proliferative growths (Fig-04). Some presented as multiple irregular ulcerative nodules (Fig-05). Shapes ranged from ovoid and round to lobular or poorly defined, with most tumors well demarcated though some invaded adjacent tissue. Consistency varied from soft or firm to fluid-filled or bony hard. On cut surface, tumors were yellow to white (Fig-06), pink or greyish white with necrosis and hemorrhage (Fig-07), and occasionally contained cysts with creamy to reddish-brown fluid (Fig-08). Tumors with cartilaginous or osseous tissue (Fig-09) were firm and difficult to section, while some showed a predominantly white, highly cellular surface (Fig-10).

Cytology

In animals with multiple gland involvement, the largest tumor was sampled using impression smears or FNAC. Of 50 samples, 13 (26%) were adenomas, 35 (70%) carcinomas, and 2 (4%) hyperplastic lesions. Carcinomas showed high cellularity with epithelial cells arranged singly or in clusters, sometimes forming acini. Cells were round to oval with eccentric nuclei, marked pleomorphism, coarse chromatin (Fig-11), binucleation, and prominent nucleoli (Fig-12). A high nuclear-to-cytoplasmic ratio and cytoplasmic basophilia were common (Fig-13). Myoepithelial cells appeared spindle-shaped with dense nuclei and occasional vacuoles (Fig-14). Mixed tumors contained osteocytes and osteoid material (Fig-15). Squamous cell carcinomas exhibited variably differentiated cells with abundant basophilic cytoplasm, hyperchromatic nuclei, and perinuclear vacuolation, along with polymorphonuclear and multinucleated cells (Fig-16). Malignant myoepitheliomas showed oval to spindle cells (Fig-17) with basophilic cytoplasm, vacuoles, elongated nuclei, and a myxoid matrix (Fig-18). Adenomas displayed moderate to high cellularity with uniform cells, mild anisocytosis, and fine granular chromatin (Fig-19).

Histopathology

The canine mammary gland tumors were classified according to Goldschmidt *et al.* (2011) into malignant, special and benign types, and further classified into specific subtypes.

Among the 50 mammary gland tumors, n = 2 (4%) cases were duct ectasia, n = 13 (26.0 %) cases were benign and n = 35 (70.0 %) cases were malignant, out of 35 malignant tumors n = 26 (74.28 %) cases were classified as malignant epithelial tumors, n = 7 were diagnosed as a malignant epithelial neoplasm of special types (20.0 %) and n = 2 were diagnosed as carcinosarcoma types upon histopathological examination (5.72 %) (Table-5). The 35 malignant tumors were classified into distinct types according to the cell populations involved, patterns of cellular arrangement, participation of glandular and/or myoepithelial components, and the presence of heterologous tissues such as bone or cartilage.

The categories included tubular carcinoma, tubulo-papillary carcinoma, cystic papillary carcinoma, comedocarcinoma, complex carcinoma, squamous cell carcinoma, malignant myoepithelioma, complex carcinoma and carcinosarcoma. Among the 35 malignant mammary gland tumors, tubular carcinoma was the most frequently observed type, accounting for 25.71 Percent. This was followed by complex carcinoma (20.00%), cystic papillary carcinoma (14.28%), malignant myoepithelioma (14.28%), tubulo-papillary carcinoma (11.42%), squamous cell carcinoma (5.71%), carcinosarcoma (5.71%), and comedocarcinoma (2.85%). Among the thirteen cases of benign neoplasm of mammary gland tumors, simple adenoma was the most common type, constituting for 53.84 Percent of occurrences, followed by myoepithelioma (23.07%), complex adenoma (15.38%) and benign mixed tumor (7.69%) (Table-5).

Among malignant epithelial neoplasms (n = 26), simple carcinomas (n = 18) were classified into tubular, tubulo-papillary, and cystic-papillary types. The tubular type (n = 9) showed tubules lined by double to multiple layers of neoplastic cells, some distended with eosinophilic necrotic material (Fig-20), moderate pleomorphism, mitotic activity, and round to oval nuclei with coarse chromatin. The stroma showed mononuclear infiltration and focal hyalinization. The tubulo-papillary type (n = 4) exhibited neoplastic tubules forming pedunculated papillae on fibrovascular stroma, lined by multiple layers of cells with hypochromic nuclei, variable nucleoli, and eosinophilic cytoplasm (Fig-21), with variable mitotic activity. The cystic-papillary type (n = 5) had papillae projecting into dilated cystic lumina containing eosinophilic flocculent material mixed with degenerating granulocytes and foamy macrophages (Fig-22). Complex carcinoma (n = 7) combined malignant epithelial cells forming irregular tubules with cuboidal to columnar cells and benign spindle-shaped myoepithelial cells embedded in a myxoid matrix (Fig-23). Comedocarcinoma (n = 1) showed central necrotic foci within cell clusters, with surrounding cells forming solid nests, cords, or tubules on delicate fibrovascular stroma (Fig-24). Among special types of malignant epithelial neoplasms (n = 7), squamous cell carcinoma (n = 2) displayed islands and cords of large epithelial cells forming keratin pearls with intercellular bridges and inflammatory infiltration (Fig-25), malignant myoepithelioma (n = 5) consisted of oval to spindle-shaped cells with basophilic cytoplasm and myxoid matrix (Fig-26), and malignant mixed mammary tumor/carcinosarcoma (n = 2) contained malignant epithelial cells in nests and sheets alongside spindle-shaped mesenchymal cells showing osteoid or chondroid differentiation (Fig-27).

Among benign tumors (n = 13), simple adenomas (n = 7) were well-demarcated nodules of tubules lined by cuboidal to columnar cells with minimal anisocytosis or anisokaryosis (Fig-28). Complex adenomas (n = 2) showed epithelial and myoepithelial proliferations with fibrous stroma, the myoepithelial cells embedded in basophilic myxoid matrix (Fig-29). Benign mixed tumor (n = 1) contained epithelial and myoepithelial cells, with foci of cartilage or bone in fibrous stroma (Fig-30). Myoepithelioma (n = 3) exhibited spindle-shaped or round myoepithelial cells in basophilic myxoid matrix with minimal anisocytosis (Fig-31). Hyperplasia and duct ectasia (n = 2) showed cystic dilation of large ducts containing necrotic debris, foamy macrophages, lipid material, and cholesterol clefts (Fig-32).

Table 1: Age-wise incidence of canine mammary gland tumors.

Age Group (years)	Incidence	Incidence Rate (%)
0 to 2	1	2
4 to 6	13	26
6 to 8	16	32
8 to 10	10	20
10 to 12	5	10
12 to 14	4	8
14 to 15	1	2
Total	50	100

Table 2: Breed-wise susceptibility of mammary gland tumors

Breed	Occurrence	Percent Occurrence (%)
Labrador Retriever	19	38
Non-descript	10	20
Golden retreiver	5	10
Dachshund	4	8
Pomeranian	3	6
German Shepherd	3	6
Schitzu	2	4
Cocker spaniel	1	2
Beagle	1	2
Great dane	1	2
Mudhol	1	2
Total	50	100

Table 3: Reproductive status of dogs with mammary gland tumors

Reproductive status	No. of dogs	Percent Incidence (%)
Intact	43	86
Neutered	7	14

Table 4: Glandular distribution of canine mammary gland tumors

Gland	Right chain	Percentage (%)	Left chain	Percentage (%)	Total	Total percentage (%)
Cranial thoracic	0	0	6	5.55	6	5.55
Caudal thoracic	4	3.70	11	10.18	15	13.88
Cranial abdominal	10	9.25	10	9.25	20	18.50
Caudal abdominal	17	15.74	22	20.37	39	36.11
Inguinal	15	13.88	13	12.63	28	26.51
Total	46	42.57	62	57.98	108	100

Table 5: Histopathological classification of canine mammary tumors

I. Malignant epithelial neoplasms (n = 26)		No. of cases	Percentage (%) (Individual)	Percentage (%) (Total)
1.	Simple carcinoma-(n = 18)			
	Tubular	9	25.71	36.00
	Tubulo-papillary	4	11.42	
	Cystic papillary	5	14.28	
2	Carcinoma Complex	7	20.00	14.00
3	Carcinoma-Comedo	1	2.85	2.00
Total		26	74.28	52.00
II. Malignant Epithelial Neoplasms-Special Type (n = 7)				
1	Squamous cell carcinoma	2	5.71	4.00
2	Malignant myoepithelioma	5	14.28	10.00
Total		10	20.00	14.00
III. Carcinosarcoma-(n = 2)		2	5.72	4.00
Grand Total		35	100.00	70.00
IV. Benign neoplasm (n = 13)				
1	Adenoma-simple	7	53.84	14.00
2	Complex adenoma	2	15.38	4.00
3	Benign mixed tumor	1	7.69	2.00
4	Myoepithelioma	3	23.07	6.00
Total		13	100.00	26.00
V. Hyperplasia/Dysplasia (n = 2)				
1	Duct ectasia	2	100.00	4.00

Fig 1: Gross picture of mammary gland tumor appearing as a single, firm, well-defined growths affecting the left inguinal mammary gland.

Fig 3: Gross picture of mammary gland tumor appearing as a multiple nodular, firm, well-defined growth affecting the both left and right mammary chain.

Fig 2: Gross picture of mammary gland tumor appearing single firm ulcerative mass affecting the left caudal abdominal mammary gland

Fig 4: Gross picture mammary gland tumor showing single, firm, well-defined masses with multiple infiltrative growths affecting the left inguinal mammary gland.

Fig 5: Gross picture of mammary gland tumor appearing multiple nodular, firm ulcerative mass affecting the right cranial abdominal mammary gland.

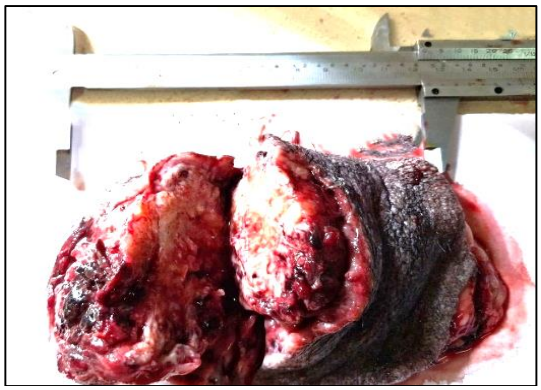

Fig 9: Gross picture of mammary gland tumor on cut surface containing heterogeneous tissues, such as cartilaginous and osseous components.

Fig 6: Gross picture of mammary gland tumor on cut surface, the tumors showed variable colors initially appeared yellow to white.

Fig 10: Gross picture of mammary gland tumor showed a predominantly white cut surface with a distinctly cellular texture.

Fig 7: Gross picture of mammary gland tumor on cut surface showed pink or greyish white, often exhibiting areas of necrosis and hemorrhage.

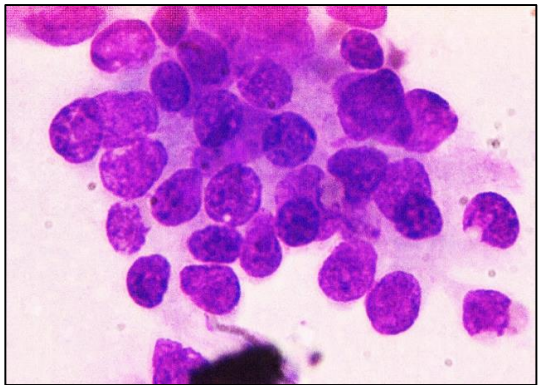

Fig 11: Cytological picture of carcinoma showing coarse chromatin and basophilic cytoplasm.
Field's X 1000

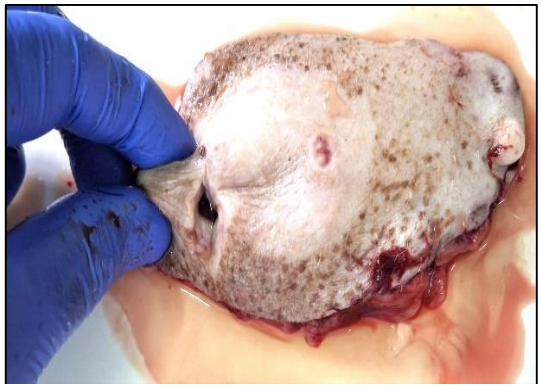

Fig 8: Gross picture of mammary gland tumor on cut surface tumors revealed multiple cysts of varying sizes filled with creamy to reddish-brown fluid or mucoid material.

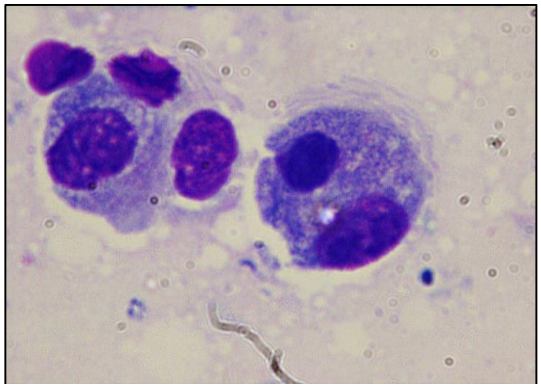

Fig 12: Cytological picture of carcinoma showing coarse chromatin and binucleated with single to multiple nucleoli.
Giemsa X 1000

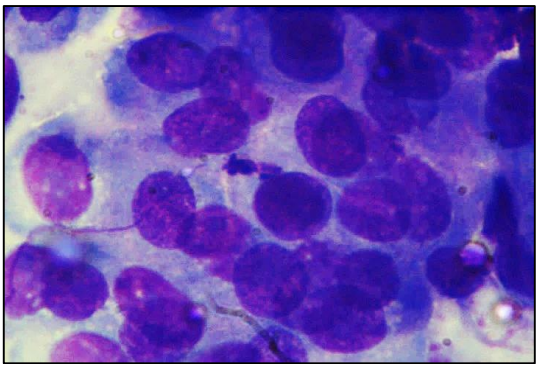

Fig 13: Cytological picture of carcinoma showing anisocytosis, anisokaryosis, basophilic cytoplasm and high nuclear to cytoplasmic ratio.
Giemsa X 1000

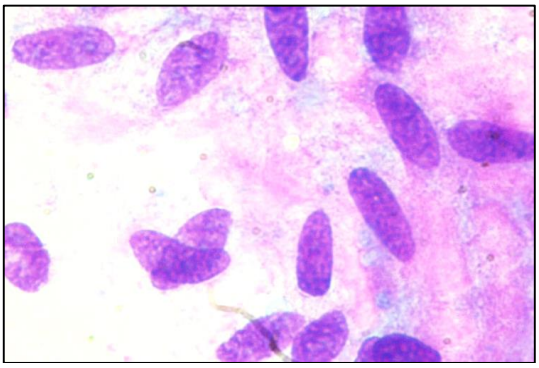

Fig 14: Cytological picture of Myoepithelial cells displayed a spindle-shaped form with elongated, dense nuclei and occasional cytoplasmic vacuolation.
Giemsa X 1000

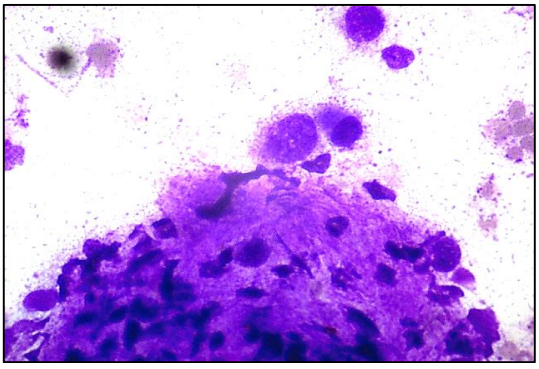

Fig 15: Cytological picture of mixed tumor exhibited osteoblast cells with round to oval shaped cells showing osteoid deposits in the around the cells.
Giemsa X 1000

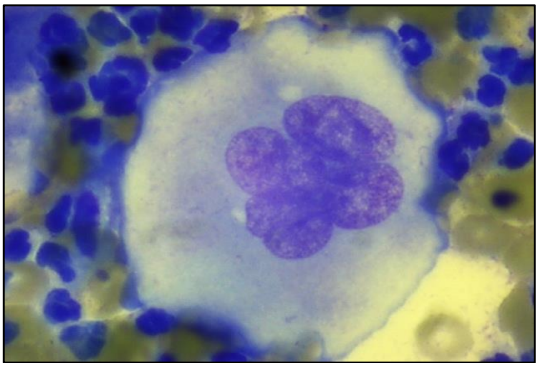

Fig 16: Cytological picture of squamous cell carcinoma showing large neoplastic squamous epithelial cells having multinucleation.
Giemsa X 1000

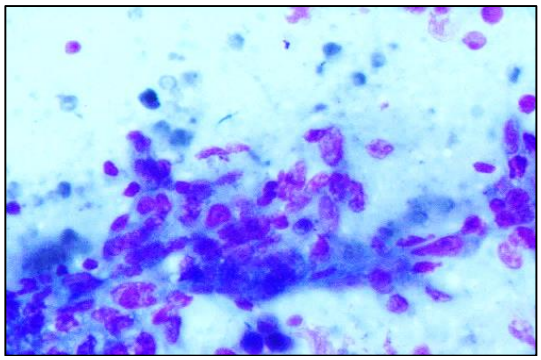

Fig 17: Cytological picture Malignant myoepithelioma showed oval to spindle-shaped cells with indistinct cell borders and a moderate amount of basophilic cytoplasm, occasionally containing intracytoplasmic clear vacuoles.
Field's X 400

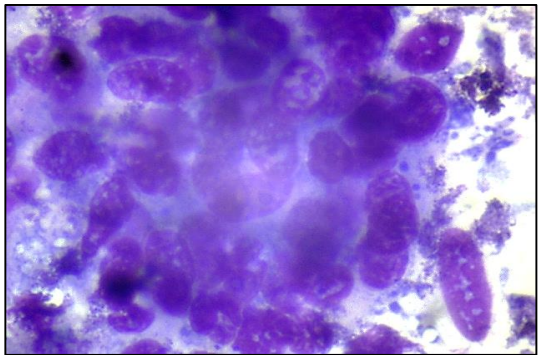

Fig 18: Cytological picture of malignant myoepithelioma exhibited spindle-shaped cells with elongated dense nuclei, occasional cytoplasmic vacuolations and blueish myxoid deposits.
Giemsa X 1000

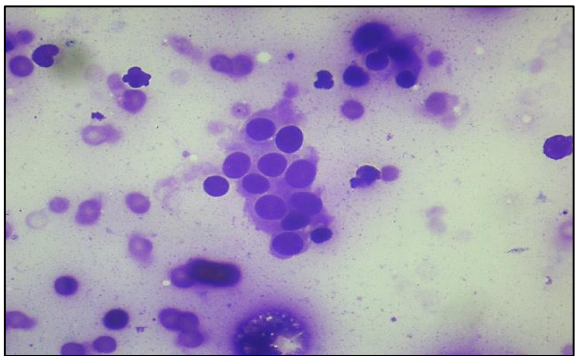

Fig 19: Cytological picture of adenoma showing glandular epithelial cells with less cellularity, uniform size and less intense chromatin.
Giemsa X 400

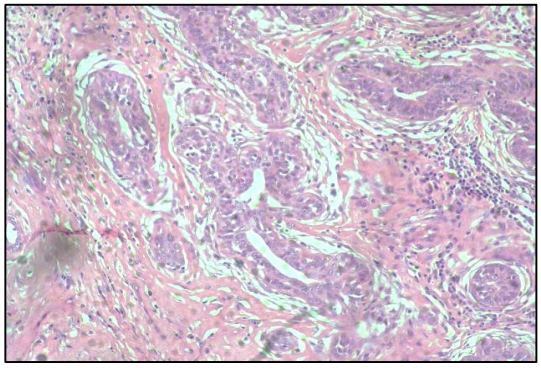

Fig 20: Histological section of tubular carcinoma with neoplastic epithelial cells predominantly arranged in a tubular fashion.
H&E X100

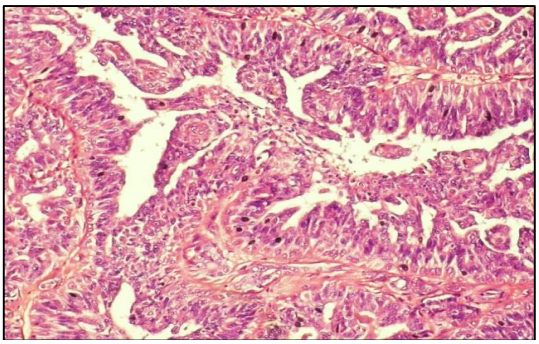

Fig 21: Histological section of tubulo-papillary carcinoma with the neoplastic cells are predominantly arranged in a pedunculated papillary fashion.
H&E X100

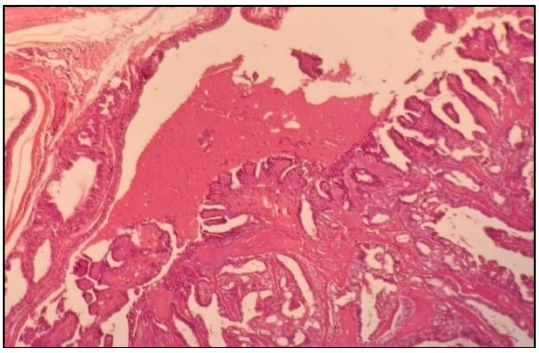

Fig 22: Histological section of cystic papillary carcinoma with neoplastic cells arranged in papillary pattern along with cystic spaces filled with secretory products and desquamated neoplastic cells.
H&E X 40

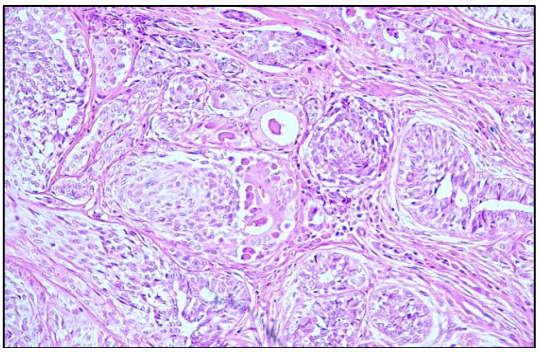

Fig 23: Histological section of Complex-type carcinoma has a malignant epithelial component arranged in tubule and a benign myoepithelial component arranged in irregular bundles with a fibrillar basophilic (myxoid) matrix.
H&E X100

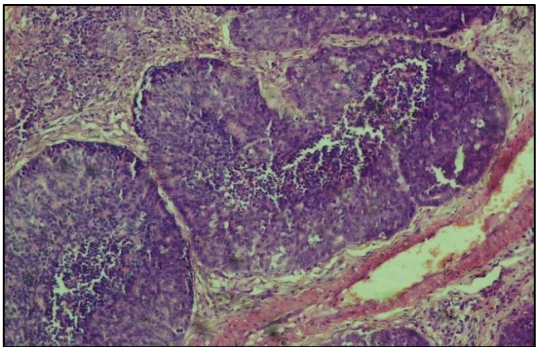

Fig 24: Histological section of Comedocarcinoma showing the presence of necrotic areas within the centre of the neoplastic cell aggregates
H&E X 100

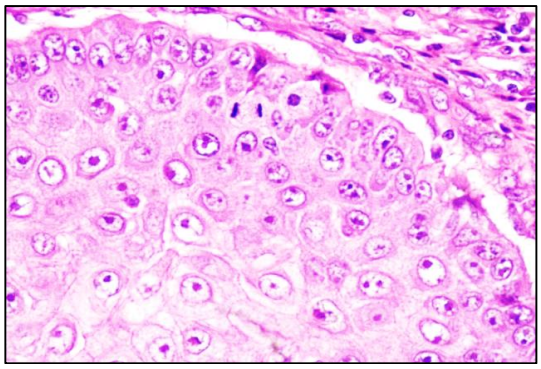

Fig 25: Histological section of squamous cell carcinoma with tumor cells were large, with prominent nuclei, and produced intracytoplasmic keratin tonofilaments; intercellular bridges.
H&E X 400

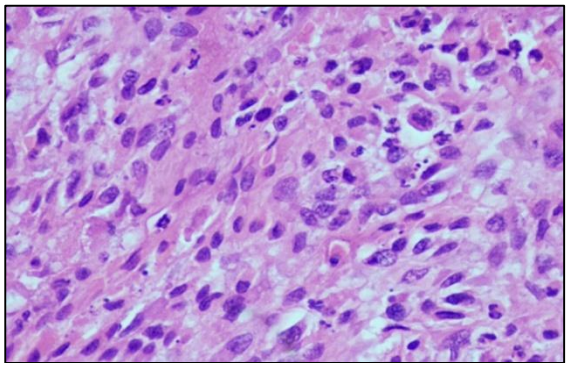

Fig 26: Histological section of malignant myoepithelioma showing neoplastic cells were oval to spindle-shaped.
H&E X 40

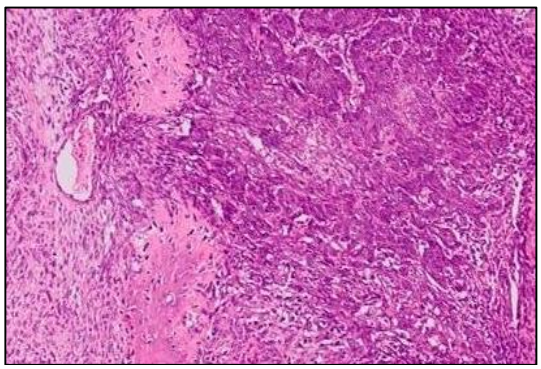

Fig 27: Histopathology of carcinosarcoma showed the presence of both malignant epithelial and mesenchymal components.
H&E X 100

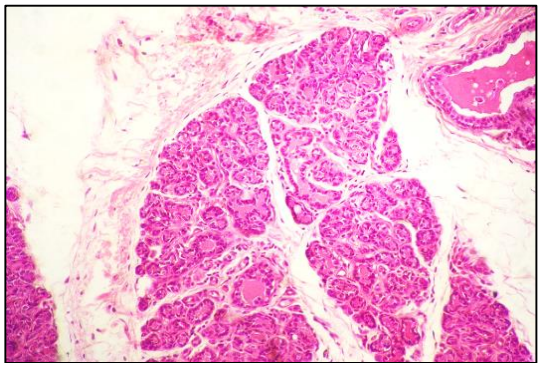

Fig 28: Histological section of Simple adenomas showing well-demarcated non-infiltrative nodular lesions composed of cells arranged in tubules.
H&E X 100

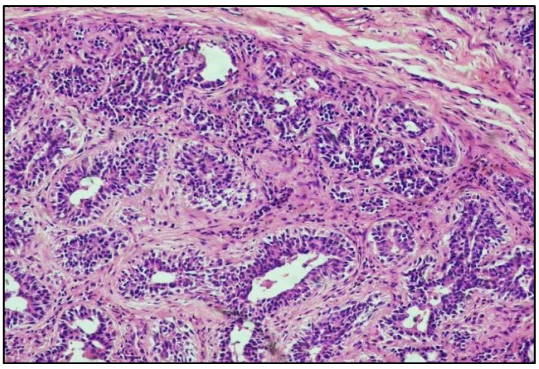

Fig 29: Histological section of Complex adenoma has both epithelial (tubular) and myoepithelial proliferation.
H&EX100

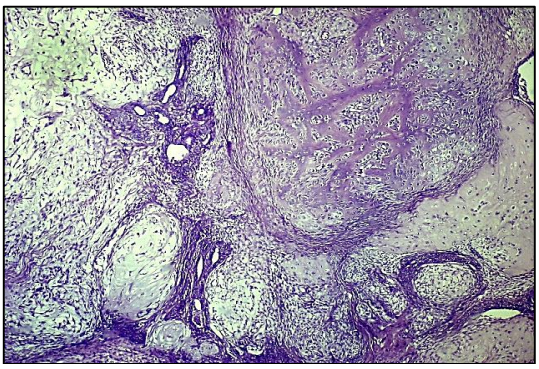

Fig 30: Histological section of Benign mixed tumor showing the ductal and myoepithelial cells with foci of chondroid and osseous differentiation.
H&E X 40

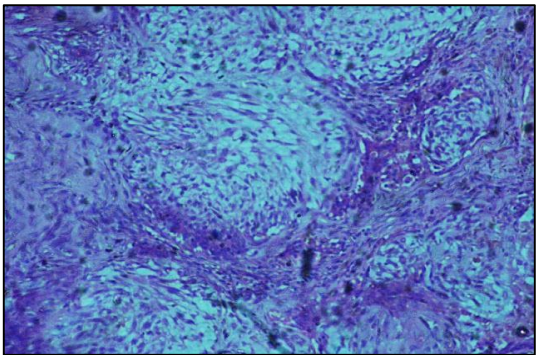

Fig 31: Histological section of Myoepithelioma showing spindle to round myoepithelial cells in a basophilic myxoid matrix with minimal atypia and absent mitoses.
H&E X 100

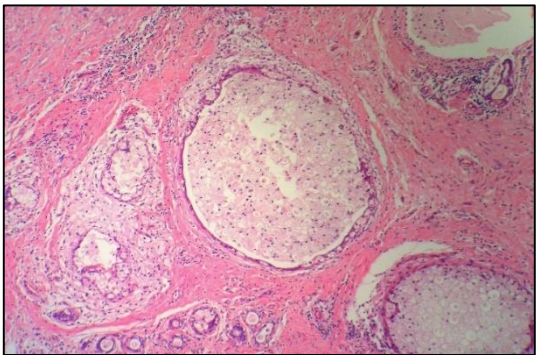

Fig 32: Histological section of Duct ectasia showed cystic dilation of large ducts was observed, with luminal accumulation of necrotic debris, variable numbers of foamy macrophages admixed with lipid material, and cholesterol clefts.
H&E X 400

Discussion

In this study, 50 canine mammary tumor cases involving 108 glands were recorded, with 28 showing multiple gland involvement. Histopathologically, 70% were malignant, 26% benign, and 4% hyperplastic, consistent with previous reports on prevalence and malignancy rates (Sorenmo, 2003; Vascellari *et al.*, 2016 and Kumar and Parasar, 2020) [25, 26, 13]. Affected dogs ranged from 1-15 years, with a mean age of 8 years and peak incidence at 6-8 years, confirming that mammary tumors predominantly affect middle-aged to older bitches (Chang *et al.*, 2005; Raposo-Ferreira *et al.*, 2021) [4, 17]. Breed predisposition was highest in Labrador Retrievers (38%), in agreement with Indian studies (Nadhiya *et al.*, 2020; Senthil *et al.*, 2018) [16, 23], though regional variations exist. Tumors occurred exclusively in females, mostly intact, emphasizing the role of reproductive hormones in tumor development (Schneider *et al.*, 1969; Senthil *et al.*, 2018 and Devarathnam *et al.*, 2021) [22, 23, 5]. Caudal abdominal and inguinal glands, particularly on the left side, were most commonly involved (Anjan Kumar, 2009; Dolka *et al.*, 2018 and Rokad *et al.*, 2023) [2, 8, 19].

Grossly, tumors varied from 2-20 cm, appearing as single or multiple nodular, ulcerative, or proliferative masses with diverse shapes, consistency, and cut surfaces, including cystic, cartilaginous, and osseous areas (Goldschmidt *et al.*, 2011; Dolka *et al.*, 2018 and Devraj, 2024) [10, 8, 6]. Cytologically, carcinomas predominated (70%) with high cellularity, pleomorphism, and elevated nuclear-to-cytoplasmic ratio, whereas benign lesions were uniform with minimal atypia (Allen *et al.*, 1986; Simon *et al.*, 2009) [1, 24]. Histopathologically, tubular carcinoma (25.7%) was most frequent, followed by complex carcinoma (20%) and cystic-papillary carcinoma (14.3%), with rare forms including comedocarcinoma, squamous cell carcinoma, carcinosarcoma, and malignant myoepithelioma (Kim *et al.*, 2018; Rasotto *et al.*, 2017 and Devraj, 2024) [12, 18, 6]. Benign tumors were mainly simple adenomas (53.8%), with myoepithelioma and complex adenoma also observed (Nadhiya *et al.*, 2020) [16]. These findings reinforce the heterogeneity of canine mammary tumors and the importance of cytological and histopathological evaluation for accurate diagnosis and management.

Conclusion

In this study of 50 canine mammary tumor cases involving 108 glands, 70% were malignant, 26% benign, and 4% hyperplastic, predominantly affecting middle-aged to older female dogs with a mean age of 8 years and peak incidence at 6-8 years. Breed predisposition was highest in Labrador Retrievers (38%), followed by non-descriptive breeds (20%) and Golden Retrievers (10%), with tumors occurring exclusively in females, 86% of which were intact, emphasizing the role of reproductive hormones. Caudal abdominal (36.1%) and inguinal (27.6%) glands, especially on the left side (57.98%), were most commonly involved. Grossly, tumors ranged from 2 to 20 cm, with variable shapes, consistency, and cut surfaces, including cystic, cartilaginous, and osseous components. Cytologically, carcinomas predominated (70%) with high cellularity, pleomorphism, and elevated nuclear-to-cytoplasmic ratio, while benign lesions were uniform with minimal atypia. Histopathologically, tubular carcinoma was the most frequent malignant subtype (25.7%), followed by complex carcinoma (20%) and cystic-papillary carcinoma (14.3%),

with rarer forms including comedocarcinoma, squamous cell carcinoma, carcinosarcoma, and malignant myoepithelioma; benign tumors were mainly simple adenomas (53.8%), with myoepithelioma and complex adenoma also observed. These findings confirm the heterogeneity of canine mammary tumors, their predominance in intact middle-aged females, and the diagnostic importance of cytological and histopathological evaluation for accurate management.

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