

Pathomorphological characterization and prevalence of canine mast cell tumors

S. Chaudhary¹, V. Jaiswal^{1*}, A. Bhatele¹, P. S. Maurya², P. Kumar³, S. Anand⁴

¹Department of Veterinary Pathology, ²Department of Veterinary Parasitology, ³Department of Veterinary Anatomy, ⁴Department of Veterinary Pharmacology & Toxicology, College of Veterinary & Animal Sciences, Sardar Vallabh Bhai Patel University of Agriculture & Technology (SVPUAT), Meerut, U.P. India;
*Corresponding author e-mail: doctorvikas@gmail.com

Journal of Livestock Science (ISSN online 2277-6214) 17: 50-54
Received on 21/6/25; Accepted on 25/1/26; Published on 30/1/26
doi. 10.33259/JLivestSci.2026.50-54

Abstract

Canine mast cell tumour (MCT), one of the highly prevalent tumors, reported to have wide range of clinicopathological manifestations. Accurate diagnosis & grading is critical as low-grade MCTs can be cured either by surgical resection with or without radiation therapy while there is no effective treatment for high-grade MCTs in dogs. The current study has been planned to study cyto-histopathological characteristics, hemato-biochemical alterations, risk factors, and grading of canine MCT. The tissue samples were taken from the dogs (n=100) showing neoplastic growth on various body parts from the university hospital, government private clinics located in and around Meerut district. The fine needle aspiration cytology (FNAC) followed by histopathology was performed for the diagnosis & histopathological grading which was done according to the internationally recognized system of grading. The study concluded 8% prevalence of canine MCT with 50% share of high grade. Serum biochemistry and hematology revealed increased alkaline phosphatase & neutrophilic leukocytosis respectively. Labrador breed, adult age group, female sex and hind limb location were found to be the major risk factors for this tumor.

Key words: Canine; cytology; histology; grading; mast cell tumor

Introduction

Tumor is important ailment of small companion animals especially canines (Bhoi et al., 2022). Mast cell tumours, also known as mastocytoma, are third most common canine malignant cutaneous tumours which accounts for 5.55 to 22.4% of cutaneous neoplasia in dogs (Šmiech et al., 2018; Oliveira et al., 2020; De Nardi et al., 2022; Dadhich et al., 2022). The biological behavior of mast cell tumours (MCTs) in dogs varies greatly ranging from completely benign cutaneous lumps to fulminating metastatic illness. Dogs with cutaneous MCTs may not exhibit any clinical symptoms at all, while those with visceral and bone marrow involvement may have life-threatening illness. Release of mast cell mediators (histamine, heparin, and proteases) are responsible for clinical manifestations such as localized flushing, gastrointestinal symptoms (vomition & Diarrhea), generalized pruritus, pyrexia, peripheral oedema vasodilatory shock and anaphylaxis. Additionally, organomegaly, organ function impairment, and pancytopenia in the event of bone marrow involvement can result from mast cell invasion alone. Due to its high occurrence & devastating clinical manifestations, Brazilian association of veterinary oncology did two Brazilian consensus meeting (2012 & 2021) on canine MCTs. Though surgical resection with radiation therapy can cure low-grade MCT cases, there is no viable therapy for high-grade canine MCTs (London & Seguin, 2003). The current study was devised to study the prevalence and pathomorphological characterization of canine MCTs in and around Meerut district.

Material & Methods

The current study was performed on hundred tumor tissue samples which have been collected from the dogs (n=100) showing neoplastic growths on various body parts from university polyclinic, government and private veterinary clinics situated in and around Meerut district of Uttar Pradesh after getting permission from institutional animal Ethics Committee (Approval number-IAEC/SVPUAT/2023/119) for the diagnosis of various tumors. Data related to age, sex, breed, location and dimension of tumor were collected at the time of sample collection. At the outset fine needle aspiration cytology (FNAC) was performed by using 24-gauge needle from the tumor tissues as well as nearby regional lymph nodes in order to diagnose tumor & possible metastasis if any. Blood and serum sample were collected for hematology & biochemical parameters related to liver function test. Surgically removed tissue samples were also collected in neutral buffered formalin and processed for histopathology. The tissue samples were fixed in formalin for 72 hours there after washed overnight and dehydrated in increasing grade of alcohol & acetone followed by clearing in benzene. The processed tissue samples were embedded in paraffin wax and 5 µm thick sections were made using rotatory microtome. These tissue sections were stained by hematoxylin & eosin and toluidine blue stain as described by Luna, (1968). The tumors were graded into Grade I, II & III as suggested by Patnaik et al., (1984) and in low- & high-grade tumor as described by Kiupel et al., (2011).

Results

Out of 100 cases, 08 were found positive for Canine MCT leading to 8% prevalence. These lesions grossly appeared as solitary mass of varying size (ranging from 12 cm³ to 630 cm³) and shape on different body locations such as posterior limbs (n=4;50%), abdomen (n=2: 25%) inguinal region (n=1:12.5%), and thorax (n=1:12.5%), many of which were often ulcerated & hemorrhagic. Clinical examination displayed varying erythema, pruritus and focal alopecia (Fig. A to F). The tumor tissues were found to be embedded deep in dermis layer extending to subcutaneous area. Peri-neoplastic mucinosis was observed in three cases. No visceral MCT case has been observed in current study. Five MCT cases were recorded in females and three in male dogs. They all fall in age group 08 to 12 years except one (4.5 years). Breed wise highest prevalence was recorded in Labrador (n=4;50%) followed by nondescript (n=2: 25%) and one each case of Pomeranian (n=1:12.5%) and German shepherd (n=1:12.5%).

Fine Needle Aspirate Cytology (FNAC) of the cutaneous mass showed moderate to high cellularity, with distinct round cells, basophilic cytoplasm having purple intracytoplasmic granulation varying from fewer to highly concentrated covering the nucleus partially to fully (Fig. G&H). The portion of nucleus appears lighter than cytoplasm due to cytoplasmic metachromatic granules. Some of these granules also appeared in the background. The morphology of these spherical cells was consistent to that of mast cells along with neoplastic alterations. The cells possessed central nuclei with scattered chromatin and mostly a single conspicuous nucleolus difficult to visualize. Mild to moderate anisocytosis & anisokaryosis were seen. Most of the tissue samples revealed distinct histologic pattern to be suspected for MCT at lower magnification. Microscopic histology showed rows & ribbon like cellular arrangement of individualized cells with dark stained granular cytoplasm, mild to moderate anisokaryosis, along with oedema, haemorrhage and few spindle supporting stromal cells at places. Eosinophilic infiltration was seen in five out of eight cases. Ruptured collagen laces and infiltration of neoplastic cells in between due to collagenolysis was prominently observed in all the cases (Fig. K&L). Toluidine blue stain used to stain mast cell granules gave distinct purple blue coloration (Fig. I) which was absent in negative control slides (Fig. J). Out of these eight cases two were

graded as Grade I, three as Grade II and three as grade III as per Patnaik system of grading while four were graded as “high” & four as “low” by employing Kiupel system of grading. No metastasis has been observed even in high grade MCTs of current study on lymph node cytopathology.

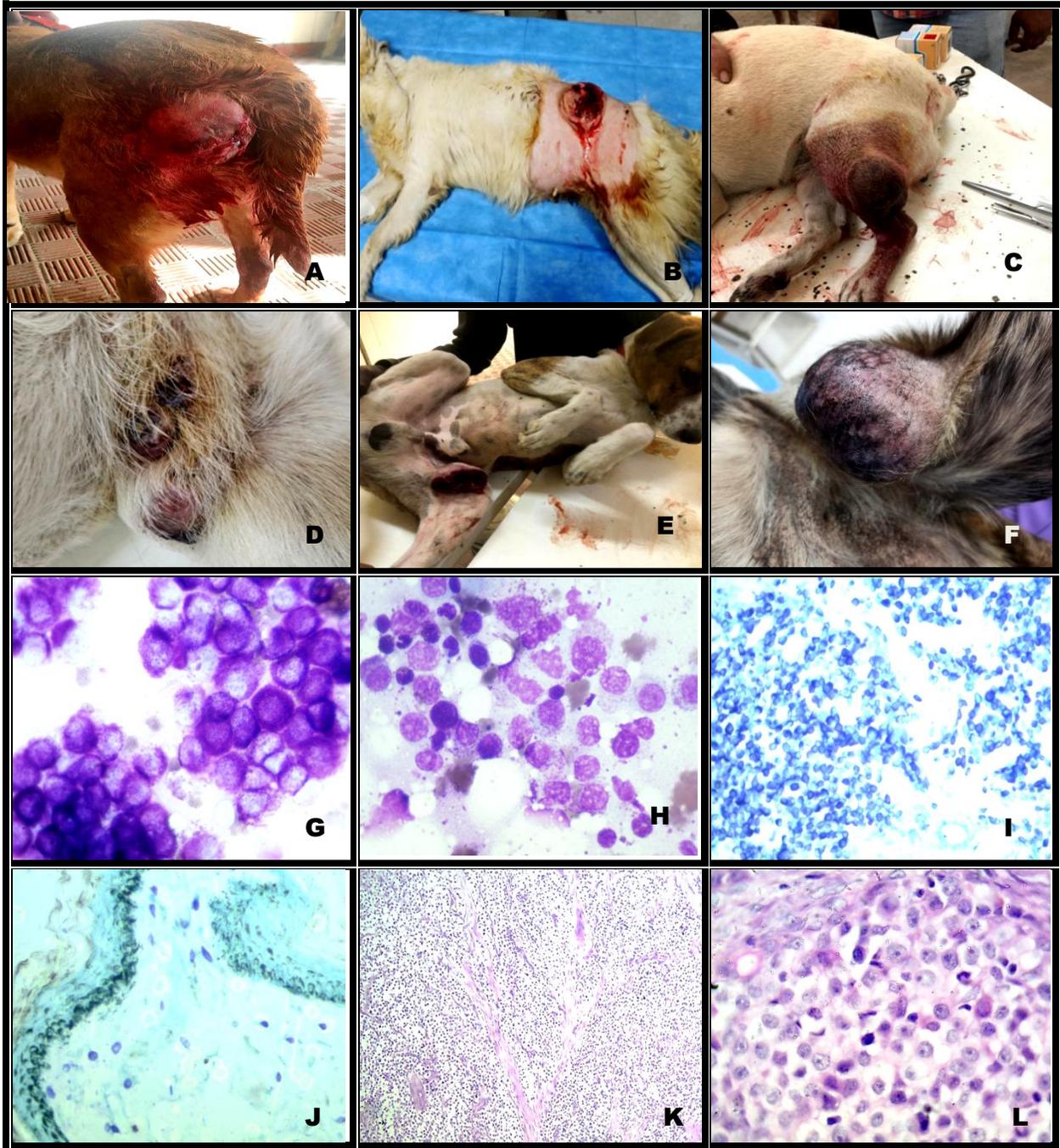


Fig. A to F: Gross pictures showing mast cell tumor on various body parts of dog with marked congestion & hemorrhage. **Fig. G:** Cytology of mast cell tumor showing round cells with marked cytoplasmic granulation (Leishman stain; 1000X). **Fig. H:** Cytology of mast cell tumor showing round cells but very little cytoplasmic granulation & marked pleomorphism (Leishman stain; 1000X). **Fig. I:** Microscopic picture of tissue section showing blue colored mast cell stained with toluidine blue stain. **Fig. J:** Microscopic picture of tissue section stained with toluidine blue stain (Negative control). **Fig. K:** Microscopic picture showing round cells with along with teared collagen laces in between (H&E stain;100X). **Fig. L:** Microscopic picture of tissue section showing round cells with abundant cytoplasm with fewer granules marked pleomorphism, prominent nucleoli and mitotic figure at places (H&E stain;400X).

Out of these eight MCT cases the hematobiochemical data of six animal was available mean±standard error of which revealed Hb13.97±1.75, PCV 42.02±3.34, RBC 6.39±0.82, TLC 18.70±4.69, Neutrophils 74.17±3.38, Eosinophils 2.33±0.21, Lymphocytes 18.67±3.35, Monocytes 4.83±1.17, Basophils 0.00±0.00, Platelets 455.50±65.72, Mean corpuscular volume 68.92±6.66, Mean corpuscular hemoglobin 21.93±0.77, Mean corpuscular haemoglobin concentration 32.89±2.34, Albumin 2.56±0.14, Globulin 4.25±0.45, Total protein 6.81±0.39, Alanine aminotransferase (ALT) 101.21±47.08, Aspartate aminotransferase (AST) 44.02±3.80, Alkaline phosphate (ALP) 215.05±79.65.

Discussion

The current study revealed 8% canine MCT prevalence which is higher than the reports of Indian researchers (5.5% by Dadhich et al., 2022) and lower than the reports of most of foreign authors (7 to 21% by Endicott et al., 2007, Śmiech et al., 2018, Oliveira *et al.*, 2020, Cavalcante et al., 2020). The presence of distinct metachromatic granules in the cytoplasm gives clearcut diagnosis of MCT. High grade tumours may have aberrant granule distribution, such as a half-moon configuration at a cell pole or severe stippling that exposes nuclei and cytoplasm. Certain mast cells with decreased cytoplasmic granulation, may have other malignant characteristics such as cell and nuclear size variations, bi-nucleation, nuclear pleomorphism, cytoplasmic vacuolation, and mitotic figures (Scarpa et al., 2016). FNAC is and inexpensive and quick technique having high sensitivity specially for the diagnosis of canine Mast cell tumors (Welle et al., 2008).

More of the high-grade cases (n=4) were observed in current study by applying Kiupel system as it relies on either of three criteria (at least 7 mitotic figures or 3 multinucleated cell or at least 3 bizarre nuclei per 10 high-power fields or karyomegaly) while in Patnaik system highest grade rely on presence of more mitotic figures which might be absent in some of the highly aggressive MCTs (Kiupel et al., 2011). The histological grade of the tumour is one of the most significant prognostic variables. Dogs with grade III tumours (poorly differentiated) frequently become problematic due to recurrences or metastases in a few months, whereas total surgical resection of a well-differentiated grade I tumour typically aids healing. Prognosis prediction also depends on the site of the neoplasm; metastases are typically caused by tumours in the inguinal and perineal regions, the snout, the oral cavity, and the nasal cavity (Kiupel et al., 2011). We applied both grading concurrently. Kiupel grade assists in predicting the biological behavior of Patnaik intermediate-grade (grade 2) MCTs, which can be somewhat unpredictable.

Mucinosis observed in three cases of current study was also described by Kiupel M. (2017) in Shar-pei breed. We did not observe any case of visceral mast cell tumor however rare cases of visceral MCTs has also been reported in intestine, craniomediastinum, lungs and oral cavity (Kiupel M. (2017) Clinically, canine MCTs can be of various shapes and sizes, with considerably varying presentation. They can be circumscribed, raised, firm, soft, pruritic, with erythematous regions, invasion of the subcutaneous tissue, and ulceration in up to 30% of instances (De Nardi et al., 2022).

In the current study labrador breed was found to be most susceptible nevertheless certain breeds, such as the Boxer, Labrador Retriever, Bull Terrier, Golden Retriever, French Bulldog, Dachshund, and Shar-pei, are more likely to acquire MCT (Garrett 2014; Kiupel M. 2017; Cavalcante et al., 2020; De Nardi et al., 2022). Similar to our findings, most of the previous researchers reported higher prevalence in in adult animals with mean age 6 to 9 years and involvement of posterior limbs (Cavalcante et al., 2020; Śmiech et al., 2019; Kiupel, 2017). In contrast to our findings of MCT cases in female animals (n=5: 62.5%) most of the previous researchers reported no sex predilection or lesser prevalence in females (Patnaik et al., 1984, Pierini et al., 2019; De Nardi et al., 2022). Neutrophilic leukocytosis observed in present study might be due to secondary bacterial infection as a result of immunosuppression while increased alkaline phosphatase might be due to soft tissue damage or mild hepatobiliary affection as a result of concurrent medication of these cases. The previous researchers documented paraneoplastic eosinophilia & anemia (Preena et al., 2020) which might be due to hemorrhage and late phase reaction of mast cell tumor however eosinophils have been detected in the tissue samples on histological examination which may due to release of IL5 (Musser, et al., 2018). The eosinophils contain histaminase, so eosinophilia might be protective mechanism to encounter histamine produced by neoplastic mast cells.

Conclusion

In conclusion, the study revealed fairly high prevalence of mast cell tumor (8%) with fifty percent share of high-grade malignant form in and around Meerut district. The cyto-histopathological characteristics emerged valuable tool to diagnose & grade canine MCTs. Increasing age, hind leg location, female sex and Labrador breed are important risk factors to suspect for canine mast cell tumor. Neutrophilic leukocytosis and increased alkaline phosphatase were the only parameters found to be altered may aid in diagnosis.

Acknowledgement

The authors are thankful to Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut for providing the facilities & funds for carrying out this work.

Conflict of interest

The authors declare that they have no conflict of interest.

References

- 1) Bhoi, D.B., Suthar, D.N., Jhala, S.K. 2022. Ovarian tumours in dogs- an overview. *Journal of Livestock Science* 13: 279-287. doi. 10.33259/JLivestSci.2022.279-287
- 2) Cavalcante, I. M. S., Bernardes, F. C. L., Freire, B. S., Cuconati, R., Munhoz, J. & Rapôso, C. (2020). A retrospective study of canine cutaneous mast cell tumor: correlation between clinical, histological and molecular characteristics. *Brazilian Journal of Development*, 6(12), 100281-100299.
- 3) Dadhich, R., Dadhich, H. & Sharma, G.D. (2022). Pathological and haemato-biochemical studies of mastocytoma in dogs. *Indian journal of canine practice*, 14(2), 146-148.
- 4) De Nardi, A. B., Santos Horta, R., Fonseca-Alves, C. E., de Paiva, F. N., Linhares, L. C. M., Firmo, B. F. & Dagli, M. L. Z. (2022). Diagnosis, prognosis and treatment of canine cutaneous and subcutaneous mast cell tumors. *Cells*, 11(4), 618.
- 5) Endicott, M. M., Charney, S. C., McKnight, J. A., Loar, A. S., Barger, A. M. & Bergman, P. J. (2007). Clinicopathological findings and results of bone marrow aspiration in dogs with cutaneous mast cell tumours: 157 cases (1999–2002). *Veterinary and Comparative Oncology*, 5(1), 31-37.
- 6) Garrett, L.D. (2014). Canine mast cell tumors: diagnosis, treatment, and prognosis. *Veterinary medicine (Auckland, N.Z.)*, 5, 49-58.
- 7) Kiupel, M., Webster, J. D., Bailey, K. L., Best, S., DeLay, J., Detrisac, C. J. & Miller, R. (2011). Proposal of a 2-tier histologic grading system for canine cutaneous mast cell tumors to more accurately predict biological behavior. *Veterinary Pathology*, 48(1), 147-155.
- 8) Kiupel, M. (2017). Mast cell tumors. In *Tumors in domestic animals*. 5th ed. Eds., Meuten, D.J. Iowa, IA: Wiley Blackwell, PP: 176–202.
- 9) London, C. A. & Seguin, B. (2003). Mast cell tumors in the dog. *Veterinary Clinics: Small Animal Practice*, 33(3), 473-489.
- 10) Luna, L.G. (1968). *Manual of histological staining methods of the armed forces Institute of Pathology*. 3rd ed. New York: McGraw-Hill Book Company, 33-40.
- 11) Musser, M., Berger, E., Flaherty, H. A., Fox, L. & Johannes, C.M. (2018). Marked paraneoplastic hypereosinophilia associated with a low-grade, metastatic canine mast cell tumour. *Veterinary Record Case Reports*, 6(2), e000563.
- 12) Oliveira, M. T., Campos, M., Lamego, L., Magalhães, D., Menezes, R., Oliveira, R. & Ferreira, D. A. (2020). Canine and feline cutaneous mast cell tumor: a comprehensive review of treatments and outcomes. *Topics in Companion Animal Medicine*, 41, 100472.
- 13) Patnaik, A. K., Ehler, W. J. & MacEwen, E. G. (1984). Canine Cutaneous Mast Cell Tumor: Morphologic Grading and Survival Time in 83 Dogs. *Veterinary Pathology*, 21(5), 469–474.
- 14) Preena, P., Jeny, K. J., Sherin, B. S., Seeja, S., Harith, R., Prasad, C. P. (2020). Cytological diagnosis of recurrent multiple cutaneous mast cell tumour in a dog. *Journal of Indian Veterinary Association*, 18 (2), 49-56
- 15) Pierini, A., Lubas, G., Gori, E., Binanti, D., Millanta, F. & Marchetti, V. (2019). Epidemiology of Breed-Related Mast Cell Tumour Occurrence and Prognostic Significance of Clinical Features in a Defined Population of Dogs in West-Central Italy. *Veterinary Sciences*, 6(2), 53.
- 16) Scarpa, F., Sabattini, S. & Bettini, G. (2016). Cytological grading of canine cutaneous mast cell tumours. *Veterinary and Comparative Oncology*. 14(3), 245-251.
- 17) Śmiech, A., Łopuszyński, W., Ślaska, B., Bulak, K. & Jasik, A. (2019). Occurrence and distribution of canine cutaneous mast cell tumour characteristics among predisposed breeds. *Journal of Veterinary Research*, 63(1), 141-148.
- 18) Śmiech, A., Ślaska, B., Łopuszyński, W., Jasik, A., Bochyńska, D & Dąbrowski, R (2018). Epidemiological assessment of the risk of canine mast cell tumours based on the Kiupel two-grade malignancy classification. *Acta Veterinaria Scandinavica*, 60, 1-9.
- 19) Welle, M. M., Bley, C. R., Howard, J. & Rüfenacht, S. (2008). Canine mast cell tumours: a review of the pathogenesis, clinical features, pathology and treatment. *Veterinary Dermatology*, 19(6), 321–39.