

HEMATOLOGICAL PARANEOPLASTIC SYNDROMES IN CANINE MAMMARY GLAND CARCINOMA: INSIGHTS FROM A STUDY ON DIAGNOSTIC VALUE

S. Sruthi¹, K.S. Prasanna^{2*}, A.J.George³, I.S Sajitha⁴, S.N. Sudheesh⁵ and P.P. Varuna⁶

¹ PhD Scholar, ² Assistant Professor, Department of Veterinary Pathology, College of Veterinary and Animal Sciences, KVASU, Mannuthy,

³ Professor and Head, Department of Veterinary Pathology, College of Veterinary and Animal Sciences, KVASU, Pookode,

⁴ Associate Professor, Department of Veterinary Pathology, College of Veterinary and Animal Sciences, KVASU, Mannuthy,

⁵ Assistant Professor, Department of Veterinary Surgery and Radiology, College of Veterinary and Animal Sciences, KVASU, Mannuthy,

⁶ Assistant professor, Department of Veterinary Biochemistry, College of Veterinary and Animal Sciences, KVASU, Mannuthy

*Corresponding author Email: prasanna@kvasu.ac.in

ABSTRACT

This hematological study was aimed to investigate the hematological abnormalities associated with mammary gland carcinoma (CMT) in dogs at various stages of progression. Blood smear examinations were initially conducted on 45 cases, with exclusion criteria applied for hemoparasitic infections. Subsequently, 28 cases were selected for comprehensive analysis, focusing on complete blood count parameters, including haematocrit, haemoglobin, erythrocytes, mean corpuscular volume, mean corpuscular haemoglobin, mean corpuscular haemoglobin concentration, leukocytes, and thrombocytes. The findings revealed hematological abnormalities associated with CMTs, notably characterized by anemia, erythropenia, thrombocytopenia,

and leukocytosis. The differential white blood cell count showed negligible variation. These findings underscore the potential diagnostic value of hematological parameters in understanding and monitoring CMT-associated hematological alterations.

INTRODUCTION

The majority of canine neoplasms diagnosed in intact female dogs are CMTs, which make up over half of all canine neoplasms (Moe, 2001). Hematological abnormalities are frequently observed in small animal tumour cases and can occur from the direct effects of tumor progression or paraneoplastic syndromes. However, few studies have investigated the occurrence of these abnormalities in dogs with specific tumors. Tumour related hematological changes encompass changes in the absolute

numbers of circulating blood elements, hemostasis alterations, and plasma protein dyscrasias (Childress, 2012). They may serve as clinical markers for specific types of cancer, aiding in quicker diagnosis; and can act as markers of therapeutic response and tumor remission.

Anaemia is a common hematologic anomaly among cancer patients in humans (Spivak *et al.*, 2009). Approximately 30 to 50% of patients with solid tumours had anaemia at the beginning of their therapy. It is unknown, therefore, how common anaemia is in cancer patients in veterinary medicine. Over 36% of dogs with cancer who are not receiving treatment for their illness have thrombocytopenia (Madewell *et al.*, 1980). These anomalies may be prognostic indications, similar to those seen in humans with breast cancer, albeit their clinical importance remains unclear. The present investigation thus seeks to characterise the incidence of haematological abnormalities in canines suffering from mammary neoplasms; and assesses the feasibility of employing these modifications as diagnostic criteria and prognostic markers.

MATERIALS AND METHODS

Hematological studies were conducted in 45 dogs with mammary gland carcinoma at varying stages of progression.

The tumours under observation were subjected to grading as per the classification system introduced by Goldschmidt *et al.* (2011). Blood smear examination was done to check for any concurrent hemoparasitic infections and such positive samples were excluded and only 28 cases were taken for the study. Complete blood count parameters such as haematocrit (%), haemoglobin (g/L), erythrocytes (T/L), mean corpuscular volume (MCV, fL), mean corpuscular haemoglobin (MCH, pg), mean corpuscular haemoglobin concentration (MCHC, g/L), leukocytes (G/L), thrombocytes (G/L) were determined. The whole blood samples were collected in EDTA vacutainer tube on day of presentation for evaluation of haematological parameters including haemoglobin concentration (Hb), the volume of packed red cells (VPRC), total leukocyte count (TLC), total erythrocyte count (TEC), differential leukocytes count (DLC) and platelet count using automatic haematology analyzer 8.

RESULTS AND DISCUSSION

Average values of the hematological parameters across various tumour grades are given in Table 1. The results showed thrombocytopenia, anemia with erythropenia and leukocytosis, and variations in primary change associated to mammary gland cancer. Thrombocytopaenia and leukocytosis are

also specific findings in canine mammary tumours. Upon statistical analysis it was found out that there is no statistically significant difference in the hematological parameters between different grades of tumours and healthy animal.

The findings of this study revealed distinct hematological abnormalities associated with CMTs, shedding light on the potential diagnostic value of these parameters. They included anemia characterised by erythropenia, thrombocytopenia and leukocytosis, along with negligible variation in the differential white blood cell count. The hematological results were consistent with the study of Gupta *et al.* (2014) which indicated that the mean values of total leukocyte count (TLC) and differential leukocyte count (DLC) stayed within the normal physiological range. However, both packed cell volume (PCV) and hemoglobin (Hb) levels were observed to fall below the normal range in cases of canine mammary neoplasms. One

of the key hematological changes noted in this study was anemia, defined by low levels of red blood cells and hemoglobin. An important characteristic of this anemia was its microcytic and normochromic in nature. Microcytic anemia suggests that the red blood cells are smaller than normal size, while normochromic indicates that the hemoglobin content within each cell is within the expected range. It also might be connected to extensive intravascular hemolysis caused by the inflammation-associated production of proinflammatory cytokines from the tumour microenvironment (Lallo *et al.*, 2016).

The presence of leukocytosis (elevated white blood cell count) and thrombocytopenia (reduced platelet count) in dogs with mammary tumours is consistent with previous research and may be indicative of inflammation and bone marrow response to the neoplastic process (Dobson *et al.*, 2002). In canine cancer patients, neutrophilic leukocytosis can

Table 1. Haematological parameters

Sl No	Grade	RBC	HB	WBC	LY	M	N	PLT	PDW	MCV	MCH	MCHC
1	I	6.2	13.5	14.41	3.34	0.92	9.92	256.25	17.1	57.8	33.16	46.16
2	II	5.95	11.68	11.71	2.06	0.78	8.08	371.33	14.5	56.76	19.81	34.8
3	II	5.9	13.26	13.533	5.91	13.26	13.53	5.917	13.26	13.53	5.91	13.26

Table 1. LY- Lymphocytes, M-Monocytes, N-Neutrophils, Haemoglobin (g/L), erythrocytes (T/L), mean corpuscular volume (MCV, fL), mean corpuscular haemoglobin (MCH, pg), mean corpuscular haemoglobin concentration (MCHC, g/L), leukocytes (G/L), thrombocytes (G/L)

result from cancer-related inflammation (either acute or chronic) or tissue necrosis. Additionally, lymphocytosis may occur due to the release of epinephrine associated with chronic inflammation (Schultze, 2000). Kumar *et al.* (2018) observed contradictory results that in dogs with CMTs have higher values of platelet counts were observed, with no noted changes in total erythrocyte count.

While the hematological changes observed in this study are noteworthy, it is essential to consider that, there was no statistically significant difference in hematological parameters between different grades of tumours and healthy animals. Out of the 45 cases included in the study, only 28 cases that tested negative for hemoprotozoan infections were taken into account. It is worth noting that conducting further research with a larger sample size may provide a more comprehensive understanding of the hematological paraneoplastic syndromes associated with CMTs in dogs.

ACKNOWLEDGEMENT

The authors acknowledge the research facilities provided by the Kerala Veterinary and Animal Sciences University, Pookode and Indian Council for Medical Research for the ICMR-JRF fellowship to carry out the research.

REFERENCES

- Childress, M.O. Hematologic abnormalities in the small animal cancer patient. 2012. *Vet. Clin. North Am. Small Animal Practicing*. 42: 123-155.
- Dobson, J. M., Samuel, S., Milstein, H., Rogers, K. and Wood, J. L. N. 2002. Canine neoplasia in the UK: estimates of incidence rates from a population of insured dogs. *JSAP*. 43: 240-246.
- Goldschmidt, M., Pena, L., Rasotto, R. and Zappulli, V. 2011. Classification and grading of canine mammary tumours. *Vet. Pathol*. 48: 117-131.
- Gupta, P., Raghunath, M., Gupta, A.K., Sharma, A. and Kour, K. 2014. Clinical study for diagnosis and treatment of canine mammary neoplasms (CMNs) using different modalities. *Indian J. Anim. Res*. 48: 45-49.
- Kumar, K., Agrawal, R., Pande, N., Sharma, S. and Kumar, H. 2018. Occurrence, clinico-haemato-biochemical and histopathological studies on mammary gland tumor in geriatric dogs. *Pharma Innov*. 7: 301.
- Lallo, M. A., Ferrarias, T. M., Stravino, A., Rodriguez, J. F. and Zucare, R. L. 2016. Hematologic abnormalities in

- dogs bearing mammary tumors. *Rev. Bras. Med. Vet.* 23: 3-8.
- Madewell, B.R., Feldman B.F., O'Neill, S. 1980. Coagulation abnormalities in dogs with neoplastic disease. *J. Thromb. Haemost.* 44: 35-38.
- Mao, Q. and Unadkat, J. D. 2015. Role of the breast cancer resistance protein (BCRP/ABCG2) in drug transport—an update. *AAPS J.* 17: 65-82.
- Schultze, A. E. 2000. Interpretation of Canine Leukocyte Responses. In: Feldman, B. F., Zinkl, J. G., Jain, N. C. (eds). *Schalm's Veterinary Hematology*. (5th Ed.). Philadelphia: Lipincott, Wilkins and Williams, pp. 366-381.
- Spivak, J.L., Gascon, P., Ludwig, H. 2009. Anemia management in oncology and hematology. *Oncologist*. 14: 43-56.