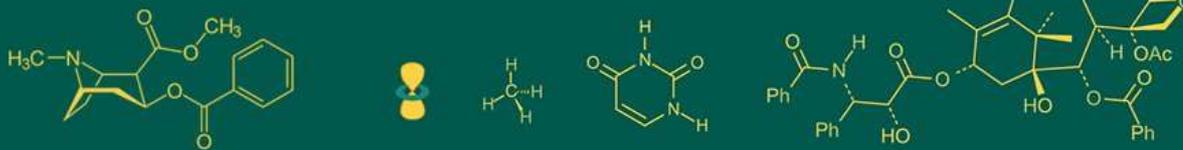


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Canine mast cell tumor

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Abstract

This study at PGIVER, Jaipur, investigated canine mast cell tumors, prevalent in veterinary oncology, comprising 20% of cutaneous tumors. Employing FNAC and impression smears for cytological diagnosis, 58 samples from diverse breeds revealed a 6.90% incidence. Mast cell tumors exhibited an irregular morphology and firm consistency. Cytologically, smears showed heightened cellularity with round neoplastic cells, anisocytosis, and metachromatic granules. Histopathologically, pleomorphic mast cells with metachromatic granules were observed. The study highlights the correlation between cytology and histopathology, suggesting routine cytological use for neoplastic disease diagnosis.

Keywords: Dog, cytopathology, histopathology, mast cell tumor

1. Introduction

Cancer stands as the primary cause of mortality in pet animals and the second leading cause in humans (Siegel *et al.*, 2013) [18]. In dogs, the frequency of cancer occurrence is double that in humans (Kiupel and Camus, 2019) [11]. Mast cell tumours (MCT) represent hematopoietic neoplasms characterized by the uncontrolled proliferation and/or accumulation of neoplastic mast cells (MCs) across various organ systems. Predominantly, the skin is the most affected organ, followed by hematopoietic organs such as lymph nodes, spleen, liver, bone marrow, and mucosal sites in the oral cavity and gastrointestinal tract (Willmann *et al.*, 2021) [24]. MCT is recognized as the most prevalent malignant skin tumour in dogs, with an incidence of approximately 20% (De Nardi *et al.*, 2022) [6].

The clinical manifestation, progression, and prognosis exhibit substantial variations among patients, contingent upon the anatomic site, grade, and stage of the disease. Solitary cutaneous nodules are the most frequent clinical presentation, but patients may also present with multiple skin tumours. Thus, the clinical presentation of cutaneous MCTs ranges from hairless, gradually expanding skin lesions as no capsulated masses, either solitary or multiple with dermal localization, to rapidly growing, often ulcerating aggressive variants that extend to subcutaneous tissue and various distant body sites (Kiupel and Camus, 2019; Galietta *et al.*, 2023) [11, 7].

The contemporary trend globally emphasizes the exploration of rapid and cost-effective tumour diagnosis methods, considering that the conventional histopathological method requires invasive tissue sampling and extended processing times. Cytopathology, utilizing numerous quick, secure, and economical techniques and stains, consistently plays a pivotal role in diagnostic assessments, encompassing the identification of infectious and neoplastic diseases (Sood *et al.*, 2008) [19].

Access to current information regarding swift diagnostic techniques, treatment, and prognosis is paramount for optimizing approaches and enhancing patient outcomes. In Rajasthan, minimal efforts have been directed towards studying the cytopathological and histopathological features of cutaneous and subcutaneous mast cell tumours in dogs (*Canis familiaris*). Recognizing the immediate need for comprehending the diverse cytohistopathological characteristics of mast cell tumours to facilitate timely diagnosis, the present research endeavor was initiated in dogs.

2. Material and Methods

2.1 Source and Collection of Samples: Preceding any interventional procedures, an exhaustive macroscopic examination was systematically conducted on all tumour masses.

This encompassed a meticulous scrutiny for indications of ulceration and precise spatial localization within the anatomical framework. Post-surgical extraction, a comprehensive analysis ensued, considering parameters such as dimensional metrics (Quantified in centimeters), morphological attributes (Circular, oval, irregular, multilobulated, etc.), mass (Expressed in grams), consistency (Soft, Hard, Firm, Cystic, etc.), and the chromatic characteristics of the excised tumour surface.

2.2 Gross Examination

Before surgery, a comprehensive macroscopic examination was conducted on all tumours. The tumour masses were scrutinized for signs of ulceration and their specific locations on the body. Following surgical removal, various parameters such as size (Measured in centimeters), shape (round, oval, irregular, multilobulated, etc.), weight (in grams), consistency (Soft, Hard, Firm, Cystic, etc.), and the colour of the cut surface of the tumour were meticulously examined.

2.3 Cytological Examination

The cytological facet of this investigation was diligently executed through the deployment of refined methodologies, specifically fine needle aspiration cytology (FNAC) and impression smear/touch imprint cytology, as detailed by Cowell and Valenciano (2014) [4].

2.4 Histopathological Examination

The dissected tissue specimens underwent meticulous immersion in a 10 percent buffered formalin solution, followed by rigorous histopathological scrutiny employing the hematoxylin and eosin staining methodology. The established protocols set forth by Luna (1960) [15] and Culling (1974) [5] were strictly adhered to in this methodological pursuit.

3. Results and Discussions

3.1 Incidence of mast cell tumour in Dogs

Among the 58 cases analyzed within the round cell tumour category, an incidence of 50% each was observed for Transmissible Venereal Tumour and Mast Cell Tumour. Additionally, four cases of Mast Cell Tumour were specifically identified, constituting a 6.90% incidence. These incidences align, in part, with the observations of Mathur *et al.* (2018) [16], who reported a 16.4% incidence in Bengaluru.

Specifically focusing on Mast Cell Tumour instances (Case no. 10, 11, 19, and 56), the recorded incidence was 6.90%. These findings exhibit approximate concurrence with the outcomes reported by Welle *et al.* (2008) [23], Chikweto *et al.* (2011) [3], and Khan (2019) [10], who documented incidences ranging from 7% to 21% in canine mast cell tumours.

Table 1: General classification of mast cell tumour

| S. No. | Pathomorphological class and typing of tumour | | Total cases | As % of its class | As % of all tumour |
|--------|---|-------------------------------|-------------|-------------------|--------------------|
| | Class of tumour | Type of tumour | | | |
| 1. | Round cell tumour | Mast cell tumour | 4 | 50 | 6.90 |
| | | Transmissible venereal tumour | 4 | 50 | 6.90 |
| | | Sub-total | 8 | | |

Table 2: Pathomorphological typing of mast cell tumour into benign and malignant tumour types

| S. No. | Type/class | Benign | Case (in no.) | Case (in %) | Malignant | Case (in no.) | Case (in %) | Grand Total | Overall (%) |
|--------|-------------------|--------------------------------------|---------------|-------------|------------------|---------------|-------------|-------------|-------------|
| 1. | Round cell tumour | Canine transmissible venereal tumour | 4 | 6.90 | | | | 8 | 13.79 |
| | | Mast cell tumour | 2 | 3.45 | Mast cell tumour | 2 | 3.45 | | |
| | | Sub-total | 6 | | | 2 | | | |

3.2 Gross-morphology, Cytology and Histopathology of Mast cell tumours

In the current investigation, the observed tumour masses exhibited an oval to irregular morphology and a firm consistency (Fig. 1). The cut surfaces presented a whitish-red coloration (Fig. 2). The size of these tumour masses ranged from 3 x 3 x 2 to 9 x 7 x 5 cm, with weights ranging from 30 g to 190 g. These findings are notably congruent with those reported by Gopal *et al.* (2017) [8] and Kumar *et al.* (2017) [13], who described similar characteristics such as oval to irregular, firm masses measuring 5 x 3 cm, with a pale brown color, located in the lower abdomen on the left side of a nine-year-old dog. The present results also align closely with those reported by Oliveira *et al.* (2012) [17].

Cytologically, the impression smear of the mast cell tumour revealed elevated cellularity of round neoplastic cells with anisocytosis. Cells were observed individually or in groups (Fig. 3). Aspirate smears depicted metachromatic granules clustered or diffusely distributed in the cytoplasm, varying in size from small to large. Some granules were noted in the background, originating from ruptured cells, occasionally obscuring nuclear visualization due to their presence in the

cytoplasm (Fig. 4 and Fig. 5). Nuclei were predominantly round, positioned eccentrically or centrally, and mitotic figures, giant cells, and binucleation were evident (Fig. 6). These cytological findings are in concordance with observations made by Krithiga *et al.* (2005) [12] and Balima and Vairamuthu (2020) [2], and show similarities with results obtained by Hosseini *et al.* (2014) [9] and Kumar *et al.* (2017) [13].

Histopathological examination revealed pleomorphic round to ovoid-shaped mast cells circumscribed by connective tissue (Fig. 7). The cytoplasm displayed purple-colored granules that stained metachromatically with toluidine blue (Fig. 8). Cells presented centrally placed large, round, occasionally vesicular nuclei with one to two distinct nucleoli. Anisokaryosis and anisocytosis were evident (Fig. 9). Infrequent binucleate cells exhibited dissimilar nuclei with indentation, and mitotic figures were observed (Fig. 10). These histopathological findings corroborate with those reported by Hosseini *et al.* (2014) [9] and Gopal *et al.* (2017) [8], where neoplastic cells displayed moderate to abundant cytoplasm, round to ovoid nuclei with scattered chromatin, and atypical metachromasia in cytoplasmic granules.



Fig 1: Image displaying a mass of mast cell tumour, exhibiting an oval to irregular shape and pale brown color, situated in the lower abdomen.



Fig 2: Photograph illustrating the cut surface of a mast cell tumour, displaying a whitish-red appearance

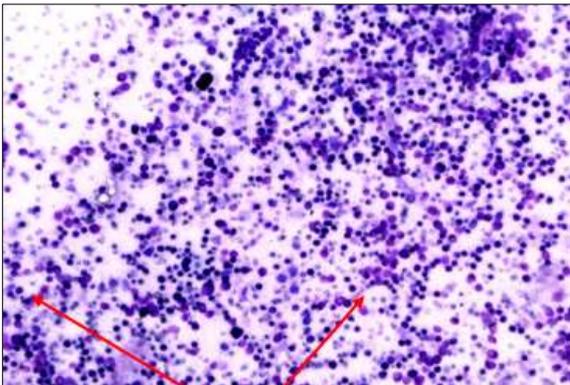


Fig 3: Photomicrograph of impression smear Displaying Elevated Cell Density, anisocytosis, round, individual cells and in groups. (Giemsa stain, 100X)

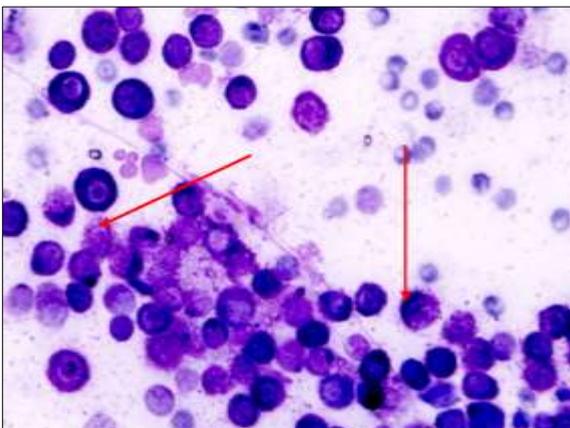


Fig 4: Microscopic Image from FNAC Smear Illustrating Varied Sizes of Metachromatic Granules in the Cytoplasm and Background. (Giemsa stain, 400X)

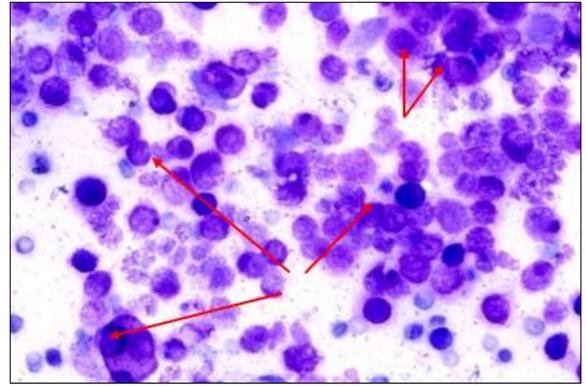


Fig 5: Microscopic Image from FNAC Displaying Circular Nuclei, Positioned either Eccentrically or Centrally, Along with Mitotic Figures, Binucleated Cells, and Giant Cells. (Giemsa stain, 400X)

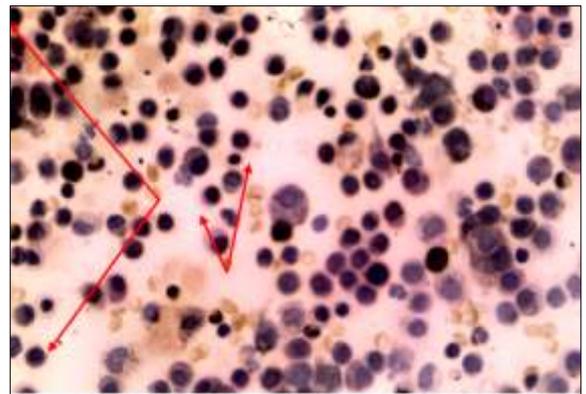


Fig 6: Microscopic Image of Impression Smear Revealing Varied Sizes of Metachromatic Granules in Both the Cytoplasm and Background. (Papanicolaou stain, 400X)

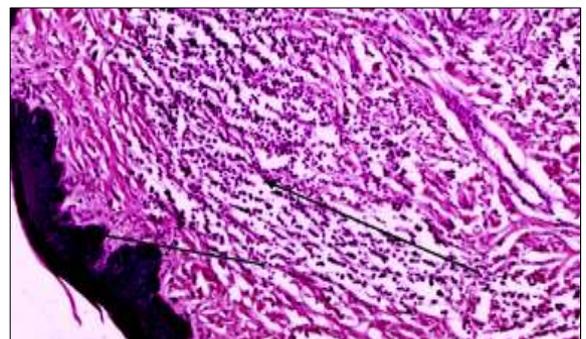


Fig 7: Microscopic Image of Tissue Section Illustrating Pleomorphic Round to Ovoid Shaped Mast Cells Encircled by Connective Tissue. (H & E stain, 100X)

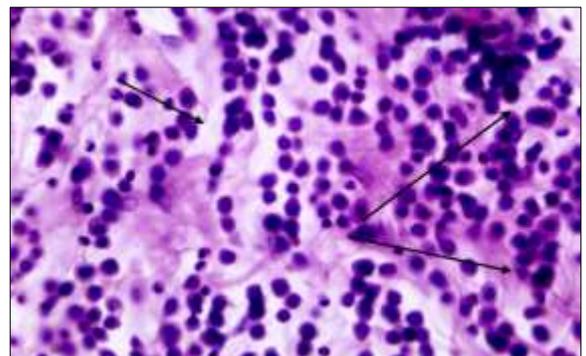


Fig 8: Microscopic Image Displaying Cells with Two Nuclei, Nuclei Exhibiting Indentation, and the Presence of Mitotic Figures. (H & E stain, 400X)

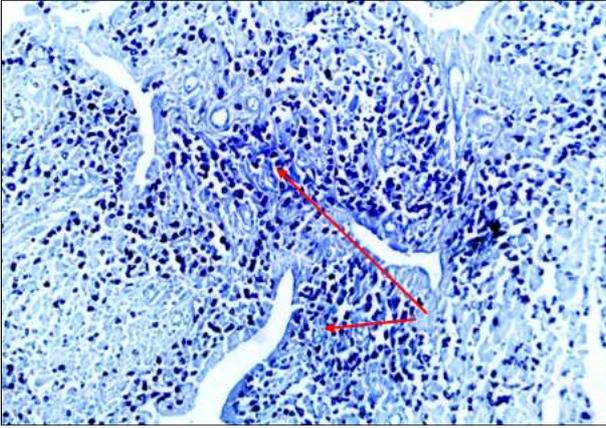


Fig 9: Microscopic Image Illustrating Granules displaying a Metachromatic Stain in Purple-Blue Color with Toluidine Blue. (Toluidine blue, 100X)

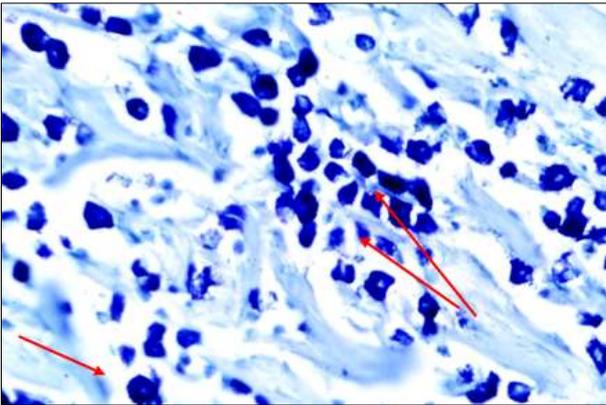


Fig 10: Microscopic Image Depicting a Large, Centrally Placed Round Nucleus with One to Two Distinct Nucleoli, anisokaryosis and anisocytosis. (Toluidine blue, 400X)

4. Conclusions

In this investigation, Giemsa stain proved optimal for highlighting cellular details, while Papanicolaou stain effectively delineated nuclear details in cytological smears. Malignant tumours consistently manifested features such as hypercellularity, anisocytosis, anisokaryosis, the presence of mitotic figures, nuclear and nucleolar abnormalities, abnormal chromatin, and an elevated nuclear-cytoplasmic ratio. The study concluded that cytopathology exhibited high diagnostic accuracy in differentiating between malignant and benign canine tumours. Emphasizing the correlation between cytopathology and standard histopathology, this research supports the routine incorporation of cytopathological techniques as an adjunct for diagnosing neoplastic diseases.

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