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General and clinical aspects, diagnosis and treatment of cutaneous mast cell tumors in dogs (1990 to 2024)

Aspectos generales y clínicos, diagnóstico y tratamiento del tumor cutáneo de mastocitos en perros (1990 a 2024)

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ABSTRACT: This review aims to present general aspects of cutaneous and subcutaneous mast cell tumors in dogs, given their relevance in clinical medicine and surgery, based on scientific publications from 1990 to 2023, to ensure an optimized approach and improve patient outcomes. Data collection was carried out online, establishing the period from 1990 to 2024. Research was conducted in databases such as SciELO, Scopus, Web of Science, and Science Direct, with subjects focused on the clinical aspects, diagnosis and treatment of cutaneous mast cell tumors in dogs. The health science descriptors used were “clinical aspects of cutaneous mastocytoma in dogs”, “diagnosis of cutaneous mast cell tumors in dogs”, “cutaneous mast cell tumors in dogs”, and “treatment of cutaneous mast cell tumors in dogs”. It is noteworthy that the search was conducted in a systematic manner, specifically within the aforementioned scientific databases, using the Boolean operators "AND" and/or "OR". Cutaneous mast cell tumors in dogs is one of the most common neoplasms in this species. This tumor is defined as an exaggerated proliferation of neoplastic mast cells. It is present in canines aged between eight and nine years, with no sexual predilection. In the cells present in lipid tissues, there is a presence of mast cells, whose origin is linked to hematopoiesis, and which retain the capacity for proliferation after maturation. The identification of cytoplasmic granules is a finding capable of indicating mature mast cell tumors, as they have active biological substances, histamine and heparin. To reach a definitive diagnosis, it is necessary to perform cytological and histological examinations.

Key words: Mast cell tumors, neoplasm, dogs.

RESUMEN: Esta revisión tiene como objetivo presentar aspectos generales de los mastocitomas cutáneos y subcutáneos en perros, dada su relevancia en medicina clínica y cirugía, basándose en publicaciones científicas desde 1990 hasta 2023, para garantizar un abordaje optimizado y mejorar los resultados de los pacientes. La recolección de datos se realizó online, estableciendo el período de 1990 a 2024, y la investigación se llevó a cabo en bases de datos como SciELO, Scopus, Web of Science y Science Direct con temas centrados en los aspectos clínicos, diagnóstico y tratamiento de los mastocitomas cutáneos en perros. Los descriptores de ciencias de la salud utilizados fueron «aspectos clínicos del mastocitoma cutáneo en perros», «diagnóstico del mastocitoma cutáneo en perros», «mastocitoma cutáneo en perros» y «tratamiento del mastocitoma cutáneo en perros». Cabe destacar que la búsqueda se realizó de manera ordenada, respectivamente, en las bases de datos científicas antes mencionadas, utilizando los indexadores bolivianos”AND y/o OR”. El tumor cutáneo de mastocitos en perros es una de las neoplasias más comunes en esta especie. Este tumor se define como una proliferación exagerada de mastocitos neoplásicos. Ocurre en caninos con edades comprendidas entre ocho y nueve años y no existe predilección sexual. En las células presentes en los tejidos lipídicos existe la presencia de mastocitos, cuyo origen está ligado a la hematopoyesis, manteniendo la proliferación tras su maduración. La identificación de gránulos citoplasmáticos es un hallazgo capaz de indicar tumores de mastocitos maduros, ya que contienen sustancias biológicas activas, histamina y heparina. Para llegar a un diagnóstico certero es necesario realizar exámenes citológicos e histológicos.

Palabras clave: Mastocitos, neoplasia, perros.

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INTRODUCTION

Oncology and dermatology are on the rise among the numerous specialties of veterinary medicine (1). There are numerous skin diseases reported in canine species; however, neoplasms are highlighted, reaching great importance (2).

Skin neoplasms in small animals are common diseases observed in Veterinary clinics (3). Among them is the mast cell tumor, which is the multiplication of neoplastic mast cells in the skin (4). There is an exaggerated proliferation of modified cells, with inappropriate characteristics (cellular anaplasia) (5).

Mast cells are granulocytes, that is, cells that contain granules in their cytoplasm (6). They are large cells, distributed in significant quantity in connective tissue throughout the dermis of the body surface and also in lymphoid organs, bone marrow and in the subepithelial connective tissue of the respiratory and digestive tracts (7). There are two subtypes of mast cells: connective tissue-type mast cells and mucosal mast cells. In dogs, there is a high concentration of mast cells in the liver and skin. (5).

Given the above, it is important to know the different aspects of mast cell tumors in dogs. Therefore, this review aims to present general aspects of cutaneous and subcutaneous mast cell tumors in dogs, given their relevance in clinical medicine and surgery, based on scientific publications from 1990 to 2023, to ensure an optimized approach and improve patient outcomes.

MATERIAL AND METHODS

Search strategy

For the construction and development of this study, an exploratory integrative literature review (ILR) and a meta-analysis were conducted. The integrative literature review is considered the broadest methodological approach because, in addition to allowing the researcher to include experimental and non-experimental studies for a comprehensive understanding of the analyzed phenomenon, it combines data from the theoretical literature and serves a wide range of purposes, such as: defining concepts, analyzing methodological problems on a particular topic, and reviewing theories and evidence.

This research was based on the following guiding question: what are the clinical aspects, diagnosis and treatment of cutaneous mast cell tumors in dogs? This question was formulated using the PICO strategy, an acronym for the words: P-Population; I- Interest; C- Control; O- Outcome, which is important for constructing the guiding question.

For the development of this research, the following steps were used: selection of the study's guiding questions; establishment of inclusion and exclusion criteria for sample selection; identification of information to be extracted from selected articles; data analysis; discussion of results; and presentation of the review.

Data collection

Data collection was conducted online, covering the period from 1990 to 2024. The search was carried out in databases such as SciELO, Scopus, Web of Science, and Science Direct, focusing on topics related to the clinical aspects, diagnosis and treatment of cutaneous mast cell tumors in dogs. The classification was based on that established by Patnaik *et al*. (8) and Kiupel *et al*. (9).

The health science descriptors used were “clinical aspects of cutaneous mastocytoma in dogs”, “diagnosis of cutaneous mast cell tumors in dogs”, “cutaneous mast cell tumors in dogs”, and “treatment of cutaneous mast cell tumors in dogs”. It is noteworthy that the search was conducted in a systematic manner, specifically within the aforementioned scientific databases, using the Boolean operators "AND" and/or "OR".

After selecting the studies, it was necessary to review and synthesize the information extracted to facilitate the management of the data obtained. For this purpose, a structured instrument was used, containing the following variables: Year; Article Title; Journal; Authors; Objectives or Research Question; and Results. This instrument was chosen because it ensured the extraction of all relevant data present in the scientific publications, minimizing the risk of transcription errors and guaranteeing the accuracy of information verification.

Inclusion and exclusion criteria

The inclusion criteria adopted for this study were: articles available in Portuguese and English, in full text; and related to the proposed topic. The exclusion criteria were: publications with incomplete or duplicate text, as well as dissertations, theses or monographs.

Data extraction and analysis

Data were extracted from the Materials and Methods and Results sections of the scientific articles selected for inclusion in the review. This involved extracting a phrase, word or set of words deemed relevant for the analysis of the collected data, which were subsequently discussed based on the theoretical framework.

REVISION

After searching the aforementioned platforms, 427 articles were found from all the databases searched, from which 40 articles were selected after applying the inclusion and exclusion criteria.

The subjects selected within each article were compiled into topics, distributed in this sequence: mast cells, general aspects, cause and degrees of mast cell tumors in dogs (Based on Patnaik's classification), age group, most affected breeds and genders, affected organs, diagnosis, and treatment.

Mast cells

Mast cells originated from hematopoietic precursors, although their development only occurred in tissues. There was a pathway that controlled the growth and development of mast cells, through a substance called precursor cell growth factor (SCF) or KIT ligand. SCF also controlled apoptosis, production, granulation, and chemotaxis of mast cells. SCF played an important role in the physiology and/or biochemistry of the mast cell tumors, as it binded to mast cell receptors encoded by an oncogene (c-kit). Another pathway that also produced mast cells involved cytokines derived from T cells (10).

Mast cells were present in almost all organs and tissues of the most diverse animal species, with their highest incidence in places with contact with external antigens, such as skin, lungs and gastrointestinal tract. In addition, a small concentration could be evidenced in lymph nodes in the paracortical region (11).

The binding of immunoglobulin E with the receptor became the most relevant mechanism of activation of mast cells. However, processes such as maturation, as well as differentiation and degranulation were modulated by the KIT ligand (2).

For mast cell identification, ideal staining preparation included Romanovsky and Giemsa staining, due to the granular affinity for basic dyes such as toluidine blue. The granules were intensely stained red or wine-colored, a characteristic termed metachromasia. This mast cell characteristic was important for the diagnosing and identifying the histopathological grade of mast cell tumors (5).

General aspects

Mast cell tumors are characterized as a neoplastic proliferation of mast cells, which originate in the bone marrow and connective tissue, and are also known as histiocytic mast cell tumors or mast cell sarcoma (12).

Mastocytoma is a cutaneous or subcutaneous tumor (Figure 1 a,b,c), occurring more frequently in canine species. They represent between 16 % and 21 % of cutaneous neoplasms and 11 % to 15 % of skin tumors, of which 11 % to 27 % are malignant (2-3, 13).

Cause and degrees of mast cell tumors in dogs

The cause of mast cell tumors is not fully understood, but some studies have demonstrated alterations in the stem cell factor receptor (KIT), responsible for encoding the juxtamembrane domain of the tyrosine kinase receptor (SCF), in canine mast cell tumor (3).

The main mutation diagnosed was a duplication that causes constitutive phosphorylation of the receptor, without the need for binding to SCF. This finding may explain the exaggerated development of the tumors and the relationship between the duplication and the malignancy of the pathology. These cells exhibit varying degrees of differentiation, based on the presence and prominence of cytoplasmic granules. Furthermore, the mitotic indices of the cells are used to classify the disease with the aim of establishing a prognosis, into three different grades: I, II, and III (15).

For histological grading, the methodology primarily considers the extent of the lesion, cellularity and cellular morphology, mitotic figures, and stromal reaction, classifying tumors into three grades: I. well-differentiated; II. intermediate differentiation and III, poorly differentiated or anaplastic. Based on this grading, dogs with grade I mast cell tumors rarely present with metastasis or complications and would have longer survival and, consequently, a better prognosis. Tumors classified as grade II exhibit variable biological behavior, with metastasis occurring in five % to 22 % of cases (17). Grade III mast cell tumors exhibit aggressive behavior; more than 80 % would cause metastasis and death from related complications (16).

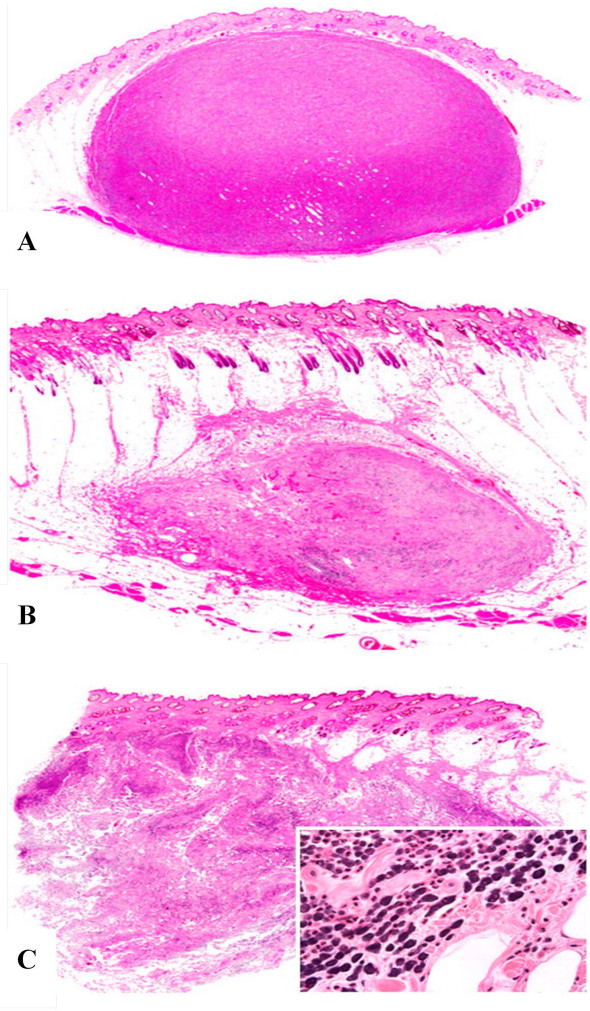

Figure 1. Subcutaneous mast cell tumor, canine. **A.** Circumscribed histologic pattern. The tumor is a nonencapsulated, well demarcated, expansile, and densely cellular neoplasm, which is elevating the overlying epidermis and invading the underlying musculature. **B.** Subcutaneous mast cell tumor, canine. Combined histologic pattern. The tumor is a solitary nodule consisting of neoplastic cells arranged in variably dense aggregates and rows and as single cells demarcated from the surrounding normal tissue by abundant collagenous fibrous connective tissue. HE. **C.** Subcutaneous mast cell tumor. Infiltrative histologic pattern. The tumor is a nonencapsulated, poorly demarcated, infiltrative neoplasm within the subcutaneous fat that extends to the surgical margins. Insert: Higher magnification (400×) at the tumor margin (box). Neoplastic mast cells are arranged as single cells, loose aggregates, and rows linearly arranged along collagen fibers, as supported by abundant collagenous stroma interspersed with eosinophils. HE. Figure and description taken from the article by Thompson *et al*. (14). / *Tumor de mastocitos subcutáneo, canino. A. Patrón histológico circunscrito. El tumor es una neoplasia no encapsulada, bien delimitada, expansiva y densamente celular, que eleva la epidermis suprayacente e invade la musculatura subyacente. B. Tumor de mastocitos subcutáneo, canino. Patrón histológico combinado. El tumor es un nódulo solitario constituido por células neoplásicas dispuestas en agregados densos variables y en hileras, y como células individuales, delimitado del tejido normal circundante por abundante tejido conectivo fibroso colágeno. Tinción H&E. C. Tumor de mastocitos subcutáneo. Patrón histológico infiltrativo. El tumor es una neoplasia no encapsulada, pobremente delimitada e infiltrativa dentro de la grasa subcutánea que se extiende hasta los márgenes quirúrgicos. Inserción: Mayor aumento (400x) del margen tumoral (recuadro). Los mastocitos neoplásicos están dispuestos como células individuales, agregados laxos y hileras alineadas linealmente a lo largo de las fibras de colágeno, sustentados por un estroma colágeno abundante intercalado con eosinófilos. Tinción H&E. Figura y descripción tomadas del artículo de Thompson et al.* (14).

Grade II mast cell tumors, which are the predominant form, have a variation in biological behavior. It may present benign or more aggressive behavior, leading the clinician to underestimate the aggressiveness of the neoplasm or to perform potentially toxic and unnecessary aggressive treatments (13).

Most affected age group, races and genders

This neoplasm affects dogs aged between eight-nine years, with apparently no predilection between sexes. In general, these neoplasms tend to occur on a large scale in elderly canines and are 41 times more likely to develop the neoplasm than dogs younger than two years (17).

A study like those of Patnaik *et al*. (8) and Shoop *et al*. (18) describe that there is no predisposition for sex among dogs with cutaneous mast cell tumors. However, Mochizuki *et al*. (19) indicate that the neoplasm has a higher occurrence in male dogs, while Śmiech *et al*. (20) report a higher occurrence in females.

Most affected breeds

Several dog breeds have a predilection for developing this neoplasm, among which the following stand out: Boxer, Boston Terrier, Bull Terrier, Labrador Retriever, Fox Terrier, Beagle, Weimaraner, Staffordshire Bull Terrier, Schnauzer, and Pug (18-20). Various studies show that mixed-breed dogs, Cocker Spaniels, Pit Bull Terriers and Shar-Peis, also have a predilection for developing mast cell tumors (15).

Affected organs

The skin is the organ most affected by the tumor, although different organs or body areas can be involved. Among the most commonly affected areas, the following stand out: the trunk, accounting for approximately 50 to 60 % of cases; the extremities, comprising 25 to 40 %; and finally, the head and neck region, at 10 % (20).

Mastocytoma is a neoplasm of mast cell origin, immunocompetent cells that play a relevant role in hypersensitivity reactions and inflammatory processes. Although its cutaneous manifestation is predominantly observed in canines, the visceral presentation in dogs has a considerably lower incidence when compared to the feline population. In cats, visceral mass cell tumors classically affect organs such as the spleen, liver and gastrointestinal tract, causing non-specific clinical symptoms including emesis, cachexia and lethargy. On the other hand, in canines, the visceral form occurs less infrequently; however, when it does occur, it can affect abdominal organs, notably the spleen and gastrointestinal tract, and it is commonly associated with an unfavorable prognosis (20).

It is noteworthy that the perineum, scrotum, dorsum, and tail are affected, but less frequently [3] . A point to be taken into account is the way in which the mast cell tumor is characterized, since this tumor can be confused with other neoplasms, thus, this disease should be adopted as a differential diagnosis [17] .

Clinical Appearance

The clinical appearance of mast cell tumors is variable (18). Lesions can be firm or friable, well or poorly circumscribed, nodular or pedunculated, and hyperpigmented in color; the diameter also varies (20). Its behavior within the biological system has varied and unpredictable characteristics. They can be benign, acting in multiple tissues with a metastatic appearance, or extremely aggressive in their malignant form, being fatal and leading to death (9).

Diagnosis and Prognosis

Although in most cases, the diagnosis of cutaneous mastocytoma in dogs is easy to detect, it normally occurs between seven and 18 years of age, except in atypical cases. This neoplasm has a biological behavior and, in most cases, pathologists seek to identify the most serious cases in a cured way (17).

Regarding clinical terms, canine MCTs can manifest in different forms with different sizes and aspects, with variable presentations, such as in the femoral anatomical region (Figure 2).

Figure 2. Canine mast cell tumors (Red circle - Mass located on the right hind limb, close to the hip joint, with a reddish and purplish color. There are areas of central necrosis, with ulcerated areas. The contour of the lesion is irregular) (Author's original). / *Tumores de mastocitos caninos (Círculo rojo - Masa localizada en el miembro posterior derecho, cerca de la articulación de la cadera, de color rojizo y violáceo. Presenta áreas de necrosis central, con zonas ulceradas. El contorno de la lesión es irregular) (Original del autor).*

Several complementary tests are indicated to enhance the research and increase the probability of diagnosing various neoplasms: ultrasonography, for the evaluation of visceral metastases in dogs with preputial tumors; and thoracic radiography, which may reveal potential pulmonary metastases. Computed tomography has proven to be a promising tool for diagnosing several types of neoplasms, such as hepatic lesions (21-22).

Biopsy is established as a standard sampling method, with high consistency of cytology and histopathology (10-11). However, histological evaluation is prone to operator subjectivity, leading to extremely variable grading results for the same tumor among different pathologists.

Histopathology (Figure 3), as reported in several studies (23-24), is essential for determining the histological grade of the neoplasm.

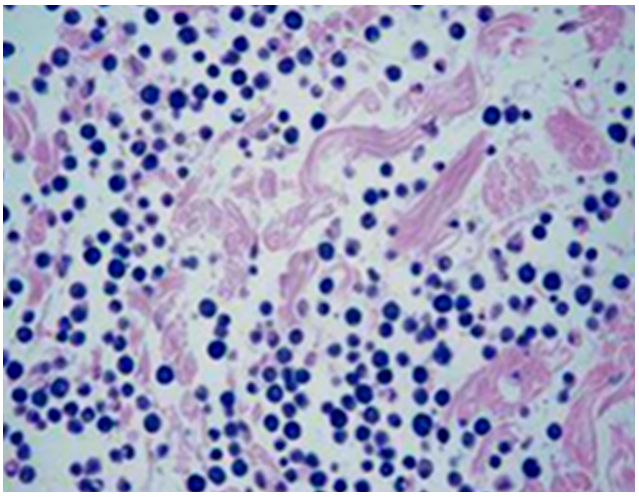

Figure 3. Differentiated mastocytoma cells showing disorganization, separated by bundles of collagen (3). / *Células de mastocitoma diferenciadas que muestran desorganización, separadas por haces de colágeno* (3).

Patnaik *et al*. (8) proposed a three-grade classification, namely: well-differentiated tumors (Grade I - low grade), with an excellent prognosis and no reported deaths; intermediately differentiated tumors (Grade II - low and high grade), with a prognosis ranging from good to fair and a mortality rate of three to 56 %; and, lastly, poorly differentiated tumors (Grade III - high grade), with high mortality of up to 75 % (23). This classification has been routinely used for surgical biopsies and, consequently, for designing appropriate treatment (21).

Considering the heterogeneous nature of moderately differentiated neoplasms and their unpredictable clinical course, Kiupel *et al*. (9) proposed a new classification with only two grades of malignancy: low grade and high grade. This classification was based on nuclear morphology and the number of mitotic figures. Thus, tumors presenting features involving at least seven mitotic figures, three multinucleated cells, three cells with bizarre nuclei per 10 high-power fields (HPF), and karyomegaly in 10 % of cells were classified as high-grade mast cell tumors (Figure 4. a, b). All other tumors not meeting these criteria are classified as low-grade mast cell tumors (4, 9, 20).

Several authors state that one of the best diagnostic approaches is through aspiration cytology, a safe and relevant method, especially in the preoperative period. It aids in establishing a definitive disease diagnosis and can support decision-making regarding the type and extent of the procedure, enabling the performance of surgical resection with a high safety margin (25).

According to Vail (26), up to 96 % of mast cell tumor cases are diagnosed by cytological examination (Figure 5 a,b), using slides prepared from fine-needle aspiration material, with sequential confirmation through histological analysis. This is because the cytoplasmic granules present in mast cells are easier to observe in cytology compared to histology, due to the larger cell size and the use of metachromatic stains such as Giemsa (27).

Regarding prognosis, clinical signs and the location of the anatomical site where the tumor is located should be considered, along with the growth rate, size, general appearance, clinical stage, recurrences, metastases, and immunohistochemical and molecular markers (16, 24).

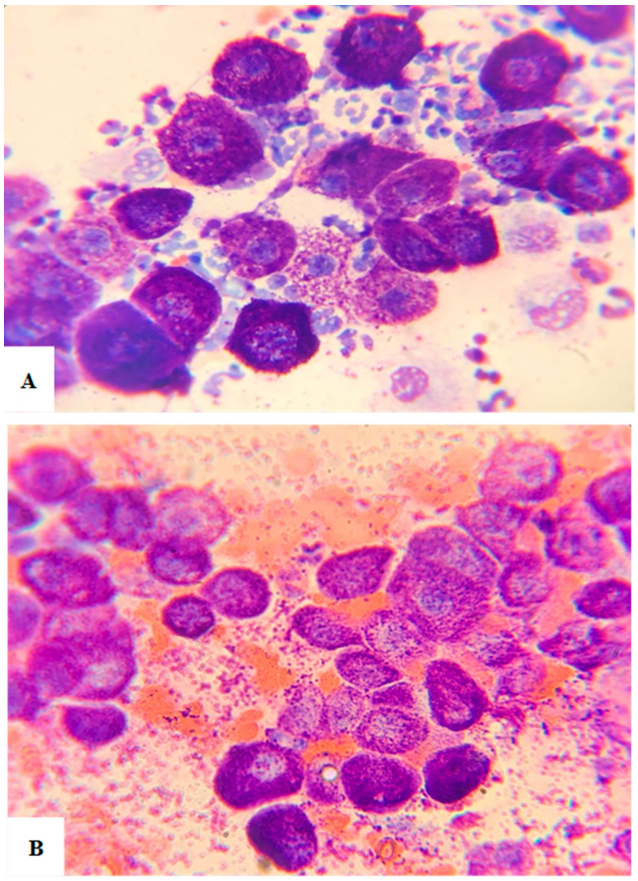

Figure 4. Cutaneous mast cell tumors from dogs. **A.** Sample with moderate amount of mast cells, neoplastic nuclei are stained light blue, some of the two with prominent nucleoli, moderate cytoplasm with purplish granules. There is also the presence of inflammatory infiltration with the presence of neutrophils and macrophages, lens 100. **B.** Aspirate from two well-differentiated cutaneous mast cell tumors from two dogs. Sample with moderate amount of uniform and well-differentiated neoplastic cells, noting the nuclei almost obscured by the presence of several coarse purplish granules (panopticon colors), lens 100 (Author's original). / *Tumores cutáneos de mastocitos en perros. **A.** Muestra con cantidad moderada de mastocitos; los núcleos neoplásicos se tiñen de azul claro, algunos de ellos con nucléolos prominentes, y citoplasma moderado con gránulos violáceos. También se observa infiltración inflamatoria con presencia de neutrófilos y macrófagos, aumento 100x. **B.** Aspirado de dos tumores cutáneos de mastocitos bien diferenciados de dos perros. Muestra con cantidad moderada de células neoplásicas uniformes y bien diferenciadas, observándose los núcleos casi oscurecidos por la presencia de numerosos gránulos gruesos violáceos (coloración pancrómica), aumento 100x (Original del autor).*

Treatment

According to Daleck *et al*. (29), treatment will depend on the animal's clinical condition, based on tumor staging and its histological classification. The treatment of choice is aggressive surgical excision, aiming to reduce the chances of tumor recurrence (27). When complete margins are achieved and there is no evidence of metastasis, the surgical technique becomes curative. However, recurrence is possible; for example, approximately 27 % of dogs with grade II mast cell tumors experienced tumor recurrence after the surgical procedure (30).

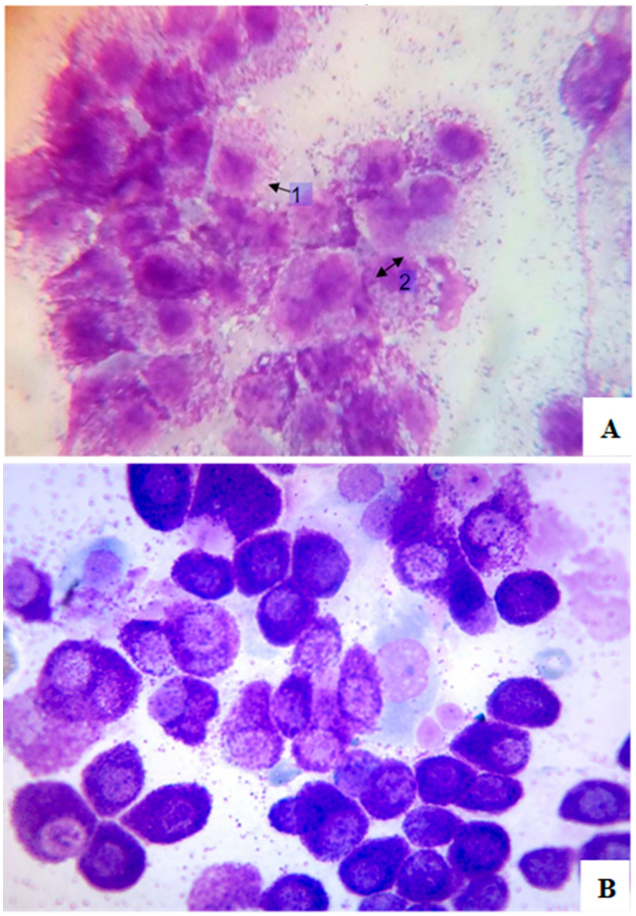

Figure 5. Mastocytoma in dog. A. Cytogram of mastocytoma of high malignancy. Mast cells with a small number of intracytoplasmic granules and slight anisocariasis; nuclear pleomorphism - the presence of non-rounded nuclear forms [1]; the presence of dinuclear [2] or multinucleated cells. According to Romanovsky-Gimza. EP. 10, lens 100. B. Cytogram of mastocytoma with a low degree of malignancy. Clusters of cells of homogeneous structure. Mixed-grained mast cells (most cells are highly granular and fewer less granular) with minimal anisocariasis; according to Romanovsky-Gimza. EP. 10, lens 100. Figure and description taken from the article by Ivashkiv *et al*. (28). / *Mastocitoma en perro. A. Citograma de mastocitoma de alto grado. Mastocitos con escaso número de gránulos intracitoplasmáticos y ligera anisocariosis; pleomorfismo nuclear - presencia de formas nucleares no redondeadas [1]; presencia de células binucleadas [2] o multinucleadas. Tinción de Romanowsky-Giemsa. IP. 10, objetivo 100x. B. Citograma de mastocitoma de bajo grado. Agregados celulares de estructura homogénea. Mastocitos de granularidad mixta (la mayoría son altamente granulares y una minoría poseen menos gránulos) con anisocariosis mínima; tinción de Romanowsky-Giemsa. IP. 10, objetivo 100x. Figura y descripción tomadas del artículo de Ivashkiv et al. (28).*

Canine mast cell tumor, a prevalent cutaneous neoplasm, originates from mast cells and exhibits heterogeneous biological behavior. Its histopathological stratification is commonly performed using the Patnaik classification, which grades them as I, II, and III, and the Kiupel classification, which categorizes them into low- and high-grade malignancy. Low-grade neoplasms are typically characterized by indolent growth, marked cellular differentiation and low metastatic propensity; whereas high-grade neoplasms display aggressiveness, poor cellular differentiation and high metastatic potential. Clinical staging of the disease is conducted using the TNM (Tumor, Lymph Nodes, Metastasis) system, and the assessment of pathological extent is supported by complementary diagnostic methods such as fine-needle aspiration cytology, abdominal ultrasonography and thoracic radiography (8-9).

In cases where surgical intervention is not feasible, combination therapy with prednisone, cyclophosphamide, and vinblastine, in addition to cryosurgery, has been reported (21). Similarly, radiotherapy is a viable treatment option for skin tumors in locations that preclude surgical excision. However, it should be noted that these therapeutic options are uncommon and not always accessible for dogs in remote regions (30).

Various therapeutic methods are documented in the literature, such as the use of tigilanol tiglate for the treatment of cutaneous mast cell tumors in dogs, as it does not require anesthesia or sedation for administration-a relevant parameter given the age and nature of the disease across different breeds and age groups. Typically, antibiotic therapy or wound dressings are not required, and healing is rapid, and curation is achieved within one month, as described by Boyle *et al*. (31) and Campbell *et al*. (32) in studies involving rats and mice. In dogs, using a concentration of 1 mg/mL dosed at 0.5 mL per cm^3 of tumor volume (50 % v/v of tumor), a high cure rate is observed (27).

Complete cure of the animals can be observed in cases of less severe tumors (Grade I) and in some Grade II cases, combining surgical excision (33-34) with radiotherapy, chemotherapy, or other complementary therapies, as described by Michels *et al*. (35), Mullins *et al*. (36), Mendez *et al*. (37), Moore *et al*. (38), and Cruz *et al*. (24).

Conventional chemotherapy protocols and complementary therapies are well-established for the treatment of canine mast cell tumors, particularly in high-grade cases with incomplete surgical margins or the presence of metastasis. Systemic chemotherapy drugs include prednisolone, due to its specific cytotoxicity against mast cells; vinblastine, used alone or in combination with prednisolone; lomustine (CCNU), effective in cases of therapeutic resistance or as monotherapy; and tyrosine kinase inhibitors, such as masitinib and toceranib (Palladia), whose efficacy in high-grade or metastatic tumors stems from their modulation of molecular pathways linked to mast cell proliferation, such as c-KIT mutations. In addition to systemic chemotherapy, localized approaches include intralesional injection of chemotherapeutic agents (e.g., tigilanol tiglate, corticosteroids) for smaller or surgically inaccessible lesions, and electrochemotherapy, which enhances the intracellular penetration of chemotherapeutic drugs through electrical impulses, demonstrating favorable outcomes in cutaneous and subcutaneous lesions (39). Radiotherapy is indicated as an adjuvant modality for local control, especially when re-excision of incomplete surgical margins is not feasible, or as a palliative treatment for inoperable tumors. The selection of the therapeutic regimen must carefully consider the histological grade, disease extent, the patient's clinical status, and resource availability (37-38, 40).

CONCLUSION

In general, it is noted that cutaneous mast cell tumors in dogs are a significant pathology, representing one of the primary disorders in the field of oncodermatology. Clinical signs and findings from fine-needle aspiration cytology must be analyzed to reach an early diagnosis. Treatment can be performed through surgical excision, chemotherapy and radiotherapy, with the approach being selected according to the histological grade of the lesions.

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