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Original Scientific Paper

CANINE FIBROSARCOMAS - A THREE-YEAR RETROSPECTIVE REVIEW AND TUMOR GRADING

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Abstract: Fibrosarcomas are malignant tumors of mesenchymal origin that occur in various animal species. In dogs, they most commonly arise in the skin and subcutis and are characterized by marked local invasiveness and variable metastatic potential.
The aim of this study was to conduct a retrospective analysis of fibrosarcomas diagnosed at the Department of Pathology, Faculty of Veterinary Medicine, University of Belgrade, from 2022 to 2024, with a special focus on histopathological grading in relation to patient age, sex, breed, and tumor localization.
A total of 60 tissue samples were histopathologically examined and graded according to the French grading system, based on cell differentiation, mitotic count, and the presence of necrosis.
Most tumors were classified as Grade II (50%), while Grades I and III were equally represented (25% each). The average age of affected dogs was 9.7 years. Fibrosarcomas were most commonly localized on the limbs (26.7%), followed by the oral cavity, back, and spleen. Necrosis was present in 76.7% of the cases, and the mitotic index ranged from 1 to 7 mitoses per 10 high-power fields (2.37 mm^2).
Histopathological grading may serve as an important prognostic factor, with the majority of analyzed fibrosarcomas demonstrating moderate biological aggressiveness. Due to potential variability in the interpretation of histopathological features and subjectivity among pathologists, further research is necessary to ensure greater accuracy in malignancy assessment and prognosis for affected animals. Despite their relatively low incidence, proper histopathological classification and grading of these tumors are of great importance for clinical prognosis and therapeutic decision-making.
Keywords: fibrosarcoma, tumor grading, mitotic index, necrosis, dog

INTRODUCTION

Fibrosarcomas are malignant tumors of mesenchymal origin, predominantly locally invasive, and therefore often associated with recurrence. In dogs, fibrosarcomas rarely metastasize distantly; approximately 9% of fibrosarcomas metastasize to the lungs,

with those exhibiting a higher mitotic index being more prone to metastasis (Carneiro et al., 2020; Gross et al., 2005). In dogs, fibrosarcomas are classified within the group of soft tissue sarcomas (STS), which includes subcutaneous tumors composed of spindle cells, such as peripheral nerve sheath tumors, vascular wall tumors, and undifferentiated pleomorphic sarcomas (Avallone et al., 2021). Some authors also include liposarcomas, leiomyosarcomas, myxosarcomas, and hemangiosarcomas in this group (Baisan et al., 2018; Bray et al., 2014). Fibrosarcomas account for less than 5% of skin and subcutaneous neoplasms in dogs (Kalkanov and Nedev, 2024; Nicole and Ehrhart, 2020).

Macroscopically, fibrosarcomas appear as firm, poorly demarcated subcutaneous masses of varying sizes. On the cut surface, they are light gray. Hemorrhagic areas are commonly present, and surface ulceration may occur (Carneiro et al., 2020; Hendrick, 2017). Histopathological examination reveals a tumor mass that often infiltrates the surrounding tissue. It comprises spindle-shaped, stellate to polygonal connective tissue cells, which occasionally form bundles (Baba and Câtoi, 2007; Gross et al., 2005). The nuclei are oval to spindle-shaped, vesicular, and contain one or more prominent nucleoli. Mitotic activity varies in intensity. The stroma consists of collagen and blood vessels, and in some cases, mucin may be present. Areas of hemorrhage and necrosis are frequently observed (Kalkanov and Nedev, 2024; Baba and Câtoi, 2007).

Although fibrosarcomas are most commonly locally invasive, their biological behavior varies depending on histopathological features; therefore, the grading of these tumors is crucial for diagnosis and prognostication (Avallone et al., 2021; Gross et al., 2005). In veterinary medicine, soft tissue sarcomas (STS) are graded using the so-called French grading system, according to which fibrosarcomas are classified into three grades based on the sum of individual scores for histologic differentiation, mitotic count in 10 high-power fields (2.37 mm^2), and the extent of necrosis. Grade I fibrosarcomas rarely recur or metastasize, particularly when excised with wide surgical margins. Grade II tumors have a higher recurrence rate when margins are narrow and show variable metastatic potential. Grade III fibrosarcomas are the least common but the most aggressive, with frequent recurrences and the highest risk of metastasis (Avallone et al., 2021; Dennis et al., 2011).

This study aims to conduct a retrospective analysis of canine fibrosarcomas diagnosed at the Department of Pathology, Faculty of Veterinary Medicine, over the past three years, with the purpose of performing histopathological grading and presenting the findings in relation to the age, sex, and breed of the patients, as well as tumor localization.

MATERIALS AND METHODS

By examining archival material from January 2022 to December 2024, a total of 60 paraffin-embedded tissue blocks diagnosed as fibrosarcoma were selected. The embedded tissue was sectioned at a thickness of 3-5 μm, stained with hematoxylin

and eosin (H&E), and examined microscopically. For each case, data on the dog (breed, sex, age), tumor location, and macroscopic characteristics of the lesion were provided. Fibrosarcomas were graded according to the French grading system (Dennis *et al*., 2011), which is based on the assessment of tumor differentiation, mitotic count, and the presence of necrosis (Table 1).

Statistical analysis was performed using descriptive methods, including the calculation of arithmetic mean, minimum and maximum values, and relative frequencies. Samples with incomplete data were excluded from the analysis. Microsoft Excel 2016 was used for data processing.

Table 1. Grading system for canine soft tissue sarcomas (Dennis *et al*., 2011)

PARAMETER	**POINTS**
Cell differentiation	
Sarcomas closely resembling normal mesenchymal tissue	1
Sarcomas with identifiable histological type, but poor differentiation	2
Undifferentiated sarcomas, unclassifiable type	3
Mitotic count (in 10 HPFs)	
0-9 mitoses	1
10-19 mitoses	2
≥20 mitoses	3
Tumor necrosis	
No necrosis	0
≤50% necrosis	1
>50% necrosis	2
Total score and tumor grade	
Total score ≤3	Grade I (low grade)
Total score 4-5	Grade II (intermediate grade)
Total score ≥6	Grade III (high grade)

RESULTS

Between January 2022 and December 2024, a total of 2,434 canine tumor biopsies were examined, of which 97 (3.99%) were diagnosed as soft tissue sarcomas (STS). Among the 97 STS cases, fibrosarcomas were identified in 60 cases (61.86%), accounting for 2.46% of all canine tumors. The proportion of fibrosarcomas among STS cases for each of the three years is presented in Figure 1.

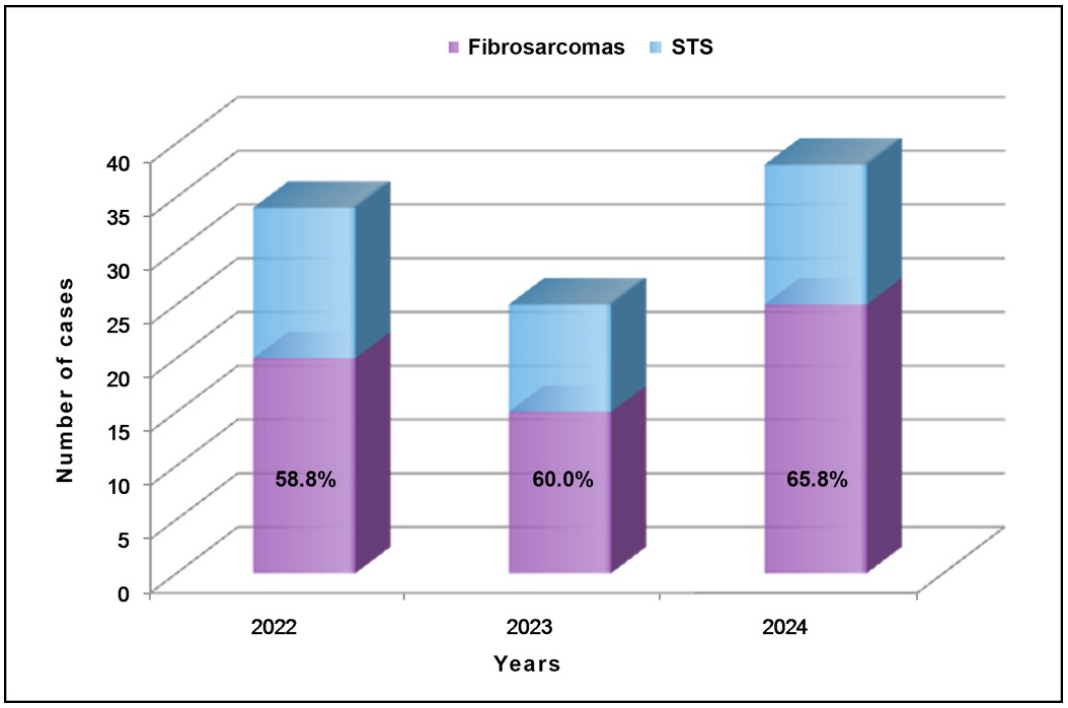

Figure 1. Ratio of STS and fibrosarcomas over the three years

Through retrospective analysis, the tumors were classified according to their malignancy grade using the French grading system. Based on tumor differentiation, mitotic count in 10 high-power fields (2.37 mm²), and the extent of necrosis, the diagnosed fibrosarcomas were categorized into three grades: 15 samples (25%) were identified as low-grade fibrosarcomas (Grade I), 30 samples (50%) as intermediate-grade fibrosarcomas (Grade II), and 15 samples (25%) as high-grade fibrosarcomas (Grade III).

The average age of dogs diagnosed with fibrosarcoma was 9.3 years (the youngest being 4 months old and the oldest 15 years). Fibrosarcomas were diagnosed in a total of 30 different dog breeds, with mixed-breed being the most represented (18 dogs, 30%), followed by American Staffordshire Terriers (4 dogs, 6.7%) and French Bulldogs (3 dogs, 5%). For one dog (1.66%), breed data were not available. No statistically significant difference was observed in the occurrence of fibrosarcomas between sexes, with 33 males (55%) and 27 females (45%) being affected.

Fibrosarcomas were most commonly localized on the limbs, a total of 16 cases (26.7%), followed by the oral cavity (11), back (6), and spleen (6). Less frequently, they were found in the region of the scapula (3), mammary gland (3), head, rump, and eyelid (2 cases each). Single occurrences were recorded in the thoracic wall, stomach, omentum, anal region, vagina, and liver (1 case each).

The number of mitoses ranged from 1 to 7 mitotic figures per 10 high-power fields (2.37 mm²), with an average of 4.47 (Figure 2). These values indicate moderate to marked proliferative activity in the majority of fibrosarcomas. Necrosis was present in 76.7% of the samples, with 28 cases (46.7%) showing necrosis in less than 50% of the

tumor section, while in 18 cases (30%), necrosis involved more than 50% of the sample (Figure 3). No necrotic changes were observed in 14 samples (23.3%).

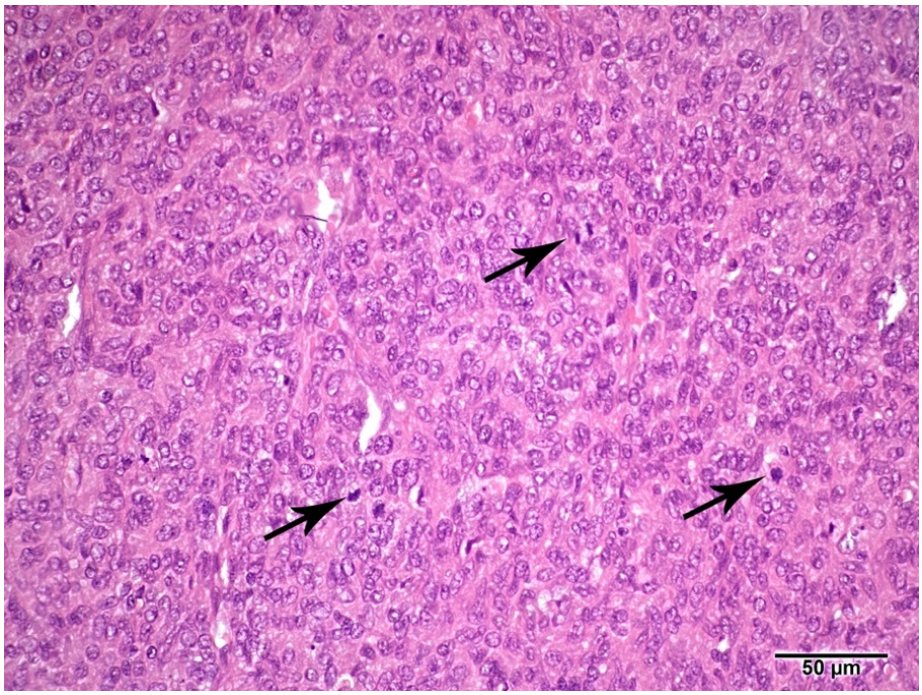

Figure 2. Fibrosarcoma in dog. Intense proliferation of atypic spindle cells and mitotic figures (arrow), HE

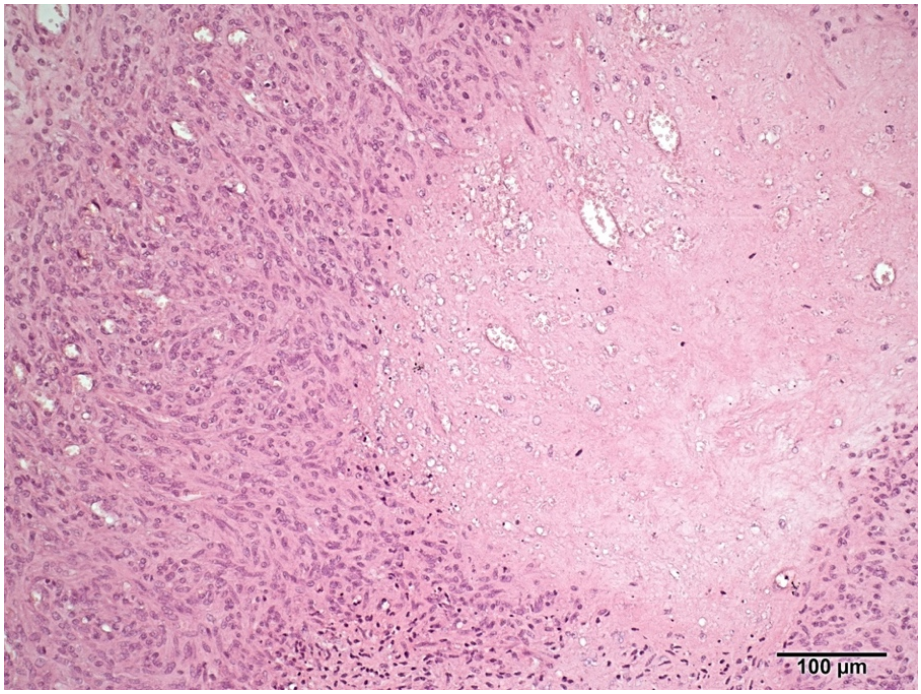

Figure 3. Fibrosarcoma in dog. Intense proliferation of spindle cells and area of necrosis, HE

DISCUSSION

The results of this study show that the majority of examined fibrosarcomas were classified as Grade II (30 out of 60 cases), while Grades I and III contained an equal number of tumors. Although Grade II soft tissue sarcomas are relatively common, most authors report that Grade I tumors are the most frequently encountered (Dennis et al., 2011; McSporran, 2009). Grade II tumors with wide surgical margins rarely recur, whereas those with narrow margins tend to recur more frequently compared to Grade I tumors and are associated with a shorter disease-free interval (Avallone et al., 2021; Dennis et al., 2011). Grade II soft tissue sarcomas can metastasize to distant organs, but the data in the literature vary, ranging from 7% in one study (Kuntz et al., 1997) to 33% in the study by Simon et al. (2007). Our findings indicate that the majority of diagnosed canine fibrosarcomas were Grade II and are likely to possess moderate biological aggressiveness, which is relevant for treatment planning and disease prognosis.

The average age of affected dogs in this study was 9.7 years, which aligns with literature citing a median age of around 8.5 to 10 years (Magalhães et al., 2015; Gross et al., 2005). No statistically significant sex-related differences in fibrosarcoma distribution were observed, consistent with previous reports showing approximately equal numbers of affected males and females (Baba and Câtoi, 2007; Gross et al., 2005). Regarding breed distribution, fibrosarcomas were diagnosed in a variety of dog breeds, most commonly in mixed-breed dogs, followed by American Staffordshire Terriers and French Bulldogs. In contrast to our data, other authors have reported higher frequencies in breeds such as Gordon Setters, Irish Wolfhounds, and Golden Retrievers (Carneiro et al., 2020; Gross et al., 2005). Although both our study and earlier reports suggest higher occurrence in certain breeds, there is insufficient evidence to support a true breed predisposition for the development of fibrosarcomas in dogs.

The majority of fibrosarcomas in this study were localized on the limbs, which is consistent with literature indicating that the extremities are a common site for soft tissue sarcomas (Hendrick, 2017; Gross et al., 2005). A notable number of fibrosarcomas were also found in visceral organs, such as the spleen and liver, highlighting the need for a broad differential diagnosis. Of particular importance is the frequency of localization in the gingiva and oral mucosa, as tumors in these sites may exhibit distinct biological behavior and present greater diagnostic challenges. In cases of oral fibrosarcoma in dogs, special attention should be paid when grading the tumor based on histopathological features, as it has been observed that oral fibrosarcomas may display aggressive clinical behavior and a poor prognosis even when histologically classified as Grade I (so-called “histologically low-grade, biologically high-grade fibrosarcoma”) (Avallone et al., 2021; Gardner et al., 2013).

The obtained values of mitotic activity indicate moderate to marked proliferative activity in most fibrosarcomas. The authors reported that the number of mitotic figures in fibrosarcomas influences the survival time of the affected dog (Bostock and Dye, 1980).

Grading of fibrosarcomas, as well as other STSs based on histopathological characteristics, has proven useful in assessing the risk of local recurrence and overall survival, particularly when surgical margin status is taken into account (Avallone et al., 2021). However, one limitation of such grading systems lies in the subjectivity of result interpretation and inter-observer variability among pathologists (Avallone et al., 2021; Dennis et al., 2011). Fibrosarcomas must be differentiated from other spindle cell tumors, such as peripheral nerve sheath tumors, leiomyosarcomas, vascular wall tumors, and histiocytic sarcomas, for which immunohistochemical staining methods are often necessary (Subramanian et al., 2018; Gross et al., 2005).

CONCLUSION

Based on the three-year retrospective analysis of canine fibrosarcomas, it can be concluded that these tumors most frequently belong to the intermediate grade of malignancy, with the average age of affected dogs being 9.7 years. The results confirm that grading based on histopathological characteristics can serve as a useful prognostic tool, particularly when used in combination with information on surgical margins and clinical progression.

However, the application of this classification system for fibrosarcomas requires careful evaluation of histopathological features, considering the potential for subjectivity in interpretation by pathologists. Additional studies involving clinical outcomes, treatment response, recurrence rates, and survival data of affected dogs are necessary to enable more precise validation and standardization of fibrosarcoma grading in everyday veterinary practice.

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Conflict of Interest Statement: The authors declare that there is no conflict of interest.

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