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Clinical, cytological, and histopathological features of canine lipomas: a retrospective study in Espírito Santo, Brazil

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Abstract

This study aimed to characterize the epidemiological, cytological, and histopathological aspects of canine lipomas diagnosed in Espírito Santo, Brazil. A retrospective analysis was conducted on 175 canine lipoma cases diagnosed between 2018 and 2024 at the Veterinary Pathology Laboratory in Espírito Santo. The variables evaluated included sex, age, breed, municipality of origin, anatomical location and diagnostic method. Most cases originated from Colatina (77.7%), and the majority of affected dogs were female (63.4%) with a mean age of 8.8 y. Mixed-breed dogs were the most frequently affected (37.1%), followed by Shih Tzus, Labrador Retrievers, and Poodles. The trunk was the most common anatomical site of disease (61.1%). Clinically, most lipomas are asymptomatic; however, large masses occasionally lead to locomotor difficulty, compression of adjacent structures, or decreased quality of life. Macroscopically, the lesions measured 0.5–20.0 cm, were soft and white, and exhibited a greasy cut surface. Cytological evaluation revealed low-cellularity smears predominantly composed of mature adipocytes with large clear vacuoles, peripherally displaced nuclei, and minimal pleomorphism. Histopathological examination revealed well-circumscribed neoplasms composed of mature adipocytes arranged in indistinct lobules, displaying anisocytosis related to vacuole size, minimal anisokaryosis, and no mitotic figures. In conclusion, lipomas in dogs from Espírito Santo mainly affected adult and elderly females and mixed-breed dogs, with the trunk being the most common site of occurrence. Cytology is a highly valuable diagnostic tool; however, histopathological confirmation remains essential, particularly for atypical presentations. These findings enhance the epidemiological and clinicopathological understanding of canine lipomas in Brazil.

Introduction

Lipomas are the most common benign mesenchymal neoplasms in dogs, characterized by the proliferation of mature adipocytes that grow slowly and expansively, primarily in subcutaneous tissues (Gross et al. 2005; Hendrick 2016; O'Neill et al. 2018). Although typically asymptomatic, large or strategically located lipomas may cause clinical complications that can negatively impact animal welfare, being common indications for surgery (Subapriya et al. 2020; Sasikala et al. 2020).

The prevalence of canine lipomas varies by region and methodology; however, they are more frequently reported in females, older dogs, and in Labrador Retrievers, Shih Tzus, and mixed-breed dogs (O'Neill et al. 2018; Subapriya et al. 2020; Pegram et al. 2020). In Brazil, epidemiological studies are scarce, particularly those integrating both cytological and histopathological diagnostic approaches.

Macroscopically, lipomas are well circumscribed, soft and mostly subcutaneous and freely moveable masses (Hendrick 2016). Cytological examination is widely used for the initial diagnosis of lipomas because of its speed, low cost, and high sensitivity (Einarsdóttir et al. 2004). However, histopathological analysis remains essential for confirming the diagnosis, especially in cases with unusual locations, large or infiltrative masses, and suspected malignancies (Avallone et al. 2017; Mcchesney et al. 1980).

Given the clinical importance and frequency of lipomas in the daily routine of veterinary medicine, studies that characterize their clinical, epidemiological, cytological, and histopathological features are fundamental for supporting the diagnosis, prognosis, and management of affected animals (Pegram et al. 2020; Conrado et al. 2019).

Therefore, this study aimed to characterize the epidemiological, cytological, and histopathological aspects of canine lipomas diagnosed in the central region of Espírito Santo, Brazil.

Material and Methods

Sample and data collection methods

This retrospective observational study included cases of canine lipomas diagnosed between 2018 and 2024 in Espírito Santo, Brazil. Data were collected from fine-needle and excisional biopsies and necropsy records of the Veterinary Pathology Laboratory located in the municipality of Colatina, Espírito Santo

Dogs of any breed, sex, or age diagnosed with lipomas through cytological or histopathological examination were included. Patients with duplicate or incomplete data were excluded.

Epidemiological and clinical data were collected from the patients

The following variables were recorded for each patient: sex, age (years), breed, municipality of origin, anatomical location of the mass, and diagnostic method (cytological and/or histopathological).

Cytological evaluation

Fine-needle aspiration (FNA) was performed on palpable masses after antisepsis of the area using 21- or 22-gauge needles attached to 5 or 10 mL syringes, respectively. The aspirated material was smeared onto glass slides, air-dried, and stained with rapid panoptic or May-Grünwald-Giemsa stains according to routine laboratory protocols.

Histopathological Evaluation

Samples for histopathology were obtained by excisional or incisional biopsy and fixed in 10% neutral-buffered formalin for at least 24 h. Tissues were processed routinely, embedded in paraffin, sectioned to a thickness of 4–5 µm, and stained with hematoxylin and eosin (HE).

Data analysis

Descriptive statistical analyses were performed for all variables using Microsoft Excel. Absolute and relative frequencies were calculated for categorical variables, whereas measures of central tendency

(mean and median) and dispersion (standard deviation) were calculated for quantitative variables (e.g., age).

Ethical considerations

This study was based on a retrospective analysis of clinical and laboratory records. No experimental procedures or interventions were performed on the animals.

Results

This study included 175 cases of canine lipomas diagnosed between 2018 and 2024 in Espírito Santo, Brazil. The majority of cases originated from the municipality of Colatina (77.7%), with additional cases distributed among Vitória, Domingos Martins, Nova Venécia, Baixo Guandu, Itaguaçu, Santa Maria de Jetibá, Santa Teresa, Rio Bananal, and Linhares (Fig. 1).

Among the affected animals, the majority were female (63.4%), with males accounting for 36% of the cases; sex was not recorded in only one case. Age data were available for 154 patients (88.0%). The ages of the animals ranged from 1 to 17 years, with a mean age of 8.8 years and a median age of 9 years, indicating a predominance of adult and older dogs.

Mixed-breed dogs were the most frequently affected (37.1%), followed by Shih-tzu (9,1%), Poodle (6,9%), Labrador Retriever (6,3%), Lhasa Apso (5,1%), Yorkshire Terrier (4,6%), and Beagle (3,4%). Other purebred dogs were less frequently represented in the study. In a small proportion of cases, the breed was not specified.

The trunk was the most common site for lipoma development, representing 61.1% of the cases. Masses located on the limbs (thoracic and pelvic) accounted for 7.4% of the cases, whereas the neck and head were less commonly affected (Fig. 2). The anatomical location was not specified in 27.4% of the records.

Macroscopic evaluation of the lipoma cases revealed a broad morphological spectrum, with lesions measuring 0.5–20.0 cm in their greatest dimension. Most masses presented as expansive subcutaneous nodules with rounded to irregular contours, predominantly soft consistency, homogeneous white coloration, and greasy appearance on the cut surface. In some cases, firmer areas and foci of hemorrhage were observed (Fig. 3A).

Cytology was the primary diagnostic method and was performed in 74.3% of cases, whereas histopathological evaluation was available in 25.7% of cases. In a subset of cases, both cytology and histopathology were performed, with histopathology serving as a confirmatory method.

Cytological evaluation of the lipomas revealed smears with low cellularity, predominantly composed of adipocytes organized in groups, and exhibiting a low nucleus-to-cytoplasm ratio. The cytoplasm was abundant and contained large negative vacuoles. The nucleus was round to elongated, compressed, and

located at the cell periphery. Cellular and nuclear pleomorphism, anisocytosis, and anisokaryosis were minimal. The background of the slides frequently showed numerous droplets of lipid material (Fig. 3B)

Histopathological analysis revealed a moderately cellular, well-circumscribed, and partially encapsulated neoplasm composed of mature adipocytes arranged in indistinct lobules within a thin fibrovascular stroma. The neoplastic adipocytes displayed distinct cell borders and a single clear (lipid) vacuole measuring 60–130 µm, which compressed and displaced a flattened hyperchromatic nucleus to the cell periphery. Anisocytosis was marked depending on the size of the vacuole, but anisokaryosis was minimal (Fig. 3C). No mitotic activity was observed in the tumor cells.

Discussion

The present study retrospectively characterized canine lipomas over six years, predominantly affecting adult and elderly dogs, with higher prevalence in females and mixed breeds. These findings agree with reports identifying age, sex, and overweight as predisposing factors (O'Neill et al. 2018; Subapriya et al. 2020; Sasikala et al. 2020; Pegram et al. 2020). The mean age (8.8 years) supports their occurrence mainly in mature and geriatric dogs (Gross et al. 2005; Hendrick 2016; O'Neill et al. 2018; Subapriya et al. 2020). Systematic palpation of subcutaneous tissues, especially in overweight dogs, is recommended for early detection and management. However, the absence of body condition data limited the assessment of its association with lipoma development.

The predominance of mixed-breed dogs, followed by Shih Tzus, Labrador Retrievers, and Poodles, agrees with reports highlighting high frequencies in crossbred animals and breed predispositions (O'Neill et al. 2018; Pegram et al. 2020). Although inconsistently reported, the higher occurrence in females may be related to hormonal and metabolic factors (Subapriya et al. 2020; Sasikala et al. 2020). Thus, assessing reproductive status during anamnesis is recommended, as hormonal influences and neutering may affect tumor development.

Regarding the anatomical location, the trunk was the most frequently affected site (Hendrick 2016; Subapriya et al. 2020). The predilection for the trunk and proximal limbs is likely related to the greater abundance of subcutaneous adipose tissue in these areas. Lipomas in the cervical, axillary, or inguinal areas may lead to functional impairment or compression. In such cases, surgical removal should be considered to preserve the animal's quality of life.

In this study, cytology was the main diagnostic method, reflecting its accuracy and widespread use in small-animal practice. Typical findings included low-cellularity smears composed of grouped or isolated mature adipocytes with abundant cytoplasm, large clear vacuoles, peripherally displaced nuclei, minimal pleomorphism, and lipid-rich background. These features are consistent with the established cytological profile of lipomas described in the literature (Subapriya et al. 2020; Einarsdóttir et al. 2004; Raskin and Conrado 2023). Despite its usefulness, cytology alone may not reliably distinguish all variants, such as infiltrative lipomas or early stage liposarcomas, which require histopathological confirmation (Gross et al. 2005; Hendrick 2016; Avallone et al. 2017; Mcchesney et al. 1980). A key cytopathological differential

diagnosis is normal subcutaneous fat, which may appear similar on smears but lacks the clinical context and organization typical of neoplastic processes. In the present study, this differentiation was based on the integration of cytological findings with clinical information obtained from the medical records, including lesion localization, growth pattern, clinically interpreted as nodular or mass-forming processes and macroscopic description when available.

A relevant observation in this study is that, following a cytological diagnosis suggestive of lipoma, many clinicians proceed with surgical excision without histopathological confirmation. Although often justified by the typically benign nature of lipomas and practical or financial considerations, this approach carries the risk of overlooking rare variants or malignant tumors that may mimic lipomas cytologically. In this context, the role of the general practitioner is essential, both in accurate clinical evaluation and in effective communication with pet owners. The routine submission of excised masses for histopathological examination should therefore be encouraged as standard practice to ensure early diagnosis and appropriate clinical decision-making.

Histopathological evaluation in this study consistently revealed well-circumscribed, partially encapsulated neoplasms composed of mature adipocytes arranged in indistinct lobules, with a single clear vacuole compressing the nucleus at the periphery of the vacuole. These features are classical and reinforce the reliability of histopathology for definitive diagnoses (Gross et al. 2005; Hendrick 2016). Mitoses are not observed, and anisocytosis, when present, is correlated with vacuole size rather than malignant transformation (Gross et al. 2005; Hendrick 2016).

Geographically, the concentration of cases in the municipality of Colatina is likely explained by the presence of the diagnostic laboratory at this location, which facilitates sample submission and case referrals from local clinics and neighboring regions. Similar findings have been reported in other regional studies, where the proximity of diagnostic centers significantly influenced case distribution (Subapriya et al. 2020). This finding highlights the importance of accessible complementary diagnostic services in ensuring accurate diagnosis, guiding clinical decisions, and improving patient outcomes.

The limitations of the present study include its retrospective design and incomplete information for some variables, especially regarding the anatomical location or signalment in a subset of records. Nevertheless, the large sample size and integration of cytological and histopathological data add robustness to our findings.

In conclusion, this study reinforces the notion that lipomas are common in dogs, especially among elderly females and mixed-breed animals, and that the trunk is the most frequently affected site of the body. Although cytology is a highly effective and accessible diagnostic tool, histopathological analysis of all excised masses should be encouraged to rule out unusual variants and ensure optimal care. These data contribute to the epidemiological and clinical understanding of lipomas in Espírito Santo and may support future improvements in the diagnostic and management strategies for canine soft tissue tumors.

Declarations

Conflict of interest statement

The authors declare no conflicts of interest.

Author Contribution

E.P. Andrade, L. Martinelli, A.T. Soares, H.H.R. Gregorio, L.F. Vieira, V.Z. Lemos, T.S. Alberti, E.S.V. Sallis, H.V. Scheid, F.C.A.Q. Castro, J.M, Cota, and C. Marcolongo-Pereira: All authors contributed equally to the study conception and design, data curation, formal analysis, investigation, and methodology, as well as to the drafting, critical revision, and final approval of the manuscript.

Acknowledgments

Data Availability

The datasets generated and analyzed during the current study are not publicly available due to patient confidentiality and institutional policies but may be made available from the corresponding author upon reasonable request.

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Figures

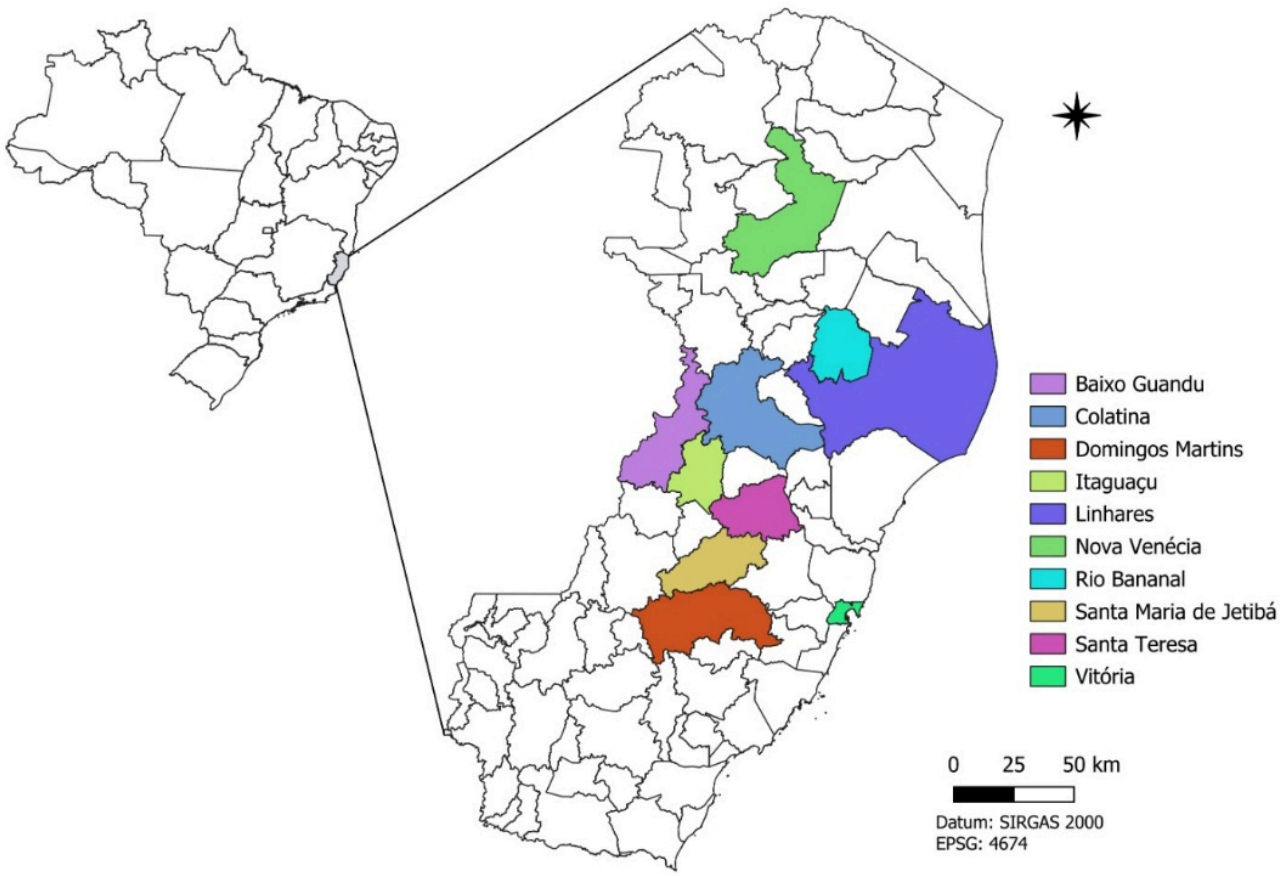
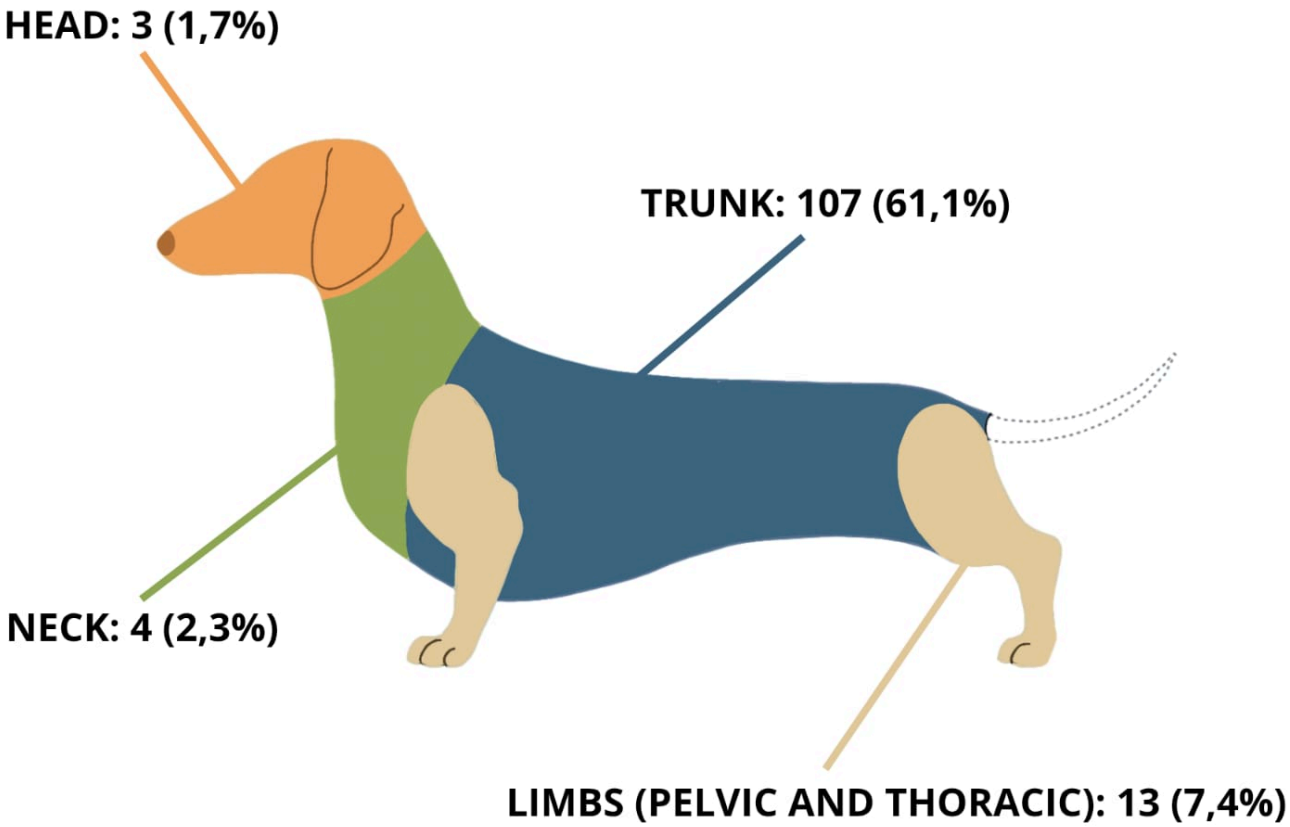


Figure 1

Distribution of canine lipomas diagnosed between 2018 and 2024 in the state of Espírito Santo, Brazil.



- **NI (NOT-INFORMED): 48 (27,4%)**

Figure 2

Anatomical distribution of lipomas in dogs. Predominance of lipomas in the trunk, followed by the thoracic and pelvic limbs, with the neck and head being less commonly affected by lipomas.

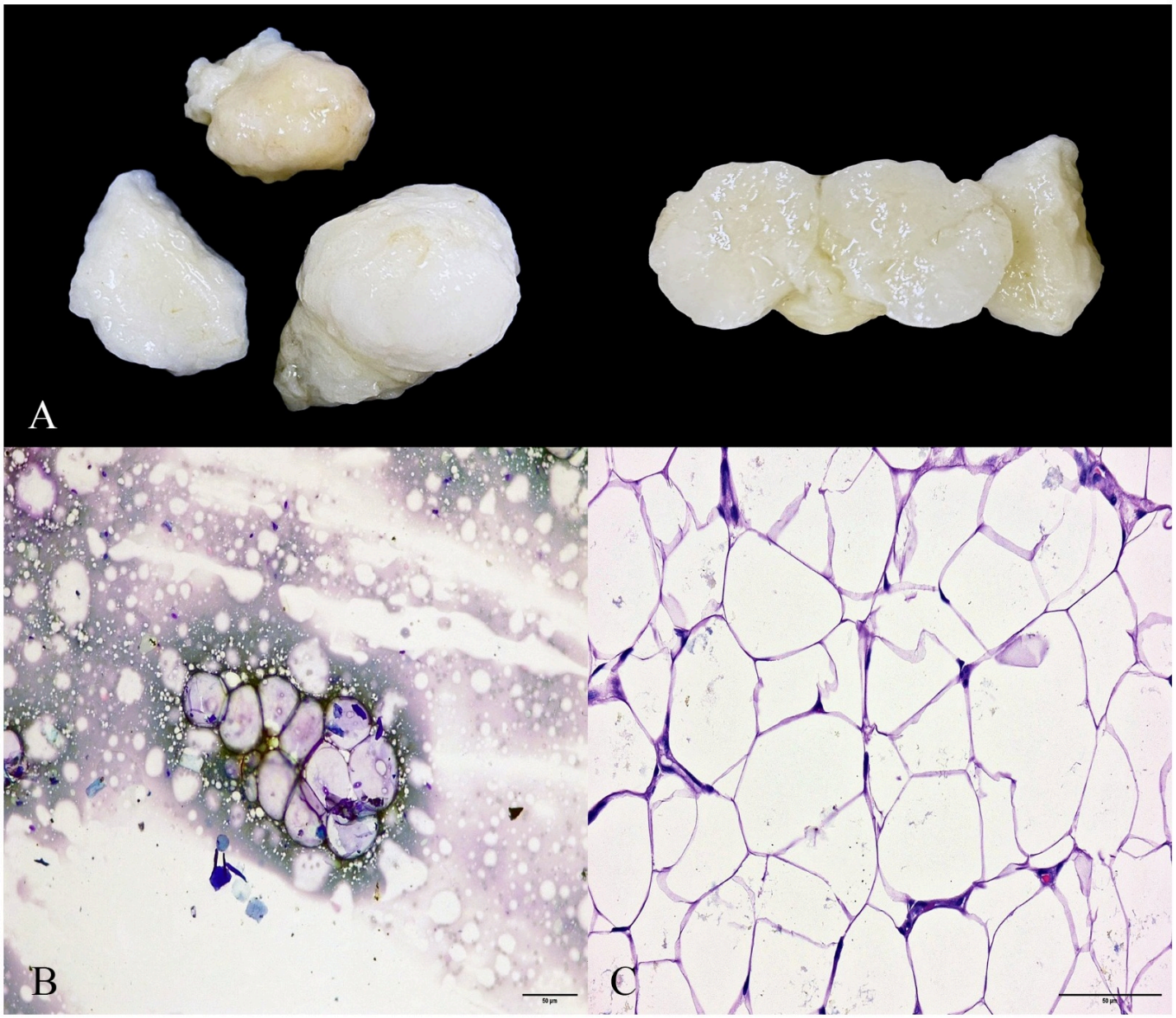


Figure 3

A) Macroscopic characteristics of lipomas in dogs. Expansive nodules, presenting contours that varied from rounded to irregular, soft, homogeneous white, and greasy, with cut surfaces. B) Cytological evaluation of a lipoma showing low cellularity smears dominated by grouped adipocytes, exhibiting a low nucleus-to-cytoplasm ratio, ample cytoplasm with a large-negative vacuole, and a peripherally compressed nucleus. Minimal cellular and nuclear pleomorphism, anisocytosis, and anisokaryosis were also observed. Romanowsky stain, bar = 50µm. C) Histopathological section of a lipoma, showing mature adipocytes organized in indistinct lobules within a thin fibrovascular stroma. Note the prominent clear lipid vacuoles compressing and displacing the flattened hyperchromatic nuclei to the cell periphery. Marked anisocytosis and minimal anisokaryosis were observed, with no evidence of mitotic figures. H&E, bar = 50µm.