# Histological Aspects of White Fatty Lesions in Dogs: Case Reports

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## ABSTRACT

White fatty tissue is an extremely important tissue through the whole spectrum, but it is also a source of non-tumorous changes, including tumorous changes. Early diagnosis followed by surgical intervention markedly improves the prognosis. In this process, the veterinary pathologist plays an important role due to examination of white fatty lesions, which lead to a final diagnosis with clear differentiation between a non-tumorous changes, benign, or malignant tumours. The objective of this work is to describe our experiences with white fatty lesions diagnosis in dogs. One lipoma, one infiltrative lipoma, one fibrolipoma, one angiolipoma, one inflammatory lipoma, one nodular panniculitis, one well-differentiated liposarcoma, and one pleomorphic liposarcoma are described. In well differentiated tumour, for the gold standard remains haematoxylin-eosin staining. From the microscopic point of view, part of the fatty lesions and tumours can be mistaken for different histopathological units, but with different prognostic significance. Here especially other poorly differentiated mesenchymal spindle, cellular, or spiral tumours types can resembling poorly differentiated liposarcoma. Even for some experienced veterinary pathologists this not a problem. Nevertheless, we suggest additional histochemical and immunohistochemical investigations. Currently well known and standardised methods like Oil Red "0", Sudan black, Vimentin, Cytokeratin, and S-100 antibodies are discussed. Also for this, reason information from clinics is very important and veterinary pathologists need to be in closer relationship with clinical colleagues and communication should be more specific and informative.

## INTRODUCTION

Fatty tissue plays an important role in a range of biological functions and is divided into white and brown fatty tissue. The once held view that fat cells function as simple storage of energy is no longer subscribed to the entire spectrum of endocrine and exocrine functions has already been described with the conclusion of expanding the range

of functions and of the importance of fatty tissue in regulation of physiological processes. These facts have greatly changed the view on fatty tissue.

On the other hand fatty tissue is also a source of tumorous changes, which can be determined as benign or malignant.[1] According to the information from the WHO's "International histological classification of tumors of domestic animals" benign white fatty tumours are classified as lipoma, and its variant of infiltrative lipoma, and angiolipoma.

Malignant tumours are classified as liposarcoma, with a variant of well-differentiated, pleomorphic, and myxoid.[2] Early diagnosis, followed by surgical intervention, strongly improves the prognosis. In this process, the veterinary pathologist plays an important role in the examination of tumorous lesions, which leads to a final diagnosis with clear differentiation between a malignant and benign white fatty tumours, type of the white fatty tumour, level, and the rate of growth of the white fatty tumour. Here we are reporting eight white fatty lesions cases from our bioptic practice. The objective of this article is to show our experiences with white fatty lesions diagnosis in dogs.

## MATERIAL AND METHODS

### Case Reports

- Case 1. A dog with solid tumor localized subcutaneously in the area of mammary gland. Laboratory received one approximately 4x3x3 cm., sized resembling chicken egg shaped sample. It is a pale, lipoid material, which is easy to cut (Figure 1 A). Two samples were selected for further histological investigation.
- Case 2. A dog with a tumour localized subcutaneously on the right thoracic part of body. Laboratory received one approximately 4x2x2 cm., sized white fatty tissue sample (Figure 1 B). For further histological examination the central part of the sample was selected and processed.
- Case 3. A dog with a large subcutaneous tumor on the left foreleg. Laboratory received two approximately 3x3x1 cm., and 2x2x1 cm., sized samples and one part form the centre was processed for further histological investigation (Figure 1 C).
- Case 4. A dog with a massive subcutaneous tumour on the dorsal part of body surrounded by several variable sized tumours. Laboratory received two approximately 3x3x2 cm., and 2x2x1 cm., sized white fatty tissue samples, which were partially

***Figure 1***
*A: Nodular fat tissue mass.*
*B: Shapeless tissue composed of fat tissue and skeletal muscles.*
*C: Two parts of tumor composed of skin and mass of tumorous material.*
*D: Fat tissue with well visible blood vessels.*
*E: Lipoma. Legend: HE: 100x.*
*F: Infiltrative lipoma. Legend: HE: 100x.*
*G: Fibrolipoma. Legend: HE: 100x.*
*H: Angiolipoma. Legend: HE: 100x.*

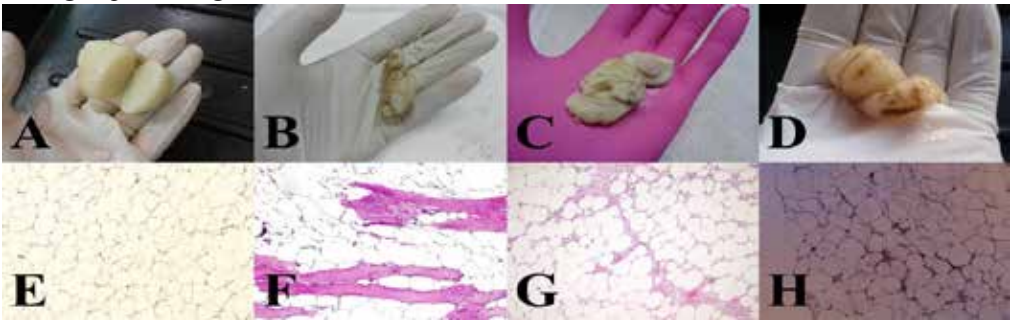
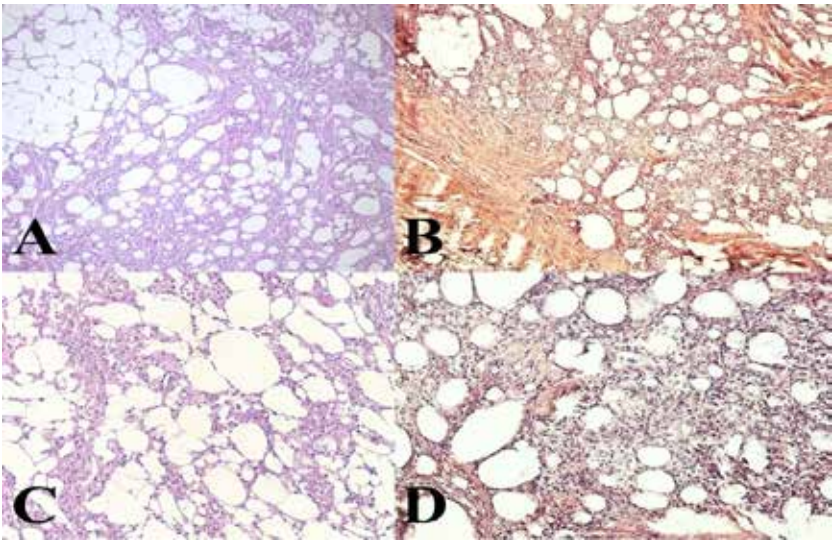


***Figure 2***
*A: Inflammatory lipoma. Legend: HE: 100x.*
*B: Nodular panniculitis. Legend: HE: 100x.*
*C: Inflammatory lipoma. Legend: HE: 200x.*
*D: Nodular panniculitis. Legend: HE: 200x.*




covered by fibrous tissue (Figure 1 D). One sample from the centre was selected for further histological investigation.

- Case 5. A dog with one large subcutaneous tumour localized in the umbilical area. The laboratory received one approximately 15x8x6 cm., encapsulated, fibrous sample and two samples were selected for further histological investigation.
- Case 6. A dog with two tumours localized subcutaneously in the dorsal part of body. Laboratory received two approximately 3.5x2.5x1.5 cm., fibrous-white fatty tissue samples and one part from each was selected for further histological investigation.
- Case 7. A dog with one tumour localized subcutaneously on the dorsal part of body. Laboratory received one approximately 2x2x2 cm., sized white fatty tissue sample and one part from center was processed for further histological investigation.
- Case 8. A dog with a large subcutaneous tumour in the umbilical area. Laboratory received one approximately 20x15x10 cm., massive tumour was delivered to laboratory and several parts of the sample were processed for histological investigation.

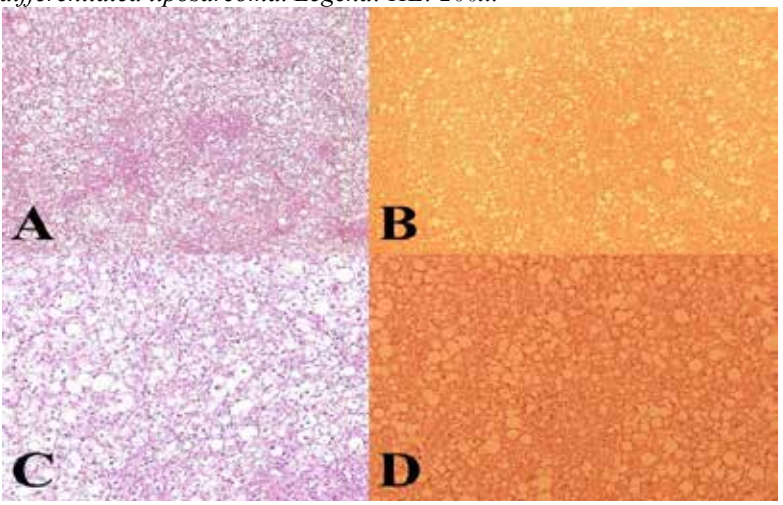
**Histological Procedures**

Formaldehyde-fixed tissues were routinely embedded in paraffin blocks. Samples were cut using a microtome with a thickness of 3–5 μm. Slices were stained using a general haematoxylin-eosin (Diapath, Italy). Samples were described and evaluated on a light-microscopic picture using Olympus microscope (Olympus Provis BX40, Japan).

## RESULTS

- Case 1: Lipoma. Microscopic image consisted of white fatty tissue with several typically shaped ovoid, polygonal, or elongated univacuolar (Author, please check spelling of the word) fat cells with minimal extracellular spaces containing periphery localised miniature darker ellipsoid nuclei (Figure 1 E).
- Case 2: Infiltrative lipoma. Sample consisted of matured white fat tissue with several approximately same sized univacuolar (Spelling?) fat cells, which are infiltrating fibrous septa, including muscular fibres of cross striated skeletal muscles (Figure 1 F).

***Figure 3***
*A: Well differentiated liposarcoma. Legend: HE: 100x.*
*B: Poorly differentiated liposarcoma. Legend: HE: 100x.*
*C: Well differentiated liposarcoma. Legend: HE: 200x.*
*D: Poorly differentiated liposarcoma. Legend: HE: 200x.*




• Case 3: Fibrolipoma. Tissue, which is composed by two parts. Dominant part consisting white fat tissue with several ovoid univacuolar fat cells and second part is created by elongated, or fusiform cells resembling fibroblast which are surrounded by richly vascularised fibre component (Figure 1 G).

• Case 4: Angiolipoma. Material consisting white fat tissue with several ovoid, or polygonal univacuolar (Sp?) fat cells with several capillaries containing mass of erythrocytes into the lumen (Figure 1 H).

• Case 5: Inflammatory lipoma. Mass of variable sized univacuolar (Author, if spelling changes are appropriate, please change the spelling of this word throughout. Thank you) fat cells and part of them are covered by massive diffuse inflammation predominantly consisting histiocytes. Part of the sample is vital and part semivital, or necrotic with residual univacuolar fat cells formations and mass of histiocytes, lymphocytes and polymorphonucleares (Figure 2 A, C).

• Case 6: Nodular panniculitis. Histologically fibrolipid tissue consisting several univacuolar fat cells, which are separated by mass of reticular, collagenous fibres and massive inflammation consisting of histiocytes. Almost full material is covered by mass of histiocytic elements with variable sized foamy slightly pinkish cytoplasm containing several miniature droplets, or some miniature palled vacuoles and one darker nucleus. In various regions some digested univacuolar fat cells on relaxed collagenous stroma are present. On the periphery muscular fibres of skeletal muscles and some individual, or groups of isolated histiocytes are visible (Figures 2 B, D).

• Case 7: Well-differentiated liposarcoma. Histology showed massive diffuse arranged mesenchymal tumour, consisting of ovoid or irregularly shaped cells with ballooned, almost empty, or slightly pinkish cytoplasm and one atypical darker nucleus containing several compact nucleoli. Part of the cells resembling signet-ring cells with polygonal shaped, pale to totally clear optically fine cytoplasm containing one darker atypical nucleus. Several focal necrotic fields are into the center of the tumor present. Tumor is infiltrating surrounded connective tissue. (Figures 3 A, C).

• Case 8: Pleomorphic liposarcoma.

Material consisting poorly differentiated mesenchymal tumour consisting of variable sized, ballooned cells with significantly pleomorphic cellular and nuclear areas. Almost in all areas of tumour there are diffuse arranged pleomorphic, polygonal, or spindle-shaped cells resembling lipoblasts. The tumour cells consist of optically clear cytoplasm containing atypically shaped nuclei with some dispersedly distributed heterochromatin, and with one or two compact nucleoli are present. Some atypical isolated cells, or groups of atypical cells, including several multinuclear lipoblastic cells and signet-ring cells are visible. The mitotic activity reach 3/40 HPF atypical mitotic figures. Part of the tumour is necrotic. Stroma is represented by fibrous septa and numerous thin-walled blood vessels (Figures 3 B, D).

## DISCUSSION

White fatty tumours are common in veterinary bioptic practice. These tumours have already been described in almost all mammalian species and in well-differentiated forms they are easily identifiable. In cases of poorly differentiated forms, the diagnosis should be supported by immunohistochemical methods, eventually by clinical investigation. Lipoma is a benign tumour, composed of univacuolar fat cells, interstitial tissue and blood vessels. In dogs, it is one of the most common type of skin tumour.[3] Histologically, compared to normal white fatty tissues, differences are minimal.

Other types, like infiltrative lipoma, fibrolipoma, and angiolipoma are characterised by morphological diagnosis. References reported also some other type of lipomas.[4,5] Most of them can be identified relatively quickly and the final diagnosis is always supported by benign white fat tissue, which is mixed with other types of tissues. Atypical lipomas are more problematic to diagnose. They are also composed by white fat tissue and can contain some differences in white fat cells, including some mitotic figurines. For instance, spindle cell lipomas are referred like benign neoplasms of adipose tissue that may resemble an undifferentiated soft tissue sarcoma and need to be clearly diagnosed.[6]

Other challenges in diagnostic veterinary pathology can be nodular panniculitis, which is characteristic by white fat cells inflammation and in some cases there is a risk of mistake with malignant tumour diagnosis.[7] Other diagnostic problems may be sebaceous sarcomas resembling pleomorphic liposarcoma. Our cases show that final conclusion is based on histological findings, with consideration for differences between other entities, including criteria for diagnosis. Information from anamnesis or therapy are helpful for final diagnosis.

Liposarcoma is a malignant tumour of white fat tissue with localization similar to lipoma, but with different morphology, infiltrated growth, and poor prognosis.[8] The pleomorphous-type variants of this tumour are widely variable, and it is not always easy to make an accurate diagnosis using only standard hematoxylin-eosin staining. Some references recommend histochemistry, and for instance, the activity of Oil Red "0" or Sudan black are useful methods in fatty tumours diagnosis.[9] On the other hand, this investigation needs closer cooperation with clinical colleagues, who need to respect the sample fixation requirements. By immunohistochemical examinations the mesenchymal origin of tumours was verified by a positive reaction to anti-vimentin and negative reactions to cytokeratin. In our previous cases the positive response of liposarcoma to anti-S-100 protein became a diagnostic marker.[10] However, it is evident, that anti-S-100 protein is not just a marker for mesenchymal cells, but is expressed by multiple cell types, notably those of neural crest origin such as malignant melanoma, chondroblastoma and Schwannoma.[11]

Other data indicated that the effectiveness of anti-S-100 protein has been demonstrated in a wide range of normal and neoplastic tissues, including some canine connective tissue tumours.[12] Immunohistochemistry is not widely established, is

an expensive method, and is not always supported by animal owners. This is the reason why veterinary pathologists need to establish a diagnosis from classical haematoxylin-eosin staining. The most important point is to differentiate other entities from malignant tumours. In our experience, in the first instance, the overall appearance of the investigated material should be noted. All components should be investigated and special attention should be given to any dominating observations, e. g., compressing of surrounding tissue by tumour, presence of peripheral infiltration, cellular composition of neoplastic mass, and morphology of cells. Benign white fatty tumours are usually localized subcutaneously and have well developed macroscopy. Histologically they can also be composed of other tissue components. Malignant white fatty tumours usually display progressive growth pattern. Poorly differentiated types can infiltrate other organs and therefore resemble other types of the tumours. This is one of the most serious problems in the diagnosing of the mesenchymal tumours.

## CONCLUSION

We present eight cases of white fatty lesions and with the objective to show the difficulties in their diagnosis using standard haematoxylin-eosin staining. In concrete cases of fatty tumors in veterinary pathology practice, there are some challenges with final diagnosis, especially in cases of poorly differentiated tumours, which can resemble other types of the tumours. Some special immunohistochemical investigation and anamnestic data from clinics in the process of tumour origin recognition are suggested.

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**Statement of Authorship**

The authors hereby certify that all work contained in this article is original. The authors claim full responsibility for the contents of the article.

**Conflict of interest**

The authors confirm that they do not have any conflict of interest.

## REFERENCES

1. ONeill DG, Corah CH, Church DB, Brodbelt DC, Rutherford L. Lipoma in dogs under primary veterinary care in the UK: prevalence and breed associations. *Canine Genet Epidemiol*. 2018;27(9):5-9.
2. Hendrick MJ, Mahaffey EJ, Moore FM, Vos JH, Walder EJ. Histological classifications of mesenchymal tumors of skin and soft tissues of domestic animals. 2nd edn. Washington: *Armed Forces Institute of Pathology*. 1998;64.
3. Villamil JA, Henry CJ, Bryan JN, Ellersieck M, Schultz L, Tyler JW, Hahn AW. Identification of the most common cutaneous neoplasms in dogs and evaluation of breed and age distribution for selected neoplasm. *J Am Vet Med Assoc*. 2011;239(7):960-965.
4. Furumoto R, Michishita M, Arai K, Soeta S, Takahashi K. Lingual chondrolipoma in a dog. *J Comp Pathol.* 2017;157(1):11-14.
5. Liggett AD, Frazier KS, Styer EL. Angiolipomatous tumors in dogs and a cat. *Vet Pathol.* 2002;39(2):286-289.
6. Avallone G, Pellegrino V, Muscatello LV, Sarli G, Roccabianca P. Spindle cell lipoma in dogs. *Vet Pathol.* 2017;54(5):792-794.
7. Contreary CL, Outerbridge CA, Affolter VK, Kass PH, White SD. Canine sterile nodular panniculitis: a restrospective study of 39 dogs. *Vet Dermatol.* 2015;26(6):451-458.
8. Baez JL, Hendrick MJ, Shofer FS, Goldkamp C, Soremo KU. Liposarcomas in dogs: 56 cases (1989-2000). *J Am Vet Med Assoc*. 2004;224(6):887-891.
9. Masserdotti C, Bonfanti U, de Lorenzi D, Ottolini N. Use of Oil Red 0 stain in the cytologic diagnosis of canine liposarcoma. *Vet Clin Pathol.* 2006;35(1):37-41.
10. Makovicky P, Makovicky P, Nagy M, Nemeth P, Rajmon R. A kutyák malignus fibrosus histiocytomájának anti-S-100 protein alapú elkülönítő kórjelzése. Immunhisztokémiai eset ismertése. *Magyar Allat Lapja*. 2012;134(2):101-105.
11. Bahrami A, Truong LD, Ro JY. Undifferentiated tumor: true identity by immunohistochemistry. *Arch Pathol Lab Med.* 2008;132(3):326-348.
12. Perez J, Baustita MJ, Rollon E, deLara FC, Carrasco L, Martin de las Mulas J. Immunohistochemical characterization of hemangiopericytomas and other spindle cell tumors in the dog. *Vet Pathol.* 1996;33(4):391-397.