

CYTOGENETIC AND MEDICO-ECOLOGICAL ASSESSMENT OF INDICATORS OF THE SKIN OF DOMESTIC ANIMALS OF THE *CANIDAE* AND *FELIDAE* FAMILIES OF CENTRAL BELARUS

A.N. Semak¹, E.G. Buško², V.A. Stelmakh²

¹Veterinary Clinic „WellVet“, Belarus, Minsk

²Belarusian State University, ISEI BSU

Abstract

The study of the genesis of domestic animals in zoogeographic, phylogenetic and cytogenetic aspects allowed us to identify patterns of occurrence and development of various diseases and to predict their dynamics in connection with changes in the complex conditions of their habitat. It was found that among the examined group of dogs in 80,3% of cases there were benign neoplasms; in 19,7% of cases the possibility of the occurrence and development of malignant neoplasms was diagnosed. Malignant neoplasms of the skin among the examined cats were detected more often and made up 63,0% of cases (benign – 37,0%).

Key words: benign neoplasms, malignant neoplasms, habitat impact.

Introduction

The skin is the most important organ of humans and animals, serving as a protective barrier against exogenous factors: physical, chemical, and microbial pathogens (Candi et al.2005, Elias et al. 2008). The genetic basis of skin diseases is widely postulated as a risk factor for the occurrence and development of specific skin diseases in both humans and animals (Sugarman et al. 2008). Certain breeds of dogs and cats are prone to skin diseases. In this regard, for the final diagnosis, additional laboratory tests are required, including thorough patho-cytohistological studies.

Materials and methods

The objects of research are biopsies from the affected areas of the skin and its derivatives, mucous membranes, lymph nodes, and neoplasms obtained from the veterinary clinic “WellVet”. The subject of the research is the cytogenetic study of the analyzed cytopathological preparations.

Sampling techniques for cytological examination of skin pathologies differ depending on the site and the type of lesion analyzed. The main sampling techniques are scraping, smear imprint, fine needle biopsy with or without aspiration. A total of 515 cytological samples were obtained.

Results

1. Results of the differential diagnosis of inflammation patterns and identification of their frequency of occurrence among dogs

In the presented study, the number of cytopathological preparations of the inflammatory type was 260 samples. Septic neutrophilic inflammation is predominant and is found in 95% of pathologies. Within the framework of this inflammatory process, the main population of cells is represented by neutrophils, accounting for up to 80-95% of the total number of cells (Figure 1). As a result of the studies, it was found that the neutrophilic inflammatory type of cytological preparation is one of the most common in dogs (Table 1).

Table 1. Differential diagnosis of inflammation patterns among dogs.

Inflammation pattern	Pathology (n=)	Extensive coefficients, %
Septic neutrophilic inflammation	247	95,0
Sterile neutrophilic inflammation	1	0,4
Neutrophilic and macrophage inflammation	8	3,1
Eosinophilic inflammation	4	1,5

Staphylococcal pyoderma commonly occurs in dogs with atopic dermatitis. The adhesion of *staphylococci* to the corneocytes of these dogs is higher than to the corneocytes of healthy dogs (Olivry et.al.2015).

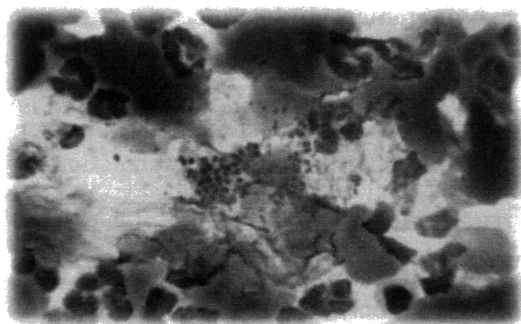


Figure 1. Septic neutrophilic inflammation. Bacterial overgrowth (cocci), Magnification X 1000

Adhesive bacteria (*Staphylococcus intermedius*) were identified using a cytological scotch test and a fingerprint smear in case of exudation on the surface of the skin lesion.

2. Results of the differential diagnosis of inflammation patterns and identification of their frequency of occurrence among cats

In the study, a total of 152 samples of inflammatory cytology of the skin and mucous membranes among cats were identified. The most common type of inflammation in cats is eosinophilic inflammation (65,1%). Table 2 presents the results of differentiation and frequency of occurrence of patterns of inflammation among cats.

Table 2. Differential diagnosis of inflammation patterns among cats.

Inflammation pattern	Pathology (n=)	Extensive coefficients,%
Septic neutrophilic inflammation	48	31,6
Sterile neutrophilic inflammation	3	2,0
Neutrophilic and macrophage inflammation	99	65,1
Eosinophilic inflammation	2	1,3

Flea allergic dermatitis and eosinophilic-granuloma complex are the most common pathologies in this cytological picture.

The eosinophilic-granuloma complex is a common diagnostic finding in veterinary dermatology.

3. Results of differential diagnosis of skin neoplasms and the revealed frequency of skin neoplasms among dogs

Due to the fact that the skin has a complex structure, a large number of different neoplasms can develop in it, including their metastases, localized in other organs and tissues. About 2/3 of all canine neoplasms are single benign neoplasms formed by epithelial cells or adnexal structures [1-3] (Table 3).

Table 3. Differential diagnosis of dog skin neoplasms.

Type of neoplasm	Pathology (n=)	Extensive coefficients, %, %
Melanocytic tumors (melanoma / melanocytoma))	3	4,0
Lymphoma	2	2,6
Histiocytoma	9	11,8
Mastocytoma	12	15,8
Lipoma	22	29,0
Cerumenous gland adenoma	2	2,6
Sebaceous adenoma	4	5,3
Keratin follicular cyst	3	4,0
Fibrosarcoma	3	4,0
Sebaceous gland hyperplasia	13	17,1
Fibroma	2	2,6
Epulis	1	1,3

According to the results of these studies, it was found that 80,3% were benign neoplasms, while in 19,7% of cases, the possibility of the onset and development of malignant neoplasms was diagnosed.

All neoplasms were surgically removed.

A case of melanoma has been reported in a Black Russian Terrier (Figure 2).

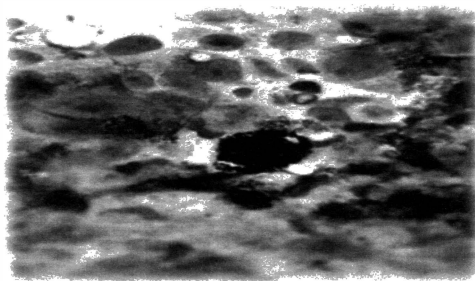


Figure 2. Melanoma. The preparation is formed of melanocytes and epithelial-like pseudogroups. Melanin is visualized in the cytoplasm and in the background of the micropreparation. Magnification X 1000.

Dogs of this breed have a genetic predisposition to this oncopathology. In dogs, cutaneous melanoma is recorded predominantly in aging animals and most often it affects breeds with intensely pigmented skin.

Canine mastocytoma is a malignant tumor that arises from the mast cells of the skin (Figure 3). The neoplasm is the most common skin tumor in dogs. Among dogs, predisposed breeds include Boxers, Boston Terriers, Labradors, Weimaraners, Beagles, Sharpei and Golden Retrievers.

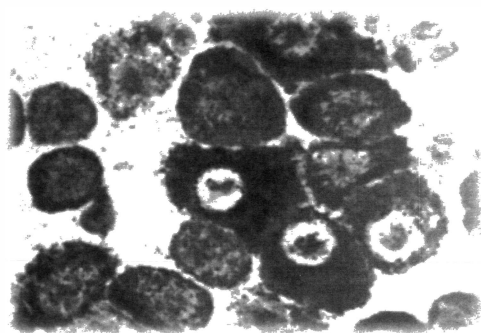


Figure 3. Highly differentiated mastocytoma. The preparation is formed of mast cells with well-visualized round-oval nuclei and purple granules, which are present in the background of the preparation. Magnification X 1000.

Lipoma in dogs is a benign neoplasia of subcutaneous adipocytes. It is most common in middle-aged or older dogs, especially Dobermans, Labradors, and Miniature Schnauzers (Figure 4).

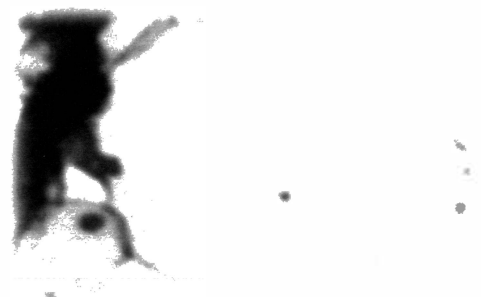


Figure 4. Group of mature adipocytes. Lipoma. Magnification X 1000.

Lipoma is common in dogs and much less common in cats.

4. Results of differential diagnosis of skin neoplasms and the revealed incidence of malignant skin neoplasms among cats

It was revealed that among cats, malignant neoplasms are recorded more often than benign ones. The etiology of neoplasms in small domestic animals remains largely unexplored. Among the known etiological factors, it is necessary to note the effect of teratogens, hormones, as well as viral infections and genetic factors.

Table 4. Differential diagnosis of feline skin neoplasms.

Type of neoplasm	Pathology (n=)	Extensive coefficients %
Lymphoma	1	3,7
Mastocytoma	12	44,4
liposarcoma	2	7,4
Cerumenous gland adenoma	1	3,7
Keratin follicular cyst	1	3,7
Fibrosarcoma	3	11,1
Sebaceous gland hyperplasia	7	25,9

As a result of the conducted cytological studies, it was revealed that malignant neoplasms of the skin among the examined cats are detected more often and account for 63.0% of all studied cases, while benign ones – 37,0%. Mastocytoma accounted for 44,4% of detected pathologies, fibrosarcoma 11,11%, liposarcoma – 7,4%, lymphoma – 3,70%, cerumenous gland adenoma – 3,7%, hyperplasia of the sebaceous glands – 25,9% of cases.

Epidermal and follicular inclusion cysts in cats are cystic structures that have epithelial walls. These lesions are uncommon in cats, with the highest incidence in middle-aged animals.

Fibrosarcoma is a malignant neoplasm that develops in the skin as well as in soft tissues (Figure 5).

There are cases when fibrosarcoma in cats can grow in the fascia, bones, ligaments, great vessels.

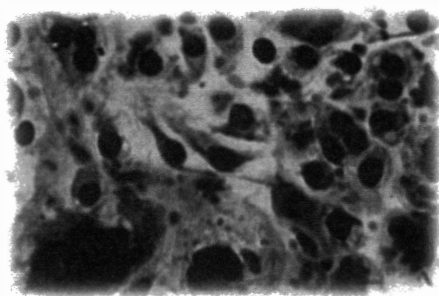


Figure 5. The preparation is formed of multinucleated cells with pronounced dysmetry of nuclei and large cells in a state of mitosis. Expressed anisocariosis. Fibrosarcoma. Magnification X 1000.

Discussion

One important aspect is the differentiation of inflammation patterns. The following inflammations are distinguished: neutrophilic inflammation, neutrophilic sterile inflammation, neutrophilic and macrophage inflammation, eosinophilic inflammation, lymphocytic and plasmacytic cell inflammation. In addition, the neutrophilic inflammatory process by its nature can be septic (purulent inflammation) or sterile. Diseases causing neutrophilic and macrophage inflammation have different etiologies, including bacterial, fungal, parasitic, protozoal diseases, as well as storage diseases (skin calcification, xanthomatosis) and diseases caused by foreign bodies. Among the diseases causing eosinophilic inflammation, eosinophilic granuloma, eosinophilic furunculosis, sterile pustular dermatitis the most common pathology is hypersensitivity reaction to insect bites. Carrying out such differential diagnostics is extremely important in modern veterinary medicine not only in the Republic of Belarus but also in world practice.

A large number of different tumors can develop in the skin; The prognosis for these cancers varies from favorable to unfavorable, depending on the type of neoplasm. A correct identification of tumors is necessary for the choice of optimal treatment.

In dogs, cutaneous melanoma occurs predominantly in aging animals, and most often affects breeds with intensely pigmented skin, such as Scottish Terriers. This tumor also occurs in aging cats, but they do not have a sexual or breed predisposition to this cancer. Outwardly, melanocytic tumors look like flat, plaque-like or button-like neoplasms with a diameter of up to 2 cm, immersed in the dermis. They are usually black-colored and fairly well distinguishable. Malignant tumors can become quite large, less intensely pigmented, and often ulcerate. In cats, melanoma should be differentiated from a basal cell tumor, which is more often highly pigmented.

A number of reactive and malignant histiocytic tumors have been described in small domestic animals. In dogs, the most common diagnosis (10% of all reported cases of skin cancer) is cutaneous histiocytoma, a benign skin tumor not found in other animal species. Most often, it affects young animals. In typical cases, the neoplasm is localized on the head, limbs and body. It is a rapidly growing tumor immersed in the dermis. Small animal histiocytic skin tumors are actually benign and it is not uncommon for them to spontaneously disappear without any treatment. The regression of these tumors is associated with their infiltration with cytotoxic *T*-lymphocytes. In most publications devoted to the histological study of these tumors, experts note the presence of lymphocytic infiltrates in them. Epithelial lymphoma is more common in dogs. During histological examination in thin sections of this tumor, diffuse infiltration of the epidermis by neoplastic lymphocytes and other inflammatory cells, microabscesses and tropism to the accessory structures of the skin are noted. As the tumor develops, the transformed cells penetrate into the deep layers of the skin (Fontaine et al.2009).

Tumors arise when exogenous factors interact with the genetic apparatus of the cell. Expressed geographical differences in morbidity, as well as a direct relationship with individual risk factors, indicate the possibility of avoiding the occurrence of a tumor in some cases.

From the standpoint of cell biology, tumor transformation is the result of a gradual accumulation of genetic disorders in cells, which can also be genetically determined, affecting various regulatory mechanisms.

Conclusions

1. Through applied cytodiagnosics, the frequency of occurrence of inflammatory patterns was revealed and their etiology was determined among dogs. The most common pattern among dogs – septic neutrophilic inflammation – was 95%, sterile neutrophilic inflammation-0,38%, neutrophilic and macrophage inflammation-3.08%, eosinophilic inflammation-1,54%. Dermatitis associated with overgrowth of yeast fungi of the genus *Malassezia*, resulting in septic neutrophilic inflammation, was diagnosed in two dachshunds. Dachshunds have a genetic predisposition to this pathology. In 5 dogs of the Jack Russell Terrier breed, a clinically verified diagnosis of atopic dermatitis was made, which is genetically determined in this breed.

2. By means of diagnostics using methods of cytological studies, the frequency of occurrence of patterns of inflammation was revealed and the etiology among cats was determined. The most common pattern among cats – eosinophilic inflammation – accounted for 65,1%, lymphocytic-plasmacytic inflammation – 1,3%, neutrophilic and macrophage inflammation – 2,0%, septic neutrophilic inflammation – 31,6%. No connection was found between the occurrence of patterns of inflammation and genetic predisposition.

3. Through cytological studies, it was found that among malignant neoplasms in dogs, the most common skin neoplasm is a mastocytoma -15,79%, among benign ones, the most common is a lipoma – 28,95%. Histiocytoma was 11,84%, lymphoma-2,63%, fibrosarcoma-3,95%, fibroma-2,63%, keratin follicular cyst-3,95%, sebaceous gland hyperplasia-17,10%, sebaceous gland adenoma-5,26%, cerumen gland adenoma-2,63%, epulis-1,32%, melanoma-3,95%. A case of melanoma was reported in a Russian black terrier. Dogs of this breed have a genetic predisposition to this oncopathology. Differentiation of malignant neoplasms from benign ones made it possible to choose the necessary protocol for subsequent therapy in a timely and accurate manner.

4. Through cytological studies, it was revealed that malignant skin neoplasms among the examined cats are detected more often and make up 62,97% (benign 37,03%). Mastocytoma was 44,44%, fibrosarcoma 11,11%, liposarcoma-7,42%, lymphoma-3,70%, adenoma of the cerumen gland-3,70%, hyperplasia of the sebaceous glands-25,93%.

5. The impact of environmental factors on the body is cumulative and subsequently causes the development of structural abnormalities in somatic cells.

The role of environmental factors in the development of oncopathologies was considered as a result of the analysis of epidemiological studies.

References

1. Candi E. (2005) The cornified envelope: a model of cell death in the skin. *Mol. Cell. Biol* ; 6(4):328-40.
2. Elias P. M. (2008) Pathogenic mechanisms in atopic dermatitis. *Invest Dermatol.* 227 (128): 1067-1070.
3. Sugarman J.L. (2008) The epidermal barrier in atopic dermatitis. *Semin Cutan Med Surg.* 27(2):108-14.
4. Olivry T., Douglas J. (2015) Treatment of canine atopic dermatitis: 2015 updated guidelines from the International Committee on Allergic Diseases of Animals (ICADA). *Veterinary Research* 292 (122): 1186–1201.
5. Fontaine J. (2009) Canine cutaneous epitheliotropic T-cell lymphoma: a review. *Vet and Comp Oncol* 7 (1): 1–14.