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Histomorphological changes in atheroma of the dog (morphological study on the example of 12 clinical cases)

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Abstract. Pathological processes in the skin of domestic animals are one of the most common diseases of domestic animals both in the Kyrgyz Republic and throughout the world. In connection with the complex differential diagnosis of oncological and non-neoplastic diseases in animals based only on clinical signs, the purpose of this work was to conduct a statistical and histomorphological analysis of cases of atheroma development in dogs. Clinical, histological and statistical methods were used during the research. The research was conducted on a controlled group of domestic dogs in

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the amount of 12 animals, which were followed for several years. When collecting the anamnesis, in addition to clinical signs, the breed, age and concomitant diseases of the dogs were recorded. During surgical removal of atheroma, histological preparations were prepared to clarify the diagnosis and study histomorphological changes in the tissues. Atheroma of the skin in dogs was most often registered in old animals, which were more than 9 years old at the time of diagnosis. At the same time, such pathology was most often localized in dogs in the area of the head and neck. Among the breeds, the Boxer turned out to be the most susceptible to the formation of sebaceous gland cysts. Also, the incidence among females was 75% of all cases of registered diseases. Histological studies revealed the prevalence of cases with the formation of multiple cysts – 67%, when a number of smaller formations are found near one huge atheroma, while cases of purulent inflammation were only 16%. Surgical removal of the atheroma was an effective method of treatment, while no cases of re-development of cysts were observed during the long postoperative follow-up. The obtained results make it possible to expand knowledge on the clinical manifestation, diagnosis and treatment of non-neoplastic skin diseases in domestic animals

Keywords: surgical and biopsy material; sebaceous gland cyst; morphological diagnosis; non-neoplastic skin pathology; operative treatment

INTRODUCTION

Skin diseases in domestic animals are quite common in world practice and the Kyrgyz Republic and arise due to numerous aetiological factors. Therewith, one of the main pathological skin problems in dogs is various oncological and tumor-like diseases that develop in all layers of the skin. In Kyrgyzstan, according to S. Ishenbaeva *et al.* (2023), pathological changes in the skin of epithelial and mesenchymal nature are most often established in domestic animals, lymphoreticular formations were less common, and melanomas were in last place in terms of prevalence. The same authors note that in the morphological diagnosis of skin diseases, benign neoplasms prevailed – 52%, malignant tumors were detected in 30% of cases, and atheromas and other tumor-like formations – 18%. In other domestic animals, and cats, in particular, in studies conducted by E. Wouters *et al.* (2022), the number of skin diseases of non-tumor aetiology was observed slightly less frequently than in dogs.

Among the skin formations, atheroma is also widespread in dogs. Most researchers indicate that atheroma is a neoplasm of a cystic nature, which is formed as a result of blockage of the sebaceous gland duct. Pathological changes of oncological and non-tumor nature in the skin can develop regardless of the area of the body and, according to J. Munday *et al.* (2022), externally appear the same, in the form of rounded elevations above the skin. Therefore, for the differential diagnosis of such formations of a non-tumor nature, it is necessary to conduct histomorphological differentiation. According to clinical signs, cysts have slow growth and contain fluid inside that has accumulated as a result of blockage of the duct. B. Hassan *et al.* (2022) indicate that sebaceous gland cysts are quite common in dogs and do not cause much discomfort to animals. Initially, according to M. Sbaraglia *et al.* (2021), cystic formations are not an oncological pathology, but unlike the opinion of the previous author, they are extremely rare in the body of animals.

In appearance, this type of pathology is difficult to distinguish from other benign skin tumors in dogs,

which, according to J. McKenzie *et al.* (2023), belong to basal cell formations and is also quite often diagnosed in cats and dogs. One of these pathologies may be an adenoma of the sebaceous gland – a benign tumor, which, as a result of not timely treatment, may carry certain risks to animal health due to the possibility of further transformation into a malignant neoplasm. Since, externally, at the initial stage, the cyst and adenoma are practically indistinguishable, it is difficult to determine the process of developing in the body and timely provide the necessary assistance to the animal, and only the histological method allows determining with high information the nature of the course of the atypical process in the epithelial cells of the skin. In addition, the contradictory results of studies on the prevalence of cystic skin pathology among dogs, given in the analysed literature, are insufficient criteria for forecasting. Therefore, the analysis of a number of cases of pathological skin morbidity in dogs in Kyrgyzstan is an urgent study to accumulate information and expand the knowledge base on the prevalence of cystic pathology in dogs of different breeds.

The purpose of this study was to conduct statistical and morphological examinations of the development and course of the pathological process in the skin of dogs in histologically confirmed cases of atheroma in animals.

LITERATURE REVIEW

Skin diseases in pets are common diseases in veterinary practice. One of them is an atheroma or cyst of the sebaceous gland, which develops due to mechanical blockage of the excretory duct. According to S. Paterson (2009), there are atheromas ranging in size from a pea to a chicken egg. These formations are usually painless, have a rounded shape and elastic consistency. Most often, atheroma is preceded by traumatic skin damage. Also one of the reasons for the formation of atheromas, according to J. Swanson *et al.* (2019), is a decrease in the expression of Keratin 79 and Gata6 factors that

regulate the expansion of the follicular duct. In most cases, according to D. Wiener (2021), cysts in dogs affect several layers of skin at once, including sebaceous glands. In this regard, there are single and multiple skin cysts. In most cases, according to A. Neff and H. Horch (2023), these are benign, expansively growing structures that are relatively common in the jaw region, less often, they are localised in the soft tissues of the face and neck. Similar areas of sebaceous gland lesions on the scalp are described by S.N. Ishenbaeva *et al.* (2012) and J. Jyothi *et al.* (2023), and also in the abdomen and chest. A frequent localisation of sebaceous gland atheroma was the soft tissues of the face, and in studies by A. Shakirova *et al.* (2020). Cysts lined with epithelium are called true cysts, and those that do not contain epithelium – pseudocysts. The growth of atheromas is relatively slow, inflammation occurs during infection, and suppuration is often observed (Chele & Mădălina, 2023).

The study by M. Patel *et al.* (2019) indicates that the pathology of the sebaceous glands accounted for 4.04% of cases of all skin diseases in dogs, while out of 23 cases, three adenocarcinomas and one hyperplasia (atheroma) were diagnosed in 19 cases. In other studies, V. Kukulj *et al.* (2021) indicate that pathological changes in the sebaceous glands had a slightly different proportion. Thus, out of 2432 skin biopsies in dogs, a cyst was detected in 35% of cases, and an adenoma – only in 4.4%. Similar results are reported by S. Ishenbaeva *et al.* (2023) in studies in which cat atheroma was diagnosed in 30% of cases of all skin diseases.

The breed dependence of cystic skin diseases in dogs is indicated by S. Hobi *et al.* (2023), B. Lancellotti *et al.* (2020). Most studies indicate that atheroma and other skin neoplasms are observed in dogs of all breeds, but the Labrador retriever was identified to be the most susceptible breed, followed by the Pomeranian and mongrel dogs. In addition, a high incidence of skin diseases of the head was observed in pugs and bulldogs. No less than the breed predisposition, the age of animals is also a factor in the morbidity of dogs. In the studies by H. Aupperle-Lellbach *et al.* (2022), the highest incidence was recorded at the age of 9 to 12 years, and it was 39.1%. D. Devathasan *et al.* (2022) and Yu. Dubinchuk (2022) also indicate an increase in the incidence of animals with ageing.

There are also no clear recommendations for the treatment of atheroma. Thus, in the study of J. Chitty (2022), it is indicated that the cyst of the sebaceous gland does not cause discomfort in animals and they need to be treated only in case of suppuration as a result of their infection.

MATERIALS AND METHODS

The studies were conducted on pathological material obtained from domestic dogs with signs of formations in the skin, whose owners turned to the veterinary clinics “Samson” and “Doctor Zoo” in Bishkek. For this

purpose, dogs were selected, regardless of breed and age, with clinical manifestations in the form of tumors or tumor-like changes in the skin. For such animals, a complete anamnesis was collected, if possible, with a detailed recording of the course of the clinical process, morphological and histological examinations, and the results of medical procedures. In total, for the period from 2020 to 2022, 12 dogs took part in monitoring studies, which at one time were given the primary diagnosis of skin atheroma, and subsequently, it was confirmed by histological results.

The procedure for conducting research and collecting information was as follows: initially, an examination of the pathological formation was conducted with detailed consideration of such parameters as shape, size, colour, the presence of a coat on the surface of the neoplasm, and the place of its localisation. Through palpation, the consistency, mobility, and soreness of the formation were determined. In the future, detailed information about the age, breed, living conditions, and other factors was collected about the animals that fell into the target group. During the observation of the development of the pathological process, changes were recorded by photographing them during the entire controlled period. During surgical treatment, histomorphological examination was performed to clarify the final diagnosis and microphotography for documentary confirmation. If the first part of the study on the examination and observation of animals was conducted in the clinic, at the place of the patient's treatment, then the histological preparation was made, and its analysis was performed in the histology laboratory of the Department of Veterinary and Sanitary Examination, Histology and Pathology of Kyrgyz National Agrarian University named after K.I. Skryabin.

In veterinary clinics, during the surgical removal of tumors and tumor-like formations, 11 samples of pathological material were taken from dogs, and one biopsy was performed for the manufacture of histological preparations. Biopsy and surgical material delivered from clinics was fixed in a 10% aqueous solution of neutral formalin. Dehydration of tissue samples with atheromas from dogs was performed at room temperature under normal conditions. After fixing the pathological material to prepare histological sections, it was poured into paraffin according to the generally accepted method (Vareniuk & Dserzhynsky, 2019). For this purpose, a set of histological equipment from the German company Thermo Scientific was used, namely an automatic device for histological tissue processing Microm STP 120 and Microm EC 350 for the preparation of paraffin blocks. Skin sections from the blocks were conducted on a rotary microtome Microm HM 340 E (Thermo Scientific, Germany) with a thickness of 4-6 microns. Washing and staining of the prepared pathological material from paraffin was conducted using an automatic Microm HMS 70 station (Thermo Scientific, Germany). Histological sections were stained

with hematoxylin and eosin. Microscopic studies were conducted using an Olympus BX51 light microscope (Japan). A mandatory method of documenting the results obtained was microphotography using a digital photo-system for processing video images of DSM-510 with pre-installed ScopePhoto computer software that ensures the objectivity of morphological analysis. In addition, records indicating the surgical or biopsy method of taking pathological material, which were also recorded in the laboratory journal, were amenable to mandatory documentation. The results obtained were amenable to analytical and mathematical processing using descriptive statistics methods, while the distribution of animals was conducted depending on their breed, age, and sex.

RESULTS

Pathological problems occurring in the skin of pets are primarily detected by their owners, and therefore, such diseases have the highest frequency of diagnosis in veterinary clinics in comparison with other cases of neoplasms in the body. Surface placement and characteristic clinical signs contribute not only to the early diagnosis of skin problems in animals but also allow for their effective treatment at an early stage, which guarantees a fairly high therapeutic effect. Among the pathology of the skin, there are both oncological problems in the form of benign and malignant formations and diseases of a non-tumor nature – cysts, atheromas, and other inflammatory processes. In most cases, at the initial stage, almost all skin diseases occur with the same symptoms – the formation of a small swelling, mobile, painless, with a low intensity of growth. Such similar symptoms reduce the effectiveness of differential diagnosis of neoplasms to clinical signs. Therefore, in most veterinary clinics, when characteristic symptoms are

detected, surgical removal of such tumors is performed to protect animals from possible further metastasis in the event of the development of a malignant neoplasm. There is also no possibility of differentiation of pathological skin problems depending on the place of formation of swellings. This is due to the fact that the skin in all areas has the same morphological structure, and any of the above pathological processes can develop in it. During the preparation of the study, cases of atheroma development were examined to conduct a comprehensive analysis of the clinical signs of the course of the pathological process in the bodies of dogs, morphological changes in tissues, and the consequences of surgical intervention for therapeutic purposes. Based on such circumstances, all cases of skin atheroma in dogs whose owners applied to veterinary clinics in Bishkek to analyse the possible manifestation of clinical symptoms in such pathology were selected to identify histological changes occurring in the skin. A total of 12 dogs of different breeds and ages with a preliminary diagnosis of atheroma were examined. All cases were documented and are given for the purpose of using the information for subsequent research.

The first case in the study was a mongrel dog named Bublik. It is a male, about two years old, with a black coat colour. At the time of diagnosis, it had a height at the withers of 38 cm and a weight of 12 kg. The pathological process was localised on the left side in the neck area. Therewith, a single swelling of 2-3 cm in size, mobile and painless, was felt. According to the dog's owner, the tumor was discovered about a year before going to the clinic, and the growth is insubstantial, about one centimetre per year. After surgical removal of the formation, histological preparations were prepared, the image of which is shown in Figure 1.

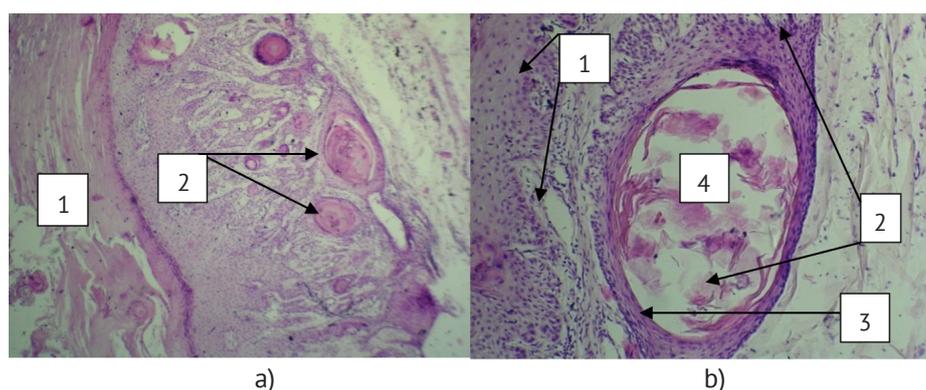


Figure 1. Histological changes in atheroma of the skin in dogs: a) magnification $\times 40$; b) magnification $\times 100$

Note: 1 – skin; 2 – atheroma; 3 – the wall of the atheroma; 4 – the cavity of the atheroma with the contents. Staining with hematoxylin-eosin

When analysing histological preparations, a diagnosis was made – multiple atheroma of the skin. After surgery, the animal's condition is good, no further relapses were observed. The second case, German boxer breed dog, named Rex, male, 8.3 years, brown colour,

weight 26 kg, and height 54 cm. The neoplasm was located on the right front paw between the 1st and 2nd phalanges of the fingers. The cyst is 1.5-2 cm in size, painless. It was discovered a few weeks ago no growth was noticed during this period. The histological picture

during microscopic examination corresponded to an atherosclerotic lesion (Fig. 2). After surgical removal of the atheroma, repeated neoplasms were not observed.

Third case. German boxer breed dog named – Rizza, female, 7.4 years. The tumor was located on the skin of the lumbar region, 1.5-2 cm in size, mobility

is limited, painless (Fig. 2). It was discovered about a month ago, during the observation period, the growth is not substantial, the increase is only a few millimetres. The general condition of the dog is good. The diagnosis after histological examination is atheroma of the skin.

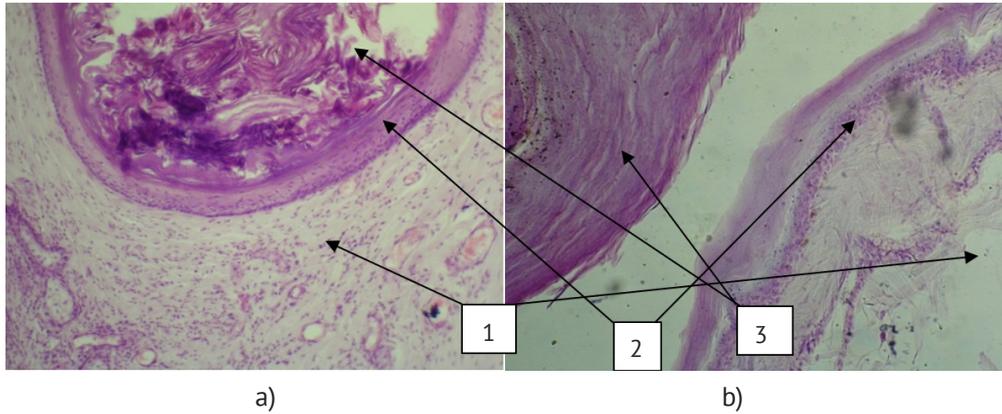


Figure 2. Histological changes in skin atheroma in dogs: a) 2nd case; b) 3rd case

Note: 1 – connective tissue that surrounds the atheroma; 2 – the wall of the atheroma; 3 – the contents of the atheroma. Staining with hematoxylin-eosin, $\times 100$ magnification

Fourth case. Dog named Linda, breed – German Shepherd, female, 8.1 years. Numerous tumors throughout the body of small and medium sizes have been formed over the past three years. The swelling is limited, almost all are mobile and not painful. The primary diagnosis of atheroma of the skin. After suppuration, two atheromas were surgically removed, the first was in the withers and the second – in the sacrum. No new swellings were established at the site of the removed

formations, and no accelerated growth was observed in the remaining atheromas. The dog is active after surgery, no noticeable deviations in behaviour and general condition were established. Histological examination of the pathological material not only confirmed the primary diagnosis but also allowed detecting small atheromas in the skin that were not detected during a clinical examination (Fig. 3). The final diagnosis, based on microscopy, is multiple atheroma of the skin.

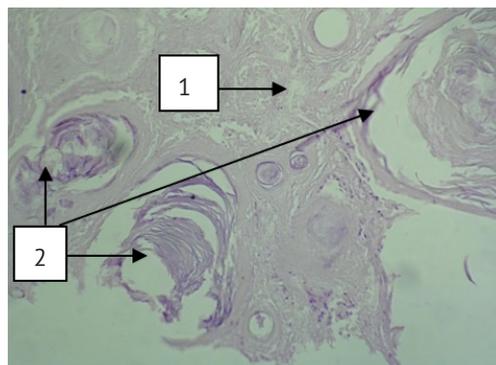


Figure 3. Histological change in atheroma

Note: 1 – connective tissue that surrounds the atheroma; 2 – atheromas. Staining with hematoxylin-eosin, $\times 40$ magnification

Fifth case. Breed – boxer, age – 13 years, colour – fawn, name – Sasha, female. Two tumors were found in the dog. The first one was located in the temple area, dense, rounded shape, measuring 6×4 cm. The tumor is hard and painful on palpation; the local temperature is higher than the surrounding tissues. The growth period is 1.5-2 months. The second neoplasm, about 1 cm in size,

was identified in the mammary gland and was painful on palpation. After removing the tumor in the temple area, a tumor formed on the ear three months later, and in February 2022, the dog died of cancer. Microscopic examination of the pathological material from the removed tumor from the temporal region of the head identified multiple atheromas of the skin with signs of inflammation (Fig. 4).

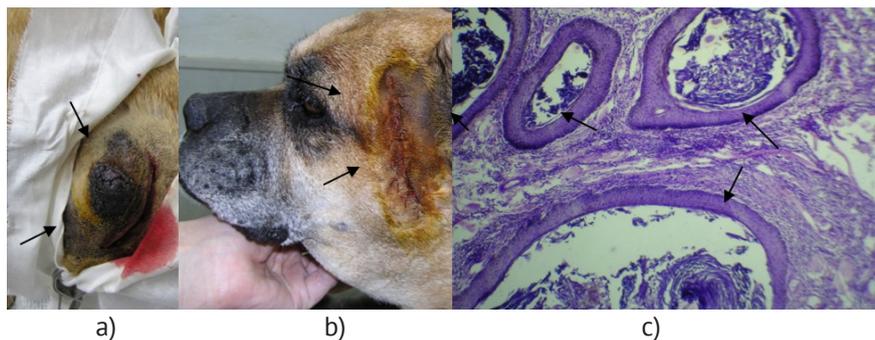


Figure 4. Fifth case: a) clinical manifestation of atheroma before surgery; b) after removal of atheroma; c) histological manifestation of atheroma in pathological material

Note: the arrows indicate the atheroma and the area of the skin after its removal. Staining with hematoxylin-eosin, $\times 40$ magnification

Sixth case. Breed – Pekingese, name – Sherry, age – 2.3 years, colour – red. The dog is not sterilised. A neoplasm of 1-2 cm in size was located on the skin of the forearm. The tumor is mobile, pale pink, painless. The

shape is rounded. The consistency is dense. The growth period is unknown; it was discovered four days before going to the clinic. After removal and histological examination, an atheroma of the skin was diagnosed (Fig. 5).

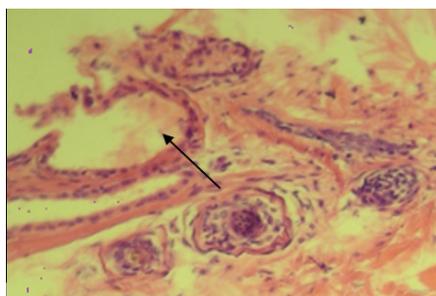


Figure 5. Microscopic changes in atheroma of the skin

Note: the arrow indicates the atheroma cavity, hematoxylin-eosin staining, $\times 100$ magnification

Seventh case. Mongrel dog named Sarah – female, about 9 years. On examination, two tumors were identified on the skin. The first is in the area of the left iliac region of the abdomen, rounded shape, dense consistency, painless, mobile, size 4 \times 2.5cm. The growth was observed

for about a year. The second one is on the left shoulder, with a rounded shape, dense consistency, and 1.5-2 cm in size. Both tumors were removed. During histological examination, the following diagnoses were made – skin atheroma and low-grade adenocarcinoma (Fig. 6).



Figure 6. 7th case: a) clinical changes in atheroma; b) histological change in atheroma

Note: the arrow indicates the atheroma cavity, hematoxylin-eosin staining, $\times 100$ magnification

Eights case. The dog of the breed is a dachshund, named Sarah. Female. Age – 13.2 years. Therewith, three tumors in the mammary gland were established

in the animal during examination at the clinic. Their growth was monitored for three years. Tumors of different sizes, from 2.5 to 6 cm.

They were slightly visibly different. As a result of the accelerated growth of one of the tumors, surgical intervention was performed. The results of the

histological examination were followed by the following diagnoses – atheroma, lipoma and low-grade adenocarcinoma (Fig. 7).



Figure 7. Eighth case: a) macroscopic change in atheroma; b) histological change in atheroma

Note: hematoxylin-eosin staining, $\times 100$ magnification

Ninth case. A German Shepherd dog, named Magla, aged 2 years and 3 months. The coat is black-and-white. A tumor in the neck, 0.5 cm in size. Discovered about a month ago. Neoplasm of oblong shape, grey colour, soft consistency. Due to the small size of the tumor, a

skin biopsy was performed. 2.5 months after the manipulation, the tumor disappeared, no re-growth was detected. The general condition of the animal after the biopsy is excellent. Histological diagnosis – skin atheroma with suppuration (Fig. 8).

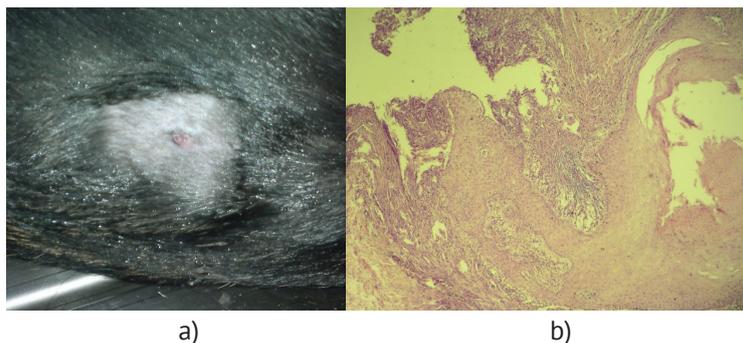


Figure 8. Ninth case: a) clinical manifestation of atheroma; b) histological change in atheroma

Note: hematoxylin-eosin staining, $\times 40$ magnification

Tenth case. An adult dog of the pit bull breed named Missiya, aged 4.5 years. The coat is red with white spots. A tumor on the scalp between the ears. The tumor is dark in colour, bumpy consistency, oval in shape, 3 \times 2 cm in size. The growth of the neoplasm

was observed for four years. After surgical removal and histology of the pathological material, a diagnosis was made – atheroma of the skin (Fig. 9). After surgery, the animal's condition was excellent, and no relapses were observed.

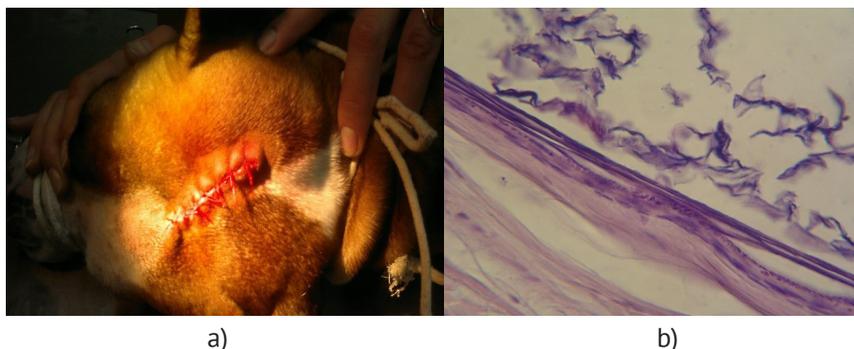


Figure 9. Tenth case: a) post-operative wound in atheroma; b) histological change in atheroma

Note: hematoxylin-eosin staining, $\times 100$ magnification

Eleventh case. A dachshund dog, named Matilda., aged 12 years and 3 months. The coat is red. The examination identified a single neoplasm on the skin of the lateral wall of the abdomen measuring 3×3 cm. The tumor is of a dense consistency, rounded shape, with a slight pain when palpating. During surgical intervention, a cavity filled with pus was found, which corresponded to an infected cyst. Subsequently, the histological diagnosis confirmed the presence of atheroma with suppuration (Fig. 10).

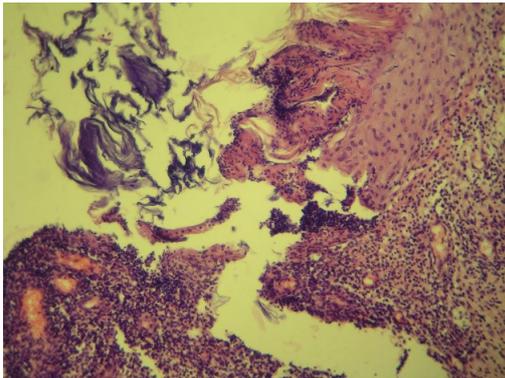


Figure 10. Histological change in purulent atheroma
Note: hematoxylin-eosin staining, ×100 magnification

Twelfth case. A German Shepherd dog named Graf, aged 5 years and 7 months, male. The coat is black-and-white. Examination of the tumor identified the presence of purulent exudate on the surface of the neck skin. The swelling is rounded, 2.5×1.5 cm in size, dense consistency. Before removal, the tumor was observed for about 1.5 months. After the shell rupture and pus discharge, a preliminary diagnosis of a furuncle was made. Histological examination identified multiple atheromas (Fig. 11).

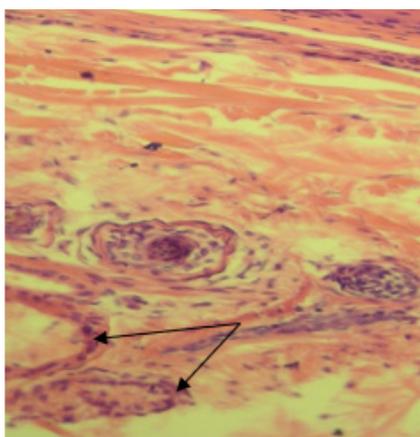


Figure 11. Histological change in atheroma
Note: the arrow indicates the atheroma cavity, hematoxylin-eosin staining, ×100 magnification

Analysing even the few results of the study of the occurrence of atheromas in dogs, an increase in cases

of the development of the pathological process in old dogs is clearly traced. Histological examination showed the formation of multiple atheromas, of which only one grows to a larger size. Surgical intervention with the surgical removal of such skin formations has a favourable prognosis and in most cases ends with a complete recovery of the animals.

DISCUSSION

Due to the surface location of pathological processes in the skin, neoplasms of any type are primarily detected by pet owners and, in this regard, occupy one of the prevailing places among oncological diseases in the statistics of veterinary clinics. Considering the almost identical clinical picture of the manifestations of various pathological processes of the skin, especially in the initial phases, confirmed in the studies of researchers such as J. Willcox *et al.* (2019) and M.A. Hasiri *et al.* (2019), and the absence of characteristic sites of formation of different types of tumors and formations of a non-tumor nature on the body of animals – S. Kim *et al.* (2022), makes the histological method the only way of differential diagnosis of skin diseases. As a consequence of the relatively low pathological effect of atheromas on the animal's health, which is associated with the non-oncological nature of the disease, the greatest immediate danger to the body is the possible suppuration of the cyst contents. The big threat to the animal from this disease is that they can mask the development of other, more dangerous oncological diseases and thereby pose certain risks to the life of animals.

In the conducted examinations, pathological formations of a non-tumor nature were diagnosed in different places of the animal body, but the formation of atheromas was most often observed in the head and neck area. Such localisation of sebaceous gland cysts in dogs accounted for 42% of the few cases used in the study. Atheromas were also identified in the abdominal wall of the abdomen and extremities – 20% each. In addition, isolated cases were diagnosed in the back and mammary gland zones. In one case, a generalised form of atheromatosis of the skin was diagnosed, when cysts of different sizes were detected throughout the body in one animal, some of them had signs of purulent inflammation. The study by J. Parmar *et al.* (2019) also confirms the main localisation of disorders in the sebaceous glands in dogs in the head area, and in this paper, the emphasis is placed on the predominant manifestation of the disease in old animals. Analysis of the results of the examinations conducted within the framework of this study also identified a substantial increase in the manifestation of atheroma in older animals. In such dogs, atheromas were observed in combination with other tumors, including malignant ones, in addition, atheromas in older dogs were of a larger size. This was not due to a longer period of their growth during the life of the animal, but, possibly, was the result of a

decrease in the body's defences in old age. The intensity of atheroma growth in young animals, even in a small population, was substantially lower than in older dogs. Similar results were obtained in the studies of E. Racine (2022), in which the main number of animals with symptoms of atheroma were over the age of 8 years. The influence of sex on the development of sebaceous gland cysts within the research group showed a substantially higher probability of developing atheroma in female dogs. Thus, in the sample of dogs that succumbed to treatment in the network of veterinary clinics in Bishkek, 75% of the animals were females. Similar studies, conducted on cats in Kyrgyzstan, showed similar results. Cat diseases were diagnosed in 79.3% of cases, whereas in dogs, only in 20.7%.

A small sample of animals included in the study did not allow determining the reliable influence of the breed on the frequency of cystic processes in the skin of dogs, although a small number of mongrel dogs may indicate that purebred dogs get sick much more often. Another side of this factor may be the fact that due attention is not paid to the health of mongrel dogs, which manifested itself in a small number of such animals. Among ten purebred dogs, three animals belonged to the boxer breed, which may indicate a substantial susceptibility to cystic diseases in this breed. This assumption is confirmed by the results obtained in the study by D. Wiener (2021), where boxers belong to the number of breeds with the maximum manifestation of this type of pathology. However, the main symptoms allow differentiating atheroma from other skin formations in animals can only be detected by microscopy of histological preparations obtained during biopsy or as a result of surgical removal of the neoplasm. In all diagnosed cases of atheroma in dogs, histomorphological changes occurring in the skin indicated the presence of one large and, in some cases, several small cavities filled with a cell-free mass. The cyst was formed due to an increase in the cavity of the sebaceous gland. Histological preparations show a wall lined with epithelial cells. The contents of the cyst do not contain cellular structures, and when stained with hematoxylin-eosin, it is stained with less intensity than the surrounding tissues. Similar characteristics of the histomorphological structure of atheroma are suggested in the methodological manual by F. Cian and P. Monti (2019). On all histological preparations from sick animals, one large cavity with dense contents is always established. But in most cases, in particular, up to 67% smaller atheromas were observed near the large one. Such placement of secondary atheromas may indicate a systemic skin disease in domestic animals and not be a random process that develops as a result of a simple blockage of the ducts of the sebaceous gland, as explained in previous studies. The probability of a simultaneous process in a number of sebaceous glands is quite low. It has not yet been possible to find a physiological explanation

or characteristic pathological factors that could lead to the development of such a process in literary sources, so this area may be of interest for further research.

In the absence of treatment, according to most researchers, the final stage in the development of atheroma is its infection with the development of purulent inflammation, and the histological preparation will have inherent changes characteristic of such a process (Jyothi *et al.*, 2023). Namely, nuclear cell structures appeared in the cyst cavity, represented by phagocytes and neutrophils, which are visualised due to the differential colouration of nuclear material from cytoplasmic structures and cystic contents. A substantial part of the cystic wall epithelium on a microscopic preparation is subject to desquamation or necrosis. Single or multiple fibrinous filaments are visible in the cyst cavity. Partial destruction of the atheroma wall with signs of purulent inflammation was observed on histological preparations obtained from pathological material from only two dogs. Infection and purulent inflammation in the animals of the research group were identified to be a rather rare phenomenon, which manifested itself only in 16% of cases, and this despite the fact that in some animals, the observation period for the development of atheroma was several years. This indicates that such a finale in the development of atheroma is a rather rare phenomenon, which may be associated with mechanical injury to the cyst wall and the entry of microorganisms there, whereas most atheromas retain growth for a long time.

Treatment of sebaceous gland cysts in dogs and other pets consists in surgical truncation of such a formation. Of the 12 controlled animals, 11 underwent surgical removal of this pathology. As a result of the manipulations performed, the condition of the animals did not differ from the condition before the surgical intervention. Observation of operated animals for a long period showed the absence of relapses of cyst formation, even due to mechanical injuries, which were surgical manipulations, which once again confirms the inaccuracy of assumptions about the traumatic nature of the cause of atheroma. Therefore, further studies on the causes of the development of cystic skin pathology in pets, and factors contributing to its occurrence are an urgent subject and will be continued in future studies.

CONCLUSIONS

Based on the materials of the analysis of veterinary records on the dynamics of development and clinical manifestation of pathological processes in the skin of dogs of a non-tumor nature and histological examinations of pathological material obtained during surgical removal of such atheromas, the following conclusions and suggestions can be made for future research. Despite the small sample of controlled animals, the majority of sick animals belonged to the group of old dogs, which at the time of the study were 9 or more years old. In addition, females were more susceptible to skin

diseases, the proportion of which was 75% of all animals. Among the presented dog breeds, boxers were more often identified to have atheromas than representatives of other breeds. The main place of localisation of cystic pathology in dogs was the area of the head and neck in up to 42% of all cases, atheromas in the extremities and abdominal wall were less often detected. In histological examination of pathological material obtained by truncation of areas with cystic skin lesions, cases of multiple atheromas prevailed. When a number of small ones were established next to the main, larger cyst. In percentage terms, such cases were more than 66%, which indicates the systemic development of this pathology in dogs.

The development of atheroma in the animal's body is a long process, in some cases, the dynamics of the development of this skin disease in dogs have been observed for 2-4 years, and only in some cases,

in particular, in these studies, only 16% of cysts are infected, which manifests itself in purulent inflammation with the formation of abscesses. The use of the surgical method of atheroma treatment allowed getting rid of the disease without cases of relapse. The results obtained in the framework of these studies do not coincide with a number of conclusions of other authors, in particular, regarding the main traumatic cause of atheroma formation and predominant suppuration of cysts. Therefore, these studies are planned to continue with the involvement of a large number of animals in a controlled group.

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CONFLICT OF INTEREST

None.

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Анотація. Патологічні процеси в шкірі домашніх тварин є одним з найбільш поширених захворювань домашніх тварин як у Киргизькій Республіці, так і в усьому світі. У зв'язку зі складною диференціальною діагностикою онкологічних хвороб та захворювань непухлинного характеру у тварин лише за клінічними ознаками, метою цієї роботи стало проведення статистичного та гістоморфологічного аналізу випадків розвитку атероми у собак. Під час проведення досліджень використовували клінічний, гістологічний та статистичні методи. Дослідження проводилися на підконтрольній групі домашніх собак у кількості 12 тварин, спостереження за якими тривало протягом кількох років. При зборі анамнезу фіксували, крім клінічних ознак, породу, вік та супутні захворювання у собак. При проведенні хірургічного видалення атером готували гістологічні препарати для уточнення діагнозу та вивчення морфогістологічних змін у тканинах. Атерома шкіри у собак найчастіше реєструвалася у старих тварин, яким на момент встановлення діагнозу було більше 9 років. При цьому найчастіше така патологія локалізувалася у собак у ділянці голови та шиї. Серед порід боксер виявився найбільш сприйнятливим до утворення кіст сальних залоз. Також захворюваність серед самок становила 75 % від усіх випадків зареєстрованих хвороб. Гістологічні дослідження виявили превалювання випадків з утворенням множинних кіст – 67 %, коли біля однієї величезної атероми виявляється ряд дрібніших утворень, при цьому випадки розвитку гнійного запалення становили лише 16 %. Ефективним методом лікування було оперативне видалення атероми, при цьому випадків повторного розвитку кіст не спостерігалось протягом тривалого постопераційного спостереження. Отримані результати дозволяють розширити знання з клінічного прояву, діагностики та лікування захворювань шкіри непухлинної природи у домашніх тварин

Ключові слова: хірургічний та біопсійний матеріал; кіста сальної залози; морфологічна діагностика; непухлинна патологія шкіри; оперативне лікування