ЕПІЗООТОЛОГІЯ ТА ІНФЕКЦІЙНІ ХВОРОБИ

UDC 619:616:578.834.1-091:636.8.053

Features of clinical and pathomorphological picture in spontaneous infection of a domestic cat (lat. Félis cátus) with SARS-CoV-2 coronavirus

Subotsina I., Gromov I., Kupryianav I.

EE «Vitebsk State Academy of Veterinary Medicine», Vitebsk, Republic of Belarus

e-mail: irin150680@mail.ru

OPEN ACCESS

Subotsina I., Gromov I., Kupryianav I. Features of clinical and pathomorphological picture in spontaneous infection of a domestic cat (lat. Félis cátus) with SARS-CoV-2 coronavirus. Nauk. vìsn. vet. med., 2021. №1. PP. 79–91.

Рукопис отримано: 30.03.2021 р.
Прийнято: 12.04.2021 р.
Затверджено до друку: 25.05.2021 р.

Doi: 10.33245/2310-4902-2021-165-1-79-91

Today, cases of infection of various animal species with the new SARS-CoV-2 coronavirus have become increasingly common. This virus has been isolated from numerous representatives of the feline family, European mink, ferret, raccoon dog, domestic dog, a number of primates and a number of other animals. In most susceptible animals, infection with this virus is manifested by certain clinical symptoms, the intensity of which depends on the type and age of the animals, on the presence of concomitant diseases. The pathological process can end in death with the development of characteristic pathoanatomical and histological changes.

According to the results of preliminary studies conducted in the Republic of Belarus, the circulation of SARS-CoV-2 was detected in domestic cats. All the animals had a history of contact with COVID-19-infected owners. The aim of this work was to determine the features of clinical and pathoanatomical manifestations, histological changes in domestic cats infected with SARS-CoV-2.

The studies were conducted among various sex and age groups of domestic cats. In total, we conducted a study of 300 flushes from various sexes and ages and pedigreed, autopsy of 10 corpses.

The work was carried out in the Vitebsk State Academy of Veterinary Medicine, the Vitebsk Regional Veterinary Laboratory, the RSPC "Epidemiology and Microbiology" in Minsk, in the Belarusian State Veterinary Center. The circulation of SARS-CoV-2 in animals was determined by polymerase chain reaction (RT - PCR). When dissecting the corpses of animals, the nature and severity of pathomorphological changes were taken into account, a pathoanatomical diagnosis was made, and macrophotography was performed in natural light.

The main clinical symptoms of the disease in adult animals are depression, refusal to feed, cough, shortness of breath; in young animals, rhinitis, conjunctivitis, diarrhea are often observed. When dissecting dead animals, macro-changes and micro-changes in organs and tissues are noted, indicating the development of pathological processes, both in the acute course of the disease and in the chronic one.

Thus, the conducted studies and the results obtained confirmed and supplemented the data of world researchers, made it possible to determine the leading clinical symptoms of the disease and pathoanatomical changes in the domestic cat when infected with SARS-CoV-2. The obtained data of histological changes allowed a deeper and more detailed assessment and study of the pathogenesis of the disease, which will contribute to a rational approach in choosing the means of therapy of this disease.

Key words: cats, coronavirus, SARS-CoV-2, clinical symptoms, pathoanatomical changes, histological examination.

Problem statement and analysis of recent research. Covid-19 is an infectious disease caused by the betta-coronavirus SARS-CoV-2, which has spread widely around the world and caused a pandemic. The disease is characterized by the development of acute viral pneumonia, which can occur in both mild and severe forms and end in death. The virus can infect various organs through direct infection or through the body's immune response. Complications include multiple organ failure, septic shock, and venous thromboembolism. The most common symp-

toms of the disease include fever, fatigue, and dry cough [1–3].

Studies published before the first quarter of 2021 in the Covid-19 issue showed that the virus not only changes in terms of genetic structure (mutates), but also expands the range of hosts [3, 4].

Initially, it was believed that this disease is inherent only in humans, although its zoonotic nature has been proven [1–3], but today there are data on the detection of this pathogen in representatives of the cat family, canids, and fur-bearing animals [4–8], it is possible to infect a number of farm animals [6–11]. To date, the transmission of the virus has been officially recorded and proven not only from person to person, but also to animals, and most often to companion animals, which directly affects and forces us to review the epidemiological and epizootic aspects of this disease. This feature is inherent not only in SARS-CoV-2, but also in a number of other coronaviruses [1, 3, 4, 12].

At the moment, about 100 different types of coronaviruses are known, and in a large number and variety of species they are selected from the body of bats and a number of other animals. Many of the known coronavirus species are capable of so-called "jumps" from one type of susceptible organism to another, which generally explains the detection of SARS-CoV-2 in a number of animals [1–4, 11, 12].

The participation of domestic pets and other susceptible animals in the epidemiological chain is still in doubt, but recent data and reports from foreign researchers and tabloids suggest that monkeys, dogs, ferrets, minks, domestic and wild representatives of the feline family (domestic cat, tigers, lions, cougars, leopards) are infected, clearly showing that one species easily infects another [5–13].

Susceptible animals infected with SARS--CoV-2 in some cases show a clinical picture, in some cases there is a death of animals [13–16]. The main clinical symptoms of the disease in cats were described: respiratory damage (nasal discharge, rhinitis, shortness of breath, shallow and frequent breathing, changes in the type of breathing with a predominance of abdominal, cough). In some cases, there was a disorder of the gastrointestinal tract (diarrhea) [7, 9, 13, 15–18].

Chinese researchers conducted an experiment and proved the transmission of SARS-CoV-2 from individual to individual within the domestic cat population. Italian scientists conducted an extensive study of cats and dogs in the most affected areas of COVID-19 in Italy and identified a fairly high percentage of animals with antibodies to SARS-CoV-2 (dogs-more than 30%, cats-more than 40% of all examined animals), which indicates the susceptibility of these animal species to the new virus [4–7].

A significant amount of data on the infection of wild cats and other zoo inhabitants comes from zoos around the world. In recent months, data have been received from the American Veterinary Association (AVMA) on large-scale studies on the circulation of the SARS-CoV-2 virus among various animal species (more than 2000 animals), and on the detection of this virus in the population of a number of cats (civets, domestic cats), dogs, dolphins, armadillos, and anteaters. Researchers note the infection of 80% of all surveyed pets (cats, dogs) [6–11, 13–16].

At the end of 2020 and at the beginning of 2021, a number of reports were received about the infection of fur-bearing animals on fur farms where sick staff was present. These are farms in the Netherlands, Denmark, Spain, Poland, France, Lithuania and a number of other European countries [4–12, 17–20]. There is evidence of rapid transmission of SARS-CoV-2 in the fur-bearing animal population. Spanish animal breeders report infection of more than 80% of the mink population on the farm. Denmark has published data on the extermination of the entire population of minks due to a possible (proven) mutation of the SARS-CoV-2 virus in the body of minks and its transmission to humans (12 people). The population is 12-17 million animals [18–21]. Previously, the Netherlands reported a possible infection of 2 people from mink [19, 22]. A large number of private American farms keeping fur-bearing animals also reported infection of the European mink [20, 21, 23, 24]. Also, in one of the US states (Utah), the circulation of SARS-CoV-2 was detected in the wild (free-living) population) mink [25].

There are data on the possibility of infection of laboratory animals (white mice), hamster and guinea pig, raccoon dog, badger, pigs (in experimental infection). Data on the possible (theoretical) infection of about 400 animal species due to their ACE-2 receptor protein have been published [11, 15, 28–30].

The World Organization for Animal Health (OIE) informs about the registration of all positive cases of COVID-19 in animals. The new virus has been reported in various animals in France, Belgium, Italy, Spain, the Netherlands, Denmark, China, Russia, and the United States of America, and the list of countries and reported cases is updated periodically [5–10, 18].

However, despite the numerous and diverse data on the spread of SARS-CoV-2 in populations of various animal species, descriptions of the clinical picture, pathoanatomical and histological changes in animals infected with this virus are practically not found, which generally complicates the diagnostic work of veterinary specialists

in case of suspected infection of an animal with SARS-CoV-2 [9, 27, 28].

In the Republic of Belarus, since the beginning of the epidemic, work has been underway to detect SARS-CoV-2 in animals. At the beginning of April 2021, several thousand clinical, pathoanatomical and histological studies of fallen animals with a confirmed diagnosis of COVID-19 (cats, dogs, fur-bearing animals) were conducted.

Among domestic pets, the most pronounced changes were in the domestic cat. The collection and systematization of the facts of the disease manifestation in domestic animals of different species, a comprehensive study of clinical signs, pathoanatomical signs and histological changes is an important element in controlling the spread of SARS-CoV-2 among animals. The study of these issues also provides an opportunity to assess the possible short-and long-term consequences of the pandemic, including its impact on the animal population. Understanding these issues will allow a rational approach to solving the problem of therapy of sick pets.

It is possible that the SARS-CoV-2 virus, when naturally infected with a domestic cat, causes the development of a pathological process, which, in turn, manifests itself with certain clinical symptoms, a pathoanatomical picture and histological changes in organs and tissues.

The aim of the research: to determine the features of clinical and pathoanatomical manifestations, histological changes in domestic cats infected with SARS-CoV-2.

Material and methods of research. The studies were conducted from April 2020 to the present day among the livestock of animals (domestic cats) owned by private individuals (domestic and free-range maintenance), kennels (home maintenance), and kept in animal shelters (domestic, free-range maintenance, stray and stray animals). A total of 300 flushes from various sexes and ages (newborn kittens, kittens from 1.5-3 months of age, adult animals) and pedigreed (Maine Coon, British cat, Cornish Rex, mongrel cats) were studied. The studies were conducted both for the purpose of monitoring (a random sample, mainly among animals of shelters of the Republic of Belarus), and according to indications (anamnestic data – sick and ill owners or breeders with a confirmed diagnosis of Covid-19), according to clinical signs (sharp deterioration of the condition, loss of appetite, weakness, fever, difficulty breathing, cough, shortness of breath). An autopsy was performed on 10 corpses from fallen animals (kittens aged 1-2 days, 3 weeks of age and adult animals), who died as a result of an illness occurring with the following clinical signs: refusal of food, loss of body weight, difficulty breathing, shortness of breath, fever). All animals had a history of contact with people who were sick or had had Covid-19. The dead animals were tested positive for SARS-CoV-2 by PCR.

The work was carried out in the Vitebsk State Academy of Veterinary Medicine, the Vitebsk Regional Veterinary Laboratory, the RSPC "Epidemiology and Microbiology" in Minsk, in the Belarusian State Veterinary Center.

The circulation of SARS-CoV-2 in animals was determined by reverse transcription polymerase chain reaction (RT – PCR), using highly specific and sensitive test systems for the detection of SARS-CoV-2 virus RNA in biological material (SARS-CoV-2 RNA isolation kit, manufacturer "ArtBioTech", Minsk, Republic of Belarus). Scrapings from the mucous membranes of the oral cavity, nasal cavity and rectum were taken with cotton swabs and placed in a sterile saline solution, after which the samples were placed in a sealed container with a cooling element and delivered to the laboratory for examination. The reaction was put in the Vitebsk regional veterinary laboratory.

The study of the clinical picture was carried out among 15 animals with clinical signs of the disease, in which positive PCR results were obtained for the detection of the genetic material of the virus.

The clinical study of animals was carried out using such methods of clinical research as examination, thermometry, auscultation, palpation, with an emphasis on the following indicators: the general condition of the animal, appetite, temperature, number of respiratory movements, type of breathing, condition of the skin and mucous membranes, assessment of defecation and urination.

The study of pathoanatomical and histological changes was carried out among the fallen animals, which had positive PCR results for the detection of the genetic material of the virus, a total of 10 corpses.

When dissecting animal corpses, the nature and severity of pathomorphological changes were taken into account, a pathoanatomical diagnosis was made [20], and macrophotography was performed in natural light. Autopsies of corpses were carried out in specially equipped rooms in compliance with personal and biosafety, followed by neutralization and disposal of biomaterial, disinfection of the room and tools that prevent contamination of premises and equipment.

For histological examination, pieces of the lungs, liver, kidneys, heart, pancreas, and spleen were selected [21, 20]. The resulting material was fixed in a 10% solution of neutral formalin. The fixed material was compacted by pouring it into

paraffin [22]. Dehydration and paraffinization of the organ pieces were performed using a "MICROM STP 120" (Germany) type "Carousel" machine for histological tissue processing. To fill the pieces and prepare the paraffin blocks, an automatic station "MICROM EC 350" was used. Histological sections of pieces of organs filled in paraffin were prepared on a rotary (pendulum) microtome "MICROM HM 340 E". The dewaxed sections were stained with hematoxylin-eosin. Dewaxing and staining of histocuts was performed using an automatic station "MICROM HMS 70". Histological examination was performed using a "Biomed-6" light microscope (Russia). The obtained data are documented by microphotography using the digital video image reading and input system "DSM-510", as well as the image input and preprocessing software "ScopePhoto". Structural changes in the stroma and parenchyma of organs were taken into account with the guidance [23, 24].

The results of the study. When studying the clinical manifestation of the disease caused by SARS-CoV-2 infection in a domestic cat (15 animals with confirmed PCR), the following was found.

Based on the anamnestic data in these studies, the incubation period for infection of animals from humans is from 6 to 10 days. The main clinical signs of COVID-19 in a domestic cat are damage to the respiratory tract and, less often, the development of conjunctivitis and the gastrointestinal tract. Adult animals are more severely ill. The disease lasts on average from two to three weeks.

The dynamics of the main symptoms of the disease in cats is as follows: the first signs of the disease appeared on 6-8 days after contact with the sick owner, the first symptoms were depression and refusal of food, in some animals there was an increase in temperature to 39.5 – 39.7, then there were outflows from the nose of a serous or serous-catarrhal character, in adult animals there was a cough, quite strong and abrupt. Then there was an increase in symptoms of respiratory tract damage: shortness of breath, profuse nasal discharge (in some animals – catarrhal-purulent nature), frequent and shallow breathing, thoraco-abdominal or abdominal type. Adult animals with severe shortness of breath and cough most of the time lay on their stomachs or stood with their limbs spread wide (Table 1).

Some animals developed conjunctivitis. 30% of the examined animals developed diarrhea (1-2 weeks after the onset of the disease), which lasted about 3-4 days and then stopped. In young animals (kittens of the first weeks or months of life), secondary infections (streptococcosis or staphylococcosis, confirmed by bacteriological research) developed against the background of coronavirus infection in most of the reported cases, which may be explained by a violation of the immune system.

The results obtained in the study of the pathoanatomical picture and histological changes were presented in the form of pathoanatomical and histological diagnoses. The pathoanatomical diagnosis is presented in a detailed form with a detailed description of the leading, complicating and concomitant processes, comments on their possible origin, genesis, interaction and outcome.

Pathoanatomic diagnosis in kittens of 1-2-day-old age:

Pulmonary edema ("carmine lungs") with areas of alveolar emphysema and small-focal pneumonia with predominant localization in the anterior and middle lobes (Fig. 1–4). Atelectasis of the caudal lobes of the lungs (Fig. 3, 4). The cranial and middle lobes of the lungs are not subside, the shape is not changed. The consistency is soft, dough-like. On the light red background of the edematous parenchyma, irregular areas of gray emphysema with indistinct borders are distinguished. When studied in detail, they show "porosity" due to multiple breaks in the parenchyma. The consistency here is "fluffy, crepitating", the pieces float easily on the surface of the water. Areas of pneumonia are dark red in color, have an irregular shape, a compacted consistency. The small size of the inflamed areas does not allow us to determine the nature of pneumonia: serous, catarrhal, fibrinous or interstitial. Here it is neces-

Table 1 – **Main clinical signs in different age groups of animals (domestic cats) with SARS-CoV-2 infection**

Clinical signs	Age			
	Up to 1 month	From 1 month to 3 months	From 3 months to 12 months	Older than 12 months
Refusal of food	100%	100%	100%	100%
Depression	100%	100%	100%	100%
Cough	50%	50%	50%	70% (in old animals)
Shortness of breath and dyspnea	100%	60%	50%	70% (in old animals)
Cyanosis of the visible mucous membranes	100%	60%	50%	70% (in old animals)
Diarrhea	30%	30%	20%	10%
Fever	-	50%	50%	40%

sary to conduct a histological examination of the lungs. The diaphragmatic lobes are subside, red-brown in color, and resemble the liver. Due to the combination with edema, they look "full". Pieces of the lungs in the area of pneumonia and atelectasis drown in the water.

Acute expansion of the heart ("round heart"), venous myocardial hyperemia (Fig. 2, 3, 4). The heart is sharply enlarged in size, the shape is close to rounded. The myocardium in the ventricular area is bluish-red. In the area of the atria it has a dark red color, so, through their thinner wall, postmortem blood clotts are visible.

Pronounced postmortem blood clotting in the heart cavities, large arteries and veins (Fig. 5). Given the deep structural changes in the lungs, the development of signs of asphyxia, it is paradoxical to form pronounced postmortem blood clotting not only in the heart cavities and large arteries, but also in veins of various calibers.

Fatty dystrophy (morphological equivalent of intoxication of the body-Fig. 1, 2) and liver edema (a sign of acute heart failure). The organ is enlarged in size, the shape is not changed, the surface is shiny, the color is yellow-brown with a clay tint. The consistency is soft. The surface of the incision is also shiny, the pattern of the lobules is not noticeable.

Acute venous hyperemia and granular renal dystrophy (Fig. 6). Serous edema of the parotid adipose tissue.

Congenital hypotrophy (underdevelopment).

Pathoanatomic diagnosis in kittens aged 10-14 days:

A. Macroscopic changes in the lungs are represented by 2 variants:

• Option #1 (Fig. 7-8). Pulmonary edema ("carmine lungs"), alveolar emphysema, focal small-focal pneumonia, subcapsular hemorrhages. The lungs are not subside, the shape is not changed, the consistency is soft, dough-like consistency. The background color is light red, "carmine". Subcapsular small-spotted hemorrhages are clearly visible.

• Option #2 (Fig. 9). Hurricane (membranogenic) pulmonary edema, pronounced blood clotting in the arteries and veins of medium caliber. The lungs are not subside, the shape is not changed, the surface is shiny, the color from the surface and on the cut is gray-pink, the consistency is dough-like. The interstitial tissue is thickened. From the severed bronchi, jelly-like clots of straw – yellow fibrin are released, and from the arteries and veins-blood clotts. Pieces of the affected lungs float heavily.

B. Macroscopic changes in the heart are also represented by 2 variants:

• Option No. 1. Acute dilation of the atria and right ventricle ("pulmonary heart"), the pulmonary vein system (Fig. 7).Increased fat content in epicardial adipose tissue ("tiger heart"). The heart has a pronounced cone-shaped shape, the atria are enlarged in size, dark red in color. Multiple fat deposits in the form of light yellow stripes are detected from the surface of the myocardium in the ventricles. They alternate with areas of unaffected myocardium of red-brown color, a "brindle" color of the myocardium appears. The pulmonary veins are sharply dilated.

• Option #2 (Fig. 10). Fatty myocardial dystrophy, concentric hypertrophy of the left ventricle, acute expansion of the right ventricle of the heart. In the area of the ventricles and atria, the myocardium has a characteristic yellow-brown color with a clay tint (both from the surface and on the incision). The fibrous pattern is not pronounced. The wall of the left ventricle is sharply thickened, the lumen is narrowed. The wall of the right ventricle of the heart, on the contrary, is thinned. Its lumen is sharply expanded ("pulmonary heart"). The ratio of the thickness of the right ventricle to the left is 1:7-8.

C. Marked postmortem blood clotting in the heart cavities, major arteries and veins (Fig. 7).

D. Fatty dystrophy with severe liver edema.

E. Acute venous hyperemia of the kidneys, fatty dystrophy of the cortical substance, pronounced edema of the medulla (Fig. 11, 12).

F. Hypotrophy (congenital, postnatal).

Histological diagnosis in kittens of 1-2 days of age: lungs (Fig. 13, 14) – areas of atelectasis (alveolar epithelium is cubic, normally – flat), pronounced serous edema of interstitial tissue and parenchyma, necrosis and desquamation of the alveolar epithelium, the presence of fibrin "mesh" in the lumen of the alveoli, fragments of necrotic epithelium and eosinophilic hyaline membranes, extensive lymphoid – macrophage peribronchitis and perivasculitis, alveolar emphysema (thinning and rupture of the walls of the alveoli); liver-granular dystrophy of hepatocytes, areas of parenchymal necrobiosis; kidneys – serous edema, granular dystrophy of the epithelium of the urinary tubules; spleen (Fig. 15) – multiple foci of extramedullary hematopoiesis (erythro-and myeloblasts, megakaryocytes), hyperemia of sinusoid capillaries, lymphoid hyperplasia of the white pulp; heart – serous edema of the myocardium.

Histological diagnosis in kittens of 10-14 days of age: lungs (Fig. 16) – pronounced proliferation of interlobular and interalveolar connective tissue, lymphoid – macrophage peribronchitis and perivasculitis, formation of nodular lymphoid tissue, extensive areas of alveolar emphysema,

atrophy or absence of alveolar epithelium; liver (Fig. 17) – total small – drop fatty dystrophy, pronounced edema (dilation of Disse spaces).); kidneys – venous hyperemia, serous edema of the glomeruli and interstitial connective tissue; heart (Fig. 18) – serous edema of the myocardium; spleen-pronounced lymphoid hyperplasia of the white pulp.

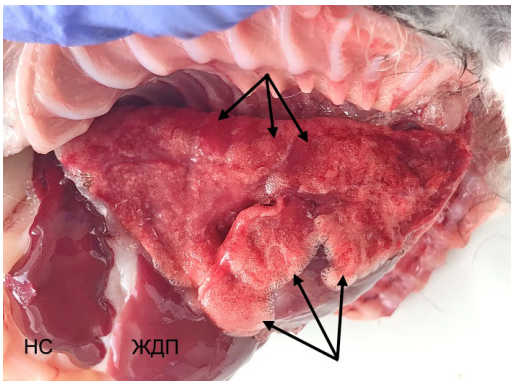

Fig. 1. **Macro photo. Pathoanatomic picture in a 1-day-old kitten with COVID-19: pulmonary edema, areas of emphysema (arrows at the bottom), pneumonia (arrows at the top), fatty liver dystrophy(ждп), unchanged spleen (нс)**

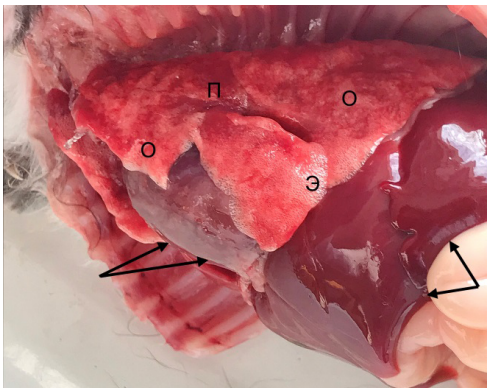

Fig. 2. **Macro photo. Structural changes in a 1-day-old kitten with COVID-19: pulmonary edema (о) and emphysema(э), focal pneumonia(п), acute heart dilation, venous myocardial hyperemia (arrows on the right), fatty liver dystrophy (arrows on the left)**

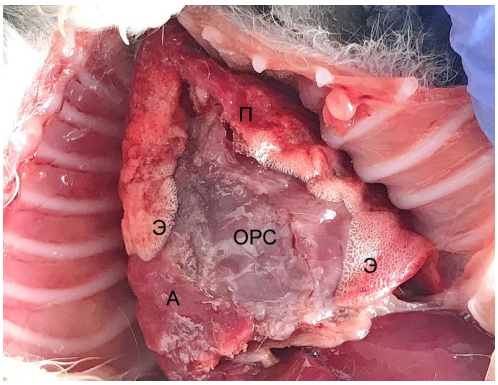

Fig. 3. **Macro photo. Macroscopic changes in the chest cavity of a 1-day-old kitten with COVID-19: pulmonary edema, areas of emphysema (э), pneumonia (п), atelectasis (а), acute heart dilation (орс)**

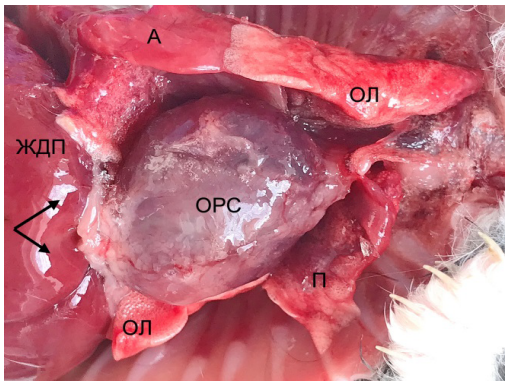

Fig. 4. **Macrophoto. Pathoanatomical picture of COVID-19 in a 1-day-old kitten: pulmonary edema (ол) with areas of atelectasis (а) and pneumonia(п), acute heart dilatation(орс), fatty liver dystrophy (ждп), signs of its edema (arrows)**

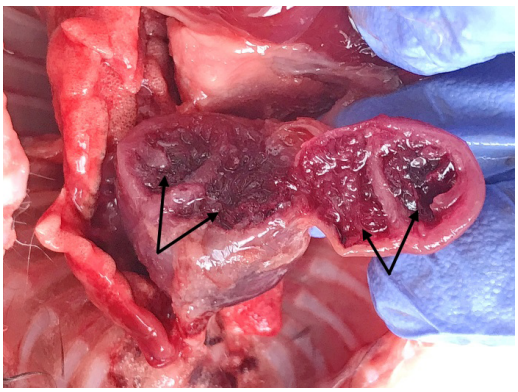

Fig. 5. **Macrophoto. Pronounced postmortem blood clotting in the heart cavities of a 1-day-old kitten infected with SARS-CoV-2 coronavirus**

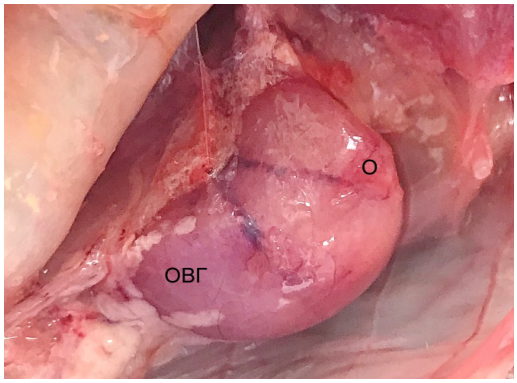

Fig. 6. **Macrophoto. Acute venous hyperemia (овг) of the kidney of a 1-day-old kitten infected with the SARS-CoV-2 coronavirus. Serous edema (о) of the perinephral adipose tissue**

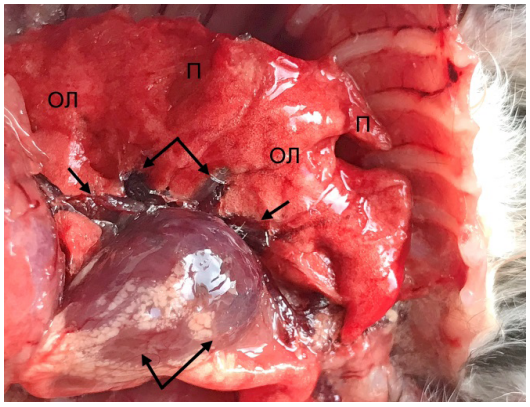

Fig. 7. **Macrophoto. Pathoanatomic picture in a 10-day-old kitten with COVID-19: pulmonary edema(ол), areas of pneumonia(п), acute expansion of the heart (arrows at the bottom) and the pulmonary vein system (arrows at the top)**

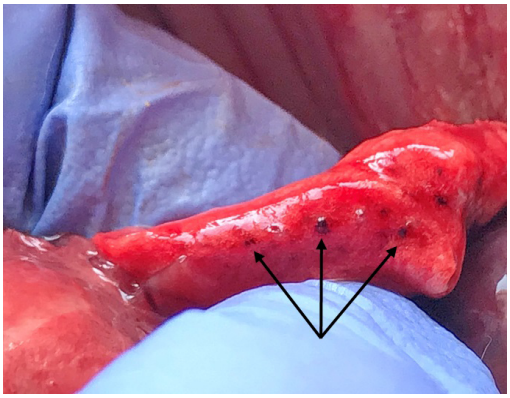

Fig. 8. **Macro photo. Subcapsular hemorrhages in the lungs of a 1-day-old kitten infected with SARS-CoV-2 coronavirus**

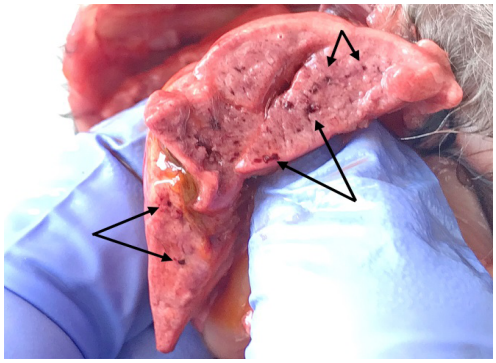

Fig. 9. **Macrophoto. Severe ("hurricane") pulmonary edema in a 10-day-old kitten with COVID-19. Severe blood clotting in medium-sized arteries and veins**

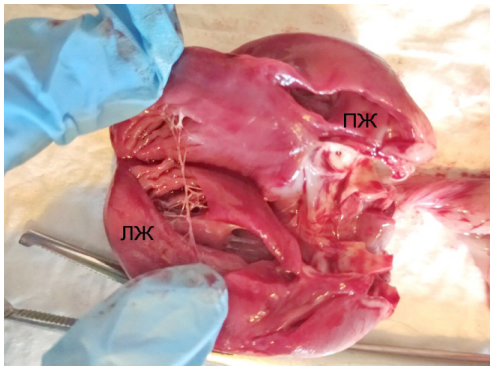

Fig. 10. **Macrophoto. Pathoanatomical changes in the heart of a 10-day-old kitten with COVID-19: fatty dystrophy, concentric hypertrophy of the left ventricle(лж), acute dilation of the right ventricle (пж)**

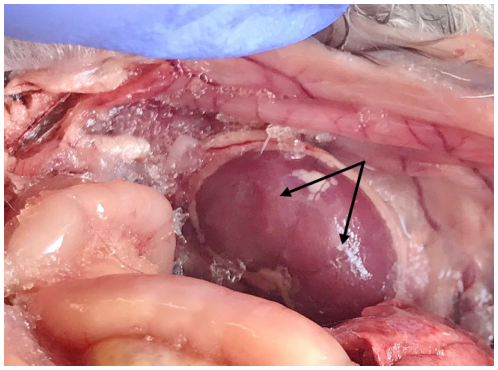

Fig. 11. **Macrophoto. Acute venous hyperemia of the kidney of a 10-day-old kitten infected with SARS-CoV-2 coronavirus**

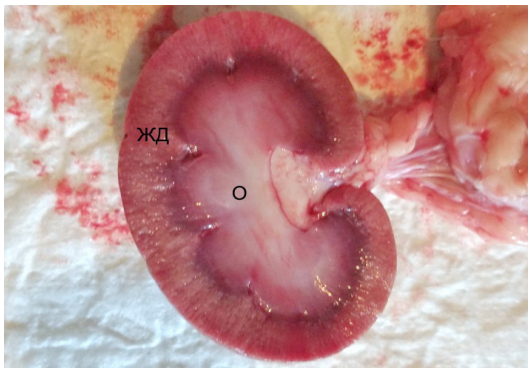

Fig. 12. **Macrophoto. Pathoanatomical changes in the kidneys of a 10-day-old kitten with COVID-19: fatty dystrophy(жд) of the cortical substance, pronounced edema (о) of the medulla**

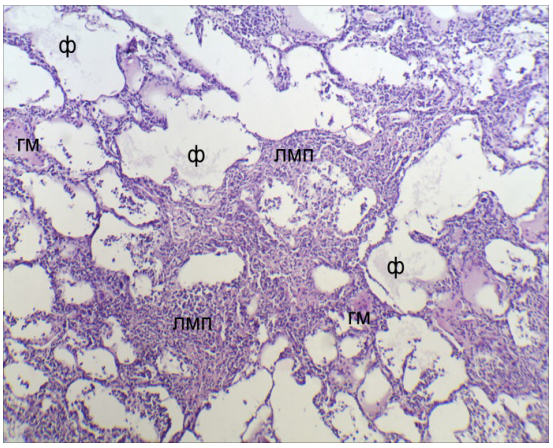

Fig. 13. **Microphoto. Lungs of a 1-day-old kitten with COVID-19. Lymphoid-macrophage proliferates (лмп), fibrin (ф), hyaline membranes (гм) in the lumen of the alveoli. Hematoxylin–eosin. Biomed-6. Mag.: x 120**

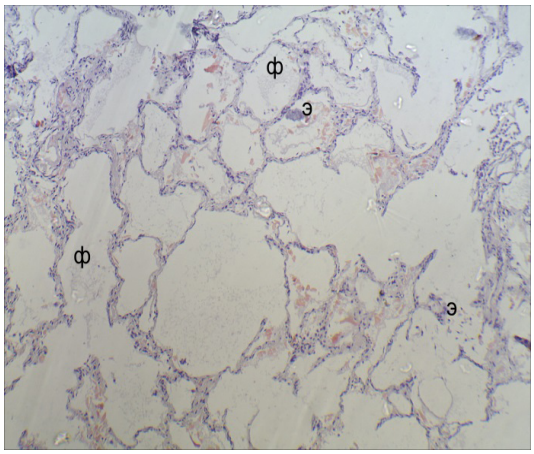

Fig. 14. **Microphoto. Emphysema of the lungs in a 1-day-old kitten with COVID-19. Fibrin (ф) and exfoliated epithelium (э) in the lumen of the alveoli. Hematoxylin–eosin. Biomed-6. Mag.: x 120**

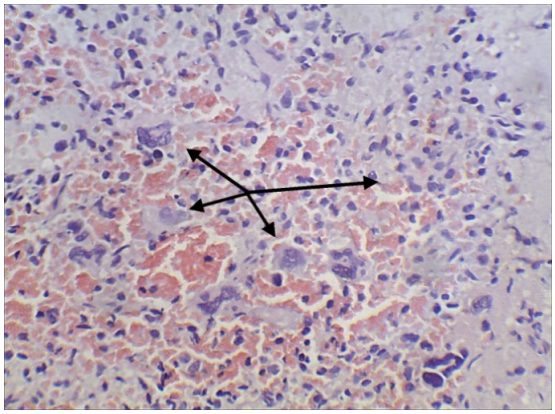

Fig. 15. **Microphoto. Foci of extramedullary hematopoiesis in the spleen of a 1-day-old kitten infected with SARS-CoV-2 coronavirus. Hematoxylin–eosin. Biomed-6. Mag.: x 480**

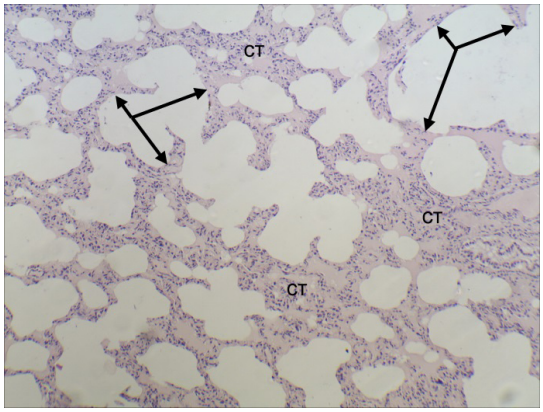

Fig. 16. **Microphoto. The lungs of a 10-day-old kitten. Connective tissue overgrowth (ст), emphysema, no alveolar epithelium (arrows). Hematoxylin–eosin. Biomed-6. Mag.: x 120**

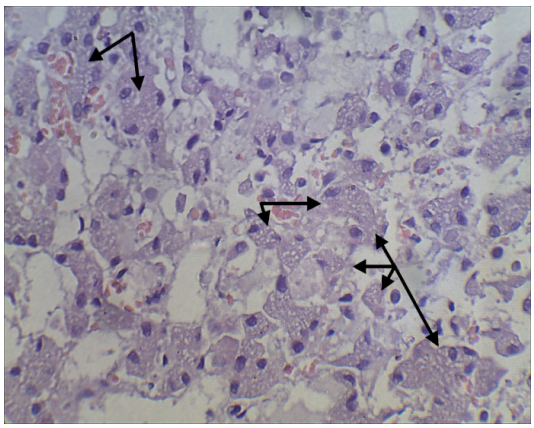

Fig. 17. **Microphoto. Small-drop fatty dystrophy of hepatocytes of the liver of a 10-day-old kitten with COVID-19. Hematoxylin–eosin. Biomed-6. Mag.: x 120**

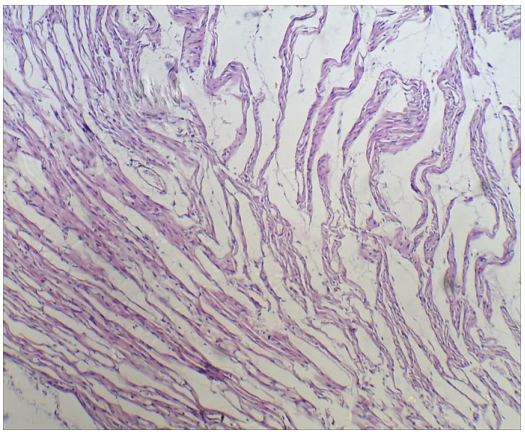

Fig. 18. **Microphoto. Severe serous edema of the myocardium of a 10-day-old kitten infected with SARS-CoV-2 coronavirus. Hematoxylin–eosin. Biomed-6. Mag.: x 120**

Discussion. The results obtained in the course of our work allowed us to confirm the available data on the clinical picture in animals infected with SARS-CoV-2, as well as to study the pathoanatomical picture and histological changes in this pathology. The analysis of the results obtained and their comparison with available literature sources and published results of other researchers, as well as comparison with data from international organizations, allowed us to identify similar signs of the disease and complete the picture of its manifestation, thereby partially explaining the pathogenesis of the disease. The obtained data allow us to understand the dynamics of developing processes, their sequence, to determine the main stages and mechanisms in the pathogenesis of the disease, which, in turn, will allow us to choose the most effective and possible treatment for infected animals.

As can be seen from the obtained data on the study of the clinical picture of the disease, the main symptoms (shortness of breath, shortness of breath, cough, cyanosis of the mucous membranes, tachycardia) indicate a violation of the respiratory and cardiovascular systems, which is primarily due to the tropicity of the virus (epitheliotropic). The data of pathoanatomical autopsy and histological studies also indicate a violation of blood circulation, congestion in tissues and organs, and increased thrombosis. In our opinion, this is due to a systemic imbalance of the blood coagulation and anticoagulation systems in the direction of thrombosis, which plays an important role in the pathogenesis of COVID-19 in humans and animals. Taking into account the severity and depth of morphological changes, primarily in the lungs of newborn animals, we can conclude that vertical (transplacental) infection of kittens.

However, to identify a number of features of the pathogenesis of the disease, epizootological data, biological characteristics of the pathogen, it is necessary to conduct more in-depth studies, including serodiagnostics at various stages of the disease, determining the state of the immune system, metabolic processes, determining the possible impact on the functions of the reproductive system, the impact on reproduction and offspring, the effect on the nervous system.

Conclusions.

1. Infection of a domestic cat with the SARS-CoV-2 coronavirus can manifest itself in individual animals with specific clinical signs, pathoanatomical signs and histological changes.

2. The main clinical symptoms in infected animals are: refusal to feed, depression, dyspnea, shortness of breath, cough, cyanosis of the mucous membranes, tachycardia, less often - diarrhea and fever. The incubation period averaged from 6 to 10 days.

3. The main pathoanatomical changes in infected animals are: hurricane (membranogenic) pulmonary edema ("carmine lungs") with areas of alveolar emphysema and small-focal pneumonia with predominant localization in the anterior and middle lobes, pronounced blood clotting in the arteries and veins of medium caliber, acute expansion of the atria and right ventricle ("pulmonary heart"), pulmonary vein systems. Pronounced postmortem blood clotting in the heart cavities, large arteries and veins, fatty dystrophy with pronounced liver edema, acute venous hyperemia of the kidneys, fatty dystrophy of the cortical substance, pronounced edema of the medulla, hypotrophy (congenital, postnatal).

4. At the histological level, the following changes were noted: pronounced proliferation of interlobular and interalveolar connective tissue, lymphoid-macrophage peribronchitis and perivasculitis, formation of nodular lymphoid tissue, extensive areas of alveolar emphysema, atrophy or absence of alveolar epithelium; liver – total small – drop fatty dystrophy, pronounced edema (dilation of Disse spaces); kidneys – venous hyperemia, serous edema of the glomeruli and intercalular connective tissue; heart-serous edema of the myocardium; spleen-pronounced lymphoid hyperplasia of the white pulp.

Based on the main clinical symptoms in a domestic cat (shortness of breath, cough, abdominal type of breathing), the main pathological processes in SARS-CoV-2 infection are lung damage and blood clotting disorders (increased blood clotting),

The leading pathomorphological changes in the body of kittens with spontaneous infection with SARS-CoV-2 coronavirus are characterized by the development of congenital and postnatal hypotrophy, the predominance of hemodynamic disorders, deep disorders of the respiratory and cardiovascular systems: edema, alveolar emphysema of the anterior and middle lobes of the lungs with areas of atelectasis and small-focal interstitial pneumonia in them, atelectasis of the caudal lobes of the lungs (in kittens 1-2 days of age); edema lungs (classic version – "carmine lungs»; "hurricane" or membranogenic edema), alveolar emphysema, focal interstitial pneumonia, lung sclerosis with locasization in the diaphragmatic lobes (at 10-14 days of age); acute expansion of the heart; acute venous hyperemia and edema of internal organs; pronounced postmortem blood clotting in the heart cavities, large arteries and veins. Complicating processes are granular and small-drop fatty dystrophy of parenchymal or-

gans, concentric hypertrophy of the left ventricle of the heart, the development of which, in our opinion, is due to a combination of hemodynamic disorders, prolonged hypoxia and intoxication of the animal body.

LIST OF REFERENCES

1. Никифоров В. Новая коронавирусная инфекция (COVID-19): этиология, эпидемиология, клиника, диагностика, лечение и профилактика. Москва, 2020. 48 с. Doi:10.20514/2226-6704-2020-10-2-87-93

2. Саксена Шайлендра К. Коронавирусная болезнь 2019 (COVID-19). Сингапур: Springer 2020. 213 с. Doi:10.1007/978-981-15-4814-7

3. WHO Coronavirus Disease (COVID-19) Dashboard. URL:http:// covid19.who.int/table (accessed on 20 January 2021)

4. Current status of epidemiology, diagnosis, therapeutics, and vaccines for novel coronavirus disease 2019 (COVID-19)/ D.G. Ahn et al. J Microbiol Biotechnol. 2020. Vol. 30(3). P. 313–324. Doi:10.4014/jmb.2003.03011.

5. OIE Technical Factsheet on Infection with SARS-CoV-2 in Animals. URL:http://oie.int/fileadmin/Home/eng/Our_scientific_expertise/docs/pdf/COV-19/A_Factsheet_SARS-CoV-2.pdf

6. OIE Guidance on working with farmed animals of species susceptible to infection with SARS-CoV-2. URL:http://oie.int/fileadmin/Home/MM/Draft_OIE_Guidance_farmed_animals_cleanMS05.11.pdf

7. World Organisation for Animal Health (OIE). OIE Technical Factsheet: Infection with SARS-CoV-2 in animals. 2021. URL:http://rr-asia.oie.int/wp-content/uploads/2020/06/200608_a_factsheet_sarscov-2.pdf (accessed on 20 January 2021)

8. World Organisation for Animal Health (OIE). OIE COVID-19 Portal: Events in animals. 2021. URL:http://oie.int/en/scientific-expertise/specific-information-and-recommendations/questions-and-answers-on-2019novel-coronavirus/events-in-animals/. (accessed on 20 January 2021)

9. World Organisation for Animal Health (OIE). Considerations for sampling, testing, and reporting of SARS-CoV-2 in animals. 2020. URL:http://oie.int/fileadmin/Home/MM/A_Sampling_Testing_and_Reporting_of_SARS-CoV-2_in_animals_3_July_2020.pdf (accessed on 20 January 2021)

10. FAO, 2021. COVID-19 and animals. Information of risk mitigation measures for livestock and agricultural professionals. URL:http://fao.org/documents/card/en/c/cb2549en. (accessed on 20 January 2021)

11. FAO, Exposure of humans or animals to SARS-CoV-2 from wild, livestock, companion and aquatic animals. URL:http:// fao.org/3/ca9959en/CA9959EN.pdf (accessed on 20 January 2021)

12. WHO, Origins of the SARS-CoV-2 virus. URL:http://who.int/health-topics/coronavirus/who-recommendations-to-reduce-risk-of-transmission-of-emerging-pathogens-from-animals-tohumans-in-live-animal-markets. (accessed on 20 January 2021)

13. Centres for Disease Control COVID-19 and Animals. URL:http://cdc.gov/coronavirus/2019-ncov/daily-life-coping/animals.html

14. Mahdy M.A.A., Younis W., Ewaida Z. An Overview of SARS-CoV-2 and Animal Infection. Front. Vet. Sci. 2020. Vol. 7. 1084 p. URL:http://frontiersin.org/articles/10.3389/fvets.2020.596391/full (accessed on 20 January 2021)

15. Hobbs E.C., Reid T.J. (2020). Animals and SARS-CoV-2: Species susceptibility and viral transmission in experimental and natural conditions, and the potential implications for community transmission. Trans. Emerg. Dis, Online ahead of print. 2020. URL:http://onlinelibrary.wiley.com/Doi/10.1111/tbed.13885 (accessed on 20 January 2021)

16. Infection and Rapid Transmission of SARS-CoV-2 in Ferrets/ Y.I. Kim et al. Cell Host Microbe. 2020. 27 (5). P. 704–709. URL:http://sciencedirect.com/science/article/pii/S1931312820301876 (accessed on 20 January 2021)

17. European Centre for Disease Prevention and Control (ECDPC). Detection of new SARS-CoV-2 variants related to mink. 2020. URL:http://ecdc.europa.eu/sites/default/files/documents/RRASARS-CoV-2-in-mink-12-nov-2020.pdf (accessed on 20 January 2021)

18. World Organisation for Animal Health (OIE). OIE statement on COVID-19 and mink. 2021. URL:http://oie.int/en/for-the-media/press-releases/detail/article/oie-statement-on-covid-19-and-mink/. (accessed on 20 January 2021)

19. WHO, Disease Outbreak News, SARS-CoV-2 mink-associated variant strain – Denmark. URL:http://who.int/csr/don/03-december-2020-mink-associated-sars-cov2-denmark/en/ (accessed on 20 January 2021).

20. United States Department of Agriculture Response and containment guidelines: Interim Guidance for Animal Health and Public Health Officials Managing Farmed Mink and other Farmed Mustelids with SARS-CoV-2. URL:http://aphis.usda.gov/publications/animal_health/sars-cov-2-mink-guidance.pdf

21. United States Department of Agriculture (USDA). Response & Containment Guidelines Interim Guidance for Animal Health and Public Health Officials Managing Farmed Mink and other Farmed Mustelids with SARS-CoV-2. 2020. URL:http://aphis.usda.gov/publications/animal_health/sars-cov-2-mink-guidance.pdf (accessed on 20 January 2021).

22. United States Department of Agriculture (USDA). Mink (July 2020), USDA, National Agricultural Statistics Service. 2020. URL:http://furcommission.com/wp-content/uploads/2020/07/USDAmink2020.pdf (accessed on 20 January 2021)

23. Guardian. Covid-19 mink variants discovered in humans in seven countries. 2020. URL:http://theguardian.com/environment/2020/nov/18/covid-19-mink-variants-discovered-in-humans-inseven-countries (accessed on 20 January 2021)

24. United States Department of Agriculture (USDA). Interim SARS-CoV-2 Guidance and Recommendations for Farmed Mink and Other Mustelids. URL:http://aphis.usda.gov/animal_health/one_health/downloads/sars-cov-2-guidance-for-farmed-mink.pdf (accessed on 20 January 2021)

25. Centers for Disease Control and Prevention. Steps to Prevent COVID-19 on Mink Farms. 2020. URL:http://furcommission.com/wp-content/uploads/2020/11/Mink-Training-Presentation_4Nov2020. pdf (accessed on 20 January 2021)

26. De Liberto T., Shriner S. Coronavirus disease 2019 update (536): Animal, USA (Utah), wild mink, first case. ProMED-mail, International Society for Infectious Diseases. Posted December. 13, 2020. URL:http://sciencenewsforstu-

dents.org/article/covid-19-coronavirus-mink-utah-first-wild-animal-test-positive

27. SARS-CoV-2 infection in farmed minks, the Netherlands/ N. Oreshkova et al. 2020. BioRxiv. Doi:10.1101/2020.05.18.101493.

28. SARA-CoV-2 infection in farmed minks, the Netherlands/. Oreshkova et al. 2020. Eurosurv, 25 (23): 2001005. Doi:10.2807/1560-7917.ES.2020.25.23.2001005

29. Dykstra M.P., Baitchman E.J. A Call for One Health in Medical Education: How the COVID-19 Pandemic Underscores the Need to Integrate Human, Animal, and Environmental Health. PMID: 33769340. AcadMed. 2021 Mar23. Doi:10.1097/ACM.0000000000004072

30. Smriti Mallapaty. The search for animals harbouring coronavirus — and why it matters. Nature 591. 2021. P. 26–28. Doi: 10.1038/d41586-021-00531-z

31. Cross-host evolution of severe acute respiratory syndrome coronavirus in palm civet and human/ H.D. Song et al. Proc. Natl. Acad. Sci. USA. 2005. Vol. 102. P. 2430–2435. Doi:10.18632/age.103988

32. Susceptibility of ferrets, cats, dogs, and other domesticated animals to SARS-coronavirus 2/ J. Shi et al. Science. 2020. Vol. 368. P. 1016–1020. Doi:10.1126/science.abb7015

33. Прудников В.С., Белкин Б. Л., Герман С. П. Патоморфологическая диагностика болезней собак, кошек и пушных зверей. Вскрытие и патоморфологическая диагностика болезней животных. Витебск: ВГАВМ, 2021. С. 168–192.

34. Методические указания по отбору патологического материала, крови, кормов и пересылки их для лабораторного исследования / А. Э. Высоцкий и др. Минск, 2008. С. 5–6. URL:http:// agriculture.uz/filesarchive/spravochnik_po_bakter.pdf

35. Микроскопическая техника: руководство / Д. С. Саркисов и др.; под ред. Д. С. Саркисова, Ю. Л. Петрова. Москва: Медицина, 1996. С. 14–25, 36–50. URL:http://studmed.ru/sarkisov-ds-perov-ds-mikroskopicheskaya-tehnika_b6c23ee3451.html

36. Шуравин, П. В. Описание гистологических препаратов: руководство (Simple Pathology). Москва, 2020. С. 5–14, 32–34, 64–70, 73–74, 77–82, 128, 135–136, 139. URL:http://simplepathology.ru/product/opisanie-gistologicheskih-preparatov-rukovodstvo-2020/

37. Патологическая анатомия COVID-19: Атлас / О. В. Зайратьянц и др.; под общ. ред. О. В. Зайратьянца. Москва: ГБУ «НИИОЗММ ДЗМ», 2020. 142 с. URL:http://scsml.ru/info/Atlas.-COVID-19/HTML/index.html

REFERENCES

1. Nikiforov, V. (2020). Novaya koronavirusnaya infekciya (COVID-19): e`tiologiya, e`pidemiologiya, klinika, diagnostika, lechenie i profilaktika [New coronavirus infection (COVID-19): etiology, epidemiology, clinic, diagnosis, treatment and prevention]. Moscow, 48 p. Doi:10.20514/2226-6704-2020-10-2-87-93

2. Saksena, Shajlendra K. (2020). Koronavirusnaya bolezn` 2019 (COVID-19) [Coronavirus disease 2019 (COVID-19)]. Singapur: Springer, 213 p. Doi:10.1007/978-981-15-4814-7

3. WHO Coronavirus Disease (COVID-19) Dashboard. Available at: https://covid19.who.int/table (accessed on 20 January 2021)

4. Ahn, D.G. (2020). Current status of epidemiology, diagnosis, therapeutics, and vaccines for novel coronavirus disease 2019 (COVID-19). J Microbiol Biotechnol. Vol. 30(3), pp. 313–324. Doi:10.4014/jmb.2003.03011.

5. OIE Technical Factsheet on Infection with SARS-CoV-2 in Animals. Available at: http://oie.int/fileadmin/Home/eng/Our_scientific_expertise/docs/pdf/COV-19/A_Factsheet_SARS-CoV-2.pdf

6. OIE Guidance on working with farmed animals of species susceptible to infection with SARS-CoV-2 Available at: http://oie.int/fileadmin/Home/MM/Draft_OIE_Guidance_farmed_animals_cleanMS05.11.pdf

7. World Organisation for Animal Health (OIE). (2021). OIE Technical Factsheet: Infection with SARS-CoV-2 in animals. Available at: http://rr-asia.oie.int/wp-content/uploads/2020/06/200608_a_factsheet_sarscov-2.pdf (accessed on 20 January 2021)

8. World Organisation for Animal Health (OIE). (2021). OIE COVID-19 Portal: Events in animals. Available at: http://oie.int/en/scientific-expertise/specific-information-and-recommendations/questions-and-answers-on-2019novel-coronavirus/events-in-animals/. (accessed on 20 January 2021)

9. World Organisation for Animal Health (OIE). (2020). Considerations for sampling, testing, and reporting of SARS-CoV-2 in animals. Available at: http://oie.int/fileadmin/Home/MM/A_Sampling_Testing_and_Reporting_of_SARS-CoV-2_in_animals_3_July_2020.pdf (accessed on 20 January 2021)

10. FAO, 2021. COVID-19 and animals. Information of risk mitigation measures for livestock and agricultural professionals. Available at: http://fao.org/documents/card/en/c/cb2549en. (accessed on 20 January 2021)

11. FAO, Exposure of humans or animals to SARS-CoV-2 from wild, livestock, companion and aquatic animals. Available at: http://fao.org/3/ca9959en/CA9959EN.pdf (accessed on 20 January 2021)

12. WHO, Origins of the SARS-CoV-2 virus. Available at: http://who.int/health-topics/coronavirus/who-recommendations-to-reduce-risk-of-transmission-of-emerging-pathogens-from-animals-tohumans-in-live-animal-markets.(accessed on 20 January 2021)

13. Centres for Disease Control COVID-19 and Animals. Available at: http://cdc.gov/coronavirus/2019-ncov/daily-life-coping/animals.html

14. Mahdy, M.A.A., Younis, W., Ewaida, Z. (2020). An Overview of SARS-CoV-2 and Animal Infection. Front. Vet. Sci. Vol. 7, 1084 p. Available at: http://frontiersin.org/articles/10.3389/fvets.2020.596391/full (accessed on 20 January 2021)

15. Hobbs, E.C., Reid, T.J. (2020). Animals and SARS-CoV-2: Species susceptibility and viral transmission in experimental and natural conditions, and the potential implications for community transmission. Trans. Emerg. Dis, Online ahead of print. Available at: http://onlinelibrary.wiley.com/Doi/10.1111/tbed.13885 (accessed on 20 January 2021)

16. Kim, Y.I, Kim, S.G., Kim E.H., Park S.J., Yu K.M., Chang J.H. (2020). Infection and Rapid Transmission of SARS-CoV-2 in Ferrets. Cell Host Microbe. Vol. 27 (5), pp. 704–709. Available at: http://sciencedirect.com/science/article/pii/S1931312820301876 (accessed on 20 January 2021)

17. European Centre for Disease Prevention and Control (ECDPC). (2020). Detection of new SARS-CoV-2 vari-

ants related to mink. Available at: http://ecdc.europa.eu/sites/default/files/documents/RRASARS-CoV-2-in-mink-12-nov-2020.pdf (accessed on 20 January 2021)

18. World Organisation for Animal Health (OIE). (2021). OIE statement on COVID-19 and mink. Available at: http://oie.int/en/for-the-media/press-releases/detail/article/oie-statement-on-covid-19-and-mink/. (accessed on 20 January 2021)

19. WHO, Disease Outbreak News, SARS-CoV-2 mink-associated variant strain – Denmark. Available at: http://who.int/csr/don/03-december-2020-mink-associated-sars-cov2-denmark/en/ (accessed on 20 January 2021)

20. United States Department of Agriculture Response and containment guidelines: Interim Guidance for Animal Health and Public Health Officials Managing Farmed Mink and other Farmed Mustelids with SARS-CoV-2. Available at: http://aphis.usda.gov/publications/animal_health/sars-cov-2-mink-guidance.pdf

21. United States Department of Agriculture (USDA). (2020). Response & Containment Guidelines Interim Guidance for Animal Health and Public Health Officials Managing Farmed Mink and other Farmed Mustelids with SARS-CoV-2. Available at: http://aphis.usda.gov/publications/animal_health/sars-cov-2-mink-guidance.pdf (accessed on 20 January 2021)

22. United States Department of Agriculture (USDA). (2020). Mink (July 2020), USDA, National Agricultural Statistics Service. Available at: http://furcommission.com/wp-content/uploads/2020/07/USDAmink2020.pdf (accessed on 20 January 2021)

23. Guardian. (2020). Covid-19 mink variants discovered in humans in seven countries. Available at: http://theguardian.com/environment/2020/nov/18/covid-19-mink-variants-discovered-in-humans-inseven-countries (accessed on 20 January 2021)

24. United States Department of Agriculture (USDA). Interim SARS-CoV-2 Guidance and Recommendations for Farmed Mink and Other Mustelids. Available at: http://aphis.usda.gov/animal_health/one_health/downloads/sars-cov-2-guidance-for-farmed-mink.pdf (accessed on 20 January 2021)

25. Centers for Disease Control and Prevention (2020). Steps to Prevent COVID-19 on Mink Farms. Available at: http://furcommission.com/wp-content/uploads/2020/11/Mink-Training-Presentation_4Nov2020. pdf (accessed on 20 January 2021)

26. DeLiberto, T., Shriner, S. (2020). Coronavirus disease 2019 update (536): Animal, USA (Utah), wild mink, first case. ProMED-mail, International Society for Infectious Diseases. Posted December. 13, Available at: http://sciencenewsforstudents.org/article/covid-19-coronavirus-mink-utah-first-wild-animal-test-positive

27. Oreshkova, N., Molenaar, R. J. (2020). SARS-CoV-2 infection in farmed minks, the Netherlands, April 2020. BioRxiv. Doi: 10.1101/2020.05.18.101493.

28. Oreshkova, N., Molenaar, R.J. (2020). SARA-CoV-2 infection in farmed minks, the Netherlands, April and May 2020. Eurosurv. Vol. 25 (23):2001005. Doi:10.2807/1560-7917.ES.2020.25.23.2001005

29. Dykstra, M. P., Baitchman, E. J. (2021). A Call for One Health in Medical Education: How the COVID-19 Pandemic Underscores the Need to Integrate Human, Animal, and Environmental Health. PMID: 33769340. AcadMed. Doi:10.1097/ACM.0000000000004072

30. Smriti, Mallapaty. (2021). The search for animals harbouring coronavirus – and why it matters. Nature 591, pp. 26–28. Doi:10.1038/d41586-021-00531-z

31. Son, H.D., Tu, C.C., Zhang, G.W., Wang, S.Y., Zheng, K., Lei, L.C., Chen, Q.X., Gao, Y.W., Zhou, H.Q., Xiang. (2005). Cross-host evolution of severe acute respiratory syndrome coronavirus in palm civet and human. Proc. Natl. Acad. Sci. USA. Vol.102, pp. 2430–2435. Doi:10.18632 / age.103988

32. Shi, J., Wen, Z., Zhong, G., Yang, H., Wang, C., Huang, B., Liu, R., He, X., Shuai, L., Sun, Z. (2020). Susceptibility of ferrets, cats, dogs, and other domesticated animals to SARS-coronavirus 2. Science. Vol. 368, pp. 1016–1020. Doi:10.1126/science.abb7015

33. Prudnikov, V.S., Belkin, B.L., German, S.P. (2021). Patomorfologicheskaya diagnostika boleznej sobak, koshek i pushny` h zverej [Pathomorphological diagnostics of diseases of dogs, cats and fur-bearing animals]. Vskry`tie i patomorfologicheskaya diagnostika boleznej zhivotny`h [Autopsy and pathomorphological diagnosis of animal diseases]. Vitebsk: VGAVM, pp. 168–192. (In Russian).

34. Vy`soczki, A.E., Ly`senko, A.P., Baranovskaya, Z.N., Fomchenko, I.V., Ivanov, S.A., Rumachik, I.I. (2008). Metodicheskie ukazaniya po otboru patologicheskogo materiala, krovi, kormov i peresy`lki ih dlya laboratornogo issledovaniya [Guidelines for the selection of pathological material, blood, feed and sending them for laboratory testing]. Minsk, pp. 5–6. (In Russian). Available at: http://agriculture.uz/filesarchive/spravochnik_po_bakter.pdf

35. Sarkisov, D. S., Petrova, Yu. L. (1996). Mikroskopicheskaya texnika: Rukovodstvo [Microscopic Technique: A Guide]. M. : Medicina. pp. 14–25, 36–50. (In Russian). Available at: http://studmed.ru/sarkisov-ds-perov-ds-mikroskopicheskaya-tehnika_b6c23ee3451.html

36. Shuravin, P. V. (2020). Opisanie gistologicheskix preparatov: Rukovodstvo (Simple Pathology) [Description of histological preparations: A Guide (Simple Pathology)]. Moscow. pp. 5–14, 32–34, 64–70, 73–74, 77–82, 128, 135–136, 139. (In Russian). Available at: http://simplepathology.ru/product/opisanie-gistologicheskih-preparatov-rukovodstvo-2020/

37. Zajrat`yancz, O. V., Samsonova, M. V., Mixaleva, L. M., Chernyaev, A. L., Mishnev, O. D., Krupnov, N. M., Kalinin D. V. (2020). Patologicheskaya anatomiya COVID-19 : Atlas [Pathological anatomy of COVID-19: Atlas]. Moscow, GBU «NIIOZMM DZM», 142 p. (In Russian). Available at: http:// scsml.ru/info/Atlas.-COVID-19/HTML/index.html

Особливості клініко-патоморфологічної картини за спонтанного зараження домашньої кішки (lat. Félis cátus) коронавірусом SARS-CoV-2

Субботіна І. А., Громов І. М., Купріянов І. І.

Нині в світі реєструють випадки інфікування різних видів тварин новим коронавірусом SARS-CoV-2. Цей вірус виділили у численних представників сімейства котячих, у норки європейської, тхора, єнотоподібного собаки, домашнього собаки, ряду приматів та інших тварин. У сприйнятливих тварин інфікування цим вірусом проявляється певними клінічними симптомами, хвороба може закінчитися летальним результатом з розвитком характерних патолого-анатомічних і гістологічних змін. За результатами проведених попередніх досліджень в Рес-

публіці Білорусь була виявлена циркуляція SARS-CoV-2 у кішки домашньої. Усі тварини в анамнезі мали контакт з хворими на Covid-19 власниками.

Метою роботи було визначити особливості клінічного і патолого-анатомічного прояву, гістологічних змін у кішки домашньої за інфікування SARS-CoV-2. Дослідження проводили серед різних статево-вікових і породних груп кішки домашньої. Загалом було проведено дослідження 300 змивів від різних статево-вікових і породних груп, розтин 10 трупів загиблих тварин.

Роботу проводили у Вітебській державній академії ветеринарної медицини, Вітебській обласній ветеринарній лабораторії, РНПЦ "Епідеміології та мікробіології" м. Мінськ, Білоруському державному ветеринарному центрі. Циркуляцію SARS-CoV-2 в організмі тварин визначали за допомогою полімеразно-ланцюгової реакції (ОТ-ПЛР). Під час розтину трупів тварин враховували особливості і тяжкість патоморфологічних змін, оформляли патолого-анатомічний діагноз, проводили макрофотографування за природного освітлення.

Основні клінічні симптоми захворювання у дорослих тварин – пригнічення, відмова від корму, кашель, задишка; у молодняку часто спостерігали риніт, кон'юнктивіт, діарею. За розтину загиблих тварин відмічали макро- і мікрозміни в органах і тканинах, як за гострого перебігу хвороби, так і хронічного.

Проведені дослідження і отримані результати підтвердили й доповнили дані світових дослідників, дали змогу визначити провідні клінічні симптоми хвороби і патолого-анатомічні зміни у кішки домашньої за інфікування SARS-CoV-2. Отримані дані гістологічних змін дозволили більш глибоко оцінити й вивчити патогенез хвороби, що сприятиме раціональному підходу у виборі засобів терапії за цієї хвороби.

Ключові слова: кішки, коронавірус, SARS-CoV-2, клінічні ознаки, патолого-анатомічні зміни, гістологічне дослідження.

Особенности клинико-патоморфологической картины при спонтанном заражении домашней кошки (lat. Félis cátus) коронавирусом SARS-CoV-2

Субботина И. А., Громов И. Н., Куприянов И. И.

На сегодня в мире регистрируют случаи инфицирования различных видов животных новым коронавирусом SARS-CoV-2. Этот вирус был выделен у многочисленных представителей семейства кошачьих, европейской норки, хорька, енотовидной собаки, домашней собаки, ряда приматов и других животных. У наиболее восприимчивых животных заражение этим вирусом проявляется определенными клиническими симптомами, болезнь может закончиться летальным исходом с развитием характерных патолого-анатомических и гистологических изменений. По результатам предварительных исследований, проведенных в Республике Беларусь, циркуляция SARS-CoV-2 была выявлена у домашних кошек. Все животные имели контакты с владельцами, инфицированными COVID-19.

Целью работы было определение особенностей клинических и патолого-анатомических проявлений, гистологических изменений у домашних кошек, инфицированных SARS-CoV-2.

Исследования проводили среди различных половозрастных групп домашних кошек. В общем провели исследование 300 смывов разных половозрастных и породных групп, вскрытие 10 трупов.

Работу проводили в Витебской государственной академии ветеринарной медицины, Витебской областной ветеринарной лаборатории, РНПЦ "Эпидемиология и микробиология" в Минске, в Белорусском государственном ветеринарном центре. Циркуляцию SARS-CoV-2 у животных определяли методом полимеразной цепной реакции (ОТ – ПЦР). При вскрытии трупов животных учитывали особенности и выраженность патоморфологических изменений, ставили патолого-анатомический диагноз, проводили макрофотографию при естественном освещении.

Основными клиническими симптомами заболевания у взрослых животных являются депрессия, отказ от корма, кашель, одышка; у молодых животных часто наблюдают ринит, конъюнктивит, диарею. При вскрытии мертвых животных отмечаются макро- и микроизменения в органах и тканях, свидетельствующие о развитии патологических процессов, как при остром течении заболевания, так и хроническом.

Таким образом, проведенные исследования и полученные результаты подтвердили и дополнили данные мировых исследователей, позволили определить ведущие клинические симптомы заболевания и патолого-анатомические изменения у домашней кошки при заражении SARS-CoV-2. Полученные данные гистологических изменений позволили глубже и детальнее оценить и изучить патогенез заболевания, что будет способствовать рациональному подходу в выборе средств терапии данного заболевания.

Ключевые слова: кошки, коронавирус, SARS-CoV-2, клинические симптомы, патолого-анатомические изменения, гистологическое исследование.

ORCID iD:
Subotsina I. https://orcid.org/0000-0001-8346-2988
Gromov I. https://orcid.org/0000-0001-8065-5661
Kupryianav I. https://orcid.org/0000-0001-7436-3099