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PECULIARITIES OF ASSESSING PATHOMORPHOLOGICAL CHANGES IN THE LUNGS IN COVID-19 FROM THE POINT OF VIEW OF FORENSIC MEDICAL EXAMINATION

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Introduction.

Morphological changes that occur with a new coronavirus infection (COVID-19) can be divided into 2 groups: changes that occur in the lungs (as the main target organ in this pathology) and changes that occur in other organs and tissues.

The purpose of this study was to study the most informative morphological features in the lungs for forensic diagnostics of COVID-19.

Research and methods.

The material for the study was 42 cases of COVID-19 that ended in death. All patients were treated at the Second Zangiata Specialized Hospital in the intensive care unit. The corpses of deceased patients were examined in the pathology department of this center.

Table 1. Distribution of deceased patients from COVID-19 by gender and age.

Gender	Age groups			
	from 30 to 40 years old	from 40 to 60 years old	60 and older	Total
1	**2**	**3**	**4**	**5**
Men	6	8	12	26
Women	3	5	8	16
Total	9	13	20	42

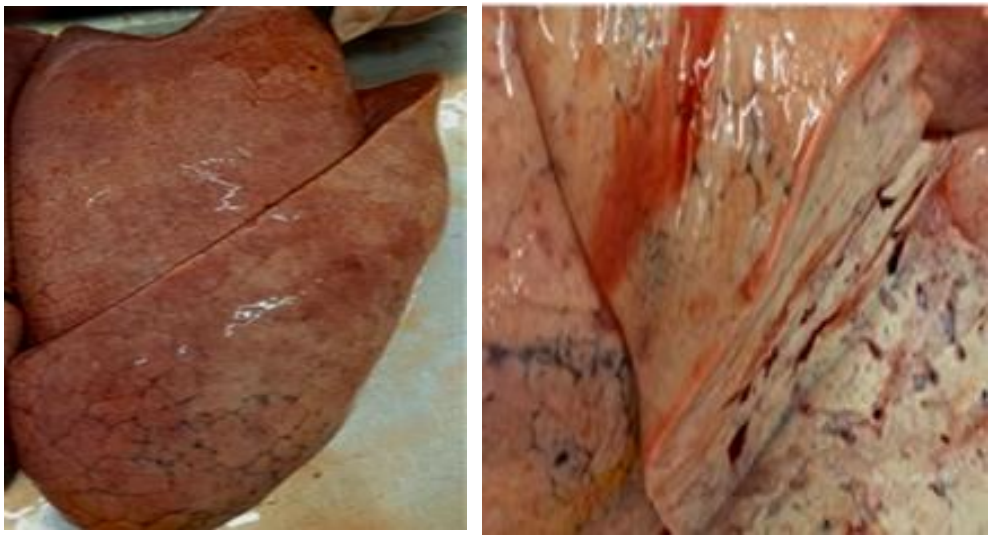
As follows from this Table 1, there were more men (26) than women (16) among those who died from COVID-19. The largest number of deaths in our studies were over 60 years old.

The clinical diagnosis of "COVID-19" was verified by PCR tests, clinical picture and instrumental methods (MSCT), as well as biochemical research methods.

Studies of the corpses of people who died from COVID-19 were carried out according to generally accepted methods in compliance with sanitary and epidemiological requirements, according to WHO guidelines (2020). Pieces of internal organs were fixed in 12% formalin solution, semi-thin sections were stained using hematoxylin and eosin, Mallory, van Gieson methods.

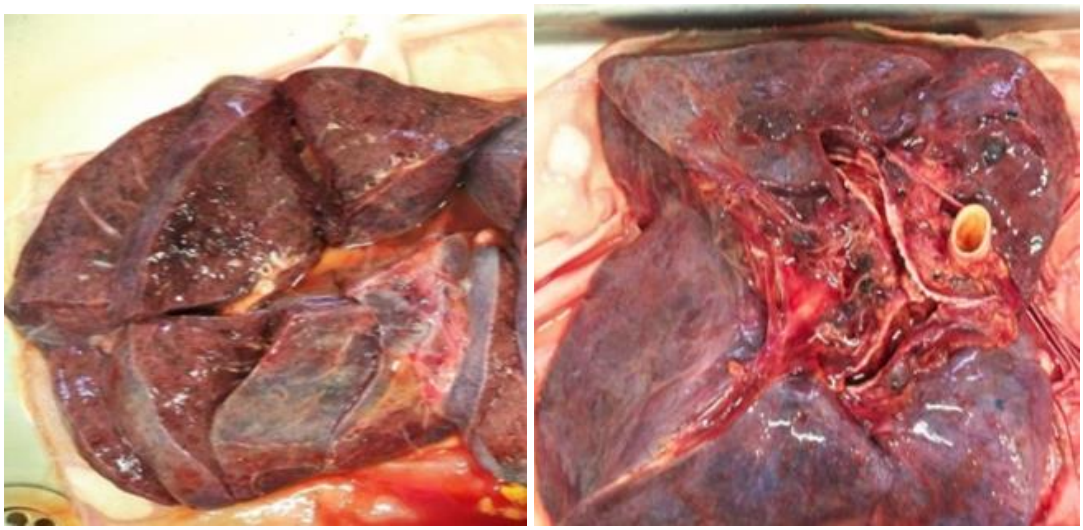
Results.

At the first stage, we conducted studies of changes occurring in the lungs. It should be noted that to date, we have not found any specific changes characteristic only of this coronavirus infection. However, we have noted that if the patient had signs of severe respiratory failure during life, then the autopsy showed a morphological picture of typical adult acute respiratory distress syndrome (ARDS). In this case, such signs as diffuse compaction of the lungs and their plethora (20.4%) were different. The appearance of such morphological changes is very similar to those in influenza (H1N1), but there is vascular damage such as endotheliitis and hemorrhagic changes in the pulmonary parenchyma. The lungs have a dense or doughy consistency, they are enlarged in volume, the color is dark red. The airiness of the parenchyma is sharply reduced or absent.



Lung tissue intact and in cut form

increased in volume, fibrous compacted consistency, vagus-pontine surface. On the cut, it is earthy gray-yellow in color, fibrous strands are visible, foamy-bloody edematous fluid flows from the cut surface.

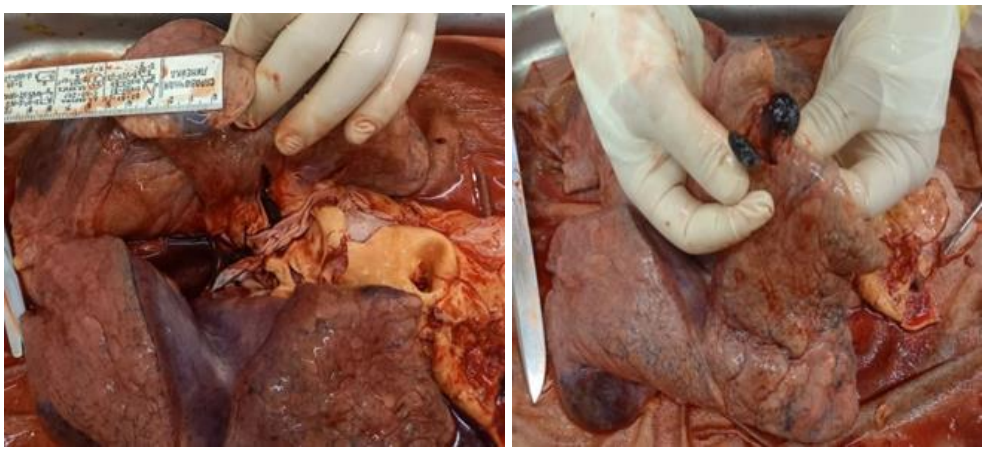


Lung tissue intact and in cut form macro.

Increased in volume, covered with fibrin adhesions on the surface, fine-point hemorrhages under the visceral pleura, fibrous compacted consistency. Peribronchial lymph nodes are enlarged. On the cut, earthy

gray-brown color with dark-bluish areas, fibrous strands are visible, foamy-bloody edematous fluid flows from the cut surface.

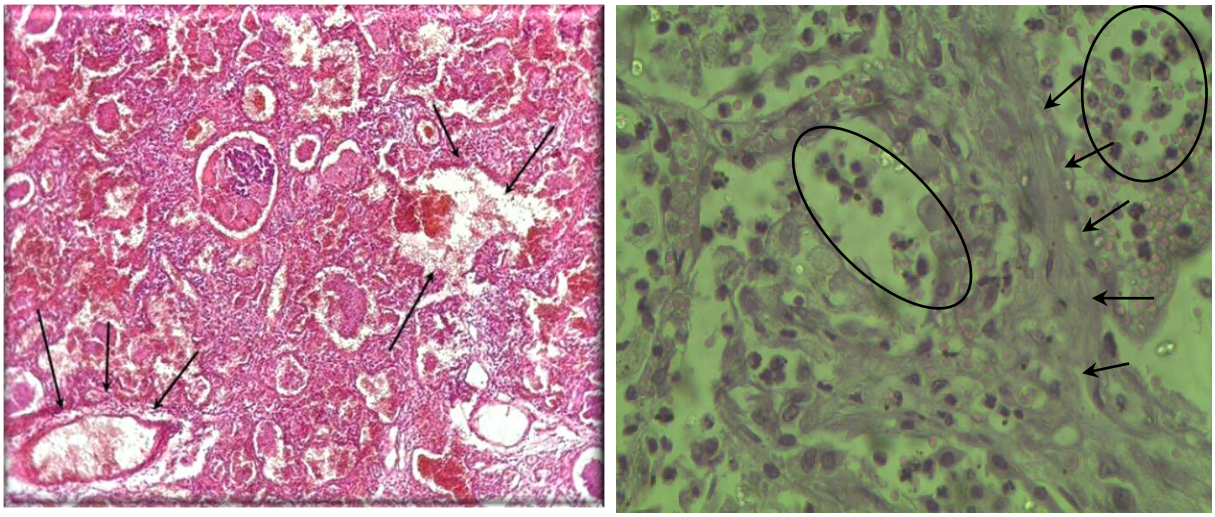
When examining the affected lungs, there are areas of hemorrhage, varying in size, as well as foci of infarction of the hemorrhagic type, with thrombi in the pulmonary vessels. It is worth noting that we did not observe signs of tracheal damage, apparently, they are secondary in nature, and are associated with the presence of an endotracheal (tracheostomy) tube in the trachea or the addition of a secondary hospital-acquired infection.



Pulmonary tissue intact and in cut form macro.

Increased in volume, fibrous compacted consistency, vagus-pontine surface. Dark-blue areas with clear boundaries are visible. In the cut marked areas of triangular shape infarction zone.

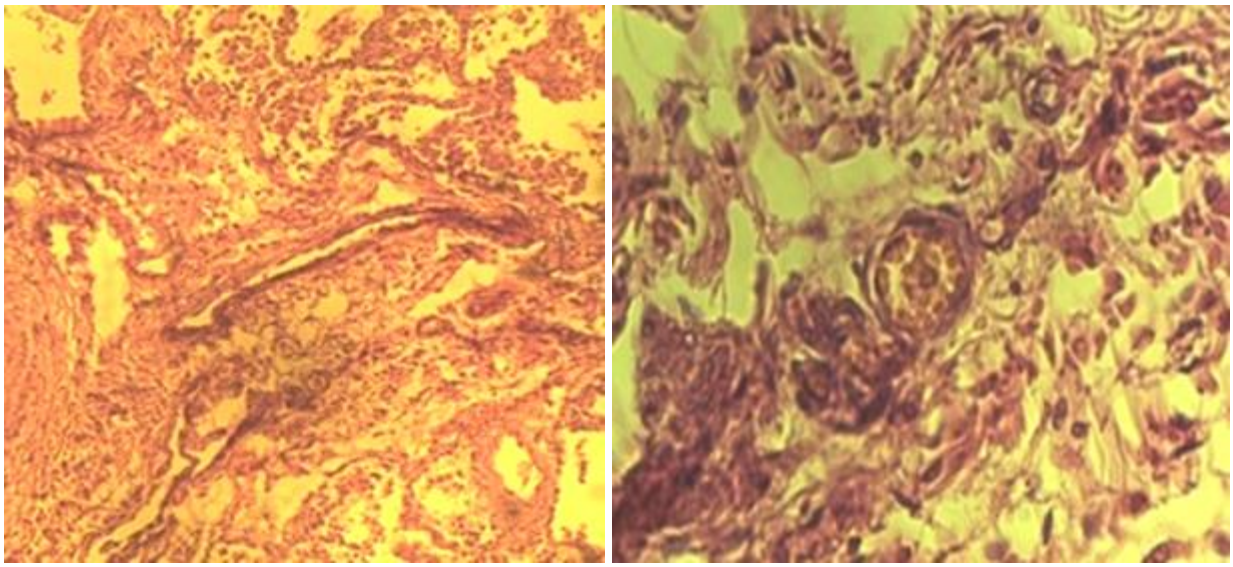
Microscopic examination of preparations obtained from the affected lungs revealed alveolar edema. Alveolocytes, erythrocytes, macrophages, lymphocytes and neutrophils were found in the edematous fluid in small quantities. Histological examination of the lungs also revealed healin membranes that extended to the inner surface of the bronchioles. Desquamation of the epithelium was observed. The presence of type II alveolocytes, which have a larger nucleus with small nucleoli included in it, was also described. Inclusions characteristic of viral infections were recorded in the cells. Pronounced infiltration of lymphocytes and macrophages was observed around the vessels and bronchi, as well as in the interalveolar septa and in the wall of small vessels.



Lung tissue micrographs. Hematoxylin and eosin staining.

Vessels of the microcirculation system are full-blooded with sludge and lysis of erythrocytes and thrombosis, vessels are dilated, in places there is sclerosis of the wall and pronounced fibrosis. Diffuse alveolar damage mixed phase (exudative and proliferative). In the lumen of the alveoli there is fibrin, exfoliated alveolocytes, erythrocytes, hyaline membranes. In places there is intraalveolar edema. Pronounced fibrosis of the interalveolar septa with desquamation of alveolocytes, in most areas there is distelectasis of the alveolar cavity. Organization of exudate and megakaryocytes in the lumen of the alveoli. In the thickness of fibrosis there are places of lympholeukocyte infiltration.

An important role in COVID-19 is played by damage to the microcirculatory bed. In this case, the lungs are characterized by such changes as capillary congestion in the area of the interalveolar septa, as well as congestion of the branches of the pulmonary arteries and veins. There are sludge of erythrocytes, fibrin thrombi, intrabronchial, intrabronchiolar hemorrhages that cause hemoptysis in patients, and perivascular hemorrhages also occur.



Lung tissue micrographs. Hematoxylin and eosin staining

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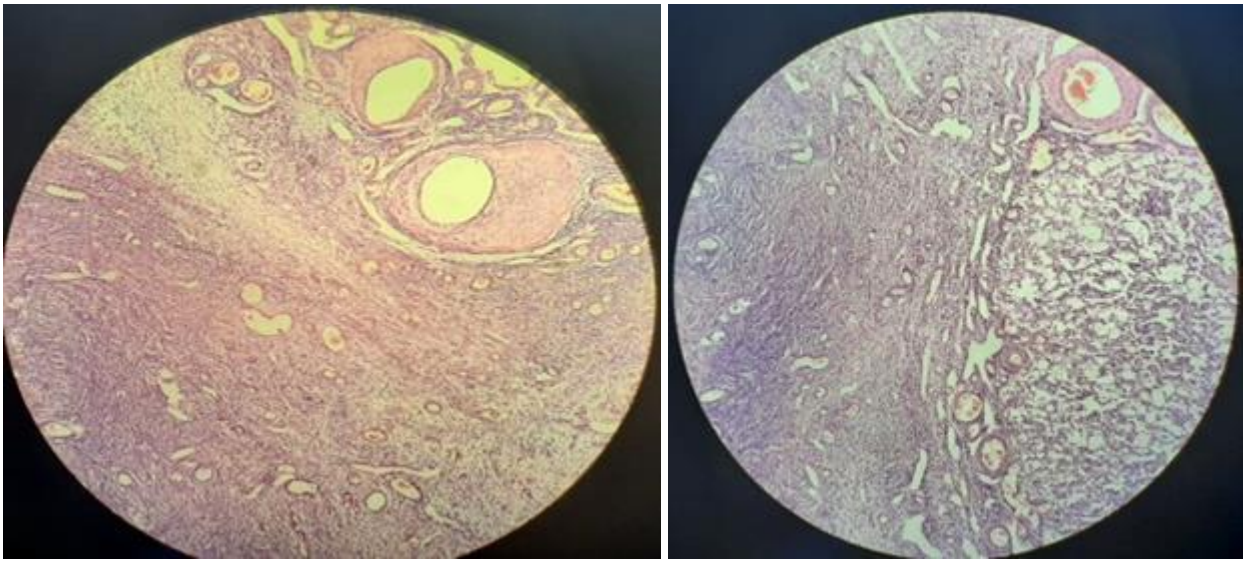

Lung tissue micrographs. Hematoxylin and eosin staining

Vessels are full-blooded with sludge and lysis of erythrocytes, thrombi formed in places. Vessels are dilated, walls are fibrotic. Diffuse alveolar damage mixed phase (exudative and proliferative). In the lumen of the alveoli fibrin, exfoliated alveolar cells, erythrocytes, hyaline membranes. In places intraalveolar edema. Pronounced fibrosis of the interalveolar septa with desquamation of alveolar cells, in most areas of distelectasis of the alveolar cavity. Organization of exudates in the lumen of the alveoli. In the thickness of fibrosis in places pronounced lympholeukocytic infiltration. Pronounced fibrosis of the bronchial wall with desquamation of the epithelium.

At the second stage of our research, we studied histological changes in internal organs in COVID-19.

According to our observations, the most informative (frequently occurring) changes are detected in other organs and tissues. They are primarily due to damage to the vascular endothelium caused by the "cytokine storm" and direct exposure to the virus. The autoimmune nature of endothelial damage in COVID-19 is also not excluded. This endothelial damage has already received its own name, SARS-Cov-2-associated endolithitis, and is the cause of the development of pulmonary microangiopathy, as well as other target organs of the heart (myocarditis), brain, etc. In some organs, we observed thrombovasculitis.

Thus, the morphological changes that occur with the new coronavirus infection - COVID-19, are of a diverse nature, and this applies to both macroscopic and microscopic signs. It is characteristic that such changes affect not only the lungs, but also other organs and tissues, which indicates the systemic nature of the infection. The identified informative morphological signs enable forensic experts and pathologists to make an objective, scientifically based diagnosis, which is necessary for further improvement of methods for the treatment and prevention of coronavirus infection.

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