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CT DIOGNOSIS OF ACUTE PULMONARY EMBOLISM

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Abstract:

A comparative analysis of two groups of patients was conducted. The first group did not show any changes in the lung parenchyma, while the second group had severe lung lesions with hemorrhages in the pulmonary alveoli and signs of pulmonary infarction. Along with the expansion of the pulmonary trunk, branches of the right and left pulmonary arteries on CT angiography, characteristic radiological signs of acute PE in the presented patients include an increase in the right and left ventricles of the heart without signs of right ventricular hypertrophy, flattening and displacement of the interventricular septum.

Keywords: Pulmonary Embolism; Clinical Observation; CT Diagnostics; Visualization.

INTRODUCTION.

Pulmonary embolism is one of the manifestations of venous thromboembolism, the clinical picture of which is variable and which can lead to the death of the patient (1,2). Based on the duration of symptoms, PE is divided into acute (immediately after thrombi enter the branches of the pulmonary artery), subacute (when clinical symptoms are observed for several weeks) and chronic (months and years after an episode of PE) (1,2). The most widely used non-invasive method for assessing the parenchyma and vascular structures of the lungs is multispiral computed tomography (MSCT) with intravenous bolus contrast (3).

PURPOSE. Detection of computed tomographic (CT) signs of acute pulmonary embolism.

MATERIAL AND METHODS.

An extended analysis of clinical and computed tomography data was conducted in 20 patients admitted to the Republican Scientific Center for Emergency Medical Care (RSCEMC), in the therapeutic resuscitation department with a symptom of shortness of breath and chest pain. All patients were divided into two groups, the first group (10 patients) - patients in whom no changes were detected in the lungs on a CT scan, the second group (10 patients) - changes in the lungs were detected. All patients were hospitalized in the therapeutic resuscitation department. Multispiral computed tomography (MSCT) of the chest organs was performed on an Aquilion Prime 160 MSCT device (Canon Medical System). Radiological studies were compared with the clinical picture at different stages of the disease.

RESEARCH RESULTS.

All patients upon admission suddenly felt shortness of breath, a feeling of lack of air, an episode of hemoptysis. To clarify the diagnosis, all patients underwent emergency computed tomography of the chest organs with subsequent intravenous bolus contrast, which allowed confirming the diagnosis of pulmonary embolism and starting intensive therapy.

In patients of the first group, the analysis of computed tomographic images in the "lung window" did not reveal any changes in the pulmonary parenchyma and tracheobronchial tree.

A sequential analysis of post-contrast changes in the pulmonary vessels revealed the prevalence and shape of thrombotic clots that caused the severity of the patients' condition. In all patients of the first group, a visual assessment of the large vessels of the heart revealed the approximate equality of the diameters of the ascending aorta and pulmonary trunk. The diameter of the ascending aorta was 3.4±0.2 cm, and the diameter of the pulmonary trunk was 3.5±0.1 cm (Fig. 1).

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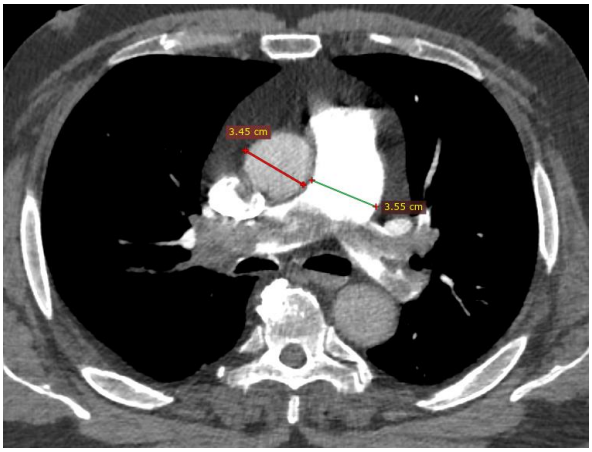
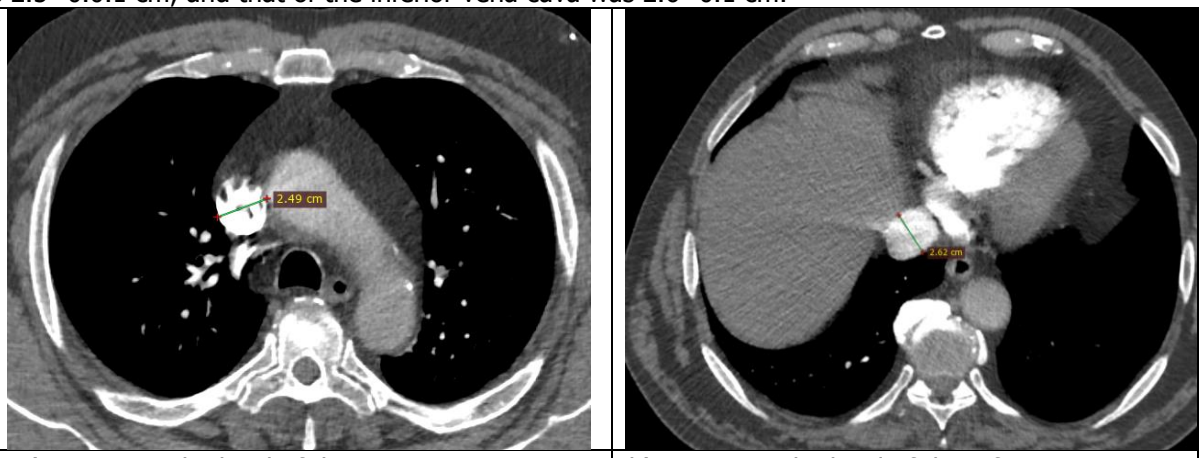


Fig. 1. CT with bolus contrast, equality of the diameter of the ascending aorta and pulmonary trunk

The expansion and roundness of the superior and inferior vena cava are noteworthy. The diameter of the superior vena cava was 2.5±0.0.1 cm, and that of the inferior vena cava was 2.6±0.1 cm.



a) section at the level of the superior vena cava | b) section at the level of the inferior vena cava

Fig. 2. Enlargement of the superior and inferior vena cava

All patients in the first group have an enlarged right ventricle, the right ventricle has a rounded shape, normally it should be flattened. An enlarged superior and inferior vena cava, as well as the right ventricle, indicates an overload of the right parts of the heart, that is, pulmonary hypertension.

Analyzing changes in the pulmonary artery, all patients were found to have thrombotic masses in the area of the pulmonary artery bifurcation, spreading to the right and left pulmonary artery.

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Fig. 3. Thrombotic masses in the area of the pulmonary artery bifurcation, spreading to the right and left pulmonary arteries

The right midlobe artery is almost 95% filled with thrombotic masses, causing subocclusion.

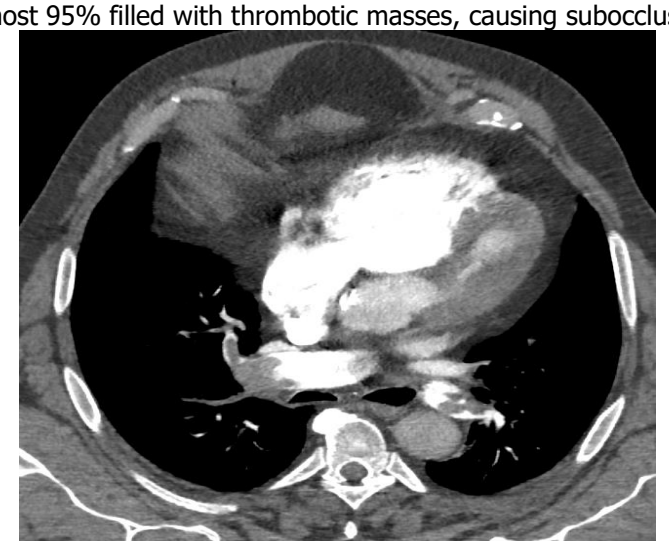
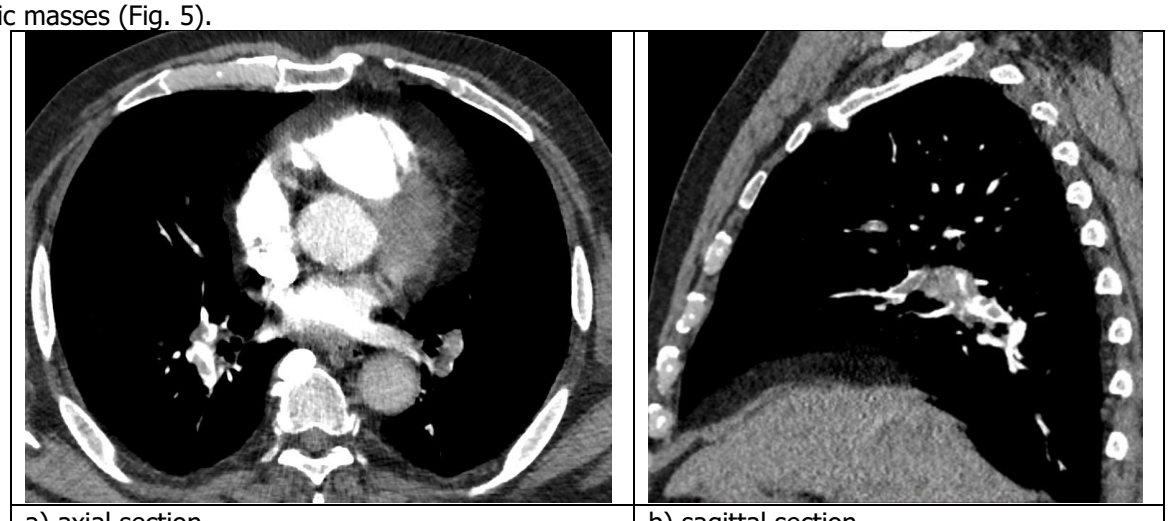


Fig. 4. Subocclusion of the middle lobe artery

The branches of the lower lobe artery on the right with the transition to the segmental branches are filled with thrombotic masses (Fig. 5).



a) axial section | b) sagittal section

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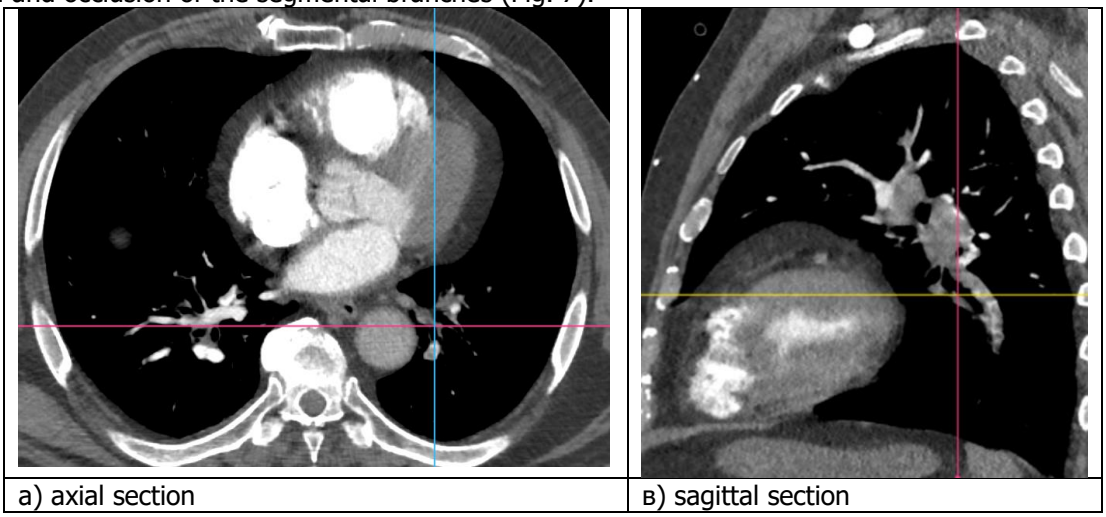
Fig. 5. Thrombotic masses in the right lower lobar and segmental branches of the pulmonary artery

In the left pulmonary artery, a central filling defect is determined in the left main pulmonary artery (Fig. 6).

Рис.6. Центральные тромботические массы в главной левой легочной артерии

Fig. 6. Central thrombotic masses in the main left pulmonary artery

In the inferior lobar artery and its segmental branches, thrombotic masses are found that are randomly located, causing subocclusion and occlusion of the segmental branches (Fig. 7).



а) axial section | в) sagittal section

Fig. 7. Thrombotic masses in the left lower lobar and segmental branches of the pulmonary artery

Thus, in the branches of the right and left pulmonary arteries, almost the same number of filling defects are detected, and predominantly filling defects are located in the lower lobar branches.

When examining the chambers of the heart, attention is drawn to:

- thickening of the interventricular septum (Fig. 8);
- dilated superior and inferior vena cava, which indicates an increase in pressure in the right chambers of the heart

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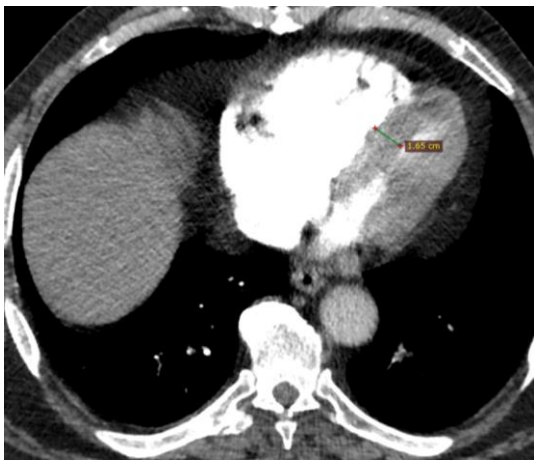

Fig. 8. Thickened interventricular septum

Thus, all patients in the first group had dilation of the superior and inferior vena cava, indicating increased pressure in the right heart chambers. The absence of right ventricular hypertrophy suggests acute pulmonary embolism. No changes in the lung parenchyma were detected in the pulmonary window.

All patients in the second group underwent CT pulmonography according to the standard program after intravenous bolus administration of a contrast agent with ECG synchronization. Post-contrast images show dilation of the pulmonary artery trunk (Fig. 9). The pulmonary artery trunk was 3.86±0.3 cm. Filling defects due to the presence of central thrombs were determined in the trunk and main branches of the pulmonary artery.

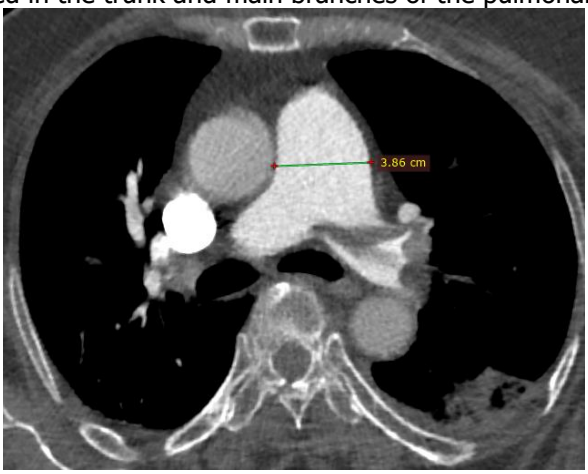

Fig.9 Pulmonary artery trunk dilation

The superior and inferior vena cava are dilated and rounded. The superior vena cava diameter was 2.8±0.01 cm, and the inferior vena cava diameter was 3.0±0.01 cm (Fig.10).

When examining the heart chambers, note:

- thickening of the interventricular septum (Fig.11);
- normal dimensions of the right ventricle

Thus, all patients in the second group had dilation of the superior and inferior vena cava, indicating increased pressure in the right chambers of the heart. Normal dimensions of the right ventricle (Fig.11) indicate acute pulmonary embolism. пользу острой ТЭЛА.

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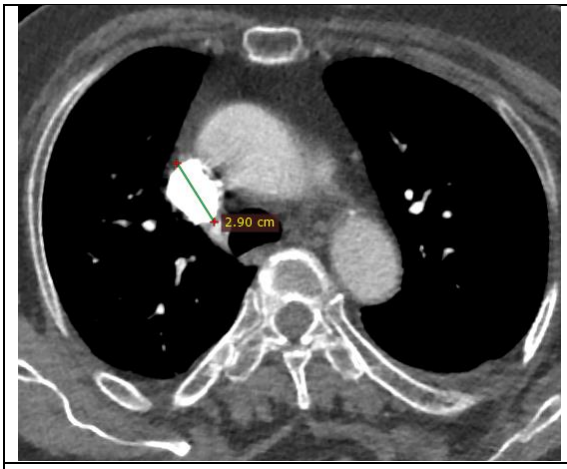
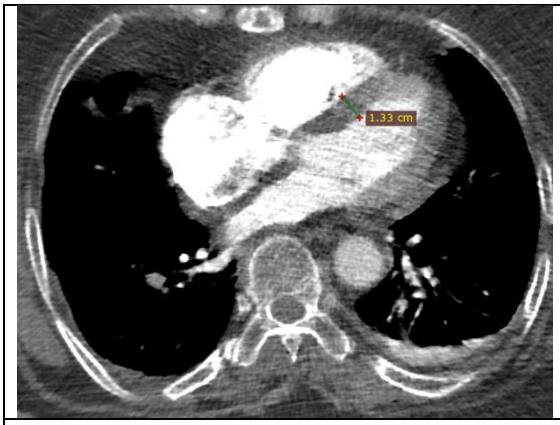


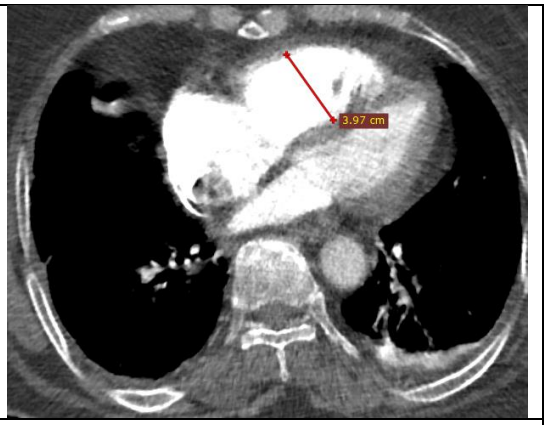
a) axial section, section at the level of the superior vena cava

b) axial section, section at the level of the inferior vena cava

Fig.10. Dilation of the superior and inferior vena cava



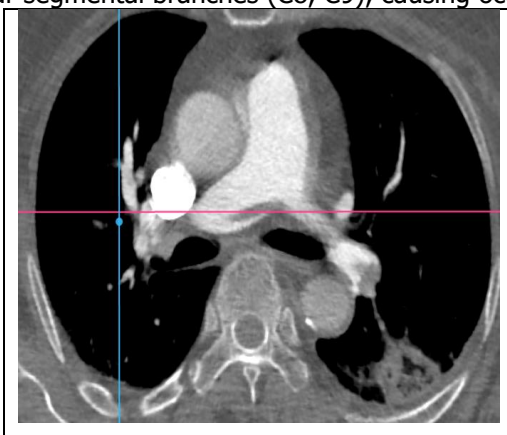
a) axial section, section at the level of the interventricular septum



b) axial section, section at the level of the right ventricle

Fig.11. Thickening of the interventricular septum, normal dimensions of the right ventricle

On the right, thrombi are not visualized in the upper lobar branches of the pulmonary artery. Thrombi are visualized in the basal lower lobar segmental branches (C8, C9), causing occlusion and subocclusion (Fig. 12).



a) axial section

b) sagittal section

Fig.12 Thrombi in the right basal segmental branches of the pulmonary artery

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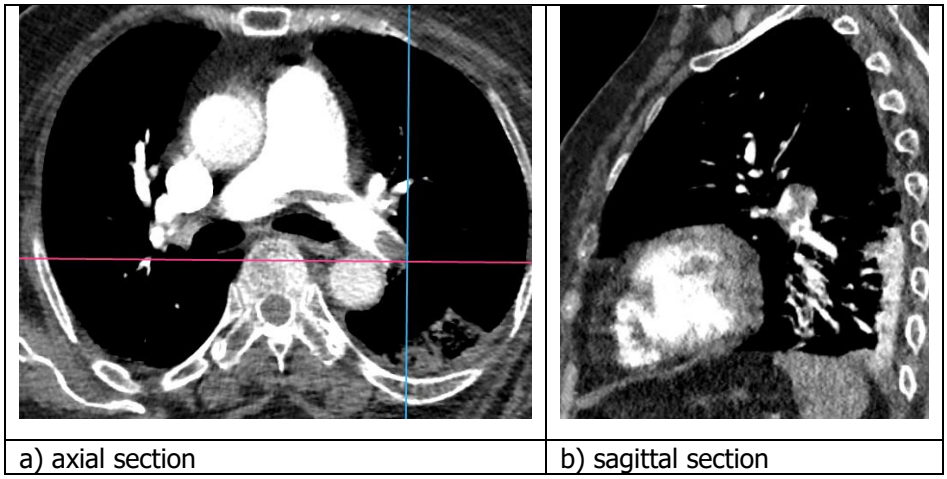
On the left, thrombi are not visualized in the upper lobar segmental branches. In the basal segmental branches of the pulmonary artery on the left, thrombi are determined, causing occlusion and subocclusion (Fig. 13).



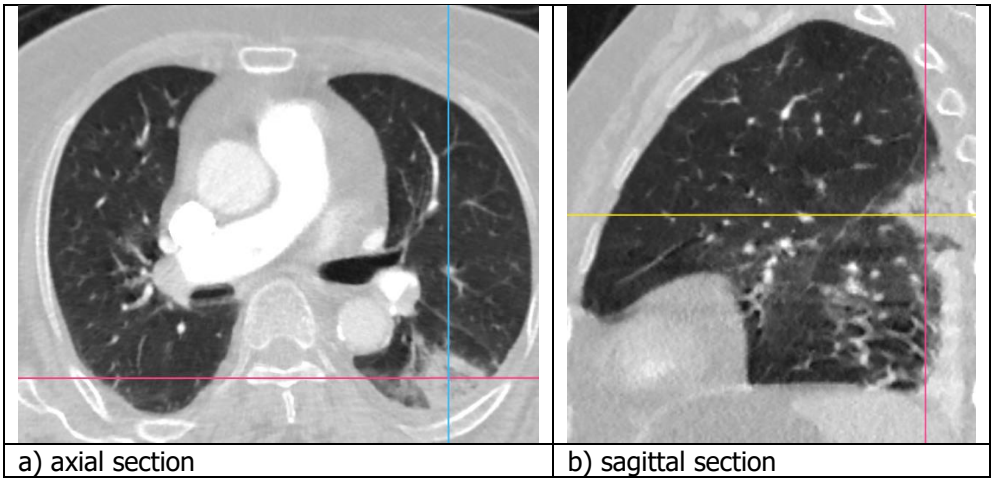
a) axial section | b) sagittal section

Fig. 13 Thrombi in the basal segmental branches on the left

Thus, in all patients of the second group, numerous contrast defects are determined in the branches of the right and left pulmonary arteries, which corresponds to acute thromboembolism.

In the lung parenchyma of all patients of the second group, changes were detected. In all patients, subpleural zones of lung parenchyma compaction are determined by the type of alveolar consolidation, with a wide base adjacent to the pleura. Subpleural zones of compaction are localized chaotically, in five patients (50%) in the lower lobe on the left, in three patients (30%) in the lower lobe on the right, in two patients (20%) in the lower lobe on both sides. Air lumens of the bronchi are visualized against the background of compactions. The zones of compaction with a wide base are adjacent to the pleura. (Fig. 14) In all patients of the second group, effusion was determined, on the right with a thickness of up to 0.8 ± 0.05 cm, on the left 1.0 ± 0.04 cm, the contents with a density of + 20 + 22 HU.

плотностью +20+22 HU.



a) axial section | b) sagittal section

Fig. 14. In the lower lobe of the left lung, there is a compaction of the parenchyma according to the alveolar consolidation type, against which an "air bronchogram" can be observed.

CONCLUSIONS.

1. Thus, all patients in the first and second groups of computed tomography were diagnosed with all the signs of acute pulmonary embolism.
2. In all patients of the first group, except for signs of pulmonary hypertension, no changes in the lungs were detected.

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3. In all patients of the second group, changes in the lungs were detected - subpleural zones of compaction of the lung tissue according to the alveolar consolidation type, against which an "air bronchogram" can be observed. Also, all patients of the second group had effusion in the right pleural cavity.

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