CLINICAL AND X-RAY PECULIARITIES OF THE COURSE OF CHRONIC OBSTRUCTIVE PULMONARY DISEASE IN COMBINATION WITH DIABETES MELLITUS

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Abstract.

At present, the important role of comorbid diseases, including diabetes mellitus, in the course of COPD has been determined. Concomitant diabetes mellitus accelerates the progression of ventilation disorders and worsens the prognosis, increasing the risk of mortality from COPD. Diabetes mellitus is associated with COPD from 2 to 16%. Potential mechanisms underlying the high incidence of the combined course of COPD and type 2 diabetes mellitus include: chronic systemic inflammation, oxidative stress, and chronic hyperglycemia.

Purpose. determination of clinical, functional and radiological features of COPD in diabetes mellitus.

Materials and methods. We examined 75 patients and studied the features of the course of COPD in combination with diabetes mellitus in comparison with the results of examining patients with COPD and patients with diabetes mellitus by X-ray and MSCT.

Results. Patients with COPD in combination with diabetes mellitus are characterized by more pronounced respiratory failure and chronic cor pulmonale, frequent exacerbations and more pronounced hypoxemia in comparison with patients with COPD. Standard radiography did not reveal pronounced differences between the examined groups of patients with COPD. COPD is formed as a result of damage to the small bronchi, which determines

the characteristic clinical and radiological symptom complex. In the structure of COPD, there is a pulmonary component and systemic manifestations that aggravate the disease. The manifestations of diabetes mellitus are based on micro- and macroangiopathies that affect pulmonary microcirculation.

Conclusions. Diagnostically significant for COPD during MSCT is a symptom of expiratory "air trap", combined with expansion and deformation of the bronchi, up to bronchioectasis. At MSCT in patients with COPD and diabetes mellitus, pathognomic changes characterizing microangiopathy: dilated parenchymal vessels, focal-like shadows of vascular origin with a diameter of 2-5 mm, a clear-cut shape of the vessels, which are considered as a consequence of specific microangiopathy and fibrotic changes in COPD.

Key words: chronic obstructive pulmonary disease, diabetes mellitus, X-ray, MSCT.

Introduction

One of the primary problems of medicine today is chronic obstructive pulmonary disease (COPD). COPD is a systemic disease and as the pathopulmonological process progresses, along with lung damage, pulmonary hypertension, chronic pulmonary heart and significant systemic effects develop cachexia, skeletal muscle atrophy, osteoporosis, anemia, and an increased risk of cardiovascular diseases[16,18].

According to the statistics, COPD occurs in men-9.34:1000, among women-7.33:1000. People over 40 years of age are predominate. The prevalence of COPD in men over 45 years of age in Europe ranges from 8.4 to 13.1%. The reasons for the higher prevalence of COPD and damage from this pathopysiological process in the last decade consider the impact of risk factors and ageing population.

According to the definition of COPD included in the main document on COPD management [13], the huge role of concomitant diseases in increasing

the severity of COPD, affecting the quality of life, prognosis and survival is emphasized. According to the American thoracic society, about 15% of COPD cases are associated with occupational exposures [8,12,7]. It should be noted that COPD patients have significant comorbidity. In modern clinical practice, it is increasingly possible to meet patients who have a combination of type 2 diabetes, coronary heart disease, arterial hypertension and COPD [12].

According to various authors, diabetes mellitus is combined with COPD from 2 to 16% [6]. Pathogenetic mechanisms underlying the high frequency of combined COPD and type 2 diabetes are being actively studied. Potential mechanisms include: chronic systemic inflammation, oxidative stress, and chronic hyperglycemia [1,2,11].

To date, there is a continuing trend of increasing mortality from COPD, which is a worrying fact. In recent years, COPD has been associated with psychological and psychiatric problems. According to many researchers, the current costs in the health and social security system in compensating for the damage caused by COPD to the health of the population are 30 to 40 times higher than the costs of preventing them. Such patients need to be hospitalized, often in intensive care units, and use more powerful and expensive antibiotics [9]. According to the documents of the European respiratory society, only 25% of cases are diagnosed in a timely manner [17].

COPD is on the 6th place among the leading causes of death in the world, 5th in Europe and 4th in the USA. The increase in mortality is associated with Smoking and an aging population. Mortality is significantly higher in patients with COPD who were hospitalized with an exacerbation due to insufficient glycemic control.

Special attention is paid to the combination of COPD and type 2 diabetes mellitus, since both diseases belong to the second half of life, and according to a number of authors, diabetes mellitus is combined with COPD in 2.0-16.0% of cases [5,6,10]. Concomitant diabetes accelerates the progression of ventilation,

disorders and worsens the prognosis, increasing the risk of death from COPD [4,14,15]

There are 195 million people with diabetes worldwide. The share of type 2 diabetes in the structure of diabetes incidence in adults exceeds 90%. In a typical case, type 2 diabetes develops in middle age. About 50% of cases of diabetes remain unrecognized [5.10].

In General, an important role of comorbid diseases, including diabetes, in the course and outcomes of COPD has been identified. At the same time, the features of x-ray diagnostics of COPD in diabetes mellitus are not sufficiently studied.

Taking into account the above, the purpose of our study is to determine the clinical, functional and radiological features of COPD in diabetes mellitus, and the possibility of predicting its development.

Material and methods of research. The object of the study was 75 patients. A random sample was made from an array of patients with established diagnoses of " Chronic obstructive pulmonary disease and "diabetes Mellitus". The inclusion criteria were the presence of chronic obstructive pulmonary disease in accordance with GOLD, as well as the presence of diabetes mellitus in accordance with the algorithms of specialized medical care for patients with diabetes.

The control group was represented by 12 healthy individuals who did not have lung diseases and diabetes at the age of 20 - 40 years: men - 6, women - 4.

To study the features of COPD in combination with diabetes, all patients were divided into 3 groups. The main group I consisted of patients with COPD combined with diabetes. To compare the results, we examined patients with COPD who made up group II and patients with diabetes who made up group III (table 1).

Table 1.

Nosological and group characteristics of patients

Groups patients	**Type of diseases**	**Abs. number**	**%**
I	COPD in combination with diabetes	40	53.7
II	COPD	20	26.7
III	SD	15	20.0
Total		75	100.0

The study of patients with COPD was conducted upon admission to the clinic after stabilization of the condition. Patients with diabetes were examined at admission to the Department or on an outpatient basis.

Among the examined patients with COPD and diabetes, there were 46 men and 29 women (table 2). The comparison groups I and II were dominated by men, which is typical for patients with COPD. Group III was dominated by women. The age of patients in the main group varied from 25 to 70 years. Patients aged 50 to 65 years prevailed.

Table 2

Distribution of patients by gender

Gender	**Patients with**					
	I		II		III	
	abs.	%	abs.	%	abs.	%
Male	27	67.5	14	70.0	5	33.3
Women	13	32.5	6	30.0	10	66.7
Total	40	100.0	20	100.0	15	100.0

Patients of the main group were more likely to have concomitant diseases of the circulatory system. Arterial hypertension and coronary disease prevailed in patients with COPD in combination with diabetes mellitus.

Traditional radiography and multispiral computer tomography (MSCT), which was performed on a Light Speed 16 tomograph (General Electric Medical Systems) using high-resolution computer tomography (KTBP) parameters, were used as x-ray morphological methods. The scanning step is 1.3 mm, with reconstruction of sections with a thickness of 1 mm or less.

Measurement of the diameter of the trunk of the pulmonary artery, right and left pulmonary arteries (mm) was performed using computed tomography using a standard technique at the level of tracheal bifurcation. To assess the diameter of the pulmonary arteries and the pulmonary trunk during CTVR, the results of a study of individuals from the control group were used as a comparison.

Research result. All the examined patients of groups I and II had various degrees of severity of leading complaints of COPD patients (shortness of breath, cough, sputum discharge). The frequency of COPD exacerbations 3 or more times a year in group I was observed in 16 (40.0%), in group II - in 3 (15.0%) patients. That is, more frequent exacerbations of COPD were observed in the COPD group with concomitant diabetes. It should be noted that the increased purulent nature of sputum was one of the signs of severity of exacerbation. In the examined patients, we detected a mild severity of COPD exacerbation in 8 (20.0%) patients of the main group, and in 5 (25.0%) patients of group II (table 3). The average severity of COPD exacerbation was detected in 27 (67.5%) patients of the main group and in 13 (65.0%) patients from group II. Severe severity of COPD exacerbation was determined in 5 patients (12.5%) in group I, and in group II - in 2 (10.0%) patients.

Table 3.

Characteristics of the severity of COPD exacerbation severity of exacerbation

Severity of exacerbation	group I		group II	
	abs.	%	abs.	%
Light	8	20.0	5	25.0
Average	27	67.5	13	65.0
Heavy	5	12.5	2	10.0
Total	40	100.0	20	100.0

As can be seen from the table, depending on the severity of COPD exacerbation, the data of group I (main) and group II did not differ in General. When analyzing risk factors, it was found that COPD patients smoked more often, followed by patients with COPD in combination with diabetes mellitus and patients with diabetes mellitus. The duration of COPD was 7.2±0.55 years in group I and 8.2±1.01 years in group II. The duration of diabetes mellitus in patients of the main (I) group was 4.6±1.15 years, in group III - 10.3±0.62 years.

Therefore, if the severity of COPD is comparable in these groups, we can assume an adverse effect of diabetes on the development of COPD. Especially, considering that diabetes mellitus preceded COPD or was detected simultaneously with COPD in 14 (35%) patients of the main group. This suggests the possibility of an adverse interaction between diabetes and COPD.

Participation in breathing of auxiliary muscles was observed in 14 (35%) patients of the main group, in group II-in 2 (10%) patients. That is, the work of breathing in patients with COPD in combination with diabetes was higher. In addition, severe shortness of breath and cough were more common in the main group.

The chest pain was less frequently observed in patients with COPD combined with diabetes mellitus. Most likely, the decrease in pain sensitivity is associated with patients with diabetic neuropathy.

The study of the frequency of occurrence of clinical forms of COPD revealed the following features. Thus, emphysematous type of COPD was more common in group II. In the main group, patients with mixed type of COPD prevailed (table 4).

Table 4.

Characteristics of COPD types

Characteristics	Patient groups			
	I group		II group	
	abs. number	%	abs. number	%
Bronchitis	8	20.0	4	20.0
Emphysematous	3	7.5	9	45.0
Mixed	29	72.5	7	35.0
Total	40	100	20	100

It is known that the emphysematous form is prognostically more favorable, since decompensation of the pulmonary heart occurs at a later stage compared to the bronchitic form of COPD.

The study of the results of the study of laboratory blood parameters showed that group I and II did not differ in terms of the General blood test, the levels of total blood protein, and fibrinogen. Blood glucose levels were elevated in the COPD group with concomitant diabetes mellitus (7.1±0.33 mmol/l) relative to patients with COPD (4.3±0.12 mmol/l). Fasting blood glucose levels in patients III were on average 12.5±0.99 mmol/l.

Patients of the main group and comparison groups, in total, did not differ in the level of hemoglobin. The prevailing percentage of observations was

characterized by a decrease in its indicators, i.e. anemia was noted, which contradicted the literature data [4,7], indicating that the blood of patients with COPD, especially in combination with diabetes, showed signs of polycythemia. Anemia (HB<110 g/l) occurred with the same frequency in the main group and comparison groups (II, III).

Comparison of COPD stage indicators showed that in the main (I) group, the mild stage of COPD was determined in 6 (15.0%) patients, the moderate stage of COPD – in 10 (25.0%), the severe stage of COPD –in 20 (50.0%) and the very severe stage of COPD –in 4 (10.0%) patients (table 5). The distribution was similar in group II. Consequently, the main group and comparison group I were randomized according to the stage of COPD.

Table 5.

Distribution of patients depending on the stage of COPD

Stages of the course of COPD	Groups of patients with COPD			
	I group		II group	
	abs.	%	abs.	%
Stage I (light)	6	15.0	3	15.0
Stage II (moderate)	10	25.0	5	25.0
Stage III (severe)	20	50,0	9	45,0
Stage IV (very severe)	4	10.0	3	15.0
Total	40	100.0	20	100.0

According to the clinical study, respiratory failure I was detected in 5 (12.5%) patients of group I, and in 8 (20.0%) patients of group II (table 6). Respiratory insufficiency of the II degree was detected in 20 (50.0%) patients of the I group and 9 (45.0 %) patients of the II group. Respiratory failure of the III degree was noted in 9 (22.5%) patients of the main group and in 8 (20.0%)

of the II group. That is, according to the clinical examination, respiratory failure developed with the same frequency in both groups.

Table 6.

Clinical characteristics of respiratory failure

Respiratory degree insufficiency	Groups of patients			
	I group		II group	
	abs.	%	abs.	%
I	9	22.5	4	20.0
II	20	50,0	9	45,0
III	9	22,5	4	20,0
Norm	2	5.0	3	15.0
Total	40	100.0	20	100.0

The study of the features of respiratory failure depending on Ra02 showed that Ra02 60-79 mm was regarded as I degree of severity, 40-59 mm-as II degree of severity, < 40 mm - as III degree of severity. Respiratory failure was detected in 39 (97.5%) patients of the main (I) group, which was 22.5% more often than in group II - in 15 (75.0%) (table 7). Thus, respiratory failure of the first degree was detected in 24 (60.0%) patients of the main group and 12 (60.0%) patients from the second group. Respiratory failure of the II degree was detected in 12 (30.0%) patients of the main group, which was 20% more often than in the II group-in 2 (10.0%) patients. Respiratory insufficiency III was detected in 3 (7.5%) patients of the main group and in 1 (5.0%) patient from group II. Consequently, respiratory failure depending on Ra02 was more common in patients with COPD in combination with diabetes mellitus.

Table 7.

Characteristics of respiratory failure depending on Ra02

The degree of respiratory failure	Patient groups			
	group I		group II	
	abs.	%	abs.	%
I	24	60.0	12	60.0
II	12	30,0	2	10,0
III	3	7,5	1	5,0
Norm	1	2.5	5	25.0
Total	40	100.0	20	100.0

Comparative analysis of ECG data showed that in the main group, 13 (32.5%) patients were more likely to have right ventricular hypertrophy, in group II-in 3 (15.0%) patients. Metabolic changes were more pronounced in the main group. In group III, left ventricular hypertrophy was detected in 2 (13.3%), metabolic changes in the myocardium in 4 (26.7%), and extrasystole in 1 (6.7%) diabetic patient. As can be seen, patients with concomitant diabetes were more likely to have right ventricular hypertrophy and metabolic changes in the myocardium.

Evaluation of the results of x-ray examination did not reveal significant differences in the assessment of lung parenchyma in groups I and II of the examined patients (table 8).

table 8.

Frequency of detection of various radiological signs of damage in COPD

Radiological changes	Patient groups			
	group I		group II	
	abs.	abs.	abs.	abs.

Emphysema	12	30.0	8	40.0
Strengthening and deformation of the pulmonary pattern by type of pneumosclerosis	16	40.0	7	35.0
Thickening of the bronchial walls	34	85.0	18	90.0
Indistinct contours of blood vessels, bronchi and lung roots	16	40.0	7	35.0
"Sabre-like" shape of the trachea	7	17,5	3	15,0
Perivascular and peribronchial "couplings" around vessels and bronchi	5	12,5	3	15,0
Flattening of the diaphragm domes and smoothness of the pleural sinuses	6	15.0	3	15.0
Thickening of the interlobular pleura	6	15.0	2	10.0
Curley Lines	2	5.0	1	5.0
Calcinates	5	12.5	3	15.0

All x-rays of the lungs were performed at the height of inspiration, with delayed breathing. The most characteristic radiological signs of obstruction in the lungs were: increased airiness of the lung tissue in the exhalation phase due to excessive air content in the respiratory parts of the lungs (in group I 30%, in group II 40%); flattening of the diaphragm domes and smoothness of the pleural sinuses (15% in both groups); vertical position of the heart axis on the chest x-ray in a direct projection (a "small" heart shadow or a so-called "drip" heart); the" sabre-shaped " shape of the trachea is the predominance of the sagittal (anteroposterior) size of the trachea, determined by the lateral

radiograph, over the transverse size, measured by the radiograph in direct projection (17.5% and 15%, respectively).

In addition, when the review radiography of the chest in patients with COPD were identified: strengthening and deformation of lung pattern in hilar and nudepregnancy lung type pulmonary fibrosis (40% and 35% respectively); the thickening of the walls of lobar and segmental bronchi (85% and 90%, respectively); blurring of blood vessels, bronchi, and the "blurred" structure of the roots of the lungs.

Assessment of the mediastinal shadow during radiography in patients with COPD revealed its own characteristics. Due to right ventricular overload in COPD, the examined patients showed some changes in the configuration of the mediastinal shadow on the x-ray. Due to increased pressure in the small circle of blood circulation, large branches and the main trunk of the pulmonary artery expand, respectively, the second arc of the left contour of the cardiovascular shadow lengthens and becomes more convex. As the load increases, the right ventricle expands, so the lower arc of the right contour shifts to the right, and the atriovasal angle moves up. Changes in the heart caused by a chronic pulmonary process in the lungs, as is known, received the General name "pulmonary heart" [3]. In patients with COPD, included in groups I and II, the prevailing percentage of our observations showed the configuration of the "pulmonary heart" ("cor pulmonalis").

Similar clinical symptoms in patients with various pathological changes in the lungs created significant difficulties in differential diagnosis of COPD with chronic bronchitis and emphysema, as well as in assessing the severity of COPD. This circumstance served as the basis for the study of additional possibilities of computed tomography (CT) in the diagnosis of COPD in order to improve the effectiveness of radiation research methods.

The results of a detailed analysis of x-ray morphological changes in patients with COPD and diabetes mellitus using multispiral computed

tomography are presented in tables 9 and 10. All analyzed data was divided into two groups. The changes included in group 1 included signs that were characteristic of COPD and the transferred inflammatory process in the lungs: thickened and deformed bronchi, emphysema, bronchiectasis, thickening of the pleura and pleural adhesions, intrapulmonary calcifications. The changes included in group 2 included signs of microangiopathy: expanded parenchymal vessels, including focal shadows of vascular origin, 2-5 mm in size; clear-cut vasodilation.

MSCT of the lungs using functional respiratory tests (inhalation phase and exhalation phase) allowed detecting early signs of COPD development already at the preclinical stage of the disease, even if the external respiratory function indicators were normal. When using CT in the expiratory phase, the predominant number of patients with COPD in groups I and II revealed the presence of air " traps "in the lungs, the" tree with kidneys " symptom, indicating pathological changes at the level of small bronchi.

Emphysema and bronchiectasis were found in groups I and II and were absent in group III patients (table 9). Pleural thickening, pleural adhesions, and calcifications were detected in all three groups. Thickened and deformed bronchi were detected in 30 (75.0%) patients of the main group and 18 (90.0%) patients of group II. In group III, thickening and deformity of the bronchi occurred in 2 (13.3%) patients, which was significantly less common in comparison with groups I and II. Therefore, this trait was typical for COPD patients with and without diabetes mellitus.

CT-symptoms of changes in the pulmonary parenchyma, such as expiratory air "trap", "ring" symptom (presence of bronchiectasis), "tree with kidneys" symptom (bronchioles lesion) they were pathognomic for patients with COPD from groups I and II.

Table 9.

CT-symptoms characteristic of COPD and previous pneumonia

Signs Of group	Patients with					
	I		II		III	
	abs.	%	abs.	%	abs.	%
thickened and deformed bronchi	30	75.0	19	95.0	2	13.3
Emphysema	38	95.0	20	100	0	0.0
Bronchiectasis	28	70.0	1	75.0	0	0,0
Pleural thickening and pleural adhesions	22	55.0	11	55.0	3	20.0
Calcinates	24	60.0	10	50.0	5	33.3
Expiratory air "trap"	37	92.5	17	85.0	-	-
ring" Symptom (presence of broichoectasis)	12	30.0	7	35.0	-	-
Symptom of " tree with kidneys "(bronchioles)	29	72.5	13	65.0	-	-

Expanded parenchymal vessels and focal shadows of vascular origin with a diameter of 2-5 mm were equally common in all compared groups (table 10). However, in patients with COPD, these signs were combined with thickening and deformity of the bronchi, bronchiectasis, emphysema and were a consequence of COPD and the transferred inflammatory process. In group III patients, thickened and deformed bronchi, emphysema, and bronchiectasis were not found.

Table 10.

CT-symptoms characteristic of microangiopathy

Signs Of group	Patients with					
	I		II		III	
	abs.	%	abs.	%	abs.	%
The dilated vessels of the parenchyma	38	95.0	14	70.0	14	93.3
Hearth-like shadows (2-5mm)	28	70.0	12	60.0	13	86.7
Clear shape of vessels	38	95.0	8	40.0	14	93.3

Consequently, in patients with diabetes mellitus, dilation of parenchymal vessels and vascular foci-like shadows of small diameter can be considered as a manifestation of diabetic angiopathy. In patients with COPD, this sign is due to the development of fibrosis.

Clear-cut vascular shape was detected in 38 (95.0%) patients of group I and 8 (40.0%) patients of group II. In group III, this sign was detected in 14 (93.3%) patients, which was 53.3% more often than in group II. Consequently, the clear shape of the vessels was characteristic of COPD patients in combination with diabetes mellitus and diabetic patients.

As you can see, the clear shape of blood vessels is more common in patients with COPD in combination with diabetes in comparison with patients with COPD, which indicates an adverse effect of diabetes on the state of microcirculation in COPD.

If the diameters of the trunk of the pulmonary artery, right and left pulmonary arteries were slightly increased in COPD, then in patients with diabetes mellitus (group III), according to CTVR data, they did not exceed the corresponding indicators of the control group (table 11), which indicates that

there are no changes in the diameter of the trunk of the pulmonary artery, its right and left branches in patients with diabetes.

Table 11.

Diameter of the trunk of the pulmonary artery, right and left pulmonary arteries in patients with diabetes in comparison with the control group

Pulmonary artery diameter	Patient groups	
	Patients with diabetes	Control
Barrel	23.4±2.30	27.1±2.10
Right	20.9±1.41	23.5±1.11
Left	19.0±1.31	21.1±1.01

Discussion of the research results. In General, studying the main manifestations of respiratory failure in patients of the main (I) and II groups, we found that the frequency of cyanosis did not differ in group I and II. Participation in breathing of auxiliary muscles was more often observed in the main group. Respiratory failure depending on Ra02 was detected in 39 (97.5%) patients of the main group and 15 (75%) patients of group II. Dyspnea in patients of the main group was more pronounced than in the comparison group.

Consequently, in General, respiratory failure detected by clinical and laboratory - instrumental methods was more pronounced in the main group than in the second group. The severity of dyspnea did not depend on the stage of COPD and prevailed in the main group.

As can be seen, when managing patients with COPD in combination with diabetes mellitus, attention should be paid to more pronounced clinical manifestations of respiratory failure (shortness of breath, participation in breathing of auxiliary muscles, hypoxemia), especially in patients with stage III COPD.

Summarizing our discussion, we can say that in the structure of COPD, there is a pulmonary component and systemic manifestations that can aggravate the disease. Extrapulmonary effects of COPD include diabetes mellitus. The manifestations of diabetes mellitus are based on micro-and macroangiopathies that affect the pulmonary microcirculation.

Standard x-ray examination revealed no significant differences between the examined groups of patients with COPD. The variety of different bronchopulmonary diseases with similar clinical symptoms makes it extremely difficult to conduct a differential diagnosis of COPD. In this regard, there is a need to identify objective diagnostic criteria that can be obtained using x-ray and computed tomography studies.

COPD is formed as a result of damage to the small bronchi, which determines the characteristic clinical and radiological symptom complex, and makes it possible to differentiate this disease with emphysema and chronic bronchitis.

To diagnose microvessel damage in patients with COPD and diabetes mellitus, to predict the course of non-specific lung diseases, based on the specific results of the study, it is advisable to conduct multispiral computed tomography with the detection of expanded parenchymal vessels, foci-like shadows of vascular Genesis with a diameter of 2-5 mm, and a clear shape of the vessels. Signs of the development of macro - and microangiopathy in patients with COPD in combination with diabetes mellitus are hypoxemia. Microangiopathy of the lungs probably plays a crucial role in unfavorable course of COPD in patients with diabetes mellitus.

Conclusions. 1. patients with COPD in combination with diabetes mellitus are characterized by more pronounced respiratory failure and chronic pulmonary heart disease, frequent exacerbations and more pronounced hypoxemia in comparison with patients with COPD.

2. Assessment of the degree of ventilation in the lungs in patients with COPD should be carried out in the conditions of CT performed in the inhalation and exhalation phases. Diagnostically significant for COPD during computed tomography is the symptom of an expiratory "air trap", combined with the expansion and deformation of the bronchi of various calibers, up to broncho - and bronchioloectasis.

3. MSCT in patients with COPD and diabetes mellitus pathognomic changes that characterize microangiopathy in: expanded parenchymal vessels, focal shadows of vascular Genesis with a diameter of 2-5 mm, a clear shape of the vessels. These changes can be considered as a consequence of specific microangiopathy and fibrotic changes characteristic of COPD.

4. the Clear shape of microvessels is a specific x-ray morphological feature in patients with COPD in combination with diabetes mellitus and diabetes mellitus itself.

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