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FEATURES OF LIPIDS PROFILE AND CARDIOHEMODINAMIC IN CHRONIC OBSTRUCTIVE LUNG DISEASE AND COMORBIDITIES

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ОСОБЕННОСТИ ЛИПИДНОГО ПРОФИЛЯ И КАРДИОГЕМОДИНАМИКИ ПРИ ХРОНИЧЕСКОЙ ОБСТРУКТИВНОЙ БОЛЕЗНИ ЛЕГКИХ И КОМОРБИДНОСТИ

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ОСОБЛИВОСТІ ЛІПІДНОГО ПРОФІЛЮ ТА КАРДІОГЕМОДИНАМІКИ ПРИ ХРОНІЧНОМУ ОБСТРУКТИВНОМУ ЗАХВОРЮВАННІ ЛЕГЕНЬ ТА КОМОРБІДНОСТІ

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Abstract.

Chronic obstructive pulmonary disease is a classic example of a comorbid condition characterized by a combination with coronary artery disease, arterial hypertension, and metabolic syndrome.

The aim of the study was to investigate the features of the interrelationships between the lipid spectrum and echocardiography parameters in patients with chronic obstructive pulmonary disease, coronary artery disease and arterial hypertension.

Material and methods. 35 patients with chronic obstructive pulmonary disease and comorbidity (57.14% male, 42.86% female) were examined. The average age was 57.0, the middle duration of the disease was 10.02 [5.0–15.0] years. 23 patients had comorbidity with coronary artery disease and arterial hypertension, 11 patients had diabetes mellitus type 2, 8 patients had coronary artery disease (cardiosclerosis, angina pectoris), 4 patients had 2nd stage of arterial hypertension.

Results and discussion. Patients were divided into 3 groups: group B (12 patients), group C (14 patients), group D (9 patients). In group B, 3 positive significant correlations of aortic diameter with total cholesterol, low-density lipoproteins, very low-density lipoproteins were revealed. In group C, there are 2 correlations with systolic pressure in pulmonary artery - positive with low-density lipoproteins and negative with high-density lipoproteins, and negative association between triglycerides and left ventricular diastolic volume. In group D, the number of correlations increases to 6: correlations of low-density lipoproteins with right atrium and right ventricle appear, as well as with left ventricular parameters. It was noted that the increase of severity of chronic obstructive pulmonary disease and comorbidity with arterial hypertension does not lead to increasing of the correlations number, but coronary artery disease increases the number of correlations by half.

Conclusions: As the severity of the chronic obstructive pulmonary disease progresses, the number of correlations between the lipid spectrum and the myocardium structural and functional condition increases according to the echocardiography data.

Keywords: comorbidity, chronic obstructive pulmonary disease, echocardiography

Резюме.

Хронічне обструктивне захворювання легень є класичним прикладом коморбідного стану, що характеризується поєднанням ішемічною хворобою серця, артеріальною гіпертензією та метаболічним синдромом.

Метою дослідження було вивчення особливостей взаємозв'язку між параметрами ліпідного спектра та ехокардіоскопії у пацієнтів з хронічним

обструктивним захворюванням легень, ішемічною хворобою серця та артеріальною гіпертензією.

Матеріалий методи. Обстежено 35 пацієнтів з хронічним обструктивним захворюванням легень і коморбідною патологією (57,14% чоловіків, 42,86% жінок). Середній вік становив 57,0, середня тривалість захворювання становила 10,02 [5,0-15,0] років. 23 пацієнти мали комрбідність з ішемічною хворобою серця та артеріальною гіпертензією, 11 пацієнтів мали цукровий діабет 2 типу, 8 пацієнтів хворі на ішемічну хворобу серця (кардіосклероз, стенокардія), 4 пацієнтів мали артеріальну гіпертензію.

Результати і обговорення. Пацієнти були розділені на 3 групи: група В (12 пацієнтів), група С (14 пацієнтів), група Д (9 пацієнтів). У групі В виявлено 3 позитивних, вірогідних кореляцій діаметра аорти з загальним холестерином, ліпопротеїдами низької щільності, ліпопротеїдами дуже низької щільності. У групі С є 2 кореляції з середнім тиском в легеневій артерії - позитивними з ліпопротеїнами низької щільності та негативними з ліпопротеїнами високої щільності, а також негативний зв'язок між тригліцеридами та діастолічним об'ємом лівого шлуночка. У групі D кількість кореляцій збільшується до 6: з'являються кореляції ліпопротеїнів низької щільності з параметрами правого передсердя та шлуночка, а також з параметрами лівого шлуночка. Було зазначено, що кількість кореляцій зростає удвічі за умови коморбідності з ішемічною хворобою серця.

Висновки. Прогресування хронічного обструктивного захворювання легень та поєднання її з коморбідними станами призводить до збільшення кількості кореляційних зв'язків між ліпідним спектром та показниками ехокардіоскопії, особливо при коморбідності з ішемічною хворобою серця.

Ключові слова: коморбідність, хронічне обструктивне захворювання легень, ехокардіографія

Резюме.

Хроническая обструктивная болезнь легких является классическим примером коморбидного состояния, ассоциирующегося с ишемической болезнью сердца, артериальной гипертензией и метаболическим синдромом.

Целью исследования было изучение особенностей взаимосвязей между липидным спектром и параметрами эхокардиоскопии у пациентов с хронической обструктивной болезнью легких, ишемической болезнью сердца и артериальной гипертензией.

Материал и методы. Обследовано 35 пациентов с хронической обструктивной болезнью легких и сопутствующей патологией (57,14% мужчин, 42,86% женщин).

Средний возраст составил 57,0, средняя продолжительность заболевания - 10,02 [5,0-15,0] лет. У 23 пациентов выявлена корбидность с ишемической болезнью сердца и артериальной гипертензией, у 11 пациентов был сахарный диабет 2 типа, у 8 пациентов была ишемическая болезнь сердца (кардиосклероз, стенокардия), у 4 пациентов была артериальная гипертензия.

Результаты и обсуждение. Пациенты были разделены на 3 группы: группа B (12 пациентов), группа C (14 пациентов), группа D (9 пациентов). В группе B выявлены 3 положительные достоверные корреляции диаметра аорты с общим холестерином, липопротеины низкой плотности, липопротеины с очень низкой плотностью. В группе C имеются 2 корреляции с среднимдавлением в легочнойартерии - положительные с липопротеинами низкой плотности и отрицательные с липопротеинами высокой плотности, а также отрицательная связь между триглицеридами и диастолическим объемом левого желудочка. В группе D число корреляций увеличивается до 6: появляются корреляции липопротеинов низкой плотности с параметрами правых предсердия и желудочка, а также с параметрами левого желудочка. Было отмечено, что при коморбидности хронической обструктивной болезни легких с ишемической болезнью сердца количесто кореляций увеличивается в два раза.

Выводы. По мере прогрессирования тяжести хронической обструктивной болезни легких количество корреляций между липидным спектром и структурно-функциональным состоянием миокарда увеличивается.

Ключевые слова: коморбидность, хроническая обструктивная болезнь легких, эхокардиография

“The mind that opens to a new idea
never returns to its original size.”
Albert Einstein

Chronic obstructive pulmonary disease (COPD) is one of the current problems of contemporary medicine due to the rapid increase in morbidity, disability and mortality rates (more than 30% in 10 years), and high treatment costs and decline in the patient’s quality of life [1-5]. COPD will have taken the third place among the mortality causes by 2030 according to WHO [2, 6].

At the end of the twentieth century, the number of patients with persistent combinations of various diseases rapidly had increased. Those combinations were called comorbidity [7, 8]. Comorbidity has become the main informational source for studying the general mechanisms of the various diseases pathogenesis [9].

The prevalence of concomitant diseases is higher in COPD than in whole population [10-12]. It attests that COPD is a classic example of a comorbid condition which is characterized by a combination with coronary artery disease (CAD), arterial hypertension (AH), and metabolic syndrome.

In recent years there has been a growing interest in studies of structural and functional disorders of the myocardium using of echocardiography in COPD and comorbidity AH and CAD [3, 13-16]. The possibility of early diagnosis of heart failure, both ventricles diastolic dysfunction, using echocardiography is noted [17, 18]. However, a consensus about the nature of the violations of the right and left ventricles of the heart and their relationship in COPD is not found [19].

The results of studying the structural and functional parameters of the myocardium in COPD using echocardiography testify the effect of pulmonary hypertension influence not only on the right ventricle (RV), but also on the left ventricle (LV). It is so-called "Interventricular interaction" which is caused by the anatomical and electrophysiological connections of both ventricles.

Cardiac remodeling in COPD and cardiovascular comorbidity (CAD and AH) is recognized as a universal process based on chronic systemic inflammation [11, 12, 20]. COPD is one of the most frequent causes of both ventricles diastolic dysfunction [15].

The achievements of modern network science in the field of molecular biology, genome and molecular genetics made it possible to study the causes of comorbidity at the organism, cellular, molecular, genetic levels. As well they permit to show the importance of cellular networks between these components and to allocate a new discipline, network medicine representing a perspective approach to understanding diseases from a network point of view, reclassification of complicated syndromological diseases [21-24]. These achievements allow selecting a special group of syntropic diseases with similar etiological and pathogenetic mechanisms. The similarity between these diseases is determined by the general predisposition genes. The modification of universal network processes at the genomic, molecular and cellular levels leads to development of syntropic diseases. They are manifested at the organ and organism levels by systemic chronic inflammation of target organs. This creates new properties of various systems (emergence), which are difficult to explain using only the signs of individual diseases and their components.

It is believed that network approaches will be used to integrate several genotypes to study the pathogenesis of the disease and to resolve the problem of synthropy and comorbidity in further studies of COPD genetics.

All of the above emphasizes the urgency of studying the problems of pathogenesis, comorbidity, synthropy, diagnosis, and treatment of COPD.

The aim: to investigate the relationships features between the lipid and echocardiography parameters in COPD in frame of CAD and AH comorbidity.

Materials and methods: The study design was created according to the principle of integrativity. This article presents the results of a study of lipid spectrum parameters (total cholesterol, triglycerides (TG), high density lipoproteins (HDL), low density lipoproteins (LDL), very low density lipoproteins (VLDL), atherogenicity coefficient (CA) and their correlation with echocardiography parameters. The diagnosis of COPD was in accordance with the criteria which were represented in the report of the working group GOLD (2018). The lung function was studied by using a computer spirograph 'Spirokom'. The ESC recommendations (2013) were used to verify the diagnosis of AH and CAD.

The serum level of total cholesterol, TG, HDL, LDL and VLDL was determined by a standard biochemical method, CA was calculated.

The study of the structural and functional state of the heart was carried out with the help of echocardiography using the standard method with determination of the LV end-diastolic volume (LV EDV), left ventricle end-diastolic dimensions (LV EDD), posterior wall thickness in diastole (PWED), interventricular septum thickness (IVS thickness), LV mass index (LV MI), ejection fraction (EF), pulmonary artery systolic pressure (PASP), aortic root diameter (ARD), RV end-diastolic dimensions (RV EDD) using the apparatus of ultrasound transthoracic examination of the heart Philips HDI - 11.

35 COPD patients with CAD and AH comorbidity were examined, 57.14% of them were men and 42.86% - women. The average age was 57.0 [54.0-67.0] years and the disease duration was 10.02 [5.0-15,0] years. 23 patients had CAD and AH comorbidity, 11 patients - type 2 diabetes mellitus (DM), 8 patients - CAD (cardiosclerosis, stable angina pectoris), and 4 patients - 2nd grade AH.

The statistical analasis was performed bynonparametric methods of the Statistica 10 package. Kraskel-Wallis one-way variance analysis was used to determine the differences between independent groups. The dependence between the variables was estimated using the Spearman correlation coefficient (R). A cluster analysis of the obtained data was also carried out; dendrograms (trees of variable) were constructed for graphical display of the results.

Study results and discussion.

COPD patients were divided into 3 groups: group B (12 patients), group C (14 patients), group D (9 patients). In group B: 8.33% didn't have comorbidity, 16.6% - CAD, 58.33% - AH in combination with CAD (3 of them had postinfarction cardiosclerosis). In group C: 21.43% of patients did not have comorbidity; 28.7% - CAD; 50% - AH in combination with CAD. In group D: all patients had comorbidity, 22.22% - CAD and 77.78% - AH in combination with CAD.

The signs of atherogenic dyslipidemia (an increasing level of atherogenic lipid fractions and a decreasing level of anti-atherogenic fractions) were revealed in the whole COPD patients, as well as in AH and CAD comorbidity (Table 1). A comparative analysis of the lipid profile (Table 1) indicates a tendency for an increasing in LDL and CA in case CAD comorbidity (in comparison with the group without CAD). These differences are especially pronounced for total cholesterol and TG ($p < 0.05$). AH comorbidity is also accompanied by a tendency to increase total cholesterol, TG, VLDL, LDL and to decrease HDL.

Table 1

Comparative characteristics of the lipid profile depending on the presence of comorbidity

	COPD	**COPD withCAD**	**COPD withoutCAD**	**COPD with AH**	**COPD without AH**
Total cholesterol, mmol/l	6.20 [4.80–6.45]	6.20 [5,3–6,5]	5,70* [4,80–6,40]	6,34 [4,80–6,34]	6,13 [5,45–6,78]
HDL, mmol/l	1.21 [1.12–1.37]	1,30 [1,15–1,37]	1,14 [1,12–1,18]	1,23 [1,12–1,37]	1,30 [1,15–1,40]
TG, mmol/l	2.76 [1.47–3.22]	2,78 [1,46–3,24]	1,69* [1,55–2,70]	2,80 [1,46–3,24]	2,12 [1,53–2,99]
LDL, mmol/l	3.70 [3.0–4.22]	3,96 [3,20–4,22]	3,45 [2,44–3,68]	4,20 [2,44–4,22]	3,96 [3,21–4,39]
VLDL, mmol/l	0.85 [0.48–1.13]	0,82 [0,53–1,13]	0,94 [0,48–1,10]	1,10 [0,53–1,10]	0,94 [0,30–1,45]
CA	3.47 [2.86–4.50]	3,55 [3,03–4,50]	3,55 [2,55–4,43]	3,55 [2,60–4,50]	3,35 [3,04–4,58]

Note: * - a significant difference between the indices in the COPD group with CAD and without CAD ($p < 0.05$).

Comparative analysis of echocardiography parameters (Table 2) revealed changes in parameters of both ventricles, which are more pronounced in AH and CAD comorbidity. Remodeling signs of the RV, RA and LV are also revealed. Changes in pulmonary blood flow lead to an increase in PASP, a right heart strain, an increase in structural and functional changes in the right heart, which are more pronounced in comorbidity. It should be noted that the average value of IVS thickness exceeds the normal values in all groups of patients with COPD, regardless of the presence of comorbidity, which is probably a manifestation of interventricular interaction.

Table 2

Comparative characteristics of structural and functional data of the heart depending on the presence of comorbid pathology

	COPD	COPD without CAD	COPD with CAD	COPD without AH	COPD with AH
LV EDV, ml	154.00 [104.00-195.00]	127.50 [67.00-192.00]	154.00 [130.00-195.00]	104.00# [68.00-179.00]	165.00 [142.00-202.00]
LV EDD, cm	5.80 [4.80-6.21]0	4.71* [4.60-4.80]	5.89 [4.92-6.32]	4.80## 4.70-4.90]	6.10 [5.80-6.43]
LV ESD,cm	4.40 [3.65-4.90]	3.60 [3.35-3.87]	4.50 [3.82-4.92]	3.80### [3.40-3.87]	4.65 [4.40-5.10]
EF, %	63.00 [58.00-65.00]	64.00 [61.00-65.00]	63.00 [58.00-65.00]	64.00 [60.50-65.50]	63.00 [58.00-65.00]
PWED , cm	1.30 [1.10-1.30]	1.10** [1.00-1.30]	1.30 [1.10-1.40]	1.15#### [1.05-1.30]	1.30 [1.20-1.40]
IVS thickness, cm	1.30 [1.20-1.40]	1.20*** [1.10-1.20]	1.30 [1.10-1.40]	1.25 [1.15-1.35]	1.30 [1.20-1.40]
LVMI, g/m^2	86.00 [76.00-96.00]	77.00 [74.00-93.00]	86.00 [76.00-96.00]	76.00^ [75.00-82.00]	88.00 [84.00-96,00]
ARD, cm	2.80 [2.60-3.20]	2.65 [2.50-3.00]	2.90 [2.70-3.20]	2.85 [2.70-3.10]	2.80 [2.40-3.20]
MPAP, mm Hg	29.50 [26.00-38.00]	27.00 [23.00-28.00]	35.50 [26.50-38.00]	28.50 [37.00-41.50]	32.00 [25.00-38.00]
EDD RV, cm	3.80 [2.70-4.20]	3.05 [2.40-3.70]	4.00 [2.70-4.30]	3.25 [2.55-3.65]	4.01 [2.70-4.30]
ESD RV, cm	2.70 [2.30-3.30]	2.40**** [2.30-2.50]	2.90 [2.00-3.60]	2.40 [1.75-3,10]	2.90 [2.40-3.60]

* - significant difference between the indicators in the group COPD with CAD and without CAD (p=0.0080),

** - significant difference between the indicators in the group COPD with CAD and without CAD (p=0.0346),

*** - significant difference between the indicators in the group COPD with CAD and without CAD (p=0.0276),

**** - significant difference between the indicators in the group COPD with CAD and without CAD (p=0.0511),

- significant difference between the indicators in the group COPD with AH and without AH (p=0.0401),

- significant difference between the indicators in the group COPD with AH and without AH (p=0.0001),

- significant difference between the indicators in the group COPD with AH and without AH (p=0.0012),

- significant difference between the indicators in the group COPD with AH and without AH (p=0.0368),

^ - significant difference between the indicators in the group COPD with AH and without AH (p=0.0120)

The analysis of significant correlations with the lipid profile in the whole for the group of COPD patients revealed a moderate positive relationship between TC and CRP (R=0.55), which indicates the lipids participation in the systemic inflammation development. Significant correlations between indices of lipid profile and echocardiogram were found, namely, TG and LV EDV (R=-0.35), LDL and IVS thickness (R=0.41), ARD and TC (R=0.48), LDL (R=0.36), VLDL (R=0.42), and CA (R=0.36) (Fig. 1).

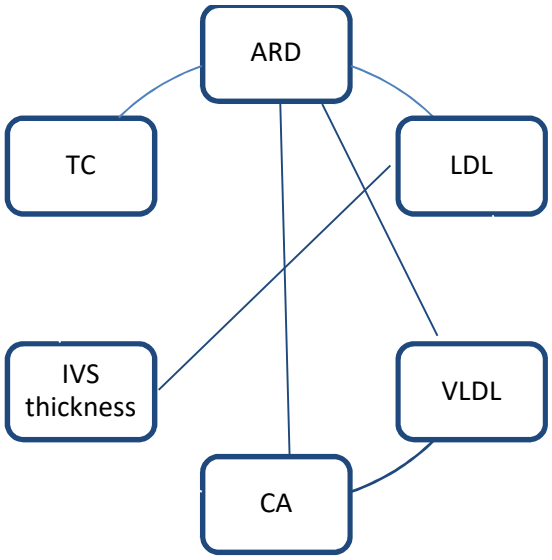

Fig.1. Relationships between lipidogram and echocardiographic indices

Significant correlations between ARD and total cholesterol (R=0.63), LDL (R=0.79), VLDL (R=0.68), between HDL and body mass index (R=0.69), patients' waist circumstance (R=0.58) and between the level of bronchial obstruction reversibility with HDL (R=-0.62) and CA (R=-0.62) were found in group B.

In group C, there is a high positive correlation of CRP with total cholesterol (R=0.80) and LDL (R=0.95) that attests to the involvement of lipid in the systemic inflammatory process in COPD. There are negative correlations between the level of TG and ARD (R=-0.54), positive correlations between ARD and total cholesterol levels (R=0.57) and VLDL (R=0.55). Correlations in this group appear lipid and MPAP: between HDL and MPAP (R=-0.55), between LDL and MPAP (R=0.67).

Positive correlations between LDL and PWED (R=0.71), between VLDL and RV ESD (R=0.82) as well as correlations between TG and LV EDD (R=-0.70), HDL and LV EDV (R=-0.88) were noted in group D.

In the whole group of COPD patients detected 7 positive correlations between lipid profile and indicators of structural and functional state of the heart, of which 4 - ARD with TC, LDL, VLDL, CA, 1 - LV EDV and TG, 1 – PWED with LDL and 1 - IVS thickness with

VLDL. There are 3 positive significant correlations of ARD with TC, LDL, and VLDL in group B. There are 2 correlations with MPAP - positive with LDL and negative with HDL as well as negative association between TG and LV EDV in group C. The correlation number increases to 6 in group D: correlations of LDL with RA, RV and LV parameters appear.

Analysis of correlation in the group without CAD comorbidity revealed 2 correlations between LDL and ARD (R=0.85) as well as LV EDD(R=-0.83).The number of significant relationship increases with CAD comorbidity (5 correlations), namely, between total cholesterol and CRP (R=0.50) indicating the lipids participation in systemic inflammation, between ARD and total cholesterol (R=0.43) and VLDL (R=0.45), as well as between LDL and IVS thickness(R=0.39), furthermore, weak positive correlation between VLDL and EF (R=0.37), which hardly applicable.

In COPD patients without AH, there were 3 significant correlations between structural and functional parameters of the heart and lipidogram indices: between HDL and LV EDV (R=-0.68), between TG and EF (R=0.66), as well as LV EDD(R=0.70).

The number of correlations between lipid levels and echocardiographic data is increased (5 correlations) in case COPD with AH comorbidity, namely, between TC and ARD (R=0.51), LDL and IVS thickness (R=0.45), ARD (R=0.44) and RV ESD (R=0.54).

Therefore, lipids form a large number of correlations with various indices in case COPD (anthropometry, spirometry, systemic inflammation, carbohydrate metabolism), including 9 correlations with indicators of the structural and functional state of the heart. The increase of COPD severity and AH comorbidity do not lead to an increase in the number of correlations besides CAD where the number of correlations are increased in half. It is also important to note close correlation links between the lipid profile indices and the parameters of the structural and functional state of the heart. In general, the correlations were quite expected indicating the lipids influence on remodeling RA, RV, LV and aorta, as well as the development of pulmonary hypertension.

There is no doubt that there is interdependence between RV and LV, which is due tothe commonality of the anatomical structure, blood supply, interventricular septum, pericardium, the continuity of muscle syncytium, the overall effect of pressure, the chest volume and elasticity. Compensatory hyperfunction is accompanied by the fibrosis development, a violation of the diastolic filling of both ventricles, and then systolic dysfunction. RV failure leads to a decrease in LV filling and a decrease cardiac output.

The obtained data indicate a certain order of the severity of the lipid and echocardiography relationships in COPD. Apparently, these trends point out the processes of adaptation and maladaptation of the body to hypoxia that occurs and progresses in COPD.

An increase in the correlations with the so-called comorbidity may be a consequence of the synthropy between COPD, AH and atherosclerotic processes. AH in COPD is considered as pulmogenic, it develops after several years of COPD, the pathogenetic basis of AH is hypoxia [25]. Remodeling of the cardiovascular system similar to that at AH is observed before its clinical manifestation. It is emphasized that even a slight increase in blood pressure in COPD is a high additional risk of cardiovascular complications and target organ damage [25].

In order to classify the obtained data, to establish hierarchical algorithms, the cluster analysis (Fig.2) of the structural and functional state of the myocardium and lipid spectrum was performed. Dendrograms were constructed for groups of patients with COPD as a whole, as well as for group B, C, D.

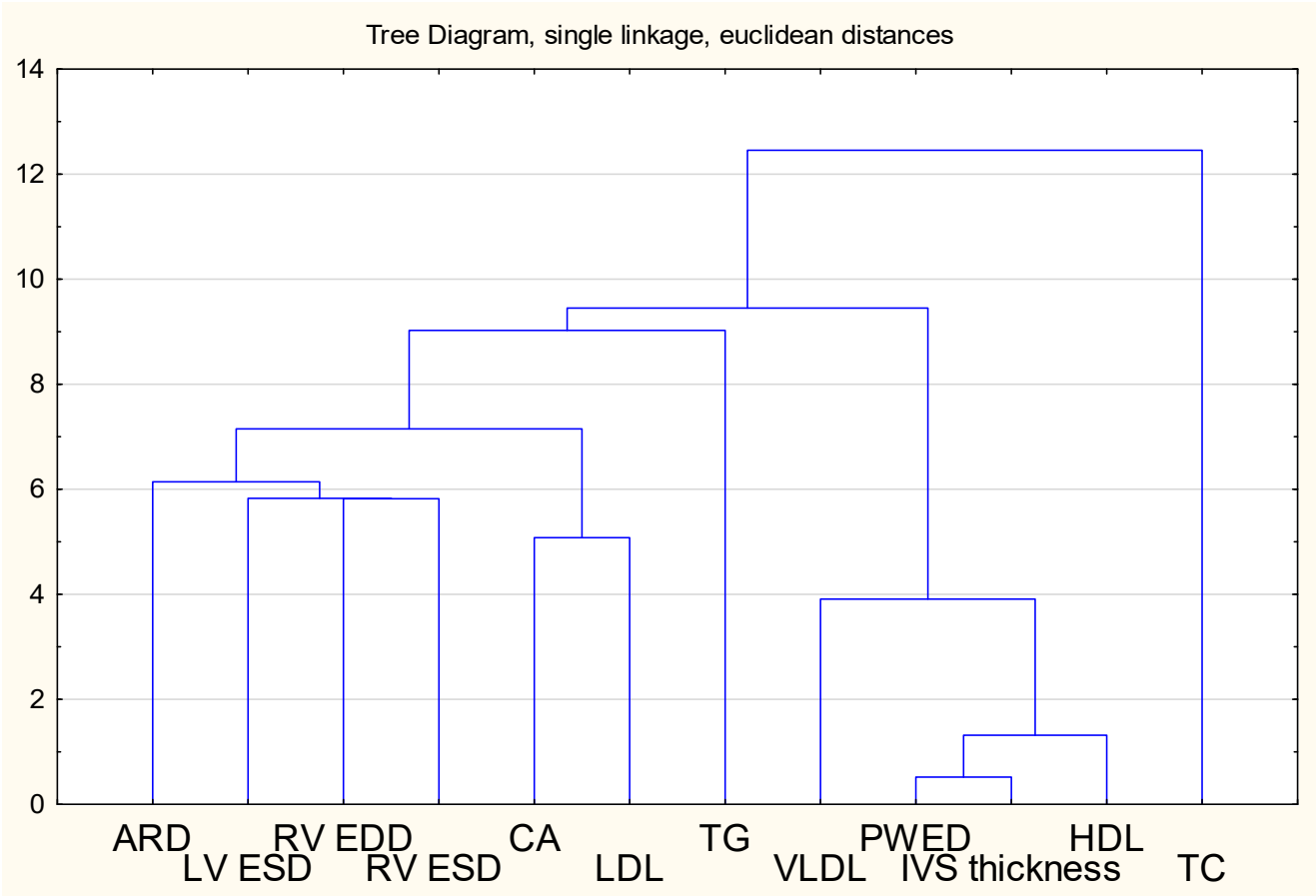

Fig.2. Cluster analysis of lipid spectrum and myocardium structural-functional state.

These indicators form 2 clusters, which include different echocardiography and lipid spectrum indicators. In the whole COPD patients, the first cluster included ARD, LV EDD, RV EDD, RV ESD combined with CA and LDL. TG is relatively remote from these indicators. The second cluster includes PWED, IVS thickness and HDL which are located at a close distance from each other and further away from the VLDL. Total cholesterol is the most distant from both clusters. It should be noted that the first cluster includes the RV and LV

functional parameters, and the second cluster - the PWED and IVS thickness. Both clusters are combined with TG.

Cluster analysis of the indicators in groups B, C, D, that were differing by the severity of the patients' condition, were also carried out. In all groups, the structure of the dendrograms is preserved – there are two clusters. However, the localization of TG varies depending on the severity of the COPD and comorbidity. Thus, in group B TG, as well as TC act as an autonomous indicator, in the group C the TG become a cluster-forming index in the first cluster; in group D, the TG localize in the second cluster, i.e. move to the "structural" cluster.Perhaps the reformatting of dendrograms depending on the severity of COPD reflects the processes of adaptation and disadaptation.

The similarity of dendrograms in all groups (generally COPD, COPD of groups B, C, D) reflects the unity of the Echo-CG and lipid spectrum networks. The lipids, especially TG, whose role in clusters depends on the severity of the process are the "nodes" of this network.

Already detected genes – candidates let us suggest that hypertension and atherosclerosis in patients with COPD and CAD are a manifestation of network links between lipid metabolism and myocardium and allow us to consider these phenomena within the framework of a single disease combining a phenom and a genom in diseasom.

This approach will allow us to search the drugs that affect the network metabolic "nodes" as targets at the cellular and molecular levels. This will help to prevent polypragmazy, which is unavoidable in comorbidity. Statins with their pleiotropic action according to the numerous studies are discussed as such drugs [22]. The practitioner now has a difficult task: to determine empirically the phenotypic features of the disease in each patient, to estimate the results of routine accessible research methods, anatomical, pathophysiological features, to evaluate their network interconnections, using the modern possibilities of the network theory, to find the signs of synthropy and to choose a pleiotropic medicinal product that will help to avoid polypragmazy, by affecting many links ("nodes", "hub") of the network pathological process [12].

Conclusions.

1. Atherogenic dyslipidemia develops in case chronic obstructive pulmonary diseasewith coronary artery disease and arterial hypertensioncomorbidity, and it accompanies by echocardiography signs of myocardial remodeling. The revealed correlation reflects the relationship between these indicators.

2.As the severity of the chronic obstructive pulmonary disease progresses, the correlations number between the lipid spectrum and the myocardium structural and functional condition increases according to the echocardiography data. In the whole group of patients and in group B, there are lipid links with only left ventricle echocardiography data, in group C

the correlations with systolic pressure in pulmonary artery appears, in group D –with right atrium's, right ventricle's, left ventricle's data.

3. The accession of arterial hypertension and coronary artery disease is accompanied by an increase the correlations number and their nature: in coronary artery disease there are 5links, without it there are 2links, with arterial hypertension there are 5 correlations, without last one there are 3 of them.

4. Correlation and cluster analyzes suggest that the obtained data reflect the interactions of various nodes of the diseasome network and can be evaluated as signs of the synthropy of chronic obstructive pulmonary disease, arterial hypertension and atherosclerosis.

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