XRONİK OBSTRUKTİV AĞCİYƏR XƏSTƏLİYİ OLAN PASİYENTLƏRDƏ ÜRƏK-DAMAR SİSTEMİ RİSKİ: MENECMENT VƏ HƏYAT KEYFİYYƏTİ

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Xülasə. Məqalədə ürək-damar xəstəlikləri riskinin səviyyəsi ilə xronik obstruktiv ağciyər xəstəlikliyi (XOAX) klinik ağırlıq göstəriciləri arasındakı əlaqələri öyrənmək məqsədilə aparılmış tədqiqat işi haqqında məlumat verilmişdir. Bundan ötrü XOAX diaqnozu qoyulmuş 52 xəstə tədqiq edilmiş, onlarda ağciyərin forsirə edilmiş heyati tutumu öyrənilmiş və sonradan ağciyərlərin forsirə edilmiş həyati tutumunun forsirə edilmiş nəfəsvermənin birinci saniyəsinin göstəricisinə nisbəti hesablanmışdır. Həmçinin pasiyentlər GOLD (2023) meyarlarından istifadə edilməklə XOAX-ın ağırlıq dərəcələrinə görə qruplara bölünmüş və ürək-damar riskinin səviyyəsi SCORE şkalası vasitəsilə müəyyənləşdirilmişdir.

Tədqiqat göstərmişdir ki, hava kütlələrinin tənəffüs yolları üzrə hərəkətinin təkcə XOAX-ın ağırlığının əsas amili deyil, həm də xəstələrdə ürək-damar patologiyasının formalaşması və artması ilə əlaqədar olan bir hadisədir. Müəyyən edilmişdir ki, ürək-damar patologiyası riskinin artması ilə şiddətləndirilmiş nəfəsvermənin ilk saniyəsinin və Hansler indeksinin səviyyəsi arasında əlaqə olduğu aşkar edilmişdir. Bunlara isə həm GOLD-2 qrupuna daxil olan pasiyentlərdə ürək-damar riskinin informativ meyarı kimi baxmaq olar; XOAX-ın kəskinləşmələrinin tezliyinin də ürək-damar riskinin səviyyəsi ilə əlaqəsi vardır. Xəstənin gündəlik fəaliyyətinin məhdudlaşması və XOAX-ın ağırlaşması da ürək-damar riskinin səviyyəsi arasında korrelyativ əlaqə vardır. Yəni fəaliyyət məhdudlaşması və XOAX-ın klinik təzahürlərinin ifadəlilik dərəcəsinin yüksəlməsi ürək-damar riskinin tezliyinin artması ilə müşayiət edilir.

Açar sözlər: *xronik obstruktiv ağciyər xəstəliyi, kardiovaskulyar risk, SCORE*
Ключевые слова: *хроническая обструктивная болезнь легких, кардиоваскулярный риск, SCORE*
Key words: *chronic obstructive pulmonary disease, cardiovascular risk, SCORE*

CARDIOVASCULAR RISK IN PATIENTS WITH CHRONIC OBSTRUCTIVE PULMONARY DISEASE: MANAGEMENT AND LIFE QUALITY

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The article presents the results of a study on the relationship between the level of cardiovascular risk and clinical indicators of the severity of chronic obstructive pulmonary disease (COPD). 52 patients with COPD were examined: the dynamics of forced expiration in the first second, forced vital capacity were analyzed, followed by calculation the ratio of forced expiration in the first second to forced vital capacity. Patients were also stratified by COPD severity groups using the GOLD criteria (2023) and the level of cardiovascular risk determined by the method of SCORE.

It has been shown that the rate of COPD exacerbations and the degree of airflow restriction are not only components of COPD severity assessment, but also interrelated with the formation / increase of

cardiovascular risk in patients. In particular, with an increase in the severity of COPD and limiting the air flow rate, a decrease in persons with low and medium cardiovascular risk levels was recorded with a progressive increase in the proportion of patients with high cardiovascular risk. It was found that an increase in the frequency of high cardiovascular risk is determined by the level of forced expiration in the first second and the value of the Gensler index, which should be considered as informative criteria for cardiovascular risk among patients of the GOLD-2 group, while the frequency of exacerbations of COPD is also interrelated with the level of cardiovascular risk. The level of restrictions on daily activities of patients and the clinical severity of COPD are also correlated with the level of cardiovascular risk.

The growth of limitations of daily activities and the severity of clinical manifestations of COPD are characterized by a direct correlation with the frequency of high cardiovascular risk, so it was shown a mutually aggravating nature of the clinical course of COPD and the level of cardiovascular risk.

Introduction. According to modern ideas, chronic obstructive pulmonary disease (COPD) is considered a disease that is not limited to involvement in the pathological process only of the respiratory tract [1, 2]. It is systemic inflammation that leads to the formation of complications and damage to other vital organs and systems. Such target organs include the cardiovascular system, the involvement of which may worsen the prognosis in this category of patients [3-6]. It is well known and proven that cardiovascular events occupy one of the leading places in the clinical manifestations of COPD, and often act as a direct cause of death of patients [2, 7]. In the structure of comorbid conditions, diseases of the cardiovascular and respiratory systems, digestive tract and rheumatological profile are in the lead [1, 8-12]. At the same time, there is an urgent need to improve the prevention of cardiovascular risk (CVR), diagnosis and treatment of patients with chronic diseases associated with long-term course, the development of severe complications and reduced quality of life [2, 13] and efficiency and quality of health [8, 14-15].

The high prevalence of CVR in the population indicates an unfavorable epidemiological situation for cardiovascular disease, and the presence of such a risk profile does not allow to expect a significant reduction in mortality in the near future and indicates the need for more active prevention methods at the population, family and individual levels. This is especially important in the case of a combination of CVR, especially in the early stages of COPD.

The aim of the study was to examine the association between cardiovascular risk and clinical indicators of COPD severity; rela-tionship with frequency of exacerbations, expressiveness of clinical pulmonary symptoms and life quality.

Materials and methods of research. 52 patients with COPD, who were divided into 2 examination groups, were involved in the study. The 1st group included 28 patients (GOLD-2), the 2nd group - 24 patients (GOLD-3). The control group consisted of 20 healthy people. All patients with COPD were examined; to assess the lung function test, the dynamics of forced expiratory volume for the first second (FEV_1, forced expiratory flow in 1 sec), forced vital capacity of the lungs (FVC), the ratio of FEV_1 / FVC were analyzed. Measurements were performed on an MS-22 spirometer (Microprocessor spirometer Controlled, Hungary); determined the following velocity indicators: FEV1 - the volume of air exhaled in the first second at the fastest exhalation; as a percentage of FCV. Calculated a special index: FEV_1 / FVC (FEV_1 / FVC = Index Gaenslar); MOS25 - the maximum volumetric expiratory rate at the level of 25% FVC, similar to MOS50 and MOS75. The degree of severity of obstruction was assessed during spirometric examination based on FEV1 (in % of the appropriate value after the use of a bronchodilator) according to GOLD, 2023 [16]. The severity of subjective symptoms was assessed using the CAT (COPD Assessment Test), www.catestonline.org (a score ≥10 indicates a significant progression of symptoms) and the mMRC (modified Medical Research Council) scale to determine the degree of dyspnea (a score ≥2 indicates about significant deterioration). Assessment of tolerance to physical exertion was carried out using the 6-minute walking distance test (6 MWD). Patients with COPD were stratified according to the level of CVR, determined by the method of SCORE [17]. Informed consent of patients to participate in the study was obtained. The study was performed according to a standardized program of collection, accumulation and analysis of results. When performing the

study, known clinical and statistical methods were used: anamnestic quantitative analysis [13,14,18], variation statistics, probability distribution of clinical signs with assessment of the reliability of the obtained results.

Results and discussion. Among patients with COPD of the GOLD-2 group with $FEV_1= 67.2 \pm 1.1\%$, high and medium levels of CVR were diagnosed equally often (40-42%), while 16.6% of patients had low levels; in the same group at $FEV_1=54.5 \pm 0.6\%$ high CVR was diagnosed significantly (p <0.05) more often than medium and low (respectively, in $(17.3 \pm 5.2\%, 7.7 \pm 3)$, 7% and $5.8 \pm 3.2\%$), while the frequency of diagnosing low and medium CVR - did not differ. ± 4.8 to 75.0 ± 3.9, p <0.05) should be considered as one of the informative criteria for increasing the frequency of CVR in patients with COPD group GOLD-2 (Table).

Among patients with COPD of the GOLD-3 group with $FEV_1 = 41.7 \pm 1.3\%$, high CVR cardiovascular disease was diagnosed significantly more often than medium and low

(respectively, $13.5 \pm 4.7\%$, $3.8 \pm 2.7\%$ and in $1.9\pm1.9\%$), while the frequency of diagnosing low and medium levels of CVR – did not differ; in the same group at $FEV_1= 38.8\pm1.1\%$ high CVR was diagnosed significantly (p<0.05) more often than medium and low (respectively, in $(17.3\pm5.2\%, 7.7\pm3)$, 7% and $1.9\pm1.9\%$).

At the same time, the frequency of diagnosing low and medium levels of CVR did not differ. Thus, with the increase of air flow rate restrictions to $FEV_1 <54.5 \pm 0.6\%$ - no increase in the frequency of persons with a high level of CVR was registered, which can be explained by the low level of sensitivity of the "SCORE" technique.

The study and clinical-statistical modeling of patterns of the relationship between CVR and the degree of restriction of air flow in patients with COPD (**Fig. 1**) allowed to obtain graphical and quantitative models for predicting the expected level of CVR depending on FEV_1.

Table. Distribution of patients depending on the severity of chronic obstructive pulmonary disease (GOLD, 2023) and the level of cardiovascular risk (SCORE scale, 2016)

The level of CVR according to the SCORE scale		Levels of restriction (%) of air flow velocity				
		GOLD-2, $^1n_{1.1}=28$		GOLD-3, $^1n_{1.2}=24$		Total
		61,0≤	60÷51	50÷41	40÷31	$^1n_1=52$
low CVR	Abs., pers	2	3	1	1	7
	P±m,%	3,8±2,7	5,8±3,2	1,9±1,9	1,9±1,9	13,5±4,7
Medium CVR	Abs., pers	5	4	2	4	15
	P±m,%	9,6±4,1	7,7±3,7 [b]	3,8±2,7 [b]	7,7±3,7 [b]	28,8±6,3 [b]
High CVR	Abs., pers	5	9	7	9	30
	P±m,%	9,6±4,1	17,3±5,2 [a]	13,5±4,7 [a]	17,3±5,2 [a]	57,7±6,9 [a]

Note: a − significant differences between patients with high and low CVR; b − significant differences between patients with medium and high CVR; c − significant differences depending on the degree of restriction of air flow velocity
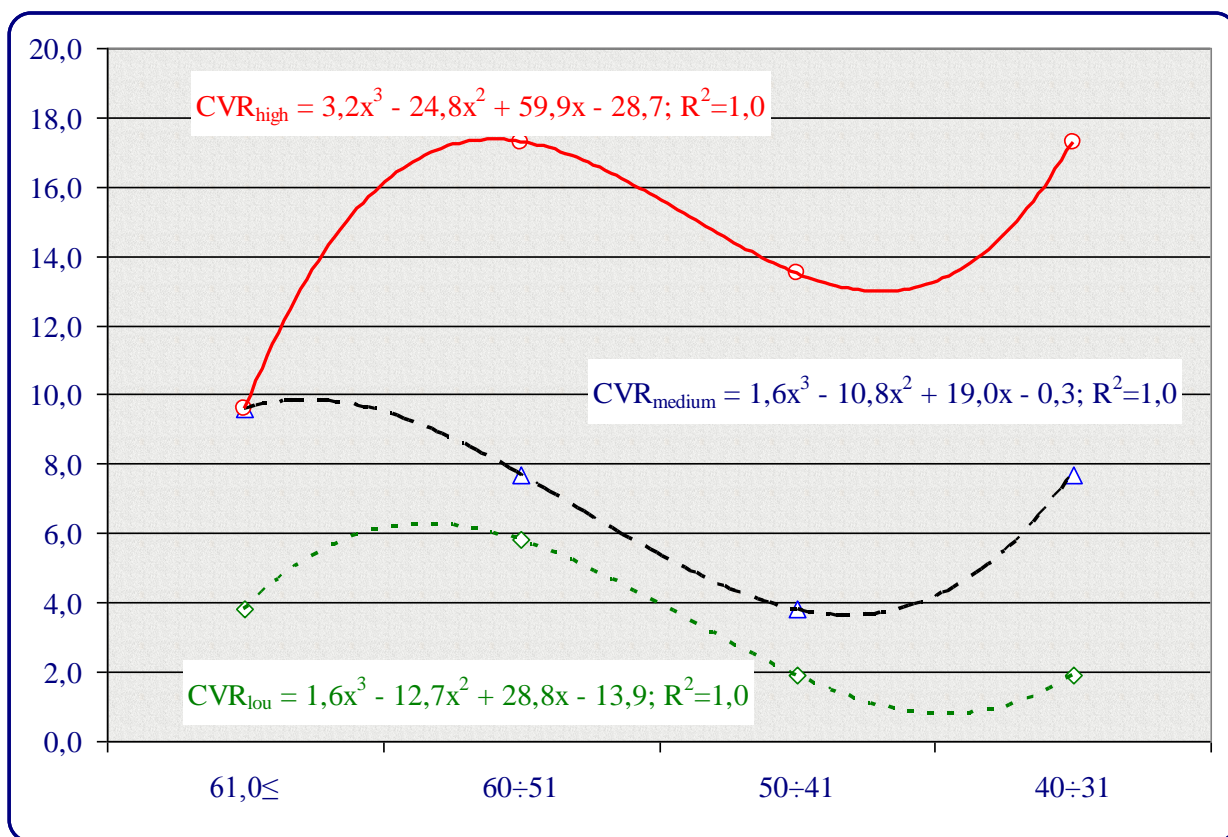
Fig. 1. The relationship between the frequency of cardiovascular risk and the degree of restriction of air flow rate in patients with COPD

These quantitative dependences allow predict at the individual level the dynamics of CVD changes at the stages of clinical monitoring of COPD patients, primarily with the deterioration of FEV_1. The application of the prognostic approach is demonstrated by a clinical example. So, at primary diagnosis of COPD with FEV≤61,0% diagnostics of CVR by the SCORE technique is executed and existence of high CVR is found out. In the process of dynamic monitoring of a patient with COPD, a decrease in FEV_1 to 55.0% was registered, which determines the need to re-determine the level of CVR. This determination can be performed by applying the appropriate formula (see Fig. 1, form. CVR_H). As shown by the graphical model, when FEV1 decreases to 55.0%, the level of CVR increases by 47.0% (from 9.0% to 17.0%) due to the decrease of persons with medium and low CVR.

It should be noted that both the pattern of growth of airflow velocity restriction and the frequency of exacerbations of COPD are characterized by a direct high-strength correlation with the frequency of high CVR (respectively, $r_{xy} = + 0.692$ and $r_{xy} = + 0.730$); that is, we are talking about the mutually aggravating nature of the impact of exacerbations of COPD and the level of CVR.

As shown in **Fig. 2**, with increasing airflow limitation, the frequency of persons with low and medium CVR decreases and the proportion of persons with high CVR progressively increases.

Thus, indicators of frequency of exacerbations of COPD and degree of restriction of speed of an air stream are not only components of a clinical assessment of severity of COPD, but also are interrelated with formation / progression of CVR available at patients.
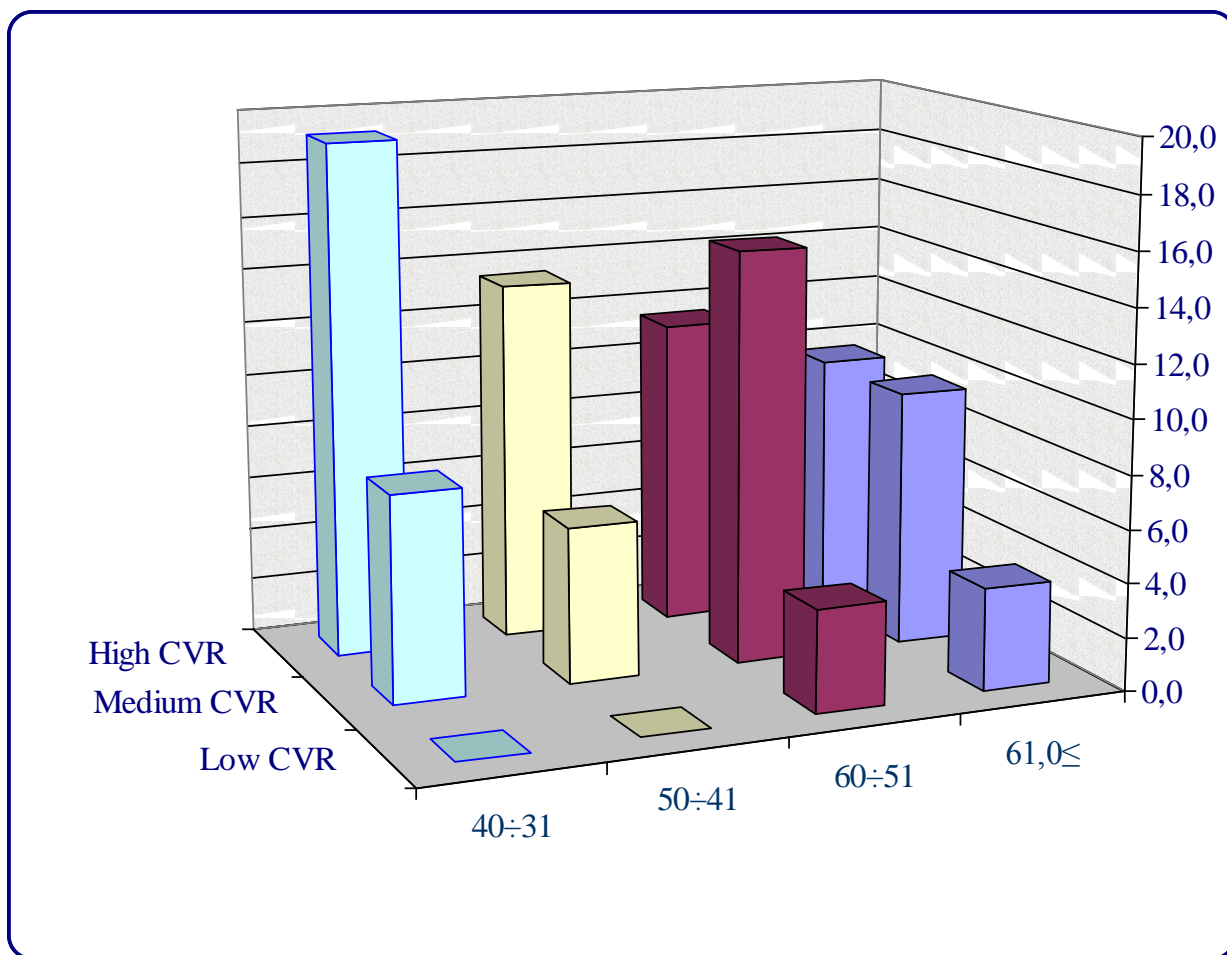
Fig. 2. Distribution of patients (as a percentage) with chronic obstructive pulmonary disease depending on the level of cardiovascular risk and the level of airflow limitation (as a percentage of FVC)

The study of the relationship between the severity of clinical manifestations of COPD in patients with varying degrees of airflow limitation and the level of cardiovascular risk revealed that among 22 people with the severity of clinical manifestations, assessed in 3 b., 15 patients − with high, 6 − with medium and 1 patient - with a low level of CVR. Moderate clinical manifestations of COPD have been reported in 12 patients with high CVR, 7 with moderate CVR and 2 patients with low CVR.

It should be noted that both the pattern of growth of airway velocity restriction and the severity of clinical manifestations of COPD are characterized by a direct correlation with the frequency of high CVR (respectively, $r_{xy} = + 0.674$ and $r_{xy} = + 0.659$); that is, it is a mutually aggravating nature of the impact of the clinical course / severity of COPD and the level of CVR.

With increasing severity (severity) of clinical manifestations of COPD and limitation of airflow rate, the frequency of people with low and medium levels of CVR decreases and the proportion of people with high CVR progressively increases. Regarding patients with COPD with an average level of CVR, it was found that among 15 people with the severity of clinical manifestations, assessed in 3 b. (see Table), 6 patients − with high, 7 − with moderate and 2 patients − with minimal clinical manifestations. At the same time, 9 people were stratified to the group of differentiated therapy GOLD-2, and 6 patients − to the group GOLD-3.

Thus, the severity of clinical manifestations of COPD and the degree of limitation of air flow rate are not only components of clinical assessment of the severity of the disease, but also interrelated with the formation /

progression of patients with high or medium levels of CVR.

The study of the relationship between the impact of COPD on the quality of life of patients with varying degrees of airflow limitation and cardiovascular risk found that among 29 people for whom the presence of COPD significantly affects quality of life, 22 patients – high, 7 – medium and 1 patient – with a low level of CVR, which demonstrates a syntropy of reduced quality of life and high CVR in patients with COPD.

At the same time, moderate restriction of daily activities by the presence of COPD was diagnosed in 18 patients with COPD: 8 – with high, 6 – with medium and 4 – with low CVR. Among patients with 30 patients with COPD with high CVR, 70.0% (21 people) identified the impact of COPD on quality of life as significant, 26.7% – moderate and only 3.3% – insignificant, which demonstrates the syntropic nature of the comorbid course Among 15 patients with COPD with an average level of COPD in 46.7% (7 people) the impact of COPD on quality of life was determined as significant, in 40.0% - moderate and 13.3% - insignificant.

It should be noted that the pattern of growth of limitations of daily activities (indicators of quality of life) and the severity of clinical manifestations of COPD are characterized by a direct correlation with the frequency of high CVR (respectively, $r_{xy} = + 0.751$ and $r_{xy} = + 0.659$); that is, it is a mutually aggravating nature of the clinical course (manifested by limitations in daily activities) of COPD and the level of CVR.

Conclusions

1. Significant increase in the frequency of diagnosis of high CVR is determined by the level of FEV1 and the Hensler index, the decrease of which (from 84.7 ± 4.8 to 75.0 ± 3.9 units, p <0,05) should be considered as one of the informative criteria for increasing the frequency of CVR in patients with COPD group GOLD-2.

2. With the increase of air flow rate restrictions to $FEV_1 <54.5 \pm 0.6\%$ - no increase in the frequency of persons with a high level of CVR was registered, which can be explained by the low level of sensitivity of the method SCORE.

3. Regularity of growth of restriction of speed of an air channel, and expressiveness of clinical displays of COPD are characterized by direct correlation interrelation with frequency of high CVR.

4. The growth of limitations of daily activities (indicators of quality of life) and the severity of clinical manifestations of COPD are characterized by a direct correlation with the frequency of high CVR; that is, it is a mutually aggravating nature of the clinical course (manifested by limitations in daily activities) of COPD and the level of CVR.

Prospects for further research are associated with the development of prognostic clinical scenarios for the personification of differentiated therapy, taking into account the level of CVR present in patients with COPD.

REFERENCES

1. Rasputina LV. Comorbidity of nonspecific diseases of the respiratory system and cardiovascular system in the practice of a doctor. *Ukrainian Journal of Pulmonology.* 2011;4:25–27.
2. Feshchenko YI. Chronic obstructive pulmonary disease: etiology, pathogenesis, classification, diagnosis, therapy (national agreement). *Ukrainian Journal of Pulmonology.* 2013;3:7-12.
3. Barchan GS, Cherkashyna LV, Shklyar AS et al. Immune disorders in recurrent respiratory infections on the background of undifferentiated connective tissue dysplasia. *Azerbaijan Medical Journal.* 2020;1:10-17. https://doi.org/10.34921/amj.2020.27.15.002
4. Mostovy Y, Rasputin L. Chronic obstructive pulmonary disease and cardiovascular diseases: a modern look at the problem. *Health of Ukraine.* 2010;2:12-13.
5. Kamyshnyi A, Krynytska I, Matskevych V, Marushchak M, Lushchak O. Arterial hypertension as a risk comorbidity associated with COVID-19 pathology. *Int J Hypertens.* 2020:8019360. doi: https://doi.org/10.1155/2020/8019360
6. Krynytska I, Marushchak M, Birchenko I, Dovgalyuk A, Tokarskyy O. COVID-19-associated acute respiratory distress syndrome versus classical acute respiratory distress syndrome (a narrative review). *Iran J Microbiol.* 2021; Dec;13(6):737-747. doi: https://doi.org/10.18502/ijm.v13i6.8072
7. Karoli NA, Orlpva EE, Markov AV. Comorbidity in chronic obstructive pulmonary disease. *Therapeutic archive.* 2008;3:20-23.

8. Gashinova KY. Systemic manifestations and comorbidity in outpatients with COPD. *Ukrainian Journal of Pulmonology.* 2013;2:41-45.
9. Marushchak M, Maksiv K, Krynytska I. ACE gene I/D polymorphism and arterial hypertension in patients with COPD. *Pneumologia.* 2019;68(3):114-119. doi: https://doi.org/10.2478/pneum-2019-0039
10. Stepanova N, Rysyev A, Rusyn O. et al. High-density lipoproteins and clinical outcomes of COVID-19 in hemodialysis patients: A multicenter, propensity-score matched case-control study. *Ukr J Nephr Dial.* 2022;1(73):22-30. doi: https://doi.org/10.31450/ukrjnd.1(73).2022.03
11. Teslyk T, Yarmolenko O, Bumeister V et al. The remodeling of lungs under the influence of alloxan-induced hyperglycemia. *Romanian Journal of Diabetes, Nutrition and Metabolic Diseases.* 2020;27(1):45-49. doi: https://doi.org/10.46389/rjd-2020-1008
12. Yarmolenko O, Bumeister V, Polak S et al. The effect of the experimental chronic hyperglycemia on the kidney and myocardium. *Ukr J Nephr Dial.* 2021;3(71):3-10. doi: https://doi.org/10.31450/ukrjnd.3(71).2021.01
13. Bondarenko LV. Improving the diagnosis of cardiovascular risk in patients with chronic obstructive pulmonary disease. *Fundamental science in modern medicine*: Annual collection of scientific works of Minsk State Medical University. 2016:52-57.
14. Demikhov O, Opanasiuk Y, Demikhova N, Merisalu E. A digital transformation into occupational health and safety systems: a review of the best practices in Europe. *Agronomy Research.* 2023;21(2):674-692. doi: https://doi.org/10.15159/AR.23.083
15. Stepanova N, Kolesnyk M, Mithani Z. et al. Lifesaving Care for Patients with Kidney Failure during the War in Ukraine 2022. *Clin J Am Soc Nephrol.* 2022; Jul;17(7):1079-1081. doi: https://doi.org/10.2215/CJN.04720422
16. Agustí A, Celli BR, Criner GJ et al. Global Initiative for Chronic Obstructive Lung Disease 2023 Report: GOLD Executive Summary. *European Respiratory Journal.* 2023;61:2300239. doi: https://doi.org/10.1183/13993003.00239-2023
17. European Guidelines on CVD Prevention in Clinical Practice 2016. *Eur J Prev Cardiol.* 2016; Jul;23(11):NP1-NP96. doi: https://doi.org/10.1177/2047487316653709
18. Demikhov O, Dehtyarova I, Motrechko V et al. Management aspects of children's health: dysplastic-dependent pathology of the bronchopulmonary system and ecological heterogeneity of the environment. *Azerbaijan Medical Journal.* 2022; 1: 144–150. https://doi.org/10.34921/amj.2022.1.023

СЕРДЕЧНО-СОСУДИСТЫЙ РИСК У ПАЦИЕНТОВ С ХРОНИЧЕСКИМ ОБСТРУКТИВНЫМ ЗАБОЛЕВАНИЕМ ЛЕГКИХ: МЕНЕДЖМЕНТ И КАЧЕСТВО ЖИЗНИ

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Резюме. В статье представлены результаты исследования проведенного с целью изучить связь между уровнем сердечно-сосудистого риска и клиническими показателями тяжести хронической обструктивной болезни легких (ХОБЛ). Обследовано 52 больных ХОБЛ; проанализирована динамика форсированного выдоха за первую секунду, форсированной жизненной емкости легких с последующим расчетом отношения форсированного выдоха за первую секунду к форсированной жизненной емкости легких. Пациенты также стратифицированы по группам тяжести ХОБЛ с использованием критериев GOLD (2023) и уровню сердечно-сосудистого риска, который определяли по шкале SCORE.

Показано, что частота обострений ХОБЛ и степень ограничения воздушного потока по дыхательным путям не только являются составляющими оценки тяжести ХОБЛ, но и взаимосвязаны с формированием/повышением сердечно-сосудистого риска у пациентов. Установлено, что увеличение частоты высокого риска сердечно-сосудистой патологии определяется уровнем форсированного выдоха за первую секунду и значением индекса Генслера, которые следует рассматривать как информативные критерии сердечно-сосудистого риска у пациентов группы GOLD-2, тогда как частота обострений ХОБЛ также взаимосвязана с уровнем сердечно-сосудистого риска. Уровень ограничений повседневной деятельности пациентов и клиническая тяжесть ХОБЛ также коррелируют с уровнем сердечно-сосудистого риска. Рост ограничений повседневной деятельности и выраженность клинических проявлений ХОБЛ характеризуются прямой корреляцией с частотой высокого сердечно-сосудистого риска.

ABBREVIATIONS:
COPD – chronic obstructive pulmonary disease
CVR – cardiovascular risk
FEV_1– forced expiratory volume for the first second
FVC – forced vital capacity of the lungs
GOLD – Global Initiative for Chronic Obstructive Lung Disease
CAT – COPD Assessment Test
mMRC – modified Medical Research Council
SCORE – Systematic Coronary Risk Evaluation

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