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# Efficacy using modified method of nebulayzer therapy in patients with chronic obstructive pulmonary disease

**Key words:** chronic obstructive pulmonary disease, modified nebulizer therapy, spirometry.

**Introduction.** The current strategy of treatment the respiratory diseases is to maximize the use of inhaled forms of drugs [2, 3]. The success of treatment the bronchoobstructive lung diseases, including chronic obstructive pulmonary disease (COPD), depends not only on the correct choice of basic treatment, but also on device for nebulizer therapy by which medications get into airways. Therefore, an important component of successful therapy is to optimize the work of these devices [4]. Today the receipt of drugs through nebulizer is one of the main places in modern inhalation therapy in patients with chronic respiratory diseases, especially in the presence of exacerbation [3, 12].

The efficiency of aerosol products, their properties and transfer to the respiratory tract depends on the type of nebulizer, its design features, the combination of compressor – nebulizer and others. However, traditional nebulizers have the following disadvantages: the duration of inhalation, relatively low pulmonary deposit of drugs, possible contamination of the device at incorrect service [3]. Among new technical solutions in the field of nebulizer technologies could be noted further development of traditional jet nebulizers. These caused new solutions in a class of adaptive delivery devices, including dosimetric nebulizers, the principal difference between them is the adaptation of production and release of aerosols from the respiratory pattern of the patient [11].

These nebulizers are controlled electronically and are attached to the patient's respiratory rhythm. They generate aerosol strictly to inspiratory phase through special valve that is electronically controlled by sensor. This increases the efficiency of drug delivery, especially to the peripheral bronchi, which is important for patients with COPD. But the disadvantage of such devices is prolonged inhalation and high cost [3, 7].

In COPD patients with prolonged obstruction develops increased respiratory muscle tension, and subsequently in all the muscles. Increase the functionality of the respiratory system by restoring freer breathing can be achieved by the inclusion in the complex of treatment the respiratory gymnastics.

**Objective** – to evaluate the effectiveness of using a modified technique of nebulizer therapy with elements of breathing exercises and the previous detection of the type of bronchial obstruction according to spirometry.

## Materials and methods

The study involved 80 patients with COPD and 30 healthy individuals. All patients were hospitalized with exacerbation of the disease, were informed about the study and expressed their consent. Parameters of respiratory function – type of bronchial obstruction (bronchitis or emphysematous) the magnitude of increase in forced expiratory volume in the first second (FEV<sub>1</sub>) after bronchodilator (more than 15 % is considered to be an effective appointment of «Nebutamol») – were determined using computer spirometry «BTL – Spiro Pro (UK). According to the classification of GOLD 2010, the study involved individuals with II and III degree of bronchial obstruction and risk group B and D. Exclusion criteria: the I degree of bronchial obstruction, the presence of severe comorbid pathology. Saturation of oxygen (SaO<sub>2</sub>) of capillary blood were determined using pulse oximeter OXY-5. 6-minute walk test was conducted in accordance with standard protocol. Patients were informed about the purpose of the test. They were offered to go on the measured corridor at their own pace, trying to get the maximum distance within 6 minutes. During this test was allowed to stop and rest and, if possible, to restore the walk. Before beginning and in the end of the test was assessed the dyspnea for Borg scale, the heart rate,

respiratory rate,  $\text{SaO}_2$ . Patients stopped the test with significant shortness of breath, dizziness, pain in the chest and / or feet, as well as at decrease of  $\text{SaO}_2$  to 80–86 %.

Patients were offered a questionnaire - test evaluation of COPD assessment test (CAT) followed by calculating the total number of points.

The BODE index was calculated by the scale of Celli and co-authors:  $\text{BMI} \geq 21 = 0$  points  $< 21 \text{ kg/m}^2 = 1$ . The scale of dyspnea: 0-1=0, 2=1, 3=2, 4=3. 6-minute walk:  $\geq 350 \text{ m} = 0$ , 250–349 m = 1, 150–249 m = 2,  $\leq 149 \text{ m} = 3$ ,  $\text{FEV}_1$ , % of the proper value:  $\geq 65 = 0$ , 50–64 = 1, 36–49 = 2,  $\leq 35 = 3$ .

A modified method of nebulizer therapy. Patients with COPD were performed the spirometry bronchodilatation test, determined the type of bronchial obstruction (bronchitis or emphysematous), the magnitude of the increase in  $\text{FEV}_1$  after bronchodilator. For inhalation therapy used compression nebulizer «Ulaizer® Home» (Yuria-Pharm, Ukraine). It was selected the individual mode of inhalation (inhalation, exhalation and pause) as an element of breathing exercises, depending on spirometry data and subjective evaluation of inhalation facilities for patients. By installing the emphysematous type of bronchial obstruction the time of expiration was extended by 1,5 times in comparison with the length of the exhalation with bronchia type of bronchial obstruction. With the increase in  $\text{FEV}_1$  more or equal to 12 % in inhaler poured «Nebutamol» (1 ml), with an increase of  $\text{FEV}_1$  less than 12 % «Berodual» (15–20 drops), which combined with «Nebuflusol» (1 ml) and 0,9 % saline (2 ml). The patient was explained that the selection of drugs occurs during the sound operation of the nebulizer, and in this period of time the patient took a breath. Time inhalation accounted for 5–10 minutes inhalation therapy was performed twice a day for 7–10 days.

Patients in the control group received the standard nebulizer therapy using «Nebutamol» and nebulizer taken in doses using direct flow of nebulizer «Ulaizer®» (Yuria-Pharm, Ukraine) without first determining the type of bronchial obstruction and increase in  $\text{FEV}_1$ .

C-reactive protein (CRP) was determined in accordance with the instruction (latex analysis, Germany).

Statistical analysis was performed using the package licensing programs «Microsoft Excel 2010 (Microsoft) and Statistica® 6.0» (StatSoft Inc., USA) using ANOVA test and Wilcoxon test.

## Results and discussion

Clinical characteristics are shown in table 1.

In the analysis of clinical efficacy of using the modified method of nebulizer therapy in COPD patients of the main group on the second day, there was a decrease of cough, amount of sputum, improve of its discharge, the positive dynamics of auscultative parameters in the lungs. In patients of the control group dynamics of these clinical data occurred more slowly (3–4 days of treatment). In COPD patients of the main group there was a significant decrease of dyspnea (42,4 %) and increased tolerance to physical activity (13,5 %) (table 2).

In COPD patients in the control group, which used conventional methods of nebulizer therapy, distance walked by a patient on 6-minute walk test was significantly increased by 9,6 %, shortness of breath decreased by 34,7 %.

Analysis of spirometry data showed that in patients of the main group was noted the improvement of bronchial obstruction ( $\text{FEV}_1$  increased by 13,3 %). Compared with the control group of patients ( $\text{FEV}_1$  increased by 9,6 %),  $\text{FEV}_1$  was on 10,8 % higher by using modified methods of nebulizer therapy.

According to the latest recommendations of the GOLD and standardized protocol, CAT can be used to assess the quality of patients life with COPD, because it has been shown, that it correlates with more complex and cumbersome tests [2, 8, 9].

By assessing the life quality of COPD patients who received a modified method of nebulizer therapy was established a significant decrease in the number of points (37,4 %). The number of points decreased by 17,1 % on the questionnaire CAT in patients of the control group.

It is known that COPD is a multicomponent disease and using only the degree of violation of bronchial obstruction for the prognosis of the disease is unjustified [1]. Therefore, Celli and co-authors suggested scale for assessing the prognosis of COPD, which includes BMI, degree of obstruction, dyspnoea and exercise tolerance [1, 6].

Recent studies have shown that this indicator can be used not only for prediction of mortality among patients with COPD, but also for acute assessment of health status, risk of hospitalization and the severity of the disease, the quality of life of patients, monitoring the progression of COPD [6]. In addition, the BODE index was used as an evaluation of the effectiveness of COPD therapy [1, 2, 6].

By evaluating the BODE index was found that patients of the main group, it was significantly decreased (46 %) and was on 30 % lower, than in patients of the control group.

It is proved that CRP can be used to assess systemic inflammation in COPD patients, serve as a predictor of relapse and disease progression [5], and also as an indicator of the effectiveness of anti-inflammatory therapy [10].

It should be noted that in COPD patients who have used a modified method of nebulizer therapy, significantly decreased the CRP levels (by 39,5 %). In Patients of the control group the decrease in CRP levels was not significant ( $p > 0,05$ ).

Therefore, a modified technique of nebulizer therapy, which consists of the combination of elements in breathing exercises (differentiation time mode of inhalation, exhalation and pause) with the production of aerosol during inhalation, and a preliminary determination of the type of bronchial obstruction and response to bronchodilator drugs, gives the opportunity to improve the effectiveness of treatment of acute COPD exacerbation, to reduce the duration of inhalation, drug dosage and to have economic benefits for the patient.

## Conclusions

The use of modified methods of nebulizer therapy in patients with chronic obstructive pulmonary disease during exacerbation contributes to accelerated regression of clinical symptoms, and also leads to a significant decrease in the degree of airway obstruction, dyspnea, improve tolerance to physical activity and quality of life of patients. The BODE index can be used to assess the effectiveness of nebulizer therapy for acute exacerbations of chronic obstructive pulmonary disease. An indicator of the effectiveness of the modified method of nebulizer therapy is a significant decrease in CRP levels.

Clinical characteristics					Table 1
Parameters	Individuals with normal spirometry test (n = 30)	Patients with COPD, study group, (n = 40)	Patients with COPD, control group, (n = 40)	p, p <sub>1</sub>	
Age, years	60,90 ± 2,12	65,33 ± 1,34	62,53 ± 1,42	p >0,05 p <sub>1</sub> >0,05	
men/women, number	22/8	29/11	30/10		
BMI, kg/m <sup>2</sup>	25,82 ± 0,55	29,41 ± 0,83	28,49 ± 0,85	p <0,05 p <sub>1</sub> >0,05	
Smoking history, pack-years	10,97 ± 2,16	19,70 ± 3,26	20,26 ± 2,60	p <0,05 p <sub>1</sub> >0,05	
mMRC scale, points	0,60 ± 0,10	2,07 ± 0,13	2,37 ± 0,12	p <0,001 p <sub>1</sub> >0,05	
CAT, points		15,29 ± 1,25	14,88 ± 1,10	p <sub>1</sub> >0,05	
FEV <sub>1</sub> , % predicted value post-bronchodilator test	97,33 ± 2,35	47,43 ± 2,74	42,43 ± 1,92	p <0,001 p <sub>1</sub> >0,05	
FEV <sub>1</sub> /FVC, % predicted value post-bronchodilator test	86,90 ± 1,44	67,52 ± 1,91	66,27 ± 2,28	p <0,001 p <sub>1</sub> >0,05	
6-minetes walk test, m	592,83 ± 23,96	323,90 ± 20,84	282,46 ± 18,30	p <0,001 p <sub>1</sub> >0,05	
BODE index, points	0,50 ± 0,12	3,85 ± 0,40	4,07 ± 0,41	p <0,001 p <sub>1</sub> >0,05	
Oxygen saturation, %	96,50 ± 0,36	93,59 ± 0,51	93,32 ± 0,57	p <0,001 p <sub>1</sub> >0,05	

Notes:  
 1. n – number of patients in the subgroup.  
 2. p – probability of difference compared with the group of practically healthy persons.  
 3. p<sub>1</sub> – the probability of difference between the group of patients on chronic obstructive pulmonary disease in control and main groups.

Dynamics of indicators using modified methods of nebulizer therapy in patients with chronic obstructive pulmonary disease					Table 2
Parameters	Control group (n = 30)		Study group (n = 30)		
	Prior treatment	After treatment	Prior treatment	After treatment	
FEV <sub>1</sub> , % predicted value post-bronchodilator test	40,13 ± 1,92	44,13 ± 1,94 p <0,001	42,91 ± 2,53	49,47 ± 2,58 p <0,001 p <sub>1</sub> = 0,001	
mMRC scale, points	2,42 ± 0,14	1,58 ± 0,11 p = 0,001	2,36 ± 0,15	1,36 ± 0,11 p <0,001 p <sub>1</sub> >0,05	
6-minetes walk test, m	314,53 ± 22,50	347,83 ± 21,79 p <0,001	279,70 ± 18,04	323,50 ± 19,14 p <0,001 p <sub>1</sub> >0,05	
CAT, points	19,07 ± 1,45	15,80 ± 1,27 p <0,05	17,37 ± 1,27	10,87 ± 0,95 p <0,05 p <sub>1</sub> <0,05	
BODE index, points	4,20 ± 0,50	3,00 ± 0,40 p <0,001	3,83 ± 0,50	2,07 ± 0,32 p <0,001 p <sub>1</sub> <0,05	
C-reactive protein, mg/l	9,37 ± 0,87	8,77 ± 1,10 p >0,05	10,30 ± 0,89	6,23 ± 0,50 p <0,001 p <sub>1</sub> >0,05	

Notes:  
 1. n – number of patients in the subgroup.  
 2. p – probability of differences before and after treatment; p<sub>1</sub> – probability of difference between the group of patients on chronic obstructive pulmonary disease in control and main groups.

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**ЭФФЕКТИВНОСТЬ ПРИМЕНЕНИЯ  
МОДИФИЦИРОВАННОЙ МЕТОДИКИ НЕБУЛАЙЗЕРНОЙ  
ТЕРАПИИ У БОЛЬНЫХ ХРОНИЧЕСКИМ  
ОБСТРУКТИВНЫМ ЗАБОЛЕВАНИЕМ ЛЕГКИХ**

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## Резюме

Данная работа выполнена с целью оценки эффективности использования модифицированной методики небулайзерной терапии с использованием элементов дыхательной гимнастики и предварительным определением типа бронхиальной обструкции по данным спирографии.

**Материалы и методы.** Обследовано 80 больных ХОЗЛ и 30 практически здоровых лиц. Больным основной группы (40 пациентов) предназначалась модифицированная методика небулайзерной терапии с предварительным определением типа бронхиальной обструкции по данным спирографии, величины прироста объема форсированного выдоха за первую секунду (ОФВ<sub>1</sub>) после бронходилатации и подбором индивидуального режима ингаляции.

**Результаты и их обсуждение.** Использование модифицированного способа небулайзерной терапии у больных ХОЗЛ приводило к ускорению положительной динамики клинических показателей обострения болезни, рост толерантности к физическим нагрузкам (на 13,5 %). Отмечалось улучшение бронхиальной проходимости (ОФВ<sub>1</sub> возрос на 13,3 %), существенное уменьшение количества баллов (на 37,4 %) по опроснику теста оценки ХОЗЛ и количества баллов индекса BODE, существенное уменьшение уровня С-реактивного белка (на 39,5 %).

**Выводы.** Использование модифицированной методики небулайзерной терапии у больных ХОЗЛ во время обострения болезни способствует ускоренному регрессу клинической симптоматики, существенному уменьшению степени обструкции дыхательных путей, одышки, улучшению толерантности к физической нагрузке и качества жизни пациентов.

**Ключевые слова:** хроническая обструктивная болезнь легких, модифицированная небулайзерная терапия, спирография.

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**EFFICACY USING MODIFIED METHOD OF NEBULAYZER  
THERAPY IN PATIENTS WITH CHRONIC OBSTRUCTIVE  
PULMONARY DISEASE**

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## Summary

This work is carried out to assess the efficiency of the modified technique of nebulizer therapy using elements of breathing exercises and previous detection type of bronchial obstruction according to spirometry.

**Materials and methods.** The study involved 80 patients with COPD and 30 healthy individuals. Patients of the main group (40 patients) was attributed a modified technique of nebulizer therapy with previous detection type of bronchial obstruction according to spirometry, value of increased forced expiratory volume in the first second after bronchodilation and individual selection mode inhalation.

**Results.** Using the modified method of nebulizer therapy in patients with COPD led to an acceleration of positive dynamics in clinical signs of exacerbation, increased exercise tolerance (13.5 %). Was noted the improvement of bronchial obstruction (FEV<sub>1</sub> increased by 13.3 %), a significant decrease in the number of points (37.4 %) with COPD questionnaire test score and the number of index points BODE, a significant reduction of CRP (39.5 %).

**Conclusions.** Using modified techniques of nebulizer therapy in patients with chronic obstructive pulmonary disease during exacerbation contributes to rapid regression of clinical symptoms, substantially reduced the degree of airway obstruction, dyspnea, improve exercise tolerance and quality of life of patients.

**Key words:** chronic obstructive pulmonary disease, modified nebulizer therapy, spirometry.

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