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Physical activity patients with bronchial asthma depending on controlled course of the disease

Key words: *bronchial asthma, physical activity.*

In recent decades have seen a significant increase in interest specialists to the problem of physical activity in patients with bronchial asthma (BA) [2, 3]. The relevance is that patients with asthma level of physical exclusion – one of the main psycho-emotional stress causes hindering the normal way of life of the patient, remains high [6, 10]. Especially the question arises the question for people of working age, which is characterized by sedentary life. They have formed the so-called "physical intolerance," leading to disability and in some cases early disability [13]. Since the cardiorespiratory system has a crucial role in physical activity was necessary because of early diagnosis of functional lesions [1, 4].

Test with dosed physical activity is the ideal and most natural method provocation to assess the usefulness of physiological compensatory – adaptive mechanisms of the organism, and the presence of overt or covert pathology – the degree of functional disability cardiorespiratory system [5, 7, 8]. Tests using physical activity based primarily on the need for increased oxygen consumption due to the transfer of the body under load to a higher metabolic rate and quantity of oxygen consumed during the growing workload is exactly reproducible quantitative measure that can be used to evaluate the patients [9, 11].

Changes in functional state of cardiorespiratory system under the influence of physical activity currently well understood primarily in healthy individuals, athletes and patients with cardiological diseases. In the literature there are works that relate to this issue in patients with asthma. According to the authors, after performing at maximum load in patients increased minute volume of blood flow (Hawk), increased resistance in the pulmonary circulation (ICC), increased pressure in the pulmonary artery, often appeared on the electrocardiogram T-wave voltage reduction, shift down segment PQ and segment ST. In addition, the observed cardiac arrhythmia by type of arrhythmia and paroxysmal tachycardia. There is evidence that patients with asthma exercise provokes bronchoconstriction [17, 18]. The main cause bronchospasm caused by exercise or hyperventilation is cooling airways, loss of moisture and heat, as well as increased osmolarity of bronchial mucus in these circumstances. The effect of these factors in patients with asthma causes degranulation of mast cells due to their increased ability to release inflammatory mediators, as evidenced by an increase in plasma concentrations during exercise histamine and several other mediators [14, 22].

Deepening the degree of obstruction, the ability to deepen breathing and to increase respiratory volume and lung ventilation in patients with asthma in response to reduced physical activity. They are characterized by a significant increase in respiratory rate which is supported by the appropriate load minute volume of respiration (PROGRESS). Changes of lung function parameters help to increase the time patients adapt to physical activity and a significant increase in energy costs. According to the same authors, were found quite close correlation between indicators of central hemodynamics and respiratory function, which constitutes a violation of coordinated cardio – vascular and respiratory systems, and there are different options hemodynamics in unilateral change in respiratory function in patients during and beyond attack [16, 23]. Therefore, the main goal of this work was to investigate physical activity in patients with asthma of moderate severity depending on the controllability of the disease.

Materials and Methods

Research conducted at the SO «National Institute Phthysiology and pulmonology named after F. G. Yanovsky NAMS of Ukraine». The study involved 30 people with an average degree of asthma (constant presence of long daytime symptoms, exacerbation on average every 3–4 months, frequent nocturnal symptoms, partial restriction of physical activity caused by asthma or POSex FEV1 of 60 % to 80 % of appropriate, daily fluctuations POShvyd or FEV1 > 15 % increase in frequency of use β_2-agonists short-acting inhaled up to 8 overnight, courses of oral corticosteroids is not more than 1–2 times a year). When the diagnosis of asthma was taken into account history, clinical symptoms, indicators of lung function, reversibility of obstruction in the sample with bronchodilators. The selection of patients by severity of asthma was conducted in accordance with the criteria of the Order of the Ministry of Health of Ukraine № 128 from 19.03.2007 "On approval of clinical protocols of care, specialty "Pulmonology". The group included 14 men and 16 women, mean age (51,3 ± 2,2) years, FEV1 (64,5 ± 2,2) %, FEV1/FVC (76,8 ± 1,9) with a duration of asthma (15,9 ± 1,8) years, the frequency of asthma exacerbations – (2,1 ± 0,3) times/year who received only standard basic therapy remission, which includes the use of inhaled corticosteroids and β_2-agonist for short-acting purchase of asthma symptoms. At the beginning of observation in all patients, whom it was

Table 1

Performance lung volumes, capacities, bronchial obstruction in patients with asthma with persistent course of moderate severity in acute and remission (M ± m)

Indicators	Patients with asthma moderate severity (n = 30)	
	acute phase	remission phase
1	2	3
R tot (%)	135,5 ± 78,2	131,4 ± 78,2
IC (%)	92,6 ± 4,4	98,4 ± 4,4
VC_{MAX} (%)	95,2 ± 4,9	99,4 ± 4,9
ERV (%)	102,5 ± 5,5	103,1 ± 5,5
RV (%)	89,2 ± 6,7	93,5 ± 6,7
ITGV (%)	98,7 ± 5,2	96,6 ± 5,2
TLC (%)	108,3 ± 7,2	105,6 ± 7,2
FEV_1 (%)	59,3 ± 5,6	68,4 ± 5,6*
FVC (%)	79,3 ± 2,4	82,3 ± 2,4
FEV_1 / VC_{MAX} (%)	85,6 ± 3,8	86,6 ± 3,8
MEF_{75} (%)	51,9 ± 6,9	68,4 ± 6,9*
MEF_{50} (%)	42,4 ± 8,7	53,2 ± 8,7*
MEF_{25} (%)	29,3 ± 10,2	35,5 ± 10,2*
PEF (%)	69,8 ± 10,5	76,9 ± 10,5*
DLCO (%)	69,8 ± 4,1	73,6 ± 4,1
KCO (%)	68,5 ± 5,6	69,2 ± 5,6
VA (%)	93,4 ± 3,2	96,4 ± 3,2
V_{IN} (%)	96,2 ± 5,2	97,3 ± 5,2
FRC (%)	94,3 ± 3,2	96,2 ± 3,2

Note. * Clinically significant difference between the performance in the second group of patients during exacerbation and remission ($p < 0,05$).

necessary, the correction was underlying disease under treatment severity of the disease. Hard comorbidity was not observed in any of the patients. As controls were examined 25 healthy volunteers had no clinically significant severe pathology.

In the course of work used the following methods:

General – clinical, collecting medical history, review of patient research ventilation lung function and determine violations of exercise tolerance and determination of the basic mechanisms of these disorders in patients with asthma using cardiorespiratory stress test (on «Erhopnevmotest» OM/05-C («Erich Jaeger», Germany) and erhospirometry system Oxycon Pro – Version JLAB 4.67 produced by VIASYS Healthcare (Germany), statistics [15, 19, 21, 24, 25].

Results and discussion

The study found that during exacerbations of asthma in patients with moderate severity course, vital capacity, forced vital capacity, forced expiratory volume in the first second, peak expiratory volume velocity, instantaneous expiratory flow volume reduced, monitored upward trend in values of bronchial resistance and residual volume of the lungs, reducing intrathoracic gas volume and capacity breath.

In evaluating the data, on acid – base and blood gas state, found that patients with asthma with persistent course of moderate severity present minor effects compensated respiratory acidosis as an exacerbation and in remission (see table 2)

Analysis of the data showed the following veloerhospirometry datas. Regardless or exacerbation or remission phase of asthma – physical activity decrease from moderate to severe. The mechanism for this is that the functional activity of the respiratory system due to chronic bronchospasm reduced, so the air gets to the lungs, according to a lesser amount, and therefore less oxygen to the bloodstream is supplied to the muscles. This confirmed the reduced erhospirometry indicators of the activity of respiratory system in absorption and utilization of oxygen: V'O2 / kg reduced to (5,8 ± 1,2) ml/min/kg, V'O2 / kg to (72,8 ± 2,4) %, V'O2 to (83,1 ± 3,5) %, V'O2p (78,6 ± 3,3) %, V'O2max, to (87,5 ± 2,4) %, V'O2 (V-slope) – (2292,6 ± 120,5) ml/kg, V'CO2 (V–slope) – (2339,2 ± 104,6) ml/kg, RER – (1, 02 ± 0,1)%, BR – (72,9 ± 4,2) %. There were discounted rates that reflect the efficiency of the cardiovascular system: dHR/dO2 to (75,6 ± 6,5) %, HR/VO2 to (6,9 ± 2,2) beats/ml/kg, HR to (125,9 ± 3,1) l/min and (84,1 ± 2,8)%, VO2 / HR (10,8 ± 2,5) brs/ml/kg and (89,5 ± 1,1) %, HR/Vkg to (8,1 ± 4,1) beats/min/kg, SAT (182,8 ± 6,1) mmHg, DAT to (71,2 ± 4,5) mmHg, SpO2 – (92,2 ± 8,5) %.

As a result, decreasing exercise tolerance and level of work performed: W to (68,6 ± 3,6) % and (0,7 ± 0,2) W/kg, (97,2 ± 5,8) BT, dO2/dW to (6,5 ± 1,1) ml/min/watt, MET to (4,2 ± 1,3) r. o., RW (0,6 ± 0,1) W/kg, PMA (76,8 ± 5,8) %, dyspnea score on a scale debt before the test was (0 ± 0,0) scores on a scale dyspnea score debt after the test was (3,9 ± 0,4) points.

After 3 months of observation, in remission of asthma, significant changes in estimated parameters compared with aggravation, was not. There was no significant change in terms of the efficiency of the cardiovascular system, resulting in exercise tolerance and level of work performed and the physical activity of patients remained reduced. More detailed information is presented in table 3.

After a year of observation, in assessing the results of remission, was found no significant changes compared to the period of exacerbation and significant differences with the group of healthy individuals.

Table 2

The evolution of the acid-base and blood gas composition in patients with asthma with the course of moderate severity in acute and remission (and compared to the healthy group) (M ± m)

Показник	Здорові (n = 25)	Хворі із перебігом середнього ступеня тяжкості (n = 30)	
		фаза загострення	фаза ремісії
1	2	3	4
HCO_3, mmol/l	23,8 ± 0,4	24,3 ± 0,5[&]	24,1 ± 0,2[&]
PCO_2, mmHG	36,8 ± 1,2	37,6 ± 1,2[&]	37,4 ± 1,1[&]
PO_2, mmHG	64,7 ± 1,7	61,3 ± 1,0[&]	63,5 ± 1,2[*&]
PH, відн.од.	7,41 ± 0,007	7,41 ± 0,02	7,41 ± 0,004
SO_2, %	97,6 ± 0,7	94,7 ± 0,4[*&]	96,3 ± 0,3[*&]
SBE, mmol/l	-0,7 ± 0,4	2,0 ± 0,3[&]	1,5 ± 0,5[&]
SBC, mmol/l	23,5 ± 0,2	24,8 ± 0,3[&]	24,1 ± 0,2

Notes:
1. * – a difference of compared to the aggravation phase, confirmed statistically (p < 0,05).
2. & – a difference of compared with the rate of healthy, confirmed statistically (p < 0,05).

Table 3

Indicators of cardiorespiratory stress test in patients with asthma dynamics, (M ± m)

Indicators	Healthy (n=25)	Patients with asthma moderate severity (n = 30)		
		acute phase	remission phase	
			3 months of observation	12 months of observation
1	2	3	4	5
The duration of the 3rd phase of the test (min)	12,92 ± 3,2	6,3 ± 2,1#	6,4 ± 2,2#	6,3 ± 2,2#
$V'O_2$/kg (ml/hv/kg)	7,7 ± 1,1	5,8 ± 1,2#	4,2 ± 1,4#	3,3 ± 1,6#
$V'O_2$/kg (%)	82,3 ± 5,6	72,8 ± 2,4#	73,9 ± 2,2#	74,2 ± 2,4#
$V'O_2$ (%)	102,3 ± 5,6	83,1 ± 3,5#	84,9 ± 3,6#	85,3 ± 4,1#
$V'O_{2p}$ (%)	94,3 ± 8,9	78,6 ± 3,3#	78,2 ± 3,2#	77,9 ± 3,6#
$V'O_{2max}$ (%)	99,3 ± 10,3	87,5 ± 2,4#	88,7 ± 2,2#	87,9 ± 2,4#
$V'O_2$ (ml/kg)	2498,3 ± 135,3	2292,6 ± 120,5#	2320,2 ± 122,8#	2315,3 ± 128,8#
$V'CO_2$ (ml/hv)	2106,2 ± 125,3	2339,2 ± 104,6#	2366,3 ± 101,6#	2381,3 ± 111,2#
RER (r.o.)	0,95 ± 0,1	1,02 ± 0,1	1,06 ± 0,1	1,01 ± 0,1
BR (%)	88,1 ± 6,2	72,9 ± 4,2#	73,6 ± 3,6#	73,2 ± 2,3#
t_i (hv)	0,66 ± 0,1	0,52 ± 0,1	0,55 ± 0,2	0,52 ± 0,1
t-ex (hv)	1,28 ± 0,2	1,35 ± 0,4	1,33 ± 0,5	1,31 ± 0,2
t_i/tot (hv)	0,51 ± 0,1	0,50 ± 0,1	0,50 ± 0,1	0,49 ± 0,1
BF (l/hv)	46,5 ± 5,6	51,2 ± 3,1	52,4 ± 3,2	52,3 ± 3,3
BF (%)	88,6 ± 6,1	79,2 ± 6,1	79,5 ± 5,2	78,5 ± 4,8
VDe/VT (%)	11,1 ± 2,5	9,65 ± 1,5	10,2 ± 1,6	9,8 ± 1,8
VDc/VT (%)	19,3 ± 1,2	16,3 ± 2,7	17,5 ± 2,7	16,9 ± 2,9
V'E (l/hv)	7,1 ± 1,5	6,9 ± 1,9	7,0 ± 1,9	7,1 ± 1,8
V'E (%)	58,3 ± 2,1	56,3 ± 3,7	57,1 ± 3,7	53,9 ± 3,2
$V'E/VCO_2$ (%)	23,6 ± 2,2	24,1 ± 4,2	23,8 ± 4,2	23,3 ± 4,1
$V'E/VO_2$ (%)	23,9 ± 1,4	23,3 ± 4,1	23,5 ± 3,9	23,2 ± 3,2
AT (%)	49,65 ± 4,3	48,1 ± 3,5	49,3 ± 3,6	48,9 ± 3,2
SVc (ml)	8,4 ± 1,5	7,1 ± 1,7	7,6 ± 1,7	7,2 ± 1,4
$FECO_2$ (%)	4,01 ± 1,6	3,56 ± 1,1	3,88 ± 1,1	3,82 ± 1,2
$FETCO_2$ (%)	5,23 ± 1,2	4,9 ± 1,9	5,0 ± 1,9	5,2 ± 1,8
$FETO_2$ (%)	16,21 ± 4,4	15,56 ± 2,2	15,74 ± 2,2	14,89 ± 2,4

Continuation of table 3

Indicators of cardiorespiratory stress test in patients with asthma dynamics, (M ± m)

Indicators	Healthy (n=25)	Patients with asthma moderate severity (n = 30)		
		acute phase	remission phase	
			3 months of observation	12 months of observation
1	2	3	4	5
FEO_2 (%)	15,25 ± 5,3	16,24 ± 3,1	15,99 ± 3,1	14,87± 4,1
$FECO_2$ (%)	2,6 ± 0,9	2,0 ± 0,2	2,2 ± 0,2	2,1 ± 0,4
$PETCO_2$ (кPa)	5,92 ± 1,1	4,95 ± 1,3	5,01 ± 1,3	5,14 ± 1,7
$PETO_2$ (кPa)	14,82 ± 3,2	12,89 ± 2,1	13,01 ± 2,1	12,98 ± 3,2
DI (r. o.)	0,69 ± 0,2	0,45 ± 0,1	0,51 ± 0,2	0,50 ± 0,1
W (%)	92,9 ±3,5	68,6 ± 3,6#	72,4 ± 4,1#	72,1 ± 4,1#
W (Wt/кg)	2,9 ± 1,1	0,7 ± 0,2#	0,8 ± 0,1#	1,2 ± 0,1#
W (Wt)	185,0 ± 6,3	97,2 ± 5,8#	96,3 ± 7,1#	95,9 ± 8,1#
dO_2/dW (ml/hv/Wт)	11,42 ± 1,3	6,5 ± 1,1#	6,9 ± 1,1#	6,4 ± 1,1#
dHR/dO_2 (beats/min/ml)	78,6 ± 4,5	75,6 ± 6,4	78,5 ± 6,5	76,5 ± 5,9
HR/VO_2 (beats/ml/kg)	2,7 ± 1,6	6,9 ± 2,2#	6,7 ± 2,1#	6,5 ± 2,8#
HR (l/hv)	112,5 ±8,6	125,9 ± 3,1#	120,8 ± 3,1#	119,3 ± 2,9#
HR (%)	93,5 ± 9,2	84,1 ± 2,8#	85,8 ± 2,9	88,1 ± 2,2
VO_2/HR (sp/ml/kg/)	10,2 ± 2,6	10,8 ± 2,5	6,5 ± 2,1#	7,1 ± 2,2
VO_2/HR (%)	88,6 ± 9,6	89,5 ± 1,1	72,4 ± 1,1#	67,8 ± 0,8#
HR/Vkg (%)	9,2 ± 3,8	8,1 ± 4,1	7,9 ± 3,9	8,2 ± 2,2
SpO_2 (%)	98,6 ± 8,2	92,2 ± 8,5	93,4 ± 8,5	92,9 ± 8,2
CAT (mmHg)	155,3 ± 6,2	182,8 ± 6,1#	181,9 ± 6,2#	182,7 ± 6,2#
ДАТ (mmHg)	82,3 ± 5,3	71,2 ± 4,5#	72,8 ± 4,6#	72,1 ± 4,2#
$EqCO_2$ (%)	24,3 ± 2,3	22,9 ± 2,1	23,9 ± 2,2	23,6 ± 2,4
EqO_2 (%)	25,2 ± 1,2	24,1 ± 2,6	24,9 ± 2,8	24,6 ± 2,1
MET (kcal/kg)	8,4 ± 1,6	4,2 ± 1,3#	4,9 ± 1,4#	5,2 ± 1,2#
RW (relative workload) (W/kg)	1,2 ± 0,1	0,6 ± 0,1#	0,7 ± 0,2#	0,6 ± 0,1#
PMA (patient maximally achieved) (%)	89,3 ± 6,2	76,8 ± 5,8#	80,9 ± 6,5#	82,4 ± 6,1#
Evaluation of breathlessness on a scale debt before the test (points)	0 ± 0,0	0 ± 0,0	0 ± 0,0	0 ± 0,0
Evaluation of breathlessness on a scale debt after the test (points)	0-1	3,9 ± 0,4#	3,3 ± 0,4#	2,2 ± 0,4#

Note. # – A difference of compared with the index of healthy individuals proved statistically (p <0,05).

Conclusions

In patients with asthma of moderate severity, regardless of controllability of the disease during exercise comes as no effective functioning of the pulmonary system, and not productive reaction cardio - vascular. Namely, excessively increasing respiratory minute volume due to respiration rate and not the depth (chronic bronchospasm), systolic blood pressure and heart rate, causing the heart is unable to provide an adequate minute volume of blood to meet the energy in the muscle fibers, removing excess breast acid and maintain adequate muscle work load.

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ФИЗИЧЕСКАЯ АКТИВНОСТЬ БОЛЬНЫХ БРОНХИАЛЬНОЙ АСТМОЙ В ЗАВИСИМОСТИ ОТ КОНТРОЛИРУЕМОСТИ ТЕЧЕНИЯ ЗАБОЛЕВАНИЯ

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Резюме

Основной целью проведенной работы было исследовать физическую активность у больных бронхиальной астмой (БА) средней степени тяжести в зависимости от контролируемости течения заболевания.

Материалы и методы. *Исследования проводились на базе ГУ «Национальный институт фтизиатрии и пульмонологии им. Ф. Г. Яновского НАМН Украины». В исследовании принимали участие 30 человек со средней степенью тяжести БА. При установлении диагноза БА учитывался анамнез, клинические симптомы, показатели функции внешнего дыхания, обратимость обструкции в пробе с бронхолитиком. В начале наблюдения всем больным, которым это было необходимо, проведена коррекция базового лечения в соответствии с тяжестью заболевания. Тяжелой сопутствующей патологии не наблюдалось ни у одного*

из обследованных. В качестве контроля были обследованы 25 здоровых добровольцев, не имевших тяжелой клинически значимой патологии.

Результаты и их обсуждение. *У больных БА средней степени тяжести, независимо от контролируемости заболевания, при выполнении физической нагрузки происходит как неэффективное функционирование легочной системы, так и непродуктивная реакция сердечно-сосудистой, а именно: чрезмерно возрастает минутный объем дыхания за счет частоты дыхания, а не глубины (хронический бронхоспазм), систолическое артериальное давление и частота сердечных сокращений, в результате чего сердце не в состоянии обеспечить адекватный минутный объем крови для покрытия энергозатрат в мышечных волокнах, выведение избытка молочной кислоты и поддержания адекватной нагрузки мышечной работы.*

Ключевые слова: *бронхиальная астма, физическая активность.*

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PHYSICAL ACTIVITY PATIENTS WITH BRONCHIAL ASTHMA DEPENDING ON CONTROLLED COURSE OF THE DISEASE

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Summary

The main purpose of this work was to investigate physical activity in patients with moderate BA, depending on the controllability of the disease.

Materials and methods. *The studies were conducted on the basis of the SI «National Institute Phthysiology and pulmonology named after F. G. Yanovsky NAMS of Ukraine». The study involved 30 people with moderate asthma. Diagnosis of asthma was taken into account history, clinical symptoms, lung function, reversibility of obstruction in the sample with bronchodilators. At the beginning of the observation, all patients that it was necessary, the correction of the base treatment of the disease severity of the disease, respectively. Severe comorbidity was not observed in any of the patients. As a control, were examined 25 healthy volunteers who had no severe clinically significant pathology.*

Results and conclusions. *In patients with asthma of moderate severity, regardless of controllability of the disease during exercise comes as no effective functioning of the pulmonary system, and not productive reaction cardiovascular. Namely, excessively increasing respiratory minute volume due to respiration rate and not the depth (chronic bronchospasm), systolic blood pressure and heart rate, causing the heart is unable to provide an adequate minute volume of blood to meet the energy in the muscle fibers, removing excess breast acid and maintain adequate muscle work load.*

Key words: *bronchial asthma, physical activity.*

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