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OZBEKISTON

KHUDOYBERDIEVA KHAMROKHAN TILAVOLDIEVNA,
KHALILOV OTABEK NEMATILLAYEVICH
SARIMSAKOV BAHODIR MUYDINJANOVICH

STUDY OF EXTERNAL RESPIRATORY FUNCTION IN CHILDREN WITH BRONCHIAL ASTHMA
(Monography)

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(MONOGRAPHY)

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The monograph covers pathological syndromes and diseases that are common in the practice of a pediatrician, as well as in unfortunate cases, which are now quickly diagnosed and provided with modern emergency care, and methods of restoring primary cardiopulmonary resuscitation are shown.

In the monograph, the clinic of some diseases and syndromes that lead to severe cases is covered in detail.

The monograph is intended for pediatricians, general practitioners, resuscitators and narrow specialists, as well as students of the medical institute.

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ANNOTATION

Despite the progress made in the treatment of chronic respiratory diseases in children, this problem remains relevant due to the high incidence of diseases, the absence of a downward trend, frequent exacerbations, poor prognosis. The study of the function of external respiration in children with lung pathology reveals the mechanism, nature and severity of ventilation disorders. The ocular mechanisms of impaired respiratory function in chronic nonspecific lung diseases are airway obstruction and a decrease in lung tissue extensibility, as well as emphysema and hypoxemia associated with this.

АННОТАЦИЯ

Несмотря на достигнутые успехи в лечении хронических заболеваний органов дыхания у детей, данная проблема остается актуальной из-за высокой заболеваемости, отсутствия тенденции к снижению, частых обострений, плохого прогноза. Изучение функции внешнего дыхания у детей с патологией легких позволяет выявить механизм, характер и выраженность вентиляционных нарушений. Глазными механизмами нарушения функции дыхания при хронических неспециических заболеваниях легких являются обструкция дыхательных путей и снижение растяжимости легочной ткани, а также связанные с этим эмфизема и гипоксемия.

ANNOTATSIYA

Bolalarda surunkali respirator kasalliklarni davolashda erishilgan yutuqlarga qaramay, bu muammo o'zining yuqori darajasi, pasayish tendentsiyasining yo'qligi, tez-tez kuchayishi va yomon prognoz tufayli dolzarbligicha qolmoqda. O'pka patologiyasi bo'lgan bolalarda tashqi nafas olish funktsiyasini o'rganish ventilyatsiya buzilishlarining mexanizmini, tabiatini va zo'ravonligini aniqlash imkonini beradi. Surunkali nospetsifik o'pka kasalliklarida nafas olish disfunktsiyasining ko'z mexanizmlari havo yo'llarining obstruktsiyasi va o'pka to'qimalarining moslashuvining pasayishi, shuningdek, amfizem va gipoksemiya bilan bog'liq.

ABBREVIATIONS AND SYMBOLS

1. Indicators, determined by the spirography

TV – tidal volume, ml. “TO% ref” refers to the difference between the value of the indicator measured after the load, with such to load (initial) divided by DO to load and multiplied by 100%.

FVC – vital capacity of the lungs, ml. The tables show the percentage from due. “VC% ref” is the difference between the VC measured after the load, and VC before the load, referred to the VC before load and multiplied by 100%.

MVB – minute volume of breathing, ml. “MVB% ref.” difference between MOD after load and MOD before load, referred to MOD to load and multiplied by 100%

MCB – maximum speed of forced exhalation, l/sec. IN tables are given as a percentage of the due.

MCB – exhalation speed of the middle part of the forced vital capacity (in the interval of exhalation 25-75% FVC), l/s The tables are given as a percentage of due.

RLV – residual lung volume, ml. The tables are given in percent of due.

MOC – minute oxygen consumption, ml/min. “PC% ref” – difference between PC after load and PC before load, referred to to PC before load and multiplied by 100%.

FVC – forced vital capacity, ml. In tables given as a percentage of due.

FVC_1 – the ratio of the volume of FVC exhaled in 1 second to the total FVC multiplied by 100%.

1. Other func tional indicators.

B/P – blood pressure, mmHg (BPs systolic arterial pressure).

ABS – acid-base state of the blood.

MVH – minute volume of the heart, ml.

FES – forced expiratory speed, determined pneumotachometer, l/sec. The tables are given as a percentage from due. “PTH% ref.” - the difference between PTH after load and PTH before load, referred to PTH before load and multiplied by 100%.

HRM – heart rate per minute. In tables given is given as a percentage of due.

$PaCO_2$, PCO_2 , PaO_2 , PO_2 – carbon dioxide (CO2) voltage and oxygen (O2) in arterial blood, mm Hg

PQ, QRST–electrocardiogram (ECG) indicators. In tables are given as a percentage of due, calculated for this heart rate.

1. DESIGNATIONS RELATED TO CLINICAL CHARACTERISTICS

BA – bronchial asthma

FT – physiotherapy

XNLD – chronic nonspecific lung diseases.

XP – chronic pneumonia

Contents

FOREWORD

Despite the progress made in the treatment of chronic respiratory diseases in children, this problem remains relevant due to the high incidence of diseases, the absence of a downward trend, frequent exacerbations, poor prognosis Chernysheva O.E et al. 2014; Chichkova N.V 2018 ; Hoho_A.N 2014 ; Fomina D.S. 2015. Recent years have been marked by the introduction of pulmonological and functional research methods into the clinic of childhood diseases, which have made it possible to discover many new things in the pathogenesis of bronchial asthma and chronic pneumonia in children and led to the creation of a new classification of these diseases in children. The study of the function of external respiration in children with lung pathology reveals the mechanism, nature and severity of ventilation disorders. The ocular mechanisms of impaired respiratory function in chronic nonspecific lung diseases are airway obstruction and a decrease in lung tissue extensibility, as well as emphysema and hypoxemia associated with this (Solovyeva I.A. 2017; Samigumina N.V. 2016; P.A. Boneria et al. 2013). Functional methods are highly effective as objective criteria for the results of therapy, and especially when testing new treatments. It should be emphasized that advances in diagnosis are generally superior to those in the treatment of chronic nonspecific lung diseases in children.

To date, the effect of dosed intense physical activity on the function of the cardiorespiratory system and the performance of children suffering from chronic lung diseases remains little studied.

The indications for the use of physiotherapy exercises with intensive exercise in such patients depend on the solution of this issue. As is known, physical activity often provokes shortness of breath in pulmonary patients and the rehabilitation of such patients is closely associated with an increase in the threshold of exercise tolerance.

CHAPTER 1. PULMONARY FUNCTION AND PHYSICAL LOAD TOLERANCE IN CHILDREN WITH BRONCHIAL ASTHMA AND CHRONIC PNEUMONIA IN THE PERIOD

The development of new directions in the treatment of chronic nonspecific lung disease (COPD) of childhood requires close attention to the choice of the phase in which pathogenetically oriented therapy can bring the greatest success. It is most reasonable to consider the period without exacerbation as such a period, while most studies are devoted to the issues of therapy just at the height of the acute phase of the disease. It seems important to give a brief summary of the pathophysiology of disorders in bronchial asthma (BA) and chronic pneumonia (CP) in children.

§ **1.1. Pathophysiology of lungs and cardiovascular system in bronchial asthma and chronic pneumonia in children.**

There is a unanimous opinion in the literature that respiratory disorders during an attack of asthma are associated with three main factors: spasm of the smooth muscles of the bronchi as a result of an increase in the tone of the vagus nerve; with swelling of the bronchial mucosa due to the expansion of capillaries; with a sharp increase in the secretion of the bronchial glands and blockage of the airways of the bronchi. The consequence of bronchial obstruction is alveolar hypoventilation, decreased PO2 in the alveoli, and hypoxemia. In response to a decrease in PO2 in the alveoli, a reflex spasm of the pulmonary artery system occurs with an increase in pressure in it. Pulmonary hypertension is supported by emphysema that develops during attacks.

The leading pathogenetic mechanism that causes clinical manifestations in asthma is a violation of bronchial patency, which occurs due to bronchospasm, hypersecretion of bronchial glands, pathological impulses from the bronchial tree and lungs, catarrhal state and edema of the bronchial mucosa, which leads to an uneven distribution of inhaled air in the alveoli . Part of the alveoli is poorly ventilated, but the blood flow in poorly ventilated areas often remains preserved.

There is a dissociation between ventilation and blood flow, the blood leaves the lungs insufficiently saturated with oxygen, which leads to oxygen deficiency. These are the modern established ideas (V.N. Mineev 2014 ; S.A. Pribylov 2016 ; Apasheva, Sh.A 2013; J.W. Dexheimer 2014; C. Rodrigue 2016).

With regard to the oxygen supply of the body of a child with asthma, there is a lot of unclear and controversial. Most researchers recognize that oxygen deficiency, especially during an asthma attack and in status asthmaticus, is clearly expressed, but questions about the mechanisms of its development, the role of oxygen debt in the pathogenesis of this suffering are still poorly understood. Needs further resolution and the question of the mechanisms of protection on the part of the body to the action of oxygen deficiency in AD. Only in recent years, single works have appeared in the literature that highlight the participation of the respiratory, cardiovascular, nervous and erythrocyte systems in the formation of compensatory-adaptive mechanisms for oxygen deficiency in children with asthma (Balabolkin, I.I. et al., 2015; Batozhargolova , B.Ts et al., 2016; Brodskaya, O.N 2016). Meanwhile, the study of the mechanisms of compensation and adaptation to oxygen deficiency is of great importance, especially in pediatric practice, since the child's body is especially sensitive to oxygen deficiency throughout all age periods (Brylinskaya, Yu.O 2016).

In children with asthma, a decrease in PaO2 is associated with a violation of the distribution of gas in the lungs and a right-to-left blood shunt through non-ventilated atelectic areas of the lungs. An increase in shunting, due to vascular resistance due to hypoxemia and acidosis, leads to cor pulmonale, right ventricular failure. Bypass, determined by cardiac catheterization, during an attack can reach 38-50% versus 2-7% in healthy people (E.Nigro 2015).

H.W. Hallas et al. (2019) observed the dynamics of changes in blood gases in patients with chronic pneumonia. The results of the control study after 3-5 years showed a significant deterioration in the values of PaO2 and PaCO2 in the observed period of time. Deterioration in blood gases PaO2 and PaCO2 correlated with parameters of airway obstruction, primarily with one-second forced vital capacity (FVC1) and airway resistance.

Less pronounced was the ratio with the values 00/0EL and MVL. The results indicate the need for a comprehensive study and monitoring of blood gases during long-term follow-up of patients with chronic bronchitis.

J. Bousquet et al. (2019) in a control study of 18 patients with chronic nonspecific lung diseases (COPD) in terms of 3 to 7 years found that 33% of patients died during this time. It is characteristic that out of 4 patients with pathological data on pH and blood gases, only one patient survived after 5 years of the study.

M.S. Taha et al (2014) analyzed the causes of hypoxemia in 18 patients with bronchial asthma, 33 patients with COPD and 18 patients with obstructive pulmonary emphysema.

The study of ventilation of the alveolar space, anatomical right-left shunts, ventilation-perfusion ratios and diffusion capacity of the lungs. The cause of hypoxemia in bronchial asthma is only the presence of areas with hypoventilation (a decrease in the ratio of ventilation to perfusion). In bronchitis, a decrease in PaO2 was also caused by a decrease in global alveolar ventilation and an increase in anatomical right-left shunts. The occurrence of hypoxemia in patients with emphysema was proportional to alveolar hypoventilation, low regional ventilation-perfusion ratios, and impaired pulmonary diffusion. The results indicate a difference in intrapulmonary gas exchange in the observed groups of diseases.

Anderson, W.C (2015) showed that the correlation of mean pulmonary artery pressure, lung volume and blood gases in patients with chronic obstruction is high, excluding the relationship between mean pulmonary artery pressure and residual lung volume. The dynamics of the mean pressure in the pulmonary artery, on the one hand, and changes in the volume of the lungs and blood gases, on the other hand, correlate poorly with repeated studies in patients in whom, during the study in an exacerbation, the pressure in the pulmonary artery was significantly higher than without an exacerbation. In such patients, more pathological abnormalities were found in relation to FVC, PaO_2 and $PaCO_2$. In patients in whom the pressure in the pulmonary artery was not increased during the control study, the volume of the lungs and blood gases did not undergo positive dynamics. This is evidence that, on the basis of a violation of one lung function, it is impossible to judge the presence and degree of impairment of another lung function.

A reliable judgment about lung function in patients requires a comprehensive study of ventilation, respiration and hemodynamics.

The study of the degree of hypoxia in COPD is of great importance for understanding the pathogenesis of hemodynamic disorders of the pulmonary circulation (A. Malinovschi 2015). According to Bushuev, E.V. (2015), the most important pathogenetic link in such patients is hypoxic hypoxia with impaired blood oxygenation. An experiment with healthy individuals in a pressure chamber convincingly showed that, depending on the degree of hypoxia, hemodynamics and cardiodynamics are disturbed, and their violations occur already at an altitude of 2000 m above sea level with a moderate violation of blood oxygenation and continue to change with an increase in hypoxia. At the same time, the most informative indicators of altered hemodynamics of the pulmonary circulation and a decrease in the contractile function of the myocardium are an increase in systolic pressure in the pulmonary artery, impaired blood rheology in the vessels of the lungs, and a change in the phase structure of the cardiac cycle.

I.N.Zakharova (2015) showed that the dynamics of the human cardiovascular system during physical work in a modified gas environment depends on the level and rate of change in PO_2 and PCO_2 in the environment. When performing the same physical activity in the atmosphere with an increase in hypoxia (decrease in PO_2 to 100 mm Hg) and hypercapia (increase in PCO_2 to 45 mm Hg), the increase in the myocardial tension index (BP x HR) and the cardiac index in the subjects are inversely proportional the rate of change of the gas medium: the slower the rate, the greater the increase in indices. It is shown that the change in the physical performance of the subjects observed depending on the rate of increase in hypoxia and hypercapia is closely related to the dynamics of the increase in the index of myocardial contractility.

According to the study of the blood gas composition of Verbova, A.F. (2016), all patients (COPD) were divided into three groups: with minor, moderate and pronounced changes in PaO2 and PaCO2.

Blood gases and functional indicators of respiration changed in the direction of deterioration in parallel. In the most severe hypoxia (PaO2 60 mmHg and below), VC was only 49.8+3.2% of the predicted value, FVC was reduced to 0.60+0.10%, and bronchial resistance increased to 2.21+ 1.50 cm w.c.l-1.s. In patients with hypercapnia, the most pronounced changes in respiratory parameters were noted - a decrease in VC to 44.4±2.7% due and an increase in lung volume by 4.03±0.85 liters compared with the norm. As dyspnea progressed in COPD patients, the degree of heart failure also increased. In patients with bronchial asthma, hypoxemia (74.2±3.2) and hypercapnia (47.1±2.1 mm Hg) were noted.

The data of the conducted studies revealed the nature of progressive respiratory failure associated in the vast majority of patients with airway obstruction. The progression of respiratory disorders shortened the remission period, predetermined the need for repeated hospitalization, and indicated the need to develop more effective methods of treatment for this group of patients compared to traditional ones.

Gubanova, G.V. and E.M. Klotokova (2014) studied PaO2 in arterialized capillary blood at rest and under constant load in 83 children aged 5-15 years with chronic lung diseases. The authors established the dependence of PaO2 as at rest. So with the load, the prevalence of lesions in 31% of patients. In healthy children, the load contributed to an increase in PaO2 by 4 mm Hg, in patients - by 6.6. It follows from the work that hypoxemia is a late sign of respiratory failure.

The issues of the uniformity of lung function - regional ventilation and ventilation - perfusion ratio in bronchial asthma - have not been studied enough.

Meanwhile, it is known that uneven ventilation that accompanies asthma underlies respiratory failure, leads to the development of alveolar hypoxia and, ultimately, to arterial hypoxemia (M.Cazzola 2019).

E.S. Dobyalova and G.K. Barkun (2015) believe that in assessing the function of external respiration, it is of great importance to determine the release of carbon dioxide from the body, which allows, on the one hand, to judge hypercapnia, and on the other hand, to draw a conclusion about the ratio of ventilation and blood flow. In the control group of 16 people, there was no increase in CO2 in the alveolar phase on the capnogram, and the average increase was only 0.28 mmHg. (fluctuations from 0 to 1.4). The difference from the data of other authors is due to different approaches to determining the beginning of the alveolar phase.

PaCO2 at the end of expiration (in the alveolar air) was on average 5 mm Hg. below PaCO2 in arterial blood: the first ranged from 35.1 to 44.8 mm Hg, while the second ranged from 36.5 to 56.0 mm Hg. The authors examined 15 patients with COPD. If, according to the magnitude of the increase in PaCO2, we judge, as is customary, the ratio of ventilation and blood flow, then we can observe a progressive violation of this balance with an increase in heart and especially pulmonary insufficiency.

According to Guryev, L.L (2014), in the group of patients with mild BA, there was an increase in bronchial resistance, a redistribution of lung volumes. With an increase in the severity of the course of BA, an increase in the 00/0EL index is observed, corresponding to the degree of emphysema.

Ershova A.V. (2014) conducted a comprehensive study of lung volumes and indicators of bronchial patency in children with asthma, and significant changes in lung volumes were revealed. The degree and nature of these changes were determined by the clinical features of the disease. The most pronounced increase in the residual volume of the lungs (00), functional residual capacity (FRC) and the ratio of these values to the total lung capacity (and) with a sharply reduced VC was noted in the onset period of asthma. During an asthma attack, the degree of these changes was more significant than in patients who were in a long-term asthmatic state.

Changes in the values of lung volumes with the use of various bronchodilators in the onset period of the disease indicated a different genesis of bronchial obstruction. A distinct positive dynamics of the studied values during asthma attacks, not associated with inflammatory changes in the respiratory system, indicated "Acute" swelling of the lungs and confirmed the leading role of bronchospasm in the violation of bronchial patency. At the same time, in patients with an active infectious process, lung volumes under the influence of bronchodilators almost did not change. The persistent nature of bronchial obstruction in this case, in all likelihood, was due to vasosecretory disorders and inflammatory infiltration.

In the non-attack period of the disease, the most pronounced and persistent increase in the residual volume of the lungs was observed in children with severe bronchial asthma in the presence of inflammatory changes in the bronchopulmonary apparatus. The results of the conducted studies can be used to substantiate a number of therapeutic effects and decide on the duration of their use in children with various forms of bronchial asthma.

Important conclusions about the function of external respiration were made by O.S. Kobyakova (2017). So, in children with asthma, there is bronchial obstruction, insufficiency of the ventilation function of the lungs, uneven alveolar ventilation, a decrease in respiratory reserves, which indicates deep violations of the function of external respiration, the severity of which depends on the severity, period of illness and exacerbation of concomitant diseases. Clinical improvement is far ahead of the recovery of functional indicators and they do not reach the proper values even in the interictal period.

A decrease in FVC1 and Tiffno's test are the most sensitive indicators that allow you to detect early signs of bronchial obstruction, still hidden from the doctor's eye, and therefore serve as a signal for the need to take measures to prevent the development of an attack. These indicators can be used in pediatric practice to assess the effectiveness of therapy and predict the duration of the interictal period.

Violations of the function of external respiration leads to the development of arterial hypoxemia. Blood oxygen saturation in the attack period is reduced to 89.2 - 92.8% at a rate of 96%. As the condition of the patients improves and catarrhal phenomena in the lungs are eliminated, blood oxygenation increases, approaching the norm in most children in the interictal period. Only in the severe course of the disease does hypoxemia last for a long time, which indicates profound violations in the mechanisms of blood oxygen saturation in AD. The correlation analysis between lung function indices showed that the development of arterial hypoxemia is most affected by uneven alveolar ventilation. In the period of an attack, the degree of severity of bronchial obstruction also plays a significant role in the violation of oxygenation.

Blood oxygenation does not depend on the volume of pulmonary ventilation, the value of VC, the amount of oxygen absorbed and the efficiency of its use. As studies by Ivannikov A.S. (2015) a comprehensive study of the parameters of respiratory mechanics at the initial stages of the disease, even with a limited form of chronic pneumonia, reveals hidden obstruction. This dictates the need to include bronchodilators in the complex treatment of stage 1 CP (according to Dembo's classification). At the same time, the extensibility of the lungs is not fully restored, which indicates more persistent changes in the structure of the lungs, which are the result of limited pneumosclerosis. In patients with stage 2 CP, obstructive pathology is combined with an equally pronounced restrictive process. It follows from this that it is more correct to speak of the predominance of an obstructive and restrictive syndrome, and not of a restrictive or obstructive process. The dynamics of respiratory mechanics parameters in this group of patients is insignificant. Bronchial resistance decreases, but does not reach a normal value and to some extent remains above the norm throughout the respiratory cycle.

The modern concept of BA treatment aims to have a therapeutic effect on the entire body and, first of all, by influencing the central nervous system through its reflex mechanisms, while symptomatic therapy should be given a subordinate position (Ilyenkova, N.A. 2015; M.V. Smolnikova 2017; E A.Sobko 2018; M.Y.Elseify 2018).

An integrated approach, taking into account the individual characteristics of the patient's body and the peculiarity of the course of the disease, is currently the basis for the treatment of chronic pneumonia as well. This is explained by the fact that the variety of factors involved in the pathogenesis of chronic nonspecific lung diseases requires the use of a wide variety of means and approaches to effectively influence, if possible, all parts of the pathogenetic process. Among pulmonologists, the opinion about the need to include physiotherapy exercises as an obligatory component in the complex of therapy has become widespread.

The complexity of the treatment of chronic nonspecific lung diseases in children is ensured, as emphasized by most experts, by the inclusion in the rehabilitation program, along with therapeutic and breathing exercises, of such activities as physiotherapy, aeronization, vibration chest massage, drug therapy. It is especially desirable to carry out such a complex against the background of sanatorium-resort treatment (N.G. Astafiev 2015; Kolosova, N.G. 2014; M.Maniscalco 2019).

An obstacle to the study of the physiology of muscular work in healthy and especially sick children is the lack of an acceptable non-invasive method for measuring hemodynamic changes that occur under the influence of physical exercises. In this regard, various combinations of functional studies have been proposed, such as the determination of pulmonary capillary blood flow, diffusive capacity of the lungs, maximum oxygen consumption, functional residual lung capacity, blood volume in the lung tissue along with the blood volume in the pulmonary capillaries (A. Cepelis 2018). It is quite clear that such complex tests do not find application in pediatrics.

There is extensive material in the literature on the results of electrocardiography in COPD (Kosyakova, N.I. 2016; Kuzina, E.N. et al., 2017; Kurbacheva, O.M. damage to the lung parenchyma. Not only during an asthma attack, but also outside it, a number of characteristic ECG changes are noted: low voltage of the P2, P3 and Pa waves, an increase in the P and T waves, deviation of the electrical axis to the right. out of 100 patients. The absence of such a wave in almost all patients gives the authors the right to assume that for some period, and sometimes for a long time, there is no hypertension of the small circle. the appearance of isoelectric and negative P1, S-T shift below the isoelectric level. The right type of ECG is detected in 15-20% of patients, the left - in 25%. then the frequency of detected disorders, as well as a decrease in the voltage of the QRS complex teeth and the T wave, increases in parallel with the severity of the disease.

The authors explain the ECG changes by alveolar hypoxia, which causes myocardial hypoxia, as well as by the presence of a focus of infection, which is revealed by a decrease in T and P voltage. A certain role in the genesis of ECG disorders is assigned to a change in the position of the heart in the chest.

Lebedenko, A.A. et al. (2015) studied the reactions of the external respiration apparatus in patients with COPD to physical activity. It has been established that a three-stage bicycle ergometric test allows you to determine the threshold load, evaluate the functional reserves of the respiratory and cardiovascular systems, and identify latent respiratory failure. The decrease in pneumotachometry during exercise tests, found by the authors, is interpreted as evidence that in a number of patients during exercise, signs of obstructive pulmonary insufficiency are revealed, which are absent in the study of external respiration under basal metabolic conditions.

An increase in minute oxygen consumption (OC), along with a significant decrease in the oxygen utilization factor during submaximal physical activity, indicates a violation of gas exchange and requires appropriate correction and improvement in the diffusion capacity of the lungs and elimination of ventilation-perfusion disorders. A number of patients received not deterioration, but improvement in pulmonary function; from here it was concluded that in case of damage to the bronchopulmonary apparatus, there are compensatory capabilities of the body that allow increasing VC and PTH and thereby improving alveolar ventilation. This should be taken into account when carrying out rehabilitation measures, including physical exercises in the rehabilitation therapy complex. A slight increase in oxygen pulse in response to submaximal physical activity indicates a reduced functionality of not only the respiratory apparatus, but also the cardiovascular system in patients with COPD, a decrease in the efficiency of the heart and the efficiency of hemodynamics.

Disturbances in the function of external respiration and the functional state of the vascular and nervous systems found in the onset period of bronchial asthma, as well as exacerbations of chronic pneumonia, persist in many patients in the non-exacerbation period, especially in severe forms of the disease.

The more pronounced the deviations of the indicators in the period after the exacerbation, the more likely the occurrence of a new exacerbation (this is especially true for BA). The patient, as it were, is in constant readiness for an exacerbation of the disease. This dictates the need for long-term complex treatment of children with COPD (P. Carter 2019).

§ 1.2. The effect of physical activity on bronchial patency and other functional indicators in children in normal conditions and with lung disease

An overview of research on the effects of physical activity on the lungs in health and disease is available in the proceedings of a symposium held in the USA in 1976 (E.W. de Roos et reed, 2018). During exercise, bronchodilatory stimuli (sympathicotonia, an increase in the concentration of catecholamines) and bronchoconstrictive stimuli (release of mediators from mast cells) occur.

Bronchial dilatation - as judged by an increase in maximum exit velocity (MSV) - most 1 minute after the start of the load. The narrowing of the bronchi in children is greatest 1-3 minutes after the end of the load (M.C. Tattersall, 2015-2018; S.J. Morgan et al., 2014). A sharp decrease in MSF, the appearance of shortness of breath and wheezing in the lungs during or after the end of the load is a sign of asthma “stress” (exercise-induced astma).

Bronchospasm develops reflexively in response to cooling of the trachea and large bronchi as a result of hypoventilation (C.K. Billington et al., 2017; M. Cazzola et ingram, 2018; M. Cazzola 2019). At high humidity and inhaled air temperature of 370, hyperventilation and exercise in the majority of moderately severe BA patients reduce MVC by about 4 times less than when breathing air at room temperature and humidity (for example, after 6-8 minutes of bicycle ergometry with warm moist air, FVC decreased on average by 6.5 ± 5.2%, while when repeating the test after 40 minutes under conditions of breathing room air, a decrease by 53.9 ± 2.5% (J.K. Brozek, 2017) As shown by the experiments of R. Buhl et al. (2019), G. Liccardi (2016), Cano-Garcinuno (2014) and others, hypocapnia during exercise and volitional hyperventilation has no significant effect on bronchospasm.

Most foreign researchers believe that if a patient with periodic asthmatic attacks after exercise gives a sharp deterioration in spirography (in particular, a decrease in MRV by more than 15% of the original), then this is an unconditional sign of bronchial asthma (E. Shafuddin et al 2018; M.C. Tattersall , 2018; S.J. Morgan 2014). However, some patients with BA in the laboratory are able to give bronchospasm on exertion only with the introduction of an allergen (whereas on the street and without an allergen - S.J. Morgan (2014) 107 children treated in the clinic for BA were examined before and after running along the corridor. more than 10% of the original was obtained in 83% of patients treated without hormones, and 93% treated with steroid hormones. Approximately 10% of BA patients consistently showed an increase in MSV after running. When the load is carried out using a bicycle ergometer, this percentage is always higher, primarily because bicycle ergometry is carried out in a room, and running in a corridor or outside, where the temperature and humidity are lower (E. Shafuddin et al 2018; J.K. Brozek, 2017).

An increase in MSV or FVC after a load of more than 15% of the initial one, as well as a decrease in these indicators lower than in healthy people, is interpreted as a sign of increased bronchial lability - (S.J. Morgan 2014; M.A. Sparks et al 2014). The latter is inherited and is the genetic basis of b/p (M.C. Tattersall, 2018). Before the onset of the disease in children with allergies, physical activity and other provocateurs often cause a decrease, but an increase in the MSV. This phenomenon is observed in many children with periodic shortness of breath and dry wheezing (that is, with asthmatic syndrome), and the transition to a stable bronchoconstrictor reflex (clinically in asthma) occurs under the influence of environmental factors and, in particular, respiratory viral infections. In healthy people, after exercise, the MSV decreases to 10-15% of the original. The opposite reaction is observed in asthmatic syndrome, in relatives of patients with asthma and asthmatic syndrome, in asthma convalescents and in chronic bronchitis. The greatest increase in MVS, indicating the expansion of the bronchi, is observed in cystic fibrosis - an average of 20% of the original (C.Antoine 2018; N.Wunderlich 2019; F.M.Ducharme 2014; M.C.Tattersall, 2018).

Not all researchers agree with this interpretation of the results of the dynamics of bronchial patency in connection with the load.

According to L.N. Abbakumov (2016), in physically trained adolescents, VC and PTH do not change after exercise, while in untrained adolescents they either increase (which is interpreted as a favorable reaction) or decrease (adverse reaction). At the symposium (E.W. de Roos et Reed, 2018), it was doubted that, based on a sharper decrease in MRV in BA, compared with healthy ones, we can talk about greater lability of the bronchi, as small as in healthy people, bronchospasm should lead to to a sharper increase in aerodynamic drag and a decrease in MSV.

The difference in the conditioning of the inhaled air alone cannot fully explain the difference in the action of different loads. The greatest decrease in MSV occurs after running (accordingly, the most pronounced increase one minute after the load is 15% of the original). Treadmill reduces MSV more than a bicycle ergometer, and the smallest decrease (equal to the smallest increase in MSV a minute after the start of the load) is during swimming (Nenasheva N.M 2014; M.C. Tattersall, 2018). It is unclear why the prophylactic effect of intal on post-exercise bronchospasm in atonic BA is somewhat weaker than in infectious-allergic BA (S.Durrani 2015).

It is practically important that with repeated loads, a decrease in bronchospasm is observed and adaptation to the load of an asthmatic patient is possible (W.J.Song 2014; M.Jain 2018). Bronchospasm is less caused by intense short (less than three minutes), as well as long-term (15-20 minutes) exercise (S.Durrani et J.K.Brozek, 2017).

Some children are able, as it were, to “Overtake” asthma: when they begin to have difficulty breathing, they do not slow down their runs and shortness of breath recedes. The mechanism of bronchospasm has a refractory phase. At this point, the mast cells "discharged", threw out the active substances. This is judged, in particular, by measuring the content of histamine in the blood (S.J. Morgan 2014). After the destruction of mediators, it takes some time before the mast cells are “charged” again.

Physical exercise tolerance in terms of functional indicators of blood circulation and gas exchange in patients with COPD is significantly lower than in healthy people (Nenasheva N.M 2014; C.A. Ducsay 2018). Recent authors have studied healthy children and patients with asthma aged 11–13 years when creating increasing loads on a bicycle ergometer, and the power limit in healthy people was

2.77 W/kg, and in patients 1.82 W/kg. All studied patients received bronchodilators, and 17 - hormones. The conclusions of the work are as follows: in BA, the maximum aerobic capacity is significantly reduced. Patients stop exercising upon reaching a lower minute oxygen consumption and heart rate, which indicates a decrease in cardiovascular and metabolic reserves. Patients are prone to greater hyperventilation (mainly due to an increase in tidal volume), which is explained by reduced regional ventilation-perfusion ratios (with hyperventilation in these situations, pulmonary gas exchange improves). The noted tendency to greater tachycardia, as well as relatively increased oxygen consumption, is partly associated with the intake of sympathicotonic medications. Characteristically, there is no decrease in the ratio of inspiratory to expiratory rate (stably observed during exercise in healthy people), which causes bronchial obstruction. It is she who limits the exercise tolerance in a patient with asthma - when at rest FVC1 is below 60% of due, VC is below 80%, and 00 is above 35%. No correlation was found between the severity of functional changes before exercise and the tendency to bronchospasm after it.

§ 1.3. The role of physical dosed load in the diagnosis and treatment of bronchial asthma and chronic pneumonia

An objective assessment of therapeutic agents for bronchial asthma is difficult because most patients are highly suggestible (Nurgazizova A.K. 2014) gives improvement in most patients.

E.LFD.Gomes and D.Costa (2015) report that almost every new treatment for bronchial asthma is effective for some period. With physical therapy, if the patient believes that it helps him, the effect will be obtained regardless of the characteristics of the exercises performed. With any asthma treatment, it takes at least six months to evaluate the results (and then if this does not include summer). “Significant improvement” should be considered the cessation of seizures for at least 6 months (A.A. Odegova, 2016). The effective use of physical therapy (LFK) in bronchial asthma requires the objectification of the functional capabilities of the patient's body and the appropriate appointment of optimal power and non-damaging loads. According to the classification of physical activity, they are individualized and their power depends on the proper maximum oxygen consumption. However, the type of exercise aimed at increasing overall physical endurance is determined depending on the “motor history”, age, body weight and other parameters of the patient. On this basis, some patients are recommended running, others - walking, the third - their combination with individualization in the appointment of speed, intervals, maximum permissible loads. It is especially important at the same time to identify cardiac reserves, the possibility of compensation and take them into account when prescribing modes and timing of exercise therapy (T.P. Markova 2016.

K.C. Gracia, 2017; J. Sundh et al, 2017. According to Y. I. Verigo et al. (2017), the main requirement for exercise therapy in children with bronchial asthma is to take into account the nature of the clinical manifestations of asthma and age-related characteristics inherent in preschool, junior and middle groups children. These two factors (Yu.Yu. Pankratova et al. 2016) are supplemented by taking into account the state of the function of external respiration. Other clinicians also adhere to this position (I.D. Kaib 2016; N.S. Pahomya 2015; A.V. Pochivalov 2016; H.Hisinger-Molkanen 2019; S.Durrani 2015.

For a long time in pediatrics, the doctor's attention was focused mainly on the prevention of pulmonary infection in COPD in children, and less attention was paid to the condition of the respiratory muscles, which must adequately withstand the level of hard work caused by respiratory failure. However, the strength and endurance of the respiratory muscles can be improved (D.Readler et N.Ballenberger, 2015; J.Dratva et al 2018.

D.Readler et N.Ballenberger 2015, B.Nordlund 2014). At the same time, the reversal of exercise tolerance in patients with COPD significantly improves and, in particular, the maximum ventilation of the lungs increases, although the indicators that specifically characterize lung function - MSV, FVC1, VC, PaO2 - according to most authors, do not improve (M.J. Hung 2015; D.Readler et N.Ballenberger

2015; J.Dratva 2018; D.J.Jackson 2014). So. M.Jesenak et al. (2017) in the study of 13 patients with cystic fibrosis before and after 3 months of jogging revealed a significant increase in exercise tolerance in 5 patients, in the other 4, the same work was performed at a lower heart rate, in 4, working capacity has not increased. No changes in pulmonological tests were noted.

Many researchers associate the beneficial effect of physical activity for patients with pulmonary diseases with their effect on performance, neuromuscular coordination and mental state. (M.Johnson 2019, P.T.Muller 2018; L.Marques de Mello 2016; M.C.Mirabelli 2016; A.H.Morice 2018; T.Nurmagambetov 2018; S.G.Kapadia 2014; H.Okura 2016; M.Angelalncalza 2018).

The severity of the beneficial effect of physical training in bronchial asthma, according to various authors, is different. E.A. Ozcan et al (2016) in children in the interictal period of BA after the training run program received a decrease in the frequency and intensity of attacks of bronchial asthma caused by physical activity, while when using swimming, children developed endurance, but tolerance to the induction of "tension asthma" remained without change . Nenasheva N.M (2014); Parlar Chun (2019); J.Parnell (2019); J.Pernow (2019) . as a result of active physical activity carried out in children in the interictal period of BA, they achieved an increase in physical performance, a decrease in the provocation of attacks by exercise, but did not receive a significant effect on indicators of airway obstruction, determined at rest. On the contrary, A.A. Girina (2014); V.P. Puzyrev (2015); S.N. Avdeev (2018); I.N. Shishimorov (2015) report an improvement in most spirographic indicators.

E.Yu. Barabash et al. (2017) as a result of complex treatment with the use of intensive physical training in children with BA and CP in remission, they received a significant clinical effect, improved exercise tolerance and improved spirographic parameters of lung function (maximum pulmonary ventilation,

oxygen utilization rate, vital capacity and reserve increased). breathing). Follow-up observations with a period of 1-5 years confirmed the effectiveness of complex treatment. So, in 63% of children, persistent relief of asthma attacks was achieved, in 32%, the attacks decreased to 1-2 per year instead of 4-5 monthly, and only in 5% of cases there was no improvement. 31% of those who completed treatment were deregistered by a pulmonologist.

In children suffering from chronic pneumonia, in 78% of cases, persistent stabilization of remission periods occurred. There was a decrease in the number of days of incapacity for work of parents by more than 2 times, whose children exacerbated in 2022.

Works by V.V. Kalyuzhin (2016); V.M. Troshin et al. (2014); E.M. Sagadeeva (2015); N.V. Samigullina (2016); E.A. Vishneva (2014); it has been shown that under the influence of the generally accepted methods of physical therapy (I.A. Solovieva 2017; O.A. Kalpunova 2014;) in children with BA, there is not a sufficiently complete recovery of physical performance of general endurance and tolerance to physical activity. This indicates the need to develop a methodology for physical therapy, which allows for a more complete medical and social rehabilitation of children with asthma. All of the above indicates the relevance and need for further research on this topic.

Concluding the review of the literature on the issue of physical activity in bronchial asthma and chronic pneumonia, and the development of criteria for its applicability, one should point out the scarcity of these data on childhood. Despite the general opinion about the need to introduce physical training into the medical complex, the issues of dosage and criteria for harmlessness and effectiveness have not been resolved. It is to this question that our book is devoted.

CHAPTER 2. CHARACTERISTICS OF PATIENTS, METHODS OF TREATMENT AND EXAMINATION

The present work is based on the analysis of case histories of 70 children with bronchial asthma (BA) and chronic pneumonia (CP) who were treated in the children's clinic in Fergana. Of the 70 children, 50 suffered from bronchial asthma and 20 from chronic pneumonia. The distribution of patients by sex and age is presented in Table 1. In 26% of patients, BA was classified as atopic, in 42% it was infectious-allergic, in 32% it was mixed, in 12% it was mild, in 58% it was moderate, in 30% it was severe (the main patients treated with steroid hormones). 68% were admitted to the clinic in the post-attack period, the rest were in remission in the inter-attack period. More than half of the patients (60%) were in the age group of primary school age. The predominance of boys (57%) among children with chronic pulmonary diseases is emphasized in the literature (V.A. Polunina 2015; O.M. Uryasyev 2015; D.V. Ushakova 2018; N. Chiamvimonvat 2017). In the anamnesis, the children had frequent recurrences of the underlying disease and repeated acute respiratory viral infections.

Physical development, classified according to I.A. Soloviev (2017), as well as the methodological recommendations of L.I. Agapitov and I.V. Leontiev 2015 and A.G. Chuchalin and Z.R. Aisanov 2014 was as follows. Among 40 BA patients treated without the use of hormones, 21 had an average level of physical development, 6 were high, 10 were above average, 3 were below average. In the group of 10 BA patients treated with hormones, 6 had an average level of physical development, 2 were above average, 2 were below average. Among 20 patients with CP, 8 children had an average physical development, 3 high, 9 above average. In the BA group treated without the use of hormones, the majority of patients had an exacerbation in the autumn period. The attacks were repeated 2-3 times a month, they were stopped by theofedrine, intravenous infusion of aminophylline. In the BA group treated with hormones, exacerbations occurred in autumn and winter, 2-3 times a week. The duration of the attacks was 1.5-2 hours. They were

Table 1

Distribution of patients by age and sex

Form of the disease	**Age (in years)**						Total
	7 – 9		**10 – 12**		**13 - 15**		
	B	**G**	**B**	**G**	**B**	**G**	
1. Asthma treated without the use of steroid hormones							
a) infectious - allergic	6	4	2	2	1	1	16
б)atonic	4	2	1	1	1	1	10
в)mixed	5	3	2	2	1	1	14
1)The course of the disease							
a) heavy	-	1	2	1	1	-	5
б) medium heavy	13	7	3	3	2	1	29
в)lung	2	1	1	1	1	-	6
2)Disease period							
a) paroxysmal	-	2	2	3	1	-	8
б) post-attack	10	8	4	3	3	2	30
в) remission period	1	-	-	1	-	-	2
2. Asthma treated with steroids hormones (all patients with severe course)							
a) infectious and allergic	2	1	1	1	-	-	5
б) atopic	1	1	-	-	1	-	3
в) mixed	-	1	-	-	1	-	2
1)Disease period							
a) paroxysmal	2	1	1	-	2	-	6
б) post-attack	-	1	2	1	-	-	4
3. HP (all enrolled in exacerbation period)							
a)without bronchiectasis	5	2	3	1	1	-	12
б) with bronchiectasis	3	1	2	1	-	1	8

treated with bronchodilators and prednisolone. All BA patients, with the exception of two who were admitted to the clinic in remission, initially complained of cough and shortness of breath. Children with a hormone-dependent form complained of almost constant shortness of breath, fatigue, irritability, mood instability.

On objective examination: the chest was barrel-shaped in 26 cases, in the remaining 24 cases it was normal. During percussion of the chest, a sound with a box tone (28) or a box tone (20) was noted, an obvious pulmonary sound was determined in two patients. During auscultation, single dry rales were heard in 8 patients, scattered dry rales - in 32, against the background of hard breathing - 10.

Borders of relative dullness of the heart: normal - in 29 children, increased borders to the left - in 21 children. Heart tones are clear in 5 cases, muffled in 30, muffled in 9; systolic murmur at the apex - in 2 patients, emphasis on 2 tones on the aorta - in 1, emphasis on the pulmonary artery in 3 patients. The picture of chest radiography was distinguished by a pronounced increase in the bronchopulmonary pattern in 38, moderate - in 6, and significant - in 6 people.

Allergological examination of children with asthma revealed high sensitivity to household allergens in 15 people, food allergens in 7, bacterial allergens in 6, pollen in 5, and cold factor in 17.

The provoking effect of physical activity was noted in all hormone-dependent patients (of which 2 had a strong degree).

In the peripheral blood of BA patients, the average number of erythrocytes was 4.34 ± 0.05 million, the content of leukocytes was 7.98 ± 0.7 thousand, the hemoglobin content was 76.5 ± 1.2% units; ESR - 5.1±0.2 mm/h, eosinophilia - 6.38±0.7%. For patients with chronic pneumonia, the onset of an exacerbation of the underlying disease against the background of acute respiratory infections was typical.

Outside of their exacerbation, CP was not accompanied by an increase in temperature; exacerbations were always manifested by an increase in the number of wheezing, predominantly moist, low-caliber local or widespread, depending on the prevalence of bronchitis. During the period of exacerbation, the condition worsened, muffled heart tones appeared. Bronchological examination revealed endobronchitis of varying degrees of activity.

The duration of the disease was 7.3±0.7 years. In 12 children, chronic pneumonia was without formed bronchiectasis, 4 saccular and 4 cylindrical bronchiectasis; unilateral lesions occurred in 6 patients, in 2 bilateral bronchiectasis. In all patients, the diagnosis was confirmed by bronchography and bronchoscopy.

Studies and the appointment of dosed physical activity in patients with chronic pancreatitis were carried out in the period of incomplete remission against the background of the subsidence of the bronchitis process. All patients during this period had a cough (rough, paroxysmal cough with sputum, more often in the morning), patients complained of shortness of breath, fatigue. On physical examination, the condition is satisfactory. Children are active, skin and visible mucous membranes are pale pink. Percussion in the lungs was noted pulmonary sound with a box tone (2 children), boxed sound (6), dullness of pulmonary sound (3) during auscultation, scattered small bubbling moist rales (9 children), single dry rales (8), hard breathing (3). The borders of the heart were normal (14), increased to the left (6). Heart sounds are clear in 6, muffled in 10, systolic murmur at the apex in 2, emphasis on the pulmonary artery in 2 patients.

Chest X-ray showed increased and deformed roots of the lungs in 13 patients (moderate in 2 and significant in 5 patients). In the peripheral blood of patients with CP, the average number of erythrocytes was 4.25±0.5 million, the content of leukocytes was 8.76±0.8 thousand, the hemoglobin content was 73.9±1.0 units, the ESR was 9.25±1, 3 mm/h The observed patients received the following treatment. Patients with asthma treated without the use of steroid hormones took "complex powder" 2-4 times a day (for the age of 10-15 years, its composition is as follows: luminal 0.015 + ephedrine 0.015 + eufillin 0.05), suprastin ½ tab x 3 times a day, multivitamins. 9 patients received antibiotics (treatment with erythromycin 0.2 x 3 times a day for 7-10 days). Of the patients with bronchial asthma treated with steroid hormones, 4 people received a complex powder, 6 took prednisolone per os at 0.001 per kg / mass and simultaneously took potassium orotate. Along with drug treatment, all patients took physiotherapeutic procedures, vibromassage and respiratory physiotherapy exercises.

Of the 50 asthma patients (40 treated without hormones and 10 hormone-dependent), 14 (8 and 6, respectively) were admitted to the clinic in the attack period, 34 (30 and 4, respectively) in the post-attack period, and 2 patients treated without the use of steroid hormones were admitted in the interictal period. period. The study and treatment with the use of physical activity started when the patients were in a satisfactory condition at 2.1±0.5 days after the end of the attack. 9

patients received a course of treatment for 8-10 days with erythromycin (0.1 per kg /mass), all patients received sulfodimesin (0.5 x 3 times a day) for 5-8 days, vitamin B1 - 5% - 1, 0 intramuscularly for a course of 10 injections, ascorbic acid 0.1 x 3 times a day, calcium gluconate 0.5 x 3 times a day. All patients from 1 to 3 times in the clinic received endobronchial sanitation, as well as vibromassage and drainage. All received physiotherapeutic treatment - UHF - during the period of exacerbation, then electrophoresis with calcium and magnesium (in the absence of pus).

The central place in the clinical picture of asthma is occupied by an asthma attack, which is caused by difficulty in exhaling against the background of spasm of the smooth muscles of the bronchi. Therapeutic exercise, affecting the central nervous system, can first of all change the nature of the general and local reactions of the body. Of the methods of physical therapy, therapeutic exercises were prescribed (complexes of therapeutic exercises were built according to the schemes proposed by Prof. D.S. Fomina. When dividing children into groups for physical therapy, the age and severity of the disease, the functions of external respiration were taken into account Therapeutic exercises were aimed at general physical training, strengthening the respiratory muscles, reducing bronchospasm, normalizing and regulating breathing.Chest massage was performed according to the classical method in the morning in the supine position.

§ 2.2 Therapeutic exercise by prescribing dosed physical activity using a bicycle ergometer (justification and methodology)

The complex of treatment of patients includes the method of dosed physical activity, carried out by means of bicycle ergometry. This treatment was prescribed in a satisfactory condition of patients, after the end of the attack period in BA and in the period of incomplete remission against the background of the subsidence of bronchitis in patients with chronic pancreatitis. In the BA group treated without steroid hormones, physical activity was introduced on day 3.1±0.2 after admission to the clinic; in the BA group treated with hormones - at 6.7±0.3 days after admission to the clinic and in the CP group - at 3.3±0.2 days.

Only in two children of the 1st group (BA treated without hormones, this method of treatment provoked asthmatic dyspnea at the first use, and therefore, in one patient, therapeutic bicycle ergometry had to be abandoned), but in the other, the technique was reintroduced (as a result, with great success - after a week of drug therapy). In the rest of the patients, the effectiveness of the dosed load from the very first session was undeniable, and in all patients, usually on the first day of classes (at the latest - on the second), bronchodilator medications were canceled. In 9 patients with CP, the course of bicycle ergometry was interrupted for 3-4 days due to therapeutic bronchoscopy.

The use of dosed physical activity is based on the principle of pathogenetic treatment. The deterioration of the function of external respiration in patients with bronchial asthma and chronic pneumonia is largely associated with a change in the mechanism of the respiratory act (violation of the normal ratio of the respiratory phases due to difficulty in exhalation, superficial increased breathing, discoordination of respiratory movements, etc.) all this disrupts ventilation and gas exchange and reduces the adaptive capacity of the respiratory apparatus to the increased requirements imposed by physical activity (fast walking, climbing stairs, physical work), which was observed in 13 patients with asthma. Drug therapy only partially eliminates the violation of respiratory function. Changes such as the inspiratory position of the chest, weakened difficult expiration, tension of the respiratory and skeletal muscles, etc. require corrective exercise therapy.

In addition to strengthening the respiratory muscles, maintaining a more even ventilation of the lungs and ensuring sufficient oxygen tension in the arterial blood, when prescribing physical activity sessions, they also counted on their positive effect on the neuropsychic state of patients, on mood and emotional status, increasing the overall tone of the body, causing a feeling of cheerfulness and faith in a good result of treatment. Like all therapeutic agents, physical activity obviously requires dosing, and the latter is easiest to do with the help of a bicycle

ergometer. The use of dosed physical activity through bicycle ergometry in the complex treatment of patients with bronchial asthma and chronic pneumonia does not contradict the principles of a therapeutic and protective regimen. An active and strengthening regime contributes to the development of a more stable “dynamic stereotype” with increased working capacity and is also a “protective regime” that protects a sick organism from slight vulnerability and rapid exhaustion. Using dosed physical activity in the complex treatment of patients with bronchial asthma and chronic pneumonia, we first of all tried to achieve an improvement in the clinical course of a pulmonary disease and, as an objective reflection of this, an improvement in lung function. an attack, which occurred in most cases on the 3rd day after admission to the clinic in patients treated without the use of hormones, and on the 6-7th day in hormone-dependent patients. Two patients with asthma who were admitted to the clinic in the interictal period received this treatment on the 2nd day of hospitalization. In patients with chronic pancreatitis, therapeutic bicycle ergometry was usually started on the 3rd-4th day after admission to the clinic in the period of a decrease in the activity of the bronchitis process, always without fever and with relative stabilization of the condition. A prerequisite for classes for all patients with asthma and CP is the desire of the child to become more active (“ride a bicycle”). The selected load mode was as follows: power 1.5 watts per 1 kg of body weight at a cadence of 60 pedals per minute. Classes were carried out daily for 15-20 minutes 6 times a week, for a course of 10-20 sessions.
When choosing the load mode, the following circumstances were taken into account: time less than 15 minutes (like the load, less than 1.5 watts/kg), according to our data, does not create in children a feeling of satisfaction similar to that when playing sports, and the session time longer than 30 minutes is tiring for most patients. The duration of the load is about 15-20 minutes, justified by the laws of physiology of stress tests. For a shorter load time, the oxygen consumption curve takes place in all cases, which indicates a favorable restructuring of the cardiopulmonary system (transition to a steady state).

We used a KE-12 bicycle ergometer manufactured by Medikor (VNR). The conditions for conducting bicycle ergometry are shown in Fig.1.

Fig.1. Conducting a session of dosed physical activity on a bicycle ergometer KE-12

A load of 1.5 W or 9 kg / min / kg corresponds to the initial (first) test in a three-stage step test for weakened schoolchildren and convalescents (I.A. Solovieva, 2017). A similar load on a bicycle ergometer for 10-15 minutes was given to healthy schoolchildren by the authors of the monograph, ed. R.V. Khursa and D.A. Shikhnebiev (2015), but their pedaling speed was about 100 per minute, while in our studies it was 60 per minute.

J.Lin et al (2018) used 2-minute repeated loads with a power of 1.4-4.0 W/kg for exertional asthma in children outside the stage of exacerbation. The patients ran, squatted, walked up the stairs; their pulse rate during exercise exceeded 170 per minute (this work is close to ours and was published after the collection of the material presented here was completed. In the patients we observed, the use of such high powers seems dangerous. On the other hand, according to our data, the load is lower 1.5 W/kg undoubtedly gives subjective dissatisfaction and is less able to increase the degree of fitness, while this effect was quite demonstrative at a load of 1.5 W/kg. 3), which is one of the proofs of session security.

During the time, the pulse and respiration rates were recorded from three superimposed electrodes on a Sirekust monitor manufactured by Siemens (Germany). Observation of the recovery period of the load lasted 5-7 minutes, which corresponded to the return of oxygen uptake figures and other functional indicators and initial values.

§ 2.3. Functional research methods

To solve the tasks set, a complex of functional methods for studying the cardiorespiratory system was used: spirography, pneumotachometry, spirometry, electrocardiography, examination of gases and acid-base balance (ABR) of blood.

1. S p i r o gr a f i i. We used Gould-Godart equipment, a Pulmonet spirograph with a Godamatic computer, which provide automatic measurement of tidal volumes, bringing them to standard conditions of pressure, temperature and humidity (BTPS) and printing on paper tape the obtained indicator, due and percentage of deviations from the norm. The “Godomatic” standards are calculated depending on the height of the patient and are close to those according to S.V. Yakovleva (2016). Studies were performed at 10-12 am after a light breakfast, patients were examined in a sitting position.

2. The following indicators were determined (abbreviated Russian and english names in brackets; interpretation given according to N.A. Geppe and A.B. Malakhov 2014; I.N. Protasova and O.V. Peryanova 2014; M.V. Degtyareva et al. 2017 ; T.V. Spichak 2014.

3. Functional residual capacity (FRC; FRC) ml - lung volume after a quiet exhalation. Increases with emphysema, decreases with restriction, atelectasis, pulmonary edema.

4. Residual volume (00; RV) ml - lung volume after maximum exhalation. Increases with emphysema. Along with an increase in FRC, it is sometimes the only sign of latent obstruction of the small bronchi. It also increases with insufficiently deep exhalation. It decreases with restriction, with atelectasis, pulmonary edema.

5. Relative residual volume (00/0EL%; RV/TLC%) is the ratio of 00 to total lung capacity (0EL) multiplied by 100%. is increasing with emphysema. The indicator is more sensitive than the previous one in relation to the diagnosis of emphysema, subject to good cooperation during the test.

6. Forced vital capacity (FVC) ml - the maximum amount of air exhaled forced after the deepest possible breath. In the absence of obstruction, the FVC value is close to the vital capacity (VC) performed with a full slow exhalation. With obstruction, FVC is less than VC by more than 10%. A decrease in FVC (as well as VC) is pathognomonic for restriction.

7. Volume of forced vital capacity inhaled in 1 sec divided by FVC and multiplied by 100% (FVC1; FVC1%). Decreases with obstruction, increases with restriction.

8.Maximum (peak) expiratory flow rate (MSV; PEFR) l/sec. Measured during forced exhalation. It decreases with airway obstruction, as well as with a weakening of expiratory gain.

9. Maximum exhalation rate 25-75% FVC (MSV 25-75; FEF 25-75) l/sec. A decrease in this indicator indicates obstruction.

This is one of the most sensitive indicators of asthmatic type obstruction. MSV 25-75 is slightly dependent on muscle effort and cooperation (especially with obstruction). With restriction, MSV 25-75 is normal or increased. In addition to these main indicators, Godamatic automatically calculates and analyzes 26 other indicators and draws a “volume-flow” loop. In Fig.2. given a copy of one of the protocols printed by the machine. In the first column, the English name of the indicator, in the second – the due value, in the third – the measured value as a percentage of the due value, with sharply deviated indicators highlighted. At the bottom there is a loop “volume – flow”. When making a functional diagnosis of emphysema, obstruction and restriction, all indicators given by the device were taken into account, but only 7 of the above were statistically analyzed. In addition, “Pulmonet” allows you to determine the minute oxygen consumption (PC ml / min). The latter indicator, along with the frequency and depth of respiration, was also measured using the Universal Spirograph (Medicor, VNR). Before the load, the subject breathed into the “Universal Spirograph” for 1-2 minutes, and the last 30 seconds were taken for analysis. During this time, the respiratory rate was counted and multiplied by 2, thus calculating the respiratory rate per minute (RR min-1). Minute volume of respiration (MOD ml) was calculated by summing the heights of the spirogram at 20 seconds and multiplied by 3. Tidal volume (MOD ml) was calculated by dividing MOD by RR. Minute oxygen consumption (PC ml/min) was calculated in the same part of the spirogram, where the tidal volume was determined, from the height of the rise in the oxygen uptake curve. After the load, the spirogram was analyzed during the first 20 seconds, as soon as the subject got off the bicycle ergometer and connected to the spirograph. The values obtained were multiplied by 3 to obtain figures per minute. After the load, the spirogram was analyzed during the first 20 seconds, as soon as the subject got off the bicycle ergometer and connected to the spirograph.

The values obtained were multiplied by 3 to obtain figures per minute. The definition of PC is important when conducting stress tests. PC is usually estimated by referring to kg of mass or to M2 of body surface. Under load, during excitation, as well as during an exacerbation of the disease, PC increases (as well as RR, DO and MOD, and with obstruction, DO increases more, and with restriction of RR). The higher the PC, which the subject is able to create during physical activity, the higher his “aerobic capacity”, the higher the fitness. Under the influence of training, there is also an increase in the “oxygen pulse” - the ratio of PC to the heart rate, (S.V. Nikolaeva, 2018). To assess exercise tolerance, the ratio of tidal volume to respiratory rate, the ratio of heart rate to respiratory rate, and the ratio of heart rate to minute oxygen consumption were also evaluated. An increase in during training is interpreted as an improvement in the rationality of breathing (S.V. Nikolaeva 2018). , measured during or immediately after the end of the load, is compared with the same indicator for the subject at rest, and the closer the numbers, the better the correspondence between the function of respiration and blood circulation during the load (A.A. Ploskireva and Yu.N. Khlypovka 2018) - one of the main criteria for the fitness of the subject; as a result of improving physical condition, this indicator increases before, during and after exercise - usually due to the fact that both PC increases and heart rate decreases. The dynamics of exercise tolerance was assessed by comparing PC, BH, TO, MOD, measured at rest, with the same indicators immediately after exercise.

The expiratory pneumotachometer was carried out using a pneumotachometer of domestic production PT-2 according to the generally accepted method (Yu.V. Zolotarev and A.V. Gorelov 2018; E.V. Melekhina and E. Yu.Soldatova 2019). The subject first took a deep breath, and then, taking the mouthpiece of the device into his mouth, made a quick sharp forced exhalation. This procedure was repeated 2-3 times and the highest result was recorded. The resulting indicator (PTH) characterizes airway obstruction. PTH is usually interpreted as the maximum (peak) expiratory flow and is graded in l / s. However, as its correlation analysis with other indicators given by “Pulmonet” and “Godamatic” showed, PTH correlates better with forced vital capacity exhaled in 0.5 sec (FVC 0.5) and in 1 sec (FVC1). Comparison of PTH with spirography indicators was carried out jointly with employees at the Department of Physiotherapy and Medical Control of the Andes State MI. The following results were obtained: correlation coefficients of PTH with FVC1 0.93±0.02, with FVC 0.5 0.96±0.01, with MSF 25-75 0.082±0.06, and with MSF 0.35±0, 05, that is, there is no functional connection between PTH and maximum expiratory flow. The high connection of PTH with FZhEL 0.5 and FZhEL1 was explained by the fact that the inertial properties of the pneumotachometer are such that its arrow reaches the maximum flow value (“acceleration time”) in about 1 sec. Therefore, the device, as it were, cuts off the forced expiratory volume in 0.5-1 sec.

Pneumotachometry was performed in the sitting position. Patients were examined before the load, 1-2 minutes after it began and 2 minutes after the end of the load, immediately after recording the spirogram. 1-2 minutes after the start of the load, the measurement was carried out as follows: the child stopped pedaling, but did not get off the bicycle ergometer. The device was brought to him and he made 2-3 forced exhalations.

Spirometry with the determination of vital capacity of the lungs (VC; VCl) was carried out on the domestic apparatus "Dry portable spirometer" (DSP). To measure VC, the subject first, without connecting to the device, takes the deepest possible slow breath, and then it connects to the device (takes the mouthpiece in the mouth) and produces the deepest unforced exhalation. The procedure is repeated 2-3 times and the highest value is recorded. As with pneumotachometry, measurements were taken before, during, and after exercise. The measurement "during exercise" was usually performed after assessing the PTH, while the child did not get off the bicycle ergometer, but stopped rotating. The highest VC value was chosen from 2-3 measurements. An increase in VC is observed during physical training, a decrease - with a weakening of the respiratory muscles and restriction (ie, with a decrease in the extensibility of the lungs and chest), with pulmonary edema, congestion in the small blood circulation. With obstruction and emphysema, the VC index decreases less significantly than with restriction and a decrease in the alveolar surface.

Electrocardiography was performed on a Mingograph-34 device. An electrocardiogram (ECG) in 6-12 standard leads was recorded before and after the end of treatment. In addition, during physical activity, one ECG lead and heart rate were monitored using a Sirekust cardiac monitor (Siemens) under conditions of dosed physical activity. The electrocardiogram was analyzed by the generally accepted method, assessing pulmonary hypertension, myocardial hypoxia, arrhythmia and the state of intracardiac conduction (E.A. Vyshneva and Namazova-Baranova L.S. 2017)

Blood gases, acid-base state. The direct result of respiratory failure is a change in the gas composition and acid-base state blood. Analysis of the acid-base state and oxygen tension of mixed capillary blood was carried out on the device “Micro-Astrup” (“Radiometer”), blood was taken from the pulp of the finger. The following three indicators were taken as the most important: carbon dioxide tension (PCO2), pH and oxygen tension of mixed capillary blood (PO2). Only the last indicator was statistically analyzed. Decrease below 80 mm Hg. was interpreted as a sign of hypoxemia (Khan.M.A. et al., 2014; Korchazhkina N.B. and Chervinskaya A.V. 2018)

Before prescribing a course of dosed loading and after the end of the course (before discharge from the clinic), all patients underwent spirography using the Pulmonet device, measurement of AFR and PO2, and electrocardiography. Before the first and before the last sessions of bicycle ergometry, a spirogram was recorded on the “Universal spirograph” (measured PC, RR, TO, MOD), pneumotachometry and spirometry were performed (VC was measured using the “SSP” device). The first and last session of bicycle ergometry was always carried out under the control of an ECG monitor (in this case, the heart rate was counted and the ECG was visually assessed). In the first two and last sessions, 1-2 minutes after the start and 1-3 minutes after the end of the exercise session, PTC and VC were measured (before and after these sessions, blood pressure was also measured by the Riva-Roggi-Korotkov method). After the end of the first and last exercise session, a spirogram was recorded (measured PC, RR, TO, MOD), PTH and VC were measured. A full range of studies - spirography on the Pulmonet, as well as the measurement of PC, RR, DO, MOD before and after the exercise session, the measurement of PTH and VC, the evaluation of the ECG on the monitor - were always carried out during the follow-up study. In addition to these mandatory studies, many patients periodically during the course had PTH and VC measured, ECG was evaluated on the monitor, and blood pressure was measured before and after the session.

CHAPTER 3. CLINICAL AND FUNCTIONAL EVALUATION OF THE RESULTS OF DOSED PHYSICAL ACTIVITY

§ 3.1. Patients with bronchial asthma treated without the use of hormones

From the very first day of the beginning of bicycle ergometry sessions, the general tone and well-being of patients improved, the children became more cheerful, more cheerful, their appetite improved. Positive dynamics of the underlying disease was noted: they coughed less often, did not complain of shortness of breath, all children were canceled bronchodilators for 1-2 days (on the eve of the first session of bicycle ergometry, all patients received them, on the 1-2 day of classes they were canceled in 45, for 3-4 days the rest have 5.

The exception is two patients with a severe form of BA - a boy aged 11 and a girl aged 12, who developed mild asthmatic attacks 3 minutes after the start of the first session, which were quickly stopped by a complex powder. The introduction of dosed physical activity into the course of treatment of the girl was refused. This decision is due to the fact that caution is required when testing a new one. It is possible that in combination with drug therapy (especially means of preventing seizures such as intal), a course of dosed loading in this and similar patients would be possible and useful. The boy, after a week of drug treatment, was again prescribed bicycle ergometry and he received a course of it with a good result (according to the reaction to the load, he was assigned to group “A” - see below).

The dynamics of some clinical symptoms is schematically described in Fig.3. Average data presented; symptoms were assessed on a 3-point system. 0 - no, 1 - when the symptom was observed rarely, 2 - often (wheezing in the lungs - constantly, shortness of breath at least 1 time per day, coughing several times a three symptoms improved markedly on average day). As can be seen from the figure, with the introduction of physical activity, all The spirographic data improved in the majority of patients (in 28), in the rest (12) they did not change or worsened somewhat.

When assessing according to Student, many indicators significantly improved (FOE, 00, MSV, pO2). However, Student's assessment in this case is not entirely correct, since the dynamics of indicators was not uniform ("distribution" of indicators is not "normal"). From the very first session, the patients were clearly divided into 2 groups - with a favorable reaction. We made this division based on the measurement of pneumotachometry (PTH) and lung capacity (VC), carried out 2-3 minutes after the end of the first two sessions.

Table 2

Results of pneumotachometry and measurement of lung capacity in relation to exercise in patients with asthma treated without the use of steroid hormones

Indicators	Statistical indicators	First session (n=40)	Last Session (n=40)	Catamnesis (n=31)
FES	M m	84,2 6,33	92,6 6,55	97,0 9,56
VCL	M m	92,4 7,21	108,2 7,85	118,8 8,84
FES	M m	101,4 10,00	109,5 7,90	107,7 11,88
FES % VCL	M M	21,0 124,0	18,70 133,1	11,30 129,7
VCL %	m M	9,21 34,8	8,22 23,1	8,95 9,30
FES	M m	88,2 10,13	102,00 10,40	99,90 10,38
FES % VCL	M M	49,07 112,8	2,24 121,3	0,30 121,0
VCL %	m M	10,64 22,51	9,81 1,24	10,77 1,80

Note: The indicators are given in % due, "% out." denotes the difference between the value measured before time or after exercise with the value before exercise.

In whom PTH was higher 2-3 minutes after the exercise session than before the session – and subgroup 1" B "-" conditionally positive reaction to exercise "- 12 patients in whom the decrease in PTH after exercise prevailed in the first two sessions. VC almost always changed in the same direction as PTH, but the latter indicator seems to be more specific in relation to the assessment of the dynamics of bronchospasm , which is why it was chosen as the main criterion.

Analysis of the case histories showed some clinical differences between the subgroups. In 'A', the mean age of the patients was 7.3±0.9, while in 'B' it was

9.3±1.2. In subgroup ”A” the disease was milder. The average duration of BA in subgroup A was 5.2±0.7 years, in subgroup B it was 7.4±0.6. Patients of subgroup "B" suffered more from concomitant diseases, such as sinusitis, tonsillitis, neurodermatitis. Indicated for the worst tolerance of physical activity is more in subgroup “B”, in particular, in this subgroup there was the only patient from the entire group who was exempted from physical education at school. The duration of treatment in the clinic in subgroup "A" was 26.2±4.3 days, and in "B" - 27.1±4.8.

The results of lung function assessment were different in subgroups (tables 5.6). In ”A”, a significantly greater increase in PTH and VC occurred not only after the sessions, but also during the sessions. Vital capacity increased even more than PTH. This fact is of interest, since bronchodilators usually improve PTH more markedly. Obviously, physical activity causes an increase in the volume (expansion) of the lungs and a decrease in bronchospasm (as evidenced by an increase in PTH), but it is based on a different mechanism than, for example, under the action of beta-receptor stimulants such as ephedrine or adrenaline.

An increase in VC and PTH in children was observed not only after the start of bicycle ernometry, but also before it. In 5 cases, we measured these indicators as soon as the children (all from subgroup “A”) sat on the saddle of the bicycle ergometer, but before they began to pedal. In all cases, an increase in VC and PTH was obtained. This observation indicates the leading role of the higher departments of nervous regulation in the restructuring (in particular, lung function) that occurs during physical exertion in the patient's body. Significance analysis of Student's differences in the data in Table 5 yielded the following results. A significant difference takes place in subgroup 1”A” between PTH before the start of the course and during exercise in the last session ($P<0.001$), as well as before exercise in follow-up (P 0.05) and during exercise in follow-up ($P<0.001$); in the last session before the load and after it began ($P<0.01$). For VC, a significant difference in subgroup 1”A” occurs between the study before the start of the course and the following measurements during exercise in the first session ($P<0.01$), in the last session before exercise ($P<0.01$), during exercise ($P<0.001$) and after exercise

(P<0.01), follow-up before exercise (P<0.001), during exercise (P<0.001) and after exercise (P<0.001).

The significance of the difference in VC also takes place in the last session between the study before exercise and during exercise (P<0.001). In 1 “B”, the significance of the difference takes place in VC between the study during exercise in the last session and studies before exercise in the last session and studies before exercise in the same (P<0.05) and in the first session (P<0.01). No statistically significant difference was found between other indicators. As can be seen from Table 6, in subgroup 1 "A" at discharge, all indicators of lung function improved, and significantly FFU (P<0.01), 00 (P 0.01), 00/0EL (P<0.05), FVC (P<0.01), FVC1 (P<0.01), MCV (P 0.01), MCV25-75 (P<0.001), pO2 (P<0.001). In most children, FFU, FVC, FVC1, MCV25-75 and pO2 became within the normal range.

A follow-up examination conducted a year later showed some increase in emphysema in 25 patients (a statistically insignificant decrease in FVC and MCV25-75). Apparently, most of the children came to the examination in the least satisfactory condition (in a third of cases, the patients did not appear on the exact date they were called, because at that moment they did not complain and therefore

Table 3

The results of pneumotachometry and measurement of lung capacity in connection with physical activity in patients with asthma, in subgroups 1"A" and 1"B"

Indicators		Subgroup "A" - positive reaction to the load			Subgroup "B" - conditionally positive reaction to the load		
		First Session (n=28)	Last Session (n=28)	Catamnesis (n=25)	First Session (n=12)	Last Session (n=12)	Catamnesis (n=6)
Up to load	FES M	81,3	90,8	95,1	96,3	100,3	105,0
	m	5,6	5,8	5,7	6,6	7,0	11,5
	VCL M	89,1	106,2	116,9	106,3	117,0	127,0
	m	5,2	5,4	5,1	11,4	8,8	10,0
During load	FES M	101,0	109,7	107,8	103,3	108,7	107,3
	m	9,2	6,1	7,9	10,8	9,8	12,5
	FES%.	24,23	21,2	13,4	7,3	8,4	2,2
	VCL M	123,9	132,1	128,8	124,3	137,3	133,7
	m	8,8	5,9	6,1	9,8	9,8	11,5
	VCL%.	39,0	24,4	10,2	16,9	17,4	5,3
Aft	FES M	86,2	100,7	98,7	96,5	107,5	104,9

	m	10,4	10,1	8,8	9,9	10,6	11,4
	FES%	6,02	10,90	3,79	0,21	7,18	-0,1
	VCL M	111,5	122,3	118,8	188,5	117,1	130,2
	m	9,8	9,7	8,0	11,8	9,9	11,5
	VCL%.M	25,14	15,16	1,63	11,48	0,09	2,52

Note: The indicators are given in % due, "% out." denotes the difference between the value measured during or after exercise, with the value before exercise.

In subgroup 1 "B" at discharge, most of the indicators worsened somewhat (statistically unreliable). In follow-up there was a further, albeit slight, deterioration in performance. It should be emphasized that at the beginning of treatment, the average values of all indicators in subgroup 1 "A" were worse than in subgroup 1 "B", so that the lack of effectiveness of the treatment should be associated with individual poor exercise tolerance.

Figures 4 and 5 show schematically the dynamics of some indicators of lung function in both subgroups.

Table 4

Spirometry and pO2 in patients with asthma treated with steroid hormones

Indicators	Subgroup 1 "A" - positive reaction to the load			Subgroup 2 "B" - conditionally positive reaction to the load		
	First Session (n=8)	Last Session (n=8)	Catamnesis (n=7)	First Session (n=2)	Last Session (n=2)	Catamnesis (n=2)
FOE M	134,5	113,7	115,3	128,8	119,5	129,6
m	5,44	4,01	4,06	10,22	5,17	13,47
00 M	192,3	142,8	158,5	149,4	154,3	208,3
M	6,42	6,33	8,65	18,04	11,35	21,44
$\frac{00}{0E\ell}$ M	+15,9	+7,90	+11,2	+7,63	+10,2	+21,4
m	12,12	0,87	1,54	1,91	2,34	4,65
fVCL M	76,2	85,3	86,3	78,1	86,6	83,3
m	2,56	2,52	2,54	3,5	3,54	8,37
$fVCL_1$% M	78,7	90,9	86,6	86,4	78,8	81,1
m	2,96	2,99	2,72	6,58	4,76	8,78
MCB M	56,0	65,9	96,7	57,8	53,4	59,3
m	2,48	1,27	1,34	5,46	4,16	7,84
MCB_{25-75} M	76,5	95,0	70,7	85,1	80,8	73,1

m	3,63	2,35	4,31	11,35	11,03	11,96
PO_2 M	78,4	86,4	79,4	75,8	81,2	81,2
m	1,66	1,22	1,12	2,14	3,75	1,14

Note: PO2 is given in mmHg, other values are in % due, a - in% deviation from the due

Analyzing all the indicators presented in tables 3 and 4, we can conclude that the best and simplest criterion for a favorable (or unfavorable) response to a bicycle ergometric load of a given power in this group of patients is expiratory pneumotachometry. If PTH increased after the load, this is a sign of positive, if it decreased, it is not so positive or conditionally positive. A decrease in PTH, however, cannot be called an unconditionally negative sign, since this was not accompanied by a clinic of shortness of breath and since in many cases the load still has a positive effect on emphysema (FRC decreased), performance (see below) and - most importantly - the clinical course of the disease.

Evaluation of functional performance indicators is presented in Table 7. In all the studied patients, it was possible to increase exercise tolerance. A sign of this is a decrease in the increase in minute oxygen consumption after exercise (+) in all patients. The dynamics of these parameters in subgroup ”A” was statistically significant ($P<0.01$). The lowest value of this indicator of oxygen debt is during follow-up examination. A statistically significant decrease in this indicator by the last session took place in subgroup 1”A”. Estimation of ventilatory debt based on the increase in tidal volume and minute respiratory volume after exercise showed a significant increase in the debt for DO and MOD in subgroups “A” and “B”, while the average respiratory rate practically did not change. The ratio of tidal volume to respiratory rate (DO/RR) turned out to be quite informative. The growth of this indicator can be interpreted as evidence of an improvement in the rationality of breathing, in subgroup 1”A” the difference between measuring it before exercise in the first and last sessions is statistically significant ($P<0.05$).

Oxygen pulse PC/HR, measured before exercise, increased more noticeably by the last session in subgroup ”A” (Fig. 6), however, the highest values of this indicator in both subgroups were determined in the follow-up (for the entire group, the difference is statistically significant - (P<0.001).

Table 5

Characteristics of physiological debt in connection with the load in patients with asthma treated without the use of steroid hormones

Indicators	**Subgroup 1 "A" - positive reaction to the load**			**Subgroup 1 "B" - conditionally positive reaction to the load**		
	First Session (n=18)	Last Session (n=18)	Catamnesis (n=18)	First Session(n=2)	Last Session (n=2)	Catamnesis (n=2)
1	2	3	4	5	6	7
ПК M	180	208	214	185	205	205
m	5,9	3,2	8,0			
$\frac{PK}{T}$ M	173	195	198	178	193	100
m	5,7	3,1	7,8			
NB M	11,0	10,0	10,0	11,0	11,0	10,0
m	1,8	1,0	1,3			
DO M	241	263	288	260	210	310
m	21,1	24,3	25,8			
MOD M	2700	2553	2831	2750	2300	2950
m	320	240	235			
$\frac{DO}{NB}$ M	22,3	27,98	22,71	24,64	19,34	32,67
m	2,8	3,3	3,0			
$\frac{PK}{HR}$ M	2,05	2,21	3,64	2,26	2,25	3,2
m	0,05	0,05	0,06			
$\frac{HR}{NB}$ M	8,05	9,42	8,63	7,56	8,30	8,56
m	0,62	1,1	0,92			

The heart rate during exercise in most patients decreased both when calculating heart rate before exercise, and especially during (at altitude) exercise, as well as after exercise. In 1”A”, electrocardiographic signs of hypoxia, hypertension, and arrhythmias decreased by the last session, in 1B”, the average PQ values during exercise in the first and especially in the last session were greater than in 1”A”, and there was no decrease ECG signs of hypoxia, hypertension and arrhythmias.

Clinical deterioration of the cardiovascular system was not observed in any patient. Measurement of blood pressure (BP) was carried out in all children before the start of the course of treatment, all BP figures were within the normal range. Measurement of blood pressure 2-5 minutes after the end of the load was carried out in the first or second sessions in 18 children, in 15 patients of subgroup "B" who had signs of hypoxia and hypertension on the ECG before the start, all subjects noted an increase in systolic and diastolic pressure by 5-15 mm Hg, which returned to normal after 10-20 minutes simultaneously with the normalization of heart rate. In all 3 patients of subgroup “A” and 6 patients of subgroup “B”, the

Table 6

Electrocardiogram parameters in connection with exercise in patients with asthma treated without the use of steroid hormones

Indicators			Subgroup 1 "A" - positive reaction to the load			Subgroup 1 "B" - conditionally positive reaction to the load		
			First session	Last session	Catamnesis	First session	Last session	Catamnesis
	1		2	3	4	5	6	7
HR	Up to load	n	24	18	18	6	5	4
		M	88,5	94,2	86,3	82,1	91,3	85,6
		m	2,5	1,5	1,1	2,0	1,0	
	During load	n	31	28	28	10	8	6
		M	152	149	148	148	151	148
		m	1,8	1,8	0,9	1,5	1,3	
	After load	n	24	18	18	6	5	4
		M	96,3	93,2	91,6	92,1	93,3	90,4
		m	1,5	1,2	0,9	0,5	0,5	
PQ	Up to load	n	24	18	18	6	5	4
		M	96,1	94,4	94,1	89,2	99,3	92,4
		m	9,2	9,1	8,7	8,8	9,9	
	During load	n	31	18	18	10	5	4
		M	115	113	112	121	125	116
		m	6,1	5,8	11,8	6,2	10,8	
	After load	n	24	18	18	6	5	4
		M	99,3	95,2	95,1	100,4	99,2	95,0
		m	10,0	9,9	2,1	5,3	10,1	
QRST	Up to load	n	24	18	18	6	5	4
		M	92,1	92,5	92,4	95,6	93,1	96,3
		m	9,6	9,1	9,0	9,7	5,0	
	During load	n	31	28	18	10	8	4
		M	108	109	109	105	118	118
		m	9,8	8,1	10,7	5,2	6,0	

Increase in pressure was accompanied by an increase or no change in pulse pressure (the difference between the upper and lower numbers of blood pressure) in the remaining 9 patients of subgroup "B", there was a trend noted in the first measurement carried out in the first sessions, in repeated measurements it was not

(end of table 6)

	1	2	3	4	5	6	7
hypoxia	Up to load	-12	-15	-14	-5	-3	-2
		+9	+3	+4	+3	+2	+2
		++3					
	After load	-11	-15	-14	-3	-3	-2
		+10	+2	+3	+3	+2	+2
		++3	++1	++1			
hypertension	Up to load	-15	-14	-13	-4	-3	-2
		+9	+4	+5	+2	+2	+2
	After load	-9	-15	-12	-2	-3	-1
		+15	+3	+5	+4	+2	+3
Arrhythmia	Up to load	-12	-14	-14	-4	-3	-2
		+12	+4	+4	+2	+2	+2
	After load	-9	-13	-14	-2	+2	-1
		+12	+5	+4	+4	-3	+3
		++2					

Note: Heart rate is given in absolute value (min-1), and PQ and QRST are in due, calculated for this heart rate. When assessing hypoxia, hypertension and arrhythmia, the number of patients with the corresponding disorder is moderately pronounced (+), with its pronounced (++), or without it (-).

noted. Measurement of blood pressure after the end of the course of treatment in all gave figures close to the original.

Summing up the results of studies in this group of patients, we can say that physical activity had a highly beneficial effect on the majority of patients. A minority (subgroup "B"), which can be called a subgroup of patients with "tension asthma", objectively tolerated the load not so well (they did not improve most of their lung function indicators), although clinical improvement was also noted.

Of great importance is the fact that PTH and VC began to increase by the last exercise session, which indicates the elimination of the bronchospastic reflex in response to exercise. In all likelihood, in subgroup "B", against the background of a dosed load, it would be necessary to strengthen drug treatment by introducing, for example, in the first sessions, agents that prevent bronchospasm, such as “intala”, and in this case, perhaps, it would be possible to achieve better immediate results of treatment .

An example of a patient with a favorable response to the load (subgroup “A”) is the boy Toshmatov Khozhiakbar, 11 years old (No. 12423). Diagnosis “Bronchial asthma, mixed form, moderate severity, post-attack period”. At the age of 7, the boy suffered from acute bronchitis with high fever, severe cough. In the next 3 years, the boy had acute bronchitis 3 times a year. At the age of 11, an asthmatic component joined: acute respiratory viral infection and acute bronchitis were accompanied by bouts of shortness of breath. In May 2022, acute bronchitis with high fever and cough persisted for the next 7 months until the last admission to the clinic. In September 2022, severe seizures were observed, he received theofedrine, solutan. At the end of September, the condition improved, but the cough persisted. The clinic was admitted 21 weeks after the asthmatic condition. Upon receipt of a complaint of cough and runny nose. The chest is cylindrical. In the lungs, scattered dry rales and wet rales of various sizes. On percussion, the sound is boxy.

In the general blood test: erythrocytes 4,600,000, leukocytes 8200, eosinophils 1, ESR 18 mm/h. X-ray of the lungs shows increased vascular pattern. Allergy tests are strongly positive for house dust, as well as the pollen of some trees and flowers. The child was prescribed: ascorbic 0.1 3 times a day, vitamin B6 0.02 times a day, ephedrine 0.02 eufillin 0.05, physiotherapy exercises for 15 minutes and chest massage for 5 minutes a day. From the third day of stay in the clinic, the complex of measures included a dosed physical activity carried out on a bicycle ergometer at a power of 70 watts, daily for 20 minutes, 6 times a week. In total, the patient received 12 sessions. Complex powder was canceled on the first day of therapeutic bicycle ergometry. After 12 sessions, the condition improved, the clinical symptoms of emphysema decreased, wheezing in the lungs disappeared, cough does not bother.

After 1 year, they called for a re-examination. Satisfactory condition, feels good. Vesicular breathing in the lungs, no wheezing. There was no exacerbation throughout the year. The boy, after being discharged from the clinic, regularly rides a bicycle or licks.

The spirogram showed signs of emphysema. When the study was discharged, before the dosed load course, the “first session” was indicated, after the course “the last session”, in the follow-up after 1 year - “follow-up”. The most important indicators, most noticeably improved after the course of treatment, are underlined. Thus, emphysema noticeably decreased (from +6 it decreased to +3), the maximum forced expiratory flow rate, the median rate (MSV25-75), pO2 increased sharply, pneumotachometry and VC increased, performance indicators and electrocardiograms improved.

A characteristic patient of subgroup "B" is a girl Kholmatova Dilnoza, 10 years old (case history 15211). The main diagnosis is Bronchial asthma, mixed form, moderate course, non-attack period. Concomitant diseases - chronic tonsillitis, vegetodystonia.

Complaints at admission to attacks of dyspnea and cough in connection with respiratory diseases and often during physical exertion. The first attack was in the winter 3 years ago. The girl was hospitalized with a diagnosis of bronchial asthma. She received antibacterial therapy, antispasmodic and desensitizing drugs. After discharge, asthmatic conditions were observed 5-7 times in the cold season, asthma attacks were stopped mainly by theofedrine. The last attack was observed a month.

Upon admission to the clinic, the patient's condition was satisfactory, complaints of a rare cough, as well as shortness of breath during exercise. The chest is barrel-shaped, percussion pulmonary sound with a box shade, breathing is hard, there are no wheezing. In the peripheral blood, erythrocytes 4,650,000, leukocytes 9450, eosinophils 3, ESR 14. On the radiograph of the lungs, there are signs of emphysema, the bronchovascular pattern is enhanced and moderately deformed. Allergic tests are positive for pollen from some plants and house dust.

The child was prescribed multivitamins, sedatives, exercise therapy, massage, physiotherapy.

§ 3.2. Patients with bronchial asthma treated with steroid hormones

As in the previous group, it was possible to divide the patients into two subgroups - “A”, consisting of 8 patients, in whom PTH after the first two sessions of exercise was higher than before exercise, and “B”, two patients, in whom PTH after the load in the first two sessions did not increase (on average, it practically did not change). Age in subgroup "A" averaged 10.1±2.3 years, and in "B" the age of one patient was 8, another 9 years; the duration of the disease in "A" is 6.2±1.5 years, in "B" in both patients the duration of the disease is about 7 years. The duration of treatment in the clinic in subgroup "A" was 27.5 ± 4.2 days, and in "B" 29 and 32 days. Bronchodilators and hormones in subgroup "A" in all patients, except for three, in whom they were canceled for 1-2 days. One patient of subgroup "B" received bronchodilators and hormones for a week, the other - 10 days, after which these drugs were canceled against the background of a course of bicycle ergometry.

The period of remission after discharge in subgroup A was 5.4±1.2 months, in subgroup B it was 4 and 5 months. Hormones after discharge from the clinic received 4 patients of subgroup "A" and both patients "B", and one of them constantly (data on follow-up are given for 1 year).

As in the previous group, since the beginning of dosed loading sessions, the subjective state of patients improved. There was also a decrease in shortness of breath, coughing, wheezing in the lungs was not observed in any child. The introduction of physical activity into the treatment complex, on average, significantly accelerated the positive dynamics of all three indicators. Both patients of subgroup “B” did not tolerate physical activity well, were exempted from physical education at school and can be called typical patients with severe “tension asthma”.

Significant differences (according to Student) in subgroup “A” are the following indicators of PTC during exercise in the last session and before exercise in the first session (P<0.05), VC before exercise in the first session and VC during exercise in the last session , as well as VC before exercise in follow-up (P<0.05). In subgroup 2"A", on average, all indicators of lung function improved by the time of discharge, except for MCV25-75 (in other words, latent bronchospasm could not be eliminated). Statistically significant increase in FVC (P<0.01) and pO2 (P<0.001). On average, FVC, FVC1% and pO2

Table 7

Spirometry and pO2 in patients with asthma treated with steroid hormones

Indicators	Subgroup 1 "A" - positive reaction to the load			Subgroup 2 "B" - conditionally positive reaction to the load		
	First Session (n=8)	Last Session (n=8)	Catamnesis (n=7)	First Session (n=2)	Last Session (n=2)	Catamnesis (n=2)
FOE M	159,3	143,3	122,3	119,5	127,5	148,5
m	7,96	10,54	7,41			
00 M	235,8	196,6	156,5	178,3	162,4	234,3
M	24,05	25,92	48,92			
$\frac{00}{0El}$ M	+23,2	+16,6	+12,5	+18,8	+10,7	+22,1
m	5,83	3,85	6,88			
FVCL M	67,2	81,1	85,7	67,4	74,5	89,5
m	5,34	7,32	5,64			
$FVCL_1$% M	71,9	83,9	80,7	76,2	68,8	82,3
m	7,96	7,32	2,95			
MCB M	55,1	63,3	61,7	61,9	40,6	58,4
m	9,19	7,71	7,15			
MCB_{25-75} M	80,4	71,3	59,5	90,8	54,2	65,8
m	12,27	9,69	4,44			
pO_2 M	78,9	81,5	76,0	70,3	73,1	75,1
m	0,32	0,42	6,20			

Note: pO2 is given in mm Hg, other values are in % due,a - in% deviation from the due

In 4 patients, showed an improvement in indicators characterizing emphysema (FFU, 00, 00/0EL) and improvement in FVC, but some deterioration in most indicators characterizing obstruction (FVC1, MCV25-75) and pO2. The dynamics of these changes was not statistically significant. In subgroup 2B, in one patient, the indicators remained practically unchanged during the stay in the clinic, in the other they worsened somewhat, although FVC increased. This indicator, as well as FVC1, also improved during the follow-up examination. As in the previous group,

Table 8

Results of pneumotachometry and measurement of lung capacity in connection with physical activity in patients with asthma treated with steroid hormones

Indicators		Subgroup 1 "A" - positive reaction to the load			Subgroup 2 "B" - conditionally positive reaction to the load		
		First Session (n=8)	Last Session (n=8)	Catamnesis (n=7)	First Session (n=2)	Last Session (n=2)	Catamnesis (n=2)
Up to load	FES M	78	83,3	100,0	87,0	87,0	93,0
	m	9,2	7,9	8,9			
	VCL M	65,6	74,0	90,3	117,0	122,0	125,0
	m	7,8	8,1	6,9			
During load	FES M	100,0	106,	109,4	95,0	101,0	93,0
	m	11,6	10,5	10,5			
	FES%	27,2	28,3	9,4	9,3	16,3	0
	VCL M	91,1	97,6	99,7	122,0	138,0	130,0
	m	10,0	10,3	10,1			
	FES%	38,9	31,9	10,4	4,55	13,0	4,25
After loading	FES M	88,8	100,3	102,2	87,0	99,5	93,0
	m	8,9	11,9	12,8			
	FES%	13,0	20,41	2,2	0	14,37	0
	VCL M	87,5	95,5	104,5	122,0	135,5	130,0
	m	8,0	11,5	11,9			
	VCL%	33,38	2,91	15,73	4,27	11,07	4,0

Note: The indicators are given in % due, “% out.” Denotes the difference between the value measured during or after exercise, with the value before exercise.

The functional signs of emphysema decreased especially significantly in the catamnesis. Comparison of functional data with the previous group allows us to draw the following conclusions. The initial means in both groups are pproximately the same, but the spread of data, characterized by the mean error (m), patients in the hormonal-treated AD group. In other words, in the 2nd group there are more patients with the worst, as well as with the best indicators. The first is explained by the fact that in this group the most severe patients, and the second, undoubtedly, by the high efficiency of hormonal therapy that the patients received. The effect of the dosed load course in complex treatment was generally more pronounced in 1”A”. Nevertheless, the achieved positive effect in one patient of group “B” with typical “tension asthma” is encouraging regarding the prospects for complex treatment with the use of dosed physical activity even for the most severe patients with bronchial asthma.

Objective performance indicators generally improved, which can be judged by the fact that in all patients, oxygen consumption after exercise and its ratio to the body surface in the last session decreased in all, and in addition, all had an increase in PC/HR, measured up to loads. As in the previous group, adaptation to the load improved more noticeably in subgroup “A”.

The RR after the load, compared with the study before the load, practically did not change by the last session, and the increase in DO and MOD decreased in both subgroups. This can probably be interpreted as a decrease in ventilation debt due to an increase in the anaerobic threshold. DO / RR before the course of treatment was low at 2 "A" (both before the load and immediately after it), but by the end of the course the indicator increased, indicating an improvement in the rationality of breathing.

In the patient of subgroup 2 "B", DO / RR in the first study turned out to be very high, after the course it decreased slightly, but remained at a high level, so this trend cannot be considered negative.

HR/RR at rest by the last session in patients did not change or slightly decreased due to some increase in breathing, and after exercise in the last session of subgroup “A” it was less than in the first session; this can be interpreted as an improvement in the synchronization of the work of breathing and circulation.

In general, exercise tolerance in group 2 improved even more clearly than in Electrocardiogram parameters improved by the last session in subgroup 2"A" - signs of hypoxia, hypertension and especially arrhythmia decreased. In subgroup 2B, these indicators did not change in one patient, while in the other they worsened somewhat (in particular, PQ lengthened compared to the data in the first session, although it remained within the normal range).

The improvement in exercise capacity reflects a decrease in heart rate after exercise. In the follow-up, the electrocardiogram as a whole became even better in all 6 studied patients.

Measurement of blood pressure before and after a course of dosed loading was carried out in all patients: the pressure practically did not change. Before and after exercise, measurements were made in 4 patients who had signs of hypoxia and hypertension of the small circle on the ECG. Immediately after exercise, systolic and diastolic blood pressure increased by 5-10 mm Hg, while systolic pressure did not change or slightly increased. BP returned to baseline after 15-20 minutes.

This group is characterized by the patient Fozilov Ulugbek, 12 years old (case history No. 12411) with a diagnosis of Bronchial asthma, atopic form, attack period, severe course (hormone dependence), diffuse neurodermatitis. From three months the child has exudative diathesis, which later transformed into common neurodermatitis. For the first time, asthmatic syndrome was diagnosed at the age of 4 months against the background of acute bronchitis. Prednisolone was first prescribed at 1 g 5 months due to severe eczema and asthma when the boy was being treated at the regional children's clinic in Fergana.

During the treatment, bronchodilators, aminofillin, courses of acupuncture and various types of breathing exercises were used. From the age of three, every summer he spent a vacation in the Crimea or Anapa, where the attacks also recurred, but were easier. Seasonality in exacerbations and connection with physical activity is not observed. Attacks are sometimes unbearable (neurodermatitis becomes aggravated), tests for various allergens are sharply positive.

Upon admission, the state of moderate severity, expiratory dyspnea, dry obsessive cough. The chest is barrel-shaped swollen, with auscultation in the lungs, hard breathing and an abundance of dry wheezing. Heart sounds are muffled, systolic murmur and accent of the 2nd tone over the pulmonary artery. Skin manifestations of neurodermatitis.

Table 8

Exercise-related electrocardiogram parameters in patients with asthma treated with steroid hormones.

Indicators		Subgroup 2 "A" - positive reaction to the load			Subgroup 2 "B" - conditionally positive reaction to the load		
		First Session	Last Session	Catamnesis	First Session	Last Session	Catamnesis
1		2	3	4	5	6	7
Up to load	n	5	5	4	2	2	2
	M	91,1	97,2	86,5	98,1	97,4	87,1
HR during load	m	2,0	1,8	0,2			
	n	7	7	5	2	2	2
	M	154,1	147,8	147,9	157,1	148,2	148,1
	m	2,1	1,1	0,2			
After load	n	5	5	4			
	M	99,9	90,1	89,7	96,8	90,3	90,2
	m	3,1	0,2	0,3			
Up to load	n	5	5	4	2	2	2
	M	93,8	82,4	84,3	85,1	93,2	100,0
	m	6,2	6,8	7,2			
PQ during load	n	7	7	4	2	2	3
	M	11,97	116,8	118,1	106,9	111,6	126,9
	m	8,0	8,9	7,2			
After load	n	5	5	4	2	2	2
	M	91,1	96,2	96,2	102,1	115,0	102,0
	n	12,9	9,0	8,6			
Up to load	n	5	5	4	2	2	2
	M	92,8	99,0	89,1	95,4	120,7	96,5
	m	10,6	11,9	6,8			
QRST during load	n	7	7	4	2	2	2
	M	117,7	115,8	97,4	115,0	117,1	99,9
	n	4,1	4,0	7,0			

(end of table 8)

	1		2	3	4	5	6	7
QRST	After load	n	5	5	4	2	2	2
		M	102,1	88,4	93,9	85,1	105,7	97,3
		m	6,2	11,5	7,2			
	Up to load		-2	-3	-2	-1	-1	-1
hypoxia			+3	+2	+2	+1	+1	+1
	After load		-1 +4	-3 +1	-2 +2	-1 +1	-1 +1	-1 +1

	Up to load		-3	-3	-2	-1	-1	-1
hypertension			+2	+2	+2	+1	+1	+1
	After load		-2 +2	-3 +1	-2 +2	+2	-1 +1	-1 +1
			++1	++1				
Arrhythmia	Up to load		+4	+2	-2	+2	-1	-1
			++1	+3	+2		+1	+1
	After load		-3 +1	-2 +3	-2 +2	-2	+2	-1
			++1					

Note: Heart rate is given in absolute value (min-1), and PQ and QRST are in % due, calculated for this heart rate. When assessing hypoxia, hypertension and arrhythmia, the number of patients with the corresponding disorder is moderately pronounced (+), with its pronounced (++) or without it (-).

In the blood, eosinophilia 5, a decrease in the concentration of 11-hydroxyketosteroids. The clinic received the following treatment: prednisolone (initial dose of 8.75 mg per day with a gradual decrease to 5 mg), Bekotid 3 injections per day, Zaditen 1 tab. 2 times a day, multivitamins. panangin, electrosleep (10 sessions), aerosol therapy with bronchodilators, physiotherapy exercises and chest massage.

From the fourth day of stay in the clinic, daily sessions of bicycle ergometry with a power of 75 W for 20 minutes per day were introduced; in total the patient received 14 sessions. The condition with the beginning of the sessions improved markedly: shortness of breath and wheezing in the lungs decreased, cough became less frequent and sputum separation became easier. The boy was discharged from the clinic in a satisfactory condition without cough and visible shortness of breath. At the follow-up study a year later, the child came in an unattackable state. The boy's physical activity has increased, but the disease as a whole remains as severe. The patient constantly receives prednisolone (5 mg per day) and is irritated.

The dynamics of functional data during the stay in the clinic is certainly positive, but the indicators at discharge are far from normal: emphysema is very severe, FVC is 49% of the norm, MSV25-75 is 32% - all this indicates, in particular, a significant increase in oxygen pulse and, possibly, improvement of the ECG, although, of course, the volume of drug therapy (the dose of steroid hormones) is of decisive importance for this patient.

Summing up, we can note the high efficiency of a dosed load in the complex treatment of this very severe group of patients. The improvement in physical performance is especially demonstrative. Obviously, it is these patients who, due to the severity of the disease, receive the least physical activity, natural for children, most of all need them. For this group, the observation made in the analysis of the ECG in patients of the 1st group is also true. That PQ prolongation (calculated as a percentage of actual heart rate) is probably the most sensitive sign of impending overload.

§ 3.3. Patients with chronic pneumonia

In contrast to the patients with BA, in this group there were no clear differences in the immediate response to the load. All children tolerated cycle ergometry sessions well, their subjective and objective condition improved.

After the start of the load and its end, in all cases, an increase in PTC and VC was noted. Therefore, it was decided to divide the patients into groups of “positive” (“A”) and “conditionally positive” (“B”) reactions to the load based on a comparison of the results of spirography before and after the course. Group A included all patients in whom, after a course of treatment, FVC and VC increased (13 children), as well as 2 patients in whom, after a course of treatment, FVC and VC decreased by no more than 20% (this is considered an error in measuring these indicators), but other indicators of spirography, as well as pO2, improved. Group "B" included patients in whom the study after the end of the course of dosed loading gave lower numbers of FVC and VC and at the same time most indicators of lung function worsened.

The mean age in subgroup A was 9.8±1.4 years, in subgroup B it was 7.8±0.6. The duration of the disease was 7.2±0.8 and 7.7±0.4 years. In subgroup

"A" in 3 children, CP was without formed bronchiectasis, the rest had saccular (3) and cylindrical (8) bronchiectasis, unilateral lobar lesions were observed in 12 patients, in 2 bilateral lesions. In the subgroup "B" during bronchoscopy, bronchitis was more often observed (bilateral in 2, localized unilateral in 4), cylindrical bronchiectasis was noted in 2 patients. The average duration of treatment in the clinic for patients of subgroup "A" was 25.7±5.6 days, "B" - 28.8±6.9 days. In subgroup “A”, all spirographic parameters and pO2 improved There was a statistically significant increase in MSV by the last session ($P<0.01$), in all likelihood, this is due to both a decrease in obstruction and an increase in expiratory muscle force due to an increase in physical fitness.

At follow-up, there was a further improvement in pO2 and emphysema scores (FOE, 00, 00/0EL - the latter two became statistically significantly different from baseline, $P<0.05$).

In subgroup “B”, by the end of the exercise course, the indicators of emphysema worsened somewhat - FFU and 00, FVC and FVC1% (statistically unreliable). Obstruction indicators - MCV25-75 and MCV, as well as pO2 by the time of discharge in most patients (and on average for the group) improved. The increase in MSV can be partly explained by the improvement in physical condition, in connection with which the strength of the respiratory muscles increases in patients, but the increase in MSV25-75 is undoubtedly a sign of a decrease in bronchial obstruction.

In follow-up, most of the indicators are intermediate between the study in the first and last sessions. An increase in FFU, 00, 00/0EL, that is, an increase in emphysema (according to functional signs) against the background of an increase in pO2 and a decrease in obstruction, cannot be interpreted as a negative sign - this is rather evidence of lung expansion, which also corresponds to an increase in VC by the last session. In general, according to the results of functional studies, the differences between subgroups “A” and “B” in CP are less than
in the BA groups. the same trend is noted: the effect of the dosed load course is somewhat greater where the initial data on FVC, MSV and 00/0EL are worse.

The results of measuring PTH and VC before, after the start and after exercise indicate an improvement in these indicators in most patients, and approximately the same in both subgroups. Particularly significantly ($P<0.01$) increased PTH in subgroup "A" in the last session after the load, compared with the study before the load in the last ($P<0.05$), first ($P<0.01$) and in the first session after exercise ($P<0.05$).

ll studied patients received objective evidence of improved exercise tolerance (table 17). This was most clearly expressed in the growth by the last session of PC/HR, as well as TO/RR (improvement in the rationality of breathing). The growth of these indicators in subgroup “A” and in total for both subgroups was statistically significant ($P<0.05$). In the catamnesis, the positive shifts achieved were maintained (and PC/HR became higher than before discharge).

An increase in heart rate/respiratory rate at rest, observed in all patients, is evidence of an improvement in lung function. When measured after the load of this indicator as a percentage of the original (before the load), on average, it slightly increased by the last session in subgroup “A” and significantly decreased in both patients of subgroup “B”, a decrease - more precisely, approaching the initial one - is considered a sign of improved respiratory coordination and circulation).In general, as in BA, the load tolerance in terms of functional characteristics in subgroups “A” and “B” increased approximately the same. The dynamics of the ECG (Table 18) reflects the positive functional changes that occurred during treatment in most patients: a decrease in heart rate by the last session during and after exercise, a decrease in the number of cases with ECG signs of hypoxia, hypertension and arrhythmia at all stages of the study. No differences were found between both subgroups. Measurement of blood pressure before and after the course of treatment was carried out in all patients: the pressure remained practically unchanged. Before and after exercise, blood pressure measurements were performed in the first two sessions in 5 patients who had ECG signs of hypoxia and pulmonary hypertension. Immediately after exercise, systolic and diastolic blood pressure in all children increased by 5-8 mm Hg. BP returned to baseline after 10-20 minutes. As an example, we present the case history of a boy Marupov Muhammadsardor., 8 years old (case history No. 7636) with a diagnosis of Chronic pneumonia, bronchiectasis of the lower lobe and basal segments of the left lung. Complaints of cough with purulent sputum, periodic rises in temperature.

The disease began at the age of 9 months. after an acute respiratory disease complicated by severe bilateral small-focal pneumonia. Over the next 4 years, the transfer of several exacerbations of pneumonia. The diagnosis of chronic pneumonia was made at the age of 3 years. 6 months after bronchological examination.

He was repeatedly hospitalized (three times in the regional children's clinic in Fergana). Received antibiotics, pancreatin, bronchoscopic sanitation. In the clinic, the general condition is satisfactory. The chest is cylindrical.

Medium bubbling rales are heard in the lungs, mainly in the lower sections on the left. In the blood test: erythrocytes - 3,950,000, leukocytes - 8800, stab - 1, segmented - 44, eosinophils - 3, lymphocytes - 46, monocytes - 6, ESR - 14 mm/h. On chest radiographs, general swelling of the lung tissue, against the background of an enhanced bronchovascular pattern on the left in the basal segments, deformation and peribronchial infiltration are noted. Conclusion on the result of bronchoscopic examination: “Chronic purulent endobronchitis on the left, especially in the lower lobe (endobronchitis of the 3rd degree)”.

During the last hospitalization, the clinic was treated with antibacterial agents (sulfonamides, penicillin, chloramphenicol), exercise therapy, massage, pulmonary drainage; received three therapeutic bronchoscopy with ultrasonic sanitation and administration of antibiotics through a bronchoscope. From the third day of stay in the clinic, a dosed physical activity with a power of 50 watts was prescribed daily for 15-20 minutes. In total, the patient received 14 sessions (for 23 days, as breaks were made during the days of bronchoscopy). In the middle of the course of treatment, antibiotics were canceled: the introduction of therapeutic bicycle ergometry improved the patient's well-being, improved sputum discharge, and cough became less frequent.

§ 3.4. Conclusion: general patterns of therapeutic and physiological effects of intense physical activity in children with COPD

The analyzed material proves the need to introduce into the complex of inpatient treatment of children with chronic nonspecific lung diseases (COPD) intense short-term physical activity carried out using a bicycle ergometer under the control of functional studies. In almost all patients, such loads are not only feasible, but also have a highly positive effect on the patient's well-being and clinical symptoms. The only exceptions that we observed were provocations of asthma in two seriously ill patients, to whom, obviously, a dosed load was prescribed before the end of the attack period, and one of them was successfully taken a course of a dosed load after a week.

The end of the exacerbation period and, accordingly, the onset of the period when it is necessary and possible to prescribe the selected physical activity - the clinical definition of this moment requires understanding the whole complex of subjective and objective data characterizing the patient's condition, introducing a dosed load into treatment are FVC and MCV25-75, as well as PTH.

For patients with asthma treated without hormones, such criteria are FVC and MCV25-75 more than 70% of the norm, as well as PTH more than 75% of the norm. For hormone-dependent patients with BA - FVC is more than 60%, MCV25-75 is more than 60%, and PTH is more than 65% of the norm. Lower values of indicators are not a contraindication to the appointment of dosed physical activity, if after the start of the first session, PTH increases. In general, the clinical course of the first exercise session and the dynamics of PTH (or VC) after its beginning and end are the most important criteria for the possibility and expediency of this type of treatment. If PTH and (or) VC increased during the session and immediately after it, this is a sign that the session has improved lung function and one can expect that the result of the entire course will be the same. At the same time, the purpose of measurements of PTH (or VC) after the end of the load is higher than immediately after the start of the load. (its termination in the first two or three sessions after 2-3 minutes after the start was important, first of all, for assessing whether the patient tolerates the load well.

On the part of the cardiovascular system, the possibility of conducting this treatment is determined by the following indicators: before exercise: normal blood pressure numbers, the absence of significant ECG changes (atrioventricular conduction disturbances and signs of significant hypertrophy of the heart, as well as coronary insufficiency, but signs of slight hypoxia and pulmonary hypertension may have place and are not a contraindication to the use of the technique.During exercise: the heart rate should not double or exceed 160 per minute, and PQ lengthen over 130% of the norm (for the existing heart rate) and there should be no severe arrhythmia.5 minutes after exercise increase in systolic and diastolic pressure not more than 15 mm Hg and return to the initial level along with heart rate 10-20 minutes after the end of the load. minutes are reduced to the original level. e and suggest that a sensitive indicator of cardiac overload is PQ lengthening over 125% of the norm during exercise and over 120% 10 minutes after it ends.

Signs of a favorable effect of the proposed course of physical activity on lung function is an increase in PTH 2-3 minutes after the end of the exercise session. After the end of the course, in addition to the growth of PTH (and VC), the indicators of emphysema most constantly improve (the previously elevated FRC, 00 and 00/0EL decrease, the pO2 of mixed capillary blood increases; indicators of bronchial obstruction, such as MCB25-75, improve in all patients with CP and in 2/3 and ¾ of patients with asthma.In 1/3-1/4 patients with bronchial asthma, spirographic indicators of obstruction do not improve by the end of the dosed load course.These children should probably be attributed to the group of patients with severe "tension asthma", and this technique for they are not so effective, although by the end of the course, their bronchospastic reflex to exercise can be removed (by the last session of PTH after exercise, it is always higher than before exercise).

The mechanism of the bronchodilatory effect of the load can be divided into the actions of three factors: 1) the central one, under the influence of which, at the moment of readiness for work, the lungs are straightened and the respiratory and circulatory systems are reorganized; 2) expansion of the lungs due to an increase in metabolism during exercise; 3) sympathicotonia and increased activity of the adaptation system (pituitary-adrenal glands) accompanying physical activity.

A regular decrease in emphysema presumably indicates that stress bronchodilation primarily covers the smallest bronchi (whereas drug-induced dilatation has a point of application of larger bronchi and therefore, with conventional treatment of BA, emphysema and latent bronchospasm persist for years (M.N. Morgunov, 2019; J. Lagan, 2019. An increase in ventilation, as is known (I.V. Leontieva and Yu.M. Belozerov 2015), activates the surfactant, which improves the compliance and regional ratio of ventilation and blood flow, resulting in an increase in pO2 in arterial blood.

Efficiency was improved in all patients, without exception, who underwent a course of dosed exercise (our data are consistent with A. Daniele et al., 2015, but these authors, however, failed to improve exercise tolerance are a decrease by the last session of heart rate during and after exercise and an increase in PC/HR measured before and after exercise.The growth of PTH and VC can also be considered signs of an increase in fitness, since these indicators depend not only on lung function, but also on muscle effort and volitional qualities (their growth along with PC / Heart rate is considered the main signs of increased fitness in healthy children (I.V. Ancut 2016; M.A. Podolnaya et al., 2016)

The beneficial effect in the complex treatment of the course of physical activity on the ECG is more noticeable in BA and was expressed in a decrease in arrhythmia in patients (disappeared in 11 out of 21), signs of hypoxia (disappeared in 11 out of 20), pulmonary hypertension (disappeared in 8 out of 16). In CP, as in BA, no negative dynamics was noted, but it took place in relation to signs of hypoxia (previously determined in 5 patients by the end of the course ceased to be determined in 4) and hypertension of the small circle (out of 5 disappeared in 1).

The data obtained indicate that, in principle, lung function is the main factor limiting the tolerance of intense physical activity in patients with COPD only in the acute period. Observations of the dynamics of functional indicators in the process of training on a bicycle ergometer in patients in the post-attack and inter-attack periods of BA and in the period after and outside the exacerbation of CP convince us that the cardiovascular system plays a leading role in limiting the transfer of physical activity. Even with typical “tension asthma”, when exercise exacerbates latent bronchospasm (as evidenced by a decrease in PTH and VC after exercise), an excessive increase in exercise is still likely to worsen the function of the cardiovascular system to a greater extent - increase blood pressure, double or more increase Heart rate and worsen the ECG (relatively lengthen atrioventricular conduction and electrical systole, increase signs of hypoxia and overload of the heart). As in healthy children (L.I. Gerasimova 2015; R.I. Sagirova and Yu.A. Dolgikh 2016), it is the cardiovascular system that is the limiting factor in increasing physical performance in chronic nonspecific lung diseases in the period outside and after exacerbation.

A normal reaction to exercise in COPD patients during the period outside and after exacerbation is an increase in blood pressure 5-10 minutes after exercise, not more than +15 mm Hg. with a decrease in pulse pressure (the difference between systolic and diastolic values) is not more than 10 mm. It is necessary to refuse from carrying out the load with an increase in blood pressure after a load of more than 15 mm, especially in combination with a significant decrease in pulse pressure. During exercise, negative symptoms can be detected using an ECG monitor. A formidable symptom is a doubling of the heart rate (or an increase of 160 beats per minute), an increase in PQ over 130% of the due value, as well as the appearance of bradycardia and severe arrhythmia. These complications were not observed in any of the observed patients, and extrapolation of the data obtained leads to these conclusions (taking into account the literature, - E.M. Klokotova 2014). Thus, the general patterns of reaction to intense short-term physical activity in children with COPD in the period after and outside the exacerbation are fundamentally similar to those in healthy people (I.A. Deev and E.S. Kulikov 2017). Follow-up studies allow us to conclude that the amount of physical activity at home in most children with COPD is sufficient. This is evidenced by lower resting heart rates and high PC/HR in the vast majority of patients compared with the last study in the clinic (comparison of the averages for all patients gives a significant difference (P 0.001). However, studies after exercise indicate that adaptation to intensive short loads in the catamnesis, on average, lower than was achieved by the end of the course of bicycle ergometry in the clinic: in the catamnesis, there is always a lower improvement in PTC and VC after exercise, lower PC/HR ($P<0.001$) and especially the increase in this indicator as well as higher indicators characterizing the ventilation debt (in particular, MOR and HR/NR%).

An analysis of indicators characterizing ventilation and pulse debt leads to the conclusion that detraining in the follow-up to a short heavy load can be qualified as related to both the cardiovascular system and respiration. It can be assumed that with such detraining, at least in part, the deterioration in lung function observed in the catamnesis in some patients is associated. So, 00, FVC1, MCV25-75 and pO2 worsening of indicators in the follow-up took place in BA treated without hormones, out of 41 patients in 34, 25, 28 and 24, in BA treated with hormones, out of 8 patients in 4, 1, 4 and 4, with CP out of 14 patients in 7, 4, 10 and 4. A relatively smaller number of patients in the follow-up with deterioration in performance among hormone-dependent patients with asthma is explained by the fact that the use of steroid hormones in asthma is highly effective (but is fraught with unknown complications).

The positive effect of sessions of intense exercise, carried out using a bicycle ergometer, is somewhat greater in AD than in CP (although in the latter group it is also quite pronounced) and is manifested in a decrease in emphysema, obstruction, and an increase in PaO2. The marked deterioration in lung function in the follow-up in a number of patients reflects - as well as has a consequence - the unsatisfactory course of the underlying disease in these patients.

CONCLUSION

Studies were conducted in 70 children aged 7-15 years with bronchial asthma (50 children, 10 of them hormone-dependent) and chronic pneumonia (20 children). Among 40 asthma patients treated without the use of hormones, 8 were admitted during the attack period, 30 - in the next day after the attack, and 2 - in the remission period. Among 10 hormone-dependent patients, 6 were admitted in the pre-attack period and 4 in the post-attack period. All patients, except for two admitted in remission, had cough, wheezing, and other physical changes in the lungs upon admission. All these children were treated with bronchodilators, 6 hormone-dependent patients received prednisolone per os at a dose of 0.001 per kg of body weight in the hospital.

Chronic pneumonia in 7 children was without formed bronchiectasis, 3 had saccular and 10 cylindrical bronchiectasis. Unilateral lesions occurred in 16 patients, 4 had bilateral bronchitis. In all, the diagnosis was confirmed by bronchography and bronchoscopy. Patients were admitted during the period of exacerbation with significant physical changes in the lungs. All patients received from 1 to 3 times in the clinic endobronchial sanitation, as well as vibromassage and drainage.

All patients with bronchial asthma and chronic pneumonia from the first day of their stay in the clinic, in addition to drug therapy, were prescribed physiotherapy, massage and gymnastics. Complexes of therapeutic gymnastics were built according to the schemes of S.M. Ivanov. when dividing children into groups for exercise therapy, the age and severity of the disease were taken into account. The exercises were aimed at general physical fitness, strengthening of the respiratory muscles, and normalization of breathing. Chest massage was carried out according to the classical method in the morning in the supine position.

From the third day of stay in the clinic (from 1-2 days after the relief of an asthmatic attack), the complex of measures included a dosed physical activity carried out on a bicycle ergometer (in a sitting position). The load was carried out using a bicycle ergometer KE-12. The load was administered with a power of 1.5

watts/kg of weight 6 times a week for 15-20 minutes daily 1 hour after breakfast for a course of 8-12 sessions. A load of 1.5 kg or 9 kgm/min/kg corresponds to the initial test in a three-stage step test for children (N.S. Paramonova 2014; I.A. Deev and E.S. Kulikov 2017). According to our data, a load below 1.5 watts/kg leads to subjective dissatisfaction and a lower degree of fitness, while at a load of 1.5 watts/kg, this effect is quite demonstrative. At the same time, the increase in heart rate at the height of the load did not exceed 160 for anyone, which is one of the proofs of the safety of the session. The use of high power in this group of patients seems inappropriate and dangerous. On average, patients received 10.2 ± 2.2 sessions per course, justified by the following. With a smaller number of sessions, there is no sufficient improvement in functional indicators. A large number of sessions in a hospital is not necessary, because after 8-12 sessions the improvement in clinical and functional parameters becomes so significant that the patient can be discharged from the clinic.

The proposed method allows, with constant clinical and functional monitoring, to obtain a significant improvement in the clinical and functional indicators of the patient's condition and reduce drug therapy up to its complete cancellation. Usually, bronchodilators in patients with bronchial asthma were canceled 1-2 days after the start of the course of bicycle ergometry. The improvement in clinical parameters was expressed in a decrease in emphysema and wheezing in the lungs, the disappearance of dyspnea, and an increase in exercise tolerance (the latter improved in all patients).

The following indicators of lung function were chosen as the main indicators of lung function: functional residual capacity (FRC), residual volume, ratio of 00 to total lung capacity, forced vital capacity (FVC), the ratio of one-second forced vital capacity (FVC1) to it %), maximum forced expiratory flow rate (MSV25-75), expiratory pneumotachometry (PTH), vital capacity (VC), as well as
oxygen tension in the mixed arterio-capillary blood PaO2.

To assess the tolerance of physical activity, the following indicators were used, measured before and immediately after the end of the load: minute oxygen consumption (OC) and the same indicator related to the body surface (PC/T), the number of breaths per minute (RR), the depth of breathing (DO), minute volume of respiration (MOD), the ratio of DO/RR, the ratio of PC to heart rate (PC/HR), the ratio of MOD/HR, PQ and QRST intervals, as well as before and after exercise, the severity of hypoxic changes in the myocardium, hypertension of the small circle and arrhythmias.

The first two or three sessions were performed under the control of an ECG monitor. 1-2 minutes after the start of the load, a stop was made: the patient stopped pedaling and his PTH and VC were measured, and his general condition was also assessed (the first sessions were always considered trial and were treated with increased alertness). The same studies were performed in the last session before discharge from the clinic and in the follow-up examination a year later. PTC and VC were measured twice each time, and the highest value of the indicator was chosen for analysis. A total of 770 double measurements of PTH and VC (dry spirometer) were made before, after the start and 2-3 minutes after the end of the load in all 70 patients during their stay in the hospital, as well as in 50 patients in follow-up after a year. Before, during and after the end of the load, such observations of the ECG and heart rate were made on the monitor of 240 full ECG studies in 70 patients and 600 monitor observations in 70 patients. Before and immediately after the end of the exercise session, the spirogram and oxygen consumption were recorded 340 times in 50 patients. Blood pressure was measured by the Korotkov method 380 times in 70 patients. A complete spirographic examination, as well as an assessment of ASC and PaO2, were performed before the first and last session in all 70 patients, as well as in 50 patients in follow-up after a year.

Patients were divided into 2 groups - with positive (subgroup "A") and conditionally positive reaction to the load (subgroup "B"). The main criterion for patients with bronchial asthma was the change in pneumotachometry (PTH) 2-3 minutes after the end of the load in the first two sessions. In subgroup “A”, PTC always steadily increased. In subgroup B, PTH and VC did not increase in most measurements in 1-2 sessions. The last group, consisting of 12 treated without hormones and 4 hormone-dependent, the term “exercise induced astma”; K.Murphy, 2017; M.T.Abdulfttah, 2014 can be applied. It is very important that PTH and VC in subgroups “B” increased by the last session after exercise compared to PTH and VC measured before exercise. This indicates that as a result of training in patients with tension asthma, it is possible to drastically reduce the bronchospastic reflex to exercise.

Evidence of the leading role of the higher divisions of nervous regulation in the effect of physical activity is the noted fact of an increase in PTC and VC not only 1-2 minutes after the start of the load, but also before it began, as soon as the child sat on the bicycle ergometer.

In patients with chronic pneumonia, PTH and VC increased after exercise almost always, and here the division into subgroups "A" and "B" was carried out on the basis of an increase in FVC and VC after the course of treatment (subgroup "A" - 14 patients) or a decrease in these indicators (subgroup " B” – 6 patients).

According to our data, intense physical activity with a power of about 1.5 W/kg is indicated for patients with bronchial asthma in the post-attack and inter-attack period - at least at the time of forced reduced activity during hospital stay. In those treated without hormones, FVC and MCV25-75 were above 70% of the norm, and PTH was 75% of the norm. In hormone-dependent patients, FVC was above 60%, and MCV25-75 and PTH were above 65% due.

In patients with chronic pneumonia, sessions of intensive metered exercise were carried out by us against the background of a subsidence of exacerbation of bronchitis and, in particular, during bronchoscopic sanitation (for their implementation, cycle ergometry was interrupted for 3-4 days). Intensive exercise, most likely, should not be carried out during a period of sharp exacerbation of chronic pneumonia, when patients themselves do not show a tendency to physical activity. In the patients we treated, FVC and MCV25-75 were above 60%, and PTH was above 65% of the expected values.

In addition to PTH and VC, ECG monitoring, especially in the first sessions (when it is not yet clear how the patient will react to the load), as well as measuring blood pressure before and after sessions, is of the most important practical importance during intensive exercise sessions. With the favorable effect of the load, the heart rate should not double or exceed 160 per minute, and PQ should not lengthen more than 130% of the proper heart rate. On the part of blood pressure, an increase in systolic and diastolic pressure of no more than 15 mm Hg seems to be positive. (at the same time, the systolic difference does not change or increases), and the return of blood pressure to the initial level occurs simultaneously with the normalization of heart rate 10-20 minutes after the end of the load. In the subgroup "A" of bronchial asthma treated without hormones (28 patients), PTH before the start of the load in the first session was 81.3±5.6% due, and by the end of the first session - 86.2±10.4, after the course treatment before exercise - 90.8±5.8, and after exercise - 100.7±10.1. Corresponding VC values are 89.1±5.2% due, 11.5±9.8, 106.2±5.4 and 122.3±9.7. After the load, the absolute increase in VC before and after the load, as well as in the first and last sessions, were statistically significant. After the end of the course, in addition to the increase in PTH and VC, in subgroup “A” almost all indicators of lung function improved: for example, the average 00/0EL decreased from 15.9±1.21 to 7.90±0.87 (P<0.001) , MSV25-75 from 76.5±3.63% predicted increased to 95.0±2.35 (P<0.001), PaO2 from 78.4±1.66 mm Hg. changed to 86.4±1.22 (P<0.001). Indicators characterizing exercise tolerance have improved. For example, PC/HR before exercise in the first session was 2.05±0.05, in the last session 2.21±0.05 (P<0.001). Improvement also took place in the electrocardiogram. Thus, signs of hypoxia in the first session before the load out of 24 patients were in 13, while in the last session out of 18 patients in 3 before and after the load. Signs of hypertension of the small circle in the first session of 24 patients before exercise were noted in 9, and after exercise in 15, in the last session of 18 patients they were diagnosed in 4 before and after exercise. In subgroup "B" (12 patients), PTH before the start of the load in the first session was 96.3±6.6% due, and by the end of the first session - 96.5±9.9, after the course of treatment before the load - 100.3 ±7.0, and after the load - 107.5±10.6. The corresponding VC values were 106.3±18.4% due, 96.5±9.9, 117.0±9.9, respectively. On the part of lung function, by the end of the course of treatment, only an improvement in FRC: from 128.8±10.22% of the predicted value, it decreased to 119.5±5.7 (P>0.05). Exercise tolerance improved no less than in subgroup “A”, and the ECG improved even slightly more. Clinical dynamics was positive in both subgroups without significant differences. In the group of hormone-dependent patients, the clinical results and dynamics of lung function are determined primarily by the appointment of prednisolone - whether the patient is receiving it at the moment, what is its dose, whether it is reduced or increased (among the observed children at the time of the course of bicycle ergometry, 6 people received prednisolone). Apparently, for this reason, the difference between subgroups "A" and "B" in relation to the response to the course of physical activity in the group of hormone-dependent patients was not as significant as in the previous group. In subgroup “A” of hormone-dependent patients (8 patients), PTH before the start of exercise in the first session was 78.6 ± 9.2 due, and after the session - 88.8 ± 8.9, after the course of treatment before exercise - 83.3 ± 7.9 and 100.8±11.0 after exercise. Corresponding VC values were 65.6±7.8% due, 87.5±8.0, 74.0±8.1 and 95.5±11.5, respectively (the difference between VC before and after exercise in the first and last sessions statistically significant).

In addition to the growth of VC and PTH, emphysema indicators improved by the end of treatment (00/0EL decreased from 23.3±5.83 to 16.6±3.85 (P>0.05), FVC increased (67.2±5.34 % of pre-course and 81.1 ± 7.32 after the course (P>0.05), however, MSV25-75 and PaO2 did not improve.Indicators characterizing exercise tolerance improved in general. Thus, PC/HR at rest up to load in the first session - 2.02 ± 0.05, and in the last session - 2.11 ± 0.05 (P<0.01) ECG parameters also improved: in the first session before the load, out of 5 patients, signs of hypoxia and hypertension had 3 and 2 patients, respectively, after exercise 4 and 3, while in the last session only two had signs of hypoxia and

hypertension before and after exercise. : 117 (87), 122 (87), 135.5 (99.5).In other words, PTH did not increase due to the load in the first session (according to this criterion, patients were assigned to subgroups "B"): PTH after load has increased very little in the last session, and when measured to the load to the last session did not increase. The dynamics of VC was more positive, but significantly weaker than in subgroup "A". The following indicators of lung function improved: 00 (from 178.3 to 162.4), 00/0EL (from 18.8 to 10.7), FVC (from 67.4 to 74.5), PaO2 (from 70.3 mm Hg to 73.1). Indicators of exercise tolerance improved (PC/HR before exercise in the first session on average 1.94, in the last 2.11). The ECG indicators improved somewhat: after exercise in the first session, signs of hypertension of the small circle were noted in 1 patient, and in the last session, none. Clinical indicators, as in the previous group, improved in both subgroups approximately equally. In chronic pneumonia, subgroups A (14 patients) and B (6 patients) showed positive clinical dynamics; changes in VC and PTH due to exercise, as well as other indicators of lung function in subgroups A and B, differed less than in bronchial asthma. Most of them improved in “A” and some in “B”. In subgroup “A”, VC before the start of the load in the first session was 84.4±8.1% due, and after the session it was 95.5±12.2 (P>0.05); after the course of treatment before exercise 98.6±8.8 (P>0.05 compared with the study in the first session), and after exercise 115.8±10.0 (P>0.05). PTH, respectively, 75.4±8.3; 73.8±13.5; 82.6±8.8; 115.5±10.3. By the end of treatment, all indicators of lung function improved. Thus, 00/0EL decreased from 19.1±3.03 to 13.6±3.68 (P>0.05), MSV25-75 increased from 66.8±7.7% to 84.5±11 .1 (P>0.05), PaO2 s 73.3±1.88 mmHg
increased to 79.2±2.03 (P<0.05). Indicators of exercise tolerance improved (PC/HR) to exercise in the first session 2.18±0.03, and in the last session 2.31±0.02 (P<0.001). Improved ECG: signs of hypoxia before exercise in the first session were diagnosed in 5 out of 9 patients, after exercise in 4, in the last session out of 8 patients they were diagnosed in 3; signs of hypertension of the small circle of 9 patients in the first session were determined in 4 before the load and in 9 patients after it, while out of 8 patients in the last session they were determined in

3 before and after the load. In subgroup B, VC before exercise in the first session was 83.5±9.9, after the session 98.7±13.6 (P>0.05), after the course before exercise 99.5±9.5 (compared with the study in the first session, (P>0.05) after exercise 116.8±11.0 (P>0.05). PTH, respectively, 71.5±6.8 , 81.5 ± 14.8, 84.5 ± 9.9, 95.8 ± 11.3 Simultaneously with the increase in VC and PTH, by the end of the course of treatment, 00/VC improved on average (from 15.8 ± 2.82 up to 14.6±4.74 at P>0.05), MSV) from 47.2±4.74 to 62.2±8.4; P<0.05), MCV25-75 (from 66.4±4.74 to 78.1±12.9; P>0.05), PaO2 increased from 72.4±3.8 to 76.9± 3.51 (P>0.05). Exercise tolerance also improved somewhat. This technique does not seem to be fully effective for a group of patients with tension asthma. It is likely, however, that highly favorable results can also be achieved in this group if the load of the same power is performed against the background of drugs that prevent asthma, such as intal (F.Savariaa 2016; F.Amat 2019). An increase in PTH after exercise by the last session in all patients of this category observed by us indicates that a course of short intensive training reduces the bronchospastic reflex to exercise.

According to our data, patients with tension asthma make up about 20-25% of patients with asthma in a hospital (more precisely, out of 40 treated without hormones, 12 were assigned to group B, and 2 out of 10 hormone-dependent), respectively, 75-80% of patients with a diagnosis of " bronchial asthma” responds to stress with bronchodilation. According to a foreign source (O.Scudiero 2015), only 10-15% of children diagnosed with bronchial asthma respond to the load with bronchodilation and, in principle, such a reaction is considered characteristic of the asthmatic syndrome, as well as bronchitis and chronic pneumonia. In connection with these data, the following question can be raised: whether the increase in the incidence of bronchial asthma in our country is largely the result of overdiagnosis. Would it not be more correct to replace the diagnosis of “bronchial asthma” in many patients with “asthmatic syndrome”, “asthmatic bronchitis”, “increased broncho-lability”, etc. parents, and for treatment tactics. As long as broncholability has not turned into a persistent bronchospastic reflex, preventive and non-drug methods of therapy are quite effective, in particular, as shown by our data, the method of intense physical activity carried out using a bicycle ergometer. Based on the results, the following test can be proposed to assess the nature of the bronchomotor function of a patient with suspected bronchial asthma in response to exercise. PTC is measured twice in a patient, after which a 10-minute load is given on a bicycle ergometer (with the help of 1.5 w/kg) and 2-3 minutes after the end of the load, PTC is again measured twice. The functional indicator is evaluated according to the best result. If it worsens or does not change after exercise, the diagnosis of bronchial asthma is highly likely. If it improves, there is an increased broncho-lability, which does not exclude bronchial asthma, but is more typical for pre-asthma, as well as bronchitis and chronic pneumonia. If the test provoked an asthma attack, the latter is easily stopped by bronchodilators (in an aerosol or in a complex powder). Complications from the cardiovascular system can be more serious. To exclude them, during the test, in addition to monitoring the general condition of the patient, one should monitor the heart rate and ECG on the monitor - as well as during the first treatment sessions of intense physical activity.

Based on the data obtained, it can be concluded that lung function limits the tolerance of intense physical activity in children with chronic nonspecific lung diseases only in the acute stage. In the period after exacerbation (in which the patients studied by us were observed), the main factor limiting exercise tolerance is the function of the cardiovascular system. Pathological changes on its part, such as a sharp increase or decrease in heart rate and blood pressure, relative lengthening of PQ intervals on the ECG and increased hypertension of the small circle and myocardial hypoxia, may occur the sooner than a significant deterioration in lung function both in patients with chronic lung diseases and in healthy people (S.Yu. Chikina, 2014; E.S. Mirzoyan and A.A., Eroshenko 2019; I.A. Deev and E.S. Kulikov 2017). Comprehensive studies of respiration and the cardiovascular system in follow-up after a year led to the conclusion that in children with asthma and chronic pneumonia in remission, when treated at home, adaptation to intense physical activity in follow-up is lower than it was achieved during the stay these patients in the hospital through sessions of intense dosed physical activity.

In follow-up, deterioration in the clinical course of the disease and deterioration in lung function was noted in about half of children with chronic pneumonia and hormone-dependent asthma patients, as well as in 70% of asthma patients treated without steroid hormones. It can be assumed that both clinical manifestations and functional indicators would be better if these patients would receive treatment with intensive dosed loads. Although such a technique - for patients outside the hospital - requires special development.

CONCLUSIONS

1. Most children with bronchial asthma in the period after an attack and chronic pneumonia in the period of incomplete remission tolerate intense physical activity lasting 15-20 minutes, carried out using a bicycle ergometer, at a power of 1.5 W/kg of body weight.

2. The introduction of sessions of the specified physical activity into the complex of therapy, daily 6 times a week, for a course of 8-12 sessions - in most patients it has a positive effect on well-being and clinical symptoms, as well as lung function and indicators characterizing exercise tolerance.

3. 20-25% of asthma patients can be classified as "tension asthma" patients. In such patients, a course of intensive exercise improves its tolerability in terms of functional signs, improves well-being and clinical symptoms, but some functional indicators (in particular, the characteristics of obstruction at rest) do not improve.

4. A simple test that determines the reaction of lung function to physical activity is expiratory pneumotachometry (PTH). By the end of the course of treatment, PTH, measured 2–3 minutes after the end of the exercise session, increases in all patients, including those with tension asthma (whereas before the course, exercise reduces PTH in them).

5. The positive effect of including dosed physical activity in the treatment of bronchial asthma is expressed in the abolition of bronchodilator therapy on the 1-2 day of treatment, a decrease in clinical symptoms and a significant improvement in the functional parameters of respiration, blood circulation and exercise tolerance. Physical exercise tolerance improves in all patients, blood circulation parameters do not change or slightly improve in all patients.

Lung function scores improve partially in patients with chronic pneumonia, and most asthma patients improve almost completely and substantially, with the exception of a group of tension asthma patients in whom only a few scores improve.

6. The most informative indicators of the dynamics of lung function under the influence of a course of intense physical activity are the functional residual capacity, the expiratory rate during exhalation of 25-75% of the forced vital capacity of the lungs, the oxygen tension in the mixed capillary blood. The state of the cardiovascular system characterizes the heart rate at the height of the load, the dynamics - before and after the load - of the PQ and QRST intervals and electrocardiographic signs of hypoxia, pulmonary hypertension and arrhythmia, as well as changes in blood pressure, determined indirectly. Exercise tolerance characterizes the ratio of heart rate to minute oxygen consumption before and immediately after exercise.

7. Indications for inclusion in the complex of therapy in a hospital dosed intense physical activity, carried out using a bicycle ergometer, are both inter-attack and post-attack periods of bronchial asthma, as well as the period of reducing the exacerbation of chronic pneumonia in children older than 6 years. A contraindication to the use of this method is poor exercise tolerance, which manifests itself clinically in provoked shortness of breath.

PRACTICAL RECOMMENDATIONS

1. For children with bronchial asthma in the post-attack period and patients with chronic pneumonia in the period of subsiding exacerbation at the stationary stage of rehabilitation, it is advisable to include intensive dosed physical activity in the treatment complex, carried out using bicycle ergometry under the control of functional studies.

2. The optimal mode of physical activity is its power of 1.% watts per kg of body weight (when pedaling a bicycle ergometer at a frequency of about 60 per minute) and lasting 15-20 minutes 6 times a week, for a course of 8-12 sessions. The proposed regimen is optimal for children of both sexes aged 7 to 15 years, patients with chronic pneumonia and chronic bronchial asthma without attacks and exacerbations.

3. An intensive load should be carried out under the control of functional studies - in the simplest version, by counting the pulse rate and assessing lung function using pneumotachometry. Prognostically favorable in relation to the effect of therapeutic bicycle ergometry is an increase in expiratory power 2-3 minutes after the end of the load.

4. The load in the specified mode should not be used in cases where it provokes shortness of breath, an increase in heart rate by a factor of two or more than 160 per minute, as well as a significant deterioration in the ECG or a sharp increase or decrease in blood pressure.

5. An exercise test carried out using a bicycle ergometer in the same mode as a therapeutic dosed exercise session helps to differentiate tension asthma from increased bronchial lability that developed against the background of asthmatic syndrome, bronchitis or chronic pneumonia. If VC or pneumotachometry in a patient with suspected bronchial asthma improves 2-3 minutes after the end of the load, this indicates significant bronchodilation due to increased bronchial lability. If the indicator worsens, then this fact can be considered a symptom of tension bronchial asthma.

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