

Спеціалізований рецензований науково-практичний журнал для педіатрів та сімейних лікарів

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## Scientific substantiation of approaches to physical rehabilitation of children with recurrent bronchial obstruction

**Abstract. Background.** The main objectives of the treatment of bronchopulmonary diseases in children are to control the disease, achieve a stable remission of the process, restore the function of external respiration, the nervous system, increase the body's tolerance to the action of allergens. Kinesiotherapy is one of the most effective methods in non-drug rehabilitation. The purpose of our study was the pathogenetic justification of the use of kinesiоhydrotherapy by the method of controlling the function of external respiration at the stage of rehabilitation of children with recurrent bronchial obstruction. **Results.** A comparative analysis of spirometric indicators in children with recurrent bronchial obstruction before and after kinesiоhydrotherapy in the experimental and control groups showed the effectiveness of the method of comprehensive rehabilitation with the inclusion of kinesiоhydrotherapy with special breathing exercises on land and in the pool. After a one-year rehabilitation period, violations of the ventilation capacity of the lungs by the obstructive type maintained in mild form. Children with recurrent bronchial obstruction who did not effectively use physical rehabilitation with additional medical recommendations and physiotherapy as in experimental group, still had violations of the function of external respiration during the recovery period. Clinically, the children of control group continued to have frequent relapses of bronchial obstruction on the background of acute respiratory infections. Therefore, they belong to the group with a prolonged course of bronchial obstruction and the risk of transition to bronchial asthma. After the course of treatment, the cough became much less frequent, there were no night attacks, and the body temperature was steadily normal. Auscultation of wheezing was not heard, breathing had a harsh tinge. **Conclusions.** Thus, the use of therapeutic water procedures and respiratory physical exercises, i.e. kinesiоhydrotherapy, is an effective method in the rehabilitation of children with recurrent bronchial obstruction.

**Keywords:** bronchitis; obstruction; rehabilitation; kinesiotherapy; children

### Introduction

To prevent the transition of primary bronchial obstruction in children to a chronic recurrent course and the formation of bronchial asthma (BA) in the future, it is necessary to effectively treat the disease, i.e. timely rehabilitation measures after discharge from the hospital in outpatient settings. A differentiated approach and optimization of rehabilitation measures in children with recurrent bronchial obstruction (RBO) primarily concerns children with the above-mentioned clinical and anamnestic and hereditary predisposition factors to asthma [1, 2, 6, 9]. It includes the implementation of the basic principles of medical rehabilitation: the earliest possible start of rehabilitation treatment, continuity and stages; the complex nature of medical, so-

cial, psychological and other activities; an individual approach to the preparation of rehabilitation programs, taking into account age, function of external respiration (FER) indicators in dynamics, predisposing factors, severity of the disease, conditions and lifestyle of the sick child. We agree with the statement of many authors that the problem of the widest possible use of available and necessary methods of rehabilitation measures, prevention of exacerbations of bronchial obstruction and timely diagnosis of BA at the stage of outpatient pediatric service is particularly relevant in this aspect [2, 3, 7].

After identifying the risk groups of children with RBO, we present effective rehabilitation measures that need to be carried out in outpatient settings. Based on a comparative

analysis of the above-mentioned risk factors for the development of asthma in children of RBO, we developed and introduced into the practical work of pediatricians and general practitioners more effective measures of rehabilitation observation using various methods of full-fledged and complex rehabilitation therapy.

The duration of rehabilitation treatment after the end of the acute period is 3–4 weeks. Repeated courses of rehabilitation treatment should be carried out in the spring (2–3 weeks). Initially, treatment and rehabilitation measures for children with recurrent bronchitis without obstruction or with obstruction include a gentle regime and nutrition enriched with vitamins.

Early rehabilitation of children with RBO includes the appointment of interferogenic anti-inflammatory drugs, bronchodilators, secretolytics, expectorants against the background of etiological treatment. In children with preserved bronchial obstruction,  $\beta$ -adrenomimetics are used via a spacer (salbutamol, fenoterol (1–2 doses)), combined drugs, for example, aerosol for inhalation pefsal (salmeterol fluticasone), berodual via a nebulizer. Among mucolytics, ambroxol is widely used, which also has a moderate anti-inflammatory effect [4, 7].

During the recovery period of RBO, the use of drugs with an anti-inflammatory effect is recommended, which includes singlon, L-montus, brisezi (montelukast), which also has an anti-bronchospastic effect and is anti-leukotriene receptor blocker [8]. During remission, it is recommended to continue 1 course of treatment (from 10 days to 1 month) with desensitizing drugs (cetirizine, loranez, and others).

In the period of late rehabilitation, immunocorrective therapy is planned in full and is performed during rehabilitation treatment. The appointment of immunocorrecting and immunomodulatory agents should always be justified by both clinical and laboratory data of the patient's examination. It depends on the severity of the disease and its course — acute or chronic. Immunocorrection of children with RB can be performed with the following preparations: immunal, bronchomunal, ribomunil, sodium nucleinate, polyoxidonium (children from 3 years). At the same time, vaccination of such children is carried out according to the conclusion of an immunologist. In order to increase the immunological stability, we prescribe 2 courses of an immunomodulator with an interval of 6 months (bronchomunal, imudon) or 3 courses (ismizhen) with an interval of 4 months.

Non-medicinal physiotherapeutic methods of treatment are becoming increasingly widespread due to the drug oversaturation of the body of a sick child, the emergence of drug resistance, the development of toxic and allergic reactions (Antonyuk M.V., Gvozdenko T.A., 2016). The main tasks of treating bronchopulmonary diseases in children are to control the disease, achieve a stable remission of the process, restore the function of external respiration, the nervous system, and increase the body's tolerance to allergens. Underservedly little attention is paid in world practice to methods of physical rehabilitation of children with chronic bronchopulmonary pathology.

Kinesiotherapy is one of the most effective methods in non-drug rehabilitation. Kinesiohydrotherapy (KHT) is

based on the use of physical therapy in the pool and on land [5, 6, 9, 10].

The KHT program includes: 1) general respiratory morning exercises in the open air (or in a well-ventilated area); 2) special exercises for the respiratory system 2–3 times a week physical therapy in the form of; 3) swimming 2–3 times a week with special exercises that strengthen the muscles of the respiratory system. So, exercises over and under water with breath holding, butterfly and other breathing exercises. It is necessary to conduct classes for 6 months up to 1 year 2–3 times a week for 1–1.5 hours. Kinesiohydrotherapy increases the body's adaptation to hypoxia and the hardening effect that is necessary for inflammatory diseases of the bronchi. A set of physical exercises on the water and in physical therapy classes affect the nervous sphere of the child, the endocrine and humoral system. At the same time, physical therapy and swimming positively provides an infusion of protective functions of the body. When performing KHT, it is necessary to take into account the level of health and training of children, so there are relatively healthy children who are previously hardened and children with RBO — previously not hardened, others — children who are convalescent after diseases. Therefore, physical therapy and swimming classes should be gradual, because children with a severe form of RBO need a gentle method of hardening.

**The purpose** of our study was to provide a pathogenetic justification for the use of kinesiohydrotherapy by monitoring the FER at the stage of rehabilitation of children with RBO.

## Material and methods

The material for observation was 76 children aged 6 to 15 years who were admitted to hospital treatment with a diagnosis of recurrent bronchitis with SBO. Upon admission to the hospital during the acute period on day 2, spirometric parameters were studied in patients. During the acute period, patients received traditional medical treatment and physiotherapy, drug electrophoresis, inhalation in the hospital. The study cohort of children with RBO was divided into 3 groups, of which I experimental group (EG) consisted of 42 patients with RBO and II comparison group (CG) — 30 children with RBO who received standard recommendations at discharge and 3 practically healthy children — control group of 45 children of the same age. Upon discharge from the hospital, EG children were given recommendations for comprehensive rehabilitation with KHT. At discharge, a group of children with RBO was given recommendations for conducting medical and physical rehabilitation measures using the KHT. The kinesiohydrotherapy program included the above-mentioned program. Upon discharge, parents of EG and CG were notified about the arrival of children in 6 and 12 months for spirometric and clinical anamnestic studies. Comprehensive rehabilitation of children with RB includes medical supervision, medical recommendations, and physical therapy.

## Results

Analysis of clinical and functional parameters in the examined patients was performed by spirometry using a computer spirograph type Spiro-spector “Neurosoft” (Rus-

sia) and Spirolab (Italy) for 1–2 days of hospital stay from 5–6 years of age. Technique of spirometry according to the standard method. The main indicators obtained during spirometry were: 1) vital capacity; 2) forced vital capacity (FVC); 3) forced expiratory volume in 1 second (FEV1); 4) spirometry indicators, including flows measured at different levels of FVC (MOS25, MOS50, MOS75, SOS25–75); 5) maximum ventilation of the lungs (MVL); 6) peak expiratory velocity (PSV) [5, 10].

The method for determining the effectiveness of CGT in children with RBO in rehabilitation was the study of FER initially on the 2<sup>nd</sup> day of hospital stay (study 1) and after 6 (study 2) and 12 months (study 3). During spirometry, the following main indicators were analyzed: FEV1; FVC; Tiffeneau index — the ratio of FEV1/FVC; PSV; MOS25, MOS50 and MOS75; MVL.

Children with RBO initially showed signs of impaired respiratory function, which is characteristic of SBO, during the acute period (Fig. 1).

It was manifested by a decrease in respiratory indicators — forced expiratory volume in 1 s (FEV1 decrease below 80 % of the required value), maximum expiratory velocity and maximum volumetric velocities, FEV1/FVC. At the same time, moderate violations of MOS50 and MOS25 were found in more than 80 % of patients, MVL in 40 %, FVC in 1/3 of patients, PSV in 1/4 of patients, IT in 14.7 and 16.7 %, respectively, MOS75 in 17.6 and 20.0 % of subjects, respectively.

The results of observations in children with RBO on day 2 of the disease showed that the initial FER data were lower than the expected values from the norm. In all the examined children, PSV was initially lower than normal and had different degrees of severity, which in 36.8 % of children this indicator was more than 80 % of the proper values, in

23.6 % — more than 70 %, in 17 % — more than 60 %, and in 2 % of cases — less than 60 %. These results indicate that patients with acute RB have moderate, and some patients have pronounced, manifestations of obstruction in medium and large-caliber bronchi. It is caused by edema of the bronchial mucosa, hypersecretion of mucus, violation of the rheological properties of bronchial secretions and desquamation of bronchial epithelial cells. It was found that in 42 (54.2 %) of children, FER was within the normal range, mild obstructive ventilation disorders were observed in 18 (23.6 %) of patients, moderate disorders were observed in 12 (15.7 %), and significant disorders were observed in 4 (5.2 %).

We analyzed the results of a study of EG children with RBO at 6 and 12 months after treatment and rehabilitation measures, including effective KHT. During the recovery period, positive clinical dynamics were observed against the background of KHT — a decrease in cough, its productive nature, the disappearance of shortness of breath during exercise, and a decrease in the number of wheezes over the pulmonary fields were recorded in parallel with an improvement in FER indicators.

Table 1 shows the average values of spirometric parameters from the proper values before and after KHT in children of RB, proceeding with SBO. After a 1-year rehabilitation course, a significant positive effect was revealed in both the experimental and control groups. As can be seen from Table 1, in children with RBO after 6 months of rehabilitation, there is a gradual recovery of FVD, while the indicators of FEV1 ( $68.1 \pm 4.1$  %), FEV1/FVC ( $70.2 \pm 3.2$  %) and PIC ( $68.7 \pm 2.4$  %) did not yet correspond to the official values. When performing complex differentiated rehabilitation of annual KHT in  $76.5 \pm 4.6$  % of children with RB, spirometry indicators approached the proper values. Re-

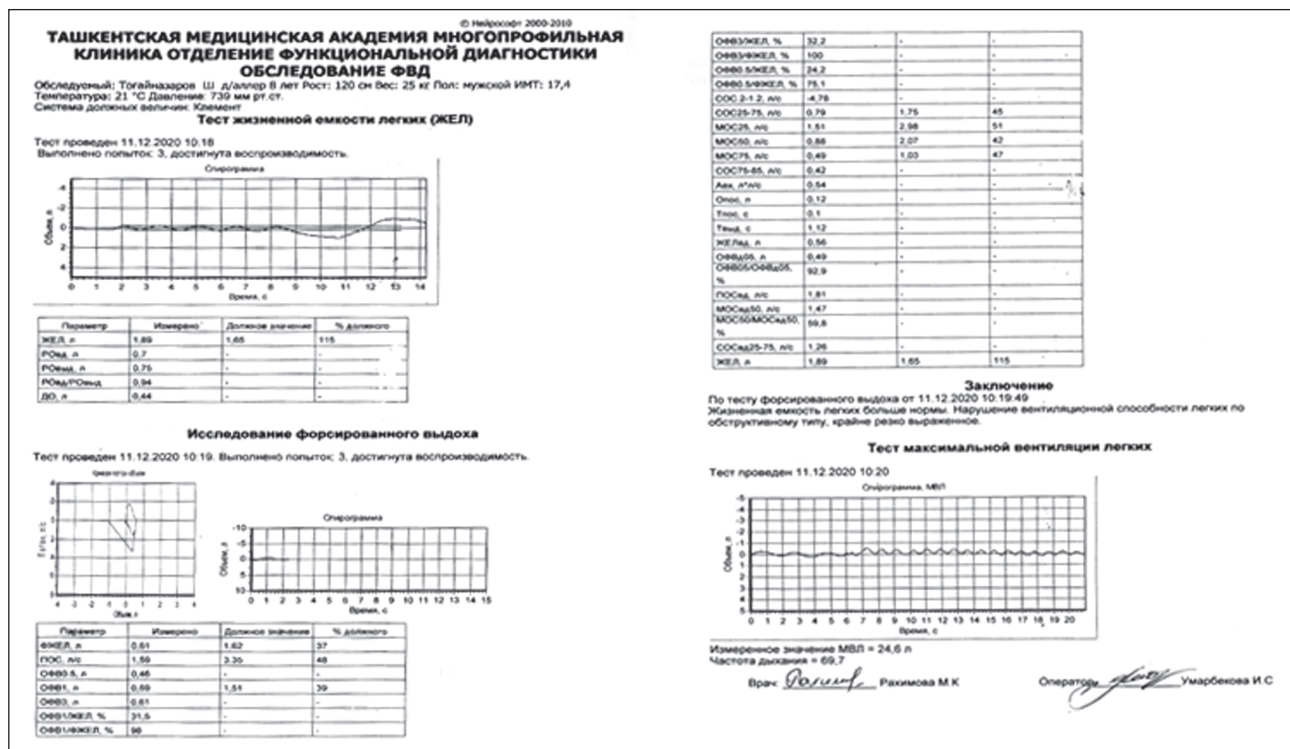


Figure 1. Spirometry results of a patient with RBO



**Table 1. Comparative analysis of spirometric parameters in children with RBO before and after KHT, % (M ± m)**

Spirometric parameters	Baseline (n = 85)	After 6 months	After 1 year
WEL	76.4 ± 4.2	82.5 ± 1.4	98.7 ± 3.4*
FGEL	51.4 ± 2.8	76.8 ± 3.0*	82.3 ± 5.4*
FEV1	52.3 ± 2.3	68.1 ± 4.1*	76.1 ± 4.3*
FEV1/FVC	64.5 ± 5.1	70.2 ± 3.2*	89.4 ± 3.7*
PIC	54.2 ± 2.1	68.7 ± 2.4	74.1 ± 1.6*
MOS25	53.5 ± 2.4	70.2 ± 3.0*	79.4 ± 4.3*
MOS50	58.1 ± 2.8	75.2 ± 2.5*	81.7 ± 3.2*
MOS75	65.9 ± 5.2	78.4 ± 4.3	80.2 ± 4.1*

**Note:** \* —  $p < 0.05$  — significant differences in indicators relative to the baseline values.

sults of the annual KG program in children with RBO, only 3.9 % of cases had moderate obstructive FER disorders, in 19.7 % — mild disorders, in the remaining 76.3 % of patients with RBO, lung ventilation and bronchial patency were determined within the age norm.

As can be seen from the Table 1, in children of RBO after 6 months of rehabilitation, there is a gradual recovery of FER. In the control group of children, spirometry indicators showed a statistically increased number of patients with standard values of FVC from 57.3 to 76.2 % ( $p < 0.001$ ), FEV1 from 58 to 78.4 % ( $p < 0.001$ ), PIC from 48.8 to 75.6 % ( $p < 0.001$ ), MOS75 from 61.2 to 80.3 % ( $p < 0.001$ ) and MVL on average from 23.6 to 42.1 L ( $p < 0.05$ ). In the CG of patients with RBO, it was noted that after 6 months of rehabilitation, the indicators of FVC, FEV1, and the ratio of FEV1/FVC increased slightly. A comparative analysis of spirometric parameters in children with RBO before and after KHT in the EG and control groups showed the effectiveness of the method of complex rehabilitation with the inclusion of KHT with special breathing exercises in the sun and in the pool. In some patients of both groups, changes in the PIC did not have a stable trend, which can be explained by violations of the regularity of training. Spirometry showed that for children with RBO, the greatest number of cases belonged to the obstructive type of ventilation disorders.

After carrying out rehabilitation measures, it is necessary to conduct a thorough and reliable assessment of the effectiveness of the manipulations performed. A correct analysis of the results of the measures carried out makes it possible to assess the significance of the rehabilitation methods used, their application in the future, and the need to improve and introduce modern rehabilitation technologies in outpatient settings. Thus, the analysis of spirometric data in children of the RBO comparison group, who were given standard recommendations at discharge with the use of only drug rehabilitation, showed low indicators of an increase in FER (Table 1). In the CG of patients with RBO, it was noted that after 6 months of rehabilitation, the indicators of FVC, FEV1, and the FEV1/FVC ratio increased slightly. After a one-year rehabilitation period, the general hospital maintained a violation of the ventilation capacity of the lungs by the obstructive type of mild form. It follows that children with RBO who did not effectively use physical rehabilitation with additional medical recommendations and

physiotherapy as in EG, retain violations of FER during the recovery period. Clinically, the children of HS continued to have frequent relapses of bronchial obstruction on the background of ARI. Therefore, this group of children belongs to the group with a prolonged course of bronchial obstruction on and the risk of transition to BA.

## Conclusions

After a one-year rehabilitation period, the general hospital maintained a violation of the ventilation capacity of the lungs by the obstructive type of mild form. It follows that children with RBO who did not effectively use physical rehabilitation with additional medical recommendations and physiotherapy as in EG, retain violations of FER during the recovery period. Clinically, the children of CG continued to have frequent relapses of bronchial obstruction on the background of ARI. Therefore, this group of children belongs to the group with a prolonged course of bronchial obstruction and the possibility of transition to BA. After the course of treatment, the cough became much less frequent, there were no night attacks, and the body temperature was steadily normal. Auscultation of wheezing was not heard, breathing had a hard tinge. Against this background, it was recommended to cancel budesonide with the continuation of montelukast. As an immunorehabilitation, the use of polyoxidonium in complex therapy in children with RBO is recommended, which makes it possible to effectively reduce the clinical symptoms of the disease in a shorter time and significantly improve the indicators of external respiratory function (FEV1) in comparison with children who received only standard anti-relapse therapy.

Thus, the use in rehabilitation therapy of a complex of necessary medical rehabilitation and physical training in the form of therapeutic water procedures and respiratory physical education, i.e. kinesiotherapy is an effective method in the rehabilitation of children with recurrent bronchial obstruction.

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Каримджанов І.А., Закірова У.І., Ісраїлова Н.А., Содікова Н.Б.

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### Наукове обґрунтування підходів до фізичної реабілітації дітей із рецидивною бронхообструкцією

**Резюме. Актуальність.** Основними завданнями лікування бронхолегеневих захворювань у дітей є контроль хвороби, досягнення стійкої ремісії, відновлення функції зовнішнього дихання, нервової системи, підвищення толерантності організму до дії алергенів. Кінезотерапія є одним з найефективніших методів немедикаментозної реабілітації. **Метою** нашого дослідження було патогенетичне обґрунтування застосування кінезогідротерапії методом контролю функції зовнішнього дихання на етапі реабілітації дітей із рецидивною бронхообструкцією. **Результати.** Порівняльний аналіз спірометричних показників у дітей із рецидивною бронхообструкцією до та після кінезогідротерапії в дослідній та контрольній групах показав ефективність методу комплексної реабілітації з включенням кінезогідротерапії зі спеціальною дихальною гімнастикою на суші та в басейні. Після річного реабілітаційного періоду порушення вентиляційної здатності легень за обструктивним типом зберігалися в легкій формі. У дітей

із рецидивною бронхообструкцією, які неефективно застосували фізичну реабілітацію з додатковими лікарськими рекомендаціями та фізіотерапією, як у дослідній групі, зберігаються порушення функції зовнішнього дихання у відновний період. Клінічно в дітей контрольної групи зберігалися часті рецидиви бронхообструкції на фоні гострих респіраторних захворювань. Отже, ці діти належать до групи із затяжним перебігом бронхообструкції та ризиком переходу в бронхіальну астму. Після курсу лікування значно порідшав кашель, нічних нападів не було, температура тіла стабільно нормалізувалася. При аускультатії хрипів не вислуховується, дихання мало жорсткий відтінок. **Висновки.** Таким чином, використання комплексу лікувальних водних процедур і дихальної фізкультури, тобто кінезогідротерапії, є ефективним методом реабілітації дітей із рецидивною бронхообструкцією.

**Ключові слова:** бронхіт; обструкція; реабілітація; кінезотерапія; діти