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V. P. Kostromina, E. A. Rechkina, L. B. Yaroshchuk, V. A. Striz, A. S. Doroshenkova
SO «National Institute of Phthysiology and Pulmonology named after F. G. Yanovsky of National Academy of Medical Sciences of Ukraine», Kiev

Adaptation and spare capacities in children with bronchial asthma

Keywords: children, bronchial asthma, adaptation, course.

One of the most pressing problem in pediatric is bronchial asthma (BA) in children [9, 11]. The prevalence of severe asthma is only 0.4–0.8 % in the pediatric population (or 7,12 % of all cases of child asthma). Severe asthma causes the high economic costs, significant reduces quality of life and increases disability [5]. In 75 % cases of severe asthma which had been in childhood, keeps the same course in adulthood [1]. In addition, this category of patients are most difficult to diagnose, because on the one hand, children are often overlooked symptoms, on the other hand - in clinical practice, there are often cases of over-diagnosis of asthma.

According to various authors [1, 6, 7, 10, 12] health and progress of different diseases cannot be treated without adaptation processes. Processes of adaptation directed to the development optimal strategies of living system to ensure its homeostasis. There is a clear relationship between level of health of the organism and its adaptive capacity. It is thought that adaptation is adaptation of the organism at the individual and population levels to environmental conditions which arise during evolution.

Adaptive norm» is a concept which includes part of manifestations general rate of reaction of the genotype which combines only checked complex reactions in these conditions. Biological and social stress factors primarily affect the individual level of adaptation. In order to estimate the level of health person, must know his normal indicators. So, not a whole person, a representative of a particular population with a certain amplitude of adaptation and reserve capacity should take place in the major medical and biological prediction [5, 13].

The set of reactive of function are essence of adaptation. These functions ensures adequate adaptation of the organism to the effects of environment, effective and economic activity, harmonious development and preservation of the relevant parameters of homeostasis. Practically all the manifestations of adaptation of the organism due to increased load on the

respiratory and cardiovascular systems. For example, studies have found that the level of adaptation of the child is formed not only by the presence of certain variations in health status as individual functional and reserve capacity which specific to each constitutional type [1, 2].

Pathogenetic problems in the organism based on violation of adaptation and regulation of homeostasis. Prevalence of non-specific manifestations over specific largely determine course of disease, effectiveness of treatment and prevention. It was established, that the degree of stress adaptation mechanisms depend from the level of chronic stress in the body. The decompensated adaptive mechanisms predominate. As a results the remorbid status of the organism moves into disease and result in disability. Diagnosis of the type of adaptive responses allows to predict the course and severity premorbid status and diseases and justify the correct treatment.

The prevalence of severe asthma in children is 1:1000, and suffer mostly children older than 10 years. There are factors of risk for development severe asthma include triggers (tobacco smoke, exposure of allergens, viral infections, pollutants, stress), lack adherence to treatment, presence of comorbidities. Of course, all this leads to disruption of adaptation. This idea resulted us to determine the relevance of our study.

The aim of the study was study adaptation and spare capacities in children with bronchial asthma (BA) depending of age, course and severity of disease.

Materials and methods

There were examined 120 patients 3–18 years old with BA. All patients were examined after receiving inform consent from the patient and his parents in accordance with GCP IHC. Diagnosis of asthma and its severity and controllability were established Document under the Ministry of Health of Ukraine dated October 8, 2013 № 868 «Uniform clinical protocol of primary, secondary (specialized) medical care. Asthma in children

In order to study were made groups: Preschoolers – 3 to 5 years – 32 patients; schoolchildren – 6 to 11 years – 55 patients; teens – 12 to 18 – 33 patients. Depending on severity disease were following groups: patients with mild asthma – 40 patients; patients with moderate asthma – 64 patients; patients with severe asthma – 16 patients. To solve this problem applied research general and special clinical methods.

Set of factors and indicators that can be easily identified practitioner, including an outpatient basis were resaeched.

Historical information by interviewing parents and older children were studied in order to fully assess of children and the characteristics of asthma. All data were obtained through questionnaire of parents, were supported by analysis of relevant medical records (history of the child (f. 112), statement epicrisis).

The level of functional adaptation (adaptive potential) was determined by an index of functional changes (IFC) of the body and evaluated according to the formula:

$$IFC=0,011\times HR+0,014\times SBP+0,008\times DBP+0,014\times A+0,009\times BW-0,009\times Hi-0,27$$

where HR – heart rate; SBP – systolic blood pressure; DBP – diastolic blood pressure; A – age, number of years; BW – weight, kg; Hi – height, cm.

Were identified four levels of IFC on the average and deviation [4]. There are: satisfactory, stress adaptation, unsatisfactory, failure of adaptation (Tabl. 1). Value IFC allow to classify by levels of adaptive capacity: satisfactory adaptation (2,59), stress adaptation (2,6–3,09), unsatisfactory (3,10–3,49), failure of adaptation (3,50 or more). Evaluation IFC for all its simplicity provides a systematic way to solve the problem of quantitative measurement of health. It is determined that IFC as a complex integral indicator displays a complex system of relationships and characterizes the functioning of all systems.

Asthma has exacerbation, control and remission. Standardized questionnaire Asthma control test (ACT) has been used for monitoring of assessing severity of BA which enables fast, just by history to assess the level of controllability of the disease. Level of asthma control was assessed every three months of treatment according to degree of care and patients were divided into groups in which asthma was controlled, partly controlled and uncontrolled according to the evaluation of the physician and the patient and parents completed Asthma Control Test (ACT test). There were used ACT test – for children from 4 to 11 years old and ACT test – for children over 12 years old. Children under 12 years used (ACT–child) which contains 4 questions for child and 3 questions for parents. Score ≤ 19 – asthma is uncontrolled, Score ≥ 20 – asthma is controlled.

Results

Work carried out by public funds. Was analiesed level of the IFC in children with different levels of severity of asthma. Severity of asthma were divided into two options: intermittent (episodic) and persistent (chronic). According to the classification, BA were: intermittent – mild asthma (1step) and persistent asthma (mild, moderate, severe – 2–4th steps).

There were not patients with satisfactory adaptation among of the examined one. Stress adaptation was in half of children patients (50,8 %). Unsatisfactory of adaptation (3) was in 40.8 % of children and failure of adaptation (4) was detected in 8.4 % of cases. Thus, processes stress and poor adaptation (88,3 %) predominate in children with asthma.

It was established that in children with mild asthma predominate unsatisfactory (50.0 %) and stress adaptation (45,8 %) and failure of adaptation in a large percentage value is present in patients with severe course of disease (18,2 %). Children with mild and moderate BA versus with patients with severe course, were significant decrease in the proportion of children with stress adaptation (27,3 % vs. 50,0 % and 54,1 %) and significant increase in those with unsatisfactory adaptation (54,5 % vs. 45,8 % and 37,6). Failure of adaptation in the largest percentage is present in patients with severe course of disease (18,2). It was established that more excited adaptive capabilities of the organism, more severe course of asthma.

Thus, was established that degree of severity BA dependence from level of adaptation in children with asthma.

Also we studied distribution of children by level adaptation capabilities based on age. According to data table. 3 there are significant differences in the adaptation and reserve capacity, depending on the age group in children with BA.

Depending of age stress adaptation predominates (78,1 %) in preschool children. With increasing age of patients is a redistribution towards poor adaptation: 41.8 % patients of 6–11 years old versus 21,9 % patients of 3–5 years old ($p < 0,05$). Among adolescents unsatisfactory adaptation is predominate (57.6 %) and 30.3 % of patients had failure of adaptation ($p < 0,05$). Violation of adaptive capacity in this age group perhaps explained by inadequate answers from adrenals, low levels of endogenous cortisol, which reduces t adaptive capacity of the psyche to the formation of pathological type of response to stress [13, 14]. All this indicates neuroendocrine disintegration, reduced adaptive potential. Thus, was established dependence of adaptation and reserve capacity of the organism to age and disease severity in children with BA. So level of adaptation of the organism which determined by index of functional changes can be one of the criteria for prognosis of BA in children.

The goal of treatment of asthma is to achieve and maintain full control under symptoms, asthma control and quality of life for all patients, regardless of the severity disease. Forecasting output to asthma control is an important element of medical – diagnostic process. There are criterias for full control of disease: lack of symptoms during the day, lack of need for short–acting bronchodilators, lack exacerbations and limitations in physical activity due to asthma symptoms and normal lung function (in practice – achievement of forced expiratory volume in the first second (FEV 1) and / or peak expiratory flow volume (PEF) > 80 % due predicted or individually best values). One aspect of achieving control under asthma is its rational development of criteria and selection of optimal therapy.

Asthma was predominantly partly controlled, especially severe asthma in the examined patients. By the level of asthma control was assessed every three months of treatment,

Table 1

The index of functional changes to the definition of adaptive capacity in children 6–17 years					
Age, years	Sex	The index of functional changes			
		satisfactory adaptation	stress adaptation	unsatisfactory adaptation	failure of adaptation
6	Boys	1,74–1,82	1,47–1,73 1,82–2,09	1,20–1,46 2,10–2,36	≤1,19 ≥2,37
	Girls	1,80–1,88	1,53–1,80 1,89–2,15	1,26–1,52 2,16–2,42	≤1,25 ≤2,43
7	Boys	1,73–1,81	1,46–1,73 1,82–2,08	1,19–1,45 2,09–2,35	≤1,18 ≥2,36
	Girls	1,78–1,86	1,51–1,77 1,87–2,13	1,24–1,50 2,14–2,40	≤1,23 ≥2,41
8	Boys	1,73–1,81	1,46–1,72 1,82–2,08	1,19–1,45 2,09–2,35	≤1,18 ≥2,36
	Girls	1,80–1,88	1,53–1,79 1,89–2,15	1,26–1,52 2,16–2,42	≤1,25 ≥2,43
9	Boys	1,74–1,82	1,47–1,73 1,83–2,10	1,20–1,46 2,10–2,36	≤1,19 ≥2,37
	Girls	1,75–1,83	1,45–1,71 1,81–2,07	1,21–1,47 2,11–2,37	≤1,20 ≥2,38
10	Boys	1,72–1,80	1,45–1,71 1,81–2,07	1,18–1,44 2,08–2,34	≤1,17 ≥2,35
	Girls	1,72–1,80	1,45–1,71 1,81–2,07	1,18–1,44 2,08–2,34	≤1,17 ≥2,35
11	Boys	1,76–1,84	1,49–1,75 1,85–2,11	1,22–1,48 2,12–2,38	≤1,21 ≥2,39
	Girls	1,72–1,80	1,45–1,71 1,81–2,07	1,19–1,44 2,08–2,34	<1,18 >2,35
12	Boys	1,73–1,81	1,46–1,72 1,82–2,08	1,19–1,45 2,09–2,35	≤1,18 ≥2,36
	Girls	1,73–1,81	1,46–1,72 1,82–2,08	1,19–1,45 2,09–2,35	≤1,18 ≥2,36
13	Boys	1,73–1,81	1,46–1,72 1,82–2,08	1,19–1,45 2,09–2,35	≤1,18 ≥2,36
	Girls	1,74–1,82	1,47–1,73 1,83–2,09	1,20–1,46 2,10–2,36	≤1,19 ≥2,37
14	Boys	1,77–1,85	1,50–1,76 1,86–2,12	1,23–1,49 2,13–2,39	≤1,22 ≥2,40
	Girls	1,78–1,86	1,51–1,77 1,87–2,13	1,25–1,50 2,14–2,40	≤1,24 ≥2,41
15	Boys	1,82–1,90	1,55–1,81 1,91–2,17	1,29–1,54 2,18–2,44	≤1,28 ≥2,45
	Girls	1,85–1,93	1,58–1,84 1,94–2,20	1,31–1,57 2,21–2,47	≤1,30 ≥2,48
16	Boys	1,86–1,94	1,59–1,85 1,95–2,21	1,32–1,58 2,22–2,48	≤1,31 ≥2,49
	Girls	1,89–1,97	1,62–1,88 1,98–2,24	1,35–1,61 2,25–2,51	≤1,34 ≥2,52
17	Boys	1,90–1,98	1,63–1,89 1,99–2,25	1,37–1,62 2,26–2,52	≤1,36 ≥2,53
	Girls	1,93–2,01	1,66–1,92 2,02–2,28	1,39–1,66 2,29–2,55	≤1,38 ≥2,56

Table 2
Distribution of children by level adaptation possibilities considering severity of disease

Level IFC	Patients with BA						All	
	Mild		Moderate		Severe			
	Abs	%	Abs	%	Abs	%	Abs	%
1	–	–	–	–	–	–	–	–
2	12	50,0*	46	54,1*	3	27,3	61	50,8*
3	11	45,8	32	37,6	6	54,5*	49	40,8
4	1	4,2#	7	8,2#	2	18,2#	10	8,4#
All	24	100,0	85	100,0	11	100,0	120	100,0

Notes: * – significant difference between the degree of severity BA ($P < 0.05$); # – significant difference between IFC ($p < 0.05$).

Table 3
Distribution of patients different age groups with BA according IFC

Level IFC	Age patients, years						All	
	3–5		6–11		12 – 18			
	abs	%	abs	%	abs	%	abs	%
1	0	0	0	0	0	0	0	0
2	25	78,1*#	32	58,2*#	4	12,1	61	50,8
3	7	21,9	23	41,8	19	57,6*#	49	40,8
4	0	0	0	0	10	30,3*#	10	8,4#
All	32	100,0	55	100,0	33	100,0	120	100,0

Notes: * – significant difference between the patients with different age ($p < 0.05$); # – significant difference between IFC ($p < 0.05$).

and patients were allocated to groups in which asthma was controlled, partly controlled and uncontrolled as assessed by doctor, patient and parents. Assessment course of asthma is a complex process, because the severity disease can vary depending on the patient's behavior, response to therapy and reflects complexity of predicting course of disease.

According to the evaluation of the physician, patient and parents filled asthma control test there were only 8 (6,7 %) children with full control asthma, in 51 (42,5 %) patients was partially controlled asthma and half patients (61 or 50,8 %) – uncontrolled ($p < 0,05$).

Despite the fact that almost patients received basic anti-inflammatory therapy as monotherapy IGCS or in combination with long-acting β_2 -agonists or anti leukotrienes, 76,7 % of patients took a few times per week a short-acting bronchodilators (Ventolin), 32,5 % of patients during the past year were hospitalized with exacerbation of asthma.

When analyzing the ratio of patients and their parents to their health how they assess level of control of disease were found conflict with data were obtained by questionnaire ACT. Among patients with partially controlled asthma in 60,1 % of parents and patients were classified as disease control «relatively good», and among patients with uncontrolled asthma – in 27,9 % cases. Almost half of patients were corrected supportive therapy. They took less medicines by themselves when they felt good and more drugs when they felt worse. At same

time, according to Western experts criterias of asthma control in clinical practice were achieved only in 5 % of patients [15]. We received the same data (complete control of asthma in 6,7 % of patients).

Some patients (27,5 %) had partly controlled and uncontrolled BA. It was due to wrong tactics of treatment which didn't met criteria of severity of disease. Among the defects of therapy have been established by medical errors: appointment of reduced doses of inhaled corticosteroids short courses of treatment, no correction of treatment (basic therapy) uncontrolled BA, reduced dose of IGCS and discontinuation of treatment by parents without consulting a doctor, incorrect assessment of symptoms by child, by his parents and by a doctor. All this led to lack of control over disease.

Thus, among examined children with BA disease was usually partially controlled or uncontrolled course, especially when asthma had severe course. Most common reasons for this were: respiratory infections, atopy and inadequate pre-treatment. Evaluation of controlled disease subjectively by the patient, his parents or got filled in asthma control tests are not the same. So to clearly identify degree of controllability of BA in children should be used questionnaires.

Conclusions

It was shown there were significant differences in the level of adaptation and spare capacities in children with BA.

There was correlation between severity of the disease and level adaptation and spare capacities of the body. With increasing age of the patients is a redistribution towards poor adaptation. There were 88,3 % of patients with stress and unsatisfactory adaptation. Failure of adaptation were observed in 8.4 % of cases. Patients with severe BA had a failure of adaptation (18,2) and asthma was partially controlled or uncontrolled. Should be applied questionnaire (ACT) for clearly define of controllability asthma in children. Level of adaptation and spare capacities in children with BA is determined by the IFC, which may be one of criteria for predicting course of asthma in children.

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АДАПТАЦИОННО-РЕЗЕРВНЫЕ ВОЗМОЖНОСТИ ОРГАНИЗМА ДЕТЕЙ С БРОНХИАЛЬНОЙ АСТМОЙ

В. П. Костромина, Е. А. Речкина, Л. Б. Ярошук,
В. А. Стриж, А. С. Дорошенкова

Резюме

Цель исследования. Изучить адаптационно-резервные возможности организма детей, больных бронхиальной астмой (БА), и течение заболевания в зависимости от выявленных нарушений.

Материалы и методы. Обследовано 120 детей, больных БА, в возрасте от 3 до 18 лет, с различным течением заболевания. Применялись общеклинические и специальные методы обследования.

Уровень функциональной адаптации организма (адаптационный потенциал) оценивали по индексу функциональных изменений (ИФИ) организма и вычисляли по формуле:

$$\text{ИФИ} = 0,011 \times \text{ЧСС} + 0,014 \times \text{САТ} + 0,008 \times \text{ДАО} + 0,014 \times \text{В} + 0,009 \times \text{МТ} - 0,009 \times \text{Р} - 0,27.$$

Для оценки адаптационных возможностей для мальчиков и девочек школьного возраста на основе средней величины и стигмального отклонения определены четыре уровня ИФИ: удовлетворительный, напряжение адаптации, неудовлетворительный и срыв адаптации.

В течении астмы выделяли период обострения, контроль и период ремиссии. Для мониторинга оценки тяжести течения БА был использован стандартизированный опросник — тест по контролю над астмой (АСТ), который позволяет быстро, только на основании данных анамнеза оценить уровень контролируемости болезни: АСТ-детский — для детей от 4 до 11 лет и АСТ для детей старше 12 лет.

Результаты и их обсуждение. Проведен анализ уровня ИФИ у детей с различной степенью тяжести БА. По степени тяжести астму разделяли на два варианта: интермиттирующая (эпизодическая) и персистирующая (хроническая).

Среди обследованных больных не было ни одного пациента, имеющего удовлетворительную адаптацию. Напряжение адаптации наблюдалось у половины обследованных детей (50,8 %). Состояние неудовлетворительной адаптации — у 40,8 % детей, срыв адаптации был обнаружен в 8,4 % случаев. Таким образом, у детей, больных БА, преобладают процессы напряжения и неудовлетворительной адаптации (88,3 %). У детей с легкой тяжестью БА преобладают процессы напряжения (50,0 %) и неудовлетворительной адаптации (45,8 %), а срыв адаптации в большом процентном значении присутствует у больных с тяжелым течением заболевания (18,2 %). У детей дошкольного возраста в функционировании адаптационной системы преобладают процессы напряжения адаптации (78,1 %). С увеличением возраста пациентов происходит перераспределение в сторону неудовлетворительной адаптации: у 41,8 % пациентов в возрасте 6–11 лет против 21,9 % пациентов в возрасте 3–5 лет ($p < 0,05$).

У обследованных детей БА имела преимущественно частично контролируемый характер, особенно при тяжелой степени. По уровню контроля БА, который оценивали каждые три месяца лечения, больные распределялись на группы, в которых БА была контролируемой, частично контролируемой и неконтролируемой — по данным оценки врача и заполненного пациентом и родителями АСТ. По данным оценки врача и заполненного пациентом и родителями АСТ, среди обследованных больных было только 8 (6,7 %) детей, которые имели полный контроль над течением заболевания, у 51 (42,5 %) астма была частично контролируемой и у половины больных (61 или 50,8 %) — неконтролируемой ($p < 0,05$).

Выводы. Установлено, что у детей, больных БА, наблюдаются существенные различия в уровне адаптационно-резервных возможностей, а также имеет место зависимость степени тяжести заболевания от уровня адаптационно-резервных возможностей организма. С увеличением возраста пациентов происходит перераспределение в сторону неудовлетворительной адаптации: у детей, больных БА, преобладают процессы напряжения и неудовлетворительной адаптации.

Больные с тяжелым течением болезни в 18,2 % случаев имели скрытые адаптационные возможности организма, а БА у этих детей была преимущественно частично контролируемой или неконтролируемой. Для четкого определения степени контролируемости течения БА у детей следует применять опросник, а уровень адаптационных возможностей организма, определяющийся по ИФИ, может быть одним из критериев прогнозирования течения БА у детей.

Ключевые слова: дети, бронхиальная астма, адаптация организма, течение.

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В. П. Костромина

ГУ «Национальный институт фтизиатрии и пульмонологии

им. Ф. Г. Яновского НАМН Украины», профессор

ул. Амосова, 10, Киев, 03680, Украина

тел./факс: 380 44 270 35 44,

e-mail: vpk@ifp.kiev.ua

ADAPTATION AND SPARE CAPACITIES IN CHILDREN WITH BRONCHIAL ASTHMA

V. P. Kostromina, E. A. Rechkina, L. B. Yaroshchuk,

V. A. Striz, A. S. Doroshenkova

Abstract

Aim. The aim of study was study adaptation and spare capacities in children with bronchial asthma (BA) depending of age, course and severity of disease.

Materials and methods. There were examined 120 patients 3–18 years old with BA.

The level of functional adaptation (adaptive potential) was determined by an index of functional changes (IFC) of the body and evaluated according to the formula:

$$IFC = 0,011 \times HR + 0,014 \times SBP + 0,008 \times DBP + 0,014 \times A + 0,009 \times BW - 0,009 \times Hi - 0,27$$

Were identified four levels of IFC on the average and deviation. There are: satisfactory, stress adaptation, unsatisfactory, failure of adaptation. Asthma has exacerbation, control and remission. Standardized questionnaire Asthma control test (ACT) has been used for monitoring of assessing severity of BA which enables fast, just by history to assess the level of controllability of the disease. C-ACT test was used for children from 4 to 11 years old, and ACT test – for children over 12 years old.

Results. IFC level was analyzed of the in children with different levels of severity of asthma. Severity of asthma was divided into two options:

intermittent (episodic) and persistent (chronic). There were no patients with satisfactory adaptation among of the examined one. Stress adaptation was in half of children patients (50,8 %). Unsatisfactory of adaptation was in 40.8% of children and failure of adaptation was detected in 8,4 % of cases. Thus, processes stress and poor adaptation (88,3 %) predominate in children with asthma. In children with mild asthma predominate unsatisfactory (50,0 %) and stress adaptation (45,8%) and failure of adaptation in a large percentage value is present in patients with severe course of disease (18,2%). Depending on the age stress adaptation predominates (78,1 %) in preschool children. With increasing age of the patients is a redistribution towards poor adaptation: 41,8 % patients of 6–11 years old versus 21–9 % patients of 3–5 years old ($p < 0,05$).

Asthma was predominantly partly controlled, especially severe asthma in the examined patients. By the level of asthma control was assessed every three months of treatment, and patients were allocated to groups in which asthma was controlled, partly controlled and uncontrolled as assessed by doctor, patient and parents. According to the evaluation of the physician, patient and parents filled asthma control test there were only 8 (6.7%) children with full control asthma, in 51 (42,5%) patients was partially controlled asthma and half patients (61 or 50,8 %) – uncontrolled ($p < 0,05$).

Conclusions. It was shown there were significant differences in the level of adaptation and spare capacities in children with BA. There was correlation between severity of the disease and level adaptation and spare capacities of the body. With increasing age of the patients is a redistribution towards poor adaptation. Failure of adaptation was observed in 8,4 % of cases. Patients with severe BA had a failure of adaptation (18,2 %) and asthma was partially controlled or uncontrolled. Should be applied questionnaire (ACT) for clearly define of controllability asthma in children. Level of adaptation and spare capacities in children with BA is determined by the IFC, which may be one of criteria for predicting course of asthma in children.

Keywords: children, bronchial asthma, adaptation, course.

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V. P. Kostromina

National Institute of Phthisiology
and Pulmonology named after F. G. Yanovskii

National Academy of medical sciences of Ukraine

Academician of NAMS of Ukraine, professor

03680, Kyiv, M. Amosova street, 10

tel.: 380 44 270 35 44, fax: 380 44 2753126

e-mail: vpk@ifp.kiev.ua