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O. O. Rechkina, A. S. Doroshenkova

SO «National Institute of Phthisiology and Pulmonology named after F. G. Yanovsky NAMS of Ukraine», Kiev

Incorrect use of metered aerosol inhalers in case of children's bronchial asthma

Key words: bronchial asthma, errors, metered aerosol inhaler.

Bronchial asthma (BA) is a chronic disease of the respiratory tracts whose main pathogenou mechanism is bronchial hyperresponsiveness caused by inflammation and whose main clinical manifestation are attacks of short-wind owing to bronchospasm, hypersecretion and edema of mucous membrane of the bronchi. Bronchial asthma is one of the most widespread chronic diseases causing a significant socio-medical problem both for the adults and the children [1].

However, in spite of existing domestic and international standards and proceedings for diagnosing and therapy of the bronchial asthma [2–6] uniforming the approach to estimation and monitoring of patients, the clinical manifestations of the disease can not always be controlled.

The notion of 'controllability of BA' stipulates lack of BA exacerbations, day-time symptoms (twice or less a week), limitation of every-day and physical activity during the day, night-time asthma symptoms, need for symptomatic treatment (twice or less a week), as well as normal or approximating to them parameters of respiratory function [7].

The problems of delivery of medical drugs into the respiratory tracts hold a significant position in the children's BA treatment. According to modern algorithms of BA attacks treatment and of the supporting therapy, the drugs are advised to be administered as inhalation. Such a mode of delivery contributes to high drug concentration in within the respiratory tracts, reduces its system effects and the total drug dose [8]. But, at the same time, such a delivery mode is difficult, because incorrect inhalation techniques does not ensure receipt of an adequate drug dose into the lungs [9]. One of the main factors determining efficiency of the inhalation therapy is an optimal delivery of the drugs into the respiratory tracts

depending principally on the inhalation device use techniques. An inhalation carried out technically incorrectly not only reduces essentially the therapeutic efficiency of the drug, but also causes development of undesirable phenomena [8]. In other words, the efficiency of the inhalation therapy depends 90 per cent on the correct inhalation techniques [10].

All the physicians prescribing the inhalation medicine, from a family doctor to a narrow-specialized physician, should explain and demonstrate the inhalation techniques to the patient and his parents, as well as control the correctness at each next visit [11], however, unfortunately, it is rarely done [9].

The metered aerosol inhalers (MAI) were introduced into the medical practice in the 1950ies, at the same time with the first portable multidose devices for inhalation of bronchodilators. The MAI are the most widespread medical drug administration devices used for basic (supporting) and symptomatic (urgent) BA therapy at children [12, 13]. The MAI are represented by usual metered inhalers activated by pressing the spray can, by inhalers activated by breathing in and by powder inhalers. But, despite of spreading of modern powder inhalers, the most extensively are used the MAI activated by pressing the spray can and delivering the drug by breathing-in directly into the bronchi and the lungs [12]. They are especially widespread among the children of preschool age who are not able to make an adequate inhalation, which makes necessary to use MAI with spacer (relay tank). However, inhalations made by means of MAI involve some difficulties, too, because the patient needs to synchronize the breathing-in with pressing the spray can [9]. Because of incorrect inhalation, a part of aerosol settles down in the buccal cavity,

in the larynx, trachea and main bronchi, sometimes a portion of drugs gets into the esophagus.

Purpose of the paper: Exposure of technical errors of MAI use by children suffering from BA and making the inhalation inefficiently.

Materials and methods. Have been analysed the inhalation techniques while using MAI by 50 children suffering from BA aged from 3 to 17 and undergoing an in-patient treatment at the Children's Pulmonology and Allergology Department of the Public Institution 'F.G.Yanovski Phthisiology and Pulmonology Institute' of the National Academy of Medical Sciences of Ukraine. The diagnosis of BA, its severity level and clinical course have been established according to the criteria formulated in the Uniform Clinical Proceedings of Primary, Secondary (Specialized) Medical Assistance in Case of Children's Bronchial Asthma [2]. All the patients had the medium severity level of BA with partially controlled or uncontrolled clinical course.

For the purpose of study of MAI use examination, the children were divided into the following age-related groups: preschool children (from 3 to 5 years) 8 persons (16 per cent of the whole), schoolchildren (from 6 to 11) 28 persons (56 per cent), teenagers (from 12 to 17) 14 persons (28 per cent).

Besides, the patients were divided according to the level of controllability of the clinical course of the disease. Among the examined patients, children with uncontrolled clinical course of BA (62 per cent) prevailed over the patients with partial control of the disease (38 per cent) (table 1).

Results

The inhalation techniques were estimated both at the children hospitalized for the first time and those who already had been observed at the In-Patient Section of the Department of the Children's Pulmonology and Allergology Department. The children who had been at the Department before, had been taught the correct inhalation techniques during the previous hospitalizations.

The inhalation techniques has not been described or demonstrated before the estimation.

The study of distribution of the patients according to age and to disease controllability degree established that among the preschool children and the teenagers the uncontrolled clinical course of BA prevailed (table 1). So, while at the 3 to 5 age patients' group the number of children with partially controlled and uncontrolled clinical course of BA was equal,

at the age of 6 to 12 the number of children with uncontrolled clinical course fell to 34 per cent, and in the age group of 12 and above the number of patients with uncontrolled clinical course amounted to 20 per cent. Thus, the more the age increased, the greater was the number of patients with uncontrolled clinical course of the disease.

While evaluating the MAI use techniques, the following errors were revealed (table 2). Only 20 persons (40 per cent of the whole) shook the spray can before use; the majority of patients held the inhaler correctly while using it: 46 persons (92 per cent), only 4 persons (8 per cent) held the can with bottom down; 5 persons (10 per cent) observed the correct head position; only 22 persons (44 per cent) made an adequate deep inhalation; only 15 persons (30 per cent) observed the deep breathing-in synchronized with the dispersion of the drug; only 37 persons (74 per cent) made a single pressing onto the spray can during a single breathing-in; only 15 persons (30 per cent) held their breath on the top of breathing-in for 10 seconds; only 15 persons (30 per cent) made nasal exhalation after 10 seconds of breathholding; only 23 persons (46 per cent) observed the rule to exhale only after the spray can had been removed from the mouth; 7 persons (14 per cent) used the spacer; while using the spacer, 5 persons (10 per cent) made a single pressing onto the can. In consideration of the obtained results, 92 per cent of the patients had some incorrectness of the inhalation techniques, or the inhalation techniques themselves were generally incorrect.

An analysis of the results showed that some patients did not know that the spray can must be shaken before use, some of them forgot.

At control of correct position of the inhaled, one child stated that it had been taught to hold the can bottom up by the family doctor; the other just did not pay attention to it.

Nobody at all observed the correct head position: thrown a little back. The majority of children bow the head forward.

The execution of a deep inhalation in general, as well as to synchronize it with dispersion of the drug is impossible for the children of preschool age. An analysis of the anamnesis data of the children of this age revealed the majority of parents had not known about the possibility and necessity of use of the MAI through the spacer. In other age groups some patients did not know about the necessity of deep inhalation, especially synchronized with the drug dispersion, some children had difficulties to execute the inhalation in such a way.

Distribution of patients according to age and controllability level of the bronchialasthma clinical course.

Table 1

Patients age, years	Patients suffering from bronchial asthma			
	partially controlled clinical course		uncontrolled clinical course	
	absol.	%	absol.	%
3-5	4	8	4	8
6-11	11	22	17	34
> 12	4	8	10	20
Total	19	38	31	62

Table 2

Evaluatio of the metered aerosol inhalers use techniques				
MAI use rules	Age groups			Total
	preschool ch. 8 (16 %)	schoolcholdren 28 (56 %)	teenagers 14 (28 %)	50 (100 %)
Shook the spray can before use	4 (8 %)	8 (16 %)	8 (16 %)	20 (40 %)
Correct inhaler position (bottom up)	7 (14 %)	26 (52 %)	13 (26 %)	46 (92 %)
Correct head position (a little thrown back)	0 (0 %)	2 (4 %)	3 (6 %)	5 (10 %)
Deep inspiration	0 (0 %)	12 (24 %)	10 (20 %)	22 (44 %)
Deep inspiration synchronized with drug dispersion	0 (0 %)	7 (14 %)	8 (16 %)	15 (30 %)
Only a single pressing onto the can	5 (10 %)	20 (40 %)	12 (24 %)	37 (74 %)
Breathhold on the inhalation top for 10 seconds	0 (0 %)	10 (20 %)	5 (10 %)	15 (30 %)
Exhalation after the spray can has been removed from the buccal cavity	0 (0 %)	14 (28 %)	9 (18 %)	23 (46 %)
Removal of the can from the buccal cavity after an exhalation through the nose	0 (0 %)	10 (20 %)	5 (10 %)	15 (30 %)
Use of spacer	5 (10 %)	2 (4 %)	0 (0 %)	7 (14 %)
Use of spacer: a single pressing onto the can (1 dose) = 10 inhalations	4 (8 %)	1 (2 %)	0 (0 %)	5 (10 %)

If the drug has been prescribed in form of two inhalations, some of patients think that the two inhalations should be made at once, some make the correct single pressing by a single breathing-in. The inadequate double pressing upon the spray can during the inhalation prevailed among the preschool children. This resulted mainly from incorrectness of the whole inhalation techniques; there was no adequate breathing-in, that is why the children did not feel the drug inhalation and made more pressings.

The majority of children did not know about the breath-holding for 10 seconds at the top of inhalation, such a delay is impossible for the children of preschool age.

Almost all the children take the can off the buccal cavity immediately after pressing upon it. This makes impossible the breathholding for 10 seconds. As a result, the lungs do not receive an adequate drug dose, and no therapeutic effect follows.

There are some problems while using the spacer, too; most patients make double pressing onto the can at once (if prescribed), and they usually make less than 10 inhalations.

It was revealed that most people learn to use the inhaler by themselves, reading the enclosed instructions. Only 8 persons (26.7 per cent) were shown the inhalation techniques by the physician prescribing the drug. But only to 5 patients the inhalation techniques were shown correctly.

The obtained results prove the necessity to control the inhalation techniques of the children to whom they have been shown, because with time the children relax their vigilance and do not observe the correctness of MAI use. It also results from lack of due control on the part of the parents, especially in case of teenagers who are able to do inhalations by themselves.

The results of the examinations show that only 4 persons (8 per cent) of children had optimal inhalation techniques. Thus, 92 per cent of patients have difficulties while using the MAI, which result in problems of controllability of the BA clinical course and increase of dose of inhaled glucocorticosteroids for supporting therapy.

An analysis of the instructions placed on the different packings of MAI drugs shows that by no means all the instructions contain explanations of all the stages of inhalation techniques. Not all the instruction state that the inhaler should be shaken before use, that a possibly deepest breathing-in should be made before inhaling. The breathhold for 10 seconds is not mentioned by any instructions at all: the advise just to hold the breath, to hold it for several seconds of for as long as possible.

All the instruction state that after the breathhold the inhaler should be removed from the mouth, and only after that the air should be exhaled. Our practice proves that the children should make the exhalation through the nose, and only after that, while finishing the inhalation, remove the spray can. This is explained by the fact that, while opening the mouth to remove the can, the children make an automatic exhalation releasing some drug.

Also, not all the instructions state that the patients having difficulty to synchronize the inhalation with breathing-in should additionally use the spacer, a device intended to facilitate the delivery of the inhaled drugs. Therefore, this is exactly the device for preschool children or for the children suffering from a concomitant pathology complication a deep inhalation (for example, a cardiac defect with cardiac insufficiency).

If a double inhalation is prescribed (two doses), equally not all the instructions state that that the inhalations should be made with an interval of several seconds.

All this obliges the physician to explain and to show the inhalation techniques, to control its correctness at each next visit. Therefore, the physicians themselves should be taught the correct techniques of the MAI use.

As it results from questioning of the children and their parents, nobody has seen the connection between controllability of the disease and incorrect inhalation techniques, supposing the techniques to be correct.

After the errors in the MAI use techniques had been evaluated, a training for the children and their parents was held and a correction of the inhalation techniques was made.

Conclusion

It has been revealed that the number of patients with uncontrolled clinical course of the disease increases with age. One of the reasons for this is lack of control of the inhalations done by teenagers able to do them by themselves, on the part of parents as well as on the part of physician.

It has been established that frequent technical errors at use of the MAI reduce considerably the therapy efficiency and involve development of the uncontrolled BA. Therefore, one of the most considerable reasons for children's uncontrolled BA are errors in inhalation techniques of the supporting and urgent therapy drugs. The correct inhalation techniques are one of the conditions for adequate therapeutic effect of the inhaled drug.

Even the patients using the MAI durably, to whom the correct inhalation techniques had been shown, loose the skill with time and start using the inhaler technically incorrectly. At that, the younger the children are, the more errors they make in inhalation techniques. The preschool children, sometimes even the schoolchildren, can not use the MAI without an additional device: the spacer.

Observance of the inhalation techniques requires patients' and their parents' training and control on the part of physician. Also there is necessity of teaching the correct inhalation techniques to physicians, especially those who are not narrow-specialized.

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ОШИБКИ ИСПОЛЬЗОВАНИЯ ДОЗИРОВАННЫХ АЭРОЗОЛЬНЫХ ИНГАЛЯТОРОВ ПРИ БРОНХИАЛЬНОЙ АСТМЕ У ДЕТЕЙ

Е. А. Речкина, А. С. Дорошенкова

Резюме

Согласно клиническим рекомендациям основной путь введения лекарственных средств при бронхиальной астме (БА) – ингаляционный, так как при этом создаются высокие концентрации препарата в дыхательных путях и минимизируются системные нежелательные эффекты. Однако эффективная доставка лекарства в легкие является сложной задачей и зависит от ингаляционной техники ингаляции. Неправильная техника ингаляций приводит к плохой доставке лекарства в дыхательные пути и, соответственно, снижает контроль над заболеванием.

Проводилось изучение ошибок использования дозированного аэрозольного ингалятора (ДАИ) у 50 детей в возрасте от 3 до 17 лет с частично контролируемой и неконтролируемой БА. У всех пациентов была средняя степень тяжести БА.

При оценке техники ингаляции ДАИ выявлены следующие основные ошибки: только 40 % больных встряхивали ингалятор перед использованием, лишь у 10 % при проведении ингаляции было правильное положение головы, только 44 % детей делали глубокий вдох, синхронизация вдоха с действием ингалятора соблюдалась у 30 % пациентов, лишь 30 % – задержали дыхание на высоте вдоха на 10 секунд, лишь 14 % пациентов при ингаляции ДАИ использовали спейсеры, при этом только 10 % однократно нажимали на баллончик соответственно дозе. Нарушение техники ингаляции с использованием ДАИ имела место у 92 % больных, у некоторых детей было несколько ошибок.

Установлено, что частые технические ошибки при использовании ДАИ значительно снижают эффективность терапии и являются одной из причин развития неконтролируемой БА. Большинство ошибок наблюдалось в дошкольной возрастной группе, что связано с возрастными физиологическими и психологическими особенностями.

Ключевые слова: бронхиальная астма, ошибки, дозированный аэрозольный ингалятор.

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Е. А. Речкина,

д-р мед. наук, стар. науч. сотруд,

заведующая отделением детской пульмонологии и аллергологии

ГУ «Национального института фтизиатрии и пульмонологии

им. Ф. Г. Яновского НАМН Украины»,

03680, Украина, г. Киев, ул. Амосова, 10,

тел.: +38(044)273-31-26

e-mail: child@ifp.kiev.ua

INCORRECT USE OF METERED AEROSOL INHALERS IN CASE OF CHILDREN'S BRONCHIAL ASTHMA

O. O. Rechkina, A. S. Doroshenko

Summary

According to clinical advice, the main mode of medical drug administration in case of bronchial asthma (BA) is inhalation, because it allows to concentrate the drug considerably in the respiratory tracts and to minimize undesirable system effects. However, an efficient delivery of the drug into the lung is a difficult task and it depends on inhalation techniques. Incorrect inhalation techniques involves bad delivery of the drug into the respiratory tracts and, accordingly, reduces the disease controllability.

A study of the errors of use of the metered aerosol inhalers (MAI) has been fulfilled involving 50 children aged from 3 to 17 suffering from partially controlled and uncontrolled BA. All the patients had medium severity level of BA.

While evaluating the MAI use techniques, the following errors were revealed: only 40 per cent of the whole shook the spray can before use; only 10 per cent observed the correct head position; only 44 per cent made an adequate deep inhalation; only 30 per cent observed the deep breathing-in synchronized with the dispersion of the drug; only 30 per cent held their breath on the top of breathing-in for 10 seconds; only 14 per cent used the spacer for MAI inhalation; while using the spacer, only 10 per cent made a single pressing onto the can corresponding to one dose. Therefore, 92 per cent of the patients had some incorrectness of the inhalation techniques, some children made at once.

It has been established that frequent technical errors at use of the MAI reduce considerably the therapy efficiency and involve development of the uncontrolled BA. Most errors were observed in the preschool age group, which results from age-related physiological and psychological features.

Key words: bronchial asthma, errors, metered aerosol inhaler.

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E. A. Rechkina,

MD, senior research assistant,

chief of department of children's pulmonology and allergology

SO «National Institute of Phthisiology and Pulmonology

named after F. G. Yanovsky NAMS of Ukraine»,

03680, Ukraine, Kyiv, M. Amosova str., 10,

tel.: +38(044)273-31-26

e-mail: child@ifp.kiev.ua