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KLİNİK ÇALIŞMA
RESEARCH ARTICLE

Metered dose inhaler-spacer use education effects on achieve asthma control in children

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SUMMARY

Metered dose inhaler-spacer use education effects on achieve asthma control in children

Introduction: Improper Metered Dose Inhaler (MDI)-spacer use technique can result in less than optimal delivery of medicine to the lungs and poor asthma outcomes. The aim of this study was to evaluate the influence of standardized education on proper MDI-spacer use and asthma control in children with asthma and to identify the factors associated with these results.

Materials and Methods: This is a cohort study that evaluated the influence of standardized education about MDI-Spacer device use on asthma control in children. Asthmatic children using MDI-Spacer device and their parents were enrolled in this study. Children were followed up for two months after standardized education and the change in asthma control was recorded.

Results: Thirty eight children (14 females and 24 males) aged between 2.5 and 13 years were enrolled in the study. Mean age of the children was 7.5 ± 2.8 years. Six patients were lost to follow up and thirty two patients completed the study. Mean inhalation technique score was 4.9 ± 1.3 before education and increased significantly to 7.8 ± 0.4 after education ($p < 0.001$). Mean Asthma Control Questionnaire (ACQ) score decreased significantly with education (0.77 ± 0.9 vs 0.1 ± 0.1 respectively, $p < 0.001$). Similarly, mean asthma symptom score (ASS) decreased significantly from 4.3 ± 3.6 to 0.2 ± 0.7 with education ($p < 0.001$). Most common mistake in use of MDI-Spacer device use was detected to be lack of mouth rinsing after use before education in 78.9% of the patients.

Conclusion: Providing standardized education about MDI-Spacer device use to children and parents leads to correct MDI-Spacer device use and is associated with improvement in asthma symptom score and asthma control.

Key words: Asthma control, children, inhalation technique, metered dose inhaler, spacer, education

ÖZET

Ölçülü doz inhaler-spacer kullanımını eğitiminin çocuklarda astım kontrolü sağlanmasındaki etkileri

Giriş: Hatalı ölçülü doz inhaler(ÖDİ)-spacer kullanım tekniği ilaçların akciğerlere optimalden daha az dağılmasına ve kötü astım sonuçlarına neden olabilir. Bu çalışmanın amacı doğru ÖDİ-spacer kullanımını ve astım kontrolünde standardize edilmiş eğitimin etkilerini değerlendirmek ve bu sonuçlar ile ilişkili faktörleri belirlemektir.

Materyal ve Metod: Bu çalışma çocuklarda astım kontrolünde ÖDİ-spacer cihazı kullanımına ilişkin standart eğitimin etkisini

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değerlendiren kohort bir çalışmadır. Bu çalışmaya ÖDİ-spacer kullanan astımlı çocuklar ve ebeveynleri alındı. Çocuklar standart eğitimin ardından iki ay boyunca takip edildi ve astım kontrolündeki değişiklikler kaydedildi.

Bulgular: 2.5 ve 13 yaşları arasında otuz sekiz çocuk (14 kız ve 24 erkek) çalışmaya alındı. Çocukların yaş ortalaması 7.5 ± 2.8 yıl idi. İzlemede 6 hasta çalışmadan ayrıldı ve otuz iki hasta çalışmayı tamamladı. Ortalama inhalasyon tekniği puanı eğitim öncesinde 4.9 ± 1.3 idi ve eğitim sonrası 7.8 ± 0.4 olarak anlamlı şekilde arttı ($p < 0.001$). Ortalama astım kontrol ölçeği (ACQ) puanı eğitim ile anlamlı derecede azaldı (Sırasıyla 0.77 ± 0.9 vs 0.1 ± 0.1 , $p < 0.001$). Benzer şekilde astım semptom skoru (ASS) da eğitim ile anlamlı şekilde 4.3 ± 3.6 'dan 0.2 ± 0.7 'ye düştü ($p < 0.001$). ÖDİ-spacer kullanımında en sık yapılan hata hastaların %78.9'unun eğitim öncesinde kullanım sonrası ağzın durulanmaması olarak tespit edilmiştir.

Sonuç: Çocuklar ve ebeveynler için ÖDİ-spacer cihazı kullanımında standardize eğitimin verilmesi doğru ÖDİ-spacer kullanımına yol açar ve bu da astım semptom skoru ve astım kontrolündeki iyileşmeyle ilişkilidir.

Anahtar kelimeler: Astım kontrolü, çocuk, inhalasyon tekniği, ölçülü doz inhaler, spacer, eğitim

INTRODUCTION

Inhalation therapy is a necessary part of treatment for many of the chronic lung diseases of childhood such as asthma (1). Global initiative for asthma (GINA) indicates that inhaled steroids are the mainstay of asthma treatment in children (2). However effective asthma management can only be done with good self management and optimal use of asthma medications via inhaler device (3,4). In 2011, GINA is focused on patient education about asthma (2). Inhaled treatment has many advantages such as direct fast onset of action due to local delivery high concentration of the drug to the airways with minimal systematic side effects however, use of these medications with improper technique leads to the inefficacy of treatment (5-8). Inefficient inhaler treatment results in poor asthma outcomes, frequent exacerbations, increased hospitalization rates and medication cost (3,5,8-11).

A large number of inhalation devices are used for delivery of asthma medication in children (12). Proper prescription of inhaler devices especially in young children are important to the success of drug treatment (10). MDI are the therapy of choice for inhaled treatment in young children, but this often requires the use of spacers (7,9,10,13). Spacers that require breathing at tidal volume, have high clinical efficacy with low oropharyngeal deposition. These devices eradicate the problem of cooperation that exists with MDIs due to the one way valve system that open with inspiration and close with expiration (6,9). Younger children may need the use of a mask tightly sealing to the face (6,9). Although, use of spacers increases the clinical MDI therapy in young children, improper technique may eliminate this advantage. Therefore, the most important step for the effective

asthma management is achieved by demonstration of the correct inhaler device technique by healthcare professionals (HCP) to patients and/or caregivers.

Influence of standardized education of patients on improvement of inhalation technique has been demonstrated (3,4,7,9,10). However influence of this modality on asthma control on long term has only achieved in a few number of previous studies in children (3,14,15). Therefore, the aim of this study was to evaluate the change in asthma control and after standardized education on proper MDI-Spacer use.

MATERIALS and METHODS

Study Population

Children with uncontrolled asthma despite treatment with MDI-Spacer and their parents were enrolled in this study. They were recruited consecutively from the Pediatric Allergy and Pulmonology outpatient department. Diagnosis of asthma was based on GINA criteria. All children had recurrent exacerbations detected by a physician before and reversibility of bronchoconstriction was demonstrated either by clinical findings or by spirometry (2). Inclusion criteria;

1. Being diagnosed as having uncontrolled asthma despite treatment.
2. Using inhaled treatment MDI-Spacer.

Exclusion criteria;

1. Having a chronic lung disease other than asthma that may influence Asthma control questionnaire (ACQ) results.
2. Having received a standardized education MDI-Spacer use from a physician previously.

Study Design

This is a cohort study that evaluated the influence of standardized education about MDI-Spacer use on asthma control in children. Children were followed up for two months after standardized education and the change in asthma control was recorded.

Measurements

Age, gender, duration of asthma diagnosis, duration of aerosol treatment use were recorded as well as the age, gender, education and occupation of the parents. Asthma symptom score was evaluated for all children and ACQ was filled in by all parents at the beginning and end of the study period.

Asthma Symptom Score

Asthma symptom score (ASS) consisted of four items scored 0 to three. Total score was expressed as the sum of all scores. The items were "how commonly did you feel wheezing or tightness in the chest?", "how often did you wake up due to cough or tightness in the chest?", "how often did you have asthma symptom upon waking up in the morning?" and "how often did cough, wheezing or tightness in the chest bother you during your physical activities?". The responses ranged between never, less often than once a week, 1-3 days a week and 4-7 days a week. The score increased as the symptoms increased (16).

Asthma Control Questionnaire

ACQ was developed by Juniper et al and validity and reliability has been demonstrated (17). It is composed of 5 questions about symptoms, 1 question about bronchodilator use during the previous week and one question about FEV₁% change. The last item about spirometry may be omitted when children don't cooperate with respiratory function test. All questions are scored 0 to 6 and total score is expressed as the mean of these scores. Asthma control deteriorates as the score increases (18). Clinically important change in ACQ score is reported to be 0.5 (17).

Standardized Education on Metered Dose Inhaler-Spacer Use

All children and/or parents were instructed to demonstrate how they use their MDI-Spacer at the beginning of the study. Then, the pediatric allergy and pulmonology nurse told and demonstrated MDI-Spacer use to the child and parent. Finally, the child and/or parent was asked to MDI-Spacer use again. Inhalation technique evaluation form that consisted of eight steps of MDI-Spacer use was filled in for both demonstrations by the study participants and one point was given for each step that was completed successfully (Table 1) (13). Total spacer use score was expressed as the sum of points received for each step. Study participants were called in two months later and were asked to demonstrate MDI-Spacer use again and inhalation technique evaluation form was filled in again.

Statistical Analysis

Sociodemographic and clinical findings were presented as number or mean \pm SD as appropriate. Statistical analysis of data was performed by SPSS 15.0 (Chicago IL) computer software. Mean MDI-Spacer use scores, ASS and ACQ scores at the beginning and end of the study period were compared by paired samples t test. Correct MDI-Spacer use step before and after education in each step were compared with Pearson's Chi-square test. Statistical significance was defined as $p < 0.05$.

The study was approved by the ethical committee of the University and informed consent was taken from the parents of children.

RESULTS

Sociodemographic and Asthma Characteristics

Thirty eight children (14 females and 24 males) aged between 2.5 and 13 years were enrolled in the study. Mean age of the children was 7.5 ± 2.8 years. Six

Table 1. Steps of MDI-spacer use

1. Removing the cap of the inhaler
2. Shaking the inhaler
3. Exhalation
4. Placing the mask of the spacer to cover the mouth and nose preventing leaks
5. Releasing one dose from the inhaler and breathing deeply simultaneously
6. Holding the breath for fifteen seconds after inhaling and exhaling 15 times
7. Removing the mask of the spacer from the face
8. Washing the face and rinsing the mouth after inhaled steroid use

Table 2. Sociodemographic and clinical findings

	Study group (n= 38)
Age, mean ± SD (months)	90.2 ± 33.6
Sex	
Male	24
Female	14
Duration after diagnosis of asthma (months)	21.2 ± 27.2
Duration of inhaled steroid use (months)	17.4 ± 23.3

patients were lost to follow up and thirty two patients completed the study.

Mean duration of asthma was 21.2 ± 27.2 months and mean duration of Spacer with MDI-Spacer use was 17.4 ± 23.3 months (Table 2).

Asthma Symptom, Asthma Control Questionnaire and Inhalation Technique Scores

Mean inhalation technique score was 4.9 ± 1.3 before education and increased significantly to 7.8 ± 0.4 after education (p< 0.001). Mean ACQ score decreased significantly with education (0.77 ± 0.9 vs 0.1 ± 0.1 respectively, p< 0.001). Similarly, mean asthma symptom score decreased significantly from 4.3 ± 3.6 to 0.2 ± 0.7 with education (p< 0.001) (Table 3).

Frequency of correct MDI-Spacer use step before and after education in each step is shown in Table 4 and figure 1. Most common mistake in use of MDI-Spacer device use was detected to be lack of mouth rinsing after use before education in 78.9% of the patients. This was followed by lack of exhalation before inhaling the drug (65.8%) and not shaking the inhaler before use (60.5%). Most common mistakes that were detected after education were not shaking the inhaler before use, not exhaling before inhalation of the drug and lack of mouth rinse and face cleaning after use (2.6% each) (Table 4 and figure 1).

Table 3. Comparison of ACQ, MDI-spacer use and asthma symptom scores before and after education

	Before education	After education	p
MDI-spacer use score	4.9 ± 1.3	7.8 ± 0.4	p< 0.001
ACQ score	0.77 ± 0.9	0.1 ± 0.1	p< 0.001
ASS	4.3 ± 3.6	0.2 ± 0.7	p< 0.001

Table 4. Frequency of correct MDI-spacer use step before and after education

MDI-Spacer use step	Before education (n) (%)	After education (n) (%)	p
1	30 (78.9)	32 (100)	0.005
2	13 (34.2)	31 (96.8)	< 0.001
3	15 (39.5)	31 (96.8)	< 0.001
4	37 (97.4)	31 (96.8)	1
5	28 (73.7)	32 (100)	0.001
6	28 (73.7)	32 (100)	0.001
7	32 (100)	32 (100)	0.025
8	8 (21.1)	31 (96.8)	< 0.001

CONCLUSION

We found that MDI-Spacer use by children was frequently incorrect. The results of our study indicated a significant improvement of asthma control and symptom score with improved inhalation technique after a standardized education on MDI-Spacer use. This is in concordance with the international guidelines that state the importance of patient and family education on long term asthma treatment (2,3).

Currently, inhaled corticosteroids are very effective in reducing asthma associated morbidity and mortality (2,19). In children with asthma, technical education at the time of prescription of inhaled medication is essential for correct inhalation technique (7,20). Responsibility HCP's in inhaler use are crucial for both in achieving initial correct inhaler technique and also in maintaining this correct inhaler application over time. Most patients are trained on proper inhaler technique by physicians or nurses and, to a lesser extent, pharmacists (5,21). But only 15 to 69% of HCP can demonstrate correct inhaler device use, minority of patients receive inhaler use education (1,7,21,22). Consequently, approximately half of patients who initially learn how to use their inhalers properly, do not maintain this correct technique over time (21).

Using inhaler device is a problem for all ages of patients. In a review of 21 studies looking at misuse of metered dose inhalers, poor technique was estimated to be prevalent in 14 e 90% (with an average of 50%) of cases (20). Many research have shown that a high proportion of children do mistakes while using inhaled treatments (10,13,23). Lack of

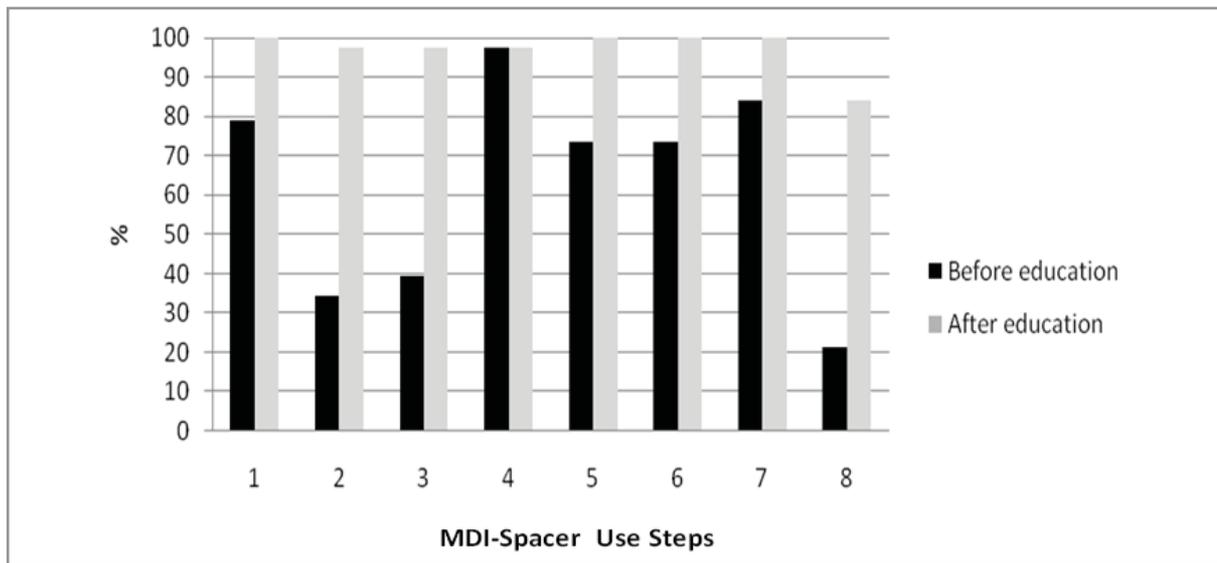


Figure 1. Frequency of MDI-Spacer use steps performed correctly before and after education.

cooperation in young children especially hand mouth coordination may interfere with effective inhalation therapy with MDI (13,24,25). It has been demonstrated that the most common mistakes include not exhaling before starting, not shaking the MDI and inhaling for a very short time (10,13,21,23-27). Similar with other studies, common mistakes detected in our study were lack of mouth rinsing after use followed by lack of exhalation before inhaling the drug and not shaking the inhaler before use.

Also repeated education is required for correct inhaler technique., due to inhaler technique may worsen after initial tutorial (9,25,28). HCP should repeat this instructions at subsequent visits to confirm correct usage of inhaler device (29,30). Another critical step is the way of the education. Verbal instruction in addition to physical demonstration is the most effective patient training technique in correct inhaler use like the method, we used in our study (28). It has been reported that most children and adults reduce their mistakes in inhalation device use after getting education about it (31,32). Repeated educations result in better inhalation technique and play a key role in successful inhalation therapy (8,9,22,23,25,30,31). It is reported that repeated education about MDI inhalation technique resulted in a statistically significant improvement in MDI technique scores when compared to single education (33,34). Getting a second education besides the one at the time of first prescription increased the rate of correct technique to 91% (33). These results are similar to our results in

which we have shown that children completed only 4.9 ± 1.3 of steps required for correct use of MDI-Spacer before receiving standard education despite the fact that they had been using it before being enrolled in the study. This number increased to 7.8 ± 0.4 after education session.

The main aim of asthma therapy in current international guidelines is to control asthma by inhibiting undesirable consequences (2). Efficacy of the inhaled treatments in asthma patients, depends on the quantity of delivered medication into the lungs which is mostly influenced by the inhalation techniques. Improvement in MDI technique provides better delivery of medication into the lungs thus clinically significant improvement (11). Inappropriate inhalation technique decreases drug delivery in the lungs and decreases the efficacy of medical treatment and hinder better asthma control (7,8,10,11). People with asthma and improper inhaler technique were shown to have poorer symptom control compared to those with good inhaler technique, with a subsequent increase in medical or emergency visits (8,11,20,25). Furthermore, as improved inhalation technique has been shown to improve adherence to asthma therapy (possibly due to the positive reinforcing effects of improved symptom relief concurrent with improved medication administration (29).

ACQ is an indicator developed by Juniper et al. to assess control of asthma. Correlation of ACQ with functional parameters related to asthma in children

has also been demonstrated in six minute walking test in a previous study (35). Some authors reported that patients who use their inhalation device correctly have better asthma control (3,5,8,11,36). McWhirter et al, Horner and Brown showed that children with asthma have lower requirement for medication, reduction in symptoms of wheeze and improvement in children's quality of life as their inhaler skill improved (14,15). It has been shown that improvement in inhalation technique is associated with an improvement in disease specific quality of life indicated by pediatric asthma quality of life questionnaire (PAQLQ) scores and a decrease in the inhaled steroid dose required (3,31). Likewise, we have demonstrated that asthma symptom score and ACQ score improved during the two months after the children received standardized education with MDI-Spacer use. On the other hand, some authors did not detect a correlation between PAQLQ scores and correct MDI-Spacer use technique score and some others showed that asthma symptom score did not worsen despite wrong use of MDI-Spacer (32,33). These differences in different research might be attributed to many factors such as differences in study populations in terms of asthma severity and differences in standardized education protocols.

The major limitation of this study was the small sample of size of the study population. However, even with this sample size, change in the outcome variables was statistically significant.

In conclusion, incorrect use of inhaled treatment in children may be a major cause of uncontrolled asthma and improvement of MDI-Spacer use technique may lead to better asthma control and a decrease in asthma symptoms. Therefore, incorrect inhalation technique should be sought in children with uncontrolled asthma before increasing the treatment step or further diagnostic work up. Moreover, standardized and interactive education about MDI-Spacer use may be recommended as an integral component of asthma treatment in children.

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Hasan Yuksel and Ozge Yilmaz involvement in the conception, hypotheses delineation, and design of the study.

Ahmet Turkeli wrote and Ozge Yilmaz, Hasan Yuksel revised the manuscript.

Ahmet Turkeli took part in acquisition of the data.

Ozge Yilmaz participated in analysis and interpretation of data.

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