



Pulmonary Medicine

ANALYSIS OF INHALER ADMINISTRATION TECHNIQUE AMONG ASTHMATIC CHILDREN AND, THEIR CAREGIVERS

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ABSTRACT **Background:** Many children with asthma do not use their inhalers correctly and consequently gain little therapeutic benefit from the treatment. Most children and their caregivers can be taught effective inhalation therapy by using a pMDI, a pMDI with a spacer, or a DPI. The focus of inhalation therapy should be on those inhalers which are easiest to use correctly by various groups of children and training required to obtain a correct technique. **Subjects and Methods:** This prospective descriptive study was conducted in 100 asthmatic children (2 to 14 years of age) attending the Department of Pulmonary Medicine, a tertiary care hospital Patiala, Punjab. All children and/or their caregivers were instructed to use the proper inhalation technique by physicians or trained technicians before prescribing the medication. Data were collected during regular follow-up visits after written informed consent was obtained from the patients and their caregivers. **Results:** Hundred children and their caregivers were evaluated for their inhalation technique. 59 children (63.4%) were male and 34 (36.6%) were female. 30 children on pMDI alone, 62 children on pMDI with spacer, and 8 children on DPI. The percentage of the children and caregivers who demonstrated the correct technique was 83.3% in the pMDI-spacer, 81.8% in the pMDI, and 50% in the DPI respectively. 10 (83.3%) patients were first given instruction of inhalation technique by a physician in pMDI- spacer group, 10 (90.9%) in the pMDI group, and 2 (100%) in the DPI group respectively. The children and caregivers were instructed by a trained technician 2 (16.7%) in the pMDI-spacer group, 1 (9.1%) in the pMDI group, and no in the DPI group. Step 7 was the most common incorrect step in the performance of pMDI-Spacer, Step 6 in the performance of pMDI and step 4 was in the performance of DPI. Children over 10 years old were found to have a significantly higher percentage of correct performance in all steps ($p < 0.001$) in pMDI, pMDI- Spacer, and in the case of DPI the p-value was 0.032. **Conclusion:** In this study, it was concluded that various factors which were education level of caregivers, medication provided under caregiver's supervision, duration of the device usage, and trained physician as the first instructor had an important role in the correction of inhalation technique in asthmatic children.

KEYWORDS : Asthma, Inhaler, pMDI , pMDI-spacer, DPI.

INTRODUCTION

Asthma is a heterogeneous disease, usually characterized by chronic airway inflammation, affecting all age groups. It is diagnosed by the history of respiratory symptoms such as wheeze, shortness of breath, chest tightness and cough that vary over time and in intensity, together with variable expiratory airflow limitation. This should be documented from bronchodilator reversibility testing or other tests. (Initiative, 2020) Drug delivery to the lungs via the inhaled route remains the cornerstone of therapy for patients with asthma. Inhaled therapy targets drug directly to the lungs and allows a distinct therapeutic advantage over systemic therapy with the use of smaller drug doses, a more rapid onset of therapeutic action, and decreased adverse effects. There are several types of inhaler device and drug delivery systems used in clinical practice for the management of asthma and these include the pressurized metered-dose inhaler (pMDI), pMDI with spacers, dry powder inhalers (DPIs), and nebulizers. (Lee et al., 2012) These three inhaler systems differ with respect to construction, aerosol cloud generation, optimal inhalation technique and ease of use. Still, with appropriate tuition and training, all paediatric patients and their caregivers can be taught effective inhaler use with one of these three systems. The precondition for this is accurate knowledge about the nature and magnitude of the problems that children of various age groups experience when using these devices correctly. (Pedersen et al., 2010) Irrespective of the type of inhaler device used, the outcome of inhaler therapy largely depends on appropriate use of the inhaler. (Uijen, Van Uijthoven, Van Der Wouden, & Bindels, 2009) Previous studies have shown that many asthmatic children and their parents are unable to perform proper inhalation techniques even after receiving instructions. (Burkhart, Rayens, & Bowman, 2005; Chen, Yin, & Huang, 2002; Kamps, Brand, & Roorda, 2002; Scarfone, Capraro, Zorc, & Zhao, 2002; Vella & Grech, 2005; Walia et al., 2006) General practitioners and pediatricians should have an important role providing children assessment of their inhaler technique and correct them when errors are detected at every follow up visit, which is

essential for good asthma control. (Pinto, Jeri, & Barbosa, 2018) Children's improper use of inhalers that lead to poor asthma control, increased number of hospitalizations, and increased health care costs. (Basheti, Armour, Bosnic-Anticevich, & Reddel, 2008; Chopra, Opreescu, Fask, & Oppenheimer, 2002; Giraud & Roche, 2002) Any improvement in inhalation therapy has the potential to improve outcomes of asthma therapy. Inadequate inhaler instruction and poor inhaler technique are another major cause of poor disease control, influencing as they do the amount of drug that reaches the lung and compliance with therapy. (Virchow et al., 2008) Effective use of inhalers requires proper inhalation technique. (Melani et al., 2011) There is no one 'perfect device' and several studies have shown that inhaler technique errors made by patients with asthma are common in real life with both pMDIs and DPIs despite advances in inhaler device technology. (Usmani et al., 2018) For correct use of these devices pMDI, pMDI with spacer and DPI patient need multiple education session for learning and maintaining of inhalation technique. (Singh, Meena, & Kishan, 2019) For previous studies conducted in the outpatient setting have demonstrated variable rates of inhaler skill, from 0% to approximately 89% of children performing all steps of inhalation correctly. (Samady et al., 2019) The children and their caregivers should be taught the correct technique of inhalation by the treating physician/pediatrician; every treating physician should revise the correctness of inhalation technique whenever the patient comes for a follow-up visit especially when the patient is not responding to the prescribed treatment. The aims of the study were evaluated the proper technique in using pMDI, with or without spacer and DPI, among asthmatic children and their caregivers and identify the factors affecting improper technique.

METHODS AND MATERIALS

This prospective descriptive study was conducted in 100 asthmatic children (2 to 14 years of age) attending the Department of Pulmonary Medicine, Government Medical College, Patiala. All asthmatic

children who were already on inhaler technique either MDI, MDI with spacer and DPI or newly diagnosed children at our chest and tuberculosis department, Government Medical College, Patiala, which was, prescribed the inhaler technique either MDI, MDI with spacer and DPI. All children were diagnosed with asthma, based on history, physical examination, and spirometry. During regular follow-up visits, the children and/or their caregivers were asked to demonstrate how they used the inhaler technique by a physician and health care worker who recorded their findings on a standardized checklist, and data were collected. Written informed consent was taken from the children and their caregivers.

Inclusion Criteria

- Asthmatic children (2 to 14 years of age)

Exclusion Criteria

- Children less than 2 years of age
- Parents/guardian of the children who did not give consent for the study
- Parents/ guardians of the children who did not come for an evaluation.
- Children who had other respiratory diseases (eg. pneumonia), cardiac diseases, etc

Steps required for proper MDI, MDI-spacer and DPI uses(X P E R T Pa NEL RE PO, 1995)

RESULT

Hundred asthmatic children and their caregivers were included in this study for evaluation of inhalation technique. The children's age ranged from two to fourteen years. Sixty children (60%) were male and forty (40%) were female. thirty children on pMDI alone, 62 on pMDI with spacer, and 8 on DPI. Children and caregivers who demonstrated the correct technique in pMDI with spacer group was 83.3%, in pMDI group was 81.8% and 50% in DPI. The children and caregivers were first instructed by a physician 10 (83.3%) in pMDI with the spacer group, 10 (90.9%) in the pMDI group, and 2 (100%) in DPI. The patient and caregivers were instructed by a trained technician 2(16.7%) in the pMDI-spacer group, 1 (9.1%) in the pMDI group, and no children in the DPI group. As shown in figure 1, the most common incorrect step in the performance of the pMDI –spacer group was step seven (Wait for at least 30 seconds before the next actuation). As shown in figure 2, the most common incorrect step in the performance of the pMDI group stepped six (Begin to breathe in at the same time of actuation and breathe in slowly) and step four (Exhale to FRC/RV) was the most common incorrect step in the performance of DPI shown in figure 3. Children over 10 years old were found to have a significantly higher percentage of correct performance in all steps (p-value <0.001) in pMDI, pMDI- Spacer, and in the DPI the p-value was non-significant (Table 4). The factors associated with correct inhalation technique in children using MDI-spacer included duration of inhaler usage for more than 1 year (p=0.003), receiving an instruction of inhalation technique by a physician (p=0.002), and the education level of the caregivers (p=0.223) (Table 1). There was no statistical significance of the caregiver's educational status in performing the correct inhalation technique. The factors associated with correct inhalation technique in children using pMDI included receiving an instruction of inhalation technique by a physician (p=0.002), and the education level of the caregivers (p=0.862) (Table 2).

Table 1: Factors Related to Correct pMDI with Spacer Technique

	Correct (n=12) (n, %)	Incorrect (n=50) (n, %)	p value
Medication provided under caregiver's supervision	10 (83.3%)	32 (64.0%)	0.198
First instruction by trained technicians	2 (16.7%)	35 (70.0%)	0.002
First instruction by trained Physician	10 (83.3%)	15 (30.0%)	
Patient age >10 year	11 (91.7%)	9 (18.0%)	<0.001
Duration of inhalation >1 year	12 (100%)	28 (56.0%)	0.003
Education			0.223
Illiterate	0 (0.0%)	9 (18.0%)	
Metric	4 (33.3%)	22 (44.0%)	
Secondary	2 (16.7%)	6 (12.0%)	
Graduation	6 (50.0%)	13 (26.0%)	

Table 2: Factors Related to Correct pMDI Technique

	Correct (n=11) (n, %)	Incorrect (n=19) (n, %)	p-value
Medication provided under caregiver's supervision	9 (81.8%)	10 (52.6%)	0.110
First instruction by trained technicians	1 (9.1%)	14 (73.7%)	0.002
First instruction by a trained Physician	10 (90.9%)	5 (26.3%)	
Patient age >10 year	11 (100%)	6 (31.6%)	<0.001
Duration Of Inhalation >1 year	11 (100%)	19 (100%)	-
Education			0.862
Illiterate	0 (0.0%)	0 (0.0%)	
Metric	1 (9.1%)	4 (21.1%)	
Secondary	2 (18.2%)	4 (21.1%)	
Graduation	8 (72.7%)	11 (57.8%)	

Medication provided under caregiver's supervision	9 (81.8%)	10 (52.6%)	0.110
First instruction by trained technicians	1 (9.1%)	14 (73.7%)	0.002
First instruction by a trained Physician	10 (90.9%)	5 (26.3%)	
Patient age >10 year	11 (100%)	6 (31.6%)	<0.001
Duration Of Inhalation >1 year	11 (100%)	19 (100%)	-
Education			0.862
Illiterate	0 (0.0%)	0 (0.0%)	
Metric	1 (9.1%)	4 (21.1%)	
Secondary	2 (18.2%)	4 (21.1%)	
Graduation	8 (72.7%)	11 (57.8%)	

Table 3: Factors Related to Correct Dry Power Inhalation Technique

	Correct (n=2) (n, %)	Incorrect (n= 6) (n, %)	p value
Medication provided under caregiver's supervision	1 (50.0%)	2 (33.3%)	0.673
First instruction by trained technicians	0 (0.0%)	4 (66.7%)	0.102
First instruction by trained Physician	2 (100%)	2 (33.3%)	
Patient age >10 year	2 (100%)	6 (100%)	-
Duration of inhalation >1 year	2 (100%)	6 (100%)	-
Education			0.643
Illiterate	0 (0.0%)	1 (16.7%)	
Metric	1 (50.0%)	4 (66.6%)	
Secondary	1 (50.0%)	0 (0.0%)	
Graduation	0 (0.0%)	1 (16.7%)	

Table 4: Correlation with the Number of Correct Steps

		Steps	
		r	p
pMDI with Spacer	Age	0.888	<0.001
	Duration of inhalation	0.865	<0.001
pMDI	Age	0.779	<0.001
	Duration of inhalation	0.903	<0.001
Dry Powder Inhalation	Age	0.749	0.032
	Duration of inhalation	0.555	0.154

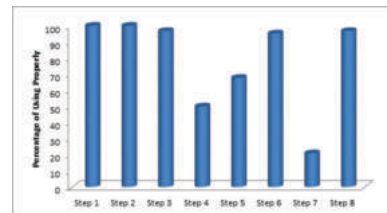


Figure 1: Percentage of Correct Performance in Each Step of pMDI with Spacer

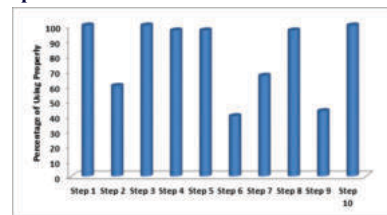


Figure 2: Percentage of Correct Performance in Each Step of pMDI

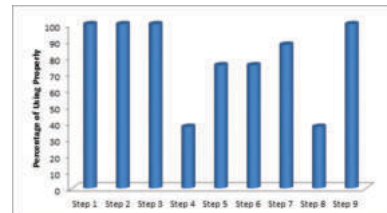


Figure 3: Percentage of Correct Performance in Each Step of Dry Powder Inhalation

DISCUSSION

Our study show that step 7(Wait for at least 30 seconds before next actuation) was the most common incorrect step in the performance of pMDI with spacer group, step 6 (Begin to breathe in at the same time of actuation and breathe in slowly) was the most common incorrect step in the performance of pMDI group, And step 4 (exhale fully before using the inhaler) was the most common incorrect step in the performance of DPI group similar to the finding in the study of Chen et al⁽⁶⁾ and Deerojanawong et al⁽⁹⁾ (2009) was shown that the most common incorrect performance was the step of breathing in slowly at the same time of actuation (step 7) in the pMDI group, and in the pMDI with spacer group, the most common error was the step of waiting for 30 seconds prior to the next pMDI actuation (step 6). In the study by Nihal M. El Rifai⁽¹⁰⁾ observed that the most frequent incorrect step for children using an MDI with spacer was shaking the inhaler, pMDI without spacer was coordinating the actuation-slow deep inhalation, and DPI was loading the dose properly before each use. In some studies the most common error of MDI usage was failure to shake the inhaler before use.^(8,20) In this study 30% of children used pMDI alone, 62% of children used pMDI with spacer, and 8% of children used DPI, similar findings were observed in the study by Nihal M. El Rifai⁽¹⁰⁾ 211 (60.3%) asthmatic children were using an pMDI with spacer, 119 (34%) were using an pMDI alone, and 20 (5.7%) were using a DPI. This study showed that the correct use was higher in children over 10 years old, similar findings were observed in the study by sleath B.⁽²⁰⁾ In our study, we found that factors associated with correct inhalation technique included the education level of the caregivers, the duration of the device usage (> 12 months), and having a trained physician as the first instructor, these findings were similar to the study by Deerojanawong et al⁽⁹⁾ Nihal M. El Rifai⁽¹⁰⁾. In the study by Johannes HJM Size (2009)⁽⁴⁾ show that 42 parents, 19 (45%) had received instruction at the pharmacy, 11 (26%) at the general practice, 7 (17%) at the hospital, 4 (10%) had more than one source of instruction, and 1 (2%) had received instruction from friends or family. In our study children who were first instructed by a trained physician do more correct steps as compared to first instructed by a trained technician.

CONCLUSION

This study revealed that pMDI with spacer was the most commonly used device as compared to pMDI alone and DPI in asthmatic children. It was advised that the evaluation and correction of the inhalation technique should be done regularly in every follow-up visit. Finally, practices should consider employing trained health professionals to demonstrate, assess, check, and correct the inhaler steps to asthmatic children/ caregivers at every single visit to ensure proper inhalation technique and asthma management.

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Conflicts of Interest

There are no conflicts of interest.

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