

Assessment of Inhalational Techniques and Their Common Errors in Bronchial Asthma Patients Coming to Tertiary Hospital of South Gujarat

Shivani Dalal, Khyati Shamaliya¹, Anas Patni²

III MBBS Student, Government Medical College and New Civil Hospital, Departments of ¹Respiratory Medicine and ²Preventive and Social Medicine, Government Medical College and New Civil Hospital, Surat, Gujarat, India

Abstract

Objective: The objective was to assess the inhalational techniques and its common errors in bronchial asthma patients. **Methodology:** This cross-sectional study was conducted from July 2019 to September 2019. All known asthmatic patients on inhaler therapy attending the Respiratory medicine outpatient department and who met the inclusion criteria were enrolled in the study. All participants were assessed using a pre-designed questionnaire and a standard checklist that was filled using the interview-based method. Data were entered into MS Excel 2010 and analyzed using Epi Info 7.0 and SPSS 16.0. Appropriate frequencies, percentages, and proportions were calculated, and necessary statistical tests were applied. **Results:** Of 113 participants, 72 (63.71%) were women and 41 (36.28%) were men. Moreover, 92 patients (81.41%) used dry powder inhalers (DPIs) and 26 patients (23%) used metered-dose inhalers (MDIs). Among these, 73 (64.60%) patients showed incorrect technique in which 57 (50.44%) patients were on DPI and 16 (14.15%) patients on MDI. Among 54 (47.78%) patients with poor clinical control, 46 (40.70%) patients with incorrect technique had partially controlled or uncontrolled asthma. **Conclusion:** Despite the availability of proper guidelines, incorrect inhaler technique remains the main causative factor for poor asthma control and compliance.

Keywords: Asthma, dry powder inhaler, inhalational technique, metered-dose inhaler

INTRODUCTION

Asthma is a common chronic inflammatory condition of the airways affecting 300 million people of all ages and sex, worldwide; about a tenth of these are living in India. This causes a significant burden to healthcare costs of our country. Inhaled medications are the first line of treatment in the patients of bronchial asthma, with the inhaler devices being the principal route for administration in such treatment.^[1,2] Many different types of inhalational devices are available, but pressurized metered-dose inhalers (MDIs) and dry powder inhalers (DPIs) are the devices most commonly used for drug delivery in the treatment of asthma. A large number of asthma patients do not use their inhaler devices correctly. Errors in device use may impact the effectiveness of the delivered drug and thereby lead to the suboptimal control of asthma.^[2-6] It is, therefore, important to understand and quantify the device usage errors so that patient interventions can be effectively instituted, and new devices can be designed so that common errors can be avoided.

Misuse of inhalers and improper inhalation technique have been commonly observed in clinical practice, and it is associated with increased inhaler use, decreased bronchodilation, reduced patient's adherence to the treatment regimen, poor drug delivery, and disease control.^[2,3]

In the present study, there was a plan to assess the inhalational techniques of eligible bronchial asthma patients and associated common errors performed during the techniques so that insinuations for maximum clinical benefits of inhaler use can be discussed.

Address for correspondence: Dr. Khyati Shamaliya, 55A, 1st Floor, Snehsmruti Society, Adajan Patiya, Opposite Adajan New Bus Depot, Rander Road, Surat - 395 009, Gujarat, India. E-mail: drkhyatid85@gmail.com

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Objectives

1. To assess the correctness of techniques used by the patients under the study according to the standard checklist
2. To document the common errors committed by the patients in the use of inhalational techniques.

After the completion of patient's performance, training was given to every participant by an expert to prevent these common errors in the future.

METHODOLOGY

Study design and study population

This cross-sectional, hospital-based observational study was conducted among the bronchial asthma patients presenting at the outpatient department (OPD) as well as inpatient department in a civil hospital of Gujarat, India. A total of 113 patients of bronchial asthma (as diagnosed by pulmonologist) who attended the OPD of respiratory medicine department over the span of 2 months, as per the inclusion and exclusion criteria, were enrolled.

Patients diagnosed with bronchial asthma (according to the GINA guidelines) from 14 to 70 years of age, of either gender, and using inhaler therapy (MDI or DPI) were included. The institutional ethical committee approval was taken to carry out the research project. A well-informed, written, as well as oral, consent was obtained from all the participants after explaining the procedure. For underage patients below 18 years, parent's consent was taken. For illiterate patients, the left thumb impression was taken after explaining full study and confirmation of their willingness to participate in the study. Furthermore, confidentiality of patients' data was maintained.

Both MDI and DPI, which were included in the study, were under government supply. The DPI which was used was Rotahaler with a combination of budesonide 200 µg + formoterol 6 µg. The MDI also contained the same dose of budesonide and formoterol. Each participant was initially judged for eligibility criteria by the pulmonologist, and after the patients gave consent to participate, they were included in the study. Those patients not willing to participate in the research, those who suffered from other complications apart from asthma, and critically ill patients were excluded from the study.

A predesigned structured questionnaire was used for taking interview from the eligible participant. Data were collected from the patient within 15 min in a single sitting, and it did not require any follow-up. The inhalational technique was directly observed by the investigator and the pulmonologist, and the evaluation of techniques was made according to the requisite steps of correct usage for each inhaler device. If mistakes were found in one or more steps, it was classified as "incorrect" inhalational technique. Patient's age, sex, diagnosis, educational level, occupation, form of inhaler therapy, patient's awareness of the diagnosis, and initial education of therapy were asked and recorded in the case study form.

The standardized steps for the inhalation technique were as follows:

- Pressurized metered-dose inhaler^[7-9]
 1. Does patient shake the inhaler before use?
 2. Does the patient breathe out before firing?
 3. Does the patient hold the inhaler upright during firing?
 4. Does the patient place the mouthpiece between the lips and over the tongue?
 5. Does the patient take a breath during the first half actuation?
 6. Does the patient take a deep breath till total lung capacity while firing?
 7. Does the patient inhale by mouth and hold his/her breath for 10 s?
 8. Does the patient tilt the head back?
 9. Does the patient exhale till residual volume (RV)?
 10. Does the patient wait for 30 s before administration of the next puff?
- DPI^[7-9]
 1. Does the patient remove cover and correctly insert the capsule?
 2. Does the patient correctly pierce the capsule and load the required dose?
 3. Does the patient hold the inhaler upright during firing?
 4. Does the patient breathe out the device mouthpiece?
 5. Does the patient inhale deeply and quickly?
 6. Does the patient use mouth inhalation?
 7. Does the patient place the mouthpiece between the lips and over the tongue?
 8. Does the patient do forceful and deep inhalation?
 9. Does the patient exhale till RV through the nose?
 10. Does the patient control breath holding if the capsule is broken or does not contain powder?

Statistical analysis and tools used

Data were entered into MS Excel 2010. Data were analyzed using Epi Info 7.0 and SPSS 16.0. (SPSS Inc. Released 2007. SPSS for Windows, Version 16.0. Chicago, IL, USA, SPSS Inc.) Appropriate frequencies, percentages, and proportions were calculated, and necessary statistical tests were applied.

RESULTS

The demographic data of the patients are given in Table 1. No significant associations were found between age, education, occupation, and demographic variation with the technique of inhalation.

Among 113 patients, only 40 (35.39%) patients were able to perform inhaler technique correctly. Among 73 patients doing incorrect technique, 16 patients were on MDI and 57 patients had DPI. The details of the patients and the errors they made are tabulated in Tables 2 and 3.

Patients made errors in one or more steps of the inhaler technique. Among 16 patients on MDI, the steps at which

Table 1: Sociodemographic profile of the study population

Variable	n (%)	Evaluation of technique		P
		Correct technique, n (%)	Incorrect technique, n (%)	
Age (years)				
<40	50 (44.24)	16 (14.15)	34 (30.08)	0.50
≥40	63 (55.75)	24 (21.23)	39 (35.51)	
Gender				
Female	72 (63.71)	20 (17.69)	52 (46.01)	0.024
Male	41 (36.28)	20 (17.69)	21 (18.58)	
Education				
Illiterate	30 (26.54)	8 (7.07)	22 (19.46)	0.243
Literate	83 (73.45)	32 (28.31)	51 (45.13)	
Occupation				
Student	2 (1.76)	-	2 (1.76)	-
Service/job	19 (16.81)	10 (8.84)	9 (7.96)	
Labor/physical work	24 (21.23)	10 (8.84)	14 (12.38)	
Retired/unemployed	65 (57.52)	18 (15.92)	47 (41.59)	
Medical staff	3 (2.65)	2 (1.76)	1 (0.88)	
Residence				
Urban	104 (92.03)	35 (30.97)	69 (61.06)	0.187
Rural	9 (7.96)	5 (4.42)	4 (3.53)	

Table 2: Stepwise errors in incorrect technique taking metered-dose inhaler

Steps	Patients performing with the error (n)
Shake inhaler before use	3
Breathe out before firing	10
Hold inhaler upright during firing	1
Place the mouthpiece between the lips and over the tongue	1
Take a breath during first half actuation	3
Deep breath till TLC while firing	13
Inhale by mouth and hold breath for 10 s	12
Tilt the head back	10
Exhale till RV	10
Wait for 30 s before next puffs	12

TLC: Total lung capacity, RV: Residual volume

maximum number of mistakes done were at Steps 6 and 7 in which patients were not able to do slow and deep inhalation and holding breath for 10 s due to lack of hand–mouth coordination at the time of actuation. The next common mistake was that multiple actuations were also observed without waiting for 30 s for the next puff (Step 10). Another common mistake was at Steps 8 and 9 which was to tilt the head back with holding breath for at least 10 s before exhalation.

In the present study, 57 (50.44%) patients who were on DPI demonstrated incorrect technique. The step at which maximum patients committed mistake was at Step 4. Patients forgot to breathe out before starting rapid and forceful inhalation (Step 5) from device. The next major incorrect steps were not breathing out till RV (Step 10) after inhalation from the device and not holding breath (Step 11).

Forty six patients (40.7%) had poor control of asthma symptoms possibly because of incorrect technique. Twenty seven patients had well-controlled asthma despite incorrect technique [Table 4].

Various side effects such as hoarseness, oral candidiasis, oral ulceration, and others were observed in a few patients [Table 5].

DISCUSSION

Inhalers are considered as the main stay of the treatment of asthma worldwide. Asthma will remain poorly controlled if there is improper technique of using inhalers.^[9] The technique of use of inhalers by our patients was analysed and the patients were educated about measures needed to optimise drug delivery for better clinical control.

The mean age of 113 respondents was 52.5 years, 63.71% being women. No associations were found between inhalational technique and gender, age, ethnicity, education, and occupation. Of the 113 patients, only 21 patients were using MDI, of whom 16 patients were doing improper technique (21.9% of all patients those performing the incorrect technique). In a similar study done in Nigeria, 79.8% of the participants used MDI incorrectly.^[10] This can be due to less number of patients taking MDI in our study. According to studies, slow and deep inhalation followed by holding breath for at least 10 s is crucial for effective drug deposition. In our study, 13 patients failed to do so, making it the most common error. A similar study conducted in Nigeria demonstrated that most patients failed to do this step properly. It is essential to keep a gap of 30–60 s between two doses that allow medication to take action and relax airways.^[10] Twelve (6.43%) patients were doing multiple actuations without any time gap. A study

Table 3: Stepwise errors in incorrect technique of using dry powder inhaler

Steps	Patients performing with the error (n)
Remove cover and insert capsule correctly	1
Pierce capsule and load require dose	1
Hold inhaler upright during firing	2
Breathe out device mouthpiece	41
Inhale deeply and quickly	15
Use mouth inhalation	7
Place the mouthpiece between the lips and over the tongue	0
Do forceful and deep inhalation	23
Breathe out mouthpiece	36
Exhale till RV through nose	36
Control breath holding if capsule is broken or does not contain powder	18

RV: Residual volume

Table 4: Clinical control in accordance with technique

	Correct technique	Incorrect technique	P
Well controlled	32	27	0.00001
Partially controlled or uncontrolled	8	46	
Total	40	73	113

Table 5: Development of side-effects in the study participants

	Correct technique	Incorrect technique	Total
Hoarseness of voice	2	3	5
Oral candidiasis	-	-	-
Oral ulceration	5	4	9
Systemic side effects	-	-	-

done in Saudi Arabia demonstrated that 80% of the patients did mistake at this step.^[11]

In our settings, the most common form of inhaler therapy was DPI. When we assessed the technique of using DPI, the most common error was failure to exhale before using inhaler. It was observed in 41 (56.16%) patients. This result matches well with a similar study done in Pakistan in which failure to exhale before inhalation was the most common error observed.^[12] Another error observed was failure to do forceful and deep inhalation, which is the most crucial step in effective drug delivery to airways. A similar error is found in a study done in Madhya Pradesh, India.^[13]

According to the GINA guidelines when we assessed clinical control of symptoms in relation to inhaler technique, 46 (63.01%) patients had poor or partial clinical control with incorrect technique. It indicates that poor inhaler technique is the most important risk factor for poor clinical control. This can be correlated well with the study done in Ethiopia in

which 80% of the patients were partially or poorly controlled with improper technique.^[9] Thus, this study indicates that asthma control status is significantly associated with inhalation technique ($P < 0.00001$). No significant association was seen between side effects associated with inhaler and the technique or dosage.^[14]

It is important that active measures should be taken to improve patients' basic knowledge regarding asthma diagnosis and inhaler technique. Apart from the current guidelines demonstrating complete steps of use of different inhalers, verbal guidance and visual demonstration in small groups or video tutorials should also be provided to improve measures. It is important to determine patient's preference while prescribing inhaler for the first time so that compliance and acceptance for prescribed device will be better.

CONCLUSION

There is a significant association between the proper use of inhaler technique and good clinical asthma control. Health professional should educate patients about inhalational technique during their first visit and constantly ask patients to bring inhaler in successive visits so that technique, compliance, and effective clinical control can be assessed for better outcomes.

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Conflicts of interest

There are no conflicts of interest.

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