An Interventional Study on Metered Dose Inhaler Technique Errors in Patients with Respiratory Illness

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Abstract

Background: Amongst the respiratory diseases, obstructive lung disorders are a leading cause of hospitalisation and correct inhaler technique can reduce the morbidity and mortality significantly.

Aims and Objectives: Checklist-based assessment and correction of the technique for effective use of Metered Dose Inhaler (MDI).

Material and methods: 100 patients using a MDI were evaluated for the inhaler technique using the checklist and re-evaluated after a structured educational intervention to impart knowledge of correct technique.

Results: The mean age was 42.14 years and the male: female ratio was 1: 1.5. The mean score of 4.4 improved to 6.42 after physical demonstration. Score of 8 was achieved by 21% of patients after intervention whereas none of the patients had achieved this score in the beginning.

Conclusion: Inhalational technique and efficacy of the MDI improves after systematic intervention. So, doctors should educate patients regarding correct inhaler technique to optimise the drug delivery to the lungs and reduce the morbidity and mortality related to pulmonary disorders.

Key words: Respiratory illness, metered dose inhaler, stepwise evaluation.

Introduction

Respiratory disorders like bronchial asthma and chronic obstructive pulmonary disease are a matter of concern for the health care system[1,2] and drug administration using a Metered dose inhaler (MDI) device has become the mainstay of therapy in most of these respiratory disorders. There are several advantages offered by this method, which are – convenience, portability, quick and local action and negligible systemic side-effects[3]. However, the effectiveness of the inhaler device depends largely on the inhalation technique which is critical in ensuring optimal drug delivery to the airways. In previous studies, it has been shown that upto 85% (77.5% - 89.2%) of patients do not use their inhalers correctly[4,5]. Poor inhaler technique results in less than optimal delivery of the drug to the lungs and consequent inadequate symptom control[6].

Systematic assessment of the deficiencies in the inhaler technique are essential to plan a structured educational protocol while initiating patients on MDI therapy, as optimal drug delivery is essential for the management of respiratory diseases. It is important to assess the patient's inhaler technique before altering a drug regimen[7]. Thus, we conducted a study to evaluate the technique of using manually operated MDIs applying a standard check-list of recommended steps (National Institute of Health [NIH]

guidelines)[8] and to re-evaluate the same after a structured educational intervention.

Aims and objectives

This study aims to:

1. Assess technique of using MDIs with a standard check-list of recommended steps (National Institute of Health [NIH] guidelines) amongst patients aged 18 years and above with respiratory illness attending outpatient or inpatient department of a tertiary care hospital and grade them on a scale of 0 - 8.

2. Re-evaluate the score immediately after a structured educational intervention to impart knowledge of correct technique.

Methodology

- **Study design:** Hospital based cross-sectional and interventional study.

- **Study population:**

     Inclusion criteria: All patients with respiratory illness, aged 18 years and above using a manually operated MDI.

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Exclusion criteria: Patients who cannot self-administer their MDI.

- **Method:**

  1. Convenient selection and assessment of 100 adults with respiratory illness undergoing treatment with MDIs and attending the department of Medicine as an outpatient or inpatient was done. After taking an informed consent, details regarding the patient's demographic data and therapy were recorded. Thereafter, they were asked to self-administer the MDI and assessed in a stepwise manner according to the NIH guidelines by giving a score 0 - 8 (with 1 point given for each step performed correctly).

  2. Interventional study: The same patient was then demonstrated the correct technique and re-evaluated immediately.

value for a two sided test is 1.96 for 95% confidence, 1.645 for 90% confidence and 2.576 for 99% confidence.

Values of variables were put according to the previous studies[9].

Data entry and analysis: The collected data was entered and analysed using Epidata version 3.0. Paired t-test was applied wherever appropriate to assess the statistical significance of the observed differences.

Results and analysis

A total of 100 patients were studied pre and post-intervention. The mean age was 42.14 years and 26 patients were in geriatric age group (above 60 years of age). It included 40 males and 60 females. The mean score of 4.48 improved to 6.42 after physical demonstration. After paired

Checklist and score card

National institute of health-expert panel 3 guidelines for inhaler usage technique

Steps	Before demonstration	After demonstration
Step 1: Remove cap from the mouth-piece of canister, hold upright, with thumb below the base and finger on top of the canister.		
Step 2: For the first use or using after more than 7 days, shake and release one puff into air.		
Step 3: Stand or sit straight. Breathe out through the mouth.		
Step 4: Place the mouth piece between teeth and close lips without leaving any gap.		
Step 5: Breathe in and release one dose with simultaneously breathing in.		
Step 6: Remove the inhaler and close the mouth immediately.		
Step 7: Hold breathe for 10 seconds or as long as possible.		
Step 8: Wait for at least one minute before taking the second dose.		
NIH score		

- **Sample size:**

  A minimum of 100 patients with respiratory illness using MDI were studied.

  The sample size was calculated using the below mentioned formula and rounding off the number obtained.

  $$n = \frac{Z^2_{1-\frac{\alpha}{2}}\,[\,P_1(1-P_1) + P_2\,(1-P_2)]}{d^2}$$

  Where n is the sample size, P_1, P_2 = anticipated value of the proportions in the two populations, d = absolute precision required on either side of the proportion. P and d are expressed in fractions, Z is a constant, and its

t-test, the difference was highly significant. None of the patients had a score of 8/8 initially, but after intervention 21% of the patients had a perfect score of 8.

The most common errors in decreasing order of frequency were:-

Step 8: Wait for a minute before taking second dose, which was incorrectly performed by 88% of the patients.

Step 2: Shaking the inhaler before use and releasing one puff into air if unused for more than a week, which was incorrectly performed by 79% of the patients.

Step 6: Remove the inhaler and close the mouth immediately for 10 seconds, which was incorrectly done by 73% of the patients.

The same trend persisted post-intervention with increased

Demonstration	Obs.	Sum	Mean	Variance	SD	95% CI	Std. Err	Median	Minmum	Maximum
Before	100	448.0	4.48	1.87	1.37	4.21-4.75	0.14	4.00	0.00	7.00
After	100	642.0	6.42	1.38	1.17	6.19-6.65	0.12	6.00	4.00	8.00
Paired T test	100	194	1.94	0.885	0.94	1.75-2.13	0.09	2.00	0.00	4.00

p value = 0.00000.

% patients correctly performing the steps before & after the demonstration

	step1	step2	step3	step4	step5	step6	step7	step8
before demo	95	21	53	77	78	27	84	12
after demo	98	62	81	90	87	71	90	61
p value	0	0.0001	0	0	0	0.0001	0	0.0032

Fig. 1:

% patients correctly performing the steps before & after the demonstration

	step1	step2	step3	step4	step5	step6	step7	step8
before demo	95	21	53	77	78	27	84	12
after demo	98	62	81	90	87	71	90	61

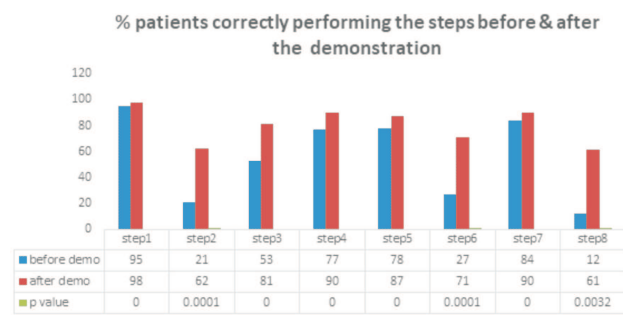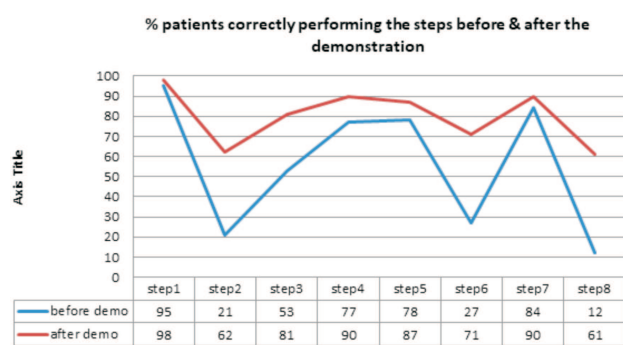**Fig. 2:**

frequencies. Younger patients had a better score probably due to better awareness and care. The lowest mean score was seen in patients who had never been instructed (3.3) or those who had been instructed by an acquaintance (3.75), followed by patients instructed by the chemists (4.103) and nurses (4.54) whereas patients who had received instructions from the doctor had the highest scores (5.39).

First instruction given by

NIH score	Never	Others	Chemist	Nurse	Doctor
1.	0	0	0	0	1
2.	0	0	2	1	1
3.	2	4	5	6	1
4.	1	7	13	10	2
5.	0	1	7	8	6
6.	0	0	1	6	4
7.	0	0	1	2	8
Total patients	3	12	29	33	23
Mean score	3.3	3.75	4.103	4.54	5.39

	Number	Sum	Mean	Variance	SD	95% CI mean	Std Err
Never	3	10.00	3.33	0.333	0.577	1.90 - 4.77	0.33
Others	12	45.00	3.75	0.386	0.622	3.36 - 4.14	0.18
Chemist	29	119.00	4.103	1.17	1.08	3.69 - 4.51	0.20
Nurse	33	150.00	4.55	1.57	1.25	4.10 - 4.99	0.22
Doctor	23	124.00	5.39	2.89	1.70	4.66 - 6.13	0.35

p value: 0.0007, Chi^2 = 13.983.

As the time gap between first instruction and test increased, the mean scores of the patient declined {4.66 (< 1 year) vs. 4.46 (> 1 year)}. Only 16.8 % patients had received physical demonstration of MDI use previously and their average score was 18% more than the patients who were given verbal instructions. Spacer was being used by 30% of the patients and the most common reason for not using a spacer was lack of information about the same.

Discussion

Metered dose inhaler is still the most frequently prescribed inhaler device despite the fact that very few patients can use it correctly[10]. In patients with asthma or COPD, poor inhaler technique is a major cause of inadequate disease control resulting in decreased deposition of the drugs in lungs, leading to reduction in the bronchodilator effect[11]. Majority of the patients have an improper inhaler technique when checked at random. In our study, we observed that none of the patients had a perfect score of 8/8 initially. Similar results have been observed in several other studies, with 76% of the patients committing errors in inhaler use[12]. We observed that after intervention 21 % of the patients had a score of 8. This was similar to the findings of Jolly *et al*, who found that 28 patients (24.1%) achieved a full score after the first intervention itself while additional 44 (37.9%) and 41 (35.3%) patients reached the full score after 2nd and 3rd intervention respectively. Yusuf had noted that out of 342 patients who had been using inhalers regularly for one month, only 55.3% of the patients were able to use the device correctly[13].

It is a common observation that patients are not instructed about the method of use of inhaler at the time of initiation of therapy. In our study, only 56% of the patients had received instructions from healthcare professionals and the remainder had either never received the instructions or

received from untrained people. According to Jolly *et al*, majority of the patients (83.5%) were initiated on inhaler therapy in a tertiary centre, but only 58.8% had received instructions from the prescribing physician. Larsen *et al* had reported that 63% of the patients had received instructions earlier. The mean score of the entire group in our study was 4.48 and this improved to 6.42 after the demonstration (p = 0.000). Jolly et al, found the median score of 3 (range, 1 - 8), which increased to 6, 7 and 8 respectively in the subsequent three interventions[9]. We noticed that the lowest mean score was seen in patients who had never been instructed (3.3) or those who had been instructed by an acquaintance (3.75), followed by patients instructed by the chemists (4.103) and nurses (4.54) whereas patients who had received instructions from the physician had the highest scores (5.39).

In our study the commonest errors in decreasing order of frequency were step 8 (88%), step 2 (79%), step 6 (73%). Jolly *et al* found that at baseline, the commonest errors were step 3 (84.6%) followed by step 7 (77.8%)[9]. In their study, follow-up assessment conducted after two months, had shown that the overall median score dropped from 8 to 7, and this increased back to 8 after providing educational intervention as per protocol.

The spacer was being used by 30% of our patients which was almost similar to the findings by Jolly *et al* (36.6%). The reasons for this could be multi-factorial, including financial constraints, the bulk and inconvenience to use or carry, or lack of information by the physician.

Conclusions

To conclude, there is a high prevalence of faulty usage of inhaler technique among patients using MDI. Repeated demonstration of the proper technique using a standard check-list significantly reduces the errors committed during inhaler use. This implies that multiple sessions and reinforcement is essential to achieve perfection in inhaler technique. Doctors should educat patients regarding correct inhaler usage, to ensure optimal effects of medication. Also, interventions should be done regularly so that the patient remembers the right technique. Preferably, the instruction should be a demonstration stressing on the above mentioned most commonly missed steps Confusion among health professionals over who should take responsibility for patient education may result in people not receiving proper education on the correct use of their inhalers, contributing to the higher morbidity and mortality in these patients.

Limitations

1. No time interval between demonstration and re-evaluation.

2. Patient's improvement could not be assessed objectively.

3. Convenient sampling was done.

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