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Benefit of hospital pharmacy intervention on the current status of dry powder inhaler technique in patients with asthma and COPD: a study from the Central Development Region, Nepal

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Background: The majority of patients with asthma and chronic obstructive pulmonary disease (COPD) have been known to perform inhaler technique inadequately. We aimed to evaluate the benefit of hospital pharmacy intervention on the current status of dry powder inhaler (Rotahaler®) technique in such patients and the factors associated with the correct use.

Methods: A pre–post interventional study was conducted at the outpatient pharmacy in a teaching hospital of the Central Development Region, Nepal, in patients with asthma and COPD currently using a Rotahaler device. Patients' demographics and Rotahaler technique were assessed before intervention. Those who failed to demonstrate the correct technique were educated and trained by the pharmacist, and their technique was reassessed after 2 weeks of intervention. Descriptive statistics, including Wilcoxon signed rank test, Mann–Whitney *U* test, Spearman's correlations and Kruskal–Wallis test, were performed for statistical analysis.

Results: Before intervention, only 5.7% (10 of 174) of the patients demonstrated the correct Rotahaler technique and the most common errors observed were failure to breathe out gently before inhalation (98.8%) and failure to hold breath for about 10 seconds after inhalation (84.8%). After the intervention (n=164), 67.1% of the patients showed their technique correctly ($p \leq 0.001$) and failure to breathe out gently before inhalation was the most common error (27.44%). Age ($p=0.003$), previous instruction ($p=0.007$), patient's education level ($p=0.013$) and source of instruction ($p<0.001$) were associated with an appropriate technique before intervention, while age ($p=0.024$), duration of therapy ($p=0.010$) and gender ($p=0.008$) were the factors correlated with correct usage after intervention.

Conclusion: The current status of Rotahaler technique is inadequate in patients with asthma and COPD attending the Chitwan Medical College Teaching Hospital in the Central Development Region, Nepal. However, a single hospital pharmacy intervention can significantly improve the correct use of the technique, highlighting the role of hospital pharmacies in the improvement of inhaler technique.

Keywords: asthma, COPD, intervention, Nepal, pharmacy, pharmacist, Rotahaler

Introduction

The prevalence of bronchial asthma and chronic obstructive pulmonary disease (COPD) is increasing worldwide.[1] Nepal bears a burden of bronchial asthma of ~0.4% of total hospital admission and 1.0% of intensive care unit (ICU) admission,[2] while COPD accounts for 12% of all admission cases.[3] These groups of patients are mainly treated with inhaled medication using inhaler devices, preferentially pressurized metered dose inhalers (pMDIs) and dry powder inhalers (DPIs).[4] The treatment outcomes of

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these techniques rely on the ability of patients to correctly perform the technique.[5] It has been reported that up to 94% of patients perform DPI technique incorrectly, resulting in diminished therapeutic effect, poor control of symptoms and therefore insufficient disease management.[6] Patients are also seldom aware that they are performing their inhaler technique inadequately due to overestimation of their own abilities.[7] However, studies have suggested that pharmacist-led interventions in asthma and COPD patients not only improve the inhaler technique but also improve the patients' compliance, positive outcomes[8,9] and quality of life.[10] Improvement of inhaler technique also decreases the frequencies of total and nocturnal asthma symptoms and β_2-agonist use[11] and improves the peak expiratory flow rate[12] and forced expiratory volume.[13] In Nepal, pharmaceutical care is in a developing state due to limited health care facilities and qualified personnel and low economic status and education level of patients. Studies have shown that Nepalese patients as well as health care professionals (HCPs) have inadequate ability on the correct use of inhaler technique.[14–16] A study in the capital city of Nepal demonstrated that the all of the COPD patients had an unsatisfactory inhaler technique[15] and about one-third of them never received instruction on the correct use of an inhaler.[15] Similarly, in another study, ~76% of the study population believed that their Rotahaler® technique was correct; however, only 44% of the patients performed the technique correctly on assessment,[16] showing significant differences between the patients' self-reporting of technique and real practice. Furthermore, Nepalese patients living with COPD have been known to experience physical and psychosocial health problems in their daily life,[17] which may be associated with inadequate disease control due to incorrect use of inhaler technique. Therefore, assessment of the inhaler technique and appropriate interventions are necessary in these patients, as majority of them perform the technique incorrectly. Our study aimed to evaluate the benefit of hospital pharmacy intervention on the current status of Rotahaler technique in patients with asthma and COPD and the factors associated with the correct use.

Methods

Study design

This study was conducted at the Medication Counseling Centre of Chitwan Medical College Teaching Hospital (CMCTH), Bharatpur, Nepal, from December 2014 to June 2015 after ethical approval was obtained from the Institutional Review Committee of the Chitwan Medical College. It was a single-group pre–post interventional study designed to evaluate the benefit of hospital pharmacy intervention on the current status of Rotahaler technique and the factors associated with the correct use. A pre-/post-intervention score comparison was used to evaluate the benefit of intervention.[16,18,19] The hospital pharmacy intervention comprised individualized education and training on the correct use of Rotahaler technique by a registered pharmacist (successful completion of 4 years bachelor degree in pharmacy and registered in Nepal pharmacy council). The pharmacists were educated and trained in DPI technique by the Health Professionals Education and Research Centre of CMC. In addition, pharmacists were suggested to use drug information leaflets enclosed inside the rotacaps and Rotahaler device. We recruited two pharmacists for this study.

Study population

A total 174 patients with asthma and COPD using Rotahaler® device (Cipla Pvt. Ltd., Mumbai, India) for >1 month and who were confident in the Rotahaler technique were recruited for this study. The confirmation of the patient confidence in the correct use of Rotahaler technique was based on their verbal agreement. Patients who demonstrated the technique through other DPI devices such as Instahaler and Rupihaler and were suffering from a mental disorder such as dementia were excluded.

Baseline assessments of technique and intervention

The first pharmacist made appointments with the patients and assessed their eligibility for the study using a predefined checklist (inclusion criteria). Patients who met the inclusion criteria of the study were requested to participate in the study. Patients were well informed about the study, and verbal informed consents were obtained from all patients before participation in the study. The Institutional Review Committee did not require that written consents be obtained due to the type of study, and as the majority of patients were formally uneducated. A structured interview was conducted by the pharmacist to obtain the sociodemographic information such as age, gender, duration of disease, duration of therapy, patient's education level, residential area, previous instruction received and source of instruction. Subsequently, patients were asked to demonstrate their technique using the placebo (capsule without active ingredient), while the pharmacist observed the technique according to the Rotahaler-specific GINA guideline checklist (eight Rotahaler-specific checklist items, three items for preparation of medication and five items for inhalation of medication).[20] Each correct step was scored "1" and incorrect or missed step was scored "0". The patients who scored "8" were considered using a correct Rotahaler technique and were excluded from the intervention. Those who failed to demonstrate the correct technique (made at least one error)

were educated and trained (intervention) on the correct use of technique, which included verbal instruction, followed by demonstration of the technique (two times) using placebo, and were trained till no error was observed. During the pharmacist's instruction, the patients were also allowed to ask questions for further clarification. The baseline assessments, education and training were carried out by the first pharmacist on the same day of visit to the hospital. Patients and their accompanying relatives were instructed to use leaflets as supplementary information. At the end of the first appointment, the pharmacist conducted an interview on the management of Rotahaler device (washing, storage and changing), provided instruction on the proper management and invited the patient for a second appointment after 2 weeks of intervention. On the second appointment, the second pharmacist reassessed the technique and marked each single step correct or incorrect according to the GINA guidelines checklist.[20]

Statistical analysis

Initially, numeric data were checked for normality using Shapiro–Wilk test; however, none of them followed the normal distribution. So, nonparametric tests were applied for statistical analysis. Wilcoxon signed rank test was used to evaluate the benefit of hospital pharmacy intervention (comparison of pre- and post-intervention scores). The scores (pre and post) were compared within dichotomous variables using Mann–Whitney *U* test. Spearman's correlation was used to determine the relationship between two numeric variables, and Kruskal–Wallis test was performed for the analysis of variance. A *p*-value of <0.05 was considered as significant. Data were analyzed using SPSS 21.0.

Results

In our study, females were predominant (55.2%). The median (interquartile range [IQR]) age was 64 (55–71) years. The median (IQR) duration of disease and therapy was 4 (1.4–10.0) and 2 (0.3–5.0) years, respectively. Most of the patients (127, 73%) were living in the rural area. The majority (84, 50.6%) of patients reported that they had received the instructions from the physician, and eight (4.6%) patients claimed that they are not instructed on the use of Rotahaler device (Table 1).

Only 10 (5.7%) patients demonstrated the correct Rotahaler technique on the baseline assessment and were excluded from the intervention. The overall median score (IQR) before intervention was 6 (5–6), which increased to 8 (7–8) after the intervention, and 110 (67.1%) patients were able to perform the correct Rotahaler technique. This difference was statistically significant at $p<0.001$ (Table 2). Significant improvement was observed in step 4 (1.2%–72.6%) and step 8 (15.2%–92.7%) after the intervention (Table 3).

The Spearman's correlation test showed a weak relationship between pre-intervention score and age ($p=0.003$; correlation coefficient −0.223); post-intervention score and age ($p=0.024$; correlation coefficient −0.178) and post-intervention score and duration of therapy ($p=0.010$; correlation coefficient −0.083). Similarly, Mann–Whitney *U* test showed that pre-intervention score was associated with

Table 1 Demographic characteristics of the patients assessed for the intervention (n=174).

Variables	Category	n (%)
Gender	Male	78 (44.8)
	Female	96 (55.2)
Age (years)*		64 (55–71)
Duration of disease (years)*		4 (1.38–10)
Duration of therapy (years)*		2 (0.34–5)
Education	Formally uneducated	125 (71.8)
	Primary education	18 (10.3)
	Secondary education	23 (13.2)
	Intermediate level	5 (2.9)
	Bachelor or above	3 (1.7)
Residential area	Rural	127 (73)
	Urban	47 (27)
Pervious instruction on Rotahaler® technique	Yes	166 (95.4)
	No	8 (4.6)
Source of instruction (n=166)	Pharmacy personnel	57 (34.33)
	Physician	84 (50.62)
	Nurse	25 (15.06)
Pre-intervention score (n=174)†	2	7 (4.0)
	3	8 (4.6)
	4	9 (5.2)
	5	39 (22.4)
	6	76 (43.7)
	7	25 (14.4)
	8	10 (5.7)
Post-intervention score (n=164)**,†	5	2 (1.2)
	6	4 (2.4)
	7	48 (29.3)
	8	110 (67.1)

Notes: *Median (IQR). **Ten patients were excluded from the intervention since they correctly performed the Rotahaler technique at baseline and were not included in the second assessment. †The possible scores were out of a total of 8; none of the patients scored 1 for the pre-intervention and none scored 1–4 for the post-intervention, so those values were not included in the table.
Abbreviation: IQR, interquartile range.

Table 2 Effect of hospital pharmacy-based educational intervention on correctness of Rotahaler® technique (n=164)

Assessment of Rotahaler technique	Median (IQR) score	*p*-value
Before intervention	6 (5–6)	<0.001*
After intervention	8 (7–8)	

Note: *Wilcoxon signed rank test.
Abbreviation: IQR, interquartile range.

Table 3 Comparison of correct Rotahaler® technique before and after intervention (n=164)

Rotahaler checklist	Before intervention, patients, n (%)	After intervention, patients, n (%)
Step 1. Hold Rotahaler vertically	156 (95.1)	164 (100)
Step 2. Put capsule into square hole	148 (90.2)	164 (100)
Step 3. Splits capsule into cap and body	146 (89.0)	164 (100)
Step 4. Breathe out gently	2 (1.2)	119 (72.56)
Step 5. Put mouthpiece between lips and teeth	146 (89.0)	162 (98.78)
Step 6. Breathe in the powder quickly and deeply	156 (95.1)	164 (100)
Step 7. Take Rotahaler out of mouth	120 (73.2)	162 (98.78)
Step 8. Hold breath for ~10 seconds	25 (15.2)	152 (92.68)

Table 4 Association of sociodemographic variables with pre-intervention score (n=174)

Variables	Category	Median (IQR) score	*p*-value
Gender*	Male	6 (5–6.25)	0.170
	Female	6 (5–6)	
Previous instruction on Rotahaler technique*	Yes	6 (5–6)	0.007
	No	4.50 (3.25–5.75)	
Residential area*	Urban	6 (5–6)	0.457
	Rural	6 (5–6)	
Source of instruction**	Pharmacy	6 (6–7)	<0.001
	Physician	6 (5–6)	
	Nurses	6 (5–6)	
Education**	Formally uneducated	6 (5–6)	0.013
	Primary education	6 (6–6.25)	
	Secondary education	6 (5–7)	
	Intermediate level	6 (5.5–7)	
	Bachelor or above	6 (6–no value)	

Notes: *Mann–Whitney *U* test, **Kruskal–Wallis test.
Abbreviation: IQR, interquartile range.

Table 5 Association of sociodemographic variables with post-intervention score (n=164)

Variables	Category	Median (IQR) score	*p*-value
Gender*	Male	8 (8–8)	0.008
	Female	8 (7–8)	
Residential area*	Urban	8 (7–8)	0.622
	Rural	8 (7–8)	
Education**	Formally uneducated	8 (7–8)	0.090
	Primary education	8 (8–8)	
	Secondary education	8 (7–8)	
	Intermediate level	8 (8–8)	
	Bachelor or above	8 (8–8)	

Notes: *Mann–Whitney *U* test, **Kruskal–Wallis test.
Abbreviation: IQR, interquartile range.

Table 6 Reponses on the management of Rotahaler® device (n=174)

Questions on Rotahaler management	Response	Patients, n (%)
Did you wash the Rotahaler at least twice a week?	Yes	95 (54.6)
	No	79 (45.4)
Did you always store the Rotahaler in its box?	Yes	149 (85.6)
	No	25 (14.4)
Did you know that a new Rotahaler is to be used every 6 months?	Yes	17 (9.8)
	No	157 (90.2)

previous instruction (p=0.007). Likewise, Kruskal–Wallis test demonstrated the association of pre-intervention score with patient's education level (p=0.013) and source of instruction (p<0.001) (Table 4). However, only gender was associated with post-intervention score (p=0.008) (Table 5).

The questions related to the management of Rotahaler device revealed that 45.4% patients did not wash their Rotahaler device twice a week. Most of them (85.6%) stored the device in its box, but the majority (90.2%) of patients were unaware that the Rotahaler device needs to be changed every 6 months (Table 6).

Discussion

In our study, >94% of the patients demonstrated the incorrect Rotahaler technique on baseline assessment. Such improper inhaler technique has been associated with poor disease control, increased risk of hospitalization, emergency room visits, courses of oral steroids and antimicrobials.[5,21] Our single hospital pharmacy intervention corrected the Rotahaler technique in 67.1% (110 of 164) of the patients. In contrast to this, a previous study by Shrestha et al showed that the combination of video and demonstration strategy corrected the technique in 33.6% of the intervened patients,[16] suggesting that the verbal instruction followed by demonstration and training might be a better strategy in improving the Rotahaler technique. Evidence showed that individual coaching (observation, verbal instruction and physical demonstration) significantly improves the technique on a long-term basis.[22] Moreover, educating patients on the correct use of inhaler technique (verbal training, demonstration movie and leaflet) also lowers the number of attacks, emergency visits and hospitalizations, together with improvement of quality of life of patients.[10,23] Our study also showed that patients had inadequate knowledge on the management of the Rotahaler device, including cleaning and frequency of changing the Rotahaler, highlighting the need of an educational intervention not only on the correct use of the technique but also on the management of the Rotahaler device.

Data showed that illiterate patients, as in our study, made more errors than postgraduates and professionals while using a DPI,[24] suggesting that drug information leaflets enclosed within DPIs might not be user-friendly to illiterate patients or patients with low literacy level. This can be overcome by providing low literacy handouts for patients with low health literacy.[25] In our study, the majority of patients failed to exhale before inhalation (98.8%) followed by holding breath after inhalation (84.8%). Similar results were reported by Lavorini et al[6] in their study. Failure to exhale before inhalation hinders the forceful and deep inhalation, particularly in children and those with severe airflow limitation, resulting in insufficient drug release and low lung deposition.[26] Similarly, failure to hold breath after inhalation may decrease the chance of adequate lung deposition. Moreover, there were some patients in our study who were unaware about the process of breaking the capsule into body and cap, which might lead to the loss of medicine and therapeutic failure. Such errors ultimately decrease the effectiveness of the drug therapy and adequate disease control.

In our study, pre-intervention score was significantly associated with age, previous instruction, patient's education level and source of instruction. This association indicates that younger patients, who received previous instruction on the Rotahaler technique and formally educated patients who received instruction from the pharmacy had better possibility of demonstrating the correct Rotahaler technique at baseline. The study by Aydemir also revealed that educational status, gender, living areas, duration of disease and being diagnosed and followed up by a specialist were associated with the correct use of inhaler technique at baseline. However, after the standard training, the correct use of the technique was associated with old age and the type of the pMDI devices.[27] In our study, post-intervention score was significantly associated with age, duration of therapy and gender, suggesting that older patients, patients having longer duration of therapy and female patients might score poorly even after single intervention. Association of post-intervention score with age and gender suggests that reinforcement and re-assessment or additional interventions were needed in older and female patients in comparison to younger and male patients in our setting. Similarly, weak negative association between post-score and duration of therapy highlights the necessities of early intervention on the Rotahaler technique.

Incorrect use of inhaler devices by the patients may be a direct consequence of inadequate instruction by the health caregivers,[5] and a 100% error has been seen in self-educated patients.[24] In our study, 4.6% of the patients had not received instruction from HCPs. A systematic review has reported that about one-fourth of the patients had never received instruction, and for those who had received some instruction it was almost always <10 minutes duration with no follow-up evaluation in nearly half of the patients.[6] Further, another study in Nepal had shown that 30% of patients had never been educated on the use of the inhaler.[15] Studies showed that training improves the capability of patients to use established DPIs[28–30]; however, repetitive training and assessment of technique were suggested for proper use of the technique,[6] adherence to therapeutic regimen and improving health-related quality of life in COPD patients.[31]

Patients can come across the HCPs to receive instructions on the correct use of inhaler devices. Therefore, the knowledge and skills of the HCPs on inhaler technique significantly affect patients' education outcomes. There was a widespread ignorance of HCPs on educating the patients regarding inhaler technique,[32] and up to 85% of them may fail to use inhalers correctly.[23] In addition, they may have poor demonstrating skills of one type of inhaler device over another.[23] Studies showed that HCPs have poor knowledge on the correct use of inhaler devices.[33,34] Hence, to ensure that correct instruction and training have been provided to patients, HCPs should be well educated and trained regarding various inhaler devices. HCPs' knowledge and skills can be significantly improved through educational intervention on a long-term basis.[33,35]

This study had some limitations that may reduce the accuracy and generalizability of the results. First, the assessment was repeated after 2 weeks of intervention; hence, the long-term effectiveness of the intervention remains unidentified. The Hawthrone effect might have also affected the accuracy of our study results, whereby the patients might act in a different manner when they are aware of being observed.[36] In this study, patients might have been motivated to demonstrate appropriate Rotahaler technique due to the unseen effect of them being observed. On the other hand, use of placebo (no real medication) might render some patients to be less motivated on the correct use of Rotahaler technique. In addition, all the patients were recruited from a single site, thus affecting the generalizability of these results. Finally, the study was limited by its design itself as the pre–post design might not be ideal for evaluating the effectiveness of an intervention. Besides these limitations, our results have a high practical relevance. Implementation of this service in every hospital pharmacy may upgrade the current status of inhaler technique in patients with asthma and COPD. Moreover, this study has been able to assess the current status of the Rotahaler technique among the patients with asthma and COPD in Nepal and will probably be one of the first studies to evaluate the effect of education and training on the current use of

Rotahaler technique from this country and will certainly add to the body of literature in this area of practice.

Conclusion

The current status of Rotahaler technique is inadequate among patients with asthma and COPD attending the CMCTH of the Central Development Region, Nepal. However, a single hospital pharmacy intervention significantly improved the correct use of the technique. Our study suggests that single educational intervention and training might not be sufficient for elderly and female patients. There is also a need to routinely assess the Rotahaler technique of asthma and COPD patients during their visits to hospital pharmacies in accordance with published guideline recommendations. Additionally, the pharmacist should focus and insist on the two steps of the technique, ie, to breathe out gently before inhalation and to hold breath for ~10 seconds after inhalation, during education and training session.

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Disclosure

The authors report no conflicts of interest in this work.

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