Short-term Evaluation of a Comprehensive Education Program Including Inhaler Training and Disease Management on Chronic Obstructive Pulmonary Disease

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Background: Proper education regarding inhaler usage and optimal management of chronic obstructive pulmonary disease (COPD) is essential for effectively treating patients with COPD. This study was conducted to evaluate the effects of a comprehensive education program including inhaler training and COPD management.

Methods: We enlisted 127 patients with COPD on an outpatient basis at 43 private clinics in Korea. The patients were educated on inhaler usage and disease management for three visits across 2 weeks. Physicians and patients were administered a COPD assessment test (CAT) and questionnaires about the correct usage of inhalers and management of COPD before commencement of this program and after their third visit.

Results: The outcomes of 127 COPD patients were analyzed. CAT scores (19.6±12.5 vs. 15.1±12.3) improved significantly after this program (p<0.05). Patients with improved CAT scores of 4 points or more had a better understanding of COPD management and the correct technique for using inhalers than those who did not have improved CAT scores (p<0.05).

Conclusion: A comprehensive education program including inhaler training and COPD management at a primary care setting improved CAT scores and led to patients’ better understanding of COPD management.

Keywords: Pulmonary Disease, Chronic Obstructive; Education; Metered Dose Inhalers; Dry Powder Inhalers
Introduction

Morbidity and mortality by chronic obstructive pulmonary disease (COPD) is increasing worldwide, and a Korean survey in 2008 detected 13.4% of COPD among subjects older than 40 years\(^1,2\). Comprehensive care including inhalation therapy and disease education for self-management is a cornerstone in the management of COPD\(^1,3,4\). However, previous studies showed that COPD patients were not using inhalers as prescribed or correctly\(^5-7\). Correct usage of inhalers is reported to be related to patients’ knowledge about disease process, educational status, age, gender, formal training, etc.\(^5,6,8,9\). It has been reported that inadequate inhalation technique and poor adherence to inhaled medication in COPD are associated with poor clinical outcomes such as increased hospitalization and high mortality\(^10,11\). Even self-management interventions in patients with COPD are associated with improved health-related quality of life, a reduction in hospital admissions, and improvement in dyspnea\(^9\).

Recently, comprehensive educational program of COPD management including smoking cessation, nutritional support, exercise, vaccination, co-morbidity evaluation, acute exacerbation, and inhaler training was developed by Korean Academy of Tuberculosis and Respiratory Disease\(^12\). We implemented this program for COPD patients in a primary care setting and evaluated the efficacy of this comprehensive education program comparing clinical markers before and after this program.

Materials and Methods

1. Inclusion and exclusion criteria

From August 2014 to April 2016, we enlisted 285 patients with asthma or COPD on an outpatient basis who volunteered to be enrolled, and primary physicians of 43 private clinics from seven provinces (Seoul, Chungcheongbuk-do, Chungcheongnam-do, Gyeonggi-do, Gangwon-do, Jeollabuk-do, Jeollanam-do, Jeju-do) throughout Korea participated in this study. We selected four to five primary clinics from each province to make our data representative of general asthma or COPD population of Korea. Among the total group, 127 patients with COPD were selected for the analysis.

Patients were diagnosed as COPD based on the primary physician’s clinical judgment according to the following criteria: (1) 40 years or older, (2) forced expiratory volume in 1 second (FEV\(_1\)) to forced expiratory volume in 6 seconds (FEV\(_6\)) <0.73, (3) no evidence of malignant cancer, severe kidney or heart disease, transplanted organ for any lesion, bronchiectasis, sequelae of tuberculosis, or pregnancy\(^13,14\).

The comprehensive educational program developed by Korean Academy of Tuberculosis and Respiratory Disease consisted of inhaler training, an action plan for emergency situation focusing on acute exacerbation of COPD, and management of COPD concerning smoking cessation, nutritional support, exercise, vaccination, and comorbidities\(^12\).

2. Study design

This prospective study was performed to evaluate a 1-month comprehensive educational program. This study enrolled subjects who had been visiting each primary clinic over 1 year or more onto the education program. Considering the
Comprehensive education program in COPD

At first visit, we obtained the informed consent from each patient and conducted a knowledge assessment about their chronic airway disease, and tested the inhaler technique before the patients received the educational program. At the second and third visits, this education program were repeated. Questionnaires were completed by patients and physicians at the first visit and third visit to evaluate the following items; the knowledge about COPD, COPD assessment test (CAT), inhaler use technique, and measurement items of each topic were composed of six (knowledge), eight (CAT), seven (inhaler use), three (satisfaction of the patients), and five items (satisfaction of the physicians). Each item had 4 grade scales such as "strongly disagree, somewhat disagree, somewhat agree, strongly agree." Minimum Clinically Important Difference (MCID) for objective evaluation of quality of life improvement was defined as the improvement of 4 points or more in CAT score.35

3. Ethics statement

The study protocol was reviewed and approved by the Inje University Institutional Review Board (IIT-2014-283). Written informed consent, describing the purpose of the study was obtained from all the participating patients.

4. Statistical methods

All data were expressed as mean±SD or percentage. We determined the 95% confidence interval of each variable from the mean and standard deviation. Paired t test was used for the comparison of continuous variables before and after education. We used chi-square test was used for categorical variables. The chi-square test was used for categorical data before and after education. A p-value of <0.05 was deemed statistically significant. All data were analyzed with SPSS version 21.0 (IBM Corp., Armonk, NY, USA).

Results

1. Baseline characteristics of the study population

Out of 147 COPD patients initially enrolled, 127 patients (male, 89%; mean age, 67.8±14.2 years) with COPD completed this study. The baseline characteristics are shown in Table 1. Hypertension was the most frequent comorbidity (n=61, 48.0%). For 1 year prior to this study, previous educa-

| Table 1. Baseline characteristics of enrolled COPD patients |
|----------------------------------------------------------|
| Variable | COPD (n=127) |
|---|---|
| Age (mean±SD), yr | 67.8±10.1 |
| Male sex | 113 (89.0) |
| Smoking current/former/never, % | 7.8/52.8/19.4 |
| Comorbidities | |
| Hypertension | 61 (48.0) |
| Cardiovascular disorder (angina pectoris, myocardial infarction) | 6 (4.7) |
| Heart failure | 5 (3.9) |
| Arrhythmia | 5 (3.9) |
| Diabetes mellitus | 17 (13.4) |
| Hyperlipidemia | 11 (8.7) |
| Osteoporosis | 3 (2.4) |
| Depression | 7 (5.5) |
| Anemia | 2 (1.6) |
| Inhaler use | |
| Metered dose inhaler | 54 (42.5) |
| Dry power inhaler | 73 (57.5) |
| Turbohaler | 28 (22.1) |
| Diskus | 45 (35.4) |
| Handihaler | 49 (38.6) |
| Soft mist inhaler | 13 (10.2) |
| Breezehaler | 7 (5.5) |
| Combination inhaler (ICS+LABA) | 45 (35.4) |
| Combination inhaler (ICS+LABA)+LAMA | 28 (22.0) |
| LABA+LAMA | 2 (1.6) |
| LAMA only | 27 (21.2) |
| LABA only | 2 (1.6) |
| SABA only | 10 (7.0) |
| Previous education for 1 year before visit | |
| About COPD | |
| Never | 76 (60.3) |
| Intermittent (1–2 times) | 27 (21.4) |
| Frequently (≥3 times) | 7 (5.6) |
| Every time | 16 (12.7) |
| About inhaler usage | |
| Never | 56 (44.4) |
| Intermittent (1–2 times) | 43 (34.1) |
| Frequently (≥3 times) | 11 (8.7) |
| Every time | 16 (12.7) |

Values are presented as number (%) unless otherwise indicated. COPD: chronic obstructive pulmonary disease; ICS: inhaled corticosteroid; LABA: inhaled long acting β 2 agonist; LAMA: long-acting muscarinic agent; SABA: inhaled short acting β 2 agonist.
tion about COPD was not performed in 60.3% and inhaler training was not done in 44.4% (Table 1).

2. Inhaler usage assessed by physicians before and after a comprehensive education program

Inhaler use technique was assessed stage by stage from opening the lid to rinsing the mouth after inhalation. Before this program, positive answer for enough breathing out before inhalation and holding their breath for 5 seconds after inhalation was only 32.3% and 40.2%, respectively. However, after the completion of this education program, every item regarding inhaler usage was improved significantly as assessed by physicians (p<0.05) (Table 2).

3. Change of CAT score and of knowledge about COPD before and after a comprehensive education program

Total CAT score and all items in the CAT score except ‘have lots of energy’ were significantly improved after this comprehensive program (p<0.05) (Figure 2). All items concerning patients’ knowledge about COPD per se and management of problems arising from COPD showed significant positive changes as well (p<0.01) (Figure 3).

4. Evaluation of CAT by the improvement with MCID (CAT score improvement ≥4) or more after a comprehensive education program

In 44.9% of enrolled patients, the improvement of MCID or

Table 2. Inhaler usage assessed by physicians before and after inhaler training

| Item                                      | Positive answer | p-value |
|-------------------------------------------|-----------------|---------|
|                                           | Before education| After education |         |
| Open the lid correctly                    | 97/127 (76.4)   | 126/127 (99.2)| <0.001  |
| Hold the inhaler correctly                | 83/127 (65.4)   | 126/127 (99.2)| <0.001  |
| Enough breathing out before inhalation    | 41/127 (32.3)   | 111/127 (87.4)| <0.001  |
| Understand the manner of inhalation well  | 57/127 (44.9)   | 122/127 (96.1)| <0.001  |
| Hold their breath for 5 seconds after inhalation | 51/127 (40.2) | 118/127 (92.9)| <0.001  |
| Exhale after fully removing inhaler from mouth | 67/127 (52.8)  | 120/127 (94.5)| <0.001  |
| Rinse their mouth after inhaler use       | 65/105 (61.9)   | 101/103 (98.1)| <0.001  |

Values are presented as number (%).

Figure 2. Chronic obstructive pulmonary disease assessment test (CAT) score before and after comprehensive education program (n=125). (A) Total CAT score (20.1±9.6 vs. 15.7±9.0, p=0.001). (B) 1: I never cough (2.67±1.48 vs. 1.91±1.43, p=0.001); 2: sputum (2.84±1.43 vs. 2.30±1.36, p=0.001); 3: chest tightness (2.34±1.69 vs. 1.75±1.46, p<0.001); 4: dyspnea (3.36±1.42 vs. 2.69±1.54, p<0.001); 5: limitation on home activity (2.08±1.67 vs. 1.39±1.37, p<0.001); 6: confidently leaving my home (2.05±1.60 vs. 1.66±1.48, p=0.008); 7: sleep soundly (2.15±1.68 vs. 1.66±1.53, p=0.001); 8: have lots of energy (2.57±1.47 vs. 2.28±2.30, p=0.019). Values are presented as mean±SD. *p<0.05.
more in CAT were achieved through this program.

After the inhaler usage education, the following four of all seven items regarding inhaler usage achieved the improvement of MCID or more (p<0.05): (1) open the lid correctly; (2) hold the inhaler correctly; (3) hold the breath for 5 seconds after inhalation; and (4) rinse their mouth after inhaler use (Table 3).

After the education of the understanding on COPD, the following four items were associated with the improvement of MCID or more (p<0.05): (1) COPD is a disease that should be consistently treated; (2) the most important medicine in the treatment of COPD is inhaler; (3) I know about the method of inhaler usage; well; and (4) I use inhalers on a regular basis according to the physician’s advice (Table 3).

Discussion

Our study demonstrated that a comprehensive education program including inhaler training and COPD management performed at primary care setting resulted in positive outcomes including correct inhaler usage, improvement of CAT score, and patients’ better understanding of COPD management.

Therefore, authors are of the opinion that education program about the clinical course of COPD should be combined with inhaler training to overcome poor adherence and improve the outcomes of COPD.

Our study has some noteworthy findings.

First, inhaler training and organized education program on COPD management with pamphlet and educational video (specially designed by The Korean Academy of Tuberculosis and Respiratory Diseases) made significant improvements on many outcomes including inhaler usage, CAT score, and knowledge about COPD, in COPD patients treated by primary care physicians. Few studies have addressed the clinical outcomes of COPD assessed by clinicians and patients through comprehensive program with a visual education by video and pamphlet, including the education of patients on the management of COPD and inhaler training.

In inhaler items of our study, positive answers for enough breathing out before inhalation, holding their breath for 5 seconds after inhalation, and understanding the manner of inhalation were only 32.3%, 40.2%, and 44.9% respectively, before inhaler training. However, positive answers for all the items regarding inhaler usage increased after inhaler training.

Previous studies showed that correct usage of inhalers was 58.9% for dry powder inhaler (DPI) and 31.1% for pressurized metered dose inhaler (pMDI), and that proper training led to an improvement in correct usage of inhalers to 92.6% for DPI and to 45.2% for pMDI.

Misuse of inhaler devices due to inadequate training can lead to poor disease control and an increase in health care cost in COPD and asthma.

Analysis of Torch study over 3-year period showed that increased adherence independent of study treatment was associated with improved mortality and reduction in hospital admission in COPD, although direct comparison between Torch study and our findings is not possible because of different study design.

Another randomized controlled trial in COPD over 3-month period demonstrated that the intervention focusing on inhalation technique and adherence to maintenance therapy could reduce hospitalization rate.

Second, all the items of our study concerning the knowledge on COPD care showed a remarkable improvement after comprehensive disease education program. The effect of comprehensive disease education was further proven in findings that most items regarding the understanding of COPD being associated with improvement of MCID or more.

One limitation is that our study cannot prove whether the comprehensive education per se may have been a placebo effect due to the single arm design. Another limitation is that this study did not demonstrate how long the effect of comprehensive education will last and how often the education should be performed on a long-term basis. Further studies are required to instruct such points.

The improvement of MCID or more were achieved in 44.9% of enrolled patients, through this program. We defined MCID
as 4 points or more of CAT score, in keeping with previous report using this cohort, although our definition is a conservative approach, compared to other studies\(^{15}\).

Comprehensive management including smoking cessation, nutrition, exercise, vaccination, and co-morbidities is necessary in the care of COPD along with proper inhalation therapy, since COPD is deemed a syndrome with a high prevalence of comorbidities\(^{18}\).

Despite advancement in medical treatment, poor adherence remains a major challenge in the management of COPD\(^{10,11,19}\). Patients’ perception about disease process and recommended treatment is critical in improving medication adherence in COPD patients\(^{8,19}\).

Before disease education program, only 36.8% of total patients gave positive answers on coping with acute exacerbation of COPD, but remarkable positive change with positive answer rate of 82.4% occurred after this education program.

Acute exacerbation of COPD can lead to more severe lung function decline and worse quality of life in the clinical course of COPD patients\(^{20,22}\). Previous studies reported a high incidence of unreported exacerbations which can have an impact on health status\(^{23,24}\).

This study has several limitations.

First, this study did not include a control group because lack of inhaler training and no education on the management of COPD could be hazardous for control group. Accordingly, we investigated the effect of educational intervention in a design comparing clinical markers before and after comprehensive educational program.

Second, observation period was not long enough to assess the major outcomes of COPD such as acute exacerbation, hospitalization, and mortality.

Third, COPD was not diagnosed with traditional post-bronchodilator ratio of FEV\(_1\) to forced vital capacity <0.7. However, the FEV\(_1\)/FEV\(_c\) can substitute FEV\(_1\)/forced vital capacity as a valid alternative in diagnosing airflow obstruction, in primary care setting for screening COPD\(^{13,14}\).

Fourth, the severity of COPD was not assessed because spi-

| Items for patients | Change of survey items after education program | p-value |
|-------------------|---------------------------------------------|---------|
| Open the lid correctly. | No change | Positive change | 0.018 |
| Less than MCID | 40/69 (58.0) | 29/69 (42.0) |
| MCID improvement or more | 21/56 (37.5) | 35/56 (62.5) |
| Hold the inhaler correctly. | | | 0.036 |
| Less than MCID | 33/69 (47.8) | 36/69 (52.2) |
| MCID improvement or more | 17/56 (30.4) | 39/56 (69.6) |
| Enough breathing out before inhalation. | | | 0.301 |
| Less than MCID | 20/69 (29.0) | 49/69 (71.0) |
| MCID improvement or more | 13/56 (23.2) | 43/56 (76.8) |
| Understand the manner of inhalation well. | | | 0.162 |
| Less than MCID | 24/69 (34.8) | 45/69 (65.2) |
| MCID improvement or more | 14/56 (25.0) | 42/56 (75.0) |
| Hold their breath for 5 seconds after inhalation. | | | 0.039 |
| Less than MCID | 23/69 (33.3) | 46/69 (66.7) |
| MCID improvement or more | 10/56 (17.9) | 46/56 (82.1) |
| Exhale after fully removing inhaler from mouth. | | | 0.077 |
| Less than MCID | 28/69 (40.6) | 41/69 (59.4) |
| MCID improvement or more | 15/56 (26.8) | 41/56 (73.2) |
| Rinse their mouth well after inhaler use. | | | 0.007 |
| Less than MCID | 29/57 (50.9) | 28/57 (49.1) |
| MCID improvement or more | 10/41 (24.4) | 31/41 (75.6) |

Values are presented as number (%).

Minimum Clinically Important Difference (MCID): improvement of 4 points or more in chronic obstructive pulmonary disease assessment test (CAT) score.
Table 4. Evaluation of CAT change by MCID after education of the understanding on COPD

| Items for patients                                                                 | Change of survey items after education program | p-value |
|-----------------------------------------------------------------------------------|------------------------------------------------|---------|
|                                                                                  | No change                               | Positive change |          |
| I understand COPD well.                                                          | 28/69 (40.6)                           | 41/69 (59.4)    | 0.282   |
| Less than MCID                                                                   | 19/56 (33.9)                           | 37/56 (66.1)    |         |
| COPD is a disease that should be consistently treated.                           | 46/69 (66.7)                           | 23/69 (33.3)    | 0.006   |
| Less than MCID                                                                   | 24/56 (42.9)                           | 32/56 (57.1)    |         |
| COPD is a disease that should be consistently treated.                           | 27/69 (39.1)                           | 42/69 (60.9)    | 0.203   |
| Less than MCID                                                                   | 17/56 (30.4)                           | 39/56 (69.6)    |         |
| COPD is a disease that should be consistently treated.                           | 35/69 (50.7)                           | 34/69 (49.3)    | 0.017   |
| Less than MCID                                                                   | 17/56 (30.4)                           | 39/56 (69.6)    |         |
| COPD is a disease that should be consistently treated.                           | 48/68 (70.6)                           | 20/68 (29.4)    | <0.001  |
| Less than MCID                                                                   | 22/56 (37.5)                           | 34/56 (62.5)    |         |
| COPD is a disease that should be consistently treated.                           | 49/69 (71.0)                           | 20/69 (29.0)    | <0.001  |
| Less than MCID                                                                   | 22/56 (39.3)                           | 34/56 (60.7)    |         |

Values are presented as number (%).
Minimum Clinically Important Difference (MCID): improvement of 4 points or more of chronic obstructive pulmonary disease assessment test (CAT) score.

rometry was not performed in primary care setting.
Fifth, other outcome measures such as exercise test and smoking cessation rate were not performed.
In conclusion, our study showed that in the primary care setting, a comprehensive education program including inhaler training and COPD management resulted in correct inhaler usage and improvement of CAT score, suggesting that such programs should be extended further in the primary care of COPD.

Conflicts of Interest

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