Original Article

Validity and Reliability of CAT and Dyspnea-12 in Bronchiectasis and Tuberculous Destroyed Lung

Bo Young Lee, M.D.[1], Seohyun Lee, M.D.[1], Jae Seung Lee, M.D.[2], Jin Woo Song, M.D.[2,3], Sang-Do Lee, M.D.[2,3,4], Seung Hun Jang, M.D.[5], Ki-Suck Jung, M.D.[5], Yong Il Hwang, M.D.[5], Yeon-Mok Oh, M.D.[2,3,4]

Departments of [1]Internal Medicine and [2]Pulmonary and Critical Care Medicine, [3]Asthma Center, [4]Clinical Reserch Center for Chronic Obstructive Airway Diseases, Asan Medical Center, University of Ulsan College of Medicine, Seoul, [5]Division of Pulmonary, Allergy and Critical Care Medicine, Department of Internal Medicine, Hallym University Sacred Heart Hospital, Hallym University College of Medicine, Anyang, Korea

Background: The objective of this study was to assess the validity and reliability of the Korean version of chronic obstructive pulmonary disease assessment test (CAT) and Dyspnea-12 Questionnaire for patients with bronchiectasis or tuberculous destroyed lung.

Methods: For 62 bronchiectasis patients and 37 tuberculous destroyed lung patients, 3 questionnaires including St. George's Respiratory Questionnaires (SGRQ), CAT, and Dyspnea-12 were obtained, in addition to spirometric measurements. To assess the validity of CAT and Dyspnea-12, correlation with SGRQ was evaluated. To assess the reliability of CAT and Dyspnea-12, Cronbach's α coefficient was calculated.

Results: The mean ages of the patients were 60.7 ± 8.3 years in bronchiectasis and 64.4 ± 9.3 years in tuberculous destroyed lung. 46.8% and 54.1% were male, respectively. The SGRQ score was correlated with the score of the Korean version of CAT (r=0.72, p<0.0001) and Dyspnea-12 (r=0.67, p<0.0001) in bronchiectasis patients. The SGRQ score was correlated with the score of CAT (r=0.86, p<0.0001) and Dyspnea-12 (r=0.80, p<0.0001) in tuberculous destroyed lung patients. The Cronbach's α coefficient for the CAT and Dyspnea-12 were 0.84 and 0.90 in bronchiectasis, and 0.88 and 0.94 in tuberculous destroyed lung, respectively.

Conclusion: We found that Korean version of CAT and Dyspnea-12 are valid and reliable in patients with tuberculous destroyed lung and bronchiectasis.

Key Words: Dyspnea; Severity of Illness Index; Questionnaires; Validation Studies; Bronchiectasis; Tuberculosis

Introduction

Health-related quality of life (HRQL) is a concept

Address for correspondence: **Yeon-Mok Oh, M.D.**
Department of Pulmonary and Critical Care Medicine, Asthma Center, Clinical Research Center for Chronic Obstructive Airway Disease, Asan Medical Center, University of Ulsan College of Medicine, 88, Olympic-ro 43-gil, Songpa-gu, Seoul 138-736, Korea
Phone: 82-2-3010-3136, Fax: 82-2-3010-6968
E-mail: ymoh55@amc.seoul.kr
Address for Co-correspondence: **Yong Il Hwang, M.D.**
Division of Pulmonary and Critical Care Medicine, Department of Internal Medicine, Hallym University Sacred Heart Hospital, 896, Pyeongchon-dong, Dongan-gu, Anyang 431-070, Korea
Phone: 82-31-380-3715, Fax: 82-31-380-3973
E-mail: hyicyk@hallym.or.kr

which involves all aspects of physical, mental and social life. Assessment and evaluation of HRQL is very important in treating many diseases[1]. In chronic pulmonary diseases such as chronic obstructive pulmonary disease (COPD), asthma, and tuberculous destroyed lung, the natural course of diseases is usually progressive, and the mainstay of treatment is to improve activity and quality of daily living. Therefore, developing tools to assess these functions and quality of life is important[2]. In case of COPD, various tools have been developed to assess quality of life, and their validity and reliability have been well established[3].

Currently, there is no disease-specific tool for assessing HRQL in tuberculous destroyed lung and bronchiectasis yet. However, St. George's respiratory ques-

tionnaire (SGRQ), which has been widely used as a tool for assessing HRQL in chronic pulmonary disease cases, has been proven to be valid and reliable by several studies[4-8]. However, since SGRQ is complex and time consuming to complete, it is not readily applicable in routine practice. COPD assessment test (CAT) was developed as a short, simple instrument for quantification of symptoms, and it was recently introduced after validation[9,10]. Modified Medical Research Council dyspnea score (MMRC) is widely used to evaluate the severity of dyspnea, but quantification of the severity using MMRC is difficult[11]. Dyspnea-12 is composed of 12 questions designed to assess the severity of dyspnea[12]. Dyspnea-12 was validated in patients with COPD[10]. However, validity and reliability of Korean version CAT and Korean version Dyspnea-12 questionnaire for tuberculous destroyed lung and bronchiectasis cases have not yet been confirmed. In the present study, the validity and reliability of Korean version CAT and Korean version Dyspnea-12 questionnaire are evaluated.

Materials and Methods

1. Study subjects

1) Inclusion criteria: Patients with either tuberculous destroyed lungs or bronchiectasis, who visited the outpatient clinic of Department of Pulmonology and Critical Care Medicine in Asan Medical Center and Hallym University Sacred Heart Pyeongchon Hospital between March 3, 2010 and May 3, 2011 were selected for the present study. These two institutions are university-affiliated tertiary hospitals in South Korea. Definition on each disease was made by pulmonologists as follows:

(1) Tuberculous destroyed lung; All patients with a history of treating pulmonary tuberculosis at least 1 year ago were included if more than half of one lung is destroyed on chest radiography[13].

(2) Bronchiectasis; Bronchiectasis was diagnosed based on computed tomography scan findings.

2) Exclusion criteria

(1) Cases with underlying diseases considered to significantly affect the quality of life were excluded.

- Heart failure
- Malignant neoplasm which is not in a disease free state
- History of myocardial infarction within 6 months
- Severe liver diseases
- Severe psychiatric diseases
- Hospitalized

(2) Patients who had difficulty in filling up the questionnaire, or who did not agree to participate in the survey were excluded from the present study.

2. Methods

As a prospective cross-sectional study, informed consents in written form were collected. Then, the patients were requested to complete Korean version SGRQ, Korean version CAT questionnaire and Korean version Dyspnea-12 questionnaire by themselves. Spirometry was also performed.

1) Questionnaires

(1) Korean version SGRQ; Korean version SGRQ is composed of 50 items divided into 3 categories: symptom, activity and impact. Scores calculated from each category and the total score from all categories were analyzed and recorded, respectively. Scores range from 0 to 100 where 0 is the best HRQL, and 100 the worst[4]. In the present study, Korean version SGRQ was used, which was previously validated[5].

(2) Korean version CAT questionnaire; Korean version CAT questionnaire is composed of 8 items. Each item has a score ranging from 0 to 5, thereby making the total score range from 0 to 40. Score of 0 represents the best quality of life and 40 does the worst[9]. Korean version CAT questionnaire was used after obtaining permission from GSK (GlaxoSmithKline).

(3) Korean version Dyspnea-12 questionnaire; Korean version Dyspnea-12 questionnaire is composed of 12 items requiring either one of the 4 types of responses: none, mild, moderate or severe. Each response receives scores ranging from 0 to 3[12]. The original version of Dyspnea-12 questionnaire was first translated into Korean under permission of the original author of the questionnaire. The quality of translation was again con-

firmed by the original author after translation and thorough revision.

2) **Spirometry tests:** Using a spirometer (Vmax22 or 2130; Sensor Medics, Yorba Linda, CA, USA), forced expiratory volume in 1 second (FEV_1) and forced vital capacity (FVC) were measured. Spirometry was conducted following the method recommended by American Thoracic Society and European Respiratory Society. With respect to normal predictive values of spirometry, the Korean reference equation reported by Choi et al.[14] was used.

3) **Statistical analysis:** In order to evaluate validity, correlation analysis was conducted using Pearson's correlation. The association between the scores of Korean version CAT questionnaire and the scores of the Korean version SGRQ, and that between the score of Korean version CAT questionnaire and the FEV_1 were evaluated. Similarly, for the scores of Korean version Dyspnea-12 questionnaire correlation analysis was underwent to evaluate its association with Korean version SGRQ and FEV_1. To assess reliability, Cronbach's α coefficient was calculated determining the internal consistency of Korean version CAT questionnaire and Korean version Dyspnea-12 questionnaire. Using SAS for Window version 18.0 (SPSS Inc., Chicago, IL, USA), statistical analysis was conducted. All data are expressed means and standard deviations or frequencies. Statistical significance was accepted for p-values less than 0.05.

4) **Approval from Institutional Review Board (IRB):** Approval from IRB of Asan Medical Center and Hallym University Sacred Heart Pyeongchon Hospital was obtained. Written informed consents from all participants were collected.

Results

1. Bronchiectasis

1) **Patient characteristics:** Sixty two patients were enrolled to this study and their mean age was 60.7 years. Most of patients in study cohort were female and non-smokers (Table 1). In average, spirometry showed

mild airflow obstruction.

2) **Correlation between Korean version CAT questionnaire or Korean version Dyspnea-12 questionnaire, and Korean version SGRQ:** The Korean version CAT questionnaire was strongly correlated with the Korean version SGRQ (Figure 1). Korean version Dyspnea-12 questionnaire also showed a significant correlation with Korean version SGRQ (Figure 2).

3) **Distribution and internal consistency of Korean version CAT questionnaire and Korean version Dyspnea-12 questionnaire:** Most subjects scored 10 and 14 in Korean version CAT questionnaire (n=5, 8.1%), and total score was below 20 in 75% of the subjects (Figure 3). Most of the subjects scored 0 in Korean version Dyspnea-12 questionnaire (n=15, 24.2%), and 36 (51.6%) of the subjects scored from 0 to 3, implying that the scores of Korean version CAT questionnaire and Korean version Dyspnea-12 questionnaire were distributed mainly in the low-score range (Figure 4). Cronbach's α coeffi-

Table 1. Characteristics of bronchiectasis patients

Characteristics	Patients (n=62)
Age, yr	60.7±8.3
Male	29 (46.8)
Smoking history	
Never-smoker	42 (67.7)
Ex-smoker	18 (29)
Current smoker	2 (3.2)
Pack year	6.5±13.0
PFT	39 (62.9)
FEV_1, L	1.8±0.5
FEV_1, % predicted	67.3±18.6
FVC, L	2.7±0.6
FVC, % predicted	76.5±14.8
FEV_1/FVC	65.9±11.6
SGRQ (total)	31.5±14.9
Symptom	49.9±19.0
Activity	40.3±21.0
Impact	20.7±16.2
CAT score	15.4±7.3
Dyspnea-12 score	4.8±5.9

Values are presented as mean±SD or number (%).
PFT: pulmonary function test; FEV_1: forced expiratory volume in 1 second; FVC: forced vital capacity; SGRQ: St. George Respiratory Questionnaire; CAT: chronic obstructive pulmonary disease assessment test; SD: standard deviation.
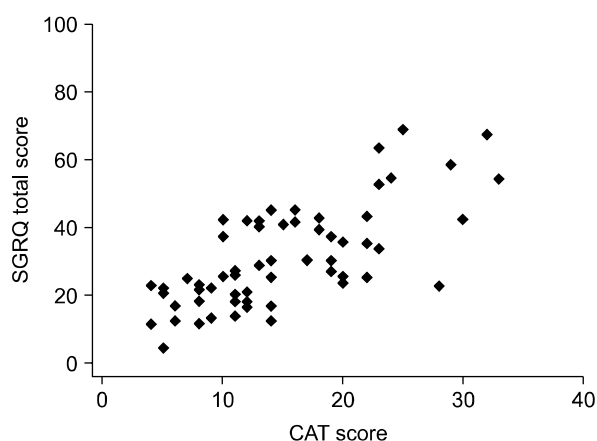
Figure 1. Correlation between chronic obstructive pulmonary disease assessment test (CAT) score and St. George's Respiratory Questionnaire (SGRQ) total score in bronchiectasis patients (r=0.72, p<0.0001; 62 patients).
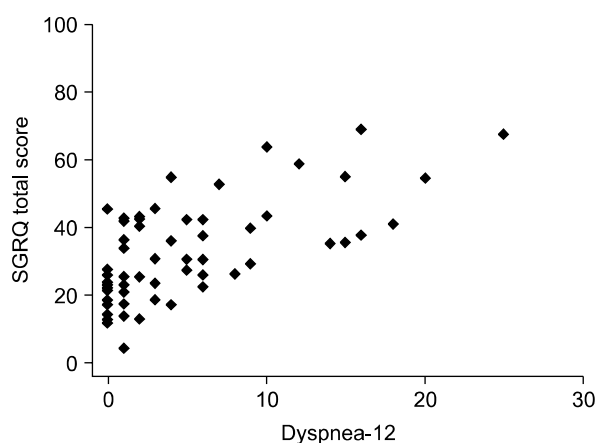

Figure 2. Correlation between Dyspnea-12 score and St. George's Respiratory Questionnaire (SGRQ) total score in bronchiectasis patients (r=0.67, p<0.0001; 62 patients).
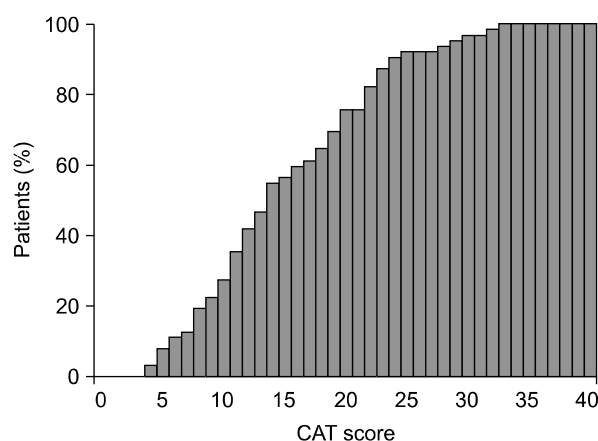

Figure 3. Cumulative frequency distribution of chronic obstructive pulmonary disease assessment test (CAT) score in 62 bronchiectasis patients.
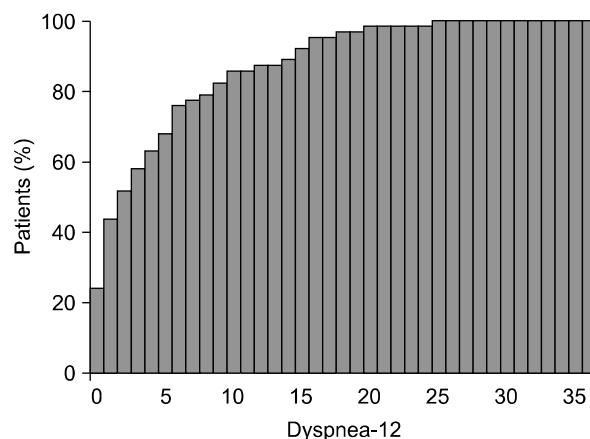

Figure 4. Cumulative frequency distribution of Dyspnea-12 score in 62 bronchiectasis patients.

cients representing internal consistency of Korean version CAT questionnaire and Korean version Dyspnea-12 questionnaire were 0.84 and 0.90, respectively.

4) Correlation between Korean version CAT questionnaire or Korean version Dyspnea-12 questionnaire, and pulmonary function test: In patients with bronchiectasis, no significant correlation was observed between Korean version CAT questionnaire and pulmonary function test. With Korean version Dyspnea-12 questionnaire, both FEV_1 and FVC showed a significant negative correlation (Table 2).

2. Tuberculous destroyed lung

1) Characteristics of the subjects: Thirty seven patients were enrolled to this study and their mean age was 64.4 years. Most of the subjects were male and non-smokers (Table 3).

In average, spirometry showed moderate airflow obstruction.

2) Correlation between Korean version CAT questionnaire or Korean version Dyspnea-12 questionnaire, and Korean version SGRQ: The Korean version CAT questionnaire was strongly correlated with the Korean version SGRQ in patients with tuberculous destroyed

Table 2. Correlation between the questionnaires and pulmonary function test in 62 bronchiectasis patients

	CAT score	Dyspnea-12 score	SGRQ total score
FEV$_1$, % predicted	−0.01 (0.96)*	−0.37 (0.019)	−0.29 (0.073)
FVC, % predicted	−0.02 (0.91)	−0.32 (0.045)	−0.34 (0.037)

*Correlation coefficients with p-values in parentheses.
CAT: chronic obstructive pulmonary disease assessment test; SGRQ: St. George's Respiratory Questionnaire; FEV$_1$: forced expiratory volume in 1 second; FVC: forced vital capacity.

Table 3. Characteristics of tuberculous destroyed lung patients

Characteristics	Patients (n=37)
Age, yr	64.4±9.3
Male	22 (54.1)
Smoking history	
Never-smoker	20 (54.1)
Ex-smoker	15 (40.5)
Current smoker	2 (5.4)
Pack year	12.4±17.5
PFT	28 (75.7)
FEV$_1$, L	1.2±0.4
FEV$_1$, % predicted	46.9±17.1
FVC, L	2.2±0.6
FVC, % predicted	62.0±16.0
FEV$_1$/FVC	56.2±17.3
SGRQ (total)	37.1±20.7
Symptom	45.0±22.3
Activity	52.9±26.1
Impact	25.2±21.2
CAT score	15.1±8.7
Dyspnea-12 score	6.1±7.8

Values are presented as mean±SD or number (%).
PFT: pulmonary function test; FEV$_1$: forced expiratory volume in 1 second; FVC: forced vital capacity; SGRQ: St. George Respiratory Questionnaire; CAT: chronic obstructive pulmonary disease assessment test; SD: standard deviation.

lung (Figure 5). In addition, Korean version Dyspnea-12 questionnaire also showed a significant correlation with Korean version SGRQ (Figure 6).

3) Distribution and internal consistency of Korean version CAT questionnaire and Korean version Dyspnea-12 questionnaire: According to the result of Korean version CAT questionnaire, a 73% of the subjects scored less than 20 (Figure 7). In Korean version Dyspnea-12 questionnaire, most of the subjects scored 0 (n=7, 18.9%), and 22 (45.9%) of the subjects scored from 0 to 2, im-
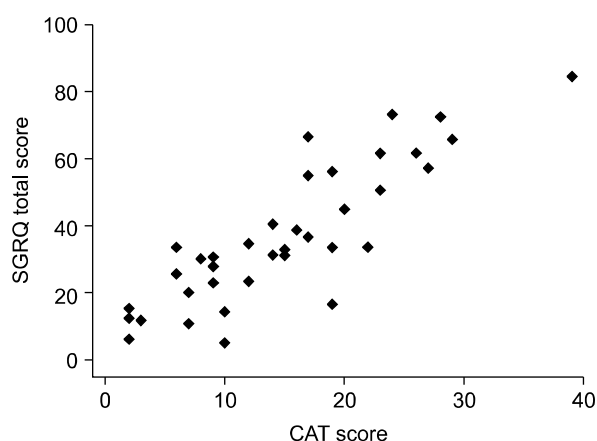

Figure 5. Correlation between chronic obstructive pulmonary disease assessment test (CAT) score and St. George's Respiratory Questionnaire (SGRQ) total score in tuberculous destroyed lung patients (r=0.86, p<0.0001; 37 patients).
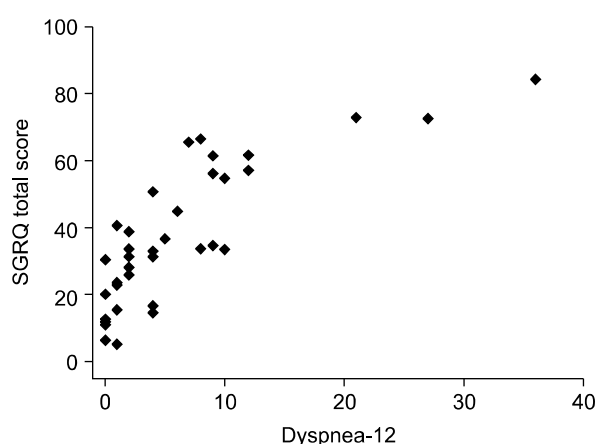

Figure 6. Correlation between Dyspnea-12 score and St. George's Respiratory Questionnaire (SGRQ) total score in tuberculous destroyed lung patients (r=0.80, p<0.0001; 37 patients).
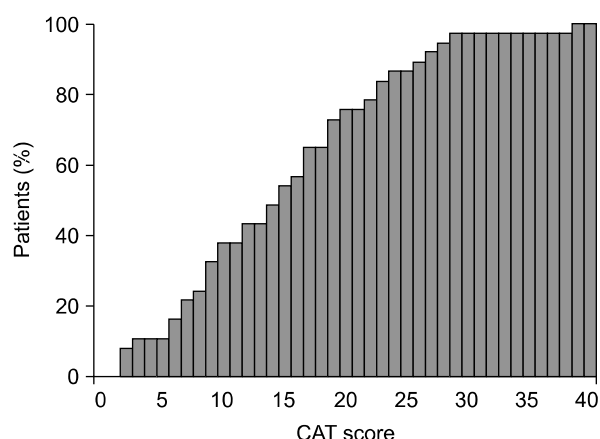
Figure 7. Cumulative frequency distribution of chronic obstructive pulmonary disease assessment test (CAT) score in 37 tuberculous destroyed lung patients.
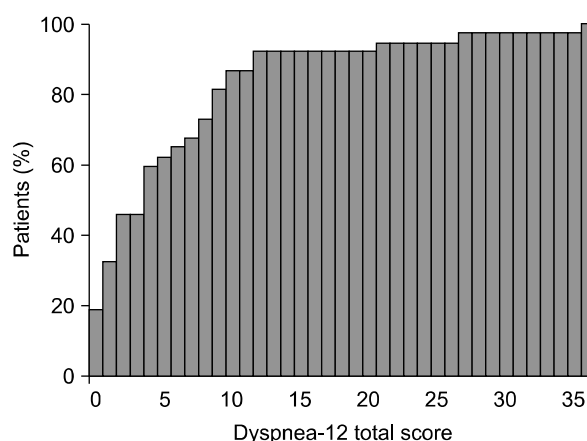

Figure 8. Cumulative frequency distribution of dyspnea-12 score in 37 tuberculous destroyed lung patients.

Table 4. Correlation between questionnaires and pulmonary function test in 37 tuberculous destroyed lung patients

	CAT score	Dyspnea-12 score	SGRQ total score
FEV_1, % predicted	−0.27 (0.16)*	−0.29 (0.13)	−0.30 (0.12)
FVC, % predicted	−0.29 (0.13)	−0.29 (0.13)	−0.30 (0.12)

*Correlation coefficients with p-values in parentheses.
CAT: chronic obstructive pulmonary disease assessment test; SGRQ: St. George's Respiratory Questionnaire; FEV_1: forced expiratory volume in 1 second; FVC: forced vital capacity.

plying that the scores of Korean version CAT and Korean version Dyspnea-12 questionnaire were distributed mainly in the low-score range (Figure 8). Cronbach's α coefficients representing internal consistency of Korean version CAT questionnaire and Korean version Dyspnea-12 questionnaire were 0.88 and 0.94, respectively.

4) Correlation between Korean version CAT questionnaire or Korean version Dyspnea-12 questionnaire, and pulmonary function test: No significant correlation was observed between Korean version CAT questionnaire and pulmonary function test in patients with tuberculous destroyed lung. Korean version Dyspnea-12 questionnaire did not show a significant correlation with pulmonary function test, either (Table 4).

Discussion

The results from this study demonstrated that the Korean version CAT questionnaire and the Korean version Dyspnea-12 questionnaire are significantly correlated with the Korean version SGRQ in patients with bronchiectasis and also those with tuberculous destroyed lung. Also, its internal consistency appeared to be good. We used Pearson's correlation analysis for convergent validity and Cronbach's α coefficient was applied to confirm internal reliability.

The annual incidence of pulmonary tuberculosis is still globally high with approximately 8.8 million[15]. Although patients can be microbiologically cured with appropriate treatment, it can result in residual anatomical and functional changes[16]. Moreover, the burden of diseases affecting HRQL is considered to be high, but only a few studies have been conducted regarding the HRQL of patients with tuberculous destroyed lung.

Bronchiectasis is a disease characterized by the irreversible bronchial dilation and deformity as a result of the destruction of bronchial muscle and its elastic tissue.

Symptoms include cough, sputum and dyspnea, which are similar to those of COPD and tuberculous destroyed lung[17]. In present study, we evaluated the validity and reliability of Korean version CAT questionnaire, which was previously developed as a simple tool for assessing quality of life in patients with COPD, in patients with bronchiectasis and tuberculous destroyed lung. To our knowledge, there has not been a disease-specific tool to assess HRQL in these diseases, to date.

In our study, the correlation between the results of pulmonary function test and the scores of Korean version CAT questionnaire was found to be low and statistically insignificant. In previous studies, significant, but low correlation between pulmonary function test results and SGRQ in chronic pulmonary disease have been reported[5-7]. Similar result was reported by another study regarding the validity and reliability of Korean version CAT in COPD patients[10]. These results reflect that each individual's physiological profile such as FEV_1 does not necessarily determine one's quality of life by itself. However, the significance of these correlation analyses might have been underestimated due to small sample size.

The study results showed that both Korean version CAT score and Korean version Dyspnea-12 Questionnaire score were distributed at a relatively low-score range. This type of distribution might be due to the fact that most patients participated in this study visited outpatient clinics with moderate to mild symptoms. However, despite this limitation, these assessment tools may be applicable to patients in routine practice as most patients in routine practice are clinically stable.

Korean version CAT questionnaire does not have any item to assess hemoptysis and recurrent infection which are common symptoms of bronchiectasis, and accordingly, this might have limited reflecting disease-specific aspects. Since this was not evaluated in our study, further studies will be required to determine whether Korean version CAT questionnaire reflects the changes in disease-specific symptoms or symptoms accompanied by exacerbation.

In summary, we have confirmed the validity and the reliability of Korean version CAT questionnaire and Korean version Dyspnea-12 questionnaire in patients with bronchiectasis and tuberculous destroyed lung. Since these two questionnaires are composed of simple items, patients can easily complete in a short period of time, thereby making them more convenient tools for assessing quality of life in routine practice.

Acknowledgements

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