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The relation of the exersional dyspnea with pulmonary function, exercise tolerance and quality of life in patients with chronic obstructive pulmonary disease

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Abstract

Introduction: Dyspnea is described as a sensation of difficulty awareness in breathing and it is a common complaint of patients with chronic obstructive pulmonary disease (COPD). This study aimed to investigate the related factors of exersional dyspnea and determine the predictors of it.

Materials and Methods: Across-sectional study was developed on 37 patients with chronic obstructive pulmonary disease referred to Specialized Pulmonary Clinic of Aria Hospital in Ahvaz in 2011. Purposive sampling method was used gathering the samples. The 6Minute Walk Test (6MWT) was performed at the end of the test based on American Thorax Society's protocol exersional dyspnea was measured by Borg scale. Also the health related quality of life was assessed by the St George's Respiratory Questionnaire (SGRQ). The data was analyzed using Pearson's linear correlation coefficient, Spearman's correlation coefficient and Multivariate linear regression.

Results: The finding revealed that there was a negative significant relation between dyspnea and exercise tolerance($r=-0.33$, $p<0.05$).A positive correlation was observed between dyspnea and quality of life ($r=0.60$, $p<0.001$).Moreover, no statistically significant correlation was found between dyspnea and blood pressure, respiratory rate, heart rate and O_2sat before 6MWT. Multiple regression analysis indicated that the O_2sat and respiratory rate after exercise and forced expiratory flow the middle 50% of the FVC (FEF_{25-75}) was identified as independent predictor of the exersional dyspnea($p<0.05$).

Conclusion: The result showed that the patients with more dyspnea had a lower exercise tolerance and quality of life. Tree factors consist of the O_2sat and respiratory rate after exercise and FEF_{25-75} maybe were the predictors of exersional dyspnea.

Keywords: Exersional dyspnea, Pulmonary function, Exercise tolerance, Quality of life, Chronic Obstructive Pulmonary disease

Introduction

Chronic obstructive pulmonary disease (COPD) is a disease characterized by airflow limitation and airway obstruction with an irreversible process (1).According to the World Health Organization (WHO), 80 million people suffer from moderate to severe COPD throughout the world. In 2005, more than 3 million mortalities have been reported because of COPD disease, which comprises about 5% of all global mortality (2).The disease is a major cause of mortality in developed countries and is expected to become the third leading cause of mortality worldwide in 2020 (1).

Regardless of the severity of the disease, COPD patients suffer from dyspnea and fatigue (3).According to the American Thoracic Society (ATS), dyspnea is a subjective experience of breathing discomfort that consists of qualitatively distinct sensations that vary in intensity. The experience derives

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from interactions among multiple physiological, psychological, social and environmental factors (4).

Dyspnea is the most common cause thatlimits activities in patients with COPD (5).Gonzalez et al.showed that dyspnea is one of the most important factors that determine the quality of life (6). Exersional dyspnea is the imbalance between the need for ventilation and the ability of pulmonary mechanics to meet the needs during activity (7).

Several studies have shown that there was significant difference between the unpleasant respiratory sensations in healthy subjects and COPD patients at the end of the activity, so that the healthy subjects mention the increased respiratory effort and work while people with COPD report respiratory distress and difficulty in breathing (8, 9).In the study of Oga et al, it was found that exercise capacity is associated with dyspnea, so that patients with dyspnea have a lower exercise capacity (10), whereas no significant relationship was found between dyspnea and exercise capacity in the study of Akkoca et al (7).

Nishimura et al. found that dyspnea is better predictor of the survival of the patients than the severity of airway obstruction (11).In the study of Bakhshandeh et al, it was found that patients with COPD have a poorer quality of life at all levels of the disease (12). Mangueria et al showed that there was a significant relationship between dyspnea and quality of life (13).In the study by Kim & et al, it was found that there is no significant relationship between dyspnea and severity based on the of Global Organization Lung Disease (GOLD) criterion (14), while the study of de Torreset al reported a significant relationship between dyspnea and severity (15).

Since dyspnea is one of the most common complaints of patients with COPD (16), determining the associated factors not only specifies the effects of dyspnea, but also by identifying the predictors of dyspnea, measures can be considered to reduce this unpleasant sensation and improve the quality of life of these patients. Thus, this study aimed to determine the factors associated with dyspnea and the predictors in patients with COPD.

Materials and Methods

A descriptive correlational study was conducted on 37 patients with COPD referred to the Specialized Pulmonary Clinic of Aria Hospital in Ahvaz. The study samples were selected according to inclusion criteria, with a purposeful sampling.

Inclusion criteria are: having mild to very severe chronic obstructive pulmonary disease based on spirometry and diagnosis of lung specialist, having 40-70 years of age, have a stable clinical condition without episodes of exacerbation in the preceding month, and the body mass index less than 35.Samples with underlying diseases such as neurological disorders, musculoskeletal and peripheral vascular diseases as well as patients who had a history of Myocardial infarction, angina attack and exacerbation during the last month or individuals who required oxygen therapy and the use of salbutamol during the 6 minute walk distance test (6MWD) were excluded (17).

Selected samples were tested for spirometry through SpiroLab Π (made in Italy), how to perform the 6-minute walk test was explained to patients; and quality of life questionnaire was completed.

Exersional dyspnea, standard was studied using Borg dyspnea measurement scale. It is a visual scale of 0 to 10 where 0 indicates no dyspnea and 10 represents the highest level of dyspnea (9).

6-minute walk test was carried out on the basis of the protocol presented by the American Thoracic Society (ATS).The reliability of this instrument was calculated equal to 0.93 in the study of Hernandes et al (18).

In addition, in a review by Morales-Blanhir et al, it became clear that the test is a valid tool for respiratory disease (19). For this test, a flat corridor with a length of 30 Centimeter was used, which was marked every 3 meters. To comply with safety issues for patients, the test was executed in a location near the emergency room. Prior to walk, 15 minute rest was given to the patients to stabilize the hemodynamic status of the patient; and after the heart rate, blood pressure and the level of arterial oxygen saturation were examined by pulse oximetry, the patients were asked to walk as far as they can in 6 minutes (17); and at the end of the test, the amount of dyspnea was measured.

St George's Respiratory Questionnaire (SGRQ) was used to assess the quality of life. This questionnaire has three dimensions of symptoms, activity and impact; and each of the subscales of the questionnaire and total score assigns a score between 0% and 100% such that the higher score indicates the worse quality of life at the scale. In connection with the validity and reliability of George quality of life questionnaire, Cronbach's alpha for the overall scores, symptoms, activity and impact are listed equal to 0.94, 0.72, 0.89, and 0.89, respectively, in the study of Tavalaee, quoted from Ferrer et al (20). The reliability and validity of the questionnaire in the country of Iran has been confirmed as α=0.93 by Tafti et al (21).

Patients'demographic data were collected using a researcher-made questionnaire, which contains information on age, sex, marital status, smoking rates and status.

Finally, the data were statistically analyzed with SPSS software version 16, using descriptive statistics and Pearson's correlation coefficient and Spearman's rho, ANOVA one way and linear regression.

Ethical considerations

This study was conducted after obtaining the confirmation of the Ahvaz Jundishapur Ethics Committee and the informed consent from all subjects participating in the study.

Results

A total of 37 patients (34 men and 3 women) participated in this study, based on grading criteria for GOLD disease severity with mild, moderate, severe and very severe COPD scale of 41.66%, 16.66%, 16.66% and 25%, respectively.38.9% of patients were exposed to occupational pollutants, for example, they work in jobs like steel industry, refineries and agriculture. In this study 38.9% of patients were active smokers, 22.2% did not smoke at

all and 38.9% were Smoker. On average, smoking cessation duration was 6 years (Table1). One-way ANOVA test showed that there was a statistically significant difference between the four levels of disease severity and dyspnea ($p < 0.01$).

The study correlation results showed a statistically significant negative relationship between exersional dyspnea and the 6MWT ($p < 0.05$).

Among the three dimensions of life quality, the strongest relationship was found between the severity of dyspnea and the dimension of activity ($r = 0.61$, $p < 0.001$) and the lowest relationship with the dimension of symptoms ($r = 0.39$, $p < 0.01$).

No statistically significant relationship was observed between dyspnea and disease duration. In addition, there was no statistical relationship between the variables of blood pressure, the number of respiration, heart rate and arterial oxygen saturation before the 6MWTand the intensity of dyspnea (Table 2).

Regression testing indicated that among the dyspnea-related variables, three variables are predictors of dyspnea: oxygen saturation of arterial blood (SPO2),FEF25-75% and respiratory rate after the 6MWT.

Table1: Demographics characteristic

Demographic factors	Mean±SD	95% CI
Age (year)	56.8±8.8	53.8-59.8
BMI ($kg.m^{-2}$)	24.9±4.7	23.2-26.4
Weight (kg)	72.6±14.8	67.4-77.5
Height (cm)	170.7±9.7	167.4-174.1
Pack/Year (year)	28.7±39.2	15.3-42.2
6MWD (m)	455.4±79.5	428.4-482.3
Dyspnea (0-10)	2.98±2.3	2.2-3.7
Total score of SGRQ (0-100)	41.2±18.4	34.9-47.4
Symptoms of SGRQ (0-100)	46.5±24.9	38.08-54.9
Activity of SGRQ (0-100)	57.7±21.7	50.4-65.1
Impact of SGRQ (0-100)	29.7±19.6	23.09-36.4
FEV_1 (L)	1.86±0.89	1.5-2.1
FEV_1% predicted	57.8±24.7	49.2-66.5
FVC (L)	3.19±1.06	2.8-3.5
FVC % predicted	80.0±22.4	72.1-87.8
FEV_1/ FVC %	69.6±16.5	63.9-75.4

BMI= Body Mass Index, 6MWD= 6- Minute Walk Distance, SGRQ= St George's Respiratory Questionnaire, FEV_1= Forced Expiratory Volume in one second, FVC= Forced Vital Capacity

Table 2: Correlation between dyspnea, clinical parameters and quality of life

parameters	Dyspnea	p-value
Age	0.16	NS
BMI	-0.37	0.02
Pack/Year	0.14	NS
Number of hospitalization	0.4	0.01
Heart rate before 6MWT	0.24	NS
Heart rate after 6MWT	0.37	0.02
Respiratory rate before 6MWT	0.24	NS
Respiratory after before 6MWT	0.50	0.002
SPO_2 before 6MWT	-0.28	NS
SPO_2 after 6MWT	-0.55	0.000
Severity of disease	0.54	0.001
FEV_1 % predicted	-0.58	0.000
FVC % predicted	-0.53	0.001
FEV_1/FVC %	-0.49	0.003
FEF_{25-75} % predicted	-0.56	0.001
6MWT	-0.33	0.04
SGRQ symptom score	0.39	0.01
SGRQ activity score	0.61	0.000
SGRQ impact score	0.51	0.001
SGRQ total score	0.60	0.000

Data expressed as Pearson's or Spearman's rho; NS= non-significant, 6MWD= 6Minute Walk Distance, BMI= Body Mass Index, FEV_1= Forced Expiratory Volume in one second, FVC= Forced Vital Capacity, FEF_{25-75}= Forced Expiratory Flow the middle 50% of the FVC, SGRQ= St George's Respiratory Questionnaire

Discussion

The results showed that dyspnea was associated with disease severity so that dyspnea in patients can also increase with severity of disease, which was similar to the results of de Torres et al (15). However, dyspnea and severity relationship of the disease was not strong enough to be placed in the calculation of regression, because there were samples with mild severity, which did not seem to be effective in causing dyspnea. In the study by Redelmeier et al, although only patients with severe intensity were contributed, nevertheless, the results still showed a moderate relationship between dyspnea and forced expiratory volume in one second (FEV1), which seems to be because of not applying the appropriate tool for the study of dyspnea (22).

Regression results showed that the obstruction of the small airways FEF25-75 was one of the predictors of dyspnea. Therefore, people with a more severe obstruction of the small airways may experience more the exersional dyspnea, compared with other patients. This could be another reason for the moderate (instead of

strong) relationship between the disease severity and dyspnea, because parameters FEV1, forced vital capacity (FVC) and FEV1/FVC were applied to determine the disease severity based on GOLD criterion (23).

The results showed that dyspnea had a significant negative relationship with exercise tolerance, which was consistent with the Oga et al. study(10). Consequently, it seems that the reduction of dyspnea can help increase exercise tolerance in these patients. In this regard, studies on rehabilitation show that pulmonary rehabilitation can improve dyspnea and thus exercise tolerance in these patients (24-26).

The importance of arterial blood gases in the progression of dyspnea (27) is unknown. Furthermore, it has been determined in this study that the arterial oxygen saturation at the end of the activity was associated with the severity of dyspnea; and this factor was a predictor of dyspnea. As a result, procedures performed to increase arterial oxygen saturation which were effective in reducing exersional dyspnea so that in the study of Izadi-oonji, it was determined that pursed-lip exercises are effective in increasing the arterial oxygen saturation (28).

The respiratory activity was another factor predicting dyspnea so that patients who had more respiratory rate at the end of the activity, reported more dyspnea.

Increased respiratory rate and its superficial nature in these patients not only could not improve their situation, but also may worsen the situation of these patients rather by creating fatigue in the respiratory muscles. In this regard, the study of Faager et al showed that pursed-lip breathing during the shuttle test increased in the distance walked in patients with COPD. Although these patients have experienced a decrease in arterial oxygen saturation during the walk, this decrease was 1.2% lower than that in people who did not performed pursed-lip breathing during activity (29).

The results also indicated that there was a significant relationship between dyspnea and quality of life. The highest relationship was associated with the dimension of activity; and the lowest correlation with the dimension of symptoms, which was consistent with Balcells et al. study(30).

Due to the inclusion criteria, the small sample size was a limitation of this study. For the following reasons, some criteria were considered that limited the number of samples: exersional dyspnea was evaluated in this study; according to the protocol provided for the 6MWT, those who had heart problems or who suffered from musculoskeletal problems were not allowed to perform this test; it is very important to maintain patient safety; andthe results will not be affected by medication or exacerbation of the disease.

Conclusion

This study showed that dyspnea was related to the quality of life and exercise tolerance so that people with more severe dyspnea had less exercise tolerance, which also affected and reduced the quality of life.

Dyspnea is a major factor determining the quality of life in patients with COPD; and there is a moderate to strong relationship between dyspnea and impaired quality of life.

It also became clear that the respiratory rate, the arterial oxygen saturation at the end of the activity and $FEF_{25-75\%}$were three factors predicting exersional dyspnea.

As a result, by proposing measures to improve these three factors, exersional dyspnea can be reduced and subsequently, the quality of life can be improved for patients.

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