COMPARISON OF DYSPNEA SCORING METHODS AND BODE INDEX WITH FUNCTIONAL PARAMETERS IN STABLE COPD

Orıgınal Artıcle

STABİL KOAH'DA DİSPNEYİ DEĞERLENDİREN YÖNTEMLER VE BODE İNDEKSİ İLE FONKSİYONEL PARAMETRELERİN KARŞILAŞTIRILMASI

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ABSTRACT

Background and Aims: To investigate correlation of dyspnea scoring methods and BODE (Body mass index, airflow Obstruction, Dyspnea, and Exercise capacity) index with functional parameters in Chronic Obstructive Pulmonary Disease (COPD).

Material and Methods: Thirty-eight COPD patients, hospitalized between January 2006 and May 2007, have been evaluated in their stable period after discharge. Pulmonary function tests, arterial blood gase (ABG) analysis, 6 minutes walk test (6-MWT), dyspnea scorings and St. George's Respiratory Questionnaire (SGRQ) were performed. Body Mass Index (BMI), FEV1%, Medical Research Council dyspnea index (MRC) and 6-MWT were used to calculate BODE index. Spearman's correlation test was used in statistical analysis.

Results: Mean values of studied parameters are as follows: Age: 64.2±10.3, BMI: 27.3±5.4, PaO2: 64.7±14.7 and PaCO2: 47.1±18.6 mmHg, 6- MWT: 276.4±99.0 m, FEV1: 1108±652 mL, IC/TLC: 15.1±6.7. The dyspnea scores were Modified Borg Scale (MBS): 4.32±0.98, Visuel analog scale (VAS): 6.47 ± 1.91, Medical Research Council Scale (MRC): 4.35±0.89, Baseline Dyspnea index (BDİ): 4.68 ± 4.18, Oxygen Cost Diagram (OCD): 4.50 ± 2.35, SGRQ total score: 66.9±15.5 and BODE index: 5.79±2.5. Age and BMI were not significantly correlated with any of the

methods whereas FEV1 was significantly correlated with all dyspnea scores. MRC had correlation with all spirometric measurements and DLCO. The strongest correlation was present between FEV1 and MRC (r=-0.514). Considering ABG, there was no correlation except the one between PaCO2 and MBS (r=0.340). BODE index showed correlation with SGRQ total score and ABG values as well as showed strongest correlation with PaO2 (r=-0.382). BODE index also had correlation with IC/TLC (r= -0.517).

Conclusions: MRC is a reliable test for COPD patients for determining dyspnea levels. Relatively higher correlation of BODE index with IC/TLC which is a hyperinflation marker and independent risk factor for mortality, supports that BODE index can be used to determine the prognosis of COPD.

Keywords: *COPD; BODE Index; dyspnea;SGRQ (St. George's Respiratory Questionnaire) , IC/TLC.*

ÖZET

Amaç: KOAH'da dispnenin değerlendirilmesini ve derecelendirilmesini sağlayan klinik ölçüm yöntemlerinin ve BODE indeksinin, klinik, laboratuar ve fonksiyonel parametrelerle korelasyonunu araştırmak.

Gereç ve Yöntem: Ocak 2006-Mayıs 2007 tarihleri arasında kliniğimizde yatırılarak izlenen 38 KOAH tanılı hasta (36 erkek, 2 kadın) yatışlarından en erken 1 ay sonra stabil dönemlerinde değerlendirilerek ayrıntılı solunum fonksiyon testleri, arter kan gazı ölçümü (AKG), 6 dakika yürüme testi (6-DYT) yapıldı. Dispne skalaları belirlendi. St. George's Respiratory Questionnaire (SGRQ) yaşam kalitesi anketi uygulandı. Vücut Kitle İndeksi (VKİ), %FEV1, Medical Research Council dispne indeksi (MRC) ve 6-DYT kullanılarak BODE indeksi hesaplandı.

Bulgular: Hastaların yaş ortalaması 64.2 ± 10.3, ortama VKİ: 27.3 ± 5.4, mL, PaO2: 64.7 ± 14.7, PaCO2: 47.1 ± 18.6, 6-DYT: 276.46 ± 99 metre, FEV1: 1108 ± 652, IC/TLC: 15.1±6.7 idi. Olguların ortama dispne şiddetleri Modifiye Borg Skalası (MBS): 4.32 ± 0.98, Visuel analog skala (VAS): 6.47 ± 1.91, Medical Research Council Skala (MRC): 4.35 ± 0.89, Baseline Dispne indeks (BDİ): 4.68 ± 4.18, Oksijen Tüketim Diyagramı (OTD): 4.50 ± 2.35, SGRQ Yaşam Kalitesi skoru: 66.93 ± 15.52 idi. BODE indeksi ortalaması 5.79 ± 2.5 olarak hesaplandı. Yaş ve VKİ'nin hiçbir yöntem ile korele olmadığı, tüm dispne skorlarının FEV1 ile korele olduğu saptandı. MRC'nin ölçülen tüm standart spirometrik ölçümler ve DLCO ile korelasyon gösterdiği bulundu. FEV1 ile en yakın korelasyonu MRC gösterdi (r=-0.514). AKG değerlerine göre PaCO2 ile MBS arasındaki orta düzeydeki korelasyon (r=0.340) dışında korelasyon saptanmadı. BODE indeksinin SGRQ total skorla yakın korelasyon gösterdiği (r=0.606), AKG ile korele olduğu ve en yakın korelasyonu PaO2'nin (r=-0.382) gösterdiği bulundu. BODE indeksinin IC/TLC ile yakın korelasyon gösterdiği (r= -0.517) saptandı.

Sonuç: MRC, KOAH'da dispne düzeyini belirlemede kullanılabilecek güvenilir bir testtir. Hiperinflasyon belirteçi ve mortalite ile ilişkili bağımsız risk faktörü olarak belirlenen IC/TLC'nin BODE indeksi ile yakın korelasyon göstermesi, KOAH'da prognozun belirlenmesinde BODE indeksinin kullanılabileceği görüşünü desteklemektedir.

Anahtar Kelimeler: *KOAH; BODE İndeksi; Dispne ; SGRQ (St. George's Respiratory Questionnaire) , IC/TLC.*

INTRODUCTION

Chronic Obstructive Pulmonary Disease (COPD) has been described as a disease with airflow limitation which is not fully reversible. The airflow limitation is usually progressive. Dyspnea is one of the major symptoms in patients with COPD. It gets

worse as the disease progresses resulting in reduced performance of daily activities and impairment of quality of life (QoL). Dyspnea, the hallmark symptom of COPD, is also an important cause of physical and phycological disability (1).

The approach to COPD is facilitated by a staging system which categorizes this heterogenous patient population according to the degree of airflow limitation (2). Since FEV1 is significantly correlated with morbidity and mortality in patients with COPD, it is the primary parameter in staging sytems (3). On the other hand, FEV_1 is known to be poorly correlated with patients' symptoms (4), quality of life (5), exacerbation frequency (6) and exercise intolerance (7). From the point of patients, dyspnea is one of the major symptoms that impacts their quality of life (8) and it is also known that a patient with low dyspnea compliance may have a spirometric analysis with severe airway obstruction (9-11).

Since COPD is a complex multidimentional disease, the degree of airflow obstruction alone is not sufficient to predict the outcomes. It is widely accepted that symptoms and QoL should also be considered in evaluation of COPD patients regarding severity of disease, treatment, and rehabilitation modalities (9). Currently there are three possible ways to assess dyspnea clinically (9): First, the measurement of dyspnea during activities of daily living (ADL) using clinical dyspnea ratings such as modified Medical Research Council (MRC) (12), the Baseline Dyspnea Index (BDI) (4), and the Oxygen Cost Diagram (OCD) (13). Second, the measurement of dyspnea during exercise testing using dyspnea ratings such as modified Borg scale (MBS) (14), or the Visual Analog Scale (VAS) (15). And third, the assessment of the influence of dyspnea on health-related quality of life (HRQoL) using a disease- specific questionnaire (15).

Individual differences in the perception of dyspnea sensation and dyspnea itself may increase the sensation of anxiety and depression determined by Hospital Anxiety and Depression (HAD) scale (16).

Recently, the BODE (Body mass index, airflow Obstruction, Dyspnea, and Exercise capacity) index, a multidimensional grading system, was shown to be better than FEV_1 in predicting the risk of death among patients with COPD (17) . BODE index was also found to be helpful in predicting hospitalization for COPD as well as better correlated to the health status indexes (18).

In this study, our aim was to investigate the relationship between these different - but also interrelated- aspects of health status in COPD patients. We planned to clarify the correlation of dyspnea scoring method with BODE index with functional parameters including pulmonary function tests (PFT) and arterial blood gases (ABG) in cases with COPD.

MATERIAL AND METHODS

Thirty-eight COPD patients, hospitalized between January 2006 and May 2007 were included in the study. They all were diagnosed as COPD by chest physician according to American Thoracic society (ATS) criteria (19). COPD exacerbation is defined when patient had worsening of at least two of the followings under standard medical therapy: dyspnea, cough, sputum amount or purulance, fever, respiratory rate and heart rate on admission to the hospital. After recovery from the COPD exacerbation, the patients have been discharged and they have been evaluated in their stable period at least 4 week after discharge. Inclusion criteria for the study were as follows: (1) chronic airflow limitation with FEV_1/FVC less than 0.7, (2) smoking history of more than 20 pack-years, (3) no history suggestive of asthma, (4) no exacerbation of COPD in the preceding at least 4 weeks, (5) no changes in treatment regimen during the preceding 4 weeks and (6) the patient's declaration of being as good as in chronic stable condition before the hospitalization.

Exclusion citeria for the study were as follows: (1) Presence of concomitant uncontrolled hypertension or heart failure, known or suspicious malignancy, chronic renal failure and neuromuscular disease, (2) evidence of difficulties in cooperation regarding PFTs and other procedures. After the approval of Institutional Review Board, 38 COPD patients who gave their consent to participate in the study were recruited.

All of the patients had physical examination. with a thorough review of medical history. A blood chemistry and blood count panel including WBC (white blood cells), ESR (erythrocyte sedimentation rate), fasting glucose level, liver and kidney function tests and electrolite levels were performed. Their chest roentgenograms were evaluated. Body Mass Index (BMI) was calculated according to the formula: [weight (kg) / (hight (m)^2]. In addition to the standard spirometric tests including FVC, FEV_1, FEF_{25-75}, PEF, measurements of total lung capacity (TLC) by nitrogen washout method and the diffusion capacity for carbon monoxide (DLCO) by single-breath method were performed (Vmax series 2130, Sensor Medics Corp, USA). ABG sampling was performed after Allen's test using radial artery in sitting position and then analysed (Radiometer Cophenagen ABL 555). In order to asses the exercise capacity, 6 minutes walk test (6-MWT) was performed in an empty corridor.

To assess dyspnea, the Turkish version of BDI, OCD, MRC and MBS were used. The BDI includes five grades for each of the following categories: functional impairment, magnitude of task, and magnitude of effort. The OCD is a visual analog scale that corresponds to oxygen requirements at different activity levels (value ranging from 0 to 100 with a score of 100 indicating no impairment). The Turkish version of the Hospital Anxiety and Depression Scale (HAD) was used to evaluate patients' anxiety and depression. The HAD consists of 14 items, seven of them score for anxiety and other seven score for depression. The cut-off values for Turkish people were considered as 10 for anxiety and 7 for depression (20). The HRQoL was assessed by the Turkish version of the St. George's Respiratory Questionnaire (SGRQ), which have been precisely validated (5,21). The SGRQ has three dimensions: "Symptoms", concerned with respiratory symptoms; "activity", concerned with activities that evoke or are limited by dyspnea; and "impacts", a measure of the overall disturbance. BMI, FEV1%, MRC dyspnea index and 6-MWT were used to calculate BODE index (17). This was a multistage scorring system that incorporates an assesment of symptoms, body habitus and exercise capacity, together with the spirometric measure of airflow (18). Every and each dispnea scoring method were analysed in order to find a correlation, if any, with standard spirometric measurements, RV/TLC, IC/TLC, DLCO, ABG, 6-MWT, BMI and HAD. Also a correlation analysis of BODE index to RV/TLC, IC/TLC, DLCO, ABG and SGRQ were performed. Spearman's correlation cooficient (r) was calculated (strength of correlation: no correlation if $r<0.30$, very low if $r=0.31$-0.40, low if $r=0.41$-0.50, moderate if $r=0.51$-0.75, high if $r=0.76$-0.85, very high if $r=0.86$-0.95 and exact correlation if $r>0.95$) and $p<0.05$ was considered as statistically significant.

RESULTS

The study population consisted of 38 COPD patients and 36 (94.7%) were male while 2 (5.3%) were female. Mean age of the patients was 64.2±10.3 (37 - 85). Patient characteristics including PFTs, ABGs, 6-MWT, dyspnea ratings, HRQoL, HAD and BODE index results are shown in **Table I.**

Table I: *Characteristics of 38 COPD patients.*

	Mean±SD	Range
Sex, M/F	36/2	-
Age, yr	64.2±10.3	37-85
BMI, kg/cm^2	27.3±5.4	18.3-44.8
PFTs		
FVC, mL	2538 ± 1021	1050-5170
FVC,% pred	72.7 ± 21.7	31-133
FEV1, mL	1108 ± 652	400-3000
FEV1, %pred	40.7 ± 19.7	16-89
RV/TLC, %	42.7 ±13.1	25-70
IC/TLC,%	15.1 ± 6.7	3.8-31.0
DLCO, mL/mmHg/min	61.4 ± 22.9	15-116
DLCO,%	25.4 ±8.17	10-45
ABG		
PaO2,mmHg	64.7 ±14.7	40-96
PaCO2,mmHg	47.1 ± 18.6	27-66
6-MWT,m	276.4 ± 99.0	27-464
Dyspnea score		
OCD (0-100),mm	45.0 ±23.5	0-90
VAS (0-100),mm	64.7 ± 19.1	30-100
MRC (0-4)	3.32 ± 0.99	1-4
BDI Function (0-4)	1.24 ± 1.21	0-4
BDI Task (0-4)	1.18 ± 1.08	0-4
BDI Effort (0-4)	1.26 ± 1.13	0-4
BDI Focal (0-12)	3.68 ± 3.18	0-12
MBS	4.92 ± 2.22	3-10
SGRQ		
SGRQ Symptoms	74.0± 16.4	30.3± 97.4
SGRQ Activity	80.0± 18.6	23.3± 100
SGRQ Impact	56.8± 18.0	23.2± 96.0
SGRQ Total	66.9± 15.5	31.8± 89.4
HAD		
Anxiety	8.31 ± 6.36	0-21
Depression	6.86 ±4.87	0-21
BODE index	5.79 ±2.50	0-10

According to the GOLD (Global Initiative for Chronic Obstructive Lung Disease) (1) classification, PFT results showed that 3 patients had mild, 7 patients had moderate, 17 patients had severe and 11 patients had very severe obstruction. Considering local (Turkish) cut-off values(20), 15 (39.5%) patients had anxiety and 18 (47.4%) had depression.

Age and BMI had no correlation with any of the methods.

FVC had significant correlation with MRC, BDI-function, BDI-focal and SGRQ-activity. FEV_1 had significant correlation with all of the dyspnea ratings and HRQoL except for SGRQ-symptoms the strongest correlation was with BDI-function (r= 0.617, p=0.001) and MRC (r= -0.514, p=0.001). MRC had correlation with all spirometric measurements (r=-0.514, p=0.001 for FEV_1) and DLCO (r= -0.355, p=0.043). RV/TLC and IC/TLC had no correlation with any of dyspnea ratings and SGRQ. The ABG values were not correlated with dyspnea ratings and HRQoL except for the very low correlation between PaCO2 and MBS (r= 0.340, p=0.037). 6-MWT showed correlation with many parameters including VAS, MRC, MBS, BDI-function, BDI-effort, BDI-focal, SGRQ-impact and SGRQ-total, the strongest correlation being with MRC (r= -0.536, p=0.001). HAD anxiety and depression scores were correlated with all of the dyspnea ratings and SGRQ except for VAS and MBS. This indicates that COPD patients have more anxiety and depression when they are more dyspneic with a poor QoL.

BODE index which includes a dyspnea score (MRC) was found to be also correlated with other dyspnea scores: OCD (r= -0.616, p<0.001), MBS (r= 0.536, p=0.001), VAS (r= 0.494, p<0.002) and BDI-focal (r= -0.721, p<0.001). BODE index showed correlation with SGRQ-symptoms (r= 0.352, p=0.030) , SGRQ-activity (r= 0.588, p<0.001), SGRQ-impact (r= 0.605, p<0.001), SGRQ-total (r= 0.606, p<0.001) (**figure 1**).

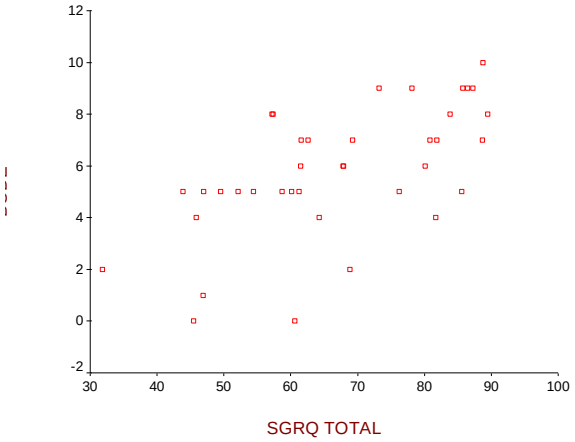

Figure 1: *The distribution SGRQ total score with respect to the BODE index.*

BODE index had positive correlation with $PaCO_2$ (r=0.368, p=0.023) and negative correlation with PaO_2 (r=-0.382, p=0.018) and SaO_2 (r=-0.326, p=0.046). BODE index was expected to be correlated with FEV_1%, but it was also correlated with FVC% (r=-0.598, p<0.001) and DLCO

(r=-0.409, p=0.018). Although BODE and RV/TLC were not correlated (r=0.285, p=0.103), there was a statistically significant correlation between BODE and IC/TLC (r= -0.517, p=0.002) which is also known as a hyperinflation marker.

DISCUSSION

In general, PFTs were used to determine both the severity of COPD and response to treatment and FEV_1 was the main parameter in many of the studies as a simple and validated test result. Since COPD is a complex multidiomentional disease, it is widely accepted that symptoms and QoL, in addition to the degree of airflow obstruction, should also be considered in evaluation of COPD patients regarding the outcome and response to treatment (9,22-25). Dyspnea is the main cause of the limitation of daily activities in COPD patients. Many of the experts suggest that dyspnea sensation and functional parameters are not parallel in most of the patients, nevertheless one of the main goals of COPD treatment is the reduction of dyspnea (9,23,25).

In the present study, OCD, as a dyspnea rating method, was found to be correlated with FEV_1 and DL_{CO} while there was not correlation with other functional parameters. In their study which compares different dyspnea rating methods each other, Hajiro et al. (9) have found that OCD has the strongest correlation with FEV1, in addition to the correlation with RV/TLC and VO_2max. Mahler et al. (4) demonstrated the correlation between OCD and FVC. In the study of Mc Gavin et al. (13), OCD was correlated with 6-MWT without correlation with FEV_1 and FVC. In the same study there was a correlation with FVC and DL_{CO} only in a subgroup patients with pulmonary infiltration. On the other hand, there were some studies showing no correlation with different functional parameters (26,27). According to the authors, major disadvantage of OCD is that the patients may not agree some of the activities on different locations that all were arranged on a single line.

In our study, MRC was correlated with standart spirometric measures (including FEV_1) and also with DL_{CO}, RV, TLC and 6-MWT. Hajiro et al. (3) have aimed to compare categorizations of the level of dyspnea with disease severity which is by the FEV_1 in 194 COPD patients. They have used MRC as dyspnea scoring method and concluded that categorizing COPD patients based on their level of dyspnea was more discriminating than disease staging with the ATS (2) criteria with respect to HRQoL. In another study of Hajiro et al. (9), all of the dyspnea scorring methods, except for MBS, were correlated with FEV_1. As there were more studies demontrating this relationship between MRC and FEV_1 (11,27-29), some other studies showed no correlation (30-32). Like many of the studies, our study demonstrated that MRC was correlated with many of functional parameters, especially with FEV_1. It was an advantage that MRC is simple and easy to understand for the patients but it also has limitations because of its not considering the magnitude of the effort. MRC may not be enough to evaluate the efficiacy of treatment, it can be used as complementary to FEV_1 in staging COPD (9,31,32).

Mahler et al. (4) have defined two new dyspne indices: BDI and transition dyspnea index (TDI). They proposed that these tests better evaluate dyspnea because magnitude of effort in addition to the magnitude of task was also considered. BDI-focal score was well correlated with 12-MWT and poorly correlated with FVC and FEV_1. In the present study BDI-function was correlated with FEV_1, FVC and 6-MWT, BDI-task was correlated with FEV_1, BDI-effort was correlated with FEV_1 and 6-MWT, BDI-focal was correlated with FEV_1 and 6-MWT supporting Mahler's study. In another study including 150 patients with dyspnea (91 COPD), the BDI was found to be correlated with FEV_1 and FVC, and this

correlation was stronger than those of OCD (28). In the study of Foglio et al. (33), BDI was found to be one of the factors predicting exercise performance whereas FEV_1 did not appear to be a predictor of physiological impairment.

As demonstrated in many studies (9,29,30,34), our study showed that MBS is not correlated with functional parameters. As MBS determines the dyspnea only at the moment of the test, it can be useful to compare the status at the begining and end of any effort such as 6-MWT. In the study of O'Donnel et al. (35), all of the exercise related ventilation parameters and TLC% were correlated with MBS. This indicates that exercise induced dyspnea in COPD is related with inspiratory muscle activity and the level ef exercise ventilation. In our study, we did not apply MBS after exercise.

Taube et al. (36) have used VAS to determine the dyspnea in a study population of 62 COPD patients, and showed that the reduction in dyspnea after inhalation of a β_2-adrenoreceptor agonist is closely correlated with the change in parameters of forced inspiration, and particularly FIV_1, but not with changes in parameters of forced expiration or lung hyperinflation. This implies that dyspnea perception may be related to the inspiratory rather than expiratory parameters. We found a correlation of VAS only with FEV_1 and 6-MWT in accordance with studies suporting that VAS is not well correlated with many of functional parameters (29,36).

In our study, SGRQ-symptom score was not correlated with any of the PFT measurements while SGRQ-activity, SGRQ-impact and SGRQ-total were correlated with many of the functional parameters including FEV_1. This finding is similar to the results of previous studies (9,37,38). In a series of 146 COPD patients, FEV_1 was correlated with SGRQ-total score in patients with FEV1>50%. Dyspnea scored with MRC was also correlated with SGRQ in this study (37). In a study including 251 COPD patients, SGRQ scores were increasing gradually in stage 2, 3, and 4 COPD (38). Unlikely, Seemungal et al. (39)found no correlation between SGRQ-total and PFT and ABG results in 61 COPD patients. From the general point of view, SGRQ, especially activity, score is correlated with many of the functional parameters. SGRQ-symptom which investigates cough and sputum in addition to dyspnea, did not show any correlation with functional parameters while SGRQ-total was in correlation with only FEV_1. To assess dyspnea, SGRQ-activity, instead of SGRQ-total may be a better choice.

Dyspnea in patients with COPD may cause panic and fear of death. Anxiety and depression can influence the dyspnea sensation. Contemporary depression in cases with chronic diseases decreases (40). This was also evident in our study with a result so that HAD anxiety and depression scores were correlated with all of the dyspnea scales except for VAS and MBC.

We found a significant correlation of BODE with SGRQ scores (symptom, activity, impact and total), ABGs ($PaCO_2$, PaO_2, SaO_2), and IC/TLC. In a series of 100 COPD patients, Ong et al. [18] analysed the correlation of BODE with QoL. They observed a correlation with SGRQ. In consistence with our study, the strongest correlation was with SGRQ-total and the weakest correlation was with SGRQ-symptom scores. SGRQ-symptom was not correlated with GOLD stages although activity and total scores showed a weak correlation (18). Casanova et al. (41) analyzed the power of lung hyperinflation as measured by the IC/TLC to predict mortality in 689 COPD patients with a mean follow-up of 34 months. They also compared the predictive value of IC/TLC with that of the BODE index. Subjects who died were older; had lower BMI, FEV_1, IC/TLC, reduced 6-MWT, and had more dyspnea, a higher BODE index, and comorbidity. IC/TLC was found to be a good and independent predictor of all-

cause and respiratory mortality. IC/TLC is a better predictor of mortality independent of BODE index when compared with FEV_1. They conclude that IC/TLC is an independent risk factor for mortality in subjects with chronic obstructive pulmonary disease. In the present study, BODE index was found to be correlated with parameters which are also important for mortality in COPD. Casanova et al. (41). also demonstrated that mortality related sensitivity and specificity were greater for BODE followed by IC/TLC and FEV_1 respectively.

CONCLUSION

Many of the dyspnea scoring methods are correlated with FEV_1 and can be used as a surrogate or adjunct method in evaluation of a patient. MRC correlated with all spirometric measurements and DLCO. Since it is significantly correlated with spirometric results, MRC is a reliable test for COPD patients to determine dyspnea levels and staging. QoL with SGRQ scoring, especially SGRQ-activity, may be a representitive of functional status acording to the correlation with FEV_1.

BODE index, which includes functional parameters and dyspnea scores, is also correlated with ABGs and SGRQ based QoL. So it can be considered as an overall value. BODE index may represent PFTs. Since one of its components is FEV_1 and it has statistically significant correlation with FVC and DLCO. Correlation of BODE index with IC/TLC which is known as a hyperinflation marker and independent risk factor for mortality, implies that BODE index as a multidimentional grading system with factors added on FEV_1 can be used to determine the prognosis of COPD.

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