CORRELATION BETWEEN BODY MASS INDEX AND FORCED EXPIRATORY VOLUME IN ONE SECOND IN PATIENTS WITH COPD

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ABSTRACT

Background: Chronic obstructive pulmonary disease (COPD) is a respiratory disease that is characterized by airflow obstruction that is persistent, progressive in nature and not fully reversible. There is increasing evidence that COPD leads to weight loss and result in low Body Mass Index (BMI) which is poor prognostic factor in these patients. This study was conducted to determine the correlation between Body Mass Index (BMI) and Forced Expiratory Volume in one second (FEV1) in patients with Chronic Obstructive Pulmonary Disease.

Methods: This cross-sectional study was conducted in the Pulmonology wards/OPD's of Khyber Teaching Hospital Peshawar. A total of 141 cases were studied based on 0.35 correlations between BMI and FEV1, with the confidence level of 95% and 99% power of the test. All patients having stable Chronic Obstructive Pulmonary Disease of either gender with age more than 40 years were included. Patients diagnosed with asthma, acute exacerbation of COPD and weight loss due to any reason were excluded. BMI and FEV1 of all patients who fulfilled the diagnostic criteria for Chronic Obstructive Pulmonary Disease as per Pakistan Chest Society Guidelines (FEV1 <70% predicted & FEV1/ FVC ratio <70%) were recorded.

Results: Out of 141 patients, 51 % were females and 49% were males. Mean FEV1 was 44.32% ± 1.68. Twenty four percent patients had very severe COPD (FEV1 < 30%), 41% patients had severe COPD (FEV1 ranged from 30-49%), 29% patients had moderate COPD (FEV1 ranged from 50-79%) and 6% patients had mild COPD (FEV1>80%). Mean BMI score was 19.53 ± 4.9. Fifty one percent of the patients had BMI score < 18.5, 34% patients had BMI score 18.5–25, and 15% patients had BMI score > 25. In our study, 51% of all the patients had a BMI of <18.5. Among these patients with very severe, severe and moderate COPD had a low BMI`s in 85.29%, 62.06% and 17.07% of patients respectively. No patient with mild COPD had low BMI.

Conclusion: There is positive correlation between FEV1 severity and BMI.

Key Words: COPD, body mass index (BMI), forced expiratory volume in one second (FEV1).

INTRODUCTION

Chronic obstructive pulmonary disease (COPD) is a respiratory disease that is characterized by airflow obstruction that is persistent, progressive in nature and not fully reversible[1]. It is progressive in nature and has both pulmonary and extra-pulmonary manifestations. COPD is an important cause of mortality and morbidity and is recognized as the 4th most common cause of death worldwide[2] with a prevalence of about 9-10% in adults over the age of 40 years[3]. COPD should be considered in any patient who has dyspnea, chronic cough or sputum production, and/or a history of exposure to risk factors for the disease. Spirometry can be used to confirm the diagnosis of COPD and can be classified into four stages on the basis of forced expiratory volume in 1 second FEVI[4]. Up till now FEV1 was considered as the single most reproducible predictor of mortality in COPD patients[5]. More recently, a new prognostic tool has been proposed that includes body mass index (calculated as weight in kilograms divided by height in meters square) (B), degree of airflow obstruction (O), functional dyspnea (D), and exercise capacity (E). This tool (BODE index) is found to be superior in predicting the severity and predictability of COPD as compared to FEV1 alone[6]. BMI can be used to classify patients into underweight (<18.5), normal (18.5-25), overweight (>25-30), obese (>30-35), severely obese (>35-40) and morbidly obese (>40). One study supports that BMI is inversely correlated to FEV1 with coefficient correlation of 0.357 while another study supports that increase or decrease in BMI is directly correlated to increase or decrease in FEV1 respectively with coefficient correlation of 0.038.

Different studies has been done which showed that patients with low BMI have lower values of FEV1 and increased stage of COPD[8] which result in increased frequency of acute exacerbation of COPD[9] longer hos-

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pital stay and higher treatment cost[10]. The purpose of this study is to determine the correlation between BMI and FEV1 in patients suffering from chronic obstructive pulmonary disease. The results of the study will provide an objective evidence of correlation between BMI & FEV1, which will be helpful in making plans for prevention of malnutrition early and initiate timely nutrition rehabilitation programs.

MATERIAL AND METHODS

This cross-sectional study was conducted in the Pulmonology ward/OPD, Khyber Teaching Hospital, Peshawar, Pakistan from 01-10-2013 to 30-03-2014. A total of 141 patients were included through consecutive, non-probability sampling technique. The sample size was calculated using the WHO software for sample size determination in health studies with the assumptions of 0.35 correlations between BMI and FEV1, 95% confidence interval and 99% power of test. All patients having stable Chronic Obstructive Pulmonary Disease of either gender with age more than 40 years were included. Patients diagnosed with asthma, acute exacerbation of COPD and weight loss due to any reason were excluded. Patients who fulfill the diagnostic criteria for Chronic Obstructive Pulmonary Disease as per Pakistan Chest Society Guidelines (FEV1 <70% predicted & FEV1/FVC ratio <70%), came to pulmonology ward/OPD for follow up were enrolled in the study. BMI (calculated as mass in kilogram/Height in meter2) and FEV1 (calculated through Spirometry done before and after administration of salbutamol, 5mg for 5 minutes, via nebulizer) were recorded. Statistical analyses were carried out with SPSS-15. Frequency and percentages were calculated for categorical variables like sex, body mass index (BMI) while Mean±SD was calculated for continuous variables like age, FEV1. Spearman's rank correlation coefficient was applied to see the relationship between BMI and FEV1.

RESULTS

Out of 141 patients, 49% (n=70) patients were male and 51% (n=71) patients were female. Mean age was 63.35 years with standard deviation ±10.28. There were 11% (n=15) patients in age range 40-50 years, 36% (n=51) in 51-60 years, 34% (n=48) patients in 61-70 years, 16% (n=23) patients in 71-80 years age range and 3% were above 80 years of age Table 1. Mean BMI score was 19.53 with standard deviation ± 4.9. Among 141 patients, 51% (n=72) patients had BMI score < 18.5, 34% (n=49) patients had BMI score 18.5–25 and 15% (n=20) patients had BMI score > 25 Table 2.

FEV1 was graded as mild, moderate, severe and very severe. In our study there were 6% (n=8) patients with mild FEV1 (>80% predicted), 29% (n=41) patients with moderate FEV1 (50-79% predicted), 41% (n=58) patients with severe FEV1 (30-49% predicted) and 24% (n=34) patients with very severe FEV1 (< 30% predicted). Mean FEV1 was 44.32% with standard deviation ± 1.68.

Stratification of FEV1 with BMI score was analyzed. In 8 patients with mild FEV1, 7 patients had normal BMI while 1 patient having BMI score > 25. In 41 patients with moderate FEV1, 7 patients had BMI score < 18.5, 24 patients had BMI score 18.5-25, and 10 patients had BMI score > 25 but less than 30. In 58 patients with Severe FEV1, 36 patients had BMI score < 18.5, 16 patients had BMI score 18.5-25, 6 patients had BMI score >25 but less than 30. In 34 patients with very severe FEV1, 29 had BMI score < 18.5, 2 patients had BMI score 18.5-25 and 3 had BMI score >25 but less than 30. Table 3.

Analysis of gender against FEV1 was done. Out of 8 patients in mild COPD, 4 were male and 4 were female. Among 41 patients with moderate COPD, 27 patients were male and 14 patients were female. 26 patients were male and 32 patients were female among 58 patients with severe COPD. In 34 patients with very severe COPD, 13 patients were male and 21 patients were female. The correlation was calculated between FEV1 and BMI by using Pearson Correlation Coefficient and was found to be 0.398. Table 8

Table 1: Age distribution (n=141)

Age Distribution	Frequency	Percentage
40-50 years	15	11%
51-60 years	51	36%
61-70 years	48	34%
71-80 years	23	16%
> 80 years	4	3%
Total	141	100%

Table 2: Frequency of Body Mass Index (n=141)

BMI	Frequency	Percentage
< 18.5	72	51%
18.5 – 25	49	34%
> 25	20	15%
Total	141	100%

Table 3: Stratification of FEV1 and BMI (n=141)

FEV_1		BMI			
		< 18.5	18.5-25	> 25	Total
> 80%	Mild	0	7	1	8
50-79%	Moderate	7	24	10	41
30-49%	Severe	36	16	6	58
< 30%	Very Severe	29	2	3	34
Total		72	49	20	141

Table 4: Correlations between FEV1 and BMI (n=141)

		Body Mass Index of the patient	Forced Expiratory Volume in First Second
Body Mass Index of the Patient	Pearson Correlation	1	.398
	Sig. (2-tailed)		.000
	N	141	141
Forced Expiratory Volume in First Second	Pearson Correlation	.398	1
	Sig. (2-tailed)	.000	
	N	141	141

DISCUSSION

Chronic obstructive pulmonary disease is an important public health problem worldwide, despite the fact that it is potentially a preventable disease. In 2002 COPD was the 5th leading cause of death worldwide and is estimated to be the 3rd common cause of death by the year 2030[11]. In Pakistan, the mortality rate due to COPD is estimated to be 71 deaths per 100,000. This is the 4th highest rate among the 25 most populous nations in the world[12].

51% of the patients were females while the rest were males. In males, the frequency of low BMI was 50% while in females it was 52.1%. This is consistent with the gender distribution of low BMI in the general population in Pakistan[13]. This means that COPD has not altered this distribution between the two genders.

COPD is associated with systemic effects apart from specific lung involvement like polycythemia, core pulmonale, metabolic syndrome etc. it also causes weight loss (low BMI).

In our study, 51% of all the patients had a BMI of <18.5. No patient with mild COPD had low BMI. Among these patients with very severe, severe and moderate COPD had a low BMI`s in 85.29%, 62.06% and 17.07% of patients respectively. This shows that frequency of low BMI increases with increase in severity of COPD. This trend is consistent with the study conducted by Steuten[14]. which showed that in each GOLD stage except mild one, the frequency of low BMI were 47.1%, 16.7% and 10.5% for very severe, severe and moderate COPD respectively.

This difference in the results of Steuten's and our study could be due to increased prevalence of malnutrition in our population as compared to Netherlands. This may also be because of recurrent episodes of acute exacerbation of COPD leading to worsening of the disease and resulting in low BMI which is very common in our population because of malnutrition, poor management and lack of vaccinations.

Van Den Bemt[15] in another study shows that the association between FEV1 and BMI is weak. In this study, low BMI was found in 11.7% of the study population. This may be due to difference in the study population as in this study 76.4% of patients had mild – moderate COPD against 35% in ours where.

In COPD, low BMI has significant effect on quality of life as patients with low BMI are more dyspneic due to decreased strength of the respiratory muscles. It is also associated with high mortality rates such that the relative risk is 1.42 in females and 1.64 in males[16]. Low BMI in COPD may be due to different factors which include, physical intolerance leading to disuse atrophy, energy imbalance, tissue hypoxia from arterial hypoxemia, systemic inflammation and anabolic hormonal insufficiency.

CONCLUSION

It is concluded that there is a positive correlation between FEV1 and BMI. This association should be further studied to understand the cause and effect phenomenon as it is not clear whether the malnourishment developed severe chronic obstructive pulmonary disease or vice versa.

RECOMMENDATIONS

Primary preventive measure should be taken to prevent the development of malnutrition in patients with COPD. Smoking cessation, exercise training, physiotherapy and nutritional interventions should be taken in order to improve the low BMI.

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