EVALUATION OF CARDIOVASCULAR ABNORMALITIES AMONG COPD PATIENTS

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Abstract

Background

Chronic Obstructive Pulmonary Disease (COPD) is characterized by persistent and progressive airflow limitation and is associated with enhanced chronic inflammatory response. Exacerbations and comorbidities contribute to the overall severity in individual patients. The present study was carried out to assess the severity of right heart disease using 2-D transthoracic echocardiography and compare the findings with BODE index among COPD patients.

Methods

This cross-sectional study was carried out among 50 patients diagnosed with COPD as per GOLD criteria in the outpatient clinic. Patients with known history of cardiovascular complications were excluded. A 2-dimensional echocardiography was performed to document the cardiovascular changes. The findings were compared with BODE index.

Results

Majority of the patients were aged between 61-80 years (52%) and were males (90%). Based on the BODE index classification, majority of the participants belonged to BODE index >5(54%). Based on the echocardiography findings, 46% of the participants had severe cardiovascular complications. It was observed that FEV1 was significantly lower in the participants with BODE index >5 and among those with severe echo findings.

Conclusion

This study infers that the although severity of airflow limitation, dyspnoea scaling and 6MWD are independent risk factors for right heart dysfunction, the integrated index of these factors along with the BODE index is a more sensitive predictor of the severity of right heart dysfunction in stable COPD patients.

Key words: BODE index, COPD, Dyspnoea, Echocardiography, FEV1

Introduction

Chronic obstructive pulmonary disease (COPD) is a a major health problem, it's the fourth leading cause of death in the world [1]. In 2020, COPD is projected to rank fifth worldwide in burden of diseases according to WHO. The median prevalence of COPD in India is about 5% in men and 2.7% in women above 30 years [2].The pathology of COPD encompasses a variety of pathologic lesions in the airways, lung parenchyma, and pulmonary vasculature. Airflow obstruction can be attributed largely to a marked increase in airways resistance secondary to a variable mix of structural abnormalities involving all or many of the compartments of the airway. COPD is characterized by persistent airflow limitation that is usually progressive and associated with an enhanced chronic inflammatory response in the airways and the lungs to noxious particles or gases. Exacerbations and comorbidities contribute to the overall severity in individual patients [3].

The disability in COPD patients is predominantly due to dyspnoea, nutritional abnormalities, cachexia and skeletal muscle weakness [4]. Cardiovascular effects such as pulmonary arterial hypertension, right ventricular hypertrophy and cor pulmonale are considered to worsen the quality of life in COPD patients [5]. Hence to diagnose the cardiac complications during early stages and to treat them appropriately will be of great benefit in improving the quality of life in COPD patients. According to GOLD guidelines COPD is staged into four depending on the spirometric values (FEV1/ FVC & FEV1). Screening for cardiovascular effects is usually advised with decline in FEV1. Recently the predictive value of FEV1 alone in assessing the severity of COPD is questioned as other markers of mortality in COPD like dyspnoea index, exercise capacity and Body Mass Index (BMI) are proving to be more accurate when assessed individually as well as in combination.

Exercise produces an increase in oxygen consumption and carbon dioxide from skeletal muscle. Patients with COPD have the same oxygen consumption for a given work load as normal

subjects; however, their dead space ventilation is higher and so a larger minute ventilation is needed to maintain carbon dioxide constant. Since in many patients expiratory airflow is limited within the tidal volume range, the only way to increase minute ventilation is either to increase inspiratory flow or shift the end expiratory position or both. Stroke volume is less than normal in severe COPD, due to combination of over inflation and pulmonary hypertension.

As there is an increase in incidence of systemic side effects of COPD, and cardiovascular side effects being the most common of them affecting the quality of life, there is a definite need for early identification of those patients with increased risk for cardiovascular side effects and also to diagnose and treat the underlying cardiovascular disease. Major cardiovascular complications in COPD include Pulmonary arterial hypertension (PAH), Right ventricular hypertrophy (RVH) and Cor pulmonale. Transthoracic echocardiography will be one investigation which can easily be done both in outpatient as well as in inpatient setting to identify the cardiac problems. As assessing BMI, Dyspnoea index and Exercise capacity in these patients will help to assess the severity of COPD as discussed early, an integrated score such as the BODE INDEX which includes all the above parameters along with FEV1 will be of great value. Hence this study is designed to compare the BODE index with severity of right heart involvement by transthoracic echocardiography in COPD patients classified according to the GOLD criteria.

Objectives

The present study was carried out among COPD patients

- To assess the severity of Right heart disease using 2-dimensional TRANSTHORACIC ECHOCARDIOGRAPHY

- To compare the findings of transthoracic echocardiography with the BODE INDEX.

Methodology

Study setting and participants

This cross-sectional study was carried out by the Department of Pulmonary Medicine of our tertiary teaching institution for a period of 20 months between August 2010 and April 2012.

Inclusion criteria

1. Patients attending the outpatient department with clinical evidence of COPD between the age group of 40 – 80 years

2. Symptomatic smokers and ex-smokers with minimum 05 smoking pack years.

3. All the patients diagnosed as COPD based on the GOLD criteria[3]

Exclusion criteria

1. COPD patients with known cardiovascular or osteo-articular impairment.

2. Patients with contraindication for spirometry.

3. History suggesting asthma, allergic rhinitis or atopy.

4. Pulmonary tuberculosis sequelae.

Ethical approval and informed consent

Approval was obtained from the Institutional Ethics Committee prior to the commencement of the study. Each participant was explained in detail about the study and informed consent was obtained prior to the commencement of data collection.

Sample size and sampling

Based on intensive literature review, the prevalence of COPD in Indian population was estimated to be 5.1%.[6] At 95% confidence limits and 6.5% absolute precision, the sample size was estimated to be 43.9. Accounting 10% for non-response, the sample size was calculated as 48.2 and rounded off to 50. The study participants were selected by convenience sampling from the patients who satisfied the selection criteria during the study period.

Data collection

A structured interview schedule was used to obtain detailed history with special reference to risk factors like occupational history, smoking history with pack years, second hand smoking and bio- mass smoke exposure. This was followed by systematic clinical examination. Spirometry was performed as per the ATS guidelines [7]. MMRC dyspnoea scale, Body mass index, Routine blood investigations, ECG and Chest radiography PA view were performed and recorded. Patients with no evidence of acute ECG changes were subjected to 6MWD in a 30meter corridor where appropriate emergency services like supplemental oxygen, sublingual GTN, aspirin,

salbutamol nebulisation and CRASH CART were available. Parameters such as BMI, FEV1, MMRC Dyspnoea grade and 6MWD were tabulated and BODE index calculated. All the participants were subjected to 2D-TRANSTHORACIC ECHOCARDIOGRAPHY done by a trained echocardiograph technician. The severity of the Right Heart involvement was thus recorded and compared with the BODE INDEX of the same individual.

Data analysis

Data was entered and analyzed using SPSS ver.20 software. The grading of COPD and findings of echocardiogram were expressed as percentages. Chi square test was used to analyze the statistical significance between BODE index and echo findings. A p value <0.05 was considered statistically significant.

Results

The present study was carried out among 50 COPD patients diagnosed by GOLD criteria. Majority of the patients were aged between 61-80 years (52%) and were males (90%). Majority of the participants were ex-smokers (50%) and type 2 diabetes mellitus was the most common co-morbidity (38%). (Table 1) Based on the BODE index classification, majority of the participants belonged to BODE index >5(54%). (Figure 1) Similarly, based on the echocardiography findings, 46% of the participants had severe cardiovascular complications. (Figure 2)

In this present study, majority of the participants in the BODE index >5 group belonged to the age group of 61-80 years and had a dyspnea grading of grade 3 based on MMRC grading. (Table 2)

In this study, majority of the participants with severe cardiovascular complications belonged to the age group of 61-80 years (52.2) and had dyspnea grading of grade 3 as per MMRC grading (86.9%) (Table 3)

On comparing the FEV1 findings between BODE index and Echo findings, it was observed that FEV1 was significantly lower in the participants with BODE index >5 and among those with severe echo findings. Similarly, 6MWD was significantly lower among those with BODE index >5 and with severe echo findings. (Table 4)

Participants with BODE index >5 had majority of the participants with severe echocardiography findings (82.6%) followed by 36.4% in the less severe group. (Table 5)

Discussion

COPD is a leading cause of morbidity and mortality worldwide and results in an economic and social burden that is both substantial and increasing [8,9]. The prevalence and burden of COPD are projected to increase in the coming decades due to continued exposure to COPD risk factors and the changing age structure of the world's population (with more people living longer and therefore expressing the long-term effects of exposure to COPD risk factors[9]. BODE index is useful, because it includes FEV1 that quantifies the degree of pulmonary impairment, MMRC dyspnoea scale that captures the patient's perception of breathlessness, six minutes walking distance (6mWD) that determines the exercise capacity of the study and body mass index that represents different aspects of nutritional abnormalities in COPD.

The present study analysed in detail certain characteristic features of COPD patients such as history of smoking, occupational history, degree of dyspnoea (MMRC), exacerbation history, treatment history and patient's compliance to the therapy. All patients were also evaluated for their Body Mass Index (BMI), Severity of airway obstruction (spirometer), 6 Minute walk distance (6MWD) and an integrated BODE INDEX was derived. In the present study, BODE index >5 was proportionately associated with increasing severity of various parameters including presence of co-morbidities, severity of dyspnea and 6MWD. Similar findings were seen with echocardiography, wherein severity of FEV1, 6MWD and severity of dyspnea showed poor cardiovascular function in echocardiography. On comparing echo findings with BODE index, majority of the participants with severe cardiovascular compromise had a BODE index >5 (82.6%) while in the less severe group, BODE index >5 was observed only in 36.4% of the participants. Similar findings were seen in studies done by Tannus-Silva et al. [10], Nageswari AD et al [11]

The present study also shows that, right heart gets significantly affected in COPD patients and there is a definitive need for an early identification of the right heart involvement. An early identification is only possible with an early suspicion of the right heart involvement. This can be achieved by using BODE INDEX as a tool. In COPD patients a increase in BODE INDEX can be used as a predictor of morbidity, mortality and worsening of associated co morbidities. It is

therefore suggested that while analysing a COPD patient, it's not just the airway obstruction which should be assessed and treated. There is an increasing trend and evidence to prove and consider COPD as a systemic inflammatory disease and it's recommended to analyse all the systems involved in addition to the airway obstruction.

Conclusion

This study infers that the although severity of airflow limitation, dyspnoea scaling and 6MWD are independent risk factors for right heart dysfunction, the integrated index of these factors along with the BMI i.e the BODE index is a more sensitive predictor of the severity of right heart dysfunction in stable COPD patients. Despite several limitations including small sample, and absence of follow up with right heart catheterization or trans-oesophageal echocardiography or arterial blood gas analysis, this study throws an insight to future research on the above topic and rectifying the limitations of this study will help in identifying the right heart structural and functional changes in a much early stage and will benefit the diseased population.

Declaration

Conflict of interest – nil

Funding –nil

Ethical approval –obtained

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Tables and Figures:

Table-1: Background characteristics of the study participants:

Parameter	Frequency (n=50)	Percentage (%)
Age		
40-60	24	48
61-80	26	52
Sex		
Male	45	90
Female	5	10
Substance abuse		
Ex- smokers	25	50
Smokers	20	40
Never smokers	5	10
Comorbidities		
Diabetes Mellitus	19	38
Hypertension	14	28
Both	3	6
Coronary Artery Disease	0	0
No comorbidities	14	28

Figure-1: Distribution of the study participants basedon BODE index:
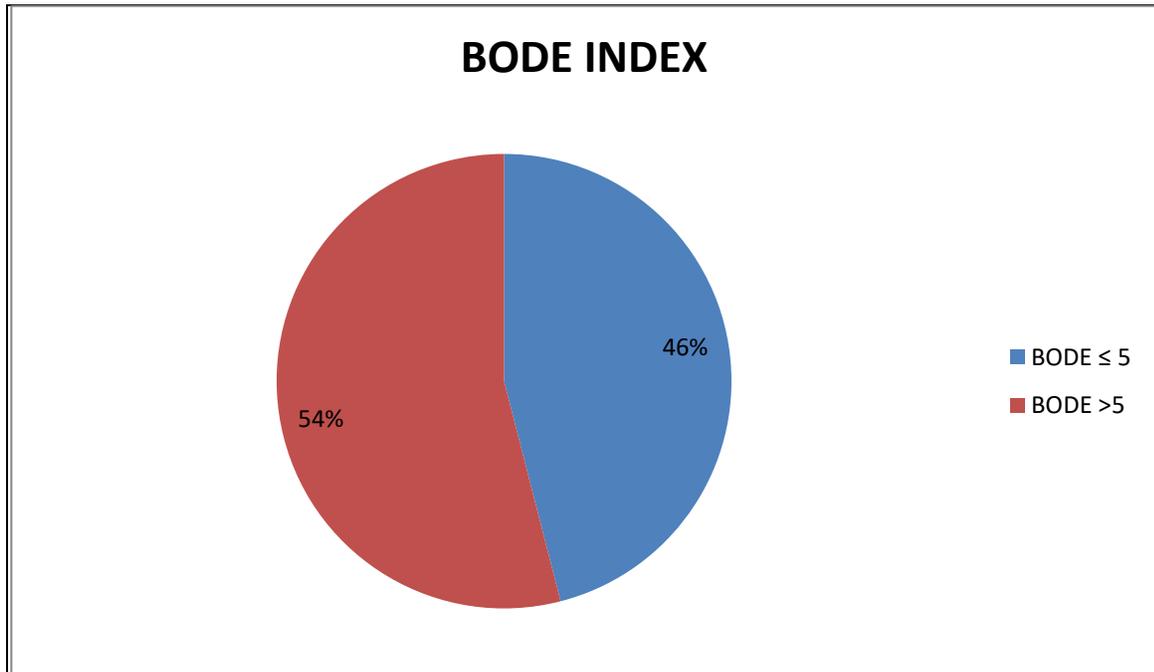
Figure-2: Distribution of the studyparticipants based on Echo findings:
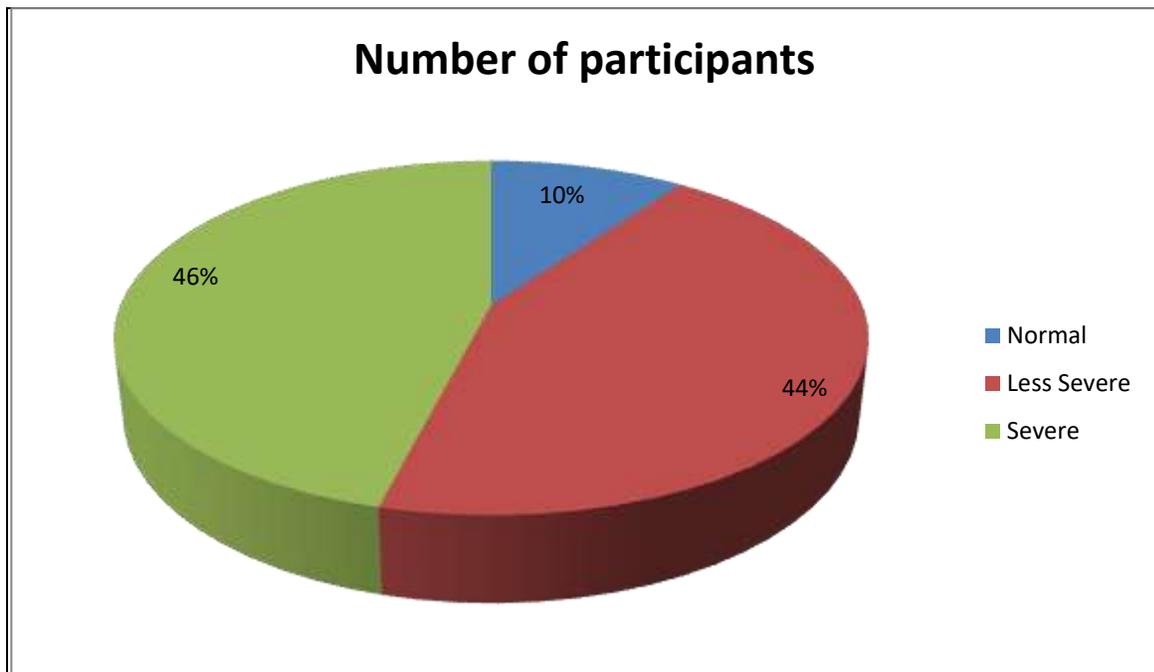
Table-2: Distribution ofparticipant characteristics according to BODE index:

S.No	Parameter	NORMAL N(%)	LESS SEVERE N(%)	SEVERE N(%)
1	Age(in years)			
	40-60	4 (80)	9 (40.9)	11 (47.8)
	61-80	1 (20)	13 (59.1)	12 (52.2)
2	MMRC			
	0	0 (0)	0(0)	0(0)
	1	0(0)	0(0)	0(0)
	2	5 (100)	7 (31.8)	3 (13.1)
	3	0 (0)	14 (63.6)	20 (86.9)
	4	0(0)	1 (4.5)	0(0)

Table-3: Distribution of participant characteristics according to Echocardiography findings:

S.No	Parameter	BODE index	
		≤5 n(%)	>5 n (%)
1	Age (in years)		
	40-60	14 (60.8)	10 (37.1)
	61-80	9 (39.2)	17 (62.1)
2	MMRC (dyspnea grading)		
	0	0 (0)	0(0)
	1	0(0)	0(0)
	2	11 (47.8)	4 (14.8)
	3	12 (52.2)	22 (81.5)
	4	0(0)	1 (3.7)

Table-4:Comparison ofFEV1 and 6MWD parametersbetween BODE Index and Echocardiography:

S.No	Test		FEV1Mean ±SD	6MWDMean ±SD
1	**BODE**	≤5	55 % ±12.61	310 ±83 m
		>5	39% ±10.17	202±60 m
2	**Echo**	NORMAL	56.2% ±9.9	366.80 ±103.48 m
		LESS SEVERE	50.4% ±16.36	271.27 ±74.37 m
		SEVERE	41.4% ±10.15	209.09 ±73.68 m

Table-5: Comparison of BODE index and Echocardiography:

S.No	Echo Findings	BODE ≤5	BODE >5	TOTAL % OF PATIENTS
1	NORMAL	5	0	05 (10%)
2	LESS SEVERE	14	8	22 (44%)
3	SEVERE	4	19	23 (46%)
	Total	23 (46)	27 (54)	50
Chi sq=16.22; p value<0.05				