

Prediction of Hospital course of Chronic Obstructive Pulmonary Disease Patients Correlation of BODE Index and Arterial Blood Gases.

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Abstract

Background: Chronic obstructive pulmonary disease (COPD) is currently one of the leading causes of morbidity and mortality worldwide. Prediction of hospital course in those patients would be of great help in understanding their future prognosis. BODE index calculation (Body mass index, airflow Obstruction, Dyspnea and Exercise capacity) has been shown to be promising in this respect.

Objective: This study aimed to find out if arterial blood gases (ABG) is correlated with BODE index in predicting the future hospital course of COPD patients?

Patients and methods: One hundred and twenty stable COPD patients were included in this study. They were studied through: history taking, clinical examination, plain chest x-ray, spirometry, BODE index calculation, arterial blood gases, routine laboratory tests, echocardiography. All patients were followed up for 6 months for their hospital course. The data were statistically analyzed for significance.

Results: The Mean \pm SD of BODE index of the studied cases was 4.82 ± 1.88 . Ninety-five patients (79.2%) visited emergency room frequently and 55 patients were admitted to hospital (45.8%). Nine patients (7.5%) died during the 6 months follow up. BODE index had a negative correlation with each of PaO₂ and PH while it was positively correlated with each of: PaCO₂, number of visits to emergency room and admission to hospital ($P < 0.001$).

Conclusion: Correlation of arterial Blood Gases with BODE Index showed the additive value of the former in prediction of the hospital course of COPD patients, which would be of great help in their future management.

Keywords: COPD, BODE index. ABG.

INTRODUCTION:

(COPD) is characterized by airflow limitation that is usually progressive and associated with an enhanced chronic inflammatory response in the airways and the lung to noxious particles or gases. Exacerbations and co morbidities contribute to the overall severity in individual patients⁽¹⁾. COPD is currently one of the leading causes of morbidity and mortality worldwide and will be the third most frequent cause of death by the year 2030⁽²⁾. Many patients with COPD develop more often

exacerbations, worsening their prognosis^(3,4,5) COPD may be also associated with systemic manifestations such as cardiovascular disease, skeletal muscle dysfunction, weight loss. Mechanisms for these changes include persistent inflammation and oxidative stress.^(6,7,8) The BODE index is a grading system for COPD. It reflects the progressive modification in the disease, and it can predict hospitalization and the risk of death among patients with COPD^(6,9,10,11).

COPD patients, life expectancy is strongly dependent on the severity of blood gas abnormalities. When significant hypoxemia and hypercapnia are present, a majority of patients will die in a few years.

Patients and methods

The study was conducted in the Department of Chest Diseases, Zagazig University Hospitals and Zagazig Chest Hospital during the period from May 2019 to November 2019. This is an observational analytical cohort study in which a simple random sampling technique was used for selection of 120 stable COPD patients according to inclusion-exclusion criteria as follows *Inclusion Criteria (14):COPD patients in stable conditions (no exacerbations due to any reason in the last 6 weeks).*Exclusion (13): Unwilling patients, non-cooperative patients and seriously ill patients, Known cases of carcinoma, active pulmonary Tuberculosis, recent myocardial infarction in the last 6 months, patient unable to perform tests properly, and patient already on Noninvasive ventilation device or oxygen therapy at home for past 6 months. A total of (120) stable COPD patients were randomly chosen from the Outpatient Department. Written informed consent was obtained from all participants, the study was approved by the research ethical committee of faculty of medicine, Zagazig University. The study was done according to The Code of Ethics of the World Medical Association (Declaration of Helsinki) for studies involving humans. Patients were subjected to the following: Careful history taking; especially smoking history. Cigarette smokers were classified into mild, moderate, and heavy according to the number of pack-years ⁽¹⁵⁾. General and local chest examination stressing on signs of co morbidities. Radiological examination by plain chest x-ray. Routine Laboratory tests: including complete blood count, kidney and liver functions, and blood glucose. Arterial blood gases analysis using a blood gas analyzer (ABL 330- Radiometer-Copenhagen, Denmark). Echocardiography for all patients to detect right sided heart failure, pulmonary hypertension and excluding patients with unstable cardiac problems. Body Mass Index ⁽¹⁶⁾, and Spirometric Pulmonary function tests (PFT): PFT

⁽¹²⁾. Therefore, this study was done to find out if BODE index and ABGs are correlated to predict the future course of those patients.

was performed utilizing MicroLab MK spirometer (Micro Medical Ltd, Rochester, England). COPD staging was done according to GOLD classification ^(14,17): Dyspnea Severity⁽¹⁸⁾ and Six-minute walking test⁽¹⁹⁾. Then BODE index^(6,20), finally Patients follow up for 6 months: all the patients of this study were followed up regarding their *Frequency of treatment visits to the emergency rooms. *Frequency of treatment admissions to hospitals. *Death. Those data were collected from patients themselves during their visits, relatives of the patients or by telephone calls. Statistical analysis of the data was fed to the computer and analyzed using IBM SPSS software package version 20.0. (Armonk, NY: IBM Corp). Significance of the results was considered at probability of < 0.05.

Results

The results are illustrated in tables 1-5 and figures 1-2 table (1) shows that the patients were 103 males (85.8%) and 17 females (14.2%) with a Mean age \pm SD 49.84 \pm 7.68 years. The majority of the patients aged 40-50 years (64%) while 48% aged >50years, 94 patients (78.3%) were current smokers with a Mean \pm SD. Pack-years of 35.16 13.17. Only 31(25.8%) patients had comorbidities such as: chronic medical conditions, including coronary artery disease, diabetes mellitus, osteoporosis, muscle weakness, and pulmonary hypertension. Table (2) shows that the studied cases had a Mean \pm SD for PaO₂ of 74.03 \pm 9.74 mmHg with a range of 60.0-95.0 while PaCO₂ had a Mean \pm SD of 52.01 \pm 6.24 mmHg with a range of 40.0-67.0 .On the other hand P^H had a Mean \pm SD of 7.40 \pm 0.02 with a range of 7.36- 7.45 .Table (3) shows that the Mean \pm SD of BODE index of the studied cases was 4.82 \pm 1.88 with a range of 2.0- 9.0 Table (4) and figures (1,2) show that BODE index has a highly significant (<0.001) positive correlation with each of number of treatments at emergency room and admission to

hospital. This table (5) shows that 31 patients with co morbidities had BODE index Mean \pm SD of 6.32 ± 1.11 comparing to those patients (89) without co morbidities 4.29 ± 1.82 ($P < 0.001$, highly significant). It also shows that BODE index Mean \pm SD of 7.0 ± 1.58 for patients who died (9) during the

Discussion

Patients with COPD are often under treated, leading to much morbidity, lost productivity, and economic cost. Identifying at risk patients could substantially improve outcomes. The FEV₁ is the single best variable to stratify COPD severity. However, it does not accurately predict dyspnea symptoms, exercise tolerance, and mortality. This is because COPD is a systemic disease, and airflow limitation alone does not capture all aspects of disease severity⁽²¹⁾. The study of Celli et al⁽⁶⁾ introduced the BODE index, as a very useful prognostic tool. The BODE index was constructed by broadening existing prognostic indicators and adding independent predictors of mortality to the FEV₁. Therefore, this study was designed to find out the capability of BODE index to throw some light on hospital course and whether it is correlated to ABGs in this respect, and hence can be used to change management plan of patients with COPD. It included 120 stable COPD patients who were followed up for 6 months duration after revision for their initial historical, laboratory and functional parameters. BODE index was calculated and its relations to every patient course was registered and statistically evaluated.

The present study showed that the majority of patients were males aged 40-50 years old and similar results were detected by Esteban et al, Horita et al^(22,23). The increased incidence of males is most probably related to increased smoking habit compared to females and the effect of smoking increases with age as observed in this study and the other ones⁽²⁵⁾. The majority of the patients of the current study were smokers. This result agrees with the previous studies concerning the effect of smoking in the pathogenesis of COPD^(24,25,26). Only 31 patients (25.8%) had co morbidities in the present

study period compared to other patients (111) 4.64 ± 1.80 ($P < 0.001$, highly significant). Table (6) shows that BODE index has a negative correlation with each of PaO₂ and pH while it is positively correlated with PaCO₂ with highly significant statistical values ($P < 0.001$)

series (table 1). Comorbidities, defined as other chronic medical conditions, including coronary artery disease, diabetes mellitus, osteoporosis, and muscle weakness, are common in chronic obstructive pulmonary disease (COPD).^(21,27,28) Unfortunately, the presence of both COPD and other comorbidities often contributes significantly to poor health outcomes⁽²⁹⁾. Smoking, aging, and other factors such as medication interactions, lack of treatment of comorbidities, add to the complexity of outcomes in patients with COPD⁽³⁰⁾. The studied cases had a Mean \pm SD for PaO₂ of 74.03 ± 9.74 with a range of 67.0-95.0 while PaCO₂ had a mean \pm SD of 52.0 ± 6.24 with a range 40.0-67.0. On the other hand, P^H had a Mean \pm SD of 7.40 ± 0.02 with a range of 7.36 - 7.45. (Table 2). Those results confirmed the stability of patients at the start of the study. Evaluation of BODE index in the present study showed that the Mean \pm SD of BODE index of the studied cases was 4.82 ± 1.88 with a range of 2.0-9.0. (Table 3). In the study of (Formiga et al⁽³¹⁾) which included 70 COPD patients, The mean \pm SD of BODE index score was 4.2 ± 2.3 . which is comparable to that of the present series. The importance of BODE index in evaluating the hospital course of COPD was studied in the present series which showed that BODE index had a highly significant (< 0.001) positive correlation with each of number of admissions to emergency room and admission to hospital This (table 4 and figures 1&2). The result of this study agreed with that of Li et al⁽³²⁾ who demonstrated that the BODE index is positively correlated with the number of hospitalizations, hospitalization days, and hospitalization expenses. Hospital utilization generates the majority of COPD-related health care expenses. Identifying patients who use the ER or hospital admission is clinically important, since mortality increases with the frequency of exacerbations⁽³³⁾. The higher frequency of ER

visitors than inpatient admissions was probably related to incomplete therapy for ER patients compared to admitted cases which pushed them to visit ER more frequently. The study of Bartels et al, Kumbhare et al^(33,34) speculated that younger individuals are more likely to visit an emergency department for less severe exacerbations of symptoms. This was observed also in the current study. Bu et al.⁽³⁵⁾ observed that patients with increased BODE index had significantly higher hospital presentation rates and longer total bed-days compared to those with low BODE index. The studies of Bu et al.⁽³⁵⁾ and Li et al⁽³²⁾ showed that both the frequency of hospitalization and the number of hospital stays increased with a higher BODE index, which is consistent with the present research. Cote and Celli,⁽³⁶⁾ found that each quartile increases in the BODE Index score yielded an increase in the risk for mortality. The results of their study indicated that the BODE index is a much better predictor of mortality than any of the individual variables alone.

Jangid et al⁽¹³⁾ observed that as the BODE index increases severity of COPD increases. So, they had got interpretation that baseline BODE index predicts the future outcome in COPD patients. Kumar and Rai⁽³⁷⁾ recommended that calculation of BODE index should be performed at least every 3 months in a COPD patient. The current study showed that 31 patients with co morbidities had BODE index Mean \pm SD of 6.32 ± 1.11 comparing to those patients (89) without co morbidities 4.29 ± 1.82 ($P < 0.001$, highly significant). It also showed that BODE index Mean \pm SD of 7.0 ± 1.58 for patients who died (9) during the study period compared to other patients (111) 4.64 ± 1.80 ($P < 0.001$, highly significant) (table 5). The result of the present study agreed with the previous ones^(13,36,37) regarding the importance of BODE index in predicting COPD outcome. Measurement of arterial blood gases is essential in patients with COPD. Most commonly, PaO₂ is the measurement used to assess the effect of respiratory disease on oxygenation of arterial blood. The adequacy of CO₂ elimination is measured by the partial pressure of CO₂ in arterial blood, i.e., PaCO₂⁽¹²⁾. The current study showed that BODE index has

a negative correlation with each of PaO₂ and pH while it is positively correlated with PaCO₂ with highly significant statistical values ($P < 0.001$) (table 6). The results of the present study agreed with (Meshram et al⁽¹²⁾) who found inverse correlation between BODE index and PO₂ and it was statistically significant ($P < 0.001$). There was a positive correlation between BODE index and PCO₂ and was statistically significant ($P < 0.001$). Therefore, the result of the present study and that of Meshram et al⁽¹²⁾ suggest that BODE Index can be considered as a better index for reflecting arterial blood gas changes and thus severity of COPD. Both studies support the view that the BODE index should be widely used in assessing COPD patients.

In conclusion Both arterial oxygen and carbon dioxide tension were correlated to BODE index and hence to future prognosis of COPD patients.

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