EVALUATION OF BRAIN NATRIURETIC PEPTIDE LEVELS IN PATIENTS WITH ACUTE EXACERBATION OF CHRONIC OBSTRUCTIVE PULMONARY DISEASE IN A TERTIARY CARE HOSPITAL

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Abstract

Introduction:

Chronic obstructive pulmonary disease (COPD) is a major global health problem associated with significant morbidity and mortality. Acute exacerbations of COPD (AECOPD) are often accompanied by cardiovascular stress, and biomarkers like brain natriuretic peptide (BNP) may help in assessing disease severity and cardiac involvement.

Aim and Objectives:

To evaluate plasma BNP levels in patients with AECOPD and to assess their correlation with disease severity, symptom burden, and clinical outcomes.

Methodology:

This prospective observational study was conducted at a tertiary care hospital from June 2024 to June 2025. A total of 110 patients with AECOPD were included. Ethical clearance was obtained, and informed consent was taken. Clinical evaluation, laboratory investigations, and spirometric assessment were performed. BNP levels were measured at admission. COPD severity was classified according to Global Initiative for Chronic Obstructive Lung Disease (GOLD) staging and Modified Medical Research Council (MMRC) grading.

Results:

The mean age of patients was 62.42±10.79 years, with a male predominance (81.8%). Smoking was present in 75% of patients. The mean BNP level was 121.31±48.29 pg/ml. BNP levels increased significantly with higher GOLD stages ($r=0.786$, $p<0.01$) and MMRC grades ($r=0.486$, $p<0.01$). Higher BNP levels were associated with increased disease severity and symptom burden.

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Conclusion:

BNP levels are significantly elevated in AECOPD and correlate with disease severity and symptom grading. BNP can serve as a valuable biomarker for assessing severity and identifying cardiac involvement in COPD patients.

Keywords:

COPD, acute exacerbation, BNP, GOLD staging, MMRC grading, cardiac involvement

Introduction

Chronic Obstructive Pulmonary Disease (COPD) is a major global health concern and currently ranks as the fourth leading cause of death worldwide[1]. It is also a significant contributor to disability, ranking ninth in terms of global years of life lost (YLLs)[1]. COPD represents a substantial public health burden due to its chronic nature, high prevalence, and associated healthcare costs, despite being both preventable and treatable.

According to the Global Burden of Disease Study, approximately 251 million individuals were living with COPD globally in 2016[2]. The World Health Organization estimates that around 3.17 million deaths were attributable to COPD in 2015, accounting for nearly 5% of all global deaths[3]. Notably, the majority of these deaths occur in low- and middle-income countries, highlighting disparities in healthcare access, early diagnosis, and management[3].

COPD is a complex and multifactorial disease characterized by persistent airflow limitation and chronic inflammatory response in the airways and lungs. While cigarette smoking remains the most significant risk factor, other contributors such as environmental pollution, occupational exposures, and genetic predisposition also play crucial roles[4]. Increasing evidence suggests that COPD is not merely a pulmonary disease but a heterogeneous condition with multisystem involvement, including cardiovascular, metabolic, and skeletal muscle dysfunction[4].

The Global Initiative for Chronic Obstructive Lung Disease (GOLD) defines an acute exacerbation of COPD (AECOPD) as a sudden worsening of respiratory symptoms that necessitates additional therapeutic intervention[1]. The hallmark symptom of exacerbation is increased dyspnoea, often accompanied by increased sputum production, changes in sputum purulence, worsening cough, and wheezing[5]. These exacerbations significantly impact disease progression, quality of life, hospitalization rates, and mortality.

Acute exacerbations are most commonly precipitated by respiratory infections, particularly viral pathogens, although bacterial infections and environmental pollutants are also recognized triggers[5]. Frequent exacerbations are associated with accelerated decline in lung function and increased risk of cardiovascular complications, further emphasizing the need for early identification and management.

B-type natriuretic peptide (BNP), also known as brain natriuretic peptide, was first isolated from porcine brain tissue in 1988[6]. Subsequent studies demonstrated that BNP is

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predominantly synthesized and released from ventricular myocardium in response to volume expansion and increased wall stress[6]. BNP serves as a well-established biomarker for cardiac dysfunction, particularly in heart failure, and has gained importance in differentiating cardiac and pulmonary causes of dyspnoea.

In patients with COPD, especially during acute exacerbations, elevated BNP levels may reflect underlying cardiac strain or coexisting cardiovascular pathology. Therefore, assessment of BNP levels may provide valuable insights into cardiac involvement in AECOPD and aid in risk stratification and management.

Aim:

To evaluate the levels of brain natriuretic peptide (BNP) in patients presenting with acute exacerbation of chronic obstructive pulmonary disease (AECOPD) and to assess its clinical significance.

Objectives:

To measure serum BNP levels in patients admitted with AECOPD.

To assess the association between BNP levels and severity of acute exacerbation.

Methodology

This prospective observational study was conducted at Emergency Medicine opd and pulmonology opd at Sree Mookambika Institute of Medical Sciences, Tamil Nadu a tertiary care hospital, over a period of one year from June 2024 to June 2025. Written informed consent was obtained from all participants before their inclusion in the study.

Patients admitted with acute exacerbation of chronic obstructive pulmonary disease (AECOPD) were enrolled based on predefined inclusion and exclusion criteria. A detailed clinical history, including smoking status and exposure to environmental risk factors, was recorded. All patients underwent thorough physical examination at the time of admission. Relevant laboratory investigations, including complete blood count, renal function tests, arterial blood gas analysis, chest radiography, and electrocardiography, were performed as part of routine evaluation.

Data were collected using a structured proforma designed for the study, which included demographic details, clinical parameters, and investigation findings. Blood samples were obtained at the time of initial presentation under aseptic conditions, and plasma brain natriuretic peptide (BNP) levels were measured using standardized laboratory techniques.

The diagnosis and staging of COPD were carried out in accordance with the guidelines of the Global Initiative for Chronic Obstructive Lung Disease (GOLD), based on clinical features and spirometric parameters wherever feasible. The severity of exacerbation and associated complications were documented.

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All collected data were systematically recorded and analyzed to assess the relationship between BNP levels and clinical severity, as well as the presence of underlying cardiac involvement in patients with AECOPD.

Result:

It was observed that t maximum number of patients in our study were more than 50 years of age with a mean age of 62.42 years (SD -10.79). The lowest age encountered was 30 years whereas the oldest patient was 88 years in our study.The study had20 (18.2%) females and 90 (81.8%) male. The male to female ratio (M:F) was 4.5:1.In our study population 27 (25 %) individuals were non-smokers and 83 (75%) individuals were smokers. The average pack years among the smokers being 39 (SD – 18.08) pack years.Among the 110 patients, 18 (16.36%) had hypertension, 20 (18.18%) had diabetes

mellitus, 3 (2.72%) had hypothyroidism and 70 (63.63%) patients had no comorbidities.

Out of the 110 patients, 26 (23.64%) patients presented with cough, 36 (32.72 %) patients presented with breathlessness and 48 (43.64 %) patients had both cough and breathlessness.Out of the 110

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patients, 21 (19.09%) patients presented with MMRC grade 1, 46 (41.81%) patients presented with

MMRC grade 2, 36 (32.73) patients presented with MMRC grade 3 and 7 (6.36%) patients presented with MMRC grade 4.

In our study out of 110 Chronic Obstructive Pulmonary Disease patients 13 (11.82%) patients belonged to GOLD stage 1, 49 (44.54%) belonged to GOLD stage 2, 39 (35.45) belonged to GOLD stage 39 and 9 (8.18%) belonged to GOLD stage 4.The mean brain natriuretic peptide levels among the 110 individuals in our study was found to be 121.31pg/ml (SD-48.29) .BNP levels in acute exacerbation of COPD increased as the severity of COPD increased. (r-0.786) (p= <0.01) (Table 1)

		BNP (in pg/ml)			
		Mean	Standard Deviation	r value (pearson correlation)	p value
GOLD STAGING	1	69.5	15.9	0.786841	<0.01*
	2	100.5	19.5		
	3	140.1	35.3		
	4	228.2	39.9		

*Correlation is significant at the 0.01 level (2-tailed).

Table 1

		BNP			
		Mean	Standard Deviation	r value (pearson correlation)	p value
MMRC GRADING	0	84.6	18.2	0.486953	<0.01
	1	89.7	22.2		

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	2	118.2	40.9		
	3	125.9	40.5		
	4	217.8	62.1		

*. Correlation is significant at the 0.05 level (2-tailed).

TABLE 2

The mean BNP value increases as the MMRC grading increases (Table 2). Among MMRC grade 0 patients mean BNP value was 84.6 pg/ml (SD - 18.2). The mean BNP value in MMRC grade 1 patients was 89.7 pg/ml (SD- 22.2). The mean BNP value in MMRC grade 2 patients was 118.2 pg/ml (SD-40.9). The mean BNP value in MMRC grade 3 patients was 125.9 pg/ml (SD-40.5). The mean BNP value in MMRC grade 4 patients was 217.8 pg/ml (SD-62.1)

In the present study there is a positive correlation between pack years among smokers (n=77) and BNP levels during acute exacerbation of COPD. The above graph shows that as the pack years

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increase the BNP levels during acute exacerbation of COPD also increases and is statistically significant. (r= 0.289) (p= 0.011)

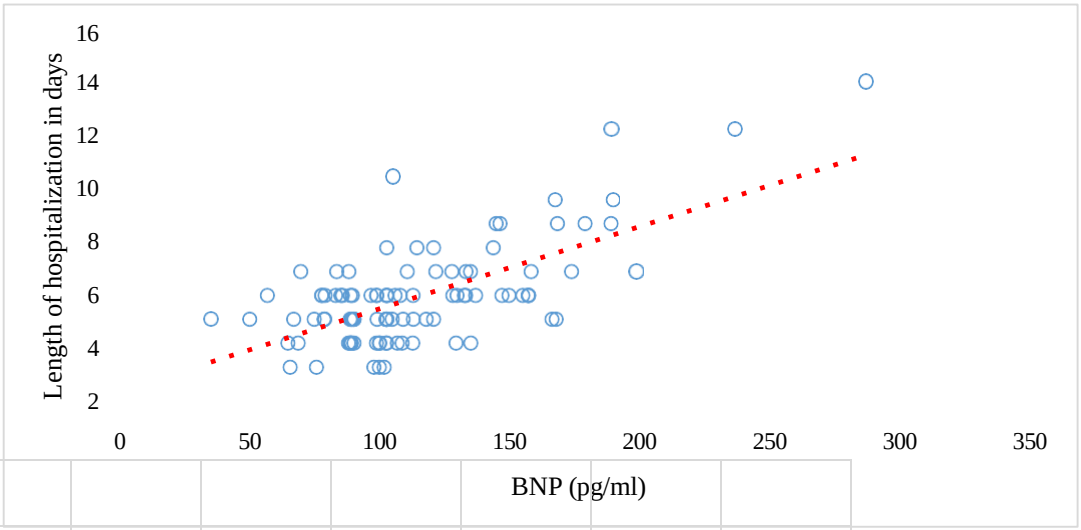

FIGURE 1

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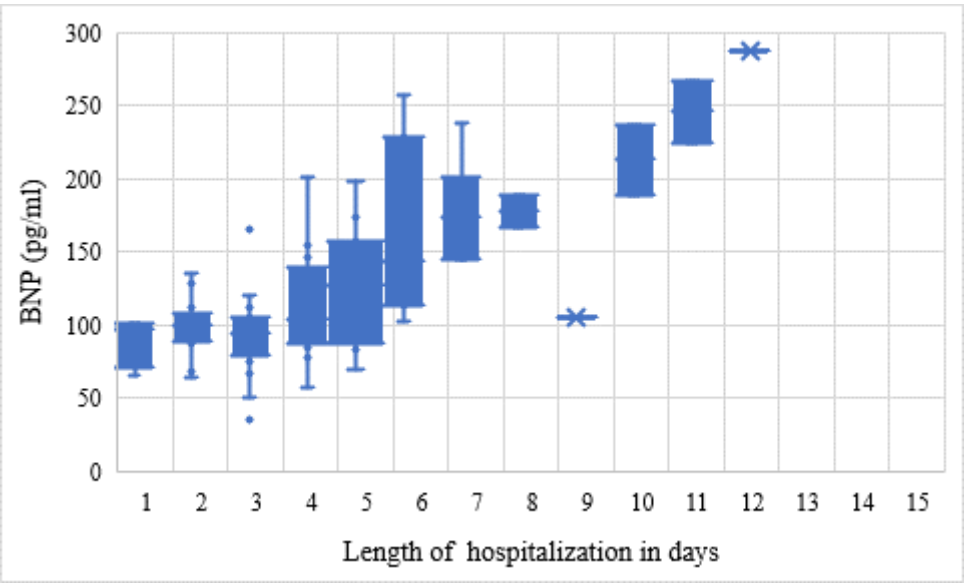

FIGURE 2

The study found a positive correlation between BNP levels during acute exacerbation of COPD and length of hospitalization.(Figure 1,2))The mean duration of hospitalization was 5.18 days. The pearson correlation coefficient between BNP levels during acute exacerbation of COPD and length of hospitalization is r= 0.717313 (p= <0.01).

	BNP Mean (pg/ml)	One way ANOVA f	P value
OXYGEN	107.0	36.052359	<0.01
NON INVASIVE VENTILATION	163.7		
INVASIVE VENTILATION	271.7		

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TABLE 3

Among the 110 patients 86 patients (78.2%) were managed with oxygen supplementation via face mask, 22 (20%) patients were managed with non-invasive ventilation and 2 (1.8%) patients were managed with invasive ventilation. The mean BNP was higher in patients who were managed with non invasive and invasive ventilation and is statistically significant. (Table 3)

	BNP Mean (pg/ml)	One way ANOVA f	P value
DISCHARGE (n=108)	119.8	13.155	<0.01
DEATH (n=2)	286.7		

TABLE 4

Among the 110 patients, 108 (98.2%) patients were discharged after treatment and 2 (1.8%) patients succumbed to death. BNP levels during acute exacerbation is significantly higher among non- survivors.(Table 4)

Discussion:

The present study evaluated brain natriuretic peptide (BNP) levels in patients with acute exacerbation of chronic obstructive pulmonary disease (AECOPD) and demonstrated a significant association between BNP levels and disease severity. The majority of patients in this study were above 50 years of age, with a mean age of 62.42±10.79 years, which is consistent with the natural history of COPD as a disease predominantly affecting older individuals due to cumulative exposure to risk factors[7]. The marked male predominance (M:F = 4.5:1) observed in this study aligns with previous reports, likely reflecting higher smoking prevalence among males in developing countries[8].

Smoking was identified as a major risk factor, with 75% of patients being smokers and a mean exposure of 39 pack-years. This finding is comparable with earlier studies that established smoking as the most significant contributor to COPD pathogenesis and progression[9]. The presence of comorbidities such as hypertension and diabetes mellitus in a subset of patients

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further supports the concept of COPD as a multisystem disorder with systemic inflammation contributing to extrapulmonary manifestations[10].

Clinically, most patients presented with breathlessness either alone or in combination with cough, and the majority belonged to MMRC grade 2 and 3, indicating moderate to severe symptom burden. Similarly, a large proportion of patients were categorized under GOLD stage 2 and 3, reflecting moderate to severe airflow limitation. These findings are in agreement with previous studies where most hospitalized AECOPD patients fall into intermediate to severe stages of disease[11].

A key finding of this study was the progressive increase in BNP levels with advancing GOLD stages, with a strong positive correlation ($r = 0.786$, $p < 0.01$). Patients in GOLD stage 4 had significantly higher BNP levels compared to those in earlier stages. This observation is consistent with earlier research suggesting that BNP levels rise in COPD patients due to right ventricular strain, hypoxia-induced pulmonary hypertension, and possible left ventricular dysfunction[12]. BNP, being a marker of myocardial wall stress, reflects the cardiovascular burden associated with severe COPD.

Similarly, BNP levels were found to increase with higher MMRC grades, with a moderate positive correlation ($r = 0.486$, $p < 0.01$). Patients with severe dyspnoea (MMRC grade 4) had markedly elevated BNP levels compared to those with mild symptoms. This supports the hypothesis that worsening respiratory symptoms are associated with increased cardiac stress and may indicate underlying cardiac involvement[13].

Additionally, a positive correlation was observed between smoking pack-years and BNP levels, suggesting that prolonged exposure to smoking may contribute not only to pulmonary damage but also to cardiovascular strain. Chronic hypoxia, oxidative stress, and systemic inflammation in smokers may lead to structural and functional cardiac changes, thereby elevating BNP levels[14].

Overall, the findings of this study highlight the clinical utility of BNP as a biomarker in AECOPD. Elevated BNP levels correlate with disease severity, symptom burden, and possibly underlying cardiac dysfunction. Therefore, BNP estimation can aid in risk stratification, early detection of cardiac involvement, and guiding management strategies in patients with COPD exacerbations.

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Conclusion :

BNP levels are significantly elevated in patients with acute exacerbation of COPD and show a strong positive correlation with disease severity, GOLD staging, and MMRC grading. BNP serves as a useful biomarker for assessing severity, identifying cardiac involvement, and aiding in risk stratification and management of AECOPD patients.

References:

Global Initiative for Chronic Obstructive Lung Disease (GOLD). Global strategy for the diagnosis, management, and prevention of COPD. 2023 report.

GBD 2016 Disease and Injury Incidence and Prevalence Collaborators. Global burden of 369 diseases and injuries in 195 countries. Lancet. 2017;390:1211–59.

World Health Organization. Chronic obstructive pulmonary disease (COPD). Geneva: WHO; 2017.

Agustí A, Hogg JC. Update on the pathogenesis of COPD. N Engl J Med. 2019;381:1248–56.

Wedzicha JA, Seemungal TA. COPD exacerbations: defining their cause and prevention. Lancet. 2007;370:786–96.

Sudoh T, Kangawa K, Minamino N, Matsuo H. A new natriuretic peptide in porcine brain. Nature. 1988;332:78–81.

7. Mannino DM, Buist AS. Global burden of COPD: risk factors, prevalence, and future trends. Lancet. 2007;370:765–73.

8. Salvi S, Barnes PJ. Chronic obstructive pulmonary disease in non-smokers. Lancet. 2009;374:733–43.

9. Doll R, Peto R. Mortality in relation to smoking: 50 years' observations. BMJ. 2004;328:1519.

10. Barnes PJ, Celli BR. Systemic manifestations and comorbidities of COPD. Eur Respir J. 2009;33:1165–85.

11. Miravitlles M, Worth H, Soler Cataluña JJ. Observational study of exacerbations in COPD. Respir Med. 2010;104:1153–61.

12. Rutten FH, Cramer MJ, Grobbee DE. NT-proBNP in diagnosis of heart failure in COPD patients. Eur Heart J. 2005;26:1886–92

13. Chang CL, Robinson SC, Mills GD. Biochemical markers of cardiac dysfunction in COPD. Thorax. 2011;66:764–8.

14. Sin DD, Man SF. Chronic obstructive pulmonary disease as a risk factor for cardiovascular morbidity. Proc Am Thorac Soc. 2005;2:8–11.

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