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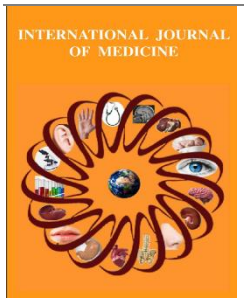

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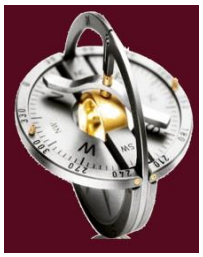

Research Article

To Analyse the Difference in Inflammatory Marker Levels Between Acute Exacerbation of COPD and Stable COPD Patients

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Abstract

Introduction: Chronic obstructive pulmonary disease (COPD) is a common, preventable, and treatable chronic respiratory disorder characterized by persistent respiratory symptoms and airflow limitation due to airway and alveolar abnormalities, most often caused by long-term exposure to noxious particles such as cigarette smoke and biomass fuel. ***Aim***: To analyse differences in inflammatory markers levels in Acute Exacerbation of COPD and stable COPD patients. ***Methodology***: This observational case–control analytical study was conducted in the Department of Medicine, Govt Medical College, Jhunjhunu, from jan 2024 to dec 2024. ***Result***: Cases and controls were comparable in terms of age, sex, smoking status, and disease duration; however, cases showed significantly reduced FEV1 and FVC along with markedly elevated inflammatory markers (TLC, neutrophils, NLR, PLR, ESR, CRP, and procalcitonin) compared to controls ($p < 0.001$).***Conclusion***: Acute exacerbation of COPD is associated with severe airflow limitation and heightened systemic inflammation, and simple hematological and inflammatory markers can serve as useful indicators of disease severity and exacerbation.

Keywords: COPD, Acute, inflammation.

Introduction:

Chronic obstructive pulmonary disease (COPD) is a common, preventable, and treatable chronic respiratory disorder characterized by persistent respiratory symptoms and airflow limitation due to airway and alveolar abnormalities, most often caused by long-term exposure to noxious particles such as cigarette smoke and biomass fuel.1 The natural course of COPD is frequently interrupted by episodes of acute exacerbations, termed acute exacerbations of COPD (AECOPD), which are defined as a sudden worsening of respiratory symptoms beyond normal day-to-day variation and require additional therapy. These exacerbations represent a critical phase of the disease, as they are associated with accelerated decline in lung function, reduced quality of life, increased healthcare utilization, and higher mortality when compared to stable COPD2. AECOPD is commonly precipitated by bacterial or viral infections and environmental pollutants, leading to heightened airway inflammation and systemic inflammatory response. In comparison to stable COPD, patients with AECOPD exhibit significantly greater systemic inflammation, which can be reflected through various hematological and biochemical biomarkers3,4. Traditional inflammatory markers such as C-reactive protein (CRP), erythrocyte sedimentation rate (ESR), and fibrinogen have been widely studied, but their routine use is limited by cost, availability, and modest prognostic accuracy5. In recent years, easily obtainable indices derived from complete blood counts, particularly the neutrophil-to-lymphocyte ratio (NLR) and platelet-to-lymphocyte ratio (PLR), have gained attention as reliable markers of systemic inflammation in AECOPD6. Several studies have demonstrated that NLR and PLR values are significantly higher in patients with AECOPD compared to those in a stable state, reflecting the predominance of neutrophil-mediated acute inflammation and relative lymphopenia during exacerbations. Evidence suggests that raised NLR correlates with disease severity, need for hospitalization, and adverse outcomes in AECOPD.7 Studies have shown that patients with higher NLR values are more likely to require invasive mechanical ventilation and have increased short-term mortality. Although NLR alone may have limited accuracy in predicting intensive care unit admission, its role as an independent risk factor for severe exacerbation is well established. PLR has also been shown to increase during AECOPD, though it appears to be less sensitive than NLR in predicting outcomes. When combined with other inflammatory markers such as CRP, the prognostic value of NLR and PLR improves further.8,9 Thus, comparison between AECOPD and stable COPD clearly demonstrates that acute exacerbations are associated with a marked increase in systemic inflammation, and simple hematological indices like NLR and PLR can be valuable tools for early risk stratification and prognostication, especially in resource-limited settings.

AIM

To analyse difference in inflammatory markers levels in Acute Exacerbation of COPD and stable COPD patients.

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MATERIALS AND METHODS

This observational case–control analytical study was conducted in the Department of Medicine, Govt Medical College, Jhunjhunu, from jan 2024 to dec 2024. Adult patients aged more than 40 years, of either sex, diagnosed with COPD according to the GOLD 2023 guidelines were included in the study. Patients were categorized into two groups: cases comprising patients presenting with acute exacerbation of COPD, defined as an acute worsening of respiratory symptoms requiring additional treatment, while controls included patients with stable COPD without any exacerbation in the preceding four weeks. Patients with bronchiectasis, pulmonary tuberculosis, bronchial asthma, recent myocardial infarction or stroke (within three months), collagen vascular diseases, and malignancies were excluded to minimize confounding factors.

After obtaining informed consent, demographic details and clinical history were recorded, followed by a detailed clinical examination. Venous blood samples were collected at presentation, prior to initiation of systemic corticosteroids or antibiotics. Laboratory investigations included complete blood count with differential counts, from which neutrophil-to-lymphocyte ratio and platelet-to-lymphocyte ratio were calculated.

RESULTS

Table:1 Age categorisation of cases and controls

Parameter	Category						P Value
Age category	Case		Control		Total		
	No.	%	No.	%	No.	%	
	14	50%	14	50%	28	18%	0.959
	12	50%	12	50%	24	15%	
	24	53%	21	47%	45	28%	
	19	47%	21	53%	40	25%	
	10	43%	13	57%	23	14%	
	80	50%	80	50%	160	100%	

The age-wise distribution of cases and controls was comparable across all age categories, with nearly equal proportions observed in both groups. The difference between cases and controls with respect to age distribution was not statistically significant (p = 0.959), indicating proper matching of study groups.

Table 2: Gender distribution of participants

Parameter		Category						P Value
		Case		Control		Total		
		No.	%	No.	%	No.	%	
SEX	Female	34	54.8%	28	45.2%	62	38.8%	0.812
	Male	52	53.6%	46	46.4%	98	61.2%	
	Total	80	50.0%	80	50.0%	160	100.0%	

Sex-wise distribution showed a predominance of males in both case and control groups, with females constituting a smaller proportion of the study population. The difference in sex distribution between cases and controls was not statistically significant (p = 0.812), indicating comparable groups.

Table:3 Smoking profile of participants

Parameter		Category						P Value
		Case		Control		Total		
		No.	%	No.	%	No.	%	
SMOKING	NO	20	43%	26	57%	46	46%	1.00
	YES	54	49%	56	51%	110	54%	
	Total	80	50%	80	50%	160	100%	

The distribution of smoking status was similar between cases and controls, with a higher proportion of smokers observed in both groups compared to non-smokers. The difference in smoking status between cases and controls was not statistically significant (p = 1.00), indicating no association.

Table:4 Duration of disease profile of participants

Parameter	Category			P Value
	Case	Control	Total	
	Mean (SD)	Mean (SD)	Mean (SD)	
DURATION OF DISEASE (years)	9.94±3.48	9.92±3.46	9.93±3.47	0.997

The mean duration of disease was comparable between cases (9.94 ± 3.48 years) and controls (9.92 ± 3.46 years), with an overall mean duration of 9.93 ± 3.47 years. There was no statistically significant difference between the two groups (p = 0.997), indicating similar disease duration.

Table: 5 FEV1 , FVC profile of participants

Parameter	Category			P Value
	Case	Control	Total	
	Mean (SD)	Mean (SD)	Mean (SD)	
FEV1	37.69±2.77	51.41±3.02	44.55±8.23	<.001
FVC	78.68±5.29	89.72±5.07	84.30±9.11	<.001

The mean FEV1 and FVC values were significantly lower in cases compared to controls, with overall mean values of 44.55 ± 8.23 and 84.30 ± 9.11 respectively. The differences in both pulmonary function parameters between cases and controls were statistically highly significant (p < 0.001).

Table: 6 TLC , Neutrophil , Lymphocyte and Platelet profile of participants

Parameter	Category			P Value
	Case	Control	Total	
	Mean (SD)	Mean (SD)	Mean (SD)	
TLC	9730.70±1128.7	5869.09±478.68	7799.89±2116.6	<.001
NEUTROPHIL	6867.00±1123.26	4491.00±365.16	5679.00±1414.86	<.001
LYMPHOCYTE	1438.00±138.6	2024.20±256.7	1731.10±358.9	<.001
Platelet	284562.00±57848.23	289682.00±57966.20	287122±57907.21	0.484

The mean TLC and neutrophil counts were significantly higher in cases compared to controls, while mean lymphocyte counts were significantly lower in cases; these differences were statistically highly significant (p < 0.001). Platelet counts were comparable between the two groups, with no statistically significant difference observed (p = 0.484).

Table: 7 NLR , PLR , ESR, PCT and CRP profile of participants

Parameter	Category			P Value
	Case	Control	Total	
	Mean (SD)	Mean (SD)	Mean (SD)	
NLR	4.18±.64	2.16±.28	3.17±1.20	<.001
PLR	188.77±40.15	136.82±32.78	162.795±44.39	<.001
ESR (mm/hr)	20.82±4.94	9.46±3.08	15.14±6.44	<.001
PCT	1.75±.2	.72±.73	1.23±.465	<.001
CRP (During	7.42±1.86	2.9±2.06	4.64±3.08	<.001

exacerbation)				

The mean values of NLR, PLR, ESR, PCT, and CRP during exacerbation were significantly higher in cases compared to controls, indicating greater inflammatory activity among cases. All these parameters showed a statistically highly significant difference between the two groups ($p < 0.001$)

DISCUSSION

The study population was distributed into different age categories with equal representation of cases and controls. In the first age group, 14 cases (50%) and 14 controls (50%) were included, contributing 18% of the total sample. Similar equal distributions were observed in the second age category with 12 cases (50%) and 12 controls (50%), accounting for 15% of participants. In the subsequent age groups, cases and controls were also comparably distributed, with minor variations in percentages. There was no statistically significant difference in age distribution between cases and controls ($p = 0.959$).

The sex-wise distribution of the study population showed a predominance of males in both groups, accounting for 61.2% of the total participants, while females constituted 38.8%. Among females, 54.8% were cases and 45.2% were controls, indicating a slightly higher proportion of cases. Similarly, among males, 53.6% were cases and 46.4% were controls. Bhoor Singh et al. 10 (2022) in their study found that there was preponderance of male patients as compared to female patients of COPD which is consistent with results of present study.

The distribution of smoking status among cases and controls is shown in the table. Among non-smokers, 43% were cases and 57% were controls, while among smokers, 49% were cases and 51% were controls. The proportion of cases and controls was nearly equal within both smoking categories. The discrepancy in the number of the cases on the basis of gender could be explained by the fact that smoking is more prevalent in males as compared to females leading to differences in prevalence of COPD among males and females.

The mean duration of disease among cases was 9.94 ± 3.48 years, while in the control group it was 9.92 ± 3.46 years. The overall mean duration of disease for the study population was 9.93 ± 3.47 years. The duration of disease was thus almost identical in both groups. Statistical analysis showed no significant difference between cases and controls. The very high p value ($p = 0.997$) indicates excellent comparability of the two groups.

The mean FEV1 was significantly lower in cases (37.69 ± 2.77) compared to controls (51.41 ± 3.02), with an overall mean of 44.55 ± 8.23. This difference was statistically highly significant ($p < 0.001$), indicating impaired expiratory function among cases. Similarly, the mean FVC was reduced in cases (78.68 ± 5.29) as compared to controls (89.72 ± 5.07), with a combined mean of 84.30 ± 9.11. The difference in FVC between the two groups was also statistically highly significant ($p < 0.001$).

The mean total leukocyte count (TLC) was significantly higher in cases (9730.70 ± 1128.70) compared to controls (5869.09 ± 478.68), with a significant overall difference ($p < 0.001$).Neutrophil counts were also markedly increased in cases as compared to controls, and this difference was statistically significant ($p < 0.001$).In contrast, mean lymphocyte counts were significantly lower in cases than controls, showing a statistically significant difference ($p < 0.001$).Platelet counts were comparable between cases and controls, with no statistically significant difference observed.Inflammatory parameters showed significant variation between groups, except for platelet count ($p = 0.484$).Similarly Lee et al.11(2016), Aida M. Yousef et al12 (2017) and Ritumbhara et al.13 (2022) in their study found that mean TLC, mean neutrophil count was significantly higher in AECOPD as compared to stable COPD which is consistent with our results.

The mean NLR and PLR values were significantly higher in cases compared to controls, indicating a greater inflammatory burden among cases. ESR levels were also markedly elevated in cases, with a significant difference observed between the two groups. Procalcitonin levels showed a significant rise in cases as compared to controls, reflecting increased systemic inflammation. Similarly, CRP levels during exacerbation were substantially higher in cases than in controls. The overall mean values of all these inflammatory markers showed wide variability. All differences were statistically highly significant with p values < 0.001.Similarly D.A. Cockayne et al.14 (2012) ,Lee et al.11 (2016), Aida M. Yousef et al.12 (2017) , Ritumbhara et al.13 (2022) and Bhoor Singh et al.10 (2022) in their study found that mean NLR was significantly higher in AECOPD as compared to stable COPD which is consistent with our results. Kurtipek et al.15 also observed that mean NLR and PLR levels were considerably higher in patients with acute exacerbation as compared to stable state COPD. Tugba and Ozturk 16 also concluded that NLR and PLR and monocyte-to-lymphocyte ratio values were significantly higher in the exacerbation group. Similarly Aida M. Yousef et al.12 (2017) and Bhoor Singh et al.10 (2022) in their study found that ESR, serum CRP as markers for inflammation showed a significant difference in patients with stable COPD in comparison to those with AE (higher in AECOPD than stable COPD) which is consistent with our results . Similarly Bhoor Singh et al.10 (2022) in their study found that PCT as markers for inflammation showed a significant difference in patients with stable COPD in comparison to those with AE (higher in AECOPD than stable COPD) which is consistent with our results.

Conclusion:

The present study demonstrates that patients with acute exacerbation of COPD exhibit significantly greater airway obstruction and systemic inflammation compared to stable COPD patients. While cases and controls were well matched with respect to age, sex distribution, smoking status, and duration of disease—ensuring excellent comparability—marked differences were observed in pulmonary function and inflammatory parameters. Cases showed significantly reduced FEV1 and FVC, reflecting severe impairment of expiratory airflow during exacerbation. Inflammatory markers including TLC, neutrophil count, NLR, PLR, ESR, CRP, and procalcitonin were significantly elevated in cases, whereas lymphocyte counts were reduced, indicating heightened inflammatory and infectious burden. These findings reinforce the role of simple, readily available hematological and inflammatory markers as useful tools in identifying disease severity and exacerbation in COPD. Routine assessment of these parameters aid in early detection, risk stratification, and improved management of patients with acute exacerbation of COPD.

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