

Research Article

Evaluation of Role of Neutrophil-To-Lymphocyte Ratio as a Predictor of Outcome in Patients with Acute Exacerbation of Chronic Obstructive Pulmonary Disease

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ABSTRACT

Background: This study evaluate the role of the Neutrophil to Lymphocyte Ratio (NLR) in predicting clinical outcomes for patients with Acute Exacerbations of Chronic Obstructive Pulmonary Disease (AECOPD)

Materials and Methods: 80 patients diagnosed with AECOPD from Dr. Pinnamaneni Siddhartha Institute of Medical Sciences & Research Foundation between September 2025 and March 2026 were included in this cross-sectional observational study. Patients >40 years old with a confirmed history of COPD and presenting with an acute exacerbation were included in the study. NLR was calculated from complete blood count parameters. Clinical outcomes studied were ICU admission, type of ventilatory support, duration of hospital stay, and discharge status.

Results: Of the 80 patients, 78 had improvement their clinical condition and 2 died. The mean NLR was significantly higher for ICU patients (11.63) than ward patients (4.39) ($p < 0.001$). The mean NLR for patients requiring invasive ventilation was the highest (24.72), while the non-invasive ventilation was (9.36) and oxygen therapy was (5.24) ($p < 0.00001$). Patients with a hospital stay >10 days had an elevated NLR (19.88). Non-survivors had a much higher NLR (30.98) than survivors (8.65) ($p < 0.001$).

Conclusion: The results demonstrate that elevated NLR is strongly correlated with worse disease severity and outcomes, including ICU admission, need for ventilatory support, prolonged hospital duration, and mortality for patients with AECOPD. Therefore, NLR can potentially serve as a rapid, easy, and inexpensive prognostic biomarker in the clinical practice for patients with AECOPD.

Keywords: Acute Exacerbation of Chronic Obstructive Pulmonary Disease, Neutrophil-To-Lymphocyte Ratio, Prognostic Biomarker, Clinical Outcomes, Mortality.

INTRODUCTION

The inflammatory lung disease known as chronic obstructive pulmonary disease (COPD) causes respiratory symptoms and airway blockage over time. This disease has persistently been one of the leading diseases causing death globally and is also a public health crisis in developing countries.^[1] The primary cause of COPD is prolonged exposure to toxic gases and particles. Examples of these types of toxins include smoke from cigar and

cigarettes, air pollution, as well as occupational exposure.^[2]

Patients with COPD often present with acute exacerbations of their respiratory symptoms due to acute exacerbations of their underlying respiratory disease, causing both the disease itself to worsen as well as increasing the risk of death, readmissions to the hospital, and decreased quality of life.^[3] The most common respiratory symptoms associated with an acute exacerbation of COPD include increased

sputum production, increased coughing, shortness of breath (dyspnea), and hardening of the airway. Respiratory infections and systemic inflammation are also frequent causes of acute exacerbations of COPD. Correct diagnosis and effective treatment are critical because they will produce fewer complications, shorter hospital stays, and reduced death.^[4,5]

Procalcitonin (PCT), total WBC and CRP can help to determine how severe an exacerbation of COPD is from an inflammatory standpoint, as well as how each patient is expected to respond to anti-inflammatory treatment. However, these lab tests can be prohibitively expensive or unavailable at many hospitals and clinics.^[6,7] The use of an NLR has been tested by researchers as a marker for systemic inflammation and has been correlated to the degree of inflammation and how severe a patient is from a general respiratory standpoint. Physicians can determine a patient's NLR during a routine complete blood count.^[8,9] The NLR is a means of representing the relative contributions of neutrophils to the inflammatory response and lymphocytes to immunoregulation in the overall response by the body to an inflammatory process. Following an acute inflammatory event, a rise in neutrophils and a decrease in lymphocytes will result in a higher NLR.^[10]

The formula for calculating NLR is:

$$\text{NLR} = \text{Relative Neutrophil \%} / \text{Relative Lymphocyte \%}$$

Based on the NLR numbers, a normal NLR value would be 1-3 and mild stress would be indicated by an NLR value of 6 or higher. Elevated NLR values would indicate significant inflammation or a severe illness if the NLR value is over 9. Higher NLR levels correlate with more severe exacerbations of COPD longer hospital stays have more ventilators used, higher ICU admission rates and higher death rates.^[11]

In a resource poor setting, NLR could provide a useful prognostic indicator as it is easily calculated from routine lab techniques. There is a significant gap in the literature pertaining to the Neutrophil to Lymphocyte ratio as a clinical outcome predictor in AECOPD patients in India. The primary objective of this study is to determine if the NLR can be used as a predictor of outcome in patients with COPD exacerbation and to examine the correlation between NLR and the need for ICU admission, the need for ventilator support, the length of hospital stay and mortality.

METHODS AND MATERIALS

In order to assess the predictive ability of the neutrophil to lymphocyte ratio (NLR) in predicting the clinical outcome of patients with acute exacerbation of chronic obstructive pulmonary disease (AECOPD), a six-month hospital-based cross-sectional observational study was carried out at the Dr. Pinnamaneni Siddharta Institute of Medical Science and Research Foundation between September 2025 and March 2026. All eligible patients over 40 years old, with a previous confirmed diagnosis of COPD who had had an exacerbation were included in the study, provided that they gave their informed consent. Patients who had had a history of myocardial infarction, bronchial asthma, tuberculosis, malignancy, haematological disorder, hepatic disease, or renal disease were excluded from the study.

A standardized form was used for data collection on patient demographics, clinical history, laboratory testing, and outcome measures. To calculate the Neutrophil to lymphocyte ratio (NLR), the neutrophil percentage and lymphocyte percentage from the full blood count were used. The clinical outcomes examined were ICU admission, type of ventilatory support, duration of hospital stay, and mortality. Data analysis was performed with IBM SPSS, version 21 and Microsoft Excel. Continuous data are expressed as a mean $\pm$ standard deviation with categorical data reported in counts and percentages. Analysis was performed using both independent t-tests and ANOVA. A statistically significant result was considered to be less than 0.05 ($p < 0.05$).

RESULTS

This study included 80 individuals with acute exacerbations of chronic obstructive pulmonary disease. The age groups of 50–59 and 60–69 years each had an equal amount of participants (27.5%), whereas the majority of participants (37.5%) were over 70. 63% of the subjects were men. The percentages of smokers, ex-smokers, and non-smokers among the entire subject population were as follows: 40%, 22.5%, and 37.5%, respectively. Seventy percent of the individuals said they had smoked for more than twenty pack-years. Sixty-three percent of the participants in this study had COPD for more than fifteen years. Diabetes mellitus and hypertension were the most often reported co-morbidities (35%), followed by COPD alone

(32.5%). Dyspnoea was present in all participants (100%), followed by cough (83.8%) and increased sputum output (71.3%) as mentioned in [Table 1].

Of the 80 participants, 31.3% received treatment in the wards and 68.8% needed to be admitted to the intensive care unit (ICU). Patients who needed to be admitted to the intensive care unit had a mean NLR that was substantially higher (11.63 ± 6.35) than those who were treated in wards (4.39 ± 1.01). The p-value (<0.001) suggested that this difference was statistically significant as mentioned in [Table 2]. Regarding respiratory support, 32.5% of patients needed oxygen supplementation, 8.8% needed invasive ventilation, and 58.8% of patients received non-invasive

ventilation (NIV). The highest NLR mean was found in invasive ventilated patients (24.72 ± 5.05), followed by NIV patients (9.36 ± 3.35)

and those receiving oxygen supplementation (5.24 ± 3.70). There was a statistically significant difference ($p < 0.00001$). [Table 3] 68.8% of patients spent five to ten days in the hospital, while 16.3% stayed longer. As stay length increased, the NLR was also substantially elevated (4.11 ± 1.40 [≤ 5 days] vs 8.05 ± 3.61 [6-10 days] vs 19.88 ± 6.57 [>10 days]; $p < 0.00001$) as mentioned in [Table 4]. The mortality rate during hospitalization among these patients was 2.5% and overall, nearly all patients experienced improvement and discharge from the study population (97.5%) which was remarkably high. A statistically significant correlation ($p < 0.001$) exists between greater NLR and increased risk of death; as seen in the significantly greater average NLR for patients that died (30.98 ± 1.03) compared to the average for surviving patients (8.65 ± 5.16). [Tables 5]

Table 1: Baseline Demographic and Clinical Characteristics of the Study Population

Variable	Category	Frequency (n)	Percentage (%)
Age (years)	<50	6	7.5
	50–59	22	27.5
	60–69	22	27.5
	≥ 70	30	37.5
Sex	Male	50	62.5
	Female	30	37.5
Smoking status	Smoker	32	40.0
	Ex-smoker	18	22.5
	Non-smoker	30	37.5
Pack-years*	<10	5	10.0
	10–20	10	20.0
	>20	35	70.0
Duration of COPD (years)	0–4	6	7.5
	5–9	10	12.5
	10–14	14	17.5
	≥ 15	50	62.5
Comorbidities	COPD only	26	32.5
	Diabetes mellitus	11	13.8
	Hypertension	15	18.8
	Diabetes & Hypertension	28	35.0
Clinical presentation	Dyspnea	80	100
	Cough	67	83.8
	Increased sputum production	57	71.3
	Fever	36	45.0
	Chest tightness	24	30.0

*Mean pack-years = 8.07 ± 9.60

Table 2: Association between NLR and Hospital Admission

Admission type	Frequency (n)	Percentage (%)	Mean NLR $\pm$ SD	T test p-value
ICU	55	68.8	11.63 ± 6.35	<0.001
Ward	25	31.3	4.39 ± 1.01	

Table 3: Association between NLR and Respiratory Support

Respiratory support	Frequency (n)	Percentage (%)	Mean NLR $\pm$ SD	ANOVA p-value
Oxygen supplementation	26	32.5	5.24 $\pm$ 3.70	<0.00001
Non-invasive ventilation	47	58.8	9.36 $\pm$ 3.35	
Invasive ventilation	7	8.8	24.72 $\pm$ 5.05	

Table 4: Association between NLR and Duration of Hospital Stay

Hospital stay (days)	Frequency (n)	Percentage (%)	Mean NLR $\pm$ SD	ANOVA p-value
≤ 5	12	15.0	4.11 $\pm$ 1.40	<0.00001
6–10	55	68.8	8.05 $\pm$ 3.61	
>10	13	16.3	19.88 $\pm$ 6.57	

Table 5: Association between NLR and Discharge Outcome

Discharge outcome	Frequency (n)	Percentage (%)	Mean NLR $\pm$ SD	T test p-value
Improved	78	97.5	8.65 $\pm$ 5.16	<0.001
Death	2	2.5	30.98 $\pm$ 1.03	

DISCUSSION

This study evaluated whether higher levels of Neutrophils to Lymphocyte (NLR) ratios predicted poor outcomes for hospitalized patients experiencing an acute exacerbation (AECOPD) of chronic obstructive pulmonary disease (COPD). This study found a statistically significant association between elevated NLR ratios and increased risk of poor clinical outcomes in AECOPD patients, including the need for ventilatory support, ICU admission, and increased length of hospital stay, as well as increased risk of death.

Similar to Pranay Bandari's previous study, most subjects in this study had a long history as male smokers and older. Typical presenting symptoms for these patients included dyspnea, cough, and increased sputum production, which is also consistent with data from other COPD research. [12] Patients who were sent to the intensive care unit (ICU) had much higher mean neutrophil-to-lymphocyte ratio (NLR) values than ward patients. A high NLR is linked to having a severe illness and having a poor prognosis. Ritumbhara et.al. (2022) shared a study conducted of patients with AECOPD where there was a significantly higher NLR in AECOPD patients than stable COPD patients, and a high NLR is linked to poor survival in that patient population. [13] The researchers shared a similar result in a different study conducted by Liu J et.al. (2019) where they observed an increase in NLR was linked to an increasing risk for the need for ICU admission and death in AECOPD.

In the current study, the majority of the patients that required invasive ventilatory support had NLR values that were significantly higher than those that were on non-invasive

ventilatory support or oxygen supplementation. Vaishnav et.al. (2023) presented similar results showing a higher NLR is linked to increased ventilatory support and worse clinical outcomes in AECOPD patients. [14] An observed correlation exists between increased NLR and lengthened stay in an acute care setting patients being in the hospital for longer periods (i.e., 10+ days) had higher average NLR's than those who did not (Gupta et al 2020). Gupta also found that a higher NLR was associated with an exacerbation of disease severity and also related to a longer hospital stay in COPD patients. [15]

In the mortality analysis performed in this study, patients who died during the hospital stay had significantly elevated NLRs compared to other patients who recovered and were discharged with lower NLRs. This finding lends support to previous studies suggesting that NLR is an important prognostic indicator of mortality in AECOPD patients. In conclusion, the current study demonstrates that a routinely available inexpensive blood test (NLR) can be utilized to evaluate the risk of AECOPD as well as evaluate long-term prognosis for patients with AECOPD.

CONCLUSION

The current study has demonstrated that among patients with Acute Exacerbation of Chronic Obstructive Pulmonary Disease (AECOPD), an elevated Neutrophil-to-Lymphocyte Ratio (NLR) is a significant predictor of poor clinical outcomes, including ICU admission, ventilatory support, and duration of hospital stay and mortality rates. Therefore, NLR can be considered a very simple, rapid, and low-cost prognostic marker

for early risk stratification and management of patients with AECOPD.

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