ORIGINAL ARTICLE

Eastern Journal of Medicine

East J Med 30(1): 59-62, 2025
DOI: 10.5505/ejm.2025.12058

Can Systemic Inflammatory Indices Be Clinically Useful in Predicting Outcomes in Patients with COPD?

Hüseyin Erdal[1*], Selen Karaoğlanoğlu[2]

[1]Deparment of Medical Genetics, Aksaray University, Aksaray, Turkey
[2]Department of Pulmonology, Ordu University, Ordu, Turkey

ABSTRACT

Systemic inflammation is effective for the onset and progression of chronic diseases. The main objective of this study was to analyze the prognostic importance of systemic inflammatory indices in patients with chronic obstructive pulmonary disease (COPD).
This retrospective case-control study included 80 patients and 80 controls treated at the Ordu University Hospital Chest Diseases outpatient clinic between January 2022 and January 2023. Patients over 18 years diagnosed with COPD exacerbations were included in the current study.
The neutrophil mean platelet volume (MPV) and monocyte levels were significantly different between the groups. Significant differences were also observed in the systemic immune-inflammation index (SII), systemic inflamation response index (SIRI), neutrophil-lymphocyte ratio (NLR), platelet-lymphocyte ratio (PLR), and pan-immune inflamation value (PIV) indices between groups ($p<0.05$). Conversely, hemoglobin and platelet values did not differ significantly between the groups ($p>0.05$).
Our results indicated that SII, SIRI and PIV is a new and practical inflammatory index that can be used in the evaluation of COPD patients. These indices can be an inexpensive, practical and safe indicator of the inflammatory state in patients with COPD. However, a larger patient population is needed to obtain stronger results.

Keywords: COPD, SII, SIRI PIV

Introduction

Chronic obstructive pulmonary disease (COPD) affects approximately 10% of individuals over the age of 40 years, and its prevalence is rising, especially in low- and middle-income nations, due to aging populations (1). COPD is a primary health threat, identified by ongoing and progressively worsening airflow blockage attributed to chronic inflammation in both the airways and lung parenchyma (2). These consequences are caused by chronic inflammation triggered by inhalation of harmful gases, cigarette smoke and air pollution (3). COPD decreases the quality of life of affected individuals and imposes a serious economic burden on the health systems of countries (4). The primary cause of COPD is oxidative stress (OS), which promotes chronic inflammation, triggers cellular aging, and inhibits autophagy. OS, resulting from an imbalance between reactive oxygen species (ROS) production and lung detoxification mechanisms, plays a crucial role in COPD pathogenesis (4, 5). Increased OS in COPD leads to oxidative damage to vital cellular components including lipids, proteins, and deoxyribonucleic acid (DNA) (2, 6, 7). This damage not only directly impairs cellular function but also activates redox-sensitive signaling pathways that exacerbate inflammatory responses and promote structural remodeling of lung tissue (8). Inflammation is a central and defining feature of COPD that supports its pathogenesis and progression (8). The inflammatory response in COPD is complex and involves a cascade of cellular and molecular processes triggered by exposure to noxious agents such as cigarette smoke and environmental pollutants (9). These agents activate innate immune responses, which are characterized by the recruitment and activation of inflammatory cells, including neutrophils, macrophages, and T lymphocytes. The persistence of inflammation in COPD is not merely a consequence of ongoing exposure to harmful stimuli but is also driven by intrinsic alterations in inflammatory and immune responses (8). This includes the release of pro-inflammatory cytokines, chemokines, and proteases, which perpetuate tissue damage and

***Corresponding Author:** Huseyin Erdal, Ph.D, Department of Medical Genetics, Aksaray University, Faculty of Medicine Aksaray, Turkey
E-mail: herdalyfa@gmail.com, Phone: + 90543 414 08 15
ORCID ID: Hüseyin Erdal: 0000-0003-0786-5077, **Selen Karaoğlanoğlu:** 0000-0001-9274-6237
Received: 26.06.2024, **Accepted:** 31.10.2024

remodeling. Furthermore, systemic inflammation is increasingly recognized as a contributor to comorbidities frequently associated with COPD, such as cardiovascular disease, osteoporosis, and metabolic syndrome, suggesting a broader systemic impact beyond pulmonary manifestations (10). Several diseases, including COPD, have been shown to be associated with inflammation (11, 12). Recent studies have identified inflammatory indices as indicators of systemic inflammation, which are valuable for forecasting clinical outcomes and therapeutic responses. Notably, inflammatory indices are easy to use and cost effective. In summary, inflammation in COPD is a critical factor that drives the disease pathophysiology and clinical manifestations. Comprehensive insights into the inflammatory mechanisms are pivotal for advancing therapeutic approaches, and it is very important for the recovery of COPD patients.

In current research, inflammatory indices are mentioned as new immune biomarkers, comprehensively reflecting immune function and systemic inflammation. Recent investigations have highlighted SII, SIRI, and PIV as indicators of systemic inflammatory states across various contexts (13-15). The current study aimed to appraise the combined benefits of inflammatory indices in patients with COPD.

Materials and Methods

This retrospective case –control study was conducted at the Ordu University, Faculty of Medicine Training and Research Hospital, Department of Pulmonology outpatient clinic between January 2022 and January 2023. Eighty controls and 80 patients matched in terms of age and sex were included in this study. The study data for the groups were obtained from the hospital automation system. This study adhered to the principles outlined in the Declaration of Helsinki.

The study's exclusion criteria included a COPD exacerbation within the past month, active neoplastic conditions, diagnosed active viral or bacterial infections, chronic kidney disease, elevated serum CRP or erythrocyte sedimentation rate, and the use of inhaled or systemic corticosteroids. Hemogram parameters, including neutrophil, lymphocyte, hemoglobin, MPV, platelet, and monocyte levels, and systemic inflammatory indices were evaluated. The following formulas were used to determine the NLR, PLR, SII, SIRI, and PIV: the ratio of platelets to lymphocytes and neutrophils to lymphocytes. (Platelets × Neutrophils)/Lymphocyte computed SII, (neutrophils × monocytes)/lymphocyte calculated SIRI, and (neutrophils × monocytes × platelets)/lymphocyte calculated PIV.

Ethical Approval**:** Ethics Committee approval for the study was obtained (Approval Date: 13.10.2023 / Approval No 2023/261).

Statistical Analysis: IBM SPSS 22 statistical software was used to analyze the group data. Kolmogorov-Smirnov test was used to confirm that the quantitative variables were normally distributed. Student's t-test and Mann-Whitney U test were used to compare the study groups. The chi-square test was used to compare categorical variables, which are presented as percentages and integers. A p-value of less than 0.05 was accepted as the statistical significance criterion.

Results

In the current study, a total of 160 individuals were included: 80 healthy controls with an average age of 62.8 ± 6.12 and 80 COPD patients with an average age of 65.6 ± 12.4. The groups did not exhibit any significant differences in age or sex. (Table 1). Table 2 presents the median (range) values of the hemogram parameters and indices for both groups. Neutrophil MPV, monocyte levels statistically significant differences were observed in levels between the groups. Moreover, inflammatory indices calculated for the study groups indices measured for the study groups showed significant differences in SII, SIRI, NLR, PLR, and PIV ($p<0.05$, Table 2). Nonetheless, hemoglobin and platelet levels were not significantly different ($p>0.05$).

Discussion

This study aimed to explore new inflammatory indices in patients with COPD. The aim of this study was to evaluate predictive inflammatory indicators for COPD diagnosis. Our findings indicated that neutrophil, MPV, and monocyte levels were significantly different between the groups. Additionally, among the inflammatory indices, SII, SIRI, NLR, PLR, and PIV showed statistically significant differences between the study groups. SII, SIRI, and PIV are recent indices recognized for the comprehensive assessment of immune responses and systemic inflammation in various diseases (13-16). Song et al. reported that the SII was positively associated with the prevalence of COPD (10). In addition, they indicated that an increase in SII is positively

Table 1: Demographic Information of the Study Groups

Parameters		COPD (n=80) Mean ± SD	Control (n=80) Mean ± SD	p
Gender	Male	66 (82.5%)	64 (80%)	0.839*
	Female	14 (17.5%)	16 (20.0%)	
Age (year)		65.6. ± 12.4	62.8 ± 6.12	0.230¥

*Chi-Square test ¥ Student t –test; COPD: chronic obstructive pulmonary disease

Table 2: Comparison of The Blood Parameters of the Study and Control Groups

Parameters	COPD (n=80) median (min-max)	Control (n=80) median (min-max)	p*
White Blood Cell (10^3µL)	8.9 (4.4- 10.4)	7.5 (4.4-10.3)	0.001
Neutrophil (10^3µL)	5.6 (0.94- 13.4)	3.6 (2.3-6.9)	0.001
Lymphocyte (10^3µL)	1.9 (0.4- 5.1)	2.3 (1.2- 3.9)	0.052
Monocyte (10^3µL)	0.67 (0.31-1.37)	0.45 (0.26-0.75)	<0.001
Hemoglobin (g/dL)	13.7 (8.7- 17.4)	13.0 (10.4 -16.6)	0.208
Platelet (10^3µL)	262 (152-402)	256 (162-438)	0.264
MPV (fL)	9.9 (7.5 -13.5)	9.1 (5.9 -12.8)	<0.001
SII	669.8 (71.8-3392)	423.3 (212.4-1045.3	<0.001
SIRI	1.8 (0.13-9.33)	0.7 (0.36-1.7)	<0.001
PIV	439.5 (33.1-2476.4)	193.6 (80.2-565.3)	<0.001
NLR	2.83 (0.3-14.6)	1.52 (0.65-3.1)	<0.001
PLR	121.9 (49.3. -464.1)	110.1 (60.5- 196.9)	0.044

*Mann- Whitney U test NLR: Neutrophil Lymphocyte Ratio, CRP: C-reactive protein, MPV: Mean Platelet Volume, PLR: Platelet Lymphocyte ratio, SII: Systemic inflammatory index (neutrophil x platelet / lymphocyte count), SIRI: Systemic inflammatory response index (neutrophil × monocyte / lymphocyte count) and PIV: Pan-immune inflammation value (neutrophil × platelet x monocyte /lymphocyte count). COPD:chronic obstructive pulmonary disease

associated with the severity of COPD, particularly at GOLD stages 1 and 3. They concluded that these findings could have significant implications in everyday clinical practice.

Indices such as SII and SIRI have been studied in other airway diseases as well as in COPD. In Erdogan's study of 105 patients with asthma and NSAID-exacerbated respiratory disease (NERD), no risk factors for the diagnosis of asthma or NERD were identified in logistic regression analysis (16). Additionally, the NLR ratio has been shown to be a risk factor affecting the categorized SII. They demonstrated that no risk factors for the diagnosis of asthma or NERD were identified in the logistic regression analysis. They concluded that the NLR ratio is a contributing risk factor that influences the systemic immune-inflammation index. In another study conducted by Benz et al., elevated SII levels increased the risk of mortality even among individuals not affected by sarcopenia, COPD, or asthma (18). They noted that older adults and middle-aged individuals with COPD had a higher mortality risk, independently linked to elevated SII levels or sarcopenia.

Another study conducted by Kanter et al. on 177 COPD patients reported that the SII value was a differential diagnosis (19). However, they showed that the SII was not a differential diagnosis for survival in patients with COPD. They concluded that the SII can be used as an indicator of outcome in COPD patients and may be a potential tool for assessing the prognosis of the disease. Our study found that SII levels were higher in patients compared than in the controls. We hypothesized that inflammatory indices have the potential to serve as cost-effective and reliable markers of the inflammatory status. Our research adds to the body of knowledge by showing that inflammatory markers are higher in COPD patients than in the control group, which is consistent with findings from previous studies. Specifically, we assessed the significance of SII,

SIRI, and PIV in COPD patients and found statistically significant associations in demonstrating inflammation.

In summary, SII, SIRI, and PIV have emerged as practical inflammatory indices for evaluating COPD patients, offering a cost-effective and safe means of assessing inflammatory status. The limitations of the study include being single-centered, which may result in a smaller patient sample size. Future studies with larger cohorts are required to validate and extend these findings.

Conflict of Interest: The authors report no conflict of interest regarding this study.

Financial support: There is no financial report.

Author Contributions: Concept: (HE), Design: (HE), Data Collection and/or Processing: (SK), Analysis and/or Interpretation: (HE, SK), Literature Review: HE, SK, Writing-Original Draft: HE, SK, Writing –Review and Revision: HE, SK

References

1. Boers E, Barrett M, Su JG, Benjafield AV, Sinha S, Kaye L, et al. Global Burden of Chronic Obstructive Pulmonary Disease Through 2050. JAMA Netw Open. 2023;6(12):e2346598
2. Christenson SA, Smith BM, Bafadhel M, Putcha N. Chronic obstructive pulmonary disease. Lancet. 2022;399(10342):2227-42.
3. Ritchie AI, Wedzicha JA. Definition, Causes, Pathogenesis, and Consequences of Chronic Obstructive Pulmonary Disease Exacerbations. Clin Chest Med. 2020;41(3):421-38.
4. Kirkham PA, Barnes PJ. Oxidative stress in COPD. Chest. 2013;144(1):266-73.
5. Zinellu E, Zinellu A, Fois AG, Fois SS, Piras B, Carru C, et al. Reliability and Usefulness of Different Biomarkers of Oxidative Stress in Chronic Obstructive Pulmonary Disease. Oxid Med Cell Longev. 2020;2020:4982324.
6. Kytikova OY, Gvozdenko TA, Vitkina TI. [Oxidative DNA damage in the pathogenesis of chronic obstructive pulmonary disease in older patients]. Adv Gerontol. 2016;29(5):784-7.
7. Özcan O, Erdal H, Çakırca G, Yönden Z. Oxidative stress and its impacts on intracellular lipids, proteins and DNA. J Clin Exp Invest. 2015;6(3):331-6.
8. Barnes PJ. Inflammatory mechanisms in patients with chronic obstructive pulmonary disease. J Allergy Clin Immunol. 2016;138(1):16-27.
9. Hattab Y, Alhassan S, Balaan M, Lega M, Singh AC. Chronic Obstructive Pulmonary Disease. Crit Care Nurs Q. 2016;39(2):124-30.
10. Decramer M, Rennard S, Troosters T, Mapel DW, Giardino N, Mannino D, et al. COPD as a lung disease with systemic consequences--clinical impact, mechanisms, and potential for early intervention. COPD. 2008;5(4):235-56.
11. Song YD, Bai XM, Ma J. The association of systemic immune-inflammation index with lung function, risk of COPD and COPD severity: A population-based study. PLoS One. 2024;19(6):e0303286.
12. Henein MY, Vancheri S, Longo G, Vancheri F. The Role of Inflammation in Cardiovascular Disease. Int J Mol Sci. 2022;23(21).
13. Akbulut Yağcı B, Erdal H. Can pan-immune inflammation value and systemic inflammatory response index be used clinically to predict inflammation in patients with cataract. 2023.
14. Huang H, Liu Q, Zhu L, Zhang Y, Lu X, Wu Y, et al. Prognostic Value of Preoperative Systemic Immune-Inflammation Index in Patients with Cervical Cancer. Sci Rep. 2019;9(1):3284.
15. Yao S, Ding K, Liu S, Zhang Q, Li W, Tang L, et al. The Managing Cancer and Living Meaningfully (CALM) Intervention Alleviates Chemotherapy-Related Cognitive Impairment in Patients with Breast Cancer by Modulating Pan-Immune-Inflammation Values. Integr Cancer Ther. 2022;21:15347354221140498.
16. Karaoglanoglu S, Erdal H, Sonmez MK. Can Pan-Immune Inflammation Value and Systemic Inflammatory Response Index be Used Clinically to Predict Inflammation in Patients with Non-Small Cell Lung Cancer? Eurasian Journal of Medical Investigation. 2024;8(1).
17. Erdogan T. Role of systemic immune-inflammation index in asthma and NSAID-exacerbated respiratory disease. Clin Respir J. 2021;15(4):400-5.
18. Benz E, Wijnant SRA, Trajanoska K, Arinze JT, de Roos EW, de Ridder M, et al. Sarcopenia, systemic immune-inflammation index and all-cause mortality in middle-aged and older people with COPD and asthma: a population-based study. ERJ Open Res. 2022;8(1).
19. Kanter E, Payza U, Coşkun Sm, Kaymaz E. The Prognostic Importance of the Systemic Immune Inflammation Index (SII) in Patients with Chronic Obstructive Pulmonary Disease (COPD). Güncel Tıbbi Araştırmaları Dergisi. 2023;3(2):43-52.