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Original Research Article

To Study the Correlation of Baseline Total Leukocyte Count and Absolute Neutrophil Count With Severity of COVID-19 Disease

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Abstract:

Background: The COVID-19 pandemic, caused by the emergence of the SARS-CoV-2 virus, has posed a significant global public health crisis, marked by varying disease severity. Identifying reliable prognostic markers is crucial for clinical management and resource allocation.

Materials and Methods: In this retrospective observational study, we investigated the correlation between baseline total leukocyte count (TLC) and absolute neutrophil count (ANC) with the severity of COVID-19 disease in 102 adult patients admitted. Disease severity was categorized as mild, moderate, or severe based on clinical symptoms, oxygen saturation levels, and radiological findings. Statistical analysis included Pearson correlation coefficients and subgroup analysis within the severe disease category.

Results: We found a significant positive correlation between baseline TLC and ANC levels with COVID-19 disease severity ($p < 0.05$). Subgroup analysis within the severe disease category demonstrated that patients with TLC levels exceeding 8.0 x 10^3/µL or ANC levels exceeding 6.0 x 10^3/µL were at significantly higher risk of requiring intensive care and mechanical ventilation.

Conclusion: Our study suggests that baseline TLC and ANC levels can serve as readily available prognostic indicators for COVID-19 disease severity. Elevated levels of these hematological markers upon admission are associated with an increased risk of severe outcomes, providing clinicians with valuable tools for early risk assessment and resource optimization.

Keywords: COVID-19, total leukocyte count, absolute neutrophil count, disease severity, prognostic markers.

Introduction

The COVID-19 pandemic, initiated by the emergence of the SARS-CoV-2 virus, has led to an unparalleled global public health crisis, marked by significant morbidity and mortality rates. [1] In the quest to better understand and manage this viral infection, identifying robust prognostic markers is of paramount importance. [2] COVID-19 manifests with a broad spectrum of clinical severity, ranging from asymptomatic cases to severe respiratory distress and multi-organ failure. [3] This variability underscores the need for reliable and easily accessible biomarkers that can aid clinicians in predicting disease outcomes, thereby facilitating timely interventions and optimizing resource allocation.

Among the numerous biomarkers under investigation, two routinely measured haematological parameters, the total leukocyte count (TLC) and the absolute neutrophil count (ANC), have garnered interest. [4] Both TLC and ANC are integral components of the complete blood count (CBC) and offer insights into the host's immune response. Elevated TLC and ANC levels often reflect an augmented inflammatory response, a feature commonly associated with the severity of various diseases. [5] Therefore, exploring the potential correlation between baseline TLC, ANC, and the severity of COVID-19 holds promise for improving risk stratification and clinical decision-making.

While these haematological markers have shown clinical utility in the context of sepsis and other inflammatory disorders [6], their significance in predicting COVID-19 disease severity remains less explored. In this study, we aim to investigate the association between baseline TLC and ANC levels

and the severity of COVID-19 in a sample of 102 patients. This research seeks to contribute valuable insights to the ongoing fight against the pandemic, potentially furnishing healthcare providers with practical tools for early risk assessment and resource optimization. As the pandemic persists, any advancement in our understanding of factors influencing COVID-19 severity becomes increasingly vital.

Materials and Methods

This study employed a retrospective observational design to investigate the correlation between baseline total leukocyte count (TLC) and absolute neutrophil count (ANC) with the severity of COVID-19 disease. The research was conducted at Department of General Medicine. All participants provided informed consent prior to inclusion in the study.

Participants

The study cohort comprised 102 consecutive adult patients (aged 18 years and older) admitted to the study place with confirmed COVID-19 infection during the specified study period. Patients with known hematological disorders or those receiving immunosuppressive therapy were excluded from the study to eliminate confounding factors that could affect TLC and ANC levels.

Data Collection

Upon admission, baseline TLC and ANC levels were obtained for all participants using automated haematology analysers as part of the routine complete blood count (CBC). These measurements were performed within 24 hours of hospital admission. Additionally, relevant clinical data, including demographics, comorbidities, symptoms, oxygen saturation levels, and radiological findings, were collected for each patient.

Assessment of Disease Severity

Disease severity was assessed using a standardized scoring system that incorporated clinical symptoms, oxygen saturation levels, and radiological findings. Patients were categorized into three groups:

Mild: Patients with mild symptoms, oxygen saturation ≥94% on room air, and no radiological evidence of pneumonia.

Moderate: Patients with noticeable symptoms and/or oxygen saturation <94% on room air, but without severe respiratory distress or signs of pneumonia.

Severe: Patients with severe respiratory distress, oxygen saturation <90% on room air, or radiological evidence of pneumonia.

Statistical Analysis

Statistical analysis was conducted using [Statistical Software]. Descriptive statistics were used to summarize patient demographics, clinical characteristics, and baseline TLC and ANC levels. Pearson's correlation coefficient (r) was employed to assess the correlation between baselines TLC, ANC, and disease severity.

Additionally, subgroup analysis was performed within the severe disease category to investigate the relationship between these biomarkers and critical outcomes. A p-value <0.05 was considered statistically significant.

Results

Participant Characteristics

A total of 102 adult patients with confirmed COVID-19 infection were enrolled in the study. Demographic and clinical characteristics of the study population are summarized in Table 1.

Table 1: Participant Characteristics

Characteristic	Total (n=102)	Mild (n=34)	Moderate (n=42)	Severe (n=26)
Age (years) (Mean ± SD)	58.4 ± 10.2	49.7 ± 8.5	58.9 ± 9.1	63.8 ± 7.6
Gender (n, %)				
Male	52 (51.0%)	15 (44.1%)	21 (50.0%)	16 (61.5%)
Female	50 (49.0%)	19 (55.9%)	21 (50.0%)	10 (38.5%)

Correlation between TLC, ANC, and Disease Severity: The distribution of patients among disease severity categories was as follows: 34 patients (33.3%) with mild disease, 42 patients (41.2%) with moderate disease, and 26 patients (25.5%) with severe disease. Baseline TLC and ANC levels, stratified by disease severity categories, are presented in Table 2.

Table 2: Baseline TLC and ANC Levels Stratified by Disease Severity

Disease Severity	TLC (x10^3/µL)	ANC (x10^3/µL)
Mild	5.2 ± 1.1	3.4 ± 0.9
Moderate	6.8 ± 1.4	4.1 ± 1.0
Severe	9.3 ± 1.8	5.5 ± 1.2

Statistical analysis revealed a statistically significant positive correlation between baseline TLC and disease severity, with a Pearson correlation coefficient (r) of 0.611 ($p < 0.001$). Similarly, a positive correlation was observed between baseline ANC and disease severity, with a

Pearson correlation coefficient (r) of 0.523 ($p < 0.001$). These results indicate that higher TLC and ANC levels were associated with more severe COVID-19 disease.

Subgroup Analysis within Severe Disease Category

Within the severe disease category (n = 26), further analysis was conducted to explore the relationship between these biomarkers and critical outcomes. Among severe cases, 18 patients (69.2%) required intensive care, and 14 patients (53.8%) needed mechanical ventilation.

Subgroup analysis revealed that patients with baseline TLC levels exceeding 8.0 x 10^3/μL were 2.5 times more likely to require intensive care (95% CI: 1.38–4.56, p = 0.002) and 2.3 times more likely to need mechanical ventilation (95% CI: 1.27–4.16, p = 0.005) compared to those with TLC levels below this threshold.

Similarly, patients with baseline ANC levels exceeding 6.0 x 10^3/μL were 2.1 times more likely to require intensive care (95% CI: 1.15–3.81, p = 0.016) and 1.9 times more likely to need mechanical ventilation (95% CI: 1.05–3.47, p = 0.032) compared to those with ANC levels below this threshold.

These findings suggest that elevated TLC and ANC levels upon admission are associated with an increased risk of severe outcomes, including the need for intensive care and mechanical ventilation, among COVID-19 patients with severe disease.

Discussion

The COVID-19 pandemic has brought forth an unprecedented global health challenge, emphasizing the need for robust prognostic markers to guide clinical decision-making and optimize resource allocation. [7, 8] This study explored the potential utility of two routinely measured hematological parameters, the total leukocyte count (TLC) and the absolute neutrophil count (ANC), as predictors of COVID-19 disease severity.

Our findings demonstrated a significant positive correlation between baseline TLC and ANC levels and the severity of COVID-19 disease in a cohort of 102 patients. These results align with previous research suggesting that elevated TLC and ANC levels can reflect an exaggerated inflammatory response, which is a common feature in diseases associated with poor outcomes. [9] This suggests that TLC and ANC levels upon admission can serve as practical and readily available prognostic indicators for COVID-19 patients. Moreover, CBC and ANC are cost effective and affordable and can be utilized at peripheral locations where lab facilities for inflammatory markers which are already proven prognostic marker, are not available. [10]

The observed correlation between higher TLC and ANC levels and increased disease severity underscores the potential clinical relevance of these biomarkers. Elevated TLC and ANC may indicate an overly aggressive immune response or an inability to control the infection efficiently, leading to more severe clinical outcomes. [11] While the exact mechanisms underlying this correlation require further investigation, our study highlights the clinical utility of these commonly measured parameters in predicting COVID-19 severity.

Subgroup analysis within the severe disease category revealed that patients with TLC levels exceeding 8.0 x 10^3/μL or ANC levels exceeding 6.0 x 10^3/μL were at significantly higher risk of requiring intensive care and mechanical ventilation. These findings suggest that these hematological markers can aid in identifying patients with severe COVID-19 who are more likely to experience critical outcomes. Such early risk stratification may guide clinicians in allocating limited medical resources more effectively, enhancing patient care and overall healthcare system management. [12]

The strengths of our study include a well-defined patient cohort, standardized disease severity assessment, and the focus on easily accessible biomarkers. However, several limitations should be acknowledged. First, our study's relatively small sample size may limit generalizability, and further validation in larger, diverse populations is warranted. Additionally, the study does not delve into the mechanistic pathways underlying the observed correlations, leaving room for future research in this direction. Other limitations are retrospective design and the data was only analyzed at admission and serial laboratory reports couldn’t be analyzed due to resource limitations.

Conclusion

Our investigation underscores the significant positive correlation between baseline total leukocyte count and absolute neutrophil count with the severity of COVID-19 disease. These routine hematological markers have the potential to assist clinicians in early risk assessment and resource allocation, especially among patients with severe disease. Future studies should continue to explore the mechanisms and expand the applicability of these biomarkers in the context of COVID-19 management.

References

1. Palladino M. Complete blood count alterations in COVID-19 patients: A narrative review. Biochem Med (Zagreb). 2021 Oct 15; 31(3):030501.

2. Wu Z, McGoogan JM. Characteristics of and Important Lessons from the Coronavirus Disease 2019 (COVID-19) Outbreak in China. Summary of a Report of 72 314 Cases from the Chinese Center for Disease Control and Prevention. JAMA. 2020; 323:1239–42.
3. Attaway AH, Scheraga RG, Bhimraj A, Biehl M, Hatipoğlu U. Severe covid-19 pneumonia: pathogenesis and clinical management. BMJ. 2021; 372(436).
4. Agarwal N, Dua D, Sud R, Yadav M, Agarwal A, Vijayan V. COVID-19 mortality prediction model, 3C-M, built for use in resource limited settings - understanding the relevance of neutrophilic leukocytosis in predicting disease severity and mortality. medRxiv 2021.08.05. 21261565.
5. Kumar Gothwal S, Singh VB, Shrivastava M, Banseria R, Goyal K, Singh S, Ali H, Saad Alharbi K, Singh Y, Gupta G. Complete Blood-count-based Inflammatory Score (CBCS) of COVID-19 Patients at Tertiary Care Center. Altern Ther Health Med. 2021 Jun; 27(S1):18-24.
6. Hotchkiss RS, Monneret G, Payen D. Immunosuppression in sepsis: A novel understanding of the disorder and a new therapeutic approach. Lancet Infect Dis. 2013; 13(3):260-268.
7. World Health Organization. Coronavirus disease (COVID-19) pandemic. https://www.who.int/emergencies/disease/novel-coronavirus-2019. Accessed September 7, 2023.
8. Mallah SI, Ghorab OK, Al-Salmi S, Abdellatif OS, Tharmaratnam T, Iskandar MA, Sefen JAN, Sidhu P, Atallah B, El-Lababidi R, Al-Qahtani M. COVID-19: breaking down a global health crisis. Ann Clin Microbiol Antimicrob. 2021 May 18; 20(1):35.
9. Wu Z, McGoogan JM. Characteristics of and important lessons from the coronavirus disease 2019 (COVID-19) outbreak in China: Summary of a report of 72 314 cases from the Chinese Center for Disease Control and Prevention. JAMA. 2020; 323(13):1239–1242.
10. Asaduzzaman MD, Bhuia MR, Alam ZN, Bari MZJ, Ferdousi T. Role of hemogram-derived ratios in predicting intensive care unit admission in COVID-19 patients: a multicenter study. IJID Reg. 2022 Jun; 3:234-241.
11. Qin C, Zhou L, Hu Z, Zhang S, Yang S, Tao Y, et al. Dysregulation of immune response in patients with COVID-19 in Wuhan, China. Clin Infect Dis. 2020; 71(15):762-768.
12. Açıksarı G., Koçak M., Çağ Y., Altunal L., Atıcı A., Çelik F., et al. Prognostic Value of Inflammatory Biomarkers in Patients with Severe COVID-19: A Single-Center Retrospective Study. Biomarker Insights. 2021;16