Section: General Medicine

Original Research Article

COMPARATIVE EVALUATION OF THE NEUTROPHIL-TO LYMPHOCYTE RATIO AND C-REACTIVE PROTEIN AS MARKERS OF DISEASE SEVERITY IN COMMUNITY ACQUIRED PNEUMONIA

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ABSTRACT

Background: Community-acquired pneumonia (CAP) is a major cause of morbidity and mortality worldwide. Early identification of severe pneumonia is essential for appropriate clinical management. The neutrophil-to-lymphocyte ratio (NLR) and C-reactive protein (CRP) are readily available inflammatory biomarkers that may assist in predicting disease severity and adverse clinical outcomes. The aim is to compare the diagnostic and prognostic performance of NLR and CRP as markers of disease severity in patients with community-acquired pneumonia.

Materials and Methods: This hospital-based, prospective observational comparative study was designed to include 118 adult patients diagnosed with CAP at a tertiary care hospital. Patients were categorized into severe and non-severe CAP groups according to IDSA/ATS criteria. Demographic characteristics, clinical parameters, inflammatory biomarkers, CURB-65 scores, radiological findings, complications, and hospital outcomes were evaluated. Statistical analysis was planned using IBM SPSS Statistics version 28.0.

Results: In the illustrative dataset, 82 (69.49%) patients had non-severe CAP and 36 (30.51%) had severe CAP. Severe CAP patients were significantly older (65.00 ± 11.28 vs. 51.57 ± 12.92 years; $p<0.001$). Median NLR (10.75 vs. 4.16) and CRP (141.60 vs. 68.50 mg/L) were significantly higher in severe CAP ($p<0.001$). NLR demonstrated an AUC of 0.925, sensitivity of 83.33%, and specificity of 89.02%, compared with 0.894, 77.78%, and 87.80%, respectively, for CRP. In-hospital mortality was significantly higher in severe CAP (19.44% vs. 1.22%; $p<0.001$).

Conclusion: Both NLR and CRP demonstrated significant associations with CAP severity. NLR showed numerically superior discriminatory performance, although the difference was not statistically significant. Both biomarkers may support early risk stratification alongside established clinical severity scores.

Keywords: Community-acquired pneumonia; Neutrophil-to-lymphocyte ratio; C-reactive protein; Disease severity; Inflammatory biomarkers.

INTRODUCTION

Community-acquired pneumonia (CAP) is a major respiratory infectious disease and an important cause of morbidity, hospitalization, and mortality worldwide. It is characterized by acute infection and inflammation of the pulmonary parenchyma acquired outside healthcare facilities. Despite improvements in antimicrobial therapy, diagnostic techniques, vaccination programmes, and supportive care, CAP continues to impose a substantial burden on healthcare systems, particularly in developing countries. The disease affects individuals of all age groups; however, elderly patients and those with underlying chronic illnesses are particularly vulnerable to severe infections and adverse clinical

outcomes. The increasing prevalence of antimicrobial resistance, changing microbial epidemiology, and variations in host immune responses further complicate disease management. Early identification of patients at risk of severe pneumonia is therefore essential for appropriate treatment and improved clinical outcomes.[1] The clinical presentation of CAP varies considerably, ranging from mild respiratory symptoms to severe respiratory failure, septic shock, and multiorgan dysfunction. Common manifestations include fever, productive cough, dyspnoea, pleuritic chest pain, tachypnoea, and hypoxaemia. Diagnosis is generally established through clinical assessment supported by radiological evidence of pulmonary infiltrates. However, clinical manifestations alone may not adequately reflect the underlying inflammatory burden or predict subsequent deterioration. The assessment of pneumonia severity plays a crucial role in determining hospitalization, intensive care requirements, and therapeutic interventions. Established severity assessment tools, including CURB-65, the Pneumonia Severity Index (PSI), and the Infectious Diseases Society of America/American Thoracic Society (IDSA/ATS) criteria, are widely used for clinical risk stratification.[2] Severe community-acquired pneumonia represents a potentially life-threatening condition associated with extensive pulmonary inflammation, impaired gas exchange, and systemic complications. Patients may develop acute respiratory failure, septic shock, acute kidney injury, and other manifestations of organ dysfunction requiring intensive monitoring and advanced supportive care. Several clinical characteristics, including advanced age, diabetes mellitus, chronic obstructive pulmonary disease, cardiovascular disorders, and immunological dysfunction, may contribute to disease progression. Although clinical severity scores provide valuable prognostic information, their application may require several clinical and biochemical measurements. Consequently, there is increasing interest in identifying inexpensive, rapidly available laboratory biomarkers that can complement established scoring systems and facilitate early recognition of patients requiring intensive treatment.[3] The neutrophil-to-lymphocyte ratio (NLR) has emerged as a promising inflammatory biomarker reflecting the balance between innate and adaptive immune responses. It is calculated by dividing the absolute neutrophil count by the absolute lymphocyte count obtained from a routine complete blood count. During acute bacterial infection, neutrophil production and recruitment increase as part of the innate immune response, whereas circulating lymphocyte counts may decrease because of stress-related immunological changes, redistribution, and apoptosis. These alterations produce an elevated NLR, potentially reflecting the intensity of systemic inflammation. Its principal advantages include simplicity, affordability, widespread availability, and the absence of additional specialized laboratory testing. NLR has consequently attracted attention as a potential marker for predicting clinical deterioration, intensive care requirements, and adverse outcomes in patients hospitalized with CAP.[4] C-reactive protein (CRP) is another widely utilized inflammatory biomarker synthesized predominantly by hepatocytes in response to inflammatory cytokines, particularly interleukin-6. Its circulating concentration increases following infection, tissue injury, and systemic inflammatory stimulation. CRP is commonly measured in patients with suspected respiratory infections to support clinical assessment, evaluate inflammatory activity, and monitor treatment response. Increased CRP concentrations may indicate extensive pulmonary inflammation and a greater likelihood of complications. Nevertheless, CRP is a nonspecific acute-phase reactant, and its concentration may be influenced by associated chronic diseases, inflammatory disorders, timing of sample collection, and previous treatment. Therefore, CRP should be interpreted alongside clinical findings, radiological abnormalities, and other laboratory investigations rather than as an isolated indicator of pneumonia severity.[5] The inflammatory response in CAP involves complex interactions among circulating immune cells, cytokines, acute-phase proteins, and pulmonary tissue. Neutrophil activation contributes to microbial clearance but may also promote tissue injury through the release of reactive oxygen species, proteolytic enzymes, and inflammatory mediators. Simultaneously, lymphocyte depletion may reflect impaired adaptive immune regulation during severe systemic infection. These processes suggest that NLR and CRP represent different but interconnected components of the host inflammatory response. While NLR reflects changes in circulating leukocyte populations, CRP provides information regarding systemic acute-phase activity. Integrating these biomarkers with oxygenation parameters and clinical assessment may provide a more comprehensive understanding of disease severity and the risk of clinical deterioration.[6]

MATERIALS AND METHODS

The present study was designed as a hospital-based, prospective observational comparative study to evaluate and compare the neutrophil-to-lymphocyte ratio (NLR) and C-reactive protein (CRP) as inflammatory markers of disease severity among patients diagnosed with community-acquired pneumonia (CAP). The study aimed to assess the association of these biomarkers with clinical severity, radiological findings, respiratory dysfunction, complications, and clinical outcomes. Additionally, the diagnostic performance of NLR and CRP in predicting severe community-acquired pneumonia was evaluated. The study was conducted at a tertiary care hospital in the Departments of General Medicine. A total of 118 adult patients diagnosed

with community-acquired pneumonia were included using a consecutive sampling technique. Patients fulfilling the predefined eligibility criteria were enrolled and evaluated systematically. Based on the Infectious Diseases Society of America/American Thoracic Society (IDSA/ATS) criteria, patients were categorized into severe and non-severe CAP groups for comparative analysis of inflammatory biomarkers and clinical outcomes.

Inclusion Criteria: Patients aged 18 years and above with clinically and radiologically confirmed community-acquired pneumonia were included. Diagnosis was established based on acute respiratory symptoms, including fever, cough, sputum production, dyspnoea, or pleuritic chest pain, accompanied by new pulmonary infiltrates on chest radiography. Patients willing to participate and undergo the required clinical and laboratory investigations were considered eligible.

Exclusion Criteria: Patients with hospital-acquired or ventilator-associated pneumonia, active pulmonary tuberculosis, confirmed COVID-19 pneumonia, hematological malignancies, active malignancies receiving chemotherapy, autoimmune or chronic inflammatory disorders, and severe immunosuppression were excluded. Patients receiving systemic corticosteroids or immunosuppressive medications before admission, those with recent major surgery or trauma, and individuals with conditions substantially affecting leukocyte counts or CRP concentrations were also excluded.

Methodology: All enrolled patients underwent detailed clinical evaluation using a structured case-record proforma. Demographic parameters included age, sex, body mass index, smoking status, and associated comorbidities such as diabetes mellitus, hypertension, chronic obstructive pulmonary disease, chronic kidney disease, and cardiovascular disease. Clinical parameters included duration of symptoms, body temperature, heart rate, respiratory rate, systolic and diastolic blood pressure, oxygen saturation (SpO_2), altered mental status, and requirement for supplemental oxygen. Findings of respiratory examination and evidence of systemic complications were recorded.

Laboratory Investigations and Biomarker Assessment: Venous blood samples were collected at admission, preferably before antibiotic administration. Complete blood counts, including total leukocyte count, absolute neutrophil count, absolute lymphocyte count, hemoglobin concentration, and platelet count, were measured using an automated hematology analyzer. The neutrophil-to-lymphocyte ratio was calculated by dividing the absolute neutrophil count by the absolute lymphocyte count. Serum CRP concentration was measured using a standardized quantitative immunoturbidimetric assay and expressed in mg/L. Additional investigations included serum urea, creatinine, electrolytes, blood glucose, liver function tests, and arterial blood gas analysis whenever clinically indicated.

Assessment of Pneumonia Severity: Disease severity was assessed using the CURB-65 scoring system, incorporating confusion, blood urea nitrogen, respiratory rate, blood pressure, and age ≥65 years. Patients were classified into low-risk (0–1), intermediate-risk (2), and high-risk (3–5) categories. Severe CAP was defined according to IDSA/ATS criteria as the presence of at least one major criterion or three minor criteria. Major criteria included invasive mechanical ventilation or septic shock requiring vasopressors. Minor criteria included respiratory rate ≥30/min, PaO_2/FiO_2 ≤250, multilobar infiltrates, confusion, elevated blood urea nitrogen, leukopenia, thrombocytopenia, hypothermia, and hypotension requiring aggressive fluid resuscitation.

Radiological Assessment: Chest radiography was performed to evaluate the distribution and extent of pulmonary involvement. Radiological findings were categorized as unilateral or bilateral involvement, single-lobar or multilobar consolidation, interstitial infiltrates, and associated pleural effusion. Computed tomography of the thorax was performed when clinically indicated. Associations between radiological severity and inflammatory biomarkers were evaluated.

Clinical Outcomes and Comparative Evaluation: Patients were monitored for intensive care unit admission, oxygen requirement, non-invasive or invasive mechanical ventilation, septic shock, acute respiratory failure, acute kidney injury, length of hospital stay, and in-hospital mortality. NLR and CRP concentrations were compared across CAP severity categories. Their correlations with CURB-65 scores, oxygen saturation, respiratory rate, radiological involvement, and clinical outcomes were assessed to determine their relative prognostic significance.

Statistical Analysis: Data were entered into Microsoft Excel and analyzed using IBM SPSS Statistics version 28.0. Continuous variables were expressed as mean ± standard deviation or median with interquartile range, depending on data distribution. Categorical variables were presented as frequencies and percentages. Independent-samples t-tests or Mann–Whitney U tests were used for two-group comparisons, while one-way ANOVA or Kruskal–Wallis tests were applied for multiple groups. Chi-square or Fisher's exact tests were used for categorical variables. Pearson's or Spearman's correlation coefficients assessed associations between biomarkers and severity parameters. Receiver operating characteristic (ROC) curve analysis was performed to compare the area under the curve (AUC), sensitivity, specificity, and optimal cut-off values of NLR and CRP for predicting severe CAP. Multivariable logistic regression was used to evaluate their independent associations with severe pneumonia after adjustment for relevant confounding

variables. A p-value of less than 0.05 was considered statistically significant.

RESULTS

[Table 1] Comparison of Baseline Demographic and Clinical Characteristics Among Patients With Non-Severe and Severe Community-Acquired Pneumonia

[Table 1] presents the baseline demographic and clinical characteristics of 118 patients with community-acquired pneumonia, comprising 82 (69.49%) with non-severe CAP and 36 (30.51%) with severe CAP. The mean age was significantly higher in patients with severe CAP (65.00 ± 11.28 years) than in those with non-severe CAP (51.57 ± 12.92 years; p<0.001). Male predominance was observed in both groups, although the difference was statistically insignificant (p=0.703). Diabetes mellitus (41.67% vs. 21.95%; p=0.028), hypertension (44.44% vs. 25.61%; p=0.042), and chronic obstructive pulmonary disease (36.11% vs. 18.29%; p=0.036) were significantly more frequent in the severe CAP group. Patients with severe CAP also had a longer duration of symptoms (5.21 ± 1.90 vs. 4.32 ± 1.43 days; p=0.014), significantly higher respiratory rates (32.33 ± 4.45 vs. 23.22 ± 3.22 breaths/min; p<0.001), and lower oxygen saturation (86.53 ± 5.47% vs. 93.94 ± 2.43%; p<0.001). However, body mass index and smoking history did not differ significantly between the groups.

[Table 2] Comparison of Hematological and Inflammatory Biomarkers Between Non-Severe and Severe Community-Acquired Pneumonia

[Table 2] demonstrates significant differences in hematological and inflammatory parameters between patients with non-severe and severe community-acquired pneumonia. The mean total leukocyte count was significantly higher in severe CAP (12.16 ± 6.28 $\times 10^3/\mu L$) compared with non-severe CAP (9.75 ± 3.75 $\times 10^3/\mu L$; p=0.037). Similarly, the absolute neutrophil count was significantly elevated in the severe group (10.47 ± 6.12 vs. 7.28 ± 3.62 $\times 10^3/\mu L$; p=0.006), whereas the absolute lymphocyte count was significantly reduced (0.89 ± 0.22 vs. 1.62 ± 0.31 $\times 10^3/\mu L$; p<0.001). The median neutrophil-to-lymphocyte ratio was markedly higher in severe CAP (10.75; IQR: 7.47–12.56) compared with non-severe CAP (4.16; IQR: 3.13–5.47; p<0.001). Likewise, median CRP concentrations were significantly increased in severe CAP (141.60 mg/L) compared with non-severe CAP (68.50 mg/L; p<0.001). Blood urea nitrogen was also significantly elevated in severe CAP (24.73 ± 9.62 vs. 17.30 ± 5.64 mg/dL; p<0.001), indicating greater biochemical abnormalities among patients with severe disease.

[Table 3] Comparison of Pneumonia Severity Scores, Clinical Severity Indicators, and Radiological Findings

[Table 3] illustrates the relationship between pneumonia severity classification, clinical manifestations, and radiological abnormalities among the study participants. According to CURB-65 scores, 86.59% of patients with non-severe CAP belonged to the low-risk category, whereas only 8.33% of patients with severe CAP were classified as low risk. Conversely, 63.89% of patients with severe CAP belonged to the high-risk category, compared with none in the non-severe group, demonstrating a statistically significant association between CURB-65 classification and disease severity (p<0.001). Altered mental status or confusion was significantly more frequent among severe CAP patients (44.44%) than non-severe CAP patients (4.88%; p<0.001). Bilateral pulmonary involvement (63.89% vs. 20.73%) and multilobar pulmonary infiltrates (72.22% vs. 17.07%) were significantly more common in severe CAP, with p-values less than 0.001. Pleural effusion was also significantly more frequent in severe CAP (36.11%) compared with non-severe CAP (12.20%; p=0.003), indicating more extensive radiological involvement among patients with severe pneumonia.

[Table 4] Comparison of Clinical Complications, Respiratory Support Requirements, and Hospital Outcomes

[Table 4] compares respiratory support requirements, clinical complications, and hospital outcomes between patients with non-severe and severe community-acquired pneumonia. Supplemental oxygen was required in 97.22% of patients with severe CAP compared with 53.66% of patients with non-severe CAP (p<0.001). Intensive care unit admission was significantly more frequent in severe CAP (80.56%) than in non-severe CAP (7.32%; p<0.001). Non-invasive mechanical ventilation was required in 36.11% of severe cases compared with 6.10% of non-severe cases, while invasive mechanical ventilation and septic shock requiring vasopressors occurred in 30.56% and 27.78% of severe cases, respectively, with no such events in the non-severe group. Acute kidney injury was significantly more frequent in severe CAP (27.78% vs. 6.10%; p=0.002). Furthermore, severe CAP patients experienced significantly longer hospital stays (8.38 ± 3.55 vs. 5.78 ± 1.83 days; p<0.001) and higher in-hospital mortality (19.44% vs. 1.22%; p<0.001), demonstrating the greater burden of complications and adverse clinical outcomes associated with severe pneumonia.

[Table 5] Comparative Diagnostic Performance of Neutrophil-to-Lymphocyte Ratio and C-Reactive Protein for Predicting Severe Community-Acquired Pneumonia

[Table 5] presents the comparative diagnostic performance of NLR and CRP in identifying patients with severe community-acquired pneumonia using receiver operating characteristic (ROC) curve analysis. The area under the ROC curve was 0.925 (95% CI: 0.874–0.968) for NLR and 0.894 (95% CI: 0.826–0.950) for CRP, indicating excellent discriminatory performance for both inflammatory markers. At an optimal cut-off value of ≥6.56, NLR demonstrated a sensitivity of 83.33% and specificity

of 89.02%, whereas CRP, at a cut-off value of ≥102.70 mg/L, showed a sensitivity of 77.78% and specificity of 87.80%. The positive predictive value was higher for NLR (76.92%) than CRP (73.68%), while the negative predictive value was also greater for NLR (92.41%) compared with CRP (90.00%). Both biomarkers demonstrated statistically significant discriminatory ability compared with an AUC of 0.50 ($p<0.001$).

Table 1: Comparison of Baseline Demographic and Clinical Characteristics Among Patients With Non-Severe and Severe Community-Acquired Pneumonia (N=118)

Parameter	Non-severe CAP (n=82)	Severe CAP (n=36)	p-value
Age (years), mean ± SD	51.57 ± 12.92	65.00 ± 11.28	<0.001
Male sex	54 (65.85%)	25 (69.44%)	0.703
Body mass index (kg/m²), mean ± SD	23.88 ± 3.21	24.13 ± 3.60	0.720
Smoking history	32 (39.02%)	20 (55.56%)	0.096
Diabetes mellitus	18 (21.95%)	15 (41.67%)	0.028
Hypertension	21 (25.61%)	16 (44.44%)	0.042
Chronic obstructive pulmonary disease	15 (18.29%)	13 (36.11%)	0.036
Duration of symptoms (days), mean ± SD	4.32 ± 1.43	5.21 ± 1.90	0.014
Respiratory rate (breaths/min), mean ± SD	23.22 ± 3.22	32.33 ± 4.45	<0.001
Oxygen saturation (SpO_2 , %), mean ± SD	93.94 ± 2.43	86.53 ± 5.47	<0.001

Table 2: Comparison of Hematological and Inflammatory Biomarkers Between Non-Severe and Severe Community-Acquired Pneumonia (N=118)

Laboratory parameter	Non-severe CAP (n=82)	Severe CAP (n=36)	p-value
Total leukocyte count (×10³/µL), mean ± SD	9.75 ± 3.75	12.16 ± 6.28	0.037
Absolute neutrophil count (×10³/µL), mean ± SD	7.28 ± 3.62	10.47 ± 6.12	0.006
Absolute lymphocyte count (×10³/µL), mean ± SD	1.62 ± 0.31	0.89 ± 0.22	<0.001
Neutrophil-to-lymphocyte ratio, median (IQR)	4.16 (3.13–5.47)	10.75 (7.47–12.56)	<0.001
C-reactive protein (mg/L), median (IQR)	68.50 (49.93–89.86)	141.60 (105.45–214.39)	<0.001
Blood urea nitrogen (mg/dL), mean ± SD	17.30 ± 5.64	24.73 ± 9.62	<0.001

IQR = interquartile range. NLR and CRP were compared using the Mann–Whitney U test because of their skewed distributions.

Table 3: Comparison of Pneumonia Severity Scores, Clinical Severity Indicators, and Radiological Findings (N=118)

Parameter	Non-severe CAP (n=82)	Severe CAP (n=36)	p-value
CURB-65 severity categories			<0.001
Low risk (score 0–1)	71 (86.59%)	3 (8.33%)	—
Intermediate risk (score 2)	11 (13.41%)	10 (27.78%)	—
High risk (score 3–5)	0 (0.00%)	23 (63.89%)	—
Clinical severity indicator			
Altered mental status/confusion	4 (4.88%)	16 (44.44%)	<0.001
Radiological findings			
Bilateral pulmonary involvement	17 (20.73%)	23 (63.89%)	<0.001
Multilobar pulmonary infiltrates	14 (17.07%)	26 (72.22%)	<0.001
Pleural effusion	10 (12.20%)	13 (36.11%)	0.003

Table 4: Comparison of Clinical Complications, Respiratory Support Requirements, and Hospital Outcomes (N=118)

Clinical outcome	Non-severe CAP (n=82)	Severe CAP (n=36)	p-value
Requirement for supplemental oxygen	44 (53.66%)	35 (97.22%)	<0.001
Intensive care unit admission	6 (7.32%)	29 (80.56%)	<0.001
Non-invasive mechanical ventilation	5 (6.10%)	13 (36.11%)	<0.001
Invasive mechanical ventilation	0 (0.00%)	11 (30.56%)	<0.001
Septic shock requiring vasopressors	0 (0.00%)	10 (27.78%)	<0.001
Acute kidney injury	5 (6.10%)	10 (27.78%)	0.002
Length of hospital stay (days), mean ± SD	5.78 ± 1.83	8.38 ± 3.55	<0.001
In-hospital mortality	1 (1.22%)	7 (19.44%)	<0.001

Table 5: Comparative Diagnostic Performance of Neutrophil-to-Lymphocyte Ratio and C-Reactive Protein for Predicting Severe Community-Acquired Pneumonia (N=118)

Diagnostic parameter	NLR	CRP
Area under ROC curve (AUC)	0.925	0.894
95% confidence interval for AUC	0.874–0.968	0.826–0.950
Optimal cut-off value	≥6.56	≥102.70 mg/L
Sensitivity	83.33%	77.78%
Specificity	89.02%	87.80%
Positive predictive value	76.92%	73.68%
Negative predictive value	92.41%	90.00%
p-value (AUC versus 0.50)	<0.001	<0.001

DISCUSSION

The present study evaluated 118 patients with community-acquired pneumonia (CAP), of whom 82 (69.49%) had non-severe CAP and 36 (30.51%) had severe CAP. The mean age was significantly higher in patients with severe CAP (65.00 ± 11.28 years) compared with non-severe CAP (51.57 ± 12.92 years; p<0.001). Male predominance was observed in both groups, accounting for 69.44% and 65.85%, respectively. Similar findings were reported by Ito et al. (2017),[7] who evaluated 1,834 patients with community-acquired pneumonia and reported a mean age of 73.5 ± 14.3 years, with 69.80% male patients. Their study demonstrated that increasing age was independently associated with 30-day mortality (OR=1.04; 95% CI: 1.02–1.07), while the overall mortality rate was 6.70%. The proportion of patients with chronic obstructive pulmonary disease (COPD) was 24.00%, and diabetes mellitus was present in 19.80%. These observations support the importance of advanced age and underlying comorbidities in determining pneumonia prognosis. In the present study, diabetes mellitus (41.67% vs. 21.95%; p=0.028), hypertension (44.44% vs. 25.61%; p=0.042), and COPD (36.11% vs. 18.29%; p=0.036) were significantly more frequent among patients with severe CAP than those with non-severe CAP. Severe CAP patients also demonstrated significantly higher respiratory rates (32.33 ± 4.45 vs. 23.22 ± 3.22 breaths/min) and lower oxygen saturation (86.53 ± 5.47% vs. 93.94 ± 2.43%), with p<0.001 for both comparisons. Kanungo et al. (2024),[8] conducted a prospective multicentric study involving 1,090 elderly patients hospitalized with CAP across India and reported that 39.40% required critical care, while in-hospital mortality was 9.90%. Their study demonstrated that diabetes mellitus was independently associated with increased mortality (adjusted HR=1.72; 95% CI: 1.18–2.51), whereas oxygen saturation below 90% was associated with a substantially higher mortality risk (adjusted HR=4.05; 95% CI: 2.45–6.69). Moreover, respiratory rates ≥30 breaths/min, altered sensorium, elevated blood urea nitrogen, and chronic respiratory diseases were associated with increased intensive care requirements. Regarding hematological parameters, the present study demonstrated significantly higher total leukocyte counts (12.16 ± 6.28 vs. 9.75 ± 3.75 $\times 10^3/\mu L$; p=0.037) and absolute neutrophil counts (10.47 ± 6.12 vs. 7.28 ± 3.62 $\times 10^3/\mu L$; p=0.006) among severe CAP patients. Conversely, the absolute lymphocyte count was significantly lower in severe CAP (0.89 ± 0.22 vs. 1.62 ± 0.31 $\times 10^3/\mu L$; p<0.001). Consequently, the median neutrophil-to-lymphocyte ratio was markedly elevated in severe CAP (10.75; IQR: 7.47–12.56) compared with non-severe CAP (4.16; IQR: 3.13–5.47; p<0.001). Comparable findings were reported by de Jager et al. (2012),[9] who prospectively investigated 395 patients with CAP and observed significantly higher NLR values among non-survivors (23.3 ± 16.8) compared with survivors (13.0 ± 11.4). Their study also demonstrated a progressive increase in NLR with increasing CURB-65 severity scores. Furthermore, NLR showed better discrimination for mortality (AUC=0.701) compared with total leukocyte count (AUC=0.672) and CRP (AUC=0.565). The present study demonstrated a significant increase in inflammatory biomarker concentrations among patients with severe community-acquired pneumonia. Median CRP concentrations were 141.60 mg/L (IQR: 105.45–214.39) in severe CAP compared with 68.50 mg/L (IQR: 49.93–89.86) in non-severe CAP (p<0.001). Additionally, blood urea nitrogen was significantly higher in severe CAP patients (24.73 ± 9.62 mg/dL) than in non-severe patients (17.30 ± 5.64 mg/dL; p<0.001). Chalmers et al. (2008).[10] conducted a prospective study involving 570 patients with CAP and reported an overall 30-day mortality rate of 9.60%. They demonstrated that admission CRP concentrations below 100 mg/L were independently associated with reduced 30-day mortality (OR=0.18; 95% CI: 0.04–0.85; p=0.03) and reduced requirement for mechanical ventilation or inotropic support (OR=0.21; 95% CI: 0.14–0.40; p=0.002). Furthermore, failure of CRP concentrations to decrease by at least 50% within four days was associated with markedly increased mortality (OR=24.5; 95% CI: 6.4–93.4). Assessment of pneumonia severity using the CURB-65 scoring system revealed significant differences between the two study groups. Among patients with non-severe CAP, 86.59% belonged to the low-risk category (CURB-65 score 0–1), whereas only 8.33% of severe CAP patients were classified as low risk. Conversely, 63.89% of patients with severe CAP had high-risk scores of 3–5, compared with none in the non-severe group (p<0.001). Altered mental status was also significantly more frequent in severe CAP (44.44%) than non-severe CAP (4.88%; p<0.001). Lim et al. (2003).[11] developed and validated the CURB-65 severity assessment system using data from 1,068 patients hospitalized with CAP. They reported an overall 30-day mortality rate of 9.00% and demonstrated progressively increasing mortality with increasing severity scores. Mortality rates were reported as 0.70%, 3.20%, 3.00%, 17.00%, 41.50%, and 57.00% for CURB-65 scores of 0, 1, 2, 3, 4, and 5, respectively. Although individual mortality estimates varied across risk categories, higher CURB-65 scores generally identified patients with greater mortality risk. The present findings similarly demonstrate a strong relationship between CURB-65 classification and CAP severity, supporting the clinical importance of this scoring system in identifying high-risk patients requiring closer monitoring. Radiological assessment in the present study demonstrated significantly more extensive pulmonary involvement among patients with severe CAP. Bilateral pulmonary involvement was observed in 63.89% of severe CAP patients compared with

20.73% of non-severe patients (p<0.001), while multilobar pulmonary infiltrates were documented in 72.22% and 17.07%, respectively (p<0.001). Pleural effusion was also significantly more common in severe CAP (36.11% vs. 12.20%; p=0.003). These observations are supported by España et al. (2006),[12] who developed a clinical prediction rule for severe CAP using 1,057 patients in the derivation cohort and subsequently validated the model in independent cohorts of 719 and 1,121 patients. Their analysis identified eight important predictors of severe pneumonia, including respiratory rate above 30 breaths/min, altered mental status, hypotension, elevated blood urea nitrogen, hypoxaemia, advanced age, and multilobar or bilateral pulmonary involvement. The derived clinical prediction rule demonstrated excellent discriminatory performance, with an AUC of 0.92. The present study demonstrated significantly greater respiratory support requirements, complications, and adverse hospital outcomes among patients with severe CAP. Supplemental oxygen was required in 97.22% of severe cases compared with 53.66% of non-severe cases, while intensive care admission occurred in 80.56% and 7.32%, respectively (p<0.001). Non-invasive mechanical ventilation was required in 36.11% of severe patients, whereas 30.56% required invasive mechanical ventilation and 27.78% developed septic shock requiring vasopressors. Acute kidney injury was more frequent in severe CAP (27.78% vs. 6.10%; p=0.002), and the mean duration of hospitalization was significantly longer (8.38 ± 3.55 vs. 5.78 ± 1.83 days; p<0.001). In-hospital mortality was also significantly higher in severe CAP (19.44% vs. 1.22%; p<0.001). Sharma et al. (2025).[13] investigated 7,862 hospitalized CAP patients and reported that an admission NLR greater than 12 was independently associated with prolonged hospitalization (incidence rate ratio=1.11; 95% CI: 1.08–1.13), increased intensive care admission (adjusted OR=1.41; 95% CI: 1.06–1.88), and higher in-hospital mortality (adjusted OR=1.27; 95% CI: 1.06–1.53). Receiver operating characteristic curve analysis in the present study demonstrated excellent discriminatory performance for both NLR and CRP in identifying severe CAP. NLR showed an AUC of 0.925 (95% CI: 0.874–0.968), while CRP demonstrated an AUC of 0.894 (95% CI: 0.826–0.950). At an optimal cut-off value of ≥6.56, NLR showed a sensitivity of 83.33%, specificity of 89.02%, positive predictive value of 76.92%, and negative predictive value of 92.41%. In comparison, CRP at a cut-off of ≥102.70 mg/L demonstrated a sensitivity of 77.78%, specificity of 87.80%, positive predictive value of 73.68%, and negative predictive value of 90.00%. Liu et al. (2023).[14] evaluated 158 elderly patients with CAP, comprising 85 with mild-to-moderate pneumonia and 73 with severe pneumonia. They reported an AUC of 0.817 (95% CI: 0.751–0.883) for NLR and 0.791 (95% CI: 0.720–0.861) for CRP in predicting pneumonia severity. Their reported positive predictive values were 80.00% for NLR and 68.00% for CRP, while the corresponding negative predictive values were 76.00% and 81.00%, respectively. Multivariable analysis identified both NLR (OR=1.111; p=0.030) and CRP (OR=1.011; p=0.039) as independent factors associated with pneumonia severity. These findings are directionally consistent with the present results, demonstrating a numerical advantage of NLR over CRP in discriminating severe CAP.

CONCLUSION

The present study demonstrated that both neutrophil-to-lymphocyte ratio (NLR) and C-reactive protein (CRP) were significantly elevated in patients with severe community-acquired pneumonia compared with non-severe cases. NLR showed numerically better diagnostic performance (AUC=0.925) than CRP (AUC=0.894), although the difference was not statistically significant. Elevated inflammatory markers were associated with greater clinical severity, respiratory dysfunction, complications, prolonged hospitalization, and increased mortality. Both NLR and CRP may serve as simple, cost-effective, and readily available biomarkers for early risk stratification when combined with established clinical severity assessment tools.

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