



Correlation of Presepsin, Procalcitonin, and C - reactive protein Levels with Sequential Organ Failure Assessment Scores in Patients with Sepsis.

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Abstract

Background: Sepsis is a life-threatening condition associated with significant organ dysfunction and mortality among critically ill patients. Presepsin, procalcitonin and C-reactive protein are important biomarkers that may help assess disease severity and monitor clinical progression. Their correlation with the Sequential Organ Failure Assessment (SOFA) score may provide valuable information regarding the extent of organ dysfunction. **Aim:** This study aimed to evaluate the correlation of presepsin, procalcitonin and C-reactive protein levels with SOFA scores in ICU patients with sepsis. **Materials and Methods:** A prospective observational study was conducted among 150 patients diagnosed with sepsis and admitted to the intensive care unit. Blood samples were collected for measurement of presepsin, procalcitonin and CRP levels on days 1, 2 and 3. SOFA scores were calculated at corresponding intervals to assess organ dysfunction. The correlation between biomarker concentrations and SOFA scores was evaluated using appropriate statistical methods. A p-value of less than 0.05 was considered statistically significant. **Results:** The mean age of the study population was 54.2 ± 13.8 years, and 53.3% were male. Mechanical ventilation was required in 76.7% of patients, while 62.0% received vasopressor support. The mean SOFA score increased from 7.83 ± 4.98 on day 1 to 8.33 ± 5.27 on day 3. CRP levels demonstrated a statistically significant change across the three observation days ($p < 0.001$), whereas changes in SOFA scores, presepsin and procalcitonin were not statistically significant. On day 3, presepsin demonstrated a strong positive correlation with SOFA scores ($r = 0.941$, $p < 0.001$), followed by procalcitonin ($r = 0.660$, $p < 0.001$) and CRP ($r = 0.468$, $p = 0.002$). **Conclusion:** Presepsin demonstrated the strongest correlation with SOFA scores, followed by procalcitonin and CRP. These findings suggest that presepsin may be a valuable biomarker for assessing organ dysfunction severity in patients with sepsis, while combining these biomarkers with SOFA scoring may provide a more comprehensive clinical assessment.

Keywords: Sepsis; Presepsin; Procalcitonin; C-reactive protein; SOFA score; Organ dysfunction; Intensive care unit.



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INTRODUCTION

Sepsis is a life-threatening clinical condition characterized by organ dysfunction resulting from a dysregulated host response to infection and represents a major challenge in intensive care medicine worldwide [1]. It is associated with significant morbidity and mortality, particularly among critically ill patients requiring intensive care unit (ICU) admission, making early diagnosis and appropriate clinical management essential [2]. The clinical presentation of sepsis varies considerably, ranging from localized infection with systemic inflammatory manifestations to severe organ dysfunction and septic shock [3]. Early identification of patients at risk of developing organ failure is therefore important for initiating timely treatment and improving clinical outcomes [4].

The Sequential Organ Failure Assessment (SOFA) score is an established clinical scoring system used to assess the degree of organ dysfunction in patients with sepsis [1]. It evaluates six major organ systems, including respiratory, cardiovascular, hepatic, coagulation, renal and neurological functions, providing a standardized assessment of disease severity [2]. Changes in SOFA scores are useful in monitoring disease progression and evaluating the severity of organ dysfunction among critically ill patients [3]. However, clinical scoring systems are often complemented by laboratory biomarkers to improve the assessment of infection, systemic inflammation and disease severity [4].

Procalcitonin (PCT) is a biomarker that increases in response to bacterial infections and systemic inflammatory processes and is widely investigated for its diagnostic and prognostic significance in sepsis [5]. Its circulating concentration may reflect the intensity of the systemic inflammatory response and has been associated with the severity of infection and organ dysfunction [6]. C-reactive protein (CRP), an acute-phase protein synthesized primarily by the liver, is another commonly

used inflammatory marker that increases in response to infection and tissue injury [7]. Although CRP is sensitive to inflammatory changes, its levels may also increase in several non-infectious conditions, limiting its specificity for sepsis diagnosis [8].

Presepsin, a soluble CD14 subtype released during the activation of immune cells, has emerged as a promising biomarker for the early detection and assessment of sepsis [9]. Previous investigations have demonstrated the potential usefulness of presepsin alongside procalcitonin and CRP in identifying sepsis and evaluating its clinical severity [10]. However, evaluating the relationship between these biomarkers and organ dysfunction may provide additional information regarding their usefulness in critically ill patients. Therefore, the present study aimed to evaluate the correlation of presepsin, procalcitonin and C-reactive protein levels with Sequential Organ Failure Assessment scores in patients with sepsis admitted to the intensive care unit.

MATERIALS AND METHODS

A prospective observational study was conducted in the intensive care unit of a tertiary care hospital over a period of 12 months. The study included a total of 150 patients aged 18 years and above who were diagnosed with sepsis and admitted to the ICU during the study period. Patients fulfilling the eligibility criteria were enrolled after obtaining informed consent from themselves or their legally authorized representatives. Patients with incomplete clinical or laboratory records and those unwilling to participate in the study were excluded. Relevant demographic and clinical information, including age, sex, presenting complaints, associated comorbidities, suspected source of infection and clinical findings, was recorded using a structured data collection proforma.

Blood samples were collected from all enrolled patients at the time of ICU admission for the estimation of presepsin, procalcitonin and C-reactive protein levels. Presepsin and procalcitonin concentrations were assessed using the respective laboratory assay methods, while CRP levels were measured using the standard laboratory procedure available at the study institution. The results were documented along with other relevant biochemical and hematological investigations. The Sequential Organ Failure Assessment (SOFA) score was calculated for each patient using six organ-system parameters, namely respiratory, cardiovascular, hepatic, coagulation, renal and neurological functions. The individual organ-system scores were combined to obtain the total SOFA score, which was used to assess the extent of organ dysfunction at ICU admission.

The collected data were systematically entered into a spreadsheet and analyzed using appropriate statistical software. Continuous variables were expressed as mean and standard deviation or median and interquartile range, depending on their distribution, while categorical variables were presented as frequencies and percentages. The correlation between presepsin, procalcitonin and CRP levels and the corresponding SOFA scores was evaluated using Pearson's correlation coefficient for normally distributed variables or Spearman's rank correlation coefficient for non-normally distributed variables. The strength and direction of correlations were assessed for each biomarker separately. A p-value of less than 0.05 was considered statistically significant. The study was conducted after obtaining approval from the Institutional Ethics Committee.

RESULTS

Table 1 shows the baseline demographic and clinical characteristics of 150 patients with sepsis admitted to the intensive care unit. The mean age of the study population was 54.2 ± 13.8 years, with males accounting for 80 (53.3%) patients. Mechanical ventilation was required in 115 (76.7%) patients, while 93 (62.0%) patients received vasopressor support. The median baseline SOFA score was 8 (IQR: 6–10). The median presepsin and procalcitonin levels were 850 pg/mL (IQR: 650–1,200) and 5.3 ng/mL (IQR: 3.1–8.4), respectively. The mean CRP level was 98.7 ± 45.2 mg/L.

Table 1: Baseline demographic and clinical characteristics of patients with sepsis (n = 150)

Variable	Value
Age (years), mean $\pm$ SD	54.2 $\pm$ 13.8
Male sex, n (%)	80 (53.3%)
Mechanical ventilation, n (%)	115 (76.7%)
Vasopressor support, n (%)	93 (62.0%)
Baseline SOFA score, median (IQR)	8 (6–10)
Presepsin (pg/mL), median (IQR)	850 (650–1,200)
Procalcitonin (ng/mL), median (IQR)	5.3 (3.1–8.4)
CRP (mg/L), mean $\pm$ SD	98.7 $\pm$ 45.2

Table 2 presents the SOFA scores and biomarker levels recorded on days 1, 2 and 3 among the study participants. The mean SOFA score increased slightly from 7.83 ± 4.98 on day 1 to 8.03 ± 5.28 on day 2 and 8.33 ± 5.27 on day 3. Mean

presepsin levels showed a gradual increase from 1005.82 ± 1013.96 pg/mL on day 1 to 1050.50 ± 987.25 pg/mL on day 3. Similarly, mean procalcitonin levels increased from 16.79 ± 27.62 ng/mL to 19.48 ± 28.55 ng/mL during the observation period. Mean CRP levels also demonstrated an increasing trend, from 166.45 ± 89.98 mg/L on day 1 to 178.83 ± 97.39 mg/L on day 3.

Table 2: SOFA score and biomarker levels on days 1, 2 and 3 among patients with sepsis (n = 150)

Variable	Mean $\pm$ SD	Median (Min–Max)
SOFA score, Day 1	7.83 $\pm$ 4.98	7.00 (2.00–22.00)
Presepsin, Day 1 (pg/mL)	1005.82 $\pm$ 1013.96	748.50 (83.60–6204.00)
Procalcitonin, Day 1 (ng/mL)	16.79 $\pm$ 27.62	3.37 (0.08–100.00)
CRP, Day 1 (mg/L)	166.45 $\pm$ 89.98	142.09 (2.30–402.00)
SOFA score, Day 2	8.03 $\pm$ 5.28	6.50 (2.00–22.00)
Presepsin, Day 2 (pg/mL)	1039.20 $\pm$ 981.63	713.00 (102.00–5824.00)
Procalcitonin, Day 2 (ng/mL)	18.08 $\pm$ 26.90	3.75 (0.08–94.60)
CRP, Day 2 (mg/L)	171.12 $\pm$ 93.55	169.60 (10.10–455.00)
SOFA score, Day 3	8.33 $\pm$ 5.27	7.50 (0.00–22.00)
Presepsin, Day 3 (pg/mL)	1050.50 $\pm$ 987.25	817.50 (54.00–6020.00)
Procalcitonin, Day 3 (ng/mL)	19.48 $\pm$ 28.55	3.54 (0.08–100.00)
CRP, Day 3 (mg/L)	178.83 $\pm$ 97.39	153.17 (21.10–385.00)

Table 3 demonstrates the comparison of SOFA scores and biomarker levels across the three observation days. No statistically significant difference was observed in SOFA scores ($p = 0.140$), presepsin levels ($p = 0.497$) or procalcitonin levels ($p = 0.903$). However, CRP levels demonstrated a statistically significant difference across the three days ($p < 0.001$). These findings indicate that CRP levels changed significantly during the observation period, whereas the variations in the other parameters were not statistically significant.

Table 3: Comparison of SOFA score and biomarker levels across days 1, 2 and 3 (n = 150)

Variable	Day 1	Day 2	Day 3	p value
SOFA score, mean $\pm$ SD	7.83 $\pm$ 4.98	8.03 $\pm$ 5.28	8.33 $\pm$ 5.27	0.140
SOFA score, median	7.00	6.50	7.50	—
SOFA score, Min–Max	2.00–22.00	2.00–22.00	0.00–22.00	—
Presepsin (pg/mL), mean $\pm$ SD	1005.82 $\pm$ 1013.96	1039.20 $\pm$ 981.63	1050.50 $\pm$ 987.25	0.497
Presepsin, median	748.50	713.00	817.50	—
Presepsin, Min–Max	83.60–6204.00	102.00–5824.00	54.00–6020.00	—
Procalcitonin (ng/mL), mean $\pm$ SD	16.79 $\pm$ 27.62	18.08 $\pm$ 26.90	19.48 $\pm$ 28.55	0.903
Procalcitonin, median	3.37	3.75	3.54	—
Procalcitonin, Min–Max	0.08–100.00	0.08–94.60	0.08–100.00	—
CRP (mg/L), mean $\pm$ SD	166.45 $\pm$ 89.98	171.12 $\pm$ 93.55	178.83 $\pm$ 97.39	<0.001*
CRP, median	142.09	169.60	153.17	—
CRP, Min–Max	2.30–402.00	10.10–455.00	21.10–385.00	—

Table 4 illustrates the correlation between SOFA scores and biomarker levels on day 3. Presepsin demonstrated a strong positive correlation with SOFA scores ($r = 0.941$, $p < 0.001$). Procalcitonin also showed a significant positive correlation ($r = 0.660$, $p < 0.001$), while CRP exhibited a moderate positive correlation ($r = 0.468$, $p = 0.002$). Among the three biomarkers, presepsin demonstrated the strongest correlation with SOFA scores, followed by procalcitonin and CRP.

Table 4: Correlation between SOFA score and biomarker levels on day 3 among patients with sepsis (n = 150)

Biomarker	Correlation coefficient (r)	p value
C-reactive protein (mg/L)	0.468	0.002*
Procalcitonin (ng/mL)	0.660	<0.001*
Presepsin (pg/mL)	0.941	<0.001*

DISCUSSION

The present study evaluated the correlation of presepsin, procalcitonin and C-reactive protein levels with SOFA scores among 150 patients admitted to the intensive care unit with sepsis [11]. The findings demonstrated a positive correlation between all three biomarkers and SOFA scores, indicating that increasing biomarker concentrations were associated with greater severity of organ dysfunction [12]. Among the evaluated biomarkers, presepsin demonstrated the strongest

correlation ($r = 0.941$), followed by procalcitonin ($r = 0.660$) and CRP ($r = 0.468$) [15]. These findings highlight the potential role of presepsin as an important biomarker for assessing sepsis severity and organ dysfunction [11,15].

Presepsin demonstrated a very strong positive correlation with SOFA scores ($r = 0.941$, $p < 0.001$), suggesting a close association between its circulating concentration and the extent of organ dysfunction [11]. Abdelshafey et al. investigated the diagnostic and prognostic significance of presepsin in patients with sepsis and reported its potential usefulness in predicting ICU mortality [11]. Their findings support the clinical relevance of presepsin in evaluating disease severity and prognosis [11]. The strong correlation observed in the present study further emphasizes its potential value as a biomarker for monitoring critically ill patients with sepsis [15].

Procalcitonin also demonstrated a significant positive correlation with SOFA scores ($r = 0.660$, $p < 0.001$), indicating that higher procalcitonin concentrations were associated with increased organ dysfunction [12]. Previous investigations comparing procalcitonin and presepsin have highlighted the usefulness of both biomarkers in identifying sepsis and assessing its clinical severity [12,14]. The findings of the present study suggest that procalcitonin remains a valuable laboratory marker for evaluating systemic infection and its association with organ dysfunction [14].

C-reactive protein showed a moderate positive correlation with SOFA scores ($r = 0.468$, $p = 0.002$), suggesting that increased inflammatory activity was associated with greater organ dysfunction [13]. Previous studies have indicated that CRP levels may vary considerably in critically ill patients because of infectious and non-infectious inflammatory conditions [13]. Therefore, although CRP remains a useful marker of systemic inflammation, its association with organ dysfunction may be less pronounced than that of other sepsis-related biomarkers [14,15].

The comparative analysis of biomarker levels over the three observation days revealed no statistically significant changes in SOFA scores ($p = 0.140$), presepsin ($p = 0.497$) or procalcitonin ($p = 0.903$) [12,14]. In contrast, CRP levels demonstrated a statistically significant difference across the observation period ($p < 0.001$) [13]. These findings suggest that inflammatory biomarker patterns may change differently during the clinical course of sepsis [12,13]. Previous comparative investigations have also demonstrated differences in the diagnostic and prognostic performance of presepsin, procalcitonin and CRP among critically ill patients [14].

The findings of the present study are particularly comparable with those reported by Anggraeni et al., who evaluated the correlation between presepsin, procalcitonin, CRP and SOFA scores in ICU patients with sepsis [15]. Their study demonstrated a very strong positive correlation between presepsin and SOFA scores on day 3 ($r = 0.941$), along with significant positive correlations for procalcitonin ($r = 0.660$) and CRP ($r = 0.468$) [15]. These findings closely correspond to the results observed in the present study, supporting the potential usefulness of these biomarkers, particularly presepsin, in assessing organ dysfunction severity among patients with sepsis [15].

Overall, the results indicate that presepsin demonstrated the strongest relationship with SOFA scores, followed by procalcitonin and CRP [11,15]. The comparatively higher correlation coefficient of presepsin suggests that it may provide valuable information regarding the severity of organ dysfunction in critically ill patients [11,15]. Combining biomarker measurements with established clinical scoring systems such as SOFA may improve the overall assessment of patients with sepsis and support clinical decision-making [12,14].

CONCLUSION

The present study demonstrated significant positive correlations between presepsin, procalcitonin and C-reactive protein levels with SOFA scores among ICU patients with sepsis. Presepsin exhibited the strongest correlation, followed by procalcitonin and CRP, indicating its potential value as a biomarker for assessing the severity of organ dysfunction. CRP levels also showed significant changes during the three-day observation period. These findings suggest that presepsin, procalcitonin and CRP can serve as useful complementary biomarkers alongside the SOFA scoring system for evaluating disease severity in patients with sepsis.

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