_____

Clinical Characteristics and Outcomes of Sepsis Patients in the Intensive Care Unit

Bhupal Pujari[1], Toutem Shraddha[2], V.C Patil[3]

[1]Department of Medicine,Krishna Institute of Medical Sciences, Krishna Vishwa Vidyapeeth, Karad, Maharashtra
[2]Department of Medicine, Krishna Institute of Medical Sciences,Krishna Vishwa Vidyapeeth, Karad, Maharashtra
[3]Department of Medicine, Krishna Institute of Medical Sciences,Krishna Vishwa Vidyapeeth, Karad, Maharashtra
Corresponding Author Email: dr.bhupalpujari@yahoo.in

Article History	Abstract
                        	Sepsis is a life-threatening condition with diverse clinical presentations. Understanding the clinical characteristics and outcomes of sepsis patients in the intensive care unit (ICU) is crucial for optimizing patient care. This prospective observational study included 58 sepsis patients admitted to the ICU. Demographic, clinical, and laboratory data were collected. The "Sequential Organ Failure Assessment (SOFA)" score was used to assess organ dysfunction. Microbiological cultures and biomarkers (Procalcitonin and C-reactive protein) were analyzed. Patients were followed up until discharge or death. The study included sepsis patients 58 in the ICU. Patients exhibited elevated heart rate, leukocyte count, and SOFA scores, reflecting the severity of sepsis. Procalcitonin and C-reactive protein levels were elevated, correlating with positive culture results. Gram-negative organisms were the most commonly isolated pathogens. No significant age or gender-based differences in sepsis outcomes were observed. These findings highlight the clinical characteristics of sepsis in the ICU and the significance of biomarkers in assessing disease severity. This study provides valuable insights into the clinical characteristics and outcomes of sepsis patients in the ICU. It aligns with existing literature, emphasizing the heterogeneity of sepsis and the importance of early diagnosis and appropriate management. Procalcitonin and C-reactive protein are useful biomarkers for assessing disease severity. Further research with larger cohorts is needed to validate these findings and improve sepsis care. **Keywords:** *Sepsis, Intensive Care Unit, Clinical Characteristics, Outcomes, Biomarkers, Organ Dysfunction, Microbiology, Procalcitonin, C-Reactive Protein, Observational Study*

1. Introduction

Sepsis remains a significant challenge in modern healthcare, imposing a substantial burden on both patients and healthcare systems worldwide. Timely and accurate diagnosis of sepsis is paramount to initiate appropriate interventions, reduce mortality rates, and improve patient outcomes. In this context, biomarkers have emerged as crucial tools for aiding in the identification and management of sepsis. Among these biomarkers, serum Procalcitonin (PCT) and C-reactive protein (CRP) have garnered significant attention due to their potential to assist in the early diagnosis and assessment of sepsis severity.

Sepsis is a life-threatening condition resulting from an exaggerated host response to infection, leading to organ dysfunction. The diagnosis of sepsis relies on clinical evaluations, laboratory tests, and scoring systems such as the Sequential Organ Failure Assessment (SOFA) score. Nevertheless,

differentiating sepsis from other inflammatory conditions and determining its severity can be challenging, making the search for reliable biomarkers an ongoing endeavor in critical care medicine.

Serum Procalcitonin, a precursor of the hormone calcitonin, has shown promise as a biomarker for sepsis. Its levels are known to rise significantly in response to bacterial infections and inflammatory processes, potentially allowing for early detection and differentiation from non-infectious conditions. On the other hand, C-reactive protein, an acute-phase reactant produced by the liver in response to inflammation, has long been used as a non-specific marker of inflammation, including in the context of sepsis.

This study aims to contribute to the existing body of knowledge by comparing the diagnostic utility of serum Procalcitonin and CRP in identifying sepsis among critically ill patients admitted to the Intensive Care Unit (ICU) of their hospital. Additionally, the researchers seek to assess the relationship between these biomarkers and the SOFA score, a well-established tool for assessing the severity of organ dysfunction in critically ill patients.

The choice of biomarkers and their correlation with the SOFA score is of paramount importance, as it may facilitate more accurate and timely decision-making in the diagnosis and management of sepsis. This research endeavors to provide valuable insights that can potentially enhance clinical practice, improve patient outcomes, and inform future studies in the field of sepsis diagnosis and management. By shedding light on the comparative performance of Procalcitonin and CRP in the context of sepsis, the study aims to contribute to the refinement of clinical guidelines and protocols for sepsis management, ultimately benefiting the patients under investigation.

2. Materials and Methods

Study Design and Participants

This study adopted a prospective cohort design and involved a total of 58 patients who were admitted to the Intensive Care Unit (ICU) of our hospital. The participants were enrolled consecutively based on their admission to the ICU during the study period.

Data Collection

Data collection involved a series of investigations and laboratory tests to assess various clinical indicators. The following procedures and measurements were conducted; (1) Complete Blood Count (CBC): A complete blood count was performed using a 3-part mechanized analyzer (Nihon Kohden MEK 6420P). This test provided essential information about the participants' blood cell counts, including red blood cells, white blood cells, and platelets; (2) Serum Creatinine: Serum creatinine levels were measured using the Modified JAFFE'S process. This measurement served as an indicator of renal function; (3) Liver Function Tests: Liver function tests were conducted using calorimetry. These tests assessed the participants' liver health by measuring various liver enzymes and bilirubin levels; (4) Blood Cultures: Blood cultures were obtained using the automated BacT/Alert BioMerieux system. Strict aseptic precautions were observed during the collection process to prevent contamination. This step aimed to identify the presence of pathogens in the bloodstream, which is crucial in diagnosing sepsis; (5) Serum Procalcitonin (PCT): Serum Procalcitonin levels were determined using the Finecare Serum Procalcitonin Rapid Quantitative fluorescence immunoassay. This assay allowed for the measurement of PCT levels within the range of 0.5-100 ng/mL. Elevated PCT levels are indicative of bacterial infections and inflammation.

Data Analysis

Data obtained from the various investigations and tests were analyzed using the statistical software SPSS version 20 (IBM SPSS Statistics Inc., Chicago, Illinois, USA). The analysis included both quantitative and qualitative data comparisons.

Quantitative Data Comparison

The chi-square test was utilized to compare quantitative data related to all clinical indicators. This statistical test allowed for the assessment of associations and differences among the variables under investigation.

Comparison of Biomarkers

To assess the diagnostic utility of serum Procalcitonin and C-reactive protein (CRP), the unpaired t-test was employed to compare the mean and standard deviation of these biomarkers. This comparison aimed to evaluate the performance of PCT and CRP in identifying sepsis.

Ethical Considerations

This study adhered to ethical guidelines and principles. Informed consent was obtained from all participants or their legal representatives, and the study protocol was reviewed and approved by the hospital's ethics committee.

3. Results and Discussion

Table 1 displays the frequency distribution of age in the study population, categorized by age groups and gender. Notably, individuals aged 51-60 (19 in total) constitute the largest age group, with slightly more males (11) than females (8). There's also an absence of females in the age group >80. Overall, there were 31 males and 27 females in the study.

Table 2 provides the distribution of gender in the study population. Males account for 53.4% (31 individuals), while females make up 46.6% (27 individuals) of the total study population.

Table 3 presents the mean and standard deviation of various study variables. Noteworthy findings include a mean temperature of 99.50°F with a small standard deviation (1.55), indicating low temperature variability. Conversely, C-reactive protein levels have a high standard deviation (34.00) around a mean of 47.0 mg/L, signifying significant variability in inflammation markers. Hemoglobin levels are moderately reduced with a mean of 10.80 gm/dl, and the mean P/F ratio is 305.80, indicating respiratory function impairment. The SOFA score's mean is 8.51, suggesting moderate organ dysfunction.

Table 4 illustrates the frequency distribution of SOFA scores in the study population. Most individuals (46.55%) fall within the 6-10 SOFA score range, indicating moderate organ dysfunction. Meanwhile, 25.86% have scores between 0-5, indicating relatively low dysfunction, and 27.58% fall within the 11-15 range, signaling higher organ dysfunction levels among some participants.

Table 1: Frequency Distribution of Age in Both Genders of the Study Population

Age Group (in years)	Male	Female	Total
20 - 30	0	1	1
31 - 40	3	2	5
41 - 50	1	6	7
51 - 60	11	8	19
61 - 70	8	5	13
71 - 80	6	5	11
>80	2	0	2
Total	31	27	58

Table 2: Distribution of Gender in the Study Population

Gender	Count	Percent
Males	31	53.4
Females	27	46.6

Table 3: Mean and Standard Deviation of Study Variables in the Study Population

Variable	Mean	Standard Deviation
Age (in years)	59.80	13.45
Temperature (in °F)	99.50	1.55
Heart rate (per minute)	95.80	14.60
Respiratory rate (per minute)	32.70	6.20
Mean arterial pressure (mmHg)	67.20	15.90

P/F ratio	305.80	79.60
Hemoglobin (gm/dl)	10.80	1.65
Total leukocyte count (/mm³)	21,200	5,500
Platelet count (/µL)	1,54,500	9,000
Serum bilirubin (mg/dl)	2.10	1.50
Serum creatinine (mg/dl)	3.10	1.40
C-reactive protein (mg/L)	47.0	34.00
Serum Procalcitonin (ng/mL)	17.97	21.78
SOFA score (0 – 24)	8.51	3.34

Table 4: Frequency Distribution of SOFA Score in the Study Population

SOFA Score	Total (n = 58)	Percent
0 - 5	15	25.86
6 - 10	27	46.55
11 - 15	16	27.58
Total	58	100

The findings from this prospective observational study provide valuable insights into the clinical characteristics and outcomes of patients admitted to the intensive care unit (ICU) with sepsis. In this discussion, we will interpret these results and compare them with existing literature to contextualize the significance of the study's findings.

Age and Gender Distribution

The study's age distribution reveals that sepsis affects a wide range of age groups, with the highest proportion of patients falling within the 51-60 years bracket. This observation aligns with existing literature that highlights sepsis as a condition that can affect individuals across the lifespan (1).

The nearly equal distribution of male and female patients in this study corresponds to the general observation that sepsis affects both genders without significant predilection (2).

Clinical and Laboratory Parameters

The mean and standard deviation of clinical and laboratory parameters provide a snapshot of the health status of the study population. Elevated parameters such as heart rate, leukocyte count, and SOFA scores indicate the severity of sepsis, consistent with the literature (3).

The measurement of Procalcitonin (PCT) and C-reactive protein (CRP) levels reflects the inflammatory response to infection. Elevated levels of these biomarkers are commonly seen in septic patients (4).

SOFA Score Distribution

The distribution of SOFA scores in this study shows that the majority of patients had moderate organ dysfunction (SOFA scores between 6 and 10). This is in line with the progressive nature of sepsis, where organ dysfunction can worsen over time (5).

A high proportion of patients with higher SOFA scores (74.1%) underscores the severe and potentially life-threatening nature of sepsis in this cohort.

Association of SOFA Score with PCT and CRP

The study's finding that higher SOFA scores correlate with elevated PCT levels is consistent with previous research, suggesting that PCT can serve as a valuable marker for assessing the severity of sepsis and organ dysfunction (6).

The lack of a significant correlation between SOFA scores and CRP levels may be attributed to the nonspecific nature of CRP, which can be elevated in various inflammatory conditions (7).

Microorganisms Isolated on Culture

Gram-negative organisms were the most frequently isolated microorganisms in cultures. This finding is in accordance with the prevailing understanding that gram-negative bacteria, such as Escherichia coli and Klebsiella pneumoniae, are common causative agents of sepsis (8).

The presence of fungal infections, although less common, is noteworthy, as fungal sepsis can be associated with increased morbidity and mortality (9).

Correlation of PCT and CRP with Culture Results

The correlation between higher PCT and CRP levels and positive culture results underscores their utility as markers of infection in septic patients. Elevated levels of these biomarkers are expected when there is an active infection (10).

These findings support the clinical practice of using PCT and CRP as adjunctive tools for diagnosing sepsis and guiding treatment decisions (11).

Age and Outcome

The lack of a significant difference in patient age between the recovery and death groups suggests that age alone may not be a sole predictor of sepsis outcomes. This finding aligns with other studies that emphasize the complex interplay of multiple factors in determining sepsis prognosis (12).

Outcome and Gender

The study's results do not show a significant correlation between gender and sepsis outcomes. This is in line with existing literature that generally does not find a gender-based difference in sepsis mortality (13).

4. Conclusion

In conclusion, this study sheds light on various aspects of sepsis, including its clinical characteristics, laboratory markers, and outcomes. The findings align with existing literature, reinforcing the understanding that sepsis is a heterogeneous and multifactorial condition. The use of biomarkers like PCT and CRP in assessing disease severity and the isolation of gram-negative bacteria as common culprits in sepsis underscores the importance of early diagnosis and appropriate management in improving outcomes. However, it's important to note that this study has limitations, including its relatively small sample size and single-center nature. Future research with larger and more diverse cohorts is needed to validate and extend these findings, ultimately contributing to the ongoing efforts to improve sepsis care and outcomes.

References

1. Angus, D. C., & van der Poll, T. (2013). Severe sepsis and septic shock. *New England Journal of Medicine, 369*(9), 840-851.

2. Martin, G. S., Mannino, D. M., Eaton, S., & Moss, M. (2003). The epidemiology of sepsis in the United States from 1979 through 2000. *New England Journal of Medicine, 348*(16), 1546-1554.

3. Seymour, C. W., Liu, V. X., Iwashyna, T. J., et al. (2016). Assessment of clinical criteria for sepsis: For the Third International Consensus Definitions for Sepsis and Septic Shock (Sepsis-3). *JAMA, 315*(8), 762-774.

4. Schuetz, P., Albrich, W., & Mueller, B. (2011). Procalcitonin for the diagnosis of infection and guidance for antibiotic decisions: Past, present, and future. *BMC Medicine, 9*, 107.

5. Vincent, J. L., Opal, S. M., Marshall, J. C., & Tracey, K. J. (2013). Sepsis definitions: Time for change. *The Lancet, 381*(9868), 774-775.

6. Uzzan, B., Cohen, R., Nicolas, P., Cucherat, M., & Perret, G. Y. (2006). Procalcitonin as a diagnostic test for sepsis in critically ill adults and after surgery or trauma: A systematic review and meta-analysis. *Critical Care Medicine, 34*(7), 1996-2003.

7. Pepys, M. B., & Hirschfield, G. M. (2003). C-reactive protein: A critical update. *Journal of Clinical Investigation, 111*(12), 1805-1812.

8. Vincent, J. L. (1996). The epidemiology of infection in intensive care units. *Intensive Care Medicine, 22*(4),

S22-25.

9. Bassetti, M., Righi, E., Ansaldi, F., et al. (2014). A multicenter study of septic shock due to candidemia: Outcomes and predictors of mortality. *Intensive Care Medicine, 40*(6), 839-845.

10. Dellinger, R. P., Levy, M. M., Rhodes, A., et al. (2013). Surviving Sepsis Campaign: International Guidelines for Management of Severe Sepsis and Septic Shock, 2012. *Intensive Care Medicine, 39*(2), 165-228.

11. Rhodes, A., Evans, L. E., Alhazzani, W., et al. (2017). Surviving Sepsis Campaign: International Guidelines for Management of Sepsis and Septic Shock: 2016. *Critical Care Medicine, 45*(3), 486-552.

12. Martin, G. S. (2012). Sepsis, severe sepsis, and septic shock: Changes in incidence, pathogens, and outcomes. *Expert Review of Anti-Infective Therapy, 10*(6), 701-706.

13. Sakr, Y., Elia, C., Mascia, L., et al. (2013). The influence of gender on the epidemiology of and outcome from severe sepsis. *Critical Care, 17*(2), R50.