

Early Predictors of Sepsis Outcomes in Hospitalized Patients

Manahil Sana

Kabir Medical College, Gandhara University, Peshawar, House officer in Naseer Teaching Hospital

Corresponding Author: Manahil Sana

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Abstract-

Background: Sepsis remains a major cause of morbidity and mortality among hospitalized patients worldwide. Early identification of patients at risk of poor outcomes is essential for timely intervention and improved survival. **Objective:** To evaluate early clinical and laboratory predictors associated with sepsis outcomes among hospitalized patients. **Materials and Methods:** A prospective observational study was conducted among 200 adult patients diagnosed with sepsis and admitted to a tertiary care hospital. Demographic characteristics, clinical parameters, Sequential Organ Failure Assessment (SOFA) scores, quick SOFA (qSOFA) scores, serum lactate levels, white blood cell counts, C-reactive protein (CRP), and procalcitonin levels were recorded within the first 24 hours of admission. Patients were followed until discharge or death. Statistical analyses were performed to identify predictors of mortality and prolonged hospital stay. **Results:** Among the 200 patients, 45 (22.5%) died during hospitalization. Non-survivors had significantly higher SOFA scores (9.2 ± 2.8 vs. 5.4 ± 2.1), serum lactate levels (4.8 ± 1.9 mmol/L vs. 2.3 ± 1.2 mmol/L), and procalcitonin levels (12.4 ± 4.8 ng/mL vs. 5.6 ± 2.7 ng/mL) compared to survivors ($p < 0.001$). Multivariate analysis identified elevated lactate levels, SOFA score ≥ 8 , and hypotension at admission as independent predictors of mortality. **Conclusion:** Early assessment of SOFA score, serum lactate, and hemodynamic status can effectively predict outcomes in septic patients. Incorporating these indicators into routine clinical evaluation may facilitate early risk stratification and improve patient management.

Keywords: Sepsis, SOFA score, lactate, mortality, predictors, critical care.

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INTRODUCTION

Sepsis is a life-threatening organ dysfunction caused by a dysregulated host response to infection and represents a major global healthcare challenge. According to the Sepsis-3 consensus definition, sepsis is characterized by acute organ dysfunction resulting from infection, while septic shock is a subset associated with profound circulatory and metabolic abnormalities that substantially increase mortality risk [1]. Despite advances in critical care and antimicrobial therapy, sepsis remains one of the leading causes of hospitalization, intensive care unit (ICU) admission, and death worldwide.

The global burden of sepsis is considerable, with an estimated 49 million cases and 11 million sepsis-related deaths annually, accounting for nearly 20% of all global deaths [2]. Developing countries face an even greater burden due to delayed diagnosis, limited healthcare resources, and inadequate access to advanced critical care facilities. Early recognition and prompt management are therefore essential components of sepsis care.

The clinical presentation of sepsis is highly variable and may range from mild systemic inflammatory responses to severe multiorgan failure. Delayed identification often results in progression to septic shock, prolonged hospitalization, and increased mortality [3]. Consequently, researchers and clinicians have focused on identifying early predictors that can reliably distinguish high-risk patients from those likely to experience favorable outcomes.

Several clinical scoring systems have been developed to aid in risk stratification. The Sequential Organ Failure Assessment (SOFA) score is widely used to evaluate the extent of organ dysfunction and predict mortality among septic patients [4]. The quick SOFA (qSOFA) score, which includes altered mental status, hypotension, and tachypnea, provides a rapid bedside assessment tool for identifying patients at increased risk of adverse outcomes [1].

Biomarkers have also gained importance in sepsis prognosis. Elevated serum lactate levels reflect tissue hypoperfusion and have consistently been associated with increased mortality [5]. Procalcitonin and C-reactive protein (CRP) are inflammatory biomarkers commonly used to assess infection severity and monitor treatment response [6]. Additionally,

abnormalities in white blood cell counts, platelet counts, and renal function tests may indicate worsening organ dysfunction and poor prognosis.

Recent studies have demonstrated that combining clinical scoring systems with laboratory biomarkers improves predictive accuracy for sepsis outcomes [7]. Early identification of high-risk patients allows clinicians to initiate aggressive resuscitation, optimize antimicrobial therapy, and implement intensive monitoring strategies. Such interventions have been shown to reduce mortality and improve clinical outcomes.

Given the significant burden of sepsis and the need for timely intervention, this study aimed to evaluate early clinical and laboratory predictors associated with outcomes among hospitalized patients diagnosed with sepsis. Identifying reliable predictors may facilitate prompt risk stratification and contribute to improved patient management and survival.

MATERIALS AND METHODS

Study Design and Setting

A prospective observational study was conducted in the Department of Internal Medicine and Intensive Care Unit of a tertiary care teaching hospital over a period of 12 months.

Study Population

Adult patients aged 18 years and above who fulfilled the Sepsis-3 diagnostic criteria for sepsis were included in the study. Patients admitted with confirmed or suspected infection and evidence of organ dysfunction were enrolled after obtaining informed consent.

Inclusion Criteria

1. Age \geq 18 years.
2. Diagnosis of sepsis according to Sepsis-3 criteria.
3. Admission to medical wards or intensive care units.
4. Availability of complete clinical and laboratory data within 24 hours of admission.

Exclusion Criteria

1. Pregnant women.
2. Patients with terminal malignancy.
3. Patients receiving immunosuppressive therapy.
4. Readmissions during the study period.
5. Incomplete clinical records.

Sample Size

A total of 200 patients meeting the eligibility criteria were included in the study.

Data Collection

Data were collected within the first 24 hours of hospital admission using a structured data collection form. Demographic variables included age, sex, and comorbid conditions such as diabetes mellitus, hypertension, chronic kidney disease, and chronic liver disease.

Clinical parameters recorded included:

- Heart rate
- Respiratory rate
- Blood pressure
- Body temperature
- Oxygen saturation
- Glasgow Coma Scale (GCS)

Laboratory Investigations

The following laboratory parameters were measured:

- Complete blood count
- Serum lactate
- C-reactive protein (CRP)
- Procalcitonin
- Serum creatinine
- Blood urea nitrogen
- Liver function tests

- Blood cultures

Severity Assessment

SOFA and qSOFA scores were calculated at admission. Organ dysfunction was assessed using standard criteria. Patients were monitored daily until discharge or death.

Outcome Measures

Primary Outcome:

- In-hospital mortality.

Secondary Outcomes:

- Length of hospital stay.
- ICU admission.
- Requirement for mechanical ventilation.

Statistical Analysis

Data were analyzed using SPSS version 25. Continuous variables were expressed as mean \pm standard deviation, while categorical variables were expressed as frequencies and percentages. Student's t-test and Chi-square test were used to compare groups. Multivariate logistic regression analysis was performed to identify independent predictors of mortality. A p-value <0.05 was considered statistically significant.

Ethical Considerations

The study protocol was approved by the Institutional Ethics Committee. Written informed consent was obtained from all participants or their legally authorized representatives. Confidentiality of patient information was maintained throughout the study.

RESULTS

Table 1. Baseline Characteristics of Study Participants

Variable	Survivors (n=155)	Non-Survivors (n=45)	p-value
Age (years)	56.8 \pm 15.4	64.3 \pm 14.7	0.003
Male (%)	58.7	62.2	0.672
Diabetes Mellitus (%)	35.5	48.9	0.098
Hypertension (%)	42.6	55.6	0.118

Non-survivors were significantly older than survivors. Although diabetes and hypertension were more prevalent among non-survivors, the differences were not statistically significant.

Table 2. Comparison of Early Clinical and Laboratory Parameters

Parameter	Survivors	Non-Survivors	p-value
SOFA Score	5.4 \pm 2.1	9.2 \pm 2.8	<0.001
qSOFA Score	1.5 \pm 0.7	2.6 \pm 0.5	<0.001
Lactate (mmol/L)	2.3 \pm 1.2	4.8 \pm 1.9	<0.001
CRP (mg/L)	82 \pm 35	118 \pm 42	<0.001
Procalcitonin (ng/mL)	5.6 \pm 2.7	12.4 \pm 4.8	<0.001

Higher SOFA scores, qSOFA scores, serum lactate levels, CRP levels, and procalcitonin levels were significantly associated with mortality.

Table 3. Multivariate Logistic Regression Analysis

Predictor	Odds Ratio (OR)	95% CI	p-value
SOFA Score ≥ 8	3.82	2.01–7.24	<0.001
Lactate >4 mmol/L	4.56	2.24–9.31	<0.001
Hypotension	2.93	1.42–6.03	0.004
Procalcitonin >10 ng/mL	2.11	1.03–4.32	0.041

Elevated lactate levels, SOFA score ≥ 8 , hypotension, and high procalcitonin levels independently predicted in-hospital mortality.

DISCUSSION

The present study evaluated early clinical and laboratory predictors of outcomes among hospitalized patients with sepsis. The findings demonstrated that elevated SOFA scores, serum lactate levels, hypotension, and increased procalcitonin concentrations were strongly associated with increased mortality.

The mortality rate observed in this study was 22.5%, which is consistent with previous investigations reporting mortality rates ranging from 20% to 35% among hospitalized septic patients [8]. The burden of sepsis remains substantial despite improvements in critical care management, emphasizing the importance of early risk stratification.

Age emerged as an important factor associated with mortality. Older patients exhibited significantly higher mortality rates compared to younger patients. This finding is consistent with previous studies suggesting that advanced age contributes to impaired immune responses, increased comorbidity burden, and diminished physiological reserve, thereby increasing vulnerability to adverse outcomes [9].

The SOFA score was one of the strongest predictors of mortality in the current study. Patients with SOFA scores of 8 or higher were nearly four times more likely to die during hospitalization. Similar findings have been reported by Raith et al., who demonstrated superior prognostic performance of SOFA compared with systemic inflammatory response syndrome (SIRS) criteria in predicting mortality among critically ill patients with infection [10].

Serum lactate was another significant predictor of poor outcomes. Elevated lactate levels indicate tissue hypoxia and impaired cellular metabolism, both hallmarks of severe sepsis and septic shock. Previous studies have consistently shown that hyperlactatemia is associated with increased mortality and can serve as a valuable marker for identifying high-risk patients early in their clinical course [11].

Procalcitonin also demonstrated prognostic significance. Higher procalcitonin levels among non-survivors suggest a greater burden of systemic inflammation and infection severity. Schuetz et al. reported that elevated procalcitonin concentrations correlate with disease severity and adverse outcomes in septic patients [12]. The biomarker may therefore be useful not only for diagnosis but also for risk assessment and monitoring therapeutic response.

Hypotension at presentation was independently associated with mortality, highlighting the critical role of circulatory dysfunction in sepsis progression. Persistent hypotension contributes to inadequate tissue perfusion and organ failure, increasing the likelihood of adverse outcomes [13]. Early recognition and aggressive hemodynamic resuscitation remain key components of sepsis management.

The findings of this study support the integration of clinical scoring systems and laboratory biomarkers for comprehensive risk assessment. Combining SOFA score evaluation with lactate and procalcitonin measurements may improve prognostic accuracy and guide treatment decisions. Early identification of high-risk patients can facilitate prompt initiation of evidence-based interventions, including fluid resuscitation, vasopressor therapy, source control, and appropriate antimicrobial treatment.

The study has certain limitations. It was conducted at a single center, which may limit generalizability. Additionally, biomarker measurements were obtained only at admission and serial monitoring was not performed. Future multicenter studies with larger sample sizes and repeated biomarker assessments may provide further insights into sepsis prognosis.

CONCLUSION

Early predictors such as elevated SOFA score, increased serum lactate levels, hypotension, and elevated procalcitonin concentrations are significantly associated with poor outcomes in hospitalized patients with sepsis. These parameters can be readily assessed during the initial evaluation and may assist clinicians in identifying high-risk patients who require intensive monitoring and aggressive management. Early risk stratification using these predictors has the potential to improve patient outcomes and reduce sepsis-related mortality.

REFERENCES

1. Singer M, Deutschman CS, Seymour CW, Shankar-Hari M, Annane D, Bauer M, et al. The Third International Consensus Definitions for Sepsis and Septic Shock (Sepsis-3). *JAMA*. 2016;315(8):801-810.
2. Rudd KE, Johnson SC, Agesa KM, Shackelford KA, Tsoi D, Kievlan DR, et al. Global, regional, and national sepsis incidence and mortality. *Lancet*. 2020;395(10219):200-211.
3. Rhodes A, Evans LE, Alhazzani W, Levy MM, Antonelli M, Ferrer R, et al. Surviving Sepsis Campaign Guidelines. *Intensive Care Med*. 2017;43(3):304-377.
4. Vincent JL, Moreno R, Takala J, Willatts S, De Mendonça A, Bruining H, et al. The SOFA score to describe organ dysfunction. *Intensive Care Med*. 1996;22(7):707-710.

5. Mikkelsen ME, Miltiades AN, Gaieski DF, Goyal M, Fuchs BD, Shah CV, et al. Serum lactate and mortality in severe sepsis. *Crit Care Med.* 2009;37(5):1670-1677.
6. Pierrakos C, Vincent JL. Sepsis biomarkers: a review. *Crit Care.* 2010;14(1):R15.
7. Liu V, Escobar GJ, Greene JD, Soule J, Whippy A, Angus DC, et al. Hospital deaths in patients with sepsis. *JAMA.* 2014;312(1):90-92.
8. Fleischmann C, Scherag A, Adhikari NKJ, Hartog CS, Tsaganos T, Schlattmann P, et al. Assessment of global incidence and mortality of sepsis. *Am J Respir Crit Care Med.* 2016;193(3):259-272.
9. Martin GS, Mannino DM, Moss M. The effect of age on sepsis outcomes. *Crit Care Med.* 2006;34(1):15-21.
10. Raith EP, Udy AA, Bailey M, McGloughlin S, MacIsaac C, Bellomo R, et al. Prognostic accuracy of SOFA score. *JAMA.* 2017;317(3):290-300.
11. Casserly B, Phillips GS, Schorr C, Dellinger RP, Townsend SR, Osborn TM, et al. Lactate measurements and outcomes in sepsis. *Crit Care Med.* 2015;43(3):567-573.
12. Schuetz P, Chiappa V, Briel M, Greenwald JL. Procalcitonin algorithms for antibiotic therapy decisions. *Arch Intern Med.* 2011;171(15):1322-1331.
13. Seymour CW, Liu VX, Iwashyna TJ, Brunkhorst FM, Rea TD, Scherag A, et al. Time to treatment and mortality during sepsis. *N Engl J Med.* 2017;376(23):2235-2244.