

Prognostic value of SOFA score and SIRS criteria for ICU mortality in adult sepsis patients admitted to the ICU of a tertiary care Hospital of Bangladesh

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ABSTRACT

Background: Sepsis is one of the most common admission-diagnosis in intensive care unit (ICU). It is associated with rapid organ dysfunction with increased mortality. Different scoring systems {e.g. Sequential [Sepsis-related] Organ Failure Assessment (SOFA) score, systemic inflammatory response syndrome (SIRS) criteria} are commonly used to identify and predict prognosis of sepsis in ICU at present. The objective was to determine the prognostic value of SOFA score and SIRS criteria among sepsis patients.

Methods: This was a prospective observational study, conducted in the department of Critical Care Medicine, BIRDEM General Hospital during the period of January, 2018 to July, 2019. Consecutive sampling was conducted in patients fulfilling the selection criteria. After admission of patients with sepsis from indoor or emergency department; SOFA score and SIRS criteria were calculated using physiological and laboratory parameters recorded within 24 hours of ICU admission. Standard criteria were applied, an increase of point of e" 2 in SOFA score, and/or SIRS criteria was regarded as sepsis. Patients who were admitted in ICU other than sepsis., known cases of acute myocardial infarction (MI), trauma victims, acute stroke, pregnancy, end stage renal disease (ESRD), decompensated chronic liver disease (CLD), who developed sepsis after admission in ICU, readmitted cases were excluded. All patients were followed up daily. Outcome was measured in terms of ICU mortality.

Results: A total 203 patients were analyzed. About one-third (29.6%) patients belonged to age group 61-70 years (mean age: 58.25 ± 15.03 years); with slightly male predominance (52.2%). Pneumonia (56%) was the most common on admission diagnosis followed by uro-sepsis (19.7%). SOFA score showed greater discrimination (AUROC, 0.900 [95% CI, 0.860-0.941]) (p value <0.001) than SIRS criteria (AUROC, 0.406 [95% CI, 0.327-0.486]).

Conclusion: SOFA score had higher prognostic value than SIRS criteria regarding ICU mortality in sepsis.

Key words: ICU mortality, prognostic value, sepsis, SOFA score, SIRS criteria.

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INTRODUCTION

Sepsis is a major problem in intensive care unit (ICU) and common cause of morbidity and mortality, especially in elderly, immunocompromised and critically ill patients.¹⁻⁵ The annual global incidence of sepsis and severe sepsis are 31.5 million and 19.4 million cases respectively, resulting in 5.3 million deaths.⁶ It has been recognized that survival following sepsis is associated with long-term physical, cognitive and psychosocial morbidity⁷ and an increased mortality rate up to 2 years.⁸

There are various terms used in relation to sepsis e.g. infection, bacteremia, sepsis, septicemia, severe sepsis, septic shock etc. Definition of these conditions have been proposed in different ways in different times. These definitions are not specific and sometimes confusing.

The systemic inflammatory response syndrome (SIRS) is a diagnostic criteria of sepsis, which is also observed in many other non-infectious conditions including pancreatitis, ischemia, multiple trauma and tissue injury, hemorrhagic shock, immune-mediated organ injury and in response to cytokines etc. thus misleading the sepsis.^{1,5,9} Sequential [Sepsis-related] Organ Failure Assessment (SOFA) score is another criteria for identifying sepsis.

Numerous clinical trials have been undertaken to evaluate the conventional sepsis related terminologies. The Third International Consensus Definitions for Sepsis and Septic Shock (Sepsis -3) concluded that the use of term severe sepsis is redundant now. Definition and clinical criteria for sepsis were also standardized. Sepsis is defined as life-threatening organ dysfunction caused by a dysregulated host response to infection.⁵ Organ dysfunction can be represented by an increase in SOFA score of ≥ 2 points¹⁰ which is associated with an in-hospital mortality of greater than 10%.⁵

An accurate diagnostic criteria and consensus definitions have an important role in ICU which provides adequate tools for research, performance monitoring and accreditation.¹¹ The use of ≥ 2 SIRS criteria to identify sepsis is not very helpful now a days.¹²⁻¹⁴ Changes in white blood cell count, temperature and heart rate reflect inflammation/other insults rather infection. The SIRS criteria do not necessarily indicate a dysregulated, life-threatening response. This criteria is present in many hospitalized patients, including those who never develop infection.^{9,15,16} Severity of organ dysfunction can be assessed by various scoring systems. The score in current use is SOFA. However, in addition to clinical variables, laboratory variables, namely partial pressure of oxygen (PaO_2), platelet count, creatinine and bilirubin level are needed for full computation of SOFA.¹⁷ SOFA score and SIRS criteria are being used for determination of prognosis among sepsis or suspected sepsis patients in different studies.^{18,25} Raith et al. showed that among adults with suspected infection admitted to an ICU, an increase in SOFA score of ≥ 2 had greater prognostic accuracy for in-hospital mortality and length of ICU stay than SIRS criteria.¹⁸ At the same time, SOFA scoring requires laboratory parameters for total calculation, it is time consuming and costly than SIRS criteria. This study was done to determine the prognostic value of SOFA score and SIRS criteria among sepsis patients in ICU.

METHODS

This study was designed as prospective observational study, done during the period from 1st January 2018 to 28th July 2019 in the Department of Critical Care Medicine, Bangladesh Institute of Research and Rehabilitation in Diabetes, Endocrine and Metabolic Disorders (BIRDEM) General Hospital, Dhaka, Bangladesh after taking ethical clearance. A total of 203 adult patients (age ≥ 18 years) admitted in ICU with sepsis were enrolled in the study. Patients with acute myocardial infarction (MI), trauma victims, acute stroke, pregnancy, end stage renal disease (ESRD) and decompensated chronic liver disease (CLD) and who developed sepsis after admission were excluded. Informed written consent was taken from patients' first degree relatives. After admission of patients from indoor or emergency department; SOFA score (range 0 to 24), SIRS criteria (range 0 to 4) were calculated using physiological and laboratory parameters recorded from within 24 hours of ICU admission.¹⁸ Standard criteria were applied, an increase of point of ≥ 2 in SOFA score and/or SIRS criteria was regarded as sepsis. Patient's resuscitation and management were done according to the standard ICU protocol of BIRDEM General Hospital. All sepsis patients were followed up daily. Outcome was measured in terms of ICU mortality. Those who were discharged or transferred were classified as survivors and those who died in ICU, categorized as non-survivors. All the information about the patient were collected by a structured data sheet and analyzed by statistical package for the social sciences (SPSS) version 23.

RESULTS

A total 203 admitted patients were selected as study population. Table I shows the age distribution; 29.6% of the study population was in the range of 61-70 years. There was male (52.2%) predominance.

Table I Distribution of study subject by age (N=203)

| | Frequency (n) | Percentage (%) |
|-------------|---------------|----------------|
| Age (years) | | |
| ≤ 40 | 26 | 12.8 |
| 41 - 50 | 28 | 13.8 |
| 51 - 60 | 52 | 25.6 |
| 61 - 70 | 60 | 29.6 |
| >70 | 37 | 18.2 |

Mean \pm SD: 58.25 \pm 15.03

Table II Distribution of study subject by sex (N=203)

| | Frequency (n) | Percentage (%) |
|--------|---------------|----------------|
| Gender | | |
| Male | 106 | 52.2 |
| Female | 97 | 47.8 |

Table III represents sepsis related diagnosis of the study population, the most common diagnosis was pneumonia 115(56%) followed by uro-sepsis 40 (19.7%).

Table III Sepsis related diagnosis of the study subject (N=203)

| Sepsis related diagnosis | Frequency (n) | Percentage (%) |
|---|---------------|----------------|
| Pneumonia | 115 | 56 |
| Uro-sepsis | 40 | 19.7 |
| Sepsis with source unidentified | 30 | 14.7 |
| Intra-abdominal sepsis | 25 | 12.3 |
| Bacterial meningitis | 15 | 7.3 |
| Neutropenic sepsis | 5 | 2.46 |
| Catheter related blood stream infection (CRBSI) | 2 | 0.9 |
| Septic arthritis | 2 | 0.9 |

Mortality was 100% among patients with SOFA score 15-17, 20 and 22. No mortality was observed for the SOFA score of ≤5 (Figure 1). Figure 2 shows that 53.1% mortality was observed in patients with SIRS criteria of 1. Mortality rate of 46.9%, 41.9% and 30.6% were found in sepsis patient with SIRS criteria of 2, 3 and 4 respectively. Patients having SIRS criteria of 0 had the mortality rate of 50%.

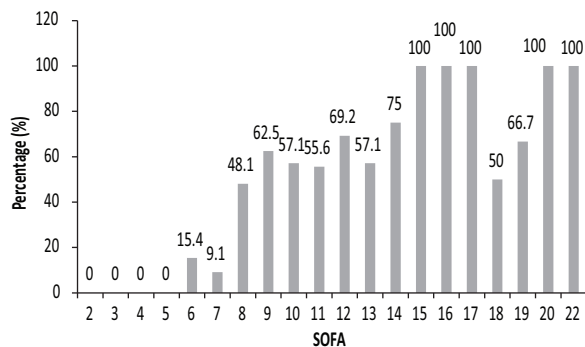


Figure 1 Distribution of mortality of study subject in relation to SOFA score

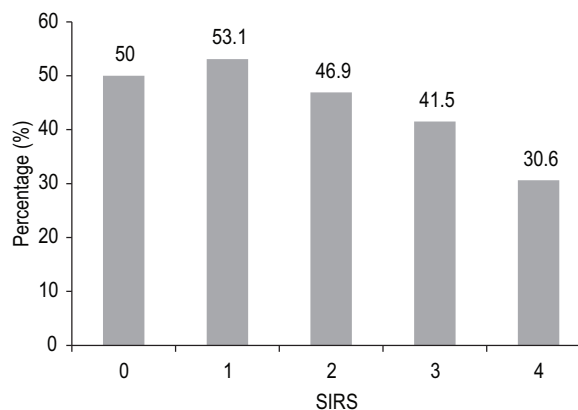


Figure 2 Distribution of mortality of the study subject in relation to SIRS criteria

The best cut-off value of SOFA was 7.50 in predicting mortality and for SIRS criteria was 3.50 in predicting mortality, was shown in tables IV and V. Figure 3 demonstrates that area under curve (AUC) for SOFA score was 0.900 [95% CI, 0.860-0.941] (p value <0.001) and for SIRS criteria Area Under the Receiver Operating Characteristics (AUROC) was 0.406 [95% CI, 0.327-0.486].

Table IV Sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV) of SOFA Score at different cut-off values

| SOFA | Sensitivity | Specificity | PPV | NPV |
|-------|-------------|-------------|-------|-------|
| 3.50 | 1.000 | 0.189 | 0.450 | 1.000 |
| 4.50 | 1.000 | 0.369 | 0.513 | 1.000 |
| 5.50 | 1.000 | 0.516 | 0.578 | 1.000 |
| 6.50 | 0.975 | 0.607 | 0.622 | 0.973 |
| 7.50 | 0.963 | 0.689 | 0.673 | 0.966 |
| 8.50 | 0.802 | 0.803 | 0.730 | 0.859 |
| 9.50 | 0.741 | 0.828 | 0.741 | 0.828 |
| 10.50 | 0.642 | 0.877 | 0.776 | 0.787 |
| 11.50 | 0.580 | 0.910 | 0.811 | 0.765 |
| 12.50 | 0.469 | 0.943 | 0.845 | 0.728 |
| 13.50 | 0.420 | 0.967 | 0.894 | 0.715 |

*Values derived from Youden’s Index

Table V Sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV) of SIRS criteria at different cut-off values

| SIRS | Sensitivity | Specificity | PPV | NPV |
|------|-------------|-------------|-------|-------|
| .50 | 0.992 | 0.025 | 0.403 | 0.825 |
| 1.50 | 0.869 | 0.213 | 0.423 | 0.710 |
| 2.50 | 0.730 | 0.400 | 0.447 | 0.691 |
| 3.50 | 0.418 | 0.738 | 0.514 | 0.656 |

*Values derived from Youden’s Index

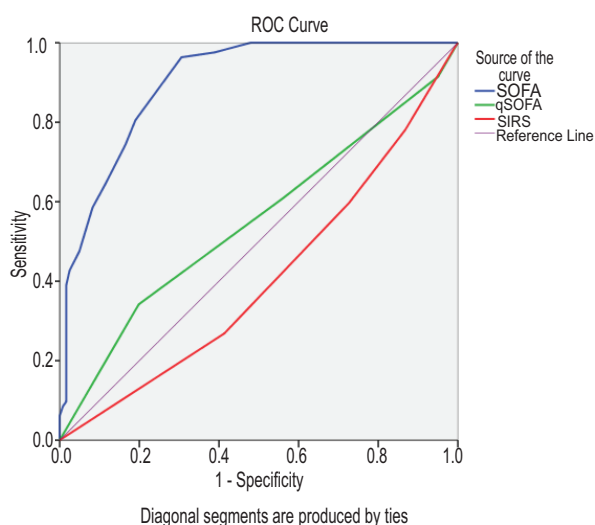


Figure 3 ROC curve of SOFA score and SIRS criteria in prediction of mortality

Table VI AUROCs for discrimination characters of SOFA score and SIRS criteria on ICU admission among patients with sepsis

| | SOFA | SIRS | Between groups difference SOFA vs SIRS |
|---------|---------------|---------------|---|
| AUROC | 0.900 | 0.406 | 0.494 |
| (95%CI) | (0.860-0.941) | (0.327-0.486) | (0.533-0.455) |
| P value | <0.001 | 0.019 | |

DISCUSSION

Total 203 patients fulfilled the inclusion criteria were analyzed. In this study, the majority patients belonged

to age group 61-70 years. The mean age was found 58.25 ± 15.03 years, indicating elderly are more prone to developed sepsis. Sanderson et al. observed that the mean age was 64.0 ± 16.6 years which was consistent with this study finding.¹⁹ Raith et al. found the median age as 62.9 years.¹⁸ Guidet et al. compared non-severe sepsis patients with severe sepsis patients and found that severe sepsis patients were significantly older and had male predominance.²⁰ In study performed by Raith et al, male was 55.4%.¹⁸ In the present study 52.2% were males and 47.8% were females.

Nguyen et al. found the predominant admission diagnoses were pneumonia and uro-sepsis.²¹ Pneumonia was also the most common (17.7%) on admission diagnosis to ICU in other study.¹⁸ The findings of this study were also similar where pneumonia was the most common followed by uro-sepsis.

In our study, SOFA score and SIRS criteria were evaluated on ICU admission among patients with sepsis. The ICU mortality according to SOFA score and SIRS criteria score were presented in figure (1-2) and the findings were consistent with other studies. Lie et al. found that on admission SOFA score of those who subsequently died was significantly higher than that of those who survived (6.7 vs. 4.6, $p < 0.001$).²² Huang et al. had similar study findings where SOFA score 6.8 ± 3.2 in survivors in comparison to 9.0 ± 3.2 in non-survivors.²³ So, a higher SOFA score is associated with increased probability of mortality.²⁴

The sensitivity, specificity, positive prediction value and negative prediction value of SOFA Score and SIRS criteria at different cut-off values according to Youden’s index are estimated. In this study, SOFA score showed greater discrimination in predicting mortality of the study subjects than SIRS criteria and between-group difference: SOFA vs SIRS criteria, 0.494 [95% CI, 0.533-0.455]. Raith et al. showed similar findings, where SOFA demonstrated significantly greater discrimination in-hospital mortality than SIRS criteria.¹⁸ In their study, discrimination using SOFA (AUROC, 0.753 [99% CI, 0.750-0.757]) vs SIRS criteria (AUROC, 0.589 [99% CI, 0.585-0.593]) with all incremental differences being statistically significant (between-group difference: SOFA vs SIRS criteria, 0.164 [99% CI, 0.159-0.169]; all $p < 0.001$). A different observation was found by the study done by Freund et al. They concluded that the AUROCs were for the quick sequential [Sepsis-related] organ failure

assessment (qSOFA) score (0.80;95% CI, 0.74-0.85) and the SOFA score (0.77;95% CI, 0.71-0.82) compared with 0.65 (95% CI, 0.59-0.70) for SIRS criteria regarding mortality at hospital discharge. They found similar results for the prediction of mortality of ICU admission.²⁵

Conclusion

SOFA score has higher prognostic value than SIRS criteria regarding ICU mortality in sepsis. According to this study SIRS criteria may not be utilized as a predictive tool for sepsis patients.

Authors' contribution: DKS and MS drafted the protocol, collected data, did literature search and drafted the manuscript. ASMAA did the guidance. KF, FA, SN and RS were involved in patient management and follow up. All authors read and approved final manuscript for submission.

Conflict of interest: Nothing to declare.

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