Original Article

Utility of quick sepsis-related organ failure assessment (qSOFA) score to predict outcomes in out-of-ICU patients with suspected infections

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Abstract

Background: Referral of sepsis patients at the level of primary care is often delayed due to the lack of an assessment tool which effectively predicts sepsis. The quick Sepsis-related Organ Failure Assessment score (qSOFA) can be used in such scenarios to improve patient outcomes. **Aim:** To assess the prognostic accuracy of qSOFA score in predicting adverse outcomes in patients with suspected infections and to compare it with the SIRS (Systemic Inflammatory Response Syndrome) and the SOFA (Sequential Organ failure Assessment Score). **Methods:** This study included 180 participants admitted in the emergency wards of the Department of Medicine, over a period of one year with suspected infection. The primary outcome was the combined outcome of mortality and/or ICU stay of more than three days. Secondary outcomes were the duration of ICU stay, duration of inotrope use, and duration of mechanical ventilation. **Statistical Analysis:** Descriptive statistics using SPSS version 19.0 was applied in the study. **Results:** Of the 180 participants, 54 had a qSOFA score of 2 at admission, 52 participants had an SIRS score of 2. The qSOFA score had the highest AUC for both mortality and the combined outcome of mortality and prolonged ICU stay (0.740 and 0.835, respectively). For a combined outcome of mortality and ICU stay >3 days, the qSOFA score had a sensitivity of 75% and a specificity of 82%. The positive likelihood ratio was 4.17. **Conclusion:** In a primary care setting, the qSOFA score of more than 2 can be used reliably to refer patients for admission and intensive care as they are likely to need longer hospital stay and can have worse outcomes.

Keywords: qSOFA, sepsis, sequential organ failure assessment score, systemic inflammatory response Syndrome

Introduction

Sepsis constitutes a dysregulated host response to an infection which results in life-threatening organ dysfunction.[1] It accounts for 30–50% of all hospital deaths and is the leading cause of death in noncoronary ICU settings.[2,3] The in-hospital mortality due to sepsis in Indian hospitals has been reported to be around 60%.[4] Despite the huge burden of sepsis-related deaths, sepsis has been poorly defined. The American College of Chest Physicians/Society of Critical Care Medicine (SCCM) consensus guidelines of 1991 first defined sepsis as a systemic inflammatory response in the presence of infection and proposed the SIRS (Systemic Inflammatory Response Syndrome) criteria. The guidelines also introduced the terms "severe sepsis" and "septic shock" in order to stratify and prognosticate patients based on the severity of sepsis and organ dysfunction.[5] At the second consensus conference in 2001, the list of signs and symptoms pertaining to sepsis were expanded; however, the definition of sepsis and severity stratification remained unchanged.[6] The Sepsis-3 guidelines (Third International Consensus Definitions for Sepsis and Septic Shock) released by the European Society of Intensive Care Medicine and the SCCM in the year 2016 proposed new definitions for sepsis and septic shock which relied on the use of the Sequential Organ Failure Assessment

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Score (SOFA) score and serum lactate levels to diagnose the two conditions respectively; the inclusion of the SIRS score in the definition of sepsis was hence removed. The Sepsis-3 guidelines also recommended the use a novel score called the qSOFA score in patients with suspected infections.[7] The qSOFA score, which comprises of bedside clinical parameters, aims at identifying patients with sepsis who are at a higher risk for adverse outcomes. The early recognition of such patients may facilitate a more aggressive management of the sepsis and in turn may help improve the outcomes.

The present study aims to assess the use of the qSOFA score to predict outcome in patients with suspected infections and to compare its utility with the SIRS and the SOFA scores. This can be a useful guide for physicians who can apply the score easily in primary care setting and plan an early referral for those who are likely to have sepsis.

Material and Methods

The study was commenced after getting due approval from the Institutional Ethics Committee (JIP/IEC/2017/0083, dated 28/3/2017) and informed consent from the participants or their legally acceptable representatives. This was a prospective, observational study conducted with participants admitted in the emergency wards of the Department of Medicine, from March 2017 to April 2018. Participants above the age of 18 years with a suspected infection were included. Suspected infection case was defined as those participants whose body fluids (blood, ascitic fluid, urine, and cerebrospinal fluid) were sent for cultures and/or those who had been started on antibiotics (oral or parenteral). Consecutive patients who fulfilled the inclusion criteria were taken. Convenient sampling was done. A total of 180 participants attending the emergency department were included for one year. Detailed history was taken from all participants and the necessary clinical examination was performed. The qSOFA score was determined for all participants at the time of admission using three parameters:

1. Respiratory Rate >22/min
2. Altered mentation (GCS <15)
3. Systolic BP ≤100 mm of Hg.

Each of the above carries a score of 1 and those with a score of more than 2 are expected to have a poor outcome. The SIRS and SOFA scores were also determined for all patients at admission. Clinical course was followed during the period of hospital stay till discharge or death, whichever was earlier. The primary outcome was the combined outcome of mortality and/or ICU stay exceeding three days. Secondary outcomes were the duration of ICU stay, duration of inotrope use, and duration of mechanical ventilation.

Statistical analysis

This was performed using SPSS ver. 19.0. Categorical data (gender, presenting complaints, focus of infection, and mortality) was summarized as proportions and analyzed using the Chi square test. Continuous data was expressed as means and analyzed using the Kruskal–Wallis test. ROC curves were determined for each of the scores and area under the curves was compared. The sensitivity, specificity, positive and negative predictive values, and likelihood ratios were determined for each of the scoring systems.

Results

The mean age of the participants was 47.5 ± 18.1 years. Males comprised 67.2% (121) of the study population. Forty-nine participants had diabetes mellitus (27%) and 24 patients (13%) had chronic kidney disease. Thirty three participants had a diagnosis of septic shock at admission. Fever was present in 146 (81.1%) of the participants. The median duration of fever was four days (IQR 2-7). The other patients had dyspnea (36.1%) and altered sensorium (17.8%) at admission.

Sixty four participants had a qSOFA score of 1, 54 had a score of 2, and 24 participants had a qSOFA score of 3 at admission [Table 1]. In the distribution based on SIRS scores at admission, 52 participants had a score of 2 followed by 45 patients with a score of 3. Community-acquired pneumonia (31%) was the most common infection seen in our study followed by urinary tract infection (22%) and meningitis (10%). Thirty nine of the 56 participants (70%) diagnosed to have pneumonia had radiological findings suggestive of consolidation while 17 participants were diagnosed on the basis of the presence of tachypnea, hypoxia and crepitations on auscultation. Forty participants with urinary tract infections had pyelonephritis. The median duration of fever was three (IQR 4) days. Renal angle tenderness was present in 10 patients (25%). Twenty two participants had positive cultures. *E. coli* was the organism isolated in 19 of the 22 participants with positive cultures. Catheter-related blood stream infections constituted 5.5% of the infections. All 10 participants with CRBSI had end-stage renal disease and were on maintenance hemodialysis. The diagnosis of CRBSI was proven by blood cultures drawn from both peripheral and central lines with a differential time to positivity of >2 hours. Seven participants in the study were diagnosed to have liver abscesses by ultrasound imaging. Three of these participants had pyogenic abscesses (2-*Klebsiella pneumonia*, 1- Methicillin-sensitive *Staphylococcus aureus*); the rest were treated as amoebic liver abscesses. Blood cultures were positive for *Salmonella typhi* in three participants (50%). Others had undifferentiated febrile illnesses like leptospirosis and scrub typhus where the diagnosis could not be confirmed and antibiotics had been started on the basis of clinical suspicion. Focus of infection was not apparent at admission in eight patients (4.4%). Laboratory parameters among the study participants: The median serum creatinine levels in the patients with a qSOFA score of 3 at admission was seen to be 2.7 (IQR 5). However, the difference was not found to be statistically significant. The differences in median values of leukocyte counts, platelet counts, and serum bilirubin levels were also not found to be statistically significant between the groups. The

Table 1: Clinical characteristics of the study participants with their qSOFA scores

	0 (*n*=38)	1 (*n*=64)	2 (*n*=54)	3 (*n*=24)	*P*
Age (years)*	41±17	47±16	51±19	49±17	0.114
Males (No.)	28 (73%)	39 (61%)	35 (64%)	19 (79%)	0.313
Duration of fever (days)†	4.5(8)	5(8)	2(4)	2.5(3)	<0.05
Diabetes mellitus (No.)	11	13	16	9	0.351
Chronic Kidney Disease (No.)	2	10	5	7	0.114
Focus of infection(most common)	UTI-10	Pneumonia-27	Pneumonia-20	UTI-6	
Pulse rate†	98±18	101±17	100±24	123±13	<0.05
Systolic BP (mm of Hg)†	119±19	119±25	105±29	77±7	<0.05
Diastolic BP (mm of Hg)†	71±14	76±13	70±20	49±8	<0.05
MAP (mm of Hg)†	87±15	91±16	78±23	58±7	<0.05
GCS†	15 (0)	15 (0)	14 (3)	12 (5)	<0.05
Positive cultures	16	12	17	10	
Mortality	3 (38%)	16 (25%)	24 (44%)	17 (71%)	<0.05

*Expressed as mean with standard deviation, †Expressed as median with IQR, Test of significance used Kruskal–Wallis testBP=Blood Pressure, MAP=Mean arterial pressure, GCS=Glasgow Coma Score, UTI=Urinary Tract Infection Mortality was significantly higher in the group with qSOFA of 3 at admission. Most common infections were UTI and Pneumonia across the three groups of study participants

patients with a qSOFA score of 3 at admission had a baseline serum lactate level of 2.8 (IQR 0.8).

Primary outcome

The overall mortality in the study was 30%. Patients with a qSOFA score of 3 had a mortality of 70%. The combined outcome of mortality and/or ICU stay was greater and significantly higher in those with a qSOFA of 3 at admission.

Secondary outcomes

All participants with a qSOFA score of 3 required inotrope supports during the course of the hospital stay. Twenty three of these patients (95%) also required an ICU stay >3 days. The median duration of inotrope requirement was more in participants with a qSOFA score of 3 as compared to those with a score of 2 (36 hours v/s 12 hours).

Prognostic accuracy

The qSOFA score was seen to have the highest AUC for both mortality and a combined outcome of mortality and ICU stay greater than three days (0.740 and 0.835 respectively). The SIRS score had the least AUC (0.605 and 0.641) among the three scores. The AUC for serum lactate levels was seen to be 0.751 [Figure 1]. The qSOFA score with 2 as a cut-off had a sensitivity of 68% and a specificity of 69% at predicting mortality. The SOFA and SIRS scores had higher sensitivities (93% and 85% respectively) but lower specificities (37% and 26%). For a combined outcome of mortality and ICU stay >3 days, the qSOFA score had a sensitivity of 75% and a specificity of 82%. The positive likelihood ratio was seen to be 4.17 [Table 2].

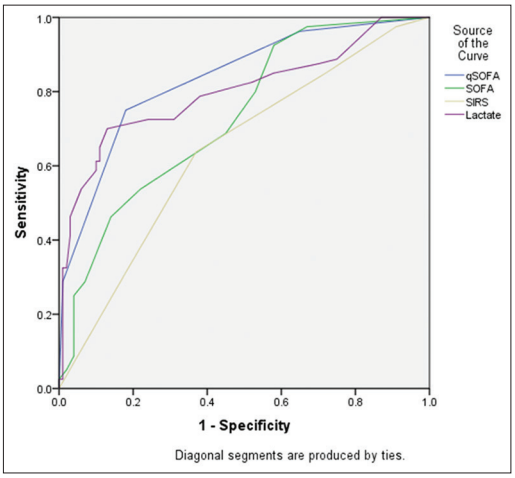

Figure 1: ROC curves for combined outcome of mortality and ICU stay >3 days

Discussion

A total of 180 patients with suspected infections were included in the study and their clinical course was followed during the period of hospital stay. The most common infections seen in our study were pneumonia (31%) followed by urinary tract infections (22%) and meningitis (10%). Earlier studies also had pneumonia as the most common infection in their centres.[8] Organisms were isolated in 53 (29%) participants, 30 from blood cultures, and 23 from body fluids/exudates. The culture yield is lower than that observed in other studies.[9] The lower yield could be attributable to prior administration of antibiotics or delay in the processing of samples due to logistic reasons.

The overall mortality seen in this study was 30% (60 patients). The mortality reported in earlier studies varied from 5 to 20%.[9-11] The higher mortality in this study may be explained by the fact that this study was conducted at a tertiary care hospital and hence a majority of the patients included were cases referred from other centres. This would also explain the greater proportion of patients with a positive qSOFA score (≥1) (78%) seen in our study as compared to other studies where a larger proportion of patients had a qSOFA score of zero.[10,11] Thirty three patients had a diagnosis of septic shock at admission in this study. The mortality in the subset with septic shock was 78% which is higher than the mortality associated with septic shock as reported from other centres.[12-14] Twenty four patients (72%) with septic shock included in our study had at

Table 2: Prognostic accuracy of the scores for the combined outcome of mortality and prolonged ICU stay of more than three days

	Sensitivity	Specificity	PPV	NPV	Positive LR	Negative LR
qSOFA (≥2)	75%	82%	77%	80.4%	4.17	0.30
SOFA (≥2)	92.5%	42%	56%	87.5%	1.59	0.18
SIRS (≥2)	85%	28%	48.5%	70%	1.18	0.54

ICU=Intensive care unit. qSOFA=quick Sepsis-related Organ Failure Assessment score. SOFA=Sequential Organ failure Assessment Score. SIRS=Systemic Inflammatory Response Syndrome. PPV=positive predictive value. NPV=negative predictive value. LR=likelihood ratio. The participants with qSOFA score of more than 2 have higher likelihood of having longer ICU stay or having higher mortality than those with lower scores.

least one previous comorbidity (9 had diabetes mellitus, seven had chronic kidney disease, four had coronary artery disease, two had cirrhosis, one had connective tissue disease, and one had obstructive airway disease) which may explain the poor outcome in these patients.

Serum lactate levels were measured in all patients at admission in this study. The difference in median lactate levels among the qSOFA groups was seen to be statistically significant. The Sepsis-3 guidelines do not recommend the measurement of lactate levels for the diagnosis of sepsis. However, previous studies have found lactate to be an independent predictor of mortality in patients with infections.[15-17] Hence, the role of lactate in the management and prognostication of sepsis needs to be further studied.

Receiver operating curves were plotted for each of the scoring systems for mortality and a combined outcome of mortality and ICU stay >3 days. The qSOFA score had areas under the curve (AUC) of 0.740 and 0.835, respectively. This was seen to be higher than the respective AUCs for both the SIRS and the SOFA scores. Other studies have found similar results regarding the AUCs of the qSOFA and the SIRS scores.[8,9,13] The utility of the qSOFA score in low- and middle-income countries was studied earlier and was seen to perform better than the SIRS score in these settings.[11] Another study compared the prognostic accuracy of the qSOFA score against the SOFA score in predicting hospital mortality among patients with infections in the ICU setting and found the SOFA score to be a better predictor of mortality in ICU settings when compared to the qSOFA score.[14] However, this study had participants in the non-ICU setting at admission.

In this study, the qSOFA score (cut off ≥2) was found to have a sensitivity of 75% and a specificity of 82% at predicting a combined outcome of mortality and/or ICU stay >3 days, with a positive predictive value of 77%, negative predictive value of 80%, and a positive likelihood ratio of 4.17. The sensitivity and specificity for predicting in-hospital mortality were 68% and 69%, respectively. The prognostic accuracy seen in this study is higher than that reported earlier, where the score was seen to have a low sensitivity of 54%.[8] Other studies have reported a sensitivity and specificity of 70% and 79%, respectively, which is similar to what was observed in this study.[10] The positive likelihood ratio of the qSOFA score was found to be 4.17 in this study, which is higher than that reported by other researchers.[13]

The SIRS score (cut off ≥2) had a high sensitivity of 85% but a low specificity (25%) in this study. Previous studies have also reported similar results with the SIRS score with a sensitivity of 85–92% and a specificity of 13–27%.[8–10] In this study the SOFA score was found to have a sensitivity of 93% and a low specificity of 37% for predicting a combined outcome. A lower sensitivity and specificity of 73% and 70% have been observed earlier using SOFA score for the prediction of mortality.[13] Other investigators have compared qSOFA with other scores like NEWS (National Early Warning Score) and found that the former had better specificity and lesser sensitivity for the detection of severe sepsis and septic shock.[18] qSOFA was also more specific than SIRS in the prediction of short-term mortality in earlier reports.[19] The limitations of this study was its small sample size and its cross-sectional design. Future studies on a larger study population with a longer follow up is needed to validate the use of qSOFA as a prognostic tool.

Conclusion

This study found the qSOFA scoring system to have a higher discriminatory capacity than the SIRS and the SOFA scoring stems at predicting outcomes in patients with suspected infections.

Key Message: This study validates the usefulness of qSOFA score in predicting worse outcome of patients with impending sepsis and can help physicians in screening and early referral of such patients to ICU-equipped hospitals.

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Conflicts of interest

There are no conflicts of interest.

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