Original Article

Comparison of qSOFA and SOFA score for predicting mortality in severe sepsis and septic shock patients in the emergency department of a low middle income country

Muhammad Akbar Baig, Sadaf Sheikh, Erfaan Hussain, Samina Bakhtawar, Muhammad Subhan Khan, Syed Mujtaba, Shahan Waheed

Department of Emergency Medicine, Aga Khan University Hospital, Stadium Road, P.O. Box 3500, Karachi, 74800, Pakistan

Section of Pulmonary and Critical Care Medicine, Department of Medicine, Aga Khan University Hospital, Stadium Road, P.O. Box 3500, Karachi, 74800, Pakistan

People’s Primary Healthcare Initiative (PPHI)- Sindh, C-27/1, Block-2, Umer Sharif Park, Block-2 Clifton, Karachi, Pakistan

Department of Emergency Medicine, Aga Khan University Hospital, Stadium Road, P.O. Box 3500, Karachi, 74800, Pakistan

Department of Emergency Medicine, Aga Khan University Hospital, Stadium Road, P.O. Box 3500, Karachi, 74800, Pakistan

ARTICLE INFO

Keywords:
qSOFA
SOFA
Sepsis

ABSTRACT

Objective: We aimed to determine a comparison between the Quick Sequential Organ Failure Assessment (qSOFA) score and existing Sequential Organ Failure Assessment (SOFA) score when applied to severe sepsis & septic shock patients in the Emergency Department (ED) for prediction of in-hospital mortality in the setting of a tertiary care hospital ED in a low-middle income country.

Method: We conducted a prospective observational cohort study on 760 subjects. The qSOFA, SOFA score and in-hospital mortality were assessed by area under the receiver operating curve (AUROC). We calculated sensitivity and specificity for each score for outcomes at cut-offs of 0.92 and 0.63 for qSOFA and SOFA in Severe Sepsis respectively and 0.89 and 0.63 for qSOFA and SOFA in Septic shock respectively.

Results: In patients with severe sepsis, the AUROC of qSOFA for predicting mortality in subjects was 0.92 (95% CI; 0.89–0.94) with 96% sensitivity and 87% specificity in comparison to the AUROC of SOFA score which was 0.63 (95% CI; 0.55–0.70 with 71% sensitivity and 57% specificity. In patients with septic shock, the AUROC of qSOFA for predicting mortality in subjects was 0.89 (95% CI; 0.85–0.92) with 92% sensitivity and 85% specificity in comparison to the AUROC of SOFA score which was 0.63 (95% CI; 0.55–0.70 with 70% sensitivity and 59% specificity.

Conclusion: Our study concludes that qSOFA score is an effective tool at predicting in hospital mortality in comparison to SOFA score when applied to severe sepsis and septic shock patients in the setting of a tertiary care hospital ED of a low-middle income country however, further studies are needed before application for this purpose.

1. Introduction

Sepsis is a fatal syndrome with dire consequences. It progresses rapidly and delays in its identification and treatment can cause a higher mortality. Presently, there are many clinical scoring systems that measure the disease severity in septic population. Many of these scores are time consuming and require information that is not readily available.

With the introduction of the Severe Inflammatory Response Syndrome (SIRS) criteria in 1991 for rapid bedside identification of sepsis to current era where various complex clinical outcome prediction model snow exist, a few of which that are notable to mention such as the Acute Physiology and Chronic Health Evaluation Score, the Simplified Acute Physiology Score III, the Logistic Organ Dysfunction
Score,9 and the Mortality Probability Model III,10 were actually derived and validated in the intensive care unit (ICU) setting. Previous investigations have demonstrated these scores to be inadequate when applied to ED patients.11 The one ED-based scoring system, the Mortality in Emergency Department Sepsis score (MEDS), was designed for ED septic patients.12,13 However, it is said to be inaccurate in severely ill patients.14 Previous investigators have determined an association between the organ dysfunction and mortality in ED septic patients.15 The Sequential Organ Failure Assessment (SOFA) score calculates the number and severity of dysfunction in six organ systems (Pulmonary, coagulation, hepatobiliary, cardiovascular, renal, and neurologic).16 The Sepsis III definitions have introduced a new diagnostic tool termed the Quick Sequential Organ Failure Assessment (qSOFA) which enables rapid risk stratification of septic patients requiring prolonged ICU stay along with hospital death. Patients having high qSOFA scores need further assessment by the SOFA score.17–19 The surviving sepsis campaign has suggested qSOFA to be used for prognostication only. Further implementation of this within existing guidelines for sepsis campaign has suggested qSOFA to be used for prognostication further.20 Our study aims to compare the qSOFA score and existing SOFA score when applied to severe sepsis & septic shock patients in the ED for prediction of in-hospital mortality in the setting of a tertiary care hospital ED in a low-middle income country.

2. Methods

We conducted a prospective observational cohort study in the ED from October to March 2017. The study was approved by the Ethical Review Committee (ERC) of (4328-EM-ERC-16) and informed consent was exempted. We recruited adult patients presenting to the ED, equal to or above 18 years of age and examined by an ED physician for as-

<table>
<thead>
<tr>
<th>Variables</th>
<th>Severe sepsis</th>
<th>Septic Shock</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>423 (53.9%)</td>
<td>339 (46.1%)</td>
</tr>
</tbody>
</table>

### Socio-demographics:
- **Age** (Mean ± SD in years)
  - Male: 59.6 ± 17.2
  - Female: 60.2 ± 17.9
- **Gender** [N%]
  - Male: 242 (57.5)
  - Female: 196 (57.7)
- **Comorbidities**
  - **Malignancy** [N%]
    - No: 386 (91.7)
    - Yes: 35 (8.2)
  - **Cardiovascular** [N%]
    - No: 202 (48.7)
    - Yes: 219 (51.2)
  - **Diabetes** [N%]
    - No: 185 (44.0)
    - Yes: 236 (56.0)
  - **Neurological** [N%]
    - No: 366 (87.0)
    - Yes: 55 (12.2)
  - **Congestive heart failure** [N%]
    - No: 17 (3.9)
    - Yes: 55 (12.2)
  - **Psychiatric illness** [N%]
    - No: 419 (99.5)
    - Yes: 2 (0.5)
  - **Others comorbidities** [N%]
    - No: 396 (94)
    - Yes: 25 (5.9)
  - **Lower Respiratory tract infection** [N%]
    - No: 234 (56)
    - Yes: 187 (44)
  - **Urinary tract infection** [N%]
    - No: 158 (77.0)
    - Yes: 47 (22.9)
  - **Gastrointestinal infection** [N%]
    - No: 320 (76.1)
    - Yes: 101 (23.9)
  - **Skin/Joint infection** [N%]
    - No: 365 (86.9)
    - Yes: 56 (13.1)
  - **Hepatobiliary infection** [N%]
    - No: 412 (97.9)
    - Yes: 9 (2.1)
  - **Other sources** [N%]
    - No: 382 (90.7)
    - Yes: 39 (9.2)
  - **Unit of admission** [N%]
    - Special care unit: 370 (88.8)
    - Intensive care unit: 51 (12.1)
  - **SOFA parameters:**
    - **Lactate** (Mean ± SD in mmol/L)
      - PaO2/FI02 ratio in nml/Hg [N%]
      - 0: 2.9 ± 2.79
      - < 400 = +1: 49 (11.6)
      - < 300 = +2: 215 (51.0)
      - < 200 & mechanically ventilated = +3: 104 (24.7)
      - < 100 & mechanically ventilated = +4: 49 (11.6)
      - < 200 = +3: 4 (0.95)
    - **Platelets** (×10^9/µL) [N%]
      - 0: 310 (73.6)
      - < 150 = +1: 55 (13.0)
      - < 100 = +2: 33 (7.8)
      - < 50 = +3: 18 (4.39)
      - < 20 = +4: 5 (1.18)
    - **GCS[N%]**
      - 0: 111 (26.3)
      - +1: 238 (56.5)
      - +2: 47 (11.2)
      - +3: 20 (4.8)
      - +4: 4 (0.98)
    - **Total bilirubin in mg/dL [N%]**
      - 0: 304 (72.2)
      - 1.2–1.9 = +1: 55 (13.0)
      - 2–5.9 = +2: 31 (7.3)
      - (continued on next page)
6–11.9 = +3
> 12 = +4

MAP or administration of vasopressin mics/kg/min [N(%)]

<table>
<thead>
<tr>
<th>Variables</th>
<th>Severe sepsis n = 421 (53.9%)</th>
<th>Septic Shock n = 339 (46.1%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>No hypotension = 0</td>
<td>170 (40.4)</td>
<td>33 (9.7)</td>
</tr>
<tr>
<td>MAP ≤ 70 mmHg = +1</td>
<td>127 (30.2)</td>
<td>58 (17.1)</td>
</tr>
<tr>
<td>Dopamine ≤ 5 or dobutamine (any dose) = +2</td>
<td>16 (3.9)</td>
<td>7 (2.2)</td>
</tr>
<tr>
<td>Dopamine &gt; 5 OR epinephrine ≤ 0.1 OR norepinephrine ≤ 0.1 = +1</td>
<td>99 (23.5)</td>
<td>163 (48)</td>
</tr>
<tr>
<td>Dopamine &gt; 15 OR epinephrine &gt; 0.1 OR norepinephrine &gt; 0.1 = +4</td>
<td>9 (1.9)</td>
<td>78 (22)</td>
</tr>
<tr>
<td>Creatinine in mg/dl [N(%)]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt; 1.2 = 0</td>
<td>100 (23.9)</td>
<td>66 (19.4)</td>
</tr>
<tr>
<td>1.2–1.9 = +1</td>
<td>85 (20.9)</td>
<td>81 (24.0)</td>
</tr>
<tr>
<td>2.0–3.4 = +2</td>
<td>57 (29.2)</td>
<td>101 (29.7)</td>
</tr>
<tr>
<td>3.5–4.9 = +3</td>
<td>124 (12.2)</td>
<td>46 (13.7)</td>
</tr>
<tr>
<td>&gt; 5.0 = +4</td>
<td>55 (13.6)</td>
<td>45 (13.1)</td>
</tr>
<tr>
<td>SOFA score [N(%)]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0 to 6 = &lt; 10% mortality</td>
<td>240 (57.0)</td>
<td>70 (20.5)</td>
</tr>
<tr>
<td>7 to 9 = 15–20% mortality</td>
<td>125 (29.7)</td>
<td>130 (38.2)</td>
</tr>
<tr>
<td>10 to 12 = 40–50% mortality</td>
<td>46 (10.7)</td>
<td>83 (24.5)</td>
</tr>
<tr>
<td>13 to 14 = 50–60% mortality</td>
<td>6 (1.6)</td>
<td>34 (10.2)</td>
</tr>
<tr>
<td>15 = &gt; 80% mortality</td>
<td>2 (0.5)</td>
<td>2 (0.57)</td>
</tr>
<tr>
<td>15 to 24 = &gt; 90% mortality</td>
<td>2 (0.5)</td>
<td>20 (5.7)</td>
</tr>
<tr>
<td>qSOFA parameters:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>New/worsened altered mentation [N(%)]</td>
<td>199 (47.3)</td>
<td>99 (29.1)</td>
</tr>
<tr>
<td>No</td>
<td>222 (52.6)</td>
<td>240 (70.8)</td>
</tr>
<tr>
<td>RR ≥ 22breaths/min [N(%)]</td>
<td>137 (32.6)</td>
<td>64 (18.8)</td>
</tr>
<tr>
<td>No</td>
<td>284 (67.4)</td>
<td>142 (81.1)</td>
</tr>
<tr>
<td>SBP ≤ 100 mmHg [N(%)]</td>
<td>220 (52.2)</td>
<td>64 (18.8)</td>
</tr>
<tr>
<td>No</td>
<td>201 (47.8)</td>
<td>275 (81.1)</td>
</tr>
<tr>
<td>qSOFA risk/score [N(%)]</td>
<td>183 (43.4)</td>
<td>52 (15.4)</td>
</tr>
<tr>
<td>Low (1)</td>
<td>238 (56.5)</td>
<td>287 (84.6)</td>
</tr>
<tr>
<td>High (&gt;1)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mortality [N(%)]</td>
<td>280 (66.6)</td>
<td>131 (38.8)</td>
</tr>
<tr>
<td>Yes</td>
<td>141 (33.3)</td>
<td>208 (61.2)</td>
</tr>
</tbody>
</table>

arrival in ED. The patients were subsequently followed for their in hospital stay for all-cause mortality. Collected data was analyzed in SPSS version 19. Descriptive data was reported as mean and median for quantitative and proportions for qualitative data. The qSOFA, SOFA score and in-hospital mortality was assessed by area under the receiver operating curve (AUROC).

3. Results

We were able to achieve a calculated sample size of 760 patients due to limitation of resources therefore we decided to proceed with data analysis.

Table 1 shows that the mean age of participants was 59.6 ± 17.2 years among the severe sepsis group and was 60.2 ± 17.9 years among the septic shock group. Urinary tract infections were reported in majority septic shock patients compared to gastrointestinal infections reported in severely septic patients. The majority of septic shock patients (60%) were admitted to the Intensive care unit while 88.8% of severe sepsis patients were admitted to Intermediate care units. The mean lactate value among the severe sepsis group was 2.9 ± 2.79 mmol/L and 4.2 ± 3.7 mmol/L among the septic shock group. The proportion of death among participants with severe sepsis was 33.3% and it was observed to be even higher among subjects with septic shock i.e. 61.2%.

Overall the SOFA score was highest among subjects with septic shock. However, a higher proportion of subjects (84.5%) with septic shock scored as high risk on qSOFA when compared to subjects with severe sepsis.

In patients with severe sepsis, the AUROC cutoff of qSOFA for predicting mortality in subjects was 0.92 (95% CI; 0.89–0.94) with 96% sensitivity and 87% specificity in comparison to the AUROC cutoff of SOFA score which was 0.63 (95% CI; 0.55–0.70) with 71% sensitivity and 57% specificity (Fig. 1). In patients with septic shock, the AUROC cutoff of qSOFA for predicting mortality in subjects was 0.89 (95% CI; 0.85–0.92) with 92% sensitivity and 85% specificity in comparison to the AUROC cutoff of SOFA score which was 0.63 (95% CI; 0.55–0.70) with 70% sensitivity and 59% specificity (Fig. 2).

The results confirm that the model for qSOFA appears well calibrated and has adequate discriminative ability indicating its clinical applicability.

4. Discussion

Our study evaluated and compared performance of the qSOFA score and SOFA in septic ED patients from a low to middle income country with a high reported severity of illness and mortality than quoted locally.15–22 as well as those from high income nations.17

The utility of qSOFA has been established in numerous instances within and outside the intensive care unit setting.17,23 Through our
study, we established that qSOFA was reported high (> 1 parameters which are Altered mentation, Systolic Blood Pressure and Respiratory rate) in accordance with the severity of sepsis with cumulative values of 56.5% in severe sepsis and 84.6% in septic shock patients. This is in contrast to prior literature, examples include one study that validated the qSOFA outside the ICU setting concluded with a low sensitivity identified in septic patients in pre-hospital setting.25Churpek et al. found that only 9% of the 30,667 patients admitted to an ED or a ward with defined infection suspicion had a qSOFA ≥ 2 at time of suspicion of infection25 and the qSOFA only had 29.9% sensitivity for detecting organ dysfunction according to the sepsis-3 definition in an Australian ED.26

Although, it has been reported previously that the discriminative ability of qSOFA is better than SIRS (qSOFA AUROC of 0.81 compared to SIRS AUROC of 0.76),27a recent retrospective study conducted in multicenter ICUs showed that the predictive ability for determining the mortality of the qSOFA score is inferior to SOFA score with AUROC of 0.75 and 0.60 respectively.27 We were able to demonstrate that qSOFA score has better discriminative ability than SOFA score in assessing mortality in our ED septic patients. In patients with severe sepsis, the AUROC for predicting mortality was higher for qSOFA score (AUROC cutoff = 0.92 with 95% CI; 0.89–0.94, sensitivity = 96% and specificity = 87%) when compared to SOFA score (AUROC cutoff = 0.63 with 95% CI; 0.55–0.70, Sensitivity = 71%, Specificity = 57%). Similarly, in patients with septic shock, the AUROC for predicting mortality was greater for qSOFA score (AUROC cutoff = 0.89 with 95% CI; 0.85–0.92, sensitivity = 92% and specificity = 85%) when compared to SOFA score (AUROC cutoff = 0.63 with 95% CI; 0.55–0.70, Sensitivity = 70%, Specificity = 59%).

4.1. Limitations

Prospective larger multicenter studies in LMIC settings are needed to validate our results. We were not able to achieve our desired sample size therefore further studies are required. Secondly, our study included more critically-ill septic patients therefore our results may be limited in the application to all septic patients in EDs. The consequences of high predictive performance of qSOFA than SOFA are useful in our setting as the application to all septic patients in EDs. The consequences of high mortality among critically ill septic patients therefore our results may be limited in the ICU environment before concluding its utility beyond what it was designed for.

5. Conclusion

From our study, qSOFA score appears to be an effective tool at predicting in hospital mortality in comparison to SOFA score when applied to severe sepsis and septic shock patients in the setting of a tertiary care hospital ED of a low-middle income country. However, it is still necessary to rigorously evaluate its applicability in settings outside the ICU environment before concluding its utility beyond what it was designed for.

Funds
N/A.

Acknowledgement
N/A.