SOFA OR APACHE II, WHICH DESERVES MORE ATTENTION IN SEPSIS PATIENTS IN ICU?
AN EXPERIENCE FROM A TERTIARY CARE HOSPITAL IN NORTH EAST INDIA

Deepak Chaudhury¹, Subhankar Paul², Chandraprakash³, IlIAS alì
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1Assistant Professor, Department of Emergency Medicine, Gauhati Medical College and Hospital, Assam.
2Postgraduate Trainee, Department of Emergency Medicine, Gauhati Medical College and Hospital, Assam.
3Former Postgraduate Trainee, Department of Emergency Medicine, Gauhati Medical College and Hospital, Assam.
4Professor and HOD, Department of Emergency Medicine, Gauhati Medical College and Hospital, Assam.

ABSTRACT

BACKGROUND
There are several well recognised scoring systems for evaluation and prognostication of critically ill patients. While APACHE II (Acute Physiology and Chronic Health Evaluation II) scoring system uses a point score based on physiologic parameters, age and previous health status, the SOFA (Sequential Organ Failure Assessment) scoring system takes into account the organ failure in critically ill patients. In the assessment of critically ill patients with suspected multiorgan dysfunction admitted in ICU, the role of SOFA in predictive validity for in-hospital mortality is being widely discussed.

MATERIALS AND METHODS
This was a prospective study undertaken in emergency ICU of a government tertiary care hospital in North East India over a period of one year to prognosticate the patients by using two different established scoring systems, e.g. SOFA and APACHE II.

RESULTS
The results showed that serial measurement of SOFA score during first week is a very useful tool in predicting the outcome especially on the day 3. The APACHE II score on day of admission, though reliable, was not very effective in predicting the mortality rate in our setup.

CONCLUSION
Serial measurement of SOFA score during first week is very useful tool in predicting the outcome of sepsis patients in ICU and better than admission APACHE II scoring in predicting mortality.

KEYWORDS
Sepsis, MODS, SOFA, APACHE II.

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BACKGROUND
Sepsis is life-threatening organ dysfunction caused by a dysregulated host response to infection.¹ Sepsis and septic shock are major healthcare problems affecting millions of people around the world each year is a common cause of Intensive Care Unit (ICU) mortality and morbidity.²

Multiorgan dysfunction syndrome is well established as the final stage of the continuum. Due to the high mortality associated with sepsis and its complications, it is necessary to rapidly diagnose and treat the underlying cause.³

Scoring systems for use in the Intensive Care Unit (ICU) have been developed from the past 30 years. They are widely used in the field of critical care medicine.⁴ Most familiar among them are Sequential Organ Failure Assessment (SOFA) score;⁵ Acute Physiology and Chronic Health Evaluation II (APACHE II);⁶ Simplified Acute Physiology Score II (SAPS II);⁷ and Multiple Organ Dysfunction Score (MODS).⁸ They allow a quantification of the severity of illness and a probability of in-hospital mortality.⁴ A well-performing ICU prognostic model helps to make meaningful comparison of the hospital's current performance with the past.⁹ This allows the hospital to identify the weakness and initiate interventions aimed at quality improvement and allow patients to choose healthcare providers based on performance. The use of these prognostic models help in providing meaningful information to physicians when discussing patient prognosis with the patient's relatives.⁴,⁵ Since the results of laboratory tests like culture and serology are available only after 24 to 48 hours using scores like APACHE II and SOFA may help in predicting outcome in the crucial initial hours of management. Our study focussed on Acute Physiology and Chronic Health Evaluation II (APACHE II) and Sequential Organ Failure Assessment (SOFA) scoring in critically-ill sepsis patients starting from the day of...
admission into ICU as they are the most commonly used scoring system in our setup.

The Acute Physiology and Chronic Health Evaluation (APACHE) score is probably the best-known and most widely used score. The original APACHE I score was first used in 1981 and scores for three patient factors that influence acute illness outcome (pre-existing disease, patient reserve and severity of acute illness). These included 34 individual variables, a chronic health evaluation and the two combined to produce the severity score.10

Knaus et al developed the next generation of APACHE scoring system- APACHE II. The APACHE II is measured during the first 24 hrs. of ICU admission; the maximum score is 71. A score of 25 predicts mortality of 50% and a score more than 35 represents a predicted mortality of 80%. The APACHE II severity score has shown a good calibration and discriminatory value across a range of disease processes and remains the most commonly used international severity scoring system worldwide.11,12

The sepsis-related organ failure assessment score was developed to evaluate organ dysfunction in patients with sepsis. Later, it was renamed as Sequential Organ Failure Assessment (SOFA) score because it’s utility was not restricted merely to patients with sepsis.13 The SOFA system was created in a consensus meeting of the European Society of Intensive Care Medicine in 1994 and further revised in 1996. The SOFA is an organ-dysfunction score measuring multiple organ failures daily. Each organ is graded from 0 to 4 providing a daily score of 0 to 24 points. Serial assessment of organ dysfunction during the initial few days of admission in ICU is a good prognostic indicator. Both the mean and highest SOFA scores are particularly useful predictors of outcome. Independent of the initial score, an increase in SOFA score during the first 48 hours in the ICU predicts a mortality rate of at least 50%.14,15

SOFA scoring system is better than APACHE II system in predicting mortality in ICU surgical patients. Serial measurements of SOFA significantly improve their predictive accuracy.16

Vital organ dysfunctions developing after the onset of sepsis influence outcome markedly. Studies have shown the APACHE II score at the onset of sepsis or the SOFA score and the number of organ dysfunctions developing thereafter are independent prognostic factors for patients with sepsis.15,17

The objectives of our study were to assess mortality and morbidity of patients with sepsis in ICU and to prognosticate the patients by using SOFA and APACHE II scores as well as comparison between these two scoring system in predicting mortality.

MATERIALS AND METHODS

This was a prospective observational study undertaken in the Emergency ICU in the Department of Emergency Medicine of Gauhati Medical College and Hospital, Guwahati, a tertiary care Government Institution in North East India over a period of one year from August 2014 to July 2015 after obtaining approval from Institutional Ethical Committee. In our study, sepsis was diagnosed as criteria laid by the American College of Chest Physicians/Society of Critical Care Medicine (ACCP/SCCM) Consensus Committee in 1992.18

Sepsis patients above 18 years of age were included in the study. Patients primarily suffering from pancreatitis, pulmonary embolism, cardiac tamponade, drug overdose, anaphylaxis, adrenal insufficiency, burns, tumour-associated lactic acidosis, patients with pregnancy and patients on treatment with immunosuppressive agents were excluded from the study. The detailed history, clinical examination and all the relevant laboratory investigations were done. All the patients of sepsis included in the study were prognosticated on the basis of APACHE II and SOFA scores. APACHE II was calculated on day of admission to predict mortality and to assess the extent of multiorgan dysfunction. SOFA scoring was done daily from day 1 to the last day.

Statistical Methods

Descriptive and inferential statistical analysis has been carried out in the present study. Results on continuous measurements are presented on Mean±SD (Min-Max) and results on categorical measurements are presented in Number (%). Significance was assessed at 5% level of significance. Student’s t-test (two-tailed, independent) has been used to find the significance of study parameters on continuous scale between two groups on metric parameters. Chi-square/Fisher exact test has been used to find the significance of study parameters on categorical scale between two or more groups. Receiver Operating Characteristic (ROC) curves were plotted to define discriminative value of scores as a prognosis of mortality. An Area under ROC (AuROC) of 1 means a perfect discrimination while 0.5 is a random chance. A model is considered acceptable if the AuROC is ≥0.7 and is considered excellent if the AuROC is ≥0.9. All data were analysed with SPSS 16.0 Microsoft word 10.0 and excel have been used to generate graphs and tables.

RESULTS AND OBSERVATIONS

After applying the inclusion and exclusion criteria, 50 patients diagnosed with sepsis were finally studied, out of which 28 were males (56%) and 22 were females (44%). Age of patients varied from 18 years to 90 years with mean 48.36 years (SD±17.16). 18 patients (36%) died and 32 patients (64%) survived in our study (Figure 1).

For all patients, APACHE II scoring was done on day of admission (Table 1). Mean APACHE II score was high among non-survivors (23.28±9.65) than survivors (18.75±7.34). However, p-value was 0.068, rendering this difference in APACHE II scoring between survivor and non-survivor groups statistically non-significant (Figure 2).

The SOFA score was done daily on and from day 1 of ICU admission. It was observed that day 1 mean SOFA score was significantly high (p=0.014) among non-survivors (10.17±3.45) than survivors (7.94±2.64).
However, most significant difference was observed from day 3 onwards as shown in (Table No.2, Figure 3).

We plotted ROC curves to define discriminative value of APACHE II and maximum SOFA scores (max SOFA) as a prognosis of mortality (Figure 4). Area under ROC (AuROC) of APACHE II was 0.643 while that of max SOFA score was 0.878, which demonstrated that max SOFA score had more discriminating value than APACHE score II in predicting mortality of sepsis patients in our study.

Table 1. Comparison of APACHE II Score in Survivors and Non-Survivors

<table>
<thead>
<tr>
<th>Apache II</th>
<th>Non-Survived</th>
<th>Survived</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;10</td>
<td>2(11.1%)</td>
<td>4(12.5%)</td>
<td></td>
</tr>
<tr>
<td>10-20</td>
<td>5(27.8%)</td>
<td>16(50.0%)</td>
<td></td>
</tr>
<tr>
<td>20-30</td>
<td>8(44.4%)</td>
<td>10(31.3%)</td>
<td></td>
</tr>
<tr>
<td>&gt;30</td>
<td>3(16.7%)</td>
<td>2(6.3%)</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>18(100.0%)</td>
<td>32(100.0%)</td>
<td></td>
</tr>
<tr>
<td>Mean±SD</td>
<td>23.28 ± 9.65</td>
<td>18.75 ± 7.34</td>
<td></td>
</tr>
</tbody>
</table>

Table 2. Comparison of Serial SOFA Scores in Survivors vs. Non-Survivors

<table>
<thead>
<tr>
<th>SOFA Score</th>
<th>Non-Survived</th>
<th>Survived</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Day 1</td>
<td>10.17 ± 3.45</td>
<td>7.94 ± 2.64</td>
<td>0.014**</td>
</tr>
<tr>
<td>Day 2</td>
<td>11.63 ± 4.33</td>
<td>8.28 ± 2.62</td>
<td>0.002**</td>
</tr>
<tr>
<td>Day 3</td>
<td>13.42 ± 4.06</td>
<td>6.84 ± 2.96</td>
<td>&lt;0.001**</td>
</tr>
<tr>
<td>Day 4</td>
<td>10.78 ± 3.77</td>
<td>5.94 ± 3.41</td>
<td>0.001**</td>
</tr>
<tr>
<td>Day 5</td>
<td>12.25 ± 4.8</td>
<td>4.55 ± 3.27</td>
<td>&lt;0.001**</td>
</tr>
<tr>
<td>Day 6</td>
<td>12.29 ± 6.1</td>
<td>3.39 ± 2.77</td>
<td>&lt;0.001**</td>
</tr>
<tr>
<td>Day 7</td>
<td>14.2 ± 3.9</td>
<td>2.82 ± 2.61</td>
<td>&lt;0.001**</td>
</tr>
<tr>
<td>Day 8</td>
<td>13 ± 3.9</td>
<td>2.45 ± 2.5</td>
<td>&lt;0.001**</td>
</tr>
<tr>
<td>Day 9</td>
<td>13.8 ± 4.09</td>
<td>1.81 ± 1.72</td>
<td>&lt;0.001**</td>
</tr>
<tr>
<td>Day 10/last day</td>
<td>13.5 ± 5.69</td>
<td>1.33 ± 1.23</td>
<td>&lt;0.001**</td>
</tr>
</tbody>
</table>

DISCUSSION

Sepsis is the main cause of mortality from infection, especially if not recognised early and treated aggressively. Its recognition thereby mandates urgent attention. The mortality recorded in our study was 36%. In large clinical trials, the mortality associated with severe sepsis and septic shock ranges between 13% and 50%. There is lack of statistical data concerning incidence of sepsis in India. The incidence and mortality rates are considered higher than in the West. In a multicentre, prospective, observational study conducted in four Intensive Therapy Units (ITUs) in India from June 2006 to June 2009 where a total of 5,478 ITU admissions were studied. Systemic Inflammatory Response Syndrome (SIRS) with organ dysfunction was found in 25% of patients of which 52.77% were due to sepsis. The incidence of severe sepsis was 16.45% of all admissions. ITU mortality of all admissions was 12.08% and that of severe sepsis was 59.26%.
The SOFA or APACHE scores are not intended to be used as a tool for patient management, but as means to clinically characterise a septic patient and prognosticate early. Because, even patients presenting with modest dysfunction can deteriorate further very rapidly emphasising the seriousness of this condition and the need for prompt and appropriate intervention, if not already being instituted. Several components of SOFA assessing systemic dysfunction require laboratory testing and thus may not be promptly available. Other elements, such as the cardiovascular score, can be affected by iatrogenic interventions. APACHE II score also has the disadvantage of complicated evaluations.9 However, APACHE II and SOFA scorings have widespread popularity within the critical care community and have a well-validated relationship with mortality in critically ill patients in various studies.4,9,14,21

Many studies have shown that high APACHE II score at the time of admission was associated with high mortality.4,6 Merwe et al22 has validated the use of the APACHE II model to accurately describe the risk of ICU death of the patient population in a tertiary ICU in a developing country. Arabiet al23 also had shown significantly high APACHE II scores in non-survivors. In our study, though it was statistically not-significant (p=0.068), mean APACHE II score on day 1 definitely high among non-survivors than survivors (23.28 v/s 18.75).

SOFA score has been validated extensively for prognostication in critically ill patients. Results of daily SOFA scoring in our study are in accordance with other similar studies around the world. Vosylius et al24 in their study on 117 ICU patients with sepsis showed that the changes in the severity of organ dysfunction were closely related to the outcome of the patients admitted to ICU, where SOFA score on day 1 and day 3 was significantly higher in non-survivors than those in survivors. They have also showed that the trend of the mean SOFA score for the first seven days of ICU stay showed a progressive decrease in the total number of patients and the significant difference of SOFA scores between survivors and non-survivors in each day over the first week in the ICU, which was also evident in our study. Vincent et al25 in their multicentric study spreading over 16 countries showed that the total SOFA score increased in 44% of the non-survivors, but in only 20% of the survivors who stayed in ICU for at least 1 week. Ferreira et al found initial SOFA score up to 9 predicted mortality of less than 33% while an initial SOFA score of greater than 11 predicted a mortality rate of 95%. However, in a recent study by Georgescu et al26 had shown that for the APACHE II and SOFA scores the differences when deceased and survivors were compared were not statistically significant (APACHE II: 26.76±6.742 vs. 23.18±8.175 respectively for SOFA: 8.029±3.099 vs. 7.136±3.342).

Furthermore, in our study, we plotted ROC curves to define discriminative value of scores as a prognosis of mortality. Value of AuROC more than 0.7 shows good discriminating value.

Ferreira et al observed that AuROC was largest for Highest SOFA scores (0.90; SE, 0.02) than other SOFA derived variables including mean SOFA score (0.88, SE 0.03) and was significantly larger than initial SOFA scores (P<0.001). Hence, in our study, we plotted ROC curves for APACHE II against maximum SOFA score (max SOFA) for predicting outcome.

AuROC of APACHE II was 0.643 while that of max SOFA score was 0.878, which demonstrated that max SOFA score had more discriminating value than APACHE score II in predicting mortality of sepsis patients.

The areas under ROC were found to be 0.622 and 0.705 for APACHE II and SOFA respectively for predicting mortality in patients with septic shock in a prospective study by Georgescu et al26 which is quite similar with our results.

However, contrary to our findings, a study by Ho KM et al27 for determining hospital mortality, APACHE II score showed a better calibration and discrimination (AuROC 0.858) than max SOFA (AuROC 0.829) and admission SOFA (AuROC 0.791). Another study by Hwang et al28 among ICU patients showed that the area under the curve for the SOFA score was not different from APACHE II scoring system in predicting the outcomes. However, it is acknowledged that method for calculating SOFA scores is easier and simpler than APACHE II.

CONCLUSION
Serial measurement of SOFA score during first week is very useful tool in predicting the outcome of sepsis patients in ICU. However, the APACHE II score on day of admission, was not very effective in predicting the mortality rate in our study, though it was found reliable in various other studies.

The trend of SOFA score was progressively declining in survivors while non-survivors had stable higher score during the first week and thereafter. The SOFA score on day 3 was better compared with SOFA score on day 1 as the tool for outcome prediction.

REFERENCES


