Utility of SOFA and APACHE II Score in Sepsis in Rural Set Up MICU

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Abstract

Aims and Objectives: To assess morbidity and mortality as well as to prognosticate the patients by using SOFA and APACHE II scores of patients with sepsis, severe sepsis and multi-organ dysfunction syndrome (MODS) in rural setup ICU.

Material and Methodology: We carried out prospective study on patients with sepsis as per ACCP guidelines and analysed their clinical and microbiological profile. We calculated SOFA score on day 1, 3 and 7. APACHE II score was also calculated on day of admission. We used both the scores for predicting the outcome.

Results: The mortality rate was 48% in our study group which had alarming proportion of MODS patients (78%). The most common organ involved was lung and the most common organism causing sepsis was Klebsiella. On day 3, the mortality rate of patients with SOFA score less than nine was 9.1%, while the mortality rate of patients with score more than nine was 78%. The trend of mean SOFA score was progressively declining in survivor group. The mean APACHE II score was marginally higher in non-survivor group compared to survivor group, however the difference was not statistically significant.

Conclusions: Serial measurement of SOFA score during first week is very useful tool in predicting the outcome. The APACHE II score on day of admission was not reliable in predicting the mortality rate in this study and we believe that it may need modification in set up like ours.

Introduction

Sepsis remains the most important cause of MODS all over the world. In India, especially in rural set up, we not only come across the usual causes of sepsis and MODS encountered in the West, but also the special infections peculiar to tropical and developing countries. P. Falciparum malaria is one of the most common causes of tropical sepsis in India.

Multiple scoring systems are available for assessment and prognosticate the severity of illness. These scoring systems though have limitations; can help to determine the chances of survival. APACHE II scoring system is used worldwide for prognosticating and assessing mortality. SOFA score is used to evaluate MODS and its correlation with survival. There are few studies on utility and validity of SOFA and APACHE II scores in Indian set up, however studies on comparison between these two scores are lacking. Thus we took up this work to evaluate the utility of these scores in rural set up ICU.

Prognostication is an important part of management of any critically ill patients. Assessing quantitatively by scoring may predict the outcome. APACHE II and III has become a routine tool to predict the outcome in its well equipped ICU’s of west and also in India. SOFA score would give us the idea of sequential organ failure, however to validate and to assess trend of SOFA score correlated well with the actual involvement of organ and outcomes this study was undertaken. One of the aims of this work was also to determine the cut-off score point above which the mortality chances are high especially in Indian and rural setup. Finally scores had any bearing on the length of hospital and ICU stay was also the aim of the study.

Material and Methods

A prospective study entitled “Profile of sepsis and utility of SOFA and APACHE II score in rural set up MICU” was undertaken at Shree Krishna Hospital, Karamsad attached to Pramukh Swami Medical College, Karamsad after the approval from Human Research Ethics Committee. The study was carried out for one and half years and 50 patients were included in the study. The patients with sepsis as defined by the ‘American College of Chest Physicians/Society of Critical Care Medicine (ACCP/SCCM) Consensus Committee - 1992’ were included in the study.

The detailed history, clinical examination and all the relevant laboratory investigations were done, including blood culture. All the patients of sepsis admitted to MICU were prognosticated on the basis of APACHE II and SOFA score. APACHE II was calculated on day of admission to MICU. The predicted mortality rate was calculated on the basis of this score. To assess sequential involvement of organ/multi-organs, calculation of SOFA score was done on day 1, 3 and 7 which gave idea whether involvement of number of organs was increasing or decreasing and if the particular organ involvement was present, it was increasing or decreasing. The minimum SOFA score was 0 and maximum of 24. The worst parameter of the day 1, 3 and 7 was considered and score calculated. We had analysed various profiles between two groups’ viz. survivor group which included the patients who were successfully discharged after recovery and non-survivor group which included the patients who died. We also found whether there was any statistical difference in any of the above mentioned profiles between survivor group and non-survivor group.
Results and Discussion

The mean age of the study group was 47.52 yrs (27 female, 23 male). The mortality rate of sepsis in our ICU was 48%. This rate was slightly higher compared to other studies. We had 78% patients of MODS, 20% patients of severe sepsis and rest 2% patients had sepsis without MODS. The mortality rate of patients of MODS was 43.6%, which was slightly lower, compared to other studies.

There were 40% patients who had diagnosis of SIRS prior to admission while 60% patients had diagnosis of SIRS on admission. The mortality rate was 60% in patients who had SIRS prior to admission as compared to 40% in patients who had diagnosis of SIRS on admission. This again signifies the importance that patients of sepsis have a better chance of survival if they come to hospital earlier in their course of disease.

The most common organ involved in MODS was lung on day of admission. Metabolic acidosis was the least among the features of MODS. The microbiological infection was established in 86% patients. The bacteraemia was documented in 44% patients. The mortality rate of patients with bacteraemia was 44.6%. The difference in mortality rate between culture +ve and culture –ve sepsis was not significant. These results were similar to other studies.

Klebsiella spp. was the most common bacteria isolated from blood.

The analysis of results was done in ‘Survivor’ and ‘Non-survivor’ groups. Glasgow Coma Scale (GCS) score on day 1 was 9.46 in survivors and 11 in non-survivors. This difference was statistically not significant. However there was statistically significant difference in mean GCS score after day 3 between survivor and non-survivor groups. The mean GCS score after day 3 was 15 and 5.30 in survivor and non-survivor group respectively. Thus one of the conclusions was that the persistence of alteration in sensorium after day 3 would be an alarming sign for the treating physician.

SOFa score was used to assess the organ involvement. Assessment of score on day 1, 3 and 7 in ‘Survivor’ and ‘Non-survivor’ groups is shown in Table 1. On day one, maximum number of survived patients (14 out of 26) had their SOFA score between 6 and 10, ‘mean’ being 9.88, while maximum number of expired patients (13 out of 24) had their SOFA score between 11 and 15 ‘mean’ being 11.50. Though ‘mean’ SOFA score was slightly higher in non-survivor group, the difference was statistically non-significant.

On day three, 13 out of 26 survived patients had their SOFA score between 6 and 10 while 9 had their score less than 5. On the contrary, 8 out of 21 expired patients (3 patients had expired before day 3) had their SOFA score > 15. On day Seven, 20 out of 25 survived patients (1 patient survived before day 7) had their SOFA score less than 5, while 8 out of 13 expired patients (11 patient expired before day 7) had their SOFA score between 11-15. The ‘mean’ SOFA score on day 3 was 6.65 and 14.14 and on day 7 it was 2.64 and 15.15 in ‘survivors’ and ‘non-survivors’, respectively. The difference of SOFA score between both the groups was statistically significant on day 3 and also of day 7.

The trend of mean SOFA score was progressively declining in survivor group, while non-survivor had stable, higher or increasing SOFA score during the first week (Figure 1). SOFA score thus should be determined not only on day one but also it should be calculated on day 3 and 7. If the score trend is on increasing side the outcome is unfavourable and vice versa. Thus, we can conclude that serial measurement of SOFA score during the first week would be very useful tool in predicting the outcome in our set up.

If the SOFA score on day three is less than 9 then chances of survival is greater, while if SOFA score is more than 9 then chances of negative outcome would be more (Figures 2 and 3). If SOFA score is more than 9 then mortality rate is 79.17%. If it is less than or equal to 9 it is 8.70%. Fereria FL, bota DP found that initial SOFA score up to 9 predicted a mortality of less than 33% while an initial SOFA score of greater than 11, predicted a
mortality rate of 95%. Vosylius S, Jurate Sipylaite, in Vilnius, Lithuania observed that SOFA score on day 1 and day 3 was significantly higher in non-survivors than those in survivors. We had similar finding like above study.

APACHE II score was also analysed in ‘survived’ and ‘expired’ group patients (Table 2). Of 50 sepsis patients, maximum number of patients (33 out of 50 i.e.66%) who survived or expired had their score between 21-30, of which 19 (73.07%) patients survived and 14 (58.33%) expired. As we can see that maximum number of patients (33 out of 50 i.e.66%) who survived or expired had their score between 21-30, predication of mortality at moderate APACHE II score was not apparent. The mean APACHE II score in ‘survivor’ group was 24.28 while that in ‘non-survivor’ group was 26.88. The mean APACHE II score was marginally higher in non-survivor group compared to survivor group. However the difference was not statistically significant (Figure 4). Hence the validity of APACHE II score in predicting the outcome was not significant. However we assume that if the APACHE II score is calculated on day 3, it might be able to predict the outcome with more reliability. APACHE II includes various acute physiological variables in first 24 hours. As majority of patients (66%) in this study, had higher APACHE II score, means majority of the patients on admission were very seriously ill and had severe physiological disturbances.

Gupta R, Arora VK evaluated the performance of APACHE II score in Indian patients. The overall mean APACHE II score was 12.87±8.25 with a range from 1 to 47; 282 (86%) patients had scores <20. There were 287 (87%) survivors and 43 (13%) non-survivors, whose mean APACHE II scores were respectively 11.34±6.75 (range 1-37) and 23.09±10.01 (range 5-47) with a significant difference (P<0.01) between them. Observed mortality (13%) was not significantly higher than predicted (7.9%) and both were generally seen to increase with every 5-point rise of APACHE II score.8

Malaria was the most common cause of sepsis in our ICU. The mortality rate for malaria was 41.66%. The mortality rate was slightly lower compared to total mortality rate in patients having bacterial sepsis but the difference was statistically not significant. Associated bacteraemia was documented in 3 out of 12 patients

Mohapatra MK and Das SP assessed severity and hospital mortality of adult falciparum malaria patients by “The Malaria Severity Score” designed by them.9 We analysed our data applying scoring system designed by them and compared it with SOFA score. In survivor’s group which consisted 7 out of 12 malaria patients mean SOFA score was 11.28 and mean MSSS was 9.71, while in nonsurvivors (5 out of 12) it was 16.6 (mean SOFA score) and MSSS(mean) was 12. Thus MSSS gives very similar prediction like SOFA score. This scoring system could be better in rural set up and hospitals where investigations like ABG analysis, electrolytes are not available to define organ involvement.9,10 Prediction of organ involvement and severity in relation to day at which risk can be better stratified (as for example we found that 3 day’s SOFA score was giving best prediction in our study as well as in some studies outside India),9 may be needed. Multicentre, prospective, daywise serial, ICU as well as general ward based studies in rural and urban-metro is required to validate this Indian scoring system for malaria and other cases of sepsis.

When various prognostic scores were compared in two groups viz. ‘survivor’ and ‘non-survivor’ (Table 3), it was found that ‘mean’ Glasgow Coma score on day 1 in survived group was 9.46 while that in non-survivor group was 11.0. The difference was statistically not significant. The mean GCS score after day 3 in survived and non-survivor group was 15 and 5.3 respectively. This difference of GCS score after day 3 was statistically significant (p=0.000). APACHE score on day of admission was 24.38 in survived patient group while was 26.68 in ‘non-survivor’ group, difference was not statistically significant. Though SOFA score was higher in non-survivors than survivors on day 1, it was not statistically significant. Sofa score on day 3 and 7 was statistically significantly higher in non-survivor group than survivor group and thus was concluded that serial SOFA score, especially of day 3 and 7 can predict mortality.

The average length of total stay in patients who survived was 14.65 days of which 8.31 days were in ICU. While the average total hospital stay in non-survivor group was 5.63 days most of which was in ICU. This means that sepsis is a fatal disease, which requires prolong hospital stay and aggressive critical care management.

Future Research : After completing this study, few glaring
facts emerge. It was felt that we would have been wiser if following points could have been incorporated in this study. In future the research or study could be planned in such a way that our insight and solution to our limitations can be incorporated. Following are such issues and points:

1. APACHE II score should be calculated on day 3. Progression of worsening or improvement in APACHE II score may give us better predictability. However these need strengthening by the documented evidences.

2. SOFA score may predict better outcome in tropical sepsis. Tropical sepsis needs different type of scoring system. May be modification of APACHE II or SOFA score may predict outcome better. This requires future research.

3. Is tropical sepsis same as non-tropical sepsis? We had only 12 patients of tropical sepsis. All were of malaria. The clinical and investigation profile difference between tropical sepsis and nontropical sepsis patients should be the area of research. Their predicting outcome by conventional or new scores also needs a broad based and well planned study. MSSS is such scoring system which is specific for Malaria patients and can predict outcome.\(^{9,10}\) However multicentre, prospective, daywise serial, ICU as well as general ward based studies in rural and urban-metro is required to validate this Indian scoring system for malaria. MSSS works for other sepsis patients or not also requires research. MSSS should include serial parasite count as a very important criterion in scoring system.

4. APACHE II score minus GCS score has predicting outcome in Indian set up. May be a worthwhile research topic.

5. A research is needed in puerperal sepsis especially in relation with predicting outcomes. APACHE II gives higher score to a patient who has advanced age and who falls in prescribed list of chronic disease. These patients come from rural area, they come late, they are young and they are not the patients who are listed in chronic illness. Thus APACHE II needs modification when it is to be applied for puerperal sepsis. As mentioned earlier it needs further documentation.

## Conclusion

Serial measurement of SOFA score during first week is very useful tool in predicting the outcome. The trend of SOFA score was progressively declining in survivors while non-survivors had stable higher score during the first week. The mortality rate of patients with SOFA score on day 3 less than 9 was 9.1\%, while the mortality rate of patients with score more than 9 was 78\%. Thus, the patients having SOFA score more than 9 on day 3 would carry bad prognosis. The APACHE II score on day of admission was not reliable in predicting the mortality rate. Once the organ failure sets in, even the most aggressive and expert critical care may be not enough. Thus to conclude, sepsis is a very fatal disease with a high mortality rate for MODS. Serial measurement of SOFA score is very valuable in predicting the outcome. APACHE II score needs modification in our set up.

As shown in this graph and as discussed above, one of the clear emergent facts which come out from the study is value of trend of SOFA score. The graph of SOFA score in survivors and non-survivors were distinctly different. SOFA score on day 1 did not predict mortality very well. However when score was seen on day 3, the increasing trend in the score definitely gave indication of the outcome. Thus, absolute number of SOFA score on day 1 was not very important. But if the score on day 3 rose it was suggestive of the bad prognosis. Again if the SOFA score decreased it meant that patient would fare better and may survive.

Bar diagram showing comparison of mortality rate between patients having SOFA score ≤9 and patients having SOFA score >9.

Absolute values on day 3 did give us clue to the outcome. The patients who had SOFA score ≤9 had mortality rate of 8.70\%. The patients who had SOFA score >9 had mortality of 79.17\%. Thus it was another evident fact that has emerged from the study that patient having absolute SOFA score more than 9 was suggestive of bad prognosis.

The Figure 3 shows the mortality rate according to SOFA score on day 3. This again depicts the same fact as the above bar diagram. The mortality rate increases as SOFA score increases on day 3. The graph shows steep rise from score 9 showing the increased mortality rate for the patients having SOFA score more than 9. Also the patients having SOFA score more than 18 on day 3 had definite mortality.

The Figure 4 shows the mortality pattern according to APACHE II score. Figure 4 also shows that as the APACHE II score rises the percentage of non-survivors increases. Hence though there was no statistical significant difference between survivor and non-survivor group, but patients having high APACHE II score did have fatal outcome. Here there is no steep rise as was seen in graph of SOFA score. So there is no absolute value of APACHE II score, which would predict the outcome. However patients having APACHE II score more than 35 had 100\% mortality.

## References