Original Research Article

Prospective longitudinal observational study in assessing prognostic accuracy of sequential organ failure assessment and quick-sequential organ failure assessment scores in detecting morbidity and mortality in critically ill children

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ABSTRACT

Background: The objective of the study was to assess prognostic accuracy of SOFA (sequential organ failure assessment score) and Q-SOFA (quick-sequential organ failure assessment) score in detecting morbidity and mortality in critically ill children admitted in our intensive care unit.
Methods: All critically ill children admitted were recruited over a time period of 7 months. Q-SOFA score was assessed at presentation, followed by SOFA score on day 1 and day 2 of ICU stay and outcome was observed.
Results: Total of 272 sick children were recruited and assessed. All eight (2.94%) mortalities had high Q-SOFA score of three (p<0.001), mean SOFA (day 1) score 11.12±0.99 (p<0.001), mean SOFA (day 2) was 11.62±1.40 (p<0.001).
Conclusions: Q-SOFA is a simple, inexpensive and rapid test to assess and predict sick children requiring ICU care in emergency department. High SOFA score predicts high probability of mortality and detects organ failure early.

Keywords: Sepsis, SOFA, Q-SOFA

INTRODUCTION

Sepsis and shock, a major cause of mortality, is a syndrome of physiologic, pathologic and biochemical abnormalities induced by infection.[1] For past two decades, sepsis has been defined as SIRS (Systemic Inflammatory Response syndrome) both for adults and children. SIRS criteria was not well validated and well-studied in paediatric population as there are age dependent factors like heart rate and respiratory rate.[2,3]

The third international consensus (2016) updated the definition of sepsis as a life-threatening organ dysfunction caused by dysregulated host response to infection and septic shock as a subset of sepsis in which profound circulatory, cellular and metabolic abnormalities are associated with a greater risk of mortality than with sepsis alone. Sepsis induced organ dysfunction may be occult in children, early recognition of which plays a vital role in their management. There are various scores used to determine the severity of disease and to predict mortality.[4] The third consensus of sepsis (2016) suggested using Q-SOFA and SOFA scores for same.[4] Application of SOFA scores in children was made possible by paediatric validation done by Matics et al.[5] Paediatric validated SOFA score is tabulated in Table 1. Q-SOFA assesses respiratory rate, systolic blood pressure and mental status. Each point noted above carries 1 score each as mentioned in Table 2.

Objective of this study is to assess prognostic accuracy of SOFA and Q-SOFA scores in detecting morbidity and mortality in critically ill children admitted in our intensive care unit.

Table 1: Validated paediatric SOFA scores.

Variables	Scores				
	0	1	2	3	4
Respiratory					
Pao2:Fio2 (or)	>400	300-399	200-289	100-199*	<100*
Sao2:Fio2	>292	264-291	221-264	148-220*	<148*
Coagulation					
Platelet count×10³ /µl	>150	100-149	50-99	20-49	<20
Hepatic					
Bilirubin, mg/dl	<1.2	1.2-1.9	2.0-5.9	6.0-11.9	>12.0
Cardiovascular					
MAP by age group (in months)					
<1	>46	<46			
1-11	>55	<55		Dopamine >5 µg/kg/min (or) epinephrine/ norepinephrine <0.1 µg/kg/min	Dopamine >15 µg/kg/min (or) epinephrine/ norepinephrine >0.1 µg/kg/min
12-23	>60	<60	Dopamine or dobutamine <5 µg/kg/min		
24-59	>62	<62			
60-143	>65	<65			
144-216	>67	<67			
>216	>70	<70			
Neurologic	15	13-14	10-12	6-9	<6
GCS					
Renal					
Creatinine (in months)					
<1	<0.8	0.8-0.9	1.0-1.1	1.2-1.5	>1.6
1-11	<0.3	0.3-0.4	0.5-.07	0.8-1.1	>1.2
12-23	<0.4	0.4-0.5	0.6-1.0	1.1-1.4	>1.5
24-59	<0.6	0.6-0.8	0.9-1.5	1.6-2.2	>2.3
60-143	<0.7	0.7-1.0	1.1-1.7	1.8-2.5	>2.6
144-216	<1.0	1.0-1.6	1.7-2.	2.9-4.1	>4.2
>216	<1.2	1.2-1.9	2.0-3.4	3.5-4.9	>5

Table 2: Q-SOFA score.

Parameters	Score
Altered mental status (GCS <15)	1
Tachypnea (Respiratory rate more than expected for age)	1
Systolic blood pressure lower than normal limit for age	1

METHODS

This study was a prospective longitudinal observational study. The study duration was from September 2017 to April 2018, conducted at KMC specialty Hospital, Tiruchirappalli, Tamil Nadu. Study was approved by institutional ethics committee.

Inclusion criteria

Children aged 6 months to 17 years, admitted to paediatric ICU in KMC speciality hospital, a tertiary centre at Tiruchirappalli, South India were included in this prospective longitudinal study.

Exclusion criteria

Children with non-infective and chronic illness were excluded.

Procedure

Q- SOFA score was assessed in triage at presentation and SOFA scores were assessed on day 1 and 2 in the PICU. Clinical details including treatment and outcome were recorded in pre-designed proforma. The study was approved by our ethical and scientific committee. SOFA scores were correlated with mortality and length of stay.

Statistical analysis

Data were processed using Epi-Info software. Independent t test and Chi square test were used to arrive at statistical significance.

RESULTS

Among 361 patients admitted in PICU, 81 were who did not fulfil criteria and 8 who were discharged against medical advice were excluded. Totally 272 children were included in the study. Fifty eight percent were boys and majority (60%) were below 5 years of age. Diagnosis of study population is tabulated in Table 3. Eight children (2.94%) died during the study.

As shown in Table 4, Q-SOFA scores of three recorded in all eight children who died and survivors had mean score of 1.77. Applying independent t test on the above variables p value was <0.001, indicating high predictive value of Q-SOFA score. As shown in Table 5, mean SOFA scores in all eight non-survivors were 11.12 and 11.62 on day 1 and day 2 respectively as against 4.17 and 3.51 in survivors. P value for above variables was <0.001, indicating high predictive value of SOFA score with regard to mortality.

On applying Pearson co-efficient on Q-SOFA, SOFA day 1 and SOFA day 2 score with PICU stay, correlation level was 0.05, 0.01 and 0.01 respectively. Though the values were above zero, they were very insignificant to correlate with ICU stay. Hence there was no significant correlation between Q-SOFA and SOFA scores with PICU stay.

Table 3: Distribution of diagnosis.

Diagnosis	Distribution	Percentage
Suspected sepsis	96	35.3
Dengue illness	92	33.8
Pneumonia	47	17.2
Viral systemic illness	22	8.1
Staphylococcal septicemia	4	1.53
Meningitis	5	1.83
Enteric fever	2	0.75
Viral hepatitis	2	0.75
Mycoplasm infection	1	0.37
Liver abscess	1	0.37
Total	272	100

Table 4: Q-SOFA versus mortality.

Outcomes	Distribution (n=272)	Mean Q-SOFA score	Standard deviation
Non-survivors	8	3.00	0.00
Survivors	264	1.77	0.42

Applying independent t test on the above variables p value is <0.001, which indicates high Q-SOFA score is highly significant in predicting mortality.

Table 5: SOFA day 1 and day 2 scores versus mortality.

Outcomes	Distribution (n=272)	Mean SOFA day 1 score	Standard deviation	Mean SOFA day 2 score	Standard deviation
Non-survivors	8	11.12	0.99	11.62	1.40
Survivors	264	4.17	1.56	3.51	1.21

Applying independent t test on the above variables p value is <0.001, which indicates high SOFA score on day 1 and day 2 is highly significant in predicting mortality.

DISCUSSION

As mentioned earlier, there were very few studies performed in paediatric patients on adapting third consensus sepsis-3 guideline and application on SOFA and Q-SOFA scores.[4] The major drawback was all Q-SOFA variables (respiratory rate, sensorium assessment and blood pressure) and three SOFA variables (bilirubin level, creatinine, sensorium assessment) were age dependant. Matics et al validated paediatric SOFA scores by performing a retrospective study.[5] Severe sepsis and septic shock were life-threatening conditions commonly treated in paediatric intensive care units (PICUs) worldwide. It was estimated that over one-third of children who die in tertiary care PICUs within the United States have severe sepsis.[6] Recent reports of a rising prevalence of paediatric sepsis may reflect an expanding vulnerable population with chronic co-morbidities increasing rates of multidrug-resistant organisms and opportunistic infections and a surge in sepsis surveillance.[7-9] For the past two decades, sepsis has been defined as systemic inflammatory response syndrome

(SIRS) caused by infection both for adults and children.[10,11] This definition, however, has long been criticized for its too broad inclusion of milder conditions, without any organ dysfunction. Sepsis is now recognized to develop major modifications in non-immunological pathways such as cardiovascular, neuronal, autonomic, metabolic and coagulation. The use of SIRS was not significantly helpful in assessing the severity of sepsis.

Churpek et al revealed that nearly half of the adult patients admitted to the hospital wards fulfilled two or more SIRS criteria at least once during their ward stay.[12] Kaukonen et al showed that about 12% of the adult ICU patients with some infection and at least one organ dysfunction were negative for the SIRS criteria but that their mortality rate was still substantial.[13] As per the third consensus of sepsis, organ system dysfunctions were best assessed with SOFA score by 2 or more.

This prospective study assessed prognostic value of q-SOFA and SOFA scores using the same validated scores. Majority of our study population were diagnosed as suspected sepsis (96 patients, 35.3%), based on positive CRP±leucocytosis. As we received lot of patients from secondary care hospitals in and around our city, it was difficult to document sepsis in culture. Ninety two patients (33.8%) were affected by dengue illness since we had an outbreak of dengue illness in our state during the period of September 2017 to early December 2017. Corresponding SOFA scores were high mainly by the second variable- platelet count, as it was well known that dropping trend of platelet count in late stage of febrile phase and throughout critical phase of dengue was its natural course irrespective of clinical condition and co-morbidities. However SOFA score predicted mortality in dengue illness early. SOFA score of dengue mortalities were high on day 1 and worsened on day 2.

Comparing our study with sepsis-3 consensus and Matics et al which stated that SOFA score >11 predicted 95% mortality, >9 , 50% mortality and >2, 10% mortality. Our study showed that 7 (87.5%) out of 8 non-survivors SOFA day 1 score was >11 and remaining one (12.5%) had SOFA day 1 score of 9. We had one survivor with SOFA score of 12 on day 1, however day 2 SOFA score was 9.

Our study compared well with studies done by Manohar et al and Raith et al which showed that non survivors had high initial, mean and highest SOFA scores compared to survivors.[14,15] They documented 75% of non survivors had highest SOFA score of 15. Length of stay was not significant. Our study also showed similar results, but however highest SOFA score was 13 in our study.

Our study had following limitations, it was a single centered study that excluded children below six month of age and the scores were not compared with other sepsis related scores.

CONCLUSION

We conclude that Q-SOFA is a rapid, inexpensive and simple test to predict sick children requiring intensive care. It is potentially helpful in outside-ICU setting in rapidly identifying patients with suspected infection. Q-SOFA can be assessed even by paramedics in emergency department. Q-SOFA scores will avoid subjective errors in assessing sick children. In our study all 8 mortality patients had highest Q-SOFA score of three. High SOFA score predicts mortality and organ failure early. Moreover, SOFA score quantifies the organ function and hence it is useful to assess the progress of critically ill patients. It is also found that SOFA scores were useful in predicting mortality in children with dengue. Fifty percent of non-survivors had dengue illness. It is easy to predict the outcome early by using serial SOFA scores.

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