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Case Report

Comparison of Pediatric Sequential Organ Failure Assessment (pSOFA) and quick Sequential Organ Failure Assessment (qSOFA) Scores in Predicting Morbidity and Mortality in Children Admitted to PICU in a Tertiary Care Hospital in Uttarakhand: A Retrospective Diagnostic Accuracy Study

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Abstract

Introduction: Projecting the chances of mortality and the assessment of its severity are very subjective. Here we try to present 2 scores - pediatric Sequential Oragan Failure Assessment (pSOFA) and Quick Sequential Organ Failure Assessment (qSOFA) as tools to measure the intensity of illness and project mortality.

Methods: This is a retrospective study. Charts of 154 children admitted to our ICU between 1/8/2019 to 30/5/2021 were reviewed and relevant details were collected. pSOFA, qSOFA scores at the entry to ICU was computed. Outcomes - mortality, survival and number of days of stay in ICU was noted and the ability of the above mentioned scores in predicting the outcomes were determined by using Receiver Operating Characteristics (ROC) curves and calculating Area Under the Receiver Operating Characteristics (AUROC).

Results: pSOFA score of more than 8, predicted mortality with a sensitivity of 70.45% and specificity of 89.09%. The AUROC was 0.936 with a P-value of 0.012. qSOFA also had comparable results with sensitivity of 90.9% and specificity of 46.6%. The Area Under the Receiver Operating Characteristics (AUROC) was 0.779, with a P-value of 0.040.

Conclusion: Calculating the pSOFA and qSOFA score of children, helps us in understanding the severity of illness. Our study shows that qSOFA score although is not as good as pSOFA in assessing the severity and projecting mortality, it still has comparable results. Hence this must be used at the point of first contact with the patient in an ICU and later confirmed with pSOFA score after the laboratory reports arrive.

Keywords: Glasgow Coma Scale; Respiratory Distress; Organ Failure

Introduction

Pediatric Sequential Organ Failure Assessment (pSOFA) score is the pediatric adaptation of Quick Sequential Organ Failure Assessment (qSOFA) score, that was introduced in 1996 and was established by the third International consensus for definitions of sepsis and septic shock in 2016. It takes into consideration respiratory status (PaO2/FiO2 or Saturation/FiO2 ratio), circulatory status (Blood pressure and inotropic requirement), renal status (creatinine levels), Neurological status (Glasgow coma Scale), bilirubin levels and platelet count. An increase of the score by 2 reflects an increase in risk of mortality due to sepsis by 10% [1]. However, SOFA score requires reports of laboratory investigations, which could be time consuming. The sepsis-3 guidelines have introduced a new diagnostic tool i.e. qSOFA which comprises of three variables-respiratory distress, blood pressure and

GCS. These variables can be assessed clinically in the Emergency department itself, making it a robust and quick evaluating tool [1]. This study compares the predictability of mortality and morbidity using qSOFA score with that of pSOFA score on children presenting to our emergency department.

Methodology

This is a retrospective study conducted at AIIMS, Rishikesh between August 2018 and May 2021, involving 154 children less than 18 years of age. Sick children who presented to the pediatric emergency and subsequently admitted to our Paediatric Intensive Care Unit (PICU), were included in our study. Those patients who were discharged against medical advice were excluded. The medical records of these patients were reviewed and details during admission to PICU were collected according to a pre-designed proforma which included, name, age, sex, duration of PICU stay, Saturation, FiO2, mode of ventilation if any, mean arterial pressure, inotropic support, GCS, platelet count, serum creatinine, serum bilirubinm. The data was analysed using SPSS IBM 23. pSOFA score and age adjusted qSOFA score were calculated from the data mentioned above and were tabulated. We used SPO2: FiO2 as a marker for lung injury as put forward by Khemani and colleagues [2]. Stay in paediatric HDU for more than 7 days was considered significant morbidity [3]. Sensitivity and Specificity of pSOFA (>=8) and qSOFA (>=2), in predicting both the above mentioned outcomes were calculated and Receiver Operating Characteristics (ROC) curves were plotted. Positive predictive value and negative predictive value were also calculated. P values below 0.05 was considered significant.

Ethical Approval

Ethical approval was obtained from IEC (Institutional Ethical Committee). The name of the board: Institutional Ethics Committee (IEC) AIIMS, Rishikesh. Approval number: AIIMS/IEC/21/328. Approval date: 11/05/2021

Results

Totally 154 children were included in our study and their data were collected 70 (45.4%) were males and 84 (54.54%) were females with a mean age was 6.83 years. The age wise distribution of these children is given in Fig. 1. 112 of the 154 children had oxygen requirement (61 of them requiring positive pressure ventilation), 47 children required inotropic support and 103 of them had altered sensorium each of the above parameter being the 3 components of qSOFA score (Fig. 2).

Out of the 154 children, 43 (28.5%) had a pSOFA score of 8 and 99 (64.28%) had qSOFA of 2 and above. There were 44 deaths and 110 survived in the study group. 48 (43.6%) amongst those who survived had an Intensive Care Unit (ICU) stay of more than 7 days. Thirty-one of the 44 deaths had a pSOFA score of 8 and above and 13 who died had a score less than 8. The sensitivity of pSOFA in predicting mortality was 70.45%. 12 children who had a score of 8 and above survived and the remaining 98 who survived had a pSOFA score of less than 8. Hence the specificity of this score for mortality is 89.09%. The positive predictive value and negative predictive value for the same outcome of pSOFA were 72.09% and 88.28% respectively. Sensitivity of qSOFA score in assessing mortality was seen to be 90.9% - 40 of the children who died had a score of 2 and above and only 4 had a score of less than 2. However, the specificity was comparatively lower 46.63%- only 51 of the 110 children who survived, had a score less than 2 and 59 of them had a score of 2 and above. Mortality increased from 2.59% in presence of less than 2 qSOFA criteria, to 25.97% in children with 2 or more qSOFA criteria. The positive predictive value was 40.4% and negative predictive value was 92.7% for qSOFA score in predicting the same outcome. The mean duration of stay of all the children who died was 6.72 days and median duration was 3 days.

The mean stay duration of all the children who survived was 9.04 days and median was 7 days. Morbidity in our study was considered significant if the child required an ICU stay of more than 7 days as in Van Nassau, et al. Forty eight children had prolonged stay, 9 with pSOFA score >=8 and 39 with a score < 8 [7]. The sensitivity of pSOFA in determining prolonged stay was 18.75% and specificity in this regard was 95.16%. Eight of the 11 survivors with pSOFA score of more than 8, had a stay in ICU of more than 7 days. Positive predictive value of pSOFA for predicting stay more than 7 days was 75% and negative predictive value was 60.2%. qSOFA had a sensitivity of 75% and specificity of 62.9% in predicting prolonged stay. The corresponding positive and negative predictive values were 61.01% and 76.4% respectively. The discriminatory capacities of both pSOFA score and age adjusted qSOFA scores were also evaluated for both mortality and prolonged stay. It was seen that in predicting mortality, a pSOFA score of more than 8 was better than a qSOFA score of more than 2 AUROC of the former being 0.936 [Confidence Interval (CI) - 95%, 0.899-0.972, P value-0.019] and the latter being 0.779 (CI-95%, 0.700-0.857, P value-0.040).

However, both the scores had lower discriminatory capacities in predicting prolonged stay beyond 7 days in our ICU - pSOFA had AUROC of 0.528 (95% CI, 0.436 - 0.620, P-value - 0.047) and qSOFA had AUROC of 0.566 (95% CI, 0.436 - 0.620, P-value - 0.046), though qSOFA was marginally better than pSOFA.

Discussion

Our study was intended to evaluate the risk of mortality and requirement of prolonged ICU stay in children less than 18 years using qSOFA and pSOFA. The Systemic Inflammatory Response Syndrome (SIRS) criteria, which were used previously, were found to have very limited diagnostic validity and poor predictability in this regard. A study done by Probst et al showed that more than 1 in 6 patients with sepsis didn't meet the required 2 or more criteria for the diagnosis [4]. Also, the same study showed a significant number of false positive cases. Similarly Costa, et al., showed in their study done on children with malignancy, that 20% of all cases with suspected infection and sepsis did not fulfil the required criteria as per the SIRS definition [5]. Levy, et al. and Bone, et al., showed that the SIRS criteria was overly sensitive leading to over diagnosis and hence inflicting a heavier cost burden and mental trauma on the caretakers [6,7]. Hence there was the requirement of better scoring system for predicting the outcome with better sensitivity and specificity.

In our study we used the pSOFA and qSOFA scores of above 8 and 2 respectively, on Day 1 of ICU stay, to predict the outcome of the child. Most of the studies done for pSOFA had used a cut off score of 2 and above as defined by sepsis 3 guidelines, 1 and Anami, et al., showed that there is an increase of mortality of 10% with every increase in pSOFA score by 2.8 A study done by Vincent JL, et al. and Ferreira, et al., showed a mortality of 20% with pSOFA scores between 7 and 9 [9,10]. Royce Kown, et al., did a study on Paediatric patients who had undergone bone marrow transplant which showed that a pSOFA score of 7 or more post-transplant was associated with significant mortality [11]. Hence, we have used a pSOFA cut off of 8 and more to assess the outcome so that we could better the specificity and negative predictive value. qSOFA of 2 and above was used as in all the studies [12].

The pSOFA score of more than 8 had a sensitivity of 70.45% and specificity of 89.09% for predicting mortality. The AUROC for the same was 0.936 with CI of 95% (0.899-0.972) and P value of 0.019. Our results showed better discriminatory capacity on using pSOFA, than those that were obtained in similar studies - Luregn J. Schlapbach et al in 2018 where AUROC was 0.829 [13].

Probst, et al., which showed an AUROC of 0.72,5 Muhammad Akbar Baig, et al., had an AUROC of 0.63 [14]. Shahin Gaini, et al., showed an AUROC of 0.83, Mohammed A Said, et al., had an AUROC of 0.799 [15,16]. This better discriminatory capacity was because of the fact that all these studies had used a lower score of 2 and above to assess the outcome whereas we in our study used 8 and above. However, it should be noted that computing a pSOFA score is time consuming since it requires reports of multiple investigations and this serves as a major limitation. This led us to compare a scoring system which is entirely clinical and robust leading to a quick score computation and at the same time has comparable sensitivity and specificity to that of pSOFA as discussed above. A study done by Kristina Rudd, et al., in 2018 showed an appropriate discrimination power for qSOFA (of 2 and above) to predict mortality with an AUROC of 0.70 [17]. Tan TL, et al., conducted a meta-analysis using 35 studies which reported on the prognostic accuracy of qSOFA score and short term mortality in 2018, which showed a pooled sensitivity of 48% and pooled specificity of 86% [12]. However, most of the studies conducted showed that qSOFA score was inferior to pSOFA score in predicting mortality. The AUROCs of qSOFA score in predicting mortality was 0.739, 0.67, 0.92, 0.67, 0.799 in Luregn J. Schlapbach, et al., Probst, et al., Muhammad Akbar Baig, et al., Shahin Gaini, et al., Mohammed A Said, et al., respectively [4,13,16]. Our intention is not only to compare pSOFA and qSOFA scores, but also to assess how closely the latter agrees with the former in predicting outcomes. In our study, qSOFA score of 2 and above had a sensitivity of 90.9% and a specificity of 46.63% in predicting mortality. The AUROC was 0.779 with CI - 95% (0.700-0.857), P value - 0.040. Few studies were done trying to improve qSOFA score's ability in projecting mortality, by adding other parameters such as lactate levels and heart rates. However, their results were not significant enough [17-20].

The other outcome studied was morbidity, reflected by prolonged duration of stay in ICU of more than 7 days. Various non-medical reasons acted as confounding factors in this regard- namely - unavailability of beds in the ward for shifting, delay in obtaining reports and anxiety of parents. Hence it was seen that both the above discussed scores had poor discriminatory capacities in predicting this parameter. The AUROCs of pSOFA and qSOFA were a meagre 0.528 and 0.566 respectively.

The strength of our studies is that we have included all the children requiring ICU stay such as pneumonia, Meningitis, Urinary Tract Infection (UTI), Nephritic and Nephrotic syndrome, Myocarditis, malignancy, Chroniv Liver Disease (CLD) etc and hence the results project the mortality and morbidity of any child who requires ICU.

Limitation

Limited Number of sample size.

Conclusion

Calculating the pSOFA and qSOFA score of children in the ICU at the beginning of their stay helps us in understanding the severity of illness. This also helps us in counselling the parents regarding the possibility of mortality and duration of stay in the ICU. Though the children in an ICU may have various different illnesses, these 2 scores give us an objective and standardised measure of the severity of illness and also project the chances of terminal outcomes. qSOFA which can be determined immediately without any lab parameters have almost similar discriminatory capacity as pSOFA.

Conflict of Interests

The authors declare no conflicts of interest.

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Informed Consent Statement

Informed consent was obtained from the participant involved in this study.

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Author Contributions

VP: Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Software, Supervision, Validation, Visualization, Writing

VKR: Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Writing

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Data Availability Statement

Data and Materials are available from the authors upon reasonable request.

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