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Evaluation of modified paediatric logistic organ dysfunction scoring system in predicting the outcome in critically ill children

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ABSTRACT

Background: The Pediatric Logistic Organ Dysfunction (PELOD) score has been earlier validated for scoring of children in the Pediatric Intensive Care Unit (PICU). We have modified the PELOD score to adapt to resource limited settings by replacing Partial pressure of Oxygen (PaO₂) / Fraction of inspired oxygen (FiO₂) ratio, Partial pressure of carbon dioxide (PaCO₂), and mechanical ventilation by three new variables i.e. Respiratory rate, Chest retraction and Peripheral Capillary Oxygen Saturation (SpO₂). Aim of this study was to assess the 'Modified PELOD' scoring system and correlate it with the prognosis of children in the PICU.

Methods: A prospective, observational, hospital-based study on 75 critically ill patients admitted in the PICU from age one month to 15 years was done, during a period of one year, from June 2015 to May 2016. The modified PELOD scoring system was calculated for the patients during the first 24 hours of admission. Patients were followed up until they got discharged from the PICU or died.

Results: Modified PELOD scores ranged from 1- 42 in this study, of which patients with higher values had worst prognosis. Modified PELOD score ≥23 had increased risk of mortality.

Conclusions: The Modified PELOD score can be used to predict outcome even in resource limited settings. The mortality rate increases with increase in number of organs having dysfunction. Length of stay less than 48 hours is critical in terms of monitoring and management, as the chances of mortality are high during this period.

Keywords: Multiple organ dysfunction syndrome, Pediatrics logistic organ dysfunction, Respiratory failure, Sepsis

INTRODUCTION

Critically ill children have huge variations in normal body homeostasis that can be estimated by the drift of the physiological variables from the normal range. Scores can be constructed from deviations of these drifted variables and can be divided into two categories: the prognostic scores-which predict the risk of death at the time of entry into the Intensive Care Unit (ICU) and the outcome scores-which describe the course of illness after admission into the ICU. Scoring systems provide objective measures for inter-unit and intra-unit

comparisonn and give useful information for comparing the severity of illness of patients.¹

Recently there has been increased legal accusations towards physicians, partly due to inadequate information given by physicians to parents on the severity of disease, prognosis and alternative therapy options. This can be avoided if there is a prognostic scoring for sick children admitted in Intensive Care Units. Prognostic predictors also explain the objectives of treatment to parents and involve them in the decision making process. Among scores which predict mortality or Multiple Organ

Dysfunction Syndrome (MODS), only one MODS score has been validated for children, the Pediatrics Logistic Organ Dysfunction (PELOD) in a prospective, multicentric study by Leteurtre et al.² Since the time of its validation in 2003, it has been tested by various workers in different intensive care settings in India and outside, and was found useful to predict the patient's probability of death. We have modified the PELOD score to make it more clinical and adoptable in resource limited settings by replacing all three variables included under respiratory dysfunction i.e. Partial pressure of Oxygen (PaO₂) / Fraction of inspired oxygen (FiO₂) ratio, Partial pressure of carbon dioxide (PaCO₂), and mechanical ventilation in PELOD score by three new variables i.e. Respiratory rate, Chest retraction and Peripheral capillary Oxygen Saturation (SpO₂) as it is not possible to measure the former in settings where there are no facilities for mechanical ventilation or taking Arterial Blood Gas (ABG). It is especially important to apply prognostic scores in treatment units where sophisticated facilities are not available, for accurate counselling regarding prognosis and for giving timely transfer options to more sophisticated centres. Therefore, the authors calculated the modified PELOD in critically ill children and studied its accuracy in predicting mortality and morbidity.

METHODS

This was a prospective, observational study conducted in the Pediatric Intensive Care Unit (PICU) of the Department of Pediatrics in a tertiary care teaching hospital, Thrissur. Seventy-five critically ill children, aging from one month to 14 years were enrolled into the study after written consent. The hospital ethical committee approval was obtained. The duration of the study period was for one year from June 2015 to May 2016.

Patients aged more than 15 years and those who did not undergo sufficient diagnostic laboratory tests in accordance with the modified PELOD score were excluded from the trial. All children who had stayed in the ICU for less than four hours and who were transferred to other units were also excluded from the study. Patients who were admitted in a state of continuous Cardiopulmonary resuscitation (CPR) without achieving stable vital signs for at least two hrs, were also excluded.

Methodology

Data was collected in a pre-designed collection sheet which included demographic characteristics, reasons for ICU admission, modified PELOD scoring system and ICU outcome. The modified PELOD scoring system consisting of physical and laboratory variables representing six organ systems namely neurological, cardiovascular, renal, respiratory, hematological and hepatic system was calculated for the patients during the first 24 hours of admission and they were followed up daily until they got discharged from the PICU or died.

The severity of organ dysfunction based on the most abnormal values of variables measured during the entire PICU stay, was the parameter used to predict outcome with the score given to each organ increasing according to the severity of organ dysfunction. To calculate the score, each organ dysfunction received a point for the variable associated with the highest point. For example, if worst Heart Rate (HR) was 200/min (10 points) and Systolic Blood Pressure (SBP) remained 30 mm Hg (20 points), then 20 points were assigned to the cardiovascular system. The maximum number of points for an organ system was 20 and the maximum score was 71. Physiological data from the preterminal period (last two hrs of life) was not included. Variables were measured only if the attending physician thought it appropriate or justified by the clinical status of patients. If a variable was not measured, we assumed that it was identical to the previous measurement or was normal. In each organ system, the highest score in any variable was taken as the score for the organ system. The sum total of the six scores for each organ system gives the modified PELOD score and this was used to predict the risk of mortality in the PICU.

Statistical analysis

The association of the mortality risk with modified PELOD score and duration of stay was assessed using Chi-Square test. Pearson's correlation coefficient was used to evaluate the correlation between modified PELOD score and duration of stay among survivors and non-survivors. Z-test was applied to determine the mean modified PELOD score in survivors and non-survivors. Statistical analyses were done using the statistical package SPSS for Windows, Version 10.0.

RESULTS

A total of 75 subjects (41 males, 34 females) were recruited in this study. Children aged between 1- 4 years accounted for 32%. The mean age of patients was 48 months (range two months to 13 years). In this study, acute lower respiratory infections (48 cases), Central Nervous System (CNS) infections (12 cases) and Dengue (six cases) constituted most of the study subjects.

Diabetic ketoacidosis, inborn errors of metabolism, Organophosphorus poisoning, Acute Diarrhoeal Disease (ADD) with shock, acute glomerulonephritis, idiopathic pulmonary hemosiderosis, TB pericarditis constituted the rest of the cases. Nearly all patients in our study had a medical emergency. Forty eight percent of children in this study had MODS and this was the most common cause of ICU morbidity and mortality. The outcome of the study is based on age, duration of stay and number of organs showing dysfunction as shown in Table 1.

The authors found that the risk of mortality is inversely proportional to the length of PICU stay. In patients who stayed for less than 48 hours, 10 out of 20 patients (50%)

died whereas in patients whose duration of stay was more than 48 hours, only three out of 55 patients (5.5%) died (P<0.001). The mean length of stay was considerably higher in patients who survived as compared to those who expired (5.00 ± 2.476 days v/s 2.93 ± 3.76 days; P<0.001).

Table 1: Outcome of the study based on age, duration of stay and number of organ dysfunction.

	Outcome in percentage		No. of	
	Expired	Survived	cases	
	n= 13	n= 62	(N-75)	
Age group				
<1	27.3	72.7	22	
1-4	16.7	83.3	24	
5-9	9.5	90.5	21	
≥10	12.5	87.5	8	
Duration of stay (hour)				
≤48	50	50	20	
>48	5.5	94.5	55	
Number of organ dysfunction				
1	0	62.9	39	
2	15.4	32.3	22	
3	23.1	4.8	6	
4	38.5	0	5	
5	15.4	0	2	
6	7.7	0	1	

The modified PELOD score was observed to be between 1- 42 in this study (Table 2). The risk of mortality varies directly with the modified PELOD score of the patients. In those patients whose modified PELOD score was more than 23, the mortality was 100% (P value <0.001). From this study, it was found that the mean of Modified PELOD scores of non-survivors was 34.92±6.64, which was significantly higher than those of survivors 14.27±6.4.

Table 2: Modified PELOD score and outcome.

Modified PELOD score	Outcome in percentage Expired n= 13	Survived n= 62	Total (n =75)
<23	0	98.4	61
≥23	100	1.6	14
Score Mean±SD	34.92±6.64	14.27±6.4	17.85±10.14
Minimum	23	1	1
Maximum	42	30	42

On studying the distribution of the modified PELOD score among survivors and non survivors, no correlation was found (using the Pearson's correlation coefficient) between modified PELOD score and duration of stay in both survivors (P >0.05, r = 0.242) and expired groups (P >0.05, r = -0.036). ROC curve was plotted to find out the cutoff value of modified PELOD score with outcome.

The area under the curve was 0.998 and cutoff value was found to be 23 with sensitivity of 98.4%, specificity of 100.0%, Positive Predictive Value (PPV) of 100.0%, Negative Predictive Value (NPV) of 92.3% and accuracy of 98.7%.

DISCUSSION

The PELOD score was validated in 2003. Since then it has been tested in intensive care settings in India and outside and found useful to determine the patient's probability of death. Developing nations like India are different from those nations where these scores were first validated in resources, patient characteristics, training of staff and clinical profile of patients. A limitation in the PELOD scoring system is that it uses ventilator derived respiratory dysfunction variables and blood gas analysis which are unavailable in resource limited settings. The present study aims to make the PELOD score more clinical, by replacing PaO₂/FiO₂ ratio, PaCO₂, and mechanical ventilation in the PELOD score with three new variables i.e. respiratory rate, chest retractions, and SpO₂.

The mean age of patients in the study by Leteurtre et al was 24 months (range 5- 90 months), which was lower than that found in the present study 48 months (range 2 months -13 years).³

Multiple organ dysfunction syndrome (MODS) was found in 48% of children admitted in PICU, which was the most common cause of morbidity and mortality. Marshall et al found that 25% of the children admitted to PICU had MODS.⁴ Incidence of MODS was 70.3% in the study conducted by Hendra et al and Thukral et al found it as high as 90%.^{5,6}

Author found that the risk of mortality is inversely proportional to length of stay in the PICU. In patients who stayed for less than 48 hours, 10 out of 20 patients (50%) died whereas in patients whose duration of stay was more than 48 hours, only 3 out of 55 patients (5.5%) succumbed to death (P <0.001). The mean length of stay was considerably higher in patients who survived, as compared to those who expired (5.00 + 2.476 days v/s 2.93 + 3.76days; P <0.001). In the study by Gaur et al, the mean length of stay was considerably higher in patients who survived, as compared to those who expired (3.68 + 1.72 days v/s 2.22 + 1.49 days; P <0.001) which is consistent with this study.

The observed modified PELOD score ranged between 1-42 in our study, while the observed PELOD score in other studies was 0-71 Leteurtre et al, 1-42 Metta et al, and 0-51 Honna et al.^{3,8,9} The risk of mortality varies directly with the modified PELOD score of the patients. In those patients whose modified PELOD score was more than 23, the mortality was 100% (P value <0.001).

In the present study, the mean of modified PELOD scores non-survivors was 34.92 ± 6.64 which significantly higher than those of survivors 14.27±6.4. In the study by Leteurtre et al, the mean PELOD scores of non-survivors was 31 and those of survivors was 9.4 (P = 0.0001).3 In a study conducted by Metta et al the mean of PELOD scores observed among survivors was 13.5±8.5, while this value among non-survivors was 22.2±10.1.8 In the study by Gaur et al, the mean of Modified PELOD scores of non-survivors was 16.25±8.63, which was significantly higher than those of survivors 7.68±5.55 (P value <0.001). Honna et al found that PELOD score was significantly higher in the deceased group (28.2±12.5) than in the improved group (11.5 ± 9.3) .

No correlation was found in our study between modified PELOD score and duration of stay in both survivors (P >0.05, r = 0.242) as well as expired groups (P >0.05, r = 0.036). So, this score cannot be used for determining the duration of stay in the PICU. This finding was consistent with the study conducted by Metta et al, which showed that the correlation between PELOD scores and duration of stay in the PICU was insignificant (P = 0.15). In the study by Gaur et al, no correlation was found between modified PELOD score and length of stay in both survivors (P >0.05, r = 0.191) as well as expired groups (P >0.05, r = 0.127).

In this study, acute lower respiratory infections (48 cases), CNS infections (12 cases) and Dengue (6 cases) constituted most of the study subjects and this differs from the study by Leteurtre et al, where neurological and cardiovascular emergencies ranked at first and second place. Nearly all patients in our study had a medical emergency, while in the study by Leteurtre et al as many as 49% of patients were surgical patients.³

In the study by Gaur et al, the mean length of stay was considerably higher in patients who survived as compared to those who expired (3.68 + 1.72 days v/s 2.22 + 1.49 days; P < 0.001) which is consistent with our study. A larger study may be conducted to see if these results remain validated.

CONCLUSION

The Modified PELOD score we used is as effective as the PELOD score in predicting mortality hence simple clinical signs like Respiratory rate, chest retractions and SpO₂ measurement can be used instead of more sophisticated variables like PaO₂/ FiO₂ ratio, PaCO₂ and mechanical ventilation which are difficult to measure in resource limited settings. A duration of stay of less than 48 hours in PICU is the critical period in terms of monitoring and management as the chances of mortality are very high during this period. As the number of organs having dysfunction increases, the mortality rate also increases. However Modified PELOD scoring system

cannot be used to predict the length of stay in the PICU. A validated organ dysfunction scoring system is essential in the PICU to give realistic, informed prognostic possibilities and thus avoid miscommunication and medicolegal complications. The Modified PELOD score presented here is comparable to the PELOD score in predicting the outcome in critically ill children and can be used to predict outcome in resource limited settings.

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