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Research Article

SOFA (Sequential Organ Failure Assessment) and PELOD (Pediatric Logistic Organ Dysfunction)

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Abstract: To compare SOFA and PELOD scoring systems as a mortality predictor at pediatric intensive care unit. To compare initial SOFA, 72 hours SOFA and delta SOFA score as a mortality predictor. A Prospective, Hospital based study. Pediatric Intensive Care Unit, G.R. Medical College, Gwalior Critically ill children admitted to Pediatric Intensive Care Unit. After recruitment in the study, patients were followed until they were discharged from PICU or deceased .The PELOD score and SOFA score was calculated for the subjects during the first 24 hours of admission in PICU. SOFA score was calculated again at 72 hours, and the delta SOFA score calculated as the difference between initial SOFA and 72 hours SOFA score. The mean sofa at 72 hours(T72) was 15.63±2.989 in non-survivors vs. 4.30±2.54 in survivors, T72 was significantly higher in non-survivors ($p<0.001$). The mean PELOD score was 30.44±8.145 in non-survivors vs 13.90±5.757 in survivors. The mean PELOD score was also significantly higher in non-survivor group ($p<0.001$). The mean length of stay was considerably higher in patients who survived as compared to those who expired (8.8 + 4.7 days vs 4.6 + 2.4 days; $p< 0.001$).Negative and positive predictive value of SOFA at 72 hours were comparable to PELOD score while were less for Initial SOFA and Delta SOFA score .Delta SOFA correlated well with hospital stay in survivors and non survivors compared through Pearson Coefficient correlation SOFA at 72 hours is a better predictor of mortality as compared to initial SOFA and Delta SOFA score. Also SOFA score at 72 hours is comparable to PELOD Score and can be used as a reliable predictor of mortality in children.
Keywords: SOFA score ,PELOD score , prognosis, PICU.

INTRODUCTION

Estimation of disease severity and probability of death are important elements in determining the prognosis of patients in ICU [1]. It has been a consistent observation that in pediatric intensive care unit children usually experience multiple organ dysfunction syndromes (MODS). In ICU mortality correlates with number of failing organ system and degree of dysfunction within any given organ system [2]. 25% of the children admitted to PICU has MODS and that the mortality associated with it is up to 50. In fact, 97% to 100% of the deaths in PICUs have been related to MODS [3]. Multiple organ dysfunction syndrome (MODS), previously known as multiple organ failure (MOF) or multisystem organ failure (MSOF), is the presence of altered organ function in acutely ill patients such that homeostasis cannot be maintained without intervention. It usually involves two or more organ systems [4]. SOFA and PELOD scoring system are based on MODS and help in predicting outcome in critically ill children [4,8]. Severity of-illness scoring systems have been widely used in pediatric intensive care units (PICUs) to quantify patient outcomes. These scoring systems can be used for internal and external benchmarking to assess severity of illness, appropriate monitoring, proper management and family counselling.

SOFA system was created in a consensus meeting of European society of Intensive care medicine in 1994 and revised in1996. SOFA system is a six organ dysfunction/failure score measuring multiple organ dysfunction daily. Each organ is graded 0(normal) to 4(most abnormal) providing a daily total score of 0 – 24 points [4-8]. The SOFA score is easy as variables measured are easily available and routinely measured in ICU but the PELOD score which is more cumbersome, uses more variables [4].

PELOD score is a tool which is used to know severity of organ dysfunction in a critically ill child. Score which is given to each organ will increase according to severity of organ dysfunction. The maximum number of points for an organ dysfunction is 20 and the maximum PELOD score is 71 [8,9].

SOFA SCORING SYSTEM

SOFA score	0	1	2	3	4
Respiration PaO_2/FIO_2 (mm Hg) SaO_2/FIO_2	>400	<400 221–301	<300 142–220	<200 67–141	<100 <67
Coagulation Platelets $10^3/mm^3$	>150	<150	<100	<50	<20
Liver Bilirubin (mg/dL)	<1.2	1.2–1.9	2.0–5.9	6.0–11.9	>12.0
Cardiovascular Hypotension	No hypotension	MAP <70	Dopamine </=5 or dobutamine (any)	Dopamine >5 or norepinephrine </=0.1	Dopamine >15 or norepinephrine >0.1
CNS Glasgow Coma Score	15	13–14	10–12	6–9	<6
Renal Creatinine (mg/dL) or urine output (mL/d)	<1.2	1.2–1.9	2.0–3.4	3.5–4.9 or <500	>5.0 or <200

PELOD SCORING SYSTEM

ORGAN DYSFUNCTION & VARIABLE	POINTS ASSIGNED			
	0	**1**	**10**	**20**
(i) NEUROLOGICAL				
(a) GCS	12 -15	7-11	4-6	3
(b) Pupillary Reaction	Both reactive	NA	Both Fixed	NA
(ii) HEMATOLOGICAL				
(a) WBC (x 109/ L)	≥ 4.5	1.5 -4.4	<1.5	NA
(b) Platelet (x 109 / L)	≥ 35	< 35	NA	NA
(iii) HEPATIC				
(a) Aspartate Transaminase IU/L)	<950	≥ 950	NA	NA
(b) Prothrombin time (or NR)	> 60 (<1.4)	≤ 60 (≥ 1.4)	NA	NA

ORGAN DYSFUNCTION & VARIABLE	POINTS ASSIGNED			
	0	**1**	**10**	**20**
(iv) RESPIRATORY				
(a) PaO_2 (kPA)/FiO_2 ratio	>9.3	NA	≤9.3	NA
(b) $PaCO_2$ (kPA)	≤11.7	NA	>11.7	NA
(c) Mechanical ventilation	No ventilation	Ventilation	NA	NA
(v) RENAL				
Creatinine (umol/ L)				
1 month-1year	<55	NA	≥55	NA
1 -12 year	<100	NA	≥100	NA
≥ 12 year	< 140	NA	≥140	NA
(VI) CARDIOVASCULAR				
(A) HR (Beats / min)				
< 12 year	≤ 195	NA	> 195	NA
≥ 12 year	≤ 150	NA	≥150	NA
(B) SBP (mmHg)				
1 month - 1 year	> 75	NA	35-75	<35
1 year to 12 year	> 85	NA	45-85	< 45
≥ 12 year	> 95	NA	55-95	<55

METHOD

The present study was conducted in Pediatric Intensive Care unit, Department of Paediatrics, a tertiary centre care of government medical hospital from August 2013 to August 2014 for a period of one year. Ethical approval for this study was obtained from Institutional Ethical Committee of hospital. The samples for the study were 100 critically ill children and these were randomly selected. Subjects excluded from the study were those who stayed in PICU for less than 72 hours, who for any reason did not undergo sufficient diagnostic laboratory tests in accordance with PELOD score and SOFA score and those who were discharged from PICU on request. Written and informed consent

was obtained from the parents or legal guardians prior to study. The SOFA and PELOD scoring system consists of physical and laboratory variables representing six organ systems namely neurological, cardiovascular, renal, respiratory, hematological and hepatic system(Eg-Neurology-Glassgocoma scale C, Haematology-WBC, Platelet count,). After recruitment in the study, patients were followed until they were discharged from PICU or deceased. The PELOD score was calculated for the subjects during the first 24 hours of admission in PICU. Initial SOFA score was calculated within 24 hours of admission and then was calculated after 72 hours. Delta SOFA score was calculated as the change in SOFA score over 72 hours (T0 SOFA - T72 SOFA). In each organ system, the highest score in any variable accounted would be taken as the score for the organ system. The sum total of the 6 scores for each organ system gives PELOD score(range 0-71) & SOFA score(range 0-24) which was used to predict risk of mortality in PICU. Z test was applied to determine mean SOFA & PELOD score in survivors and non-survivors. The SOFA and PELOD score were compared by their Positive and negative predictive value in predicting mortality. Pearson correlation coefficient was used to evaluate the correlation between Delta SOFA score and length of stay among survivors and non-survivors.

RESULT

A total of 100 subjects (63 males, 37 females) were recruited in the study. At the end of the follow up, 27 children (27.00%) died. Children aged between 5-15 years accounted for 47.0% of the subjects. In this study CNS infections (33%) Acute lower Respiratory Infections (14%) & hepatic encephalopathy stages 3 and 4 (10%) constituted most of study subjects renal failure, sepsis, snake bite, scorpion sting ,malaria ,dengue and poisonings constituted the rest of cases. Mean Initial SOFA score(T0) was (10.48±2.5) in non-survivors and (8.41±3.39) in survivors, T0 was significantly higher in non-survivors (p=0.0016).The mean sofa at 72 hours(T72) was (15.63±2.989) in non-survivors while (4.30±2.54) in survivors, t72 was significantly higher in non-survivors (p<0.001). The mean delta SOFA was (5.22±2.006) in non-survivors and (4.29±1.961) in survivors, the mean delta SOFA score was significantly higher in non survivors (p<0.037). The mean PELOD score was (30.44±8.145) in non-survivors and (13.90±5.757) in survivors. The mean PELOD score was significantly higher in non survivor group(p<0.001)(Table 1 & 2).The mean length of stay was considerably higher in patients who survived as compared to those who expired (8.8 $\pm$ 4.7 days vs 4.6 $\pm$ 2.4 days; p< 0.001) .The sofa at 72 hours has the maximum positive and negative predictive value comparable to the PELOD score .the delta sofa and initial SOFA doesn't correlated well with mortality (Fig. 1) (Table No. 2). The Delta SOFA score correlates well with the hospital stay. As the delta SOFA increases there is increase in hospital stay in survivors as pearson coefficient having positive correlation (Table No. 3). As the Delta SOFA decreases there is increase in hospital stay in the non-survivors having negative correlation.

Table-1: **Comparison of survivors and non survivors**

FEATURES	Final outcome (MS)±SD		p value
	Non survivors (27)	Survivors (73)	
DURATION OF STAY (IN DAYS)	8.8 $\pm$ 4.7	4.6 $\pm$ 2.4	< 0.001
INITIAL SOFA SCORE (T0)	10.48±.2.578	8.41±.3.390	<0.001
SOFA AT 72 HOURS SCORE (T72)	15.63 ±2.989	4.30 ±2.542	<0.001
DELTA SOFA (T0-T72)	5.22±2.006	4.29±1.961	0.037
PELOD SCORE	30.44±8.145	13.90±5.757	<0.001

Table-2: Comparison Between-Pelod , Initial Sofa, 72 Hours Sofa And Delta Sofa

Scores		Non survived	WRITE P VALUE	Survived	P VALUE	Total
PELOD	>20	25	59.52	17	40.48	42
	≤ 20	2	3.45	56	96.55	58
SOFA 0	>7	22	34.92	41	65.08	63
	≤ 7	5	13.51	32	86.49	37
SOFA 72	>10	26	89.66	3	10.34	29
	≤ 10	1	1.41	70	98.59	71
SOFA Delta	>3	23	35.38	42	64.62	65
	≤ 3	4	11.43	31	88.57	35

Table-3: Correlation between Delta Sofa and Hospital Stay

		Delta Sofa in Survivors	
survivors hospital stay	Pearson Correlation "r"	0.236*	Positive correlation
	Sig. (2-tailed)	.045	
	N	73	
		Deta Sofa in Non Survivors	
non survivors hospital stay	Pearson Correlation "r"	-.044	negative correlation
	Sig. (2-tailed)	.820	
	N	27	

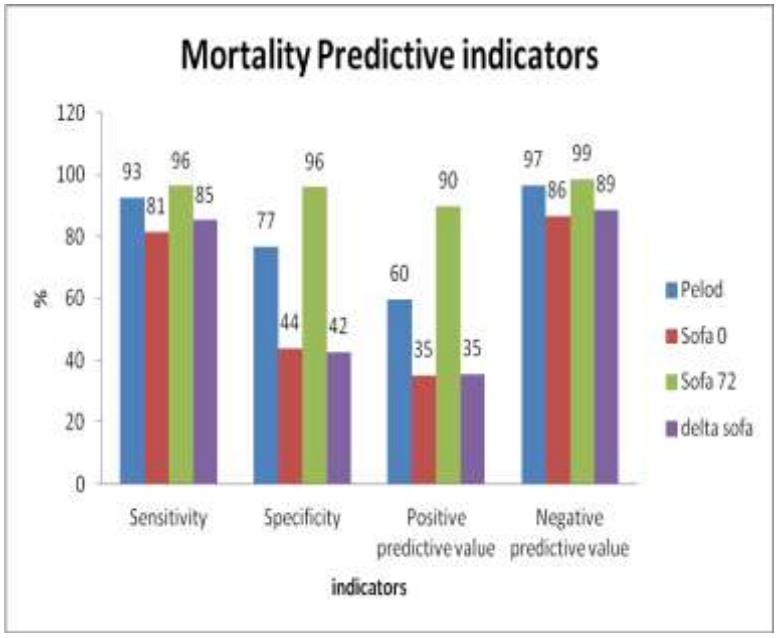

Fig-1: Mortality Predictive indicators

DISCUSSION

The development of progressive physiological dysfunction remote from the site of primary disease termed as multiple organ dysfunction syndrome appears to develop in a simultaneous way, not in a sequential manner and much earlier in children [2].

The SOFA score is easy as variables measured are easily available and routinely measured in ICU but the PELOD score which is more cumbersome, uses more variables[(4)]. Variables in the original PELOD score were chosen by the use of Delphi method on the basis of an ideal descriptor of organ dysfunction [8].

In this study cerebral malaria, hepatic encephalopathy, CNS infection Acute lower Respiratory Infections, and severe sepsis/septic shock constituted most of study subjects, which is similar to other Indian study [9]. This differs from other study (Leteutre et al) where neurological and cardiovascular emergencies ranked at first and second place [8].

SOFA Score can reliably describe the prognosis in children, regular and repeated scoring may be more helpful in identifying the categories of patient at major risk of prolonged stay or death. Our study reveals that SOFA at 72 hours score is statistically strong enough to prognosticate risk of mortality in PICU.It can correlate well to mortality as PELOD can. The SOFA score (t72) can be used as a reliable prognostic predictor of mortality among PICU patients [4].

Ferreira et al analysed the SOFA scores and found that initial SOFA, Mean SOFA, SOFA at 48 hours and delta SOFA values were high in non survivors as compared to survivors ($p<0.001$) In all scores. which is correlating well with our study but correlation of delta and initial SOFA with mortality ($p<0.037$ and $p =0.016$) is not strong. Also in study by .Ferreira et al calculated the difference between SOFA at 48 hrs and SOFA at 0 hrs and mentioned this as delta SOFA 48-0 [7].

However, Machado et al assigned Delta SOFA as the variation of SOFA score day 1 and day 3, as we did in our study [10]. Regardless of the initial SOFA score, early serial evaluation of the SOFA scores during the first 3 days of PICU admission is a better indicator of the prognosis than a single assessment obtained at

admission .similar results found in our study that sequential SOFA at 72 hours was better predictor in contrast to initial SOFA.

The validation study (Leteutre et al) of PELOD score found that mean PELOD score of non survivors was 31 and those of survivors was 9.4 (p=0.0001) [8]. The mean (SD) of PELOD score observed among survivors was 13.5(8.5) while this value among non-survivors was 22.2(10.1) in a study conducted by Metta et al. [11]. In our study mean in non-survivors was 30.44 and in survivors was 13.90($p<0.001$).

CONCLUSION

It is known that PELOD scoring system can be used to determine the probability of death in PICU. From this study SOFA score tested for prognostic reliability in children to PELOD score. Delta SOFA correlates well with hospital stay in survivors and non survivors.

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