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Original Article

Pediatric logistic organ dysfunction score as a predictive tool of dengue shock syndrome outcomes

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Abstract

Background The pediatric logistic organ dysfunction (PELOD) score is widely used as a predictive tool of patient outcomes in pediatrics intensive care unit (PICU) settings, including for dengue shock syndrome (DSS) patients. We evaluated the predictive value of PELOD scores in DSS patients taken within the first hours after PICU admission.

Objective To evaluate the usefulness of PELOD scores taken in day 1 of PICU admission for predicting outcomes in DSS patients.

Methods We included 81 DSS subjects admitted to the PICU between April 2006 – October 2009 by consecutive sampling. There were 12 children under 12 months of age, 48 children 1- 5 years of age, and 21 children above 5 years of age enrolled in the study. PELOD calculations were performed as set out by original articles, using the published formula.

Results Of the 81 PICU patients, 15 (18.5%) died. The estimated, predicted mortality using PELOD scores were 43% for infants under 12 months, 12% for children 1 - 5 years, and 10% for children above 5 years. The actual mortality rates were 58.3% (7 subjects) for infants under 12 months, 10.4% (5 subjects) for children 1 – 5 years, and 14.3% (3 subjects) for children above 5 years. In patients who died, PELOD indicated the most common organ problems to be hepatic disorders (SGOT/SGPT > 950 IU/L) and haematologic disorders (prothrombin time, INR > 1.65) in 8 (53.3%) subjects and 9 (60%) subjects, respectively.

Conclusion PELOD scores from subjects taken on day 1 of PICU admission can be used to predict mortality outcome. **[Paediatr Indones. 2012;52:72-7]**.

Keywords*: PELOD, shock, dengue haemorrhagic fever*

Almost all patients in intensive care units (ICUs) have some organ dysfunction. Various adult and pediatric studies have shown that mortality increases with the number of organs involved. Thus, multiple-organ dysfunction (MOD) syndrome (abnormalities involving two or more organs) may be related to higher death rates. Primary multiple-organ dysfunction syndrome (present at admission or occurring within the first week after admission to the ICU) accounts for 88% of children with the syndrome. Secondary multiple-organ dysfunction syndrome is less common (12%), but is associated with higher morbidity and mortality.[1-3]

Based on clinical observations, definitions and markers of organ dysfunction, a number of proposed scoring systems have been developed, variably validated, and applied to multiple clinical series, with the goal of quantifying MOD severity. In adults, the main scoring systems include multiple organ dysfunction score (MODS), the logistic organ dysfunction score (LODS), and the sequential organ failure assessment (SOFA) score, each of which

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quantifies the severity of MOD as a single score and correlates this score to outcomes.[1,3]

Wilkinson *et al* initially proposed diagnostic criteria for organ failure in critically ill children and defined multiple organ failure as the simultaneous occurrence of at least 2 organ systems. The association that they found between an increasing number of organ failures and PICU mortality, has been repeatedly confirmed. Several groups reported that the number of children who die in the PICU without fulfilling criteria for MOD syndrome is low.[3]

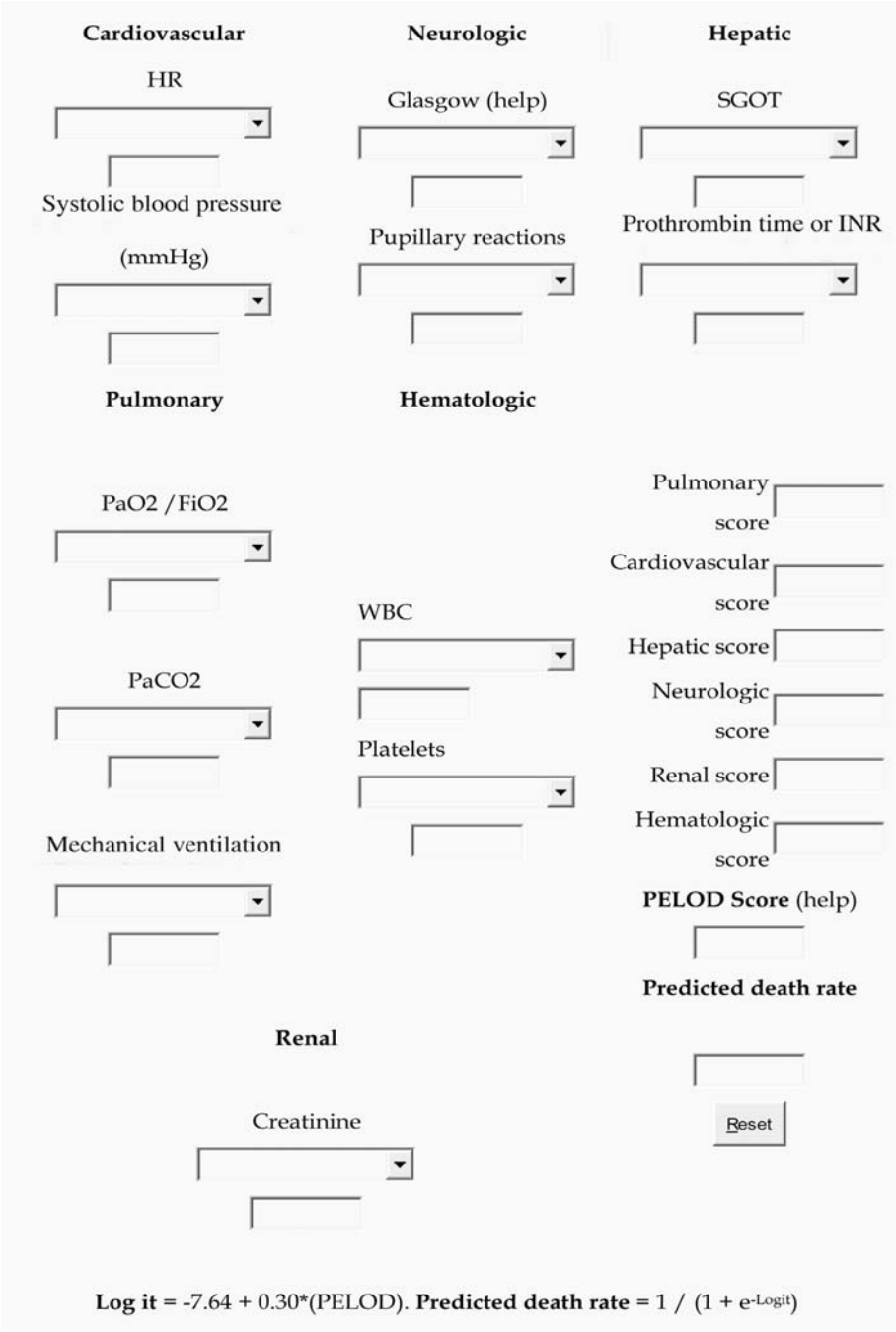

Figure 1. PELOD (pediatric logistic organ dysfunction) score

Leuteutre *et al* developed a pediatrics organ dysfunction score which included six organ systems. They found the PELOD system to be more discriminating, while having the advantage of taking into account both the relative severity of dysfunction among the organs and the degree of severity of each organ dysfunction.[4,5]

Three prognostic scores have been used in pediatric patients: the pediatric risk of mortality (PRISM III), the pediatric index of mortality (PIM) and the pediatric logistic organ dysfunction score (PELOD). The first two scores use data collected at the time of PICU admission, while the third is an outcome score based on data obtained from admission to discharge or from admission to 2 hours before death.[5]

The PELOD score calculated from data collected over the entire PICU stay has been validated (using the most abnormal value of each variable during the entire PICU stay). However, the PELOD score over the entire PICU stay cannot be calculated before discharge from the unit, therefore, it cannot be used to characterize and follow the severity of organ dysfunction on a daily basis. Measurements repeated daily may provide more useful information. The optimal period for measuring daily scores for multiple organ dysfunction in adults has been studied. Indeed, trends in the sequential organ failure assessment score over the first 48 hours in the ICU were found to be a sensitive indicator of outcome, with decreasing scores associated with a decrease in mortality from 50% to 27%. Similar data for critically ill children are lacking.[2]

In this study we evaluated PELOD performance for predicting outcomes in DSS patients taken during the first hours after PICU admission.

Methods

Subjects were DSS patients admitted to the PICU after referral by the emergency department or the pediatric ward in April 2006 - October 2009.DSS diagnoses were made according to the 1997 World Health Organization criteria and confirmed with serologic-positive dengue blots taken between the fifth and seventh days of fever.[7]PELOD scores were taken during the first hours after PICU admission.[8] For the PELOD score, six organ systems (neurologic, cardiovascular, renal, respiratory, haematologic and hepatic) were considered, each with up to 3 variables (total 12 variables). Each variable was assigned points (0, 1, 10 or 20) based on the level of severity **(Figure 1).** Levels of severity and relative weights of each organ dysfunction were determined by means of logistic regression. For each variable, the most abnormal value from each day was used to calculate the daily PELOD score.[1,3,5, 8]We excluded DSS patients with congestive heart disease and non-dengue related haematologic abnormalities. Physicians measured PELOD scores during the first hours of PICU admission, with a median time of four hours. Laboratory examinations were also performed during the first four hours after admission.

Table 1. Subject characteristics, PELOD score categories, PELOD scores, and outcomes

		n = 81
Sex	Male	39(48.1)
	Female	42(51.9)
Age group	<1 year	12(14.8)
	1-5 year	48(59.3)
	5-12 year	15(18.5)
	>12 year	6(7.4)
Heart rate	Score 0	76(93.8)
	Score 10	5(6.2)
Systolic pressure	Score 0	32(39.5)
	Score 10	47(58.0)
	Score 20	2(2.5)
GCS	Score 0	49(60.5)
	Score 1	25(30.9)
	Score 10	7(8.6)
Pupil	Score 0	79(97.5)
	Score 10	2(2.5)
SGOT	Score 0	76(93.8)
	Score 1	5(6.2)
INR	Score 0	57(70.4)
	Score 1	24(29.6)
PaO2	Score 0	65(80.2)
	Score 10	16(19.8)
PaCO2	Score 0	73(90.1)
	Score 10	8(9.9)
MV	Score 0	61(75.3)
	Score 1	20(24.7)
WBC	Score 0	63(77.8)
	Score 1	18(22.2)
Thr	Score 0	5(6.2)
	Score 1	76(93.8)
Cr	Score 0	51(63.0)
	Score 1	1(1.2)
	Score 10	29(35.8)
PELOD score		11 (2-44)
PELOD-predicted	Died	14 (17.3)
	Survived	67(82.7)
Outcome	Died	15(18.5)
	Survived	66(81.5)
Total		81 (100.0)

Categorical variables presented as n(%); PELOD score as median (min-max)

Table 2. PELOD score comparison of subjects who survived and those who died

	PELOD score	P
PELOD score of subjects who died (n=15)	33 (13-44)	<0.001#
PELOD score of subjects who survived (n=66)	11 (2-32)	
Discrimination ability (AUC)	97.9 (95.2-100.0)	<0.001*
Calibration ability (Hosmer & Lemeshow test)		0.315

#Mann-Whitney test, PELOD score in median (minimum-maximum); *ROC curve, AUC in % (95% CI)

Table 3. Day of admission PELOD-predicted versus actual mortality of DSS subjects

Subjects			Actual mortality			P#
			Died	Survived	Total	
All	PELOD-predicted	Died	12	2	14	1.000
		Survived	3	64	67	
		Total	15	66	81	
<1 year	PELOD-predicted	Died	4	0	4	0.250
		Survived	3	5	8	
		Total	7	5	12	
1-5 years	PELOD-predicted	Died	5	2	7	0.500
		Survived	0	41	41	
		Total	5	43	48	
> 5 years	PELOD-predicted	Died	3	0	3	1.000
		Survived	0	18	18	
		Total	3	18	21	

#McNemar Test

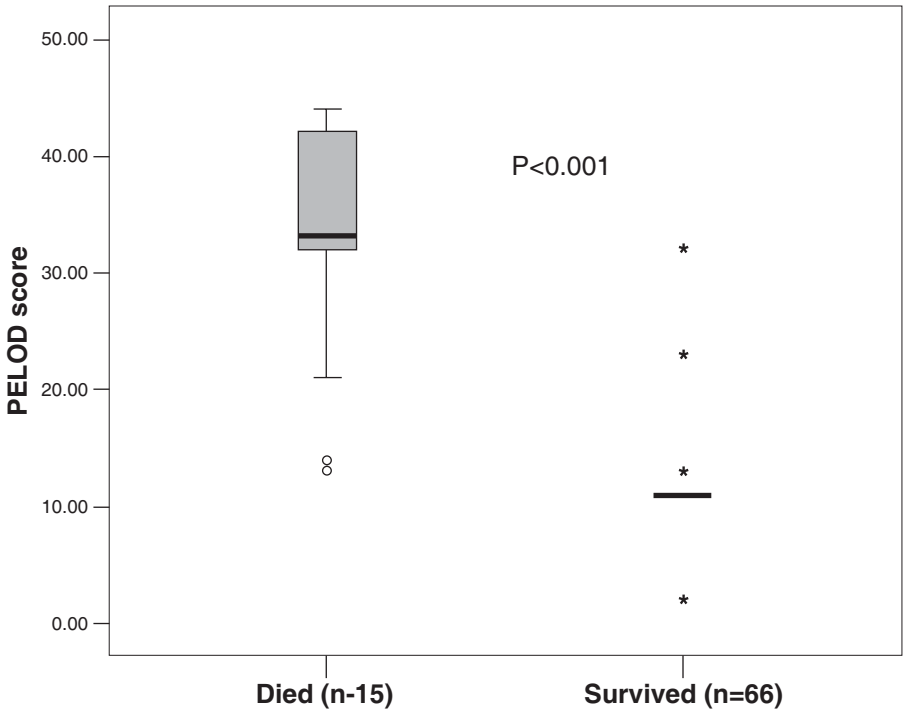

Figure 2. PELOD score comparison of subjects who survived and those who died (Mann-Whitney test, P < 0.001)

Results

Of the 81 DSS patients admitted to PICU of Fatmawati Hospital, almost 60% were 1-5 years old (**Table 1**). As shown in **Table 1**, using PELOD scores (median 11, range 2 – 44) taken on the first day of PICU admission, we predicted an estimated mortality of 14 subjects (17.3%).

Hepatic and haematologic disorders were the main problem organ systems observed in the mortality cases according to PELOD (**Table 1**). We found PELOD score could help us to predict the mortality of DSS patients (**Table 2** and **Figure 2**).

The actual mortality figures were 7 (58.3%) for infants, 5 (10.4%) for children aged 1 – 5 years and 3 (14.3%) for children above the age of 5 years. **Table 3** shows there were slight differences between PELOD-predicted and actual mortality of our DSS subjects.

Discussion

Limited data is available on the long-term outcomes of surviving patients discharged from the PICU. A normal quality of life with minimal health problems has been reported in 60% of children with MOD, while 32% indicated a fair quality of life with ongoing health, emotional, social, physical, or cognitive problems requiring intervention or hospitalization. Poor quality of life was reported in 2%. The return of organ function in pediatric MOD patients has not been examined in a systematic manner.[9]

In our study, we found PELOD scores taken on day 1 of PICU admission to be a good predictor of outcomes, despite not taking daily measurements. Likewise, Iskandar *et al* reported that PELOD measurements on the first day of PICU admission accurately predicted mortality in DSS patients at Harapan Kita Hospital, Jakarta.[10] In addition, Typpo *et al* found that children with MOD present on day one of ICU admission had worse functional outcomes, higher mortality and longer PICU stays than children without MOD on day one.[11] Lacroix *et al* also found PELOD scores to be useful for describing clinical outcomes of patients during PICU stays.[12]

Liver dysfunction (SGOT/SGPT > 950 IU/L) as one of PELOD components was observed in 8 (53.3%) patients who died in our study. Wiwanitkit *et al* in Thailand found liver dysfunction in 34.6% of pediatric patients with dengue infection (66/191 patients). The rate of liver dysfunction in patients without shock was not significantly different from those with shock. In addition, about 8% (5/66) of patients developed hepatic encephalophathy.[14]

We found haematologic disorders (prothrombin time, INR > 1.65) in 9 (60%) patients who died, indicating it may be a predictive factor for DSS patients. However, Wiwanitkit *et al* in their study of dengue hemorrhagic fever without shock in pediatric wards found no significant correlation between the hematology laboratory data they had studied and their focused outcomes by regression analysis. This finding implies that closed monitoring of dengue hemorrhagic patients is necessary.[15] In contrast, by logistic regression analyses, Gando *et al* found the Japanese Association of Acute Medicine disseminated intravascular coagulation (JAAM DIC) score and prothrombin time ratio on the day of DIC diagnosis to be predictors of patient outcomes.[16]

Despite many studies reporting the usefulness of PELOD, Qureshi found that PELOD performed poorly in Children's Hospital, Institute of Child Health, Lahore, Pakistan compared to other predictive tools, such as PRISM and PIM II.[17]

A limitation of our study was that we did not repeat PELOD measurements after the first hours of PICU admission. The critical phase of DHF generally lasts 48 hours or less, with the most critical time period being less than 24 hours. Since we have no PELOD scores after day 1, we were unable to compare the usefulness of day 1 scores to those of later times.

In conclusion, we found PELOD scores on day 1 of PICU admission for DHF patients with shock to be useful for predicting mortality rates. In addition, all subjects with low $PaCO_2$ values died, suggesting that $PaCO_2$ monitoring may add value for predicting outcomes.

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