The Use of PELOD Score in Predicting Acute Kidney Injury in Critically ill Children

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Abstract

Introduction: Acute kidney injury (AKI) significantly increases morbidity and mortality in critically ill children. Prognostic indicators such as Pediatric Logistic Organ Dysfunction (PELOD) score is associated with factors related to renal dysfunction. The aim of this study was to study the AKI incidence and correlate the PELOD score with AKI in critically ill children admitted to PICU at Dr. Soetomo Hospital Surabaya Indonesia. **Material and Methods:** A prospective study was conducted to all children admitted to PICU during 15 January-14 April 2014. Demographic data (age, sex, PICU indications, PELOD scores, AKI staging by pRIFLE at admission) and outcome after 7 days at PICU were recorded. All data were analyzed descriptively (p<0.05). **Results:** A total of 56 (47.1%) out of 119 children were studied. The rest was excluded for being <3 months old, had end-stage kidney disease or complex cardiac problem, and cardiac catheterization. Mean age of subjects was 49.7 (SD 46.2) months, male-to-female ratio of 1.2:1. PICU indication was dominated by shock (35.7%), followed by CNS dysfunction in 13 (23.2%) and respiratory failure in 12 (21.4%) children. AKI was noted in 15 (26.8%) children, mostly (10.7%) in Injury stage with 5 (8.9%) in Risk and 4 (7.1%) in Failure stages. PELOD scores at admission ranged from 0 to 20 (mean 4.34, SD 5.87), higher scores in AKI group (7.8±6.64 vs 3.1±5.09, P=0.013). Twelve (21.4%) children died, 7 (58.3%) had AKI with 3 (25.0%) each in Risk and Failure while 1(8.3%) in Injury (p<0.05). **Conclusion:**PELOD score can be used as a predictor for AKI in critically ill children.

Key words: PELOD score**,** Acute kidney injury, Critically ill children

Introduction

Acute kidney injury (AKI) is a common problem that significantly increases morbidity and mortality in pediatric intensive care units (PICUs). Prognostic indicators used to describe disease severity, such as Pediatric Risk of Mortality (PRISM), Pediatric Index of Mortality II (PIM II) and Pediatric Logistic Organ Dysfunction (PELOD) scores, are associated with factors that markedly influence renal dysfunction[1]. The incidence of AKI in this at-risk population remains unknown

due to the lack of consensus on the definition of AKI with more than 30 different definitions of this disease exist in the literature.[1] The Acute Dialysis Quality Initiative (ADQI) published RIFLE (Risk, Injury, Failure, Loss, End-stage) criteria in 2004 which delineate the important milestones for critically ill adult patients. The term Acute Kidney Injury (AKI) was proposed to cover the entire spectrum of this syndrome. Akcan-Arikan et al (2007)[2] developed a modified version of RIFLE for pediatric population (pRIFLE) based on a reduction in estimated creatinine clearance (eCCl) while monitoring urine output based on body weight (figure 1). AKI is then characterized by a sudden and generally reversible renal function impairment involving inability to maintain the homeostasis and may or not be accompanied by reduced diuresis[3].

Considering the close association between severely ill patients and AKI, the quantification of ICU patient's severity is mandatory[3]. Severity scoring systems in the intensive care unit have been developed in response to an increased emphasis on the evaluation and monitoring of health care services[4]. In pediatrics, the most used prognostic indicators are PRISM, PIM and PELOD[3]. LOD model has been introduced by Le Gall et al in 1996 and uses a multiple logistic regression analysis on a large database. The six organ failures of the LOD are then defined and the statistical model gives a 0-5 points weighting to each dysfunction[5].A previous study by Vera et al (2013)[6] found that higher PELOD score was found in AKI group in 113 critically ill children.

There was a lack of study focusing on the outcome of the critically ill children using the PELOD score correlated to AKI by pRIFLE criteria. Therefore the aim of this study was to study the AKI incidence and correlate the PELOD score with AKI in critically ill children admitted to PICU at Dr. Soetomo Hospital Surabaya Indonesia.

Material and Methods

A prospective study on children admitted to PICU at Dr. Soetomo Hospital Surabaya Indonesia was done during 15 January to 14 April 2014 was conducted. Demographic data including age and sex, PICU indications, PELOD scores and AKI staging using pRFILE criteria at PICU admission were recorded. The outcome of subjects were determined after 7 days at PICU.

All data were analyzed by descriptive statistics, chi-square and Fisher test. Cut off points of PELOD scores and receiver operating curve (ROC) were calculated by SPSS 21.0. A *p* value <0.05 was considered statistically significant.

This study was approved by The Ethical Committee on Human Research Project at Dr. Soetomo Hospital.

Results

A total of 119 children were admitted to PICU during study period. Fifty six (47.1%) of them were studied further and the other 63 children were excluded for being <3 months old, had end-stage kidney disease or complex cardiac problem, and children underwent cardiac catheterization. The characteristics of subjects included mean age of 49.7 (SD 46.2) months with male-to-female ratio of 1.2:1. Indication for PICU admission was dominated by shock (35.7%), followed by central nervous system (CNS) dysfunction in 13 (23.2%) and respiratory failure in 12 (21.4%) children (table 1).

AKI was noted in 15 (26.8%) children, mostly (10.7%) in Injury stage with 5 (8.9%) in Risk and 4 (7.1%) in Failure stages. PELOD scores at admission ranged from 0 to 20 with mean 4.34 (SD 5.87). There was a significant higher score found in AKI group (7.8±6.64 vs 3.1±5.09, *p*=0.013) when compared to non-AKI group (table 2). A cut-off point for PELOD score to AKI of 6.0 was determined by ROC curve with sensitivity of 60%, specificity of 75.6% and area under the curve (AUC) of 0.75 (figure 2). Subjects with PELOD score >6.0 had a significantly higher risk for AKI than subjects with PELOD score <6.0 (*p*=0.013) (table 3 and 4).

Twelve (21.4%) children died, 7 (58.3%) had AKI with 3 (25.0%) each in Risk and Failure stages while 1 (8.3%) in Injury (*p*<0.05). There was a significant difference on the outcome of subjects with AKI when compared to non-AKI group (*p*=0.010). Each stage of AKI had non-significant differences on the outcome (*p*>0.05) (table 5).

Table 1: Basic characteristics of subjects

Characteristic		N	%
Age	3-12 month	14	25.0
	13-60 month	23	41.1
	61-120 month	14	25.0
	>120 month	5	8.9
Gender	Male	30	53.6
	Female	26	46.4
Indication for PICU admission	Shock	20	25.7
	CNS dysfunction	13	23.2
	Respiratory failure	12	21.4
	Heart failure	6	10.7
	Respiratory and CNS dysfunction	2	3.6
	Post surgery	2	3.6
	Respiratory and heart failure	1	1.8
Outcome	Alive	44	78.6
	Died	12	21.4

Table 2: Distribution of PELOD scores and AKI staging in subjects

PELOD Score		Mean (SD)	p
AKI	Total	7.8 (6.64)	0.013*
	Risk	1.0 (0.71)	
	Injury	10.2 (0.41)	
	Failure	12.8 (9.14)	
Non AKI		3.1 (5.09)	

*significant chi-square test (p<0.05)

Table 3: Cut off point of PELOD score and AKI in subjects

Cut off point of PELOD score	AKI (n (%)	Non-AKI (n (%))	p
<6.0	6 (16.2)	31 (83.8)	0.013*
≥6.0	9 (47.4)	10 (52.6)	

*significant chi square test (P<0.05)

Table 4: Cut off point of PELOD score and AKI staging in subjects

Cut off point of PELOD score	AKI-R (n (%)	AKI-I (n (%))	AKI-F (n (%))
<6.0	5 (100.0)	0 (0.0)	1 (25.0)
≥6.0	0 (0.0)	6 (100.0)	3 (75.0)

Table 5: Outcome of AKI subjects

AKI		Alive (n (%))	Died (n (%))	p
AKI (n=56)	Yes	8 (53.3)	7 (46.7)	0.010*
	No	36 (87.8)	5 (12.2)	
AKI staging (n=15)	Risk	2 (40.0)	3 (60.0)	0.242**
	Injury	5 (83.3)	1 (16.7)	0.226***
	Failure	1 (25.0)	3 (75.0)	1.000****

*significant Fisher test (p<0.05)
** non-significant Fisher test for risk and injury groups (p>0.05)
***non-significant Fisher test for injury and failure groups (p>0.05)
**** non-significant Fisher test for risk and failure groups (p>0.05)

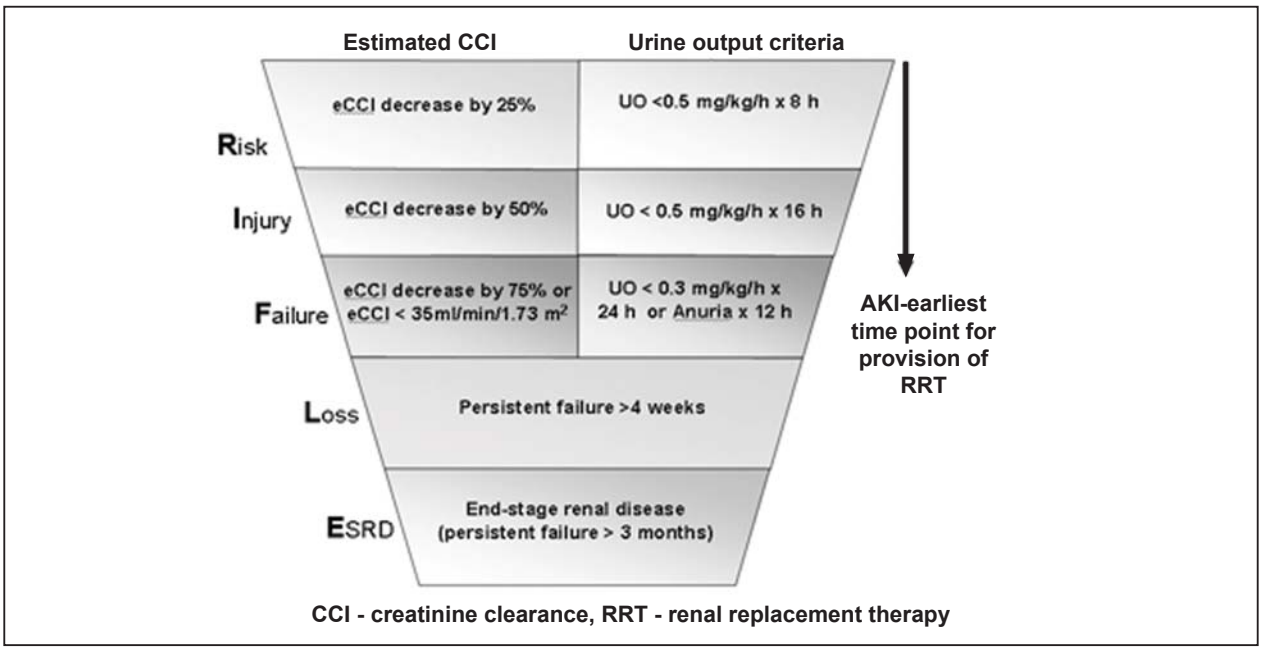

Fig 1: pRIFLE criteria for AKI(Akcan-Arikan A, Zappitelli M, Loftis LL, Washburn KK, Jefferson LS, Goldstein SL. Modified RIFLE criteria in critically ill children with acute kidney injury. Kidney Int 2007; 71: 1028-35.)

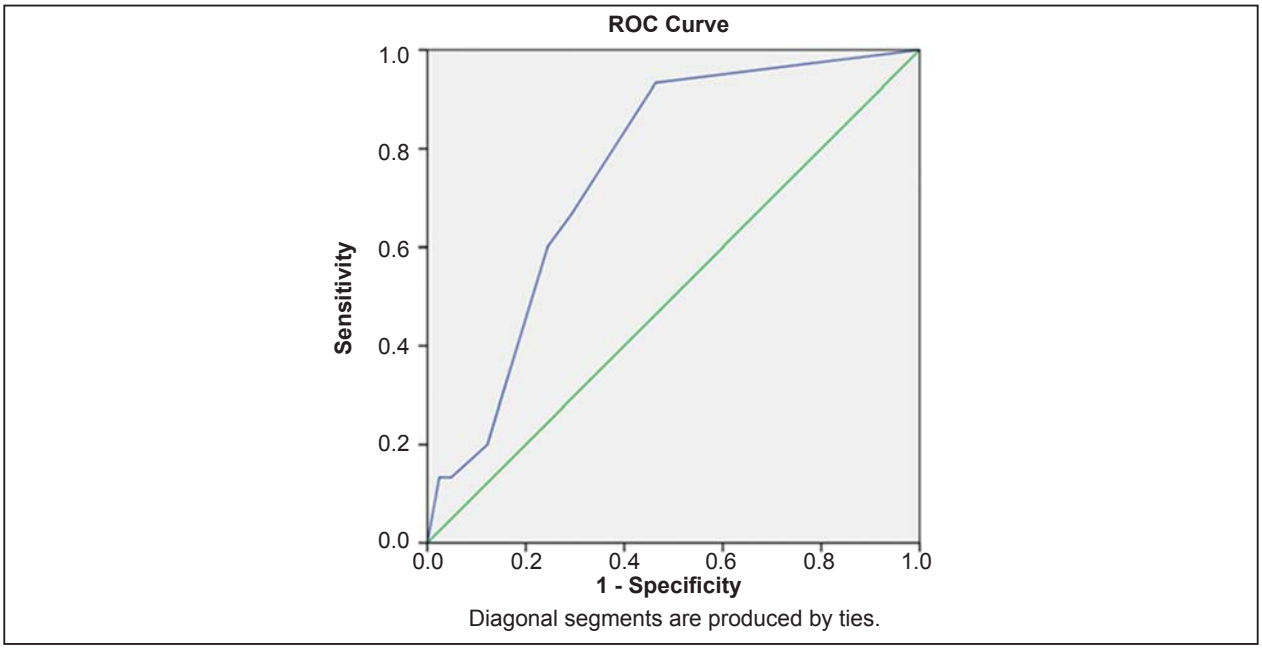

Fig 2: ROC curve of the study (A cut-off point for PELOD score to AKI of 6.0 was determined by ROC curve with sensitivity of 60%, specificity of 75.6% and area under the curve (AUC) of 0.75)

Discussion

The assessment of morbidity during ICU stay may provide important information about a patient's illness, their response to treatment and describe the patient population in clinical trials. PELOD is one of the popular model in common use throughout the world for organ dysfunction assessment. It was designed as a tool for evaluation on the probability of mortality based on organ dysfunction on the day of ICU admission[5]. AKI has a known catastrophic impact on critically ill patients. It is common among them and its cause is mostly multifactor. AKI may progress to renal failure, preventing the kidneys to play their most important role in maintaining homeostasis[3].

In this study, the AKI incidence was 26.8% in PICU children, similar to other studies that ranged from 30-80%[2,3,6,7]. Other adult studies found the incidence to be ranged from 30-60%[8,9,10]. Regarding the AKI staging, the maximal pRIFLE score found during the patients stay was 33.3% R, 40.0% I, 26.7% F, while Freire et al found 39.1% R, 39.1% I, 21.8% F; Akcan-Arikan et al found 48.8% R, 26.0% I, 25.2% F; and Plötz et al found 52.0% R, 37.0% I, 11.0% F respectively[2,3,7]. The variable AKI incidences can be explained by the different populations studied, and also by the different ICU characteristics[3].

The present study showed that the PELOD score correlated well with the AKI incidence in critically ill children admitted to PICU. A cut-off point of 6.0 was determined with AUC 0.75 (>0.50) that revealed that it has a good discrimination. The AUC for the original PELOD was 0.84 with the subsequent studies showed results ranged from 0.7 to 0.8[5].

Organ dysfunction is a dynamic process and the degree of dysfunction may vary with time and treatment. Serial or repetitive assessment of organ dysfunction scores allow for a more effective representation of an outcome prediction than does a single measurement[5]. Studies using the RIFLE and pRIFLE criterias in adults and children validated a positive statistically significant association between time of stay, both in ICU or hospital, and AKI proving a poorer prognosis predictor in critically ill patients[3]. In view of mortality rate, several studies have clearly shown that any degree of AKI is a poor prognosis indicator for critically ill patients. In this study, we found that there was a statistically significant higher mortality rate in AKI group when compared to non-AKI group. Freire et al found a ten times bigger of in-hospital mortality in AKI group; while Akcan-Arikan et al found no statistically significant difference on both groups; and Plotz et al identified a five times bigger mortalityin patients with any level of AKI[2,3,7].

Several limitations were acknowledged in this study. First, studying in only a single centre put limitations on the case-mix and quality of ICU care. Secondly, evaluation of a single assessment of organ dysfunction scores after the the first 24 hours of ICU admission may not be so accurate. It would certainly be

better to have serial measurements for the evaluation of organ dysfunction scores for predicting the outcome in critically ill patients.

Conclusion

PELOD score can be used as a predictor for higher mortality rate in critically ill children with AKI.

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