

Prognostic predictor at Pediatrics Intensive Care Unit (PICU) with Pediatric Risk of Mortality III (PRISM III) scores

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ABSTRACT

Various mortality prognostic scoring system are available for predicting mortality risk in Pediatric Intensive Care Unit (PICU). The Pediatric Risk of Mortality III (PRISM III) scoring system is one of the main indicators used in the PICU. This study was conducted to evaluate the PRISM III as prognostic predictor in PICU. This was a cohort study involving 64 patients who admitted to PICU in Dr. Sardjito General Hospital, Yogyakarta and met inclusion and exclusion criteria. The clinical state of patients were assessed and the PRISM III scores corresponding to the first 24 hours of hospitalization were calculated. Outcome analysis was defined either as death or discharged from the hospital were recorded. Multivariate analysis was performed to find out independent predictive factor that influence the outcome of death. The discriminative power of the model was calculated based on the receiver operator curve (ROC). The result showed that mental status (relative risk/RR: 13.21; 95%CI: 1.18-14.80), White Blood Count/WBC (RR: 19.51; 95%CI: 18.12-25.15) and Blood Urea Nitrogen/BUN (RR:22.87; 95%CI:1.85-28.20) were found to be the main predictive factors of death in PICU. The cut off value of 51 of PRISM III score yielded the best sensitivity (83%) and specificity (69%). In conclusion, PRISM III score can be used as a prognostic predictor to determine the death risk of patients hospitalized at PICU.

ABSTRAK

Berbagai sistem penilai prognosis mortalitas tersedia untuk memprediksi risiko kematian di Unit Perawatan Intensif Anak (UPIA). Sistem penilaian Pediatric Risk of Mortality III (PRISM III) merupakan salah satu indikator utama yang digunakan di UPIA. Penelitian ini dilakukan untuk mengkaji PRISM III sebagai prediktor prognosis di UPIA. Penelitian ini merupakan penelitian kohort yang melibatkan 64 pasien anak yang dirawat di UPIA RSUP Dr. Sardjito, Yogyakarta yang memenuhi kriteria inklusi dan eksklusi. Kondisi klinik pasien diperiksa dan nilai PRISM III pada 24 jam pertama sejak dirawat di rumah sakit dihitung. Analisis multivariat dilakukan untuk mencari faktor prediktif independen yang mempengaruhi kematian. Kekuatan pembeda model dihitung berdasarkan *receiver operator curve* (ROC). Hasil penelitian menunjukkan status mental (Relative Risk/RR: 13,21; 95% Confidence Interval/CI: 1,18-14,80), jumlah leukosit (RR: 19,51; 95%CI: 18,12-25,15) and nitrogen urea darah (RR:22,87; 95%CI:1,85-28,20) terbukti merupakan faktor prediktif utama kematian di UPIA. Nilai titik potong 50 dari skor PRISM III memberikan sensitivitas (83%) dan spesifisitas (69%) terbaik. Dapat disimpulkan, skor PRISM III dapat digunakan sebagai prediktor prognostik untuk menentukan risiko kematian pasien yang dirawat di UPIA.

Keywords: prognostic - Pediatrics Intensive Care Unit - PRISM III – death risk - predictor

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INTRODUCTION

Pediatrics intensive care unit (PICU) is an intensive care unit that provides treatment and care of critically ill children. Pediatrics ICU aim at promoting qualified care with the objective of achieving the best results and better progress for the critically ill children. The practice of PICU has developed dramatically throughout the past 3 decades. Knowledge of the pathology of life-threatening processes and the technological capacity to monitor and treat pediatric patients suffering from them has advanced rapidly during this period. Therefore, the aim of PICU to suppress the number of deaths (mortality) and the rate of disability (morbidity) can be achieved.¹⁻³

Technology advances in PICU resulted to a more sophisticated care for children, therefore making the PICU prepared to treat cases of high complexity at high cost. However, the technology available has not always succeeded in improving the quality of patient care and to augment life expectancy.⁴ Therefore, measuring the illness severity at admission and assessing its prognosis are needed.^{5,6} This procedure can be conducted using the mortality prognostic scores that objectively quantify the illness severity and predict the mortality risk according to the clinical state of patients. In addition, the mortality prognosis scores could aid in various areas of treatment and care, such as selection of treatments, ethical issues and economic strategies.⁷

Various mortality prognostic scoring systems are available for predicting mortality risk in PICU. The Pediatric Risk of Mortality (PRISM) scoring system is one of the main indicators used in the PICU. The PRISM is a physiology-based predictor for PICU patients. Recently, a new scoring system, PRISM III, an updated second generation scoring system, has been validated for use in the United States and several

other countries. PRISM III has resulted in several improvements over the original PRISM. In addition, PRISM III has an important role in clinical study protocols as it acts as a severity index for patient comparison.^{8,9}

The purpose of this study was to evaluate the use of PRISM III scores as prognostic predictor of mortality at PICU of Dr. Sardjito General Hospital, Yogyakarta.

MATERIAL AND METHODS

Subjects

A prospective cohort conducted in patients who admitted at the PICU of Dr. Sardjito General Hospital, Yogyakarta, starting from December 2012 until an appropriate sample size obtained. A minimum of 52 patients were estimated to be necessary for the present study. The sample size was calculated using sample size estimation for prognostic test. The inclusion criteria were children treated in the PICU whose parents agreed to follow the study by signing an informed consent, while the exclusion criteria was patients that have incomplete data. The study was approved by the Medical and Health Research Ethics Committee, Faculty of Medicine, Universitas Gadjah Mada, Yogyakarta.

Research procedure

The clinical state of patients who admitted at PICU were assessed and the PRISM II scores corresponding to the first 24 hours of hospitalization were determined. The PRISM III scores were calculated according to the equation described by Pollack *et al.*⁶ This involved age-related physiological parameters, including mental status, systolic blood pressure (SBP), heart rate (HR), blood urea nitrogen (BUN), creatinine, pupillary reflexes, temperature, white blood count (WBC), platelet count, acidosis (pH and total CO₂), pCO₂, pO₂,

glucose, potassium and prothrombin time or partial thromboplastin time (PT/aPTT). Outcome analysis was defined either as death or discharged from the hospital were recorded.

Statistical analysis

Data were tabulated and analyzed using SPSS version 15. Bivariate analysis was performed on PRISM III to find out predictive factors that influence the outcome of death. Whereas multivariate analysis was performed to find out independent predictive factor that influence the outcome of death. p value < 0.05 was considered indicative of statistical significance. The discriminative power of the model i.e. its ability to distinguish patients who would survive from those who would die was

calculated based on the receiver operator curve (ROC).

RESULTS

Sixty-four children who met the inclusion and exclusion criteria were enrolled in this study with clinical outcome was 28 children alive (43.6%) and 36 children died (56.4%). The characteristics of subjects are presented in TABLE 1. Among 36 of the death cases, 7 (19.4%) deaths were surgical cases and 29 (80.6%) deaths were non-surgical cases. The main cause of death on non-surgical cases included intracranial infection (40.8%), pneumonia (23.8%), malignancy (10.2%), intracranial bleeding (10.2%) and dengue shock syndrome, diabetic ketoacidosis.

TABLE 1. Characteristics of subjects

Characteristics	Alive		Dead	
	n	%	n	%
Age				
• 1-12 months	6	9.3	10	15.6
• 13-60 months	20	31.2	16	25.2
• >60 months	2	3.1	10	15.6
Gender				
• Male	17	26.5	19	29.7
• Female	11	17.3	17	26.5

Bivariate analysis performed on the PRISM III to find out predictive factors that influence of death showed that mental status, white blood

count, HR and BUN were predictive factors of death in PICU (TABLE 2).

TABLE 2. Bivariate analysis of predictive factors of death

Predictive factors	p	Relative Risk	95% CI	
			Lower	Upper
Mental status	0.011*	3.93	1.36	11.33
Systolic blood pressure	0.235	0.42	0.35	2.65
Heart rate	0.008*	4.58	1.5	14.00
BUN	0.001*	10.51	3.29	33.55
Creatinine	0.001	2.67	0.96	7.39
Pupillary reflexes	0.481	1.44	0.84	3.87
Temperature	0.629	0.464	3.55	1.28
WBC	0.001*	73.88	8.70	78.10
Platelet count	0.073	5.27	0.85	32.62
pH	0.001	0.14	0.04	0.43
CO ₂	0.225	1.43	0.65	7.54
Acidosis	0.002	0.11	0.03	0.37
pCO ₂	0.001	0.10	0.03	0.37
pO ₂	0.014	0.21	0.06	0.72
Glucose	0.001	0.13	0.04	0.42
Potassium	0.620	1.36	0.38	4.75
PT/aPTT	0.347	1.76	0.65	6.87

*BUN: blood urea nitrogen; WBC: white blood count; *significantly different (p<0.05).*

Multivariate analysis performed to find out independent predictive factor that influence of death is presented in TABLE 3. The predictive factors of death observed in this study were

mental status with a relative risk (RR) of 13.21 (95% CI 1.18 to 14.80), WBC with RR of 19.51 (95% CI 18.12 to 25.15) and BUN with RR of 22.87 (95% CI 1.85 to 28.20).

TABLE 3. Multivariate analysis

Predictor factors	p	Relative Risk	95% CI	
			Lower	Upper
Mental status	0.036	13.21	1.18	14.80
White blood count	0.001	19.51	18.12	25.15
BUN	0.015	22.87	1.85	28.20

To determine the discriminative power that distinguished patients who would survive from those who would die on PRISM scores, cut off

point was calculated based on the receiver operator curve (ROC) as presented in FIGURE 1.

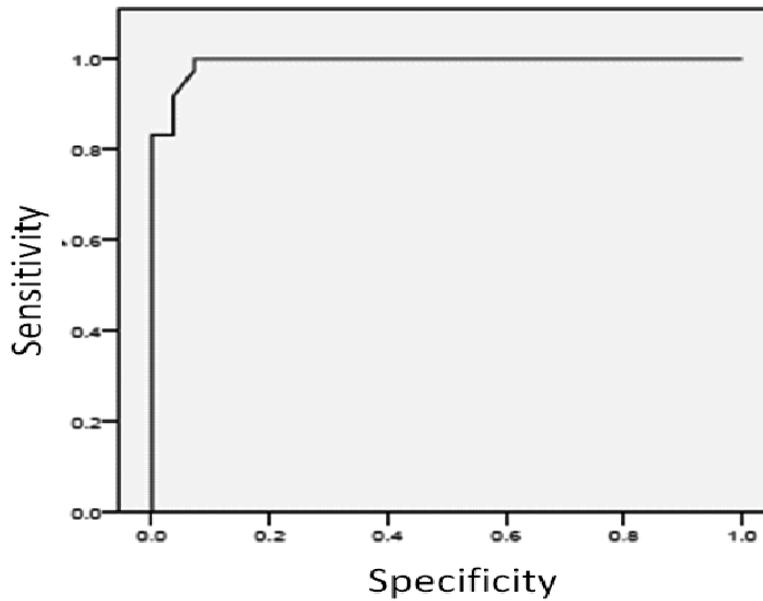


FIGURE 1. Receiver Operator Curve of sensitivity and specificity of PRISM III scores to determine the outcome (alive-dead)

TABLE 4 shows death prediction obtained from 64 patients based on the cut off point of the PRISM III scores. In this study, the cut off value of 51 gave the best sensitivity (83%) and specificity (69%), therefore it was taken as the

cut off point. On cut off value of 26-41, high sensitivity but low specificity were observed, while on cut off value of 51-62, high specificity but low sensitivity were observed.

TABLE 4. Prediction of death compared in ROC of PRISM III scores

PRISM III Score	Sensitivity (%)	Specificity (%)
26	100	0
30	100	54
37	100	54
41	100	64
49	89	65
51	83	69
54	69	100
57	36	100
60	22	100
62	11	100

DISCUSSION

In this study, the death cases in non surgical cases (80.6%) was higher than in surgical cases (19.4%). This result was similar with primary data obtained from the same PICU in 2011 that showed the death cases in non surgical cases (91.7%) was higher than in surgical cases (8.3%). However, the main cause of death in this study was different with at the same PICU in 2011 which pneumonia (29.9%) was the main cause of death, followed by intracranial infection (14.0%) and cardiac abnormalities (8.9%).

In this study, mental status, WBC and BUN were found to be the main predictive factors of death at PICU. This result was different with some other studies. De Leon *et al.*¹⁰ reported that main factors affecting death were pupillary reflexes (OR: 9.9; 95% CI: 3.5-28.4), acidosis (OR: 31.1; 95% CI: 2.0-4.9), BUN (OR: 1.03; 95% CI: 1.01-1.04) and WBC (OR: 1.02; 95% CI: 1.01-1.03). Another study conducted at PICU in Dr. Sardjito General Hospital reported that the main factors affecting death were WBC and creatinine.¹¹ The difference in the characteristics of patients may determine the main predictive factors of death in PICU.

In this study showed that the cut off value of 51 yielded the best sensitivity (83%) and specificity (69%). Therefore, it is taken as the cut off point of PRISM score. The cut off point value obtained in this study was different compare to that obtained in previous studies. De Leon *et al.*¹⁰ reported the cutoff point of 13 with sensitivity of 71% and specificity of 64%, while Tan *et al.*⁸ reported the cutoff point of 18. The severity of illness may cause the difference in the cut off point of PRISM score obtained in each study. The patients admitted at PICU unit in Dr. Sardjito General Hospital during this study had quite severe illness conditions. Therefore the cut off point on the

ROC curve was quite high. The high mortality rate (38.0%) at the PICU supported this data.

Performance of PRISM III score to predict mortality risk of children in PICU are influenced several factors. A study conducted in South Africa find poor discriminatory performance of the PRISM III score in intensive care unit. Over prediction at high PRISM score is observed due to the different demographic characteristics and different pattern of illness.^{5,12} In addition, higher mortality rate is observed in patients with endotracheal intubation, central venous catheter and sepsis compare to the PRISM III score prediction.¹³⁻¹⁵ Patients aged less than 12 months who admitted to PICU have high mortality risk.¹⁶ However, factors that influenced performance of PRISM III score are not investigated in this study.

CONCLUSION

In conclusion, PRISM III score can be used as a prognostic predictor to determine the outcome of death of patients hospitalized at PICU. Mental status, WBC and BUN are found to be the main predictive factors of death at PICU in Dr. Sardjito General Hospital. The the cut off value of 51 yields the best sensitivity (83%) and specificity (69%).

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