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Original Article

Score for Neonatal Acute Physiology Perinatal Extension II (SNAPPE II) as the predictor of neonatal mortality hospitalized in neonatal intensive care unit

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Abstract

Background The assesment of severity of illness with scoring system has been used to predict neonatal mortality in neonatal intensive care unit (NICU). Score for Neonatal Acute Physiology Perinatal Extension II (SNAPPE II) is the best scoring system although most of the studies were commonly conducted in developed countries.

Objective To evaluate SNAPPE II as the predictor of neonatal mortality in NICU Hasan Sadikin General Hospital (HSGH) Bandung.

Methods This was a longitudinal observational study. All neonates hospitalized in NICU HSGH during the period of August to November 2008 were investigated according to SNAPPE II requirements. We excluded subjects admitted more than 48 hours of age, who were discharged or moved to intermediate newborn care ward less than 24 hours after admission. Prediction of mortality and determination of SNAPPE II cut-off point were analyzed using logistic regression. Discrimination was analyzed using receiver operating characteristic (ROC) and calibration was analyzed using Hosmer-Lemeshow goodness-of-fit.

Results Forty subjects fulfilled the inclusion criteria. There was a good relation between SNAPPE II and mortality prediction (P = 0.007). The cut-off point for predicting mortality was 51. SNAPPE II showed good discrimination with AUC 0.933 (95% CI 0.843 to 1.0) and good calibration 1.69 (P = 0.97).

Conclusion SNAPPE II can be used to predict neonatal mortality in NICU similar to that found in developed countries. **[Paediatr Indones. 2009;49:155-9]**.

Keywords: *SNAPPE II, mortality, NICU*

The assessment of severity of illness is very important to determine prognosis, including predicting mortality in neonates hospitalized in neonatal intensive care unit (NICU). Some risk factors which were considered to influence the severity of illness could not be used as severity predictor in neonates. Those risk factors, i.e., birth weight, gestational age, and sex are considered inaccurate. Therefore, we need to predict neonatal mortality more accurately by measuring biochemical and physiological changes.[1-4]

Recently, many scoring systems have been developed to predict neonatal mortality in NICU, i.e., clinical risk index for babies (CRIB), CRIB II, score for neonatal acute physiology (SNAP), SNAP-perinatal extension (SNAPPE), SNAP II, SNAPPE II, Berlin score, 12 hour-SINKIN score (S12), etc.[5-9] The ideal scoring system for predicting severity of illness must fulfill certain criteria, i.e., easy to apply, could be used to predict mortality and morbidity, benefits

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on neonatal hospitalization cost, and can be used in all neonatal groups.[5] SNAPPE II is considered as the best scoring system, because of its simplicity, rapidity, accuracy, and applicable for all birth weights. SNAPPE II has been used in USA and Canada within high accuracy.[5,10,11] However, in developing countries, this scoring system needs further validation. The aim of this study was to evaluate SNAPPE II as the predictor of neonatal mortality in NICU Hasan Sadikin General Hospital (HSGH) Bandung.

Methods

We performed prognostic study from August to November 2008 involving subjects consecutively enrolled from neonates admitted in NICU HSGH after parental written informed consent was obtained. We excluded neonates admitted more than 48 hours of age, those who had been discharged or moved to intermediate newborn care less than 24 hours.

This study had been approved by the Committee for Medical Research Ethics of Medical School, University of Padjadjaran/HSGH Bandung. We performed history taking, physical examination, and blood sampling as needed for assessment using SNAPPE II. The assessment was done in the first 12 hours after the neonates were admitted in NICU, and the SNAPPE II (**Table 1**)[10] values were then calculated. The subjects were closely monitored every day until they were discharged or died.

Logistic regression analysis was done to predict mortality and to find the cut-off point of the SNAPPE II scoring system. Discrimination using the receiver operating characteristic (ROC) analysis and calibration using the Hosmer-Lemeshow goodness-of-fit test was used to validate the SNAPPE II scoring system. All the analysis was done using SPSS 17.0.

Table 1. Score for neonatal acute physiology perinatal extension II (SNAPPE II) [10]

Variable	Measure	Score
Lowest MAP	> 29 mmHg	0
	20-29 mmHg	9
	< 20 mmHg	19
Lowest temperature	> 35.60 C	0
	35-35.60 C	8
	< 350 C	15
PO2/FiO2 ratio	> 2.49	0
	1.0-2.49	5
	0.3-0.99	16
	< 0.3	28
Lowest pH	> 7.19	0
	7.10-7.19	7
	< 7.10	16
Seizure	none	0
	yes	5
Urine output	> 0.9 ml/kg/hr	0
	0.1-0.9 ml/kg/hr	5
	< 0.1 ml/kg/hr	18
Birth weight	> 999 g	0
	750-999 g	10
	<750 g	17
Small for gestational age	> 3rd percentile	0
	< 3rd percentile	12
APGAR score at 5 minute	> 7	0
	< 7	18

Source: Richardson *et al.*[10]

Results

During the study period, there were 50 subjects hospitalized in NICU, and 40 of them fulfilled the inclusion criteria. **Table 2** showed that there were eight subjects with body weight <1.500 g and seven subjects of >1.500 g died. According to the gestational age, there were 12 subjects from <37 weeks of gestational-aged group died, which was higher if compared to that of the 37-42 weeks gestational-aged group as well as to >42 weeks of gestational-aged group.

According to statistical analysis using logistic regression, with the mortality as the dependent variable and SNAPPE II as the independent variable, we had the constant of (a) = -7.238 and logistic regression coefficient (b) = 0.152. According the formula:

$$P = \frac{1}{1 + \exp^{-(a+bx)}}$$

we had the graphic of correlation between SNAPPE II and mortality prediction as shown in **Figure 1**.

Figure 1 shows that the SNAPPE II as mortality predictor at P = 0.5 was 51 (cut-off point), and there was a significant correlation between the SNAPPE II score and mortality prediction (P = 0.007). The difference between those who survived and died could be assessed using ROC, as shown in **Figure 2**.

SNAPPE II has area under receiver operating characteristic (AUC) as high as 0.933 (95% CI 843

Table 2. General characteristics of the neonates hospitalized in NICU

Characteristics	Dead	Alive
Sex		
Boy	7	11
Girl	8	14
Birth Weight (g)		
<1,500	8	3
≥1,500	7	22
Gestational age (week)		
<37	12	14
37-42	3	11
>42	0	0

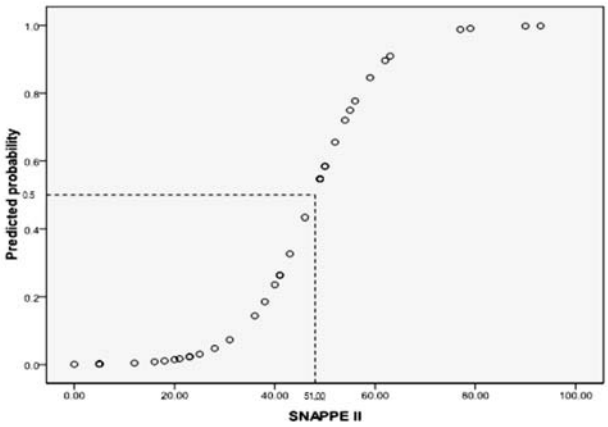

Figure 1. Correlation between SNAPPE II and mortality prediction for subjects hospitalized in NICU HSGH.

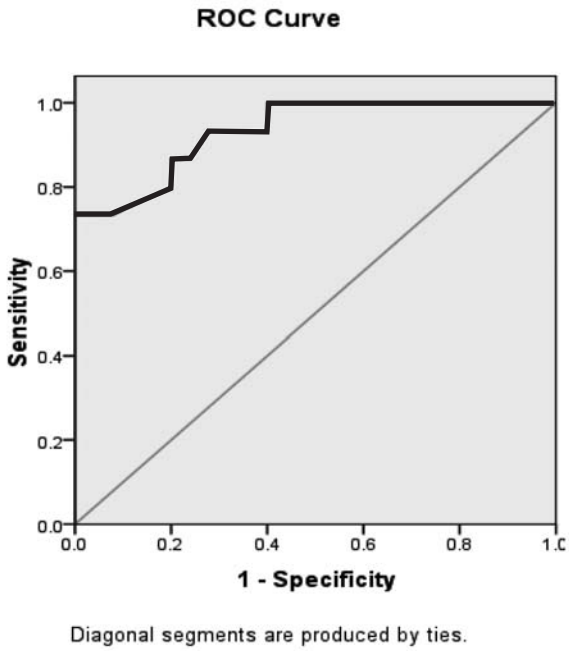

Figure 2. Receiver operating characteristic (ROC) curve for subjects hospitalized in NICU HSGH.

Table 3. Calibration between subjects who survived and died according to SNAPPE II

SNAPPE II	Subjects	Observed Death	Expected Death	Observed/ expected ratio
		n	n	
0-9	6	0	0.008	0
10-19	3	0	0.023	0
20-29	6	0	0.156	0
30-39	3	1	0.403	2.48
40-49	9	3	3.711	0.81
50-59	7	5	4.916	1.02
60-69	2	2	1.806	1.11
70-79	2	2	1.980	1.01
≥ 80	2	2	1.997	1.00
Total	40			

The Hosmer-Lemeshow goodness-of-fit test was 1.69 with P = 0.97.

to 1.0) which mean that SNAPPE II is an excellent tool to predict neonatal mortality in NICU HSGH, Bandung (**Figure 2**). Calibration was done using the Hosmer-Lemeshow goodness-of-fit test to predict the amount of patients who were expected to be dead or alive (**Table 3**).

Discussion

SNAPPE II is a scoring system which combines biochemistry and physiologic function test. The higher the score of SNAPPE II, the higher the mortality risk of neonates. Disturbance in one or more factors could result in higher SNAPPE II score.[5,10,11]

The present study showed that the higher the score of SNAPPE II, the higher the mortality predictor percentage. This result was similar to that found by the previous studies done by Richardson *et al*[10] in USA and Canada, by Mia *et al*[12] in Indonesia and Kadivar *et al*[13] in Iran. However, the cut-off point of SNAPPE II scoring system to predict the mortality in this study was different from that of previous studies. Our study showed the cut-off point was 51, while Mia *et al*[12] had a lower score (30). Higher SNAPPE II score in HSGH suggested that the neonates would have higher survival rates.

In addition to determined the cut-off point, we also validated the SNAPPE II scoring to predict neonatal mortality in NICU HSGH using the discrimination and calibration technique. Discrimination was used to differentiate the

outcomes (dead or alive) while calibration was more important to find correlation between accuracy of mortality prediction according to the SNAPPE II with observed death. Therefore, both factors are important to validate scoring system in a prognostic test.[10,14,15]

The present study showed that SNAPPE II in NICU HSGH had an excellent discrimination, AUC 0.933 (95% CI 0.843 to 1.0). Discrimination was excellent if the AUC is between 0.9 and 1.[10,14] This result supports the study done by Richardson *et al*[10] (AUC 0.91) and Zupancic *et al*[11] (AUC 0.90). Compared to the study done by Mia *et al*[12] in Soetomo Hospital, Surabaya, the present study has better result, because Mia *et al*[12] only had AUC as high as 0.863.

Different result of cut-off point and discrimination from Mia *et al*[12] was probably caused by factors influenced the score such as types and the severity of illness, quality of the NICU i.e; facilities and the patient/nurse ratio. Moreover, this study was analyzed using the logistic regression and ROC, while Mia *et al*[12] used ROC with Kappa and McNemar test.

This study also showed an excellent calibration result using the Hosmer-Lemeshow goodness-of-fit 1,69 ($P = 0.97$). The calibration score is considered good if the $P > 0.05$ which means that there were no significant differences between the observed and expected death. The result of goodness of fit is better with the P score close to 1.[10] The same result was obtained by Richardson *et al*[10] (0.90) and Zupancic *et al*[11] in Vermont Oxford Network (0.217), while study by Mia *et al*[12] did not perform the calibration using Hosmer-Lemeshow goodness-of-fit.

The present study showed that in Indonesia, especially in HSGH, the SNAPPE II scoring system can predict the neonatal mortality in NICU with an excellent discrimination (AUC) and calibration. The result was similar to that in USA, Canada and Vermont Oxford Network. Moreover, the cut-off point for SNAPPE II can predict the mortality risk rate for hospitalized neonates in NICU. This showed that Indonesia especially NICU HSGH, has an equal hospitalization quality compared to that of developed countries. In conclusion, SNAPPE II scoring system can predict neonatal mortality in NICU HSGH excellently, similar to that in developed countries.

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