



(RESEARCH ARTICLE)



Neonatal outcome in neonatal intensive care unit Sanglah Hospital: Assessed by SNAPPE- II score

Ida Ayu Agung Wijayanti, Putu Junara Putra *, I Made Kardana, I Wayan Dharma Artana and Made Sukmawati

Department of Child Health, Faculty of Medicine Udayana University/Sanglah Hospital, Bali, Indonesia.

GSC Advanced Research and Reviews, 2021, 08(02), 038–044

Publication history: Received on 25 June 2021; revised on 02 August 2021; accepted on 05 August 2021

Article DOI: <https://doi.org/10.30574/gscarr.2021.8.2.0166>

Abstract

Neonatal mortality is topic of concern for many medical faculties. Recently Score for Neonatal Acute Physiology with Perinatal Extension-II (SNAPPE-II) is used to predict the mortality and morbidity of neonates in neonatal intensive care unit (NICU). This study aimed to find the association of mortality and morbidity among neonates using SNAPPE-II score in NICU of Sanglah Hospital with cross-sectional design. All newborns admitted in NICU within 48 hours of birth since January - December 2020 were recruited as sample and assessed by using SNAPPE-II. Statistical analysis was performed by using Chi-square test and Mann–Whitney U test. Eighty-three newborns fulfilled inclusion criteria. In the mortality group, 75.6% had SNAPPE score ≥ 37 and 24% had SNAPPE score < 37 . SNAPPE-II score ≥ 37 showed an association with mortality group in NICU (p-value 0.000). Moreover, subgroup analyst of neonatal outcome in survived group related to SNAPPE-II score showed significant different in length of stay (P=0.033), ventilator usage (P=0.017) and duration of antibiotic usage (P=0.049). The Score for Neonatal Acute Physiology Perinatal Extension II (SNAPPE-II) is a useful tool to assess severity of illness and mortality. SNAPPE-II score > 37 is associated with neonatal mortality. The high SNAPPE-II score in the survived group also affects length of stay in NICU, ventilator and antibiotic usage. These findings imply that SNAPPE-II can be applied routinely in NICU to know the most critical newborn for prioritizing the management of care and for counselling the parents.

Keywords: Mortality; Neonates; Outcome; SNAPPE II score

1. Introduction

Neonatal mortality account for about 44% of deaths among children < 5 years old worldwide [1,2]. Neonatal mortality defined as deaths among live births in the first 28 days of life [1-3]. Children face the highest risk of dying in their first month of life at an average global 17 deaths per 1,000 live births in 2019, down by 52 per cent from 37 deaths per 1,000 in 1990. Globally, 2.4 million children died in the first month of life in 2019 approximately 6,700 neonatal deaths every day with about a third of all neonatal deaths occurring within the first day after birth, and close to three-quarters occurring within the first week of life [4]. Regionally, neonatal mortality was highest in sub-Saharan Africa and South Asia, with the neonatal mortality rate estimated at 27 and 25 deaths per 1,000 live births, respectively, in 2019 [4]. More than 80% of neonatal deaths were caused by 3 things that could be prevented, such as complication of prematurity, birth complications such as asphyxia and neonatal infections such as sepsis and pneumonia [5]. Based on Central Bureau of Statistics, the neonatal mortality rate in Indonesia were 15 deaths per 1000 live births in 2017 [6]. The mortality rate in Sanglah Hospital was 62.1 per 1000 live birth in 2016. The infant mortality rate decreased compared to 2015 (41.43 to 38.01) [7]. In 2019, 111 neonates died with that the rise the mortality rate into 28.2% [8].

Neonatal disease pattern and outcomes are important indicators of health care program meanwhile the outcomes are the changes in health status in which nursing and medical care have direct influence [9-11]. Neonatal morbidity and

* Corresponding author: Putu Junara Putra

Department of Child Health, Faculty of Medicine Udayana University/Sanglah Hospital, Bali, Indonesia.

mortality rates show a country's socioeconomic status, as well as the efficiency and effectiveness of their healthcare policy. These important indicators are useful to improve healthcare services [10,11] Therefore the strategy in reducing neonatal mortality rate is necessary. One of them is by using the scoring system to predict neonatal outcome especially mortality, therefore the physician able to prepare or overcome some treatable risk factor to reduce the mortality rate [10,11].

There are many scoring systems to predict neonatal outcome (mortality and morbidity) in neonatal intensive care units (NICU). Score for Neonatal Acute Physiology with Perinatal Extension-II (SNAPPE-II) is one of the scoring systems. The SNAPPE-II score was calculated on the basis of recommended physiological and clinical factor, evaluated within the first 12 hour of admission [12]. SNAPPE-II is a scoring system developed and validated by Richardson *et al* in 2001 for scoring illness severity and mortality risk for newborn in intensive care. It is simple, accurate and robust across populations [13]. This score involves recording of 9 parameters namely mean blood pressure, PO₂/FiO₂, lowest temperature (°C), serum pH, multiple seizures, urine output, birth weight, APGAR score and small for gestational age [13]. The SNAPPE-II values range from 0 to 162 and are proportional to the illness severity, with higher score indicates higher mortality or morbidity risks. The SNAPPE-II can be used in patients with all birth weight and gestational age. SNAPPE-II is considered as the best scoring system, because of its simplicity, rapidity, accuracy and applicable for all birth weights [13-14]. This scoring system has been used widely in developed country and useful in predicting the neonatal mortality and morbidity in NICU. SNAPPE-II has been used in USA and Canada with high accuracy [13-16] However, in developing countries, this scoring system needs further validation. In Indonesia, this score has not been used routinely. Study aimed to attain value of SNAPPE-II as a predictor of neonatal mortality in Sanglah Hospital had been performed in 2014 and showed optimum cut off point 37 had high probability of mortality [17]. We used this cut-off point to show the association between SNAPPE-II score and mortality as the primary outcome and other outcomes such as NICU length of stay (Los), ventilator and antibiotic usage in NICU Sanglah hospital since Sanglah hospital as the referral hospital for East part of Indonesia which plays big role in reducing the neonatal mortality rate.

2. Material and methods

This cross-sectional study aimed to determine the correlation of Score for Neonatal Acute Physiology with Perinatal Extension-II (SNAPPE-II) and mortality in Neonatal Intensive Care Unit of Sanglah Hospital. The sample population of this study were all neonates admitted in NICU within 48 hours of birth whom were collected consecutively. Exclusion criteria were neonates with major congenital anomalies, home deliveries where APGARs score were not known, discharged against medical advice within 24 hours, neonates admitted more than 48 hours of age, incomplete medical record. Minimum sample size in this study was 38 subjects calculated by using the prevalence ratio.

All data were assessed from medical record meanwhile SNAPPE-II value was calculated as the sum of the points assigned to each variable (Table 1). The components of SNAPPE II score, including mean arterial pressure, lowest temperature, hydrogen potential serum (pH), PaO₂ / FiO₂ ratio, seizures, diuresis, small for gestational age, birth weight and APGAR score. The SNAPPE-II values range from 0 to 162, presented as cut of score ≥ 37 and <37 .

The data was analyzed using computer software. Descriptive analysis was used to describe the sample's characteristics in each study group. Continuous data was presented in mean and standard deviation if data was normally distributed, or median and interquartile range if data was not normally distributed. Categorical data was presented in percentage. Analysis bivariate was conducted to evaluate outcome (mortality) to each risk factors using chi-square. nonparametric interval data were analysed with Mann-Whitney U tests. P-value less than 0.05 was considered statistically significant. This study was approved by Research Ethics Committee at Medical Faculty Udayana University-Sanglah Hospital, Denpasar (No. 104/UN14.2.2.VII.14/LT/ 2021).

3. Results

Total 322 neonates were admitted to NICU over a period of one year (January 2020 to December 2020). Among them, 99 neonates were deceased. Eighty-three neonates met inclusion criteria. Among 83 neonates completing the study, 52(62%) were males and 62(74%) were preterm infant. Most of the subject 69(83%) had birth weight > 999 grams. In the deceased group, 75.6% had SNAPPE-II score ≥ 37 and 24% had score <37 . General characteristics of neonates admitted to NICU was shown in Table 2.

Table 1 SNAPPE II score variables

Variables	Measurements	Points
Lowest mean blood pressure	>29 mmHg	0
	20-29 mmHg	9
	<20 mmHg	19
Lowest temperature	>35.6 °C	0
	35-35.5 °C	8
	<35 °C	15
PaO ₂ /FiO ₂ ratio	>2.49	0
	1.0-2.49	5
	0.3-0.99	16
	<0.3	28
Lowest serum pH	>7.19	0
	7.10-7.19	7
	<7.10	16
Seizures	No	0
	Yes	5
Urine output	>0.9 ml/BW/hour	0
	0.1-0.9 ml/BW/hour	5
	<0.1 ml/BW/hour	18
Birth weight	>999 g	0
	750-999 g	10
	<750 g	17
Small for gestational age	≥3 rd percentile	0
	<3 rd percentile	12
APGAR score at 5 min	≥ 7	0
	< 7	18

Table 2 Characteristics of the subjects

Characteristic	Deceased n=45	Survived n=38
Gender, n (%)		
Male	25(55.6)	27 (71.1)
Female	20(44.4)	11 (28.9)
Gestational age, n (%)		
<37 weeks	33 (73.3)	29 (76.3)
37-42 weeks	12 (26.7)	9 (23.7)

>42 weeks	0(0)	0(0)
Diagnosis, n (%)		
Sepsis	2 (4.4)	0(0)
Sepsis + Pneumonia neonatal	16 (35.6)	19(50)
Sepsis + Meningitis	2 (4.4)	6(15.8)
Sepsis + HMD	21(46.7)	5 (13.2)
Sepsis + other	4(8.9)	8(21.1)
NICU LoS, days		
median (IQR)	7(4-19)	11.5(7-17.5)
Ventilator, days		
median (IQR)	6(3-18.5)	5(4-10)
Antibiotic, days		
median (IQR)	6(4-18.5)	14(10-21)
SNAPPE II score, n (%)		
≥ 37	34(75.6)	2 (5.3%)
< 37	11 (24)	36 (94.7)

Table 3 SNAPPE II score and neonatal mortality

	Deceased (n=45)	Survived (n=38)	RP	95%CI	P-value
SNAPPE II score, n (%)			4.0	2.3-6.8	0.000
≥ 37	34(75.6)	2 (5.3)			
<37	11 (24.4)	36 (94.7)			

Bivariate analysis showed (listed in Table 3), 34(75.6%) subjects deceased with SNAPPE-II score ≥ 37 Ratio Prevalent (RP), 4.0 (95% CI: 2.3-6.8, P= 0.000). Moreover, subgroup analysis of neonatal outcome in survived group SNAPPE-II score showed significant different in NICU LoS (P=0.033), ventilator usage (P=0.017) and length of antibiotic usage (P=0.049) as showed in Table 4.

Table 4 Neonatal outcome in survived group related to SNAPPE-II score

	SNAPPE ≥ 37 n=2	SNAPPE <37 n=36	P-value
NICU LoS, days median (IQR)	37(30-45)	10(7-17)	0.033
Ventilator, days median (IQR)	27(25-30)	5(4-8)	0.017
Antibiotic, days median (IQR)	28(21-35)	14(10-21)	0.049

4. Discussion

SNAPPE-II combines biochemistry and physiologic function test. This simple scoring tool often used to determine evolution, prognosis and treatment. The higher the score of SNAPPE-II thus the higher the morbidity and mortality risk of neonate. Disturbance in one or more factors could result in higher score of SNAPPE-II [16]. We used cut-off points 37 obtained from study by Aryana *et al* [17]. We got 83 neonates in NICU, 45 deceased and 38 subjects survived.

In this study, 52 (62%) were male and 31 (37%) were female neonates, its similar with Sundaram *et al*, that found 67.5% subject were male [18]. In the deceased group, 25 (55.6%) subjects were male and 20 (44.4%) females. This result similar with Aryana *et al*, that found there was no difference between male or female gender in the deceased group [17].

In this study, for gestation age <37 weeks, 33 (73.3%) subjects deceased. Timothy *et al*, obtained similar results, 12 (46%) subjects whom died as premature infants, compared with 3 subjects were term infants [19] hence prematurity showed significant relationship in increasing neonatal mortality.

Most of the subjects had diagnosis sepsis and pneumonia 35 (42%) subjects. Moreover sepsis and hyaline membrane disease were the dominated diagnosis in deceased group, 21(46.7%) subjects. Aryana *et al* also found HMD as the most common diagnosis in deceased group. This is probably related to prematurity that was found in the majority of the subjects whom died [17].

Total 45 subjects whom deceased 75.6% had SNAPPE-II score ≥ 37 with P-value 0.000. Aryana *et al*, found the optimum cut-off point of SNAPPE-II was 37, which showed high probability of mortality [17]. Other study in Indonesia by Timothy *et al* found the cut-off point was 51.19 meanwhile in India, Sudaram *et al*, found cut-off point 40 has moderate diagnostic accuracy in predicting death as well as organ dysfunction in neonates [18]. The cut off point for each study was different depend on different setting of study, characteristics of subject such as types and the severity of illness, quality of NICU (facilities and the ratio of patient and nurse)

In this study, the median length of stay in survived group was significant 37(30-45) and 10(7-17) days with p-value 0.033. Its similar with Kumar *et al*, patient with higher SNAPPE-II score had longer NICU length of stay 24.6 ± 21.1 days; $p < 0.05$ [20]. Lengths of stay depend on multiple reasons like variability of gestational age, birth weight and type of illness. In our study ventilator usage was higher in subject with SNAPPE-II score ≥ 37 , with median 27(25-30) vs 5(4-8) day, with $P=0.017$. There is no study about SNAPPE- II score and length of ventilator used. However, this could be due to patients with scores ≥ 37 tended to have more severe lung function and metabolic impairment.

Length of antibiotics usage was significantly different between groups with SNAPPE-II score ≥ 37 and <37 with median 28(21-35) and 14(10-21) days ($P= 0.049$). Duration of antibiotic usage is closely related to the severity of infection or sepsis in neonates. In other words, this also affects the duration of antibiotics. There is no study on the association between SNAPPE-II and length of antibiotic usage. Pal *et al* found neonates with culture positive sepsis/meningitis had higher SNAPPE-II scores ($P=0.001$) [21].

The limitation in this study was samples were collected from medical record, therefore risky for information bias due to inaccurate data. Many factors influenced the outcome in patients that we did not analyses, such as disease spectrum and disease severity.

5. Conclusion

The SNAPPE II score > 37 is associated with neonatal mortality in NICU Sanglah Hospital. The high SNAPPE-II score in survival group also affects the length of stay in the NICU, ventilator and antibiotic used. The quality of care received antenatally or during resuscitation before the patient admitted to NICU, significantly affected the score.

Recommendation

Based on the findings of this study, SNAPPE II score must be routinely performed to identify the most critical newborn in prioritizing the management of care and for counselling the parents.

Compliance with ethical standards

Disclosure of conflict of interest

All authors of this article report no conflicts of interest throughout the work.

Statement of informed consent

Approval to carry out this study was obtained from Head of Department of Public Health, Federal University of Technology, Owerri, Imo State and Director of Capital Development of Imo State. The researcher obtained a letter of introduction as an approval for the research from the Department of Public Health, School of Health Technology, before proceeding to Owerri Metropolis. Informed consent was also given by the participants.

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