

Score for Neonatal Acute Physiology with Perinatal Extension II (SNAPPE II) in Predicting Mortality and Morbidity in NICU.

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Abstract

Introduction: A number of illness severity scores have evolved which would predict mortality and morbidity in intensive care units. One such scoring system developed by Richardson was SNAPPE-II (Score for Neonatal Acute Physiology with Perinatal extension-II). The present study was undertaken to determine the validity of SNAPPE II score in predicting outcome in terms of mortality and also determine morbidity in terms of duration of hospital stay using SNAPPE II score.

Method: This prospective observational study was conducted in 186 neonates in Neonatal Intensive Care Unit (NICU), Department of Paediatrics, SNMC & HSK Hospital and Research centre, Bagalkot from 1st Dec 2016 to 31st May 2018. At admission, detailed clinical assessment of the baby was performed and recorded within 12 hours of admission in a pre-designed questionnaire. All the babies were subjected blood gas analysis to get pH and PaO₂. And hence PaO₂/ FiO₂ ratio was calculated. Outcome was recorded based on baby's survival and duration of hospital stay.

Results: SNAPPE II score was higher among expired babies compared to survived babies. A mean score of 45.6 was associated with higher mortality had a sensitivity of 82.9%, specificity of 98.0%, positive predictive value of 90.2% and negative predictive value of 96.1%. AUC in ROC was found to be 0.960. Increased score resulted in increased duration of hospital stay.

Conclusion: SNAPPE II score is a good predictor of neonatal mortality and morbidity in terms of duration of hospital stay.

Keywords: Mortality, Morbidity, SNAPPE II score, Hospital stay predictor.

Introduction

Advances in the neonatal intensive care have significantly increased survival, decreased mortality and morbidity among neonates admitted to the Neonatal Intensive Care Unit (NICU). However, there are significant variations in practices and outcomes among NICUs [1-3]. Severity of disease measurements in NICUs has traditionally employed birth weight, gestational age, gender and APGAR scores, as main factors of mortality prediction. These factors do not adequately capture all dimensions of illness severity and do not explain such a variation. In NICUs this problem has been approached by the use of prognostication scoring systems. Assessments of morbidity and mortality in newborns have various

scoring systems that have been validated at various neonatal set-ups. One such scoring system is SNAPPE II [4].

SNAPPE-II is a scoring system which was developed and tested by Richardson et al in 2001 for mortality and morbidity risk for new-born intensive care [5]. It is simple, accurate and robust across populations. This system includes total nine physiological and laboratory parameters namely birth weight, small for gestation age (SGA), Apgar score at five minutes, urine output, lowest mean blood pressure, and occurrence of multiple seizures, lowest temperature, lowest PaO₂/FiO₂ ratio, and lowest pH [6, 7]. Score points vary depending on individual parameter range (Table 1).

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However, the SNAPPE-II score values range from 0 to 162. Score numbers are directly proportional to the severity of illness, higher scores indicate higher mortality or morbidity risks. The SNAPPE-II can be used in patients with all birth weight and gestation age. Hence the present study was undertaken to determine the validity of SNAPPE II score in predicting outcome in terms of mortality and also determine morbidity in terms of duration of hospital stay using SNAPPE II score.

Table 1: SNAPPE II Score.

Parameter	Range	Score Points
Mean Blood Pressure (mmHg)	>30	0
	20-29	9
	<20	19
Lowest Temperature (Fahrenheit)	>96	0
	95-96	8
	<95	15
PaO ₂ /FiO ₂ ratio	>2.5	0
	1-2.49	5
	0.3-0.99	16
	<0.3	28
Lowest Serum PH	>7.2	0
	7.1-7.19	7
	7.1	16
Multiple Seizures	No	0
	Yes	19
Urine Output (ml/kg/hr)	>1	0
	0.1-0.9	5
	<0.1	18
Apgar Score	<7	0
	>7	18
Birth Weight	>1000	0
	750-999	10
	<750	17
Small For Gestational Age	<10thcentile	12

Material and Methods

This prospective observational study was conducted in Neonatal Intensive Care Unit (NICU), Department of Paediatrics, SNMC & HSK Hospital and Research centre, Bagalkot from 1st Dec 2016 to 31st May 2018 after taking approval from the review board of Institutional Ethical Clearance committee. A total of 186 neonates admitted to NICU, who were less than 48 hours of life were included in the study, after taking written informed consent from baby’s parents or close relatives. It included babies who were inborn and out born including government hospital and private hospitals who were referred to our hospital for management within 48 hours of life. Neonates with

congenital anomalies who were incompatible with life and extramural neonates when Apgar score was not known were excluded.

At admission, detailed clinical assessment of the baby was performed and recorded within 12 hours of admission in a pre-designed questionnaire. As a part of study protocol, all the babies were subjected blood gas analysis to get pH and PaO₂. And hence PaO₂/ FiO₂ratio were calculated. Outcome was recorded based on baby’s survival and duration of hospital stay.

Statistical analysis: Data analysis was done using statistical package for social sciences (SPSS) software, version 20. Sensitivity, specificity, and predictive values were obtained; the receiver operating characteristics (ROC) curve was obtained by plotting the sensitivity on the Y-axis and the false positive (1-specificity) rate on the X-axis for all possible values of the cut-off point, thus, determined the point with the best combination of sensitivity and specificity for the SNAPPE II score.

Results:

A total of 186 babies were enrolled in the study, among them, 130 (69.9%) were males and 56(30.1%) females.74 (39.8%) were preterm, 107 (57.5%) were term and 5(2.7%) were post term. Among 186 babies which were included 151 (81.18%) babies improved, 35 (18.81%) babies succumbed to death. Maximum duration of hospital stay was 54 days and minimum duration was of hospital stay was 10 hours (0.4 days). Mean duration of hospital stay was 9.77 ± 8.01 days.

SNAPPE II Score - Survivors v/s Expired.

When SNAPPE II score was applied to study group we found that minimum score was 0.0 and maximum was 93.0 with a mean of 25.6 ± 20.88. It was observed that mean SNAPPE II score among improved was 18.03 ± 12.64 with minimum score of 0.0 and maximum 62.0. Among expired the mean score was 58.3 ± 17.80 with minimum score of 17.0 and maximum of 93.0. Babies with lower SNAPPE II scores got improved and as the scores increased mortality also increased (Table 2).

Table 2: Comparison of SNAPPE II score with outcome.

Total score	OUTCOME (n=186)				Total (n=186)	
	Improved		Death			
	Count	%	Count	%	Count	%
0-10	40	100.0%	0	0.0%	40	100.0%
11-20	58	96.7%	2	3.3%	60	100.0%
21-30	26	100.0%	0	0.0%	26	100.0%
31-40	19	86.4%	3	13.6%	22	100.0%
41-50	7	53.8%	6	46.2%	13	100.0%
51-60	0	0.0%	7	100.0%	7	100.0%

61-70	1	10.0%	9	90.0%	10	100.0%
71-80	0	0.0%	5	100.0%	5	100.0%
81-90	0	0.0%	1	100.0%	1	100.0%
>90	0	0.0%	2	100.0%	2	100.0%
Total	151	81.2%	35	18.8%	186	100.0%
P<0.001						

SNAPPE II Score and Duration of Hospital Stay.

It was noted that babies with lower SNAPPE II scores had lesser hospital stay and with the increase in scores duration of hospital stay also increased. On further increase in the score it was noted that duration of hospital stay decreased because of increased mortality. Over all mean duration of hospital stay was 9.77 ± 8.01 days, among improved mean duration of hospital stay was 11.38 ± 8.00 days and among expired was 2.8 ± 2.27 days. Scores 31 - 40 had highest mean duration of hospital stay of 18.82 ± 10.02. Extreme scores had lesser duration of hospital stay (Figure 1).

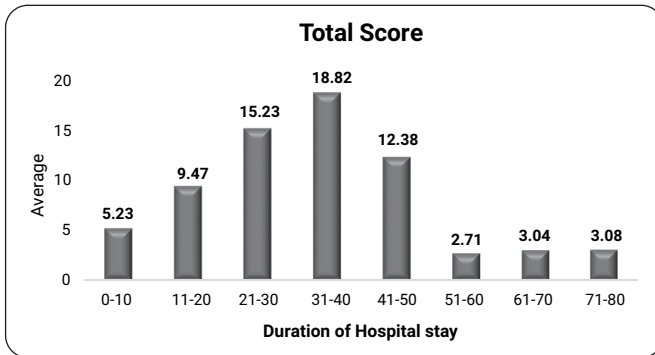


Figure 1: Comparison of SNAPPE II score with mean duration of hospital stay.

Score Prediction

Out of all deaths, 82.9% of deaths were predicted by total score cut-off value i.e., >45.6 similarly, 98.0% of improved cases were predicted by a score ≤ 45.6. Hence the score of 45.6 had a sensitivity of 82.9%, specificity of 98.0%, and positive predictive value of 90.2% and negative predictive value of 96.1% (Table 3).

Table 3: Prediction score cut-off.

Prediction by score cut-off (45.6)	Outcome		Total
	Death	Improved	
Death (>45.6)	29	3	32
	82.9%	2.0%	17.2%
Improved (≤45.6)	6	148	154
	17.1%	98.0%	82.8%
Total	35	151	186
	100.0%	100.0%	100.0%

Based on ROC curve (Figure 2) for SNAPPE II score

of 45.6 had area under curve of 0.960 with sensitivity of 82.9%, specificity of 98.0% and accuracy of 90.45% with a statistically significant p value of <0.001.

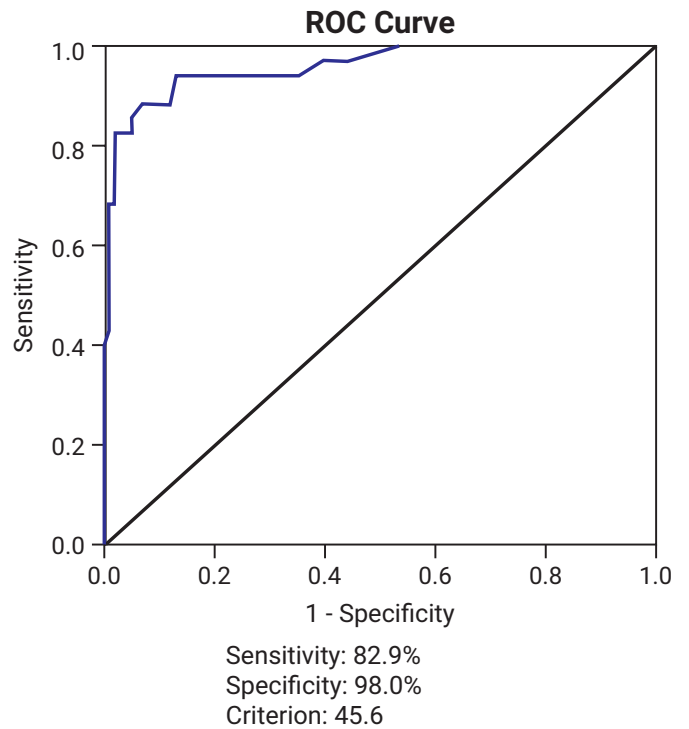


Figure 2: Area under curve in ROC curve

Discussion

The present study validates the Score for neonatal acute physiology with perinatal extension II (SNAPPE II) in predicting morbidity and mortality in NICU. On validating SNAPPE II score, we have found that 1212 babies were admitted in NICU during study period. Out of which, 186 babies were included in the study, of them 130 (69.9%) babies were males, 74 (39.8%) babies were preterm, 107 (57.5%) babies were term and 5 (2.7%) were post term babies. Similar studies [4,5,9,10] were done in different parts of world, involving varied range of population, selecting study subjects from single centre as well as multi centre. SNAPPE II score has been validated both retrospectively as well as prospectively, also among both term and preterm. First study was done by Richardson et al [5] which was large multicentric retrospective study done in Canada, California and England in 2001 comprising of 14,610 study subjects. Other similar studies are Harsha et al [4], Radfar et al [9], Veríssimo et al [10], Mia RA et al [11], Jain and Bansal [12], Dammann et al [13], Thimoty et al [14], Ramirez et al [15], Reid et al [16], Ucar et al [17].

When score was compared with mortality we found that higher the SNAPPE-II score and higher is the mortality rate. We had a predictive cut-off score of 45.6, above which predicted 89.6% of deaths and below which predicted 98% of improvement. It had

a positive predictive value of 90.2% and negative predictive value of 96.1% this score was similar to some of the studies like Jain and Bansal [12] and Ramirez et al¹⁵ both the studies had predictive cut off of 40. While Thimoty et al [14] had a higher predictive cut-off of 51 and there were some studies with lower cut-offs like Harsha et al⁴ had a cut-off of 37, Mia et al [11] and Dammann et al [13] cut-off of 30.

When area under the curve was calculated it was found to be 0.960 with confidence interval of 95%, sensitivity of 82.9% and specificity of 98.0%. Diagnostic accuracy was 90.45%. Which was similar to some the studies like Richardson et al [5] (0.9), Radfar et al [9] (0.994), Thimoty et al [14] (0.993), Reid et al [16] (0.907),

According Harsha et al [4], the mean length of stay was found to increase from score of 11-40 but this was not statistically significant. Mean length of hospital stay for children with score of more than 40 was found to be low, indicating that these babies were sick at admission and succumbed to disease early. Mean duration of hospital stay was 10.24 ± 8.056 days. Similarly, it was noted in our study that babies with lower SNAPPE II scores had lesser hospital stay, with the increase in scores duration of hospital stay increased. On further increase in the score it was noted that duration of hospital stay decreased because of increased mortality. Mean duration of hospital stay among improved was 11.8 ± 8.00 days and among expired was 2.8 ± 2.27 days with a significant p value < 0.001 .

There are some limitations of the study which include- 1) Small sample size 2) Study was conducted in single NICU, preventing the comparison of multi centre outcomes. Hence it may not represent the remaining part of the country and 3) Does not include babies who are born with birth defects.

Conclusion

The current study evaluated the usefulness of SNAPPE II score in predicting mortality and morbidity in terms of duration of hospital stay, and found that SNAPPE II score was higher among expired babies compared to survived babies. Increased score resulted in increased duration of hospital stay, on further increase in score resulted in lesser duration of hospital stay in view of increased mortality.

Hence SNAPPE II score is a good predictor of neonatal mortality and morbidity in terms of duration of hospital stay. It helps the doctors in recognising sick newborns and arranges treatment to them. It also helps in counselling the parents regarding the severity of illness, estimated duration of hospital stay

and the probable treatment cost involved.

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