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Original Research Article

Role of Score for Neonatal Acute Physiology & Score for Neonatal Acute Physiology with Perinatal Extension-Ii Score Topredict Morbidity and Mortality in Newborn Admitted to Neonatal Intensive Care Unit

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Abstract

Aim: The aim of the present study was to compare between Score for Neonatal Acute Physiology-II (SNAP-II) and Score for Neonatal Acute Physiology with Perinatal extension-II (SNAPPE-II) in predicting morbidity and mortality in Neonatal Intensive care unit (NICU).

Methods: It was a prospective observational study and study population was (preterm or term babies) born during our study period (July 2018 – June 2019) at NICU, Department of Pediatrics, (Nehru Hospital) B.R.D. Medical College, Gorakhpur, (U.P.). 311 patients were included in the study.

Results: Out of total 311 neonates enrolled in study, 64.3 % are male and 35.7% are female. Higher mortality is seen among males 8% and in females 3.9%, and (p = 0.570) shows no significant correlation with outcome. Out of total 311, 45% new born are delivered at B.R.D. Medical College, 31.2% delivered at peripheral government hospitals (PHCs, CHCs, Block hospitals, District hospitals), 19.9% delivered at private hospitals and rest 3.9% delivered at home. The mortality compared shows, 6.4% among inborn babies, 1.9% outborn government hospital,3.2% among private hospital, 0.3% among home born babies. There was no significant correlation between maturity (as per gestation weeks) and outcome. The result showed no significant correlation between values of APGAR at 5 minutes and outcome.

Conclusion: SNAP-II and SNAPPE-II both are the good predictor of severity of disease and of mortality with cut-off value for SNAP-II being 27 (sensitivity 75% and specificity 79%) and for SNAPPE-II is 39 (sensitivity 67% and specificity 87%) and may help in prioritizing the treatment of sick as well counselling of parents about disease severity.

Keywords: SNAP-II, SNAPPE-II, morbidity, mortality, Neonatal Intensive care uni

Introduction

Advances in the neonatal intensive care have significantly increased survival and decreased mortality and morbidity among neonates admitted to the Neonatal Intensive Care Unit (NICU). There are however, significant variations in practices and outcomes among NICUs. [1-3] Routinely available markers of risk such as birth weight, gestational age, and sex do not adequately capture dimensions of illness severity and do not explain such a variation. In Pediatric ICUs and NICUs this problem has been addressed by the use of prognostication scoring systems. The Score for Neonatal Acute Physiology (SNAP) developed by Richardson et al., in 1993 for babies of all birth weights and validated as a predictor of mortality, morbidity, is a physiology-based score that uses 34 routinely available vital signs and laboratory test results. [3-5]

As a first generation newborn illness severity score SNAP was cumbersome to use because of number and complexity of items. In 1998, Richardson et al., validated a second generation SNAP score- SNAP II. This score was made simpler by reducing the number of items to six and the duration for first 12 hours of admission in order to minimize the effects of early treatments. To this score were added three more perinatal variables namely birth weight, Apgar scores, and small for gestational age [6] and was known as SNAP II with Perinatal extension (SNAPPE-II). [7]

The assessment of morbidity and mortality using such scores also plays a significant role in estimating standard of care among different institutes. Although readily available, demographics like

weight at birth, gestational age, and gender are not important indicators of morbidity. The predecessor of SNAPPE-II, i.e. SNAP (Score for Neonatal Acute Physiology), which was established in 1993, was for babies of all birth weights and validated as a predictor of mortality, morbidity, and resource utilization, and was a score based on physiological values despite using commonly accessible vital signs and laboratory test values, but it consisted of a total of 34 variables. [8-12]

The Clinical Risk for Babies score, which was made for neonates less than 1.5 g, takes into account three physiologic variables additionally, i.e., weight at birth, gestational age, and congenital anomalies. [13] Studies have not only validated CRIB score as an anticipation of mortality [13] and morbidity [14], but these studies have also been replicated. [15] The modification of neonatal risk scores has been studied in the past [16], as well as the utilization of SNAP and CRIB in their initial years of usage. [17] The issue with the widespread use of these first-generation neonatal mortality scores was the limitation associated with them. SNAP was difficult to use due to the extensive number of variables and the complexity of items, while CRIB was inapplicable to infants born outside the hospital. Thus Richardson et al. developed the SNAPPE-II scoring system, a modified simpler version of SNAP score. Only nine criteria are recorded in this score: Average/mean blood pressure, PO2/FiO2, lowest temperature (ºF), serum-pH, numerous seizures, urinary output, newborn weight, Apgar score, and little for gestational age.

The aim of the present study was to compare between Score for Neonatal Acute Physiology-II (SNAP-II) and Score for Neonatal Acute Physiology with Perinatal extension-II (SNAPPE-II) in predicting morbidity and mortality in Neonatal Intensive care unit (NICU).

Materials and Methods

It was a prospective observational study and study population was (preterm or term babies) born during our study period (July 2018 – June 2019) at NICU, Department of Pediatrics, (Nehru Hospital) B.R.D. Medical College, Gorakhpur, (U.P.). 311 patients were included in the study.

Inclusion and Exclusion Criteria

Inclusion Criteria: All newborn (inborn and out born) referred and admitted to neonatal unit during our study period.

Exclusion Criteria: We excluded all newborns with the following criteria:

- ✓ Antenatal or prenatally diagnosed lethal, incompatible with life, anomalies.
- ✓ Died within 12 hours of admission
- ✓ Whose parents or caregivers do not consent to the study.
- ✓ Who left against medical advice

Variables:

1. Outcome variable
- In hospital neonatal mortality.
- Duration of hospital stay
- Status of neonate after 12 hours of admission
2. Independent Variables

Based on study specific objectives and taking into consideration the literature review the following independent variables were selected to be included in the questionnaire:

Maternal variables:

- Mother's age, parity, mode of delivery, birth order, presence or absence of antenatal care during first trimester.
- Newborn presentation.

Neonatal variables:

- Gender, place of birth, gestational age, birth weight, presence or absence of SGA status, use of assisted ventilation at admission, Arterial blood gas analysis for lowest serum p^H and PaO2/FiO2 ratio, urine output, sepsis screening.
- lowest temperature, mean arterial pressure.
- Multiple episodes of seizures
- APGAR at 5th minute, Resuscitation required
- SNAPPE II score.

Data collection procedures: We enrolled neonates (inborn and out born) meeting the inclusion criteria during our study period. Data regarding the neonate's birth and maternal prenatal status were gathered.

At admission, mothers or caregivers were asked, & through maternal medical records (inborn) and transfer notes (out born), the following information was gathered:

- Demography like age of mother, place the live
- Neonate place of birth in case of out born.
- Maternal parity, birth order, age, antenatal care consultation, mode of delivery and presentation at birth.
- 5th minute post-delivery APGAR score, or our predefined criteria in case if no APGAR score was available. So for this study ,we used WHO defined "birth asphyxia" as "failure to initiate and sustain breathing at birth" and based on APGAR score as an APGAR score of <7 at 5 minute of life. In those APGAR was not available, needed assisted ventilation in any form like nasal prongs, CPAP, mechanical ventilation given score of <7 ,and those who initiate respiration just after initial steps of resuscitation or needed positive pressure

ventilation less than < 1min, given APGAR score of >7.

Through a complete physical exam at admission the following variables were assessed:

- Plotted birth weight (SGA & severe SGA was defined as BW<10th centiles or < 3rd centiles, respectively as per FENTON'S chart).
- Gestational age, calculated according to last menstrual period and New Ballard score or any antenatal ultrasonography report in first trimester.

During the 12 hours from admission, the following variables were evaluated:

- Temperature every 4 hours.
- Respiratory distress was assessed every 2 hours and the assisted ventilation given as per requirement and FiO2 adjusted to keep saturation level in right arm between 90% to 94%.
- MAP consistently taken every 4 hours with appropriate cuffs by non- invasive method from monitors.
- Arterial blood gas analysis was done twice or thrice, with one being at the time of admission and next after 6 hours. Blood was collected in a 2ml heparinised syringe from radial artery of either hand with maximum precaution and asepsis.
- Urine output measured at end of 12 hours by diaper weight measurement; an empty diaper was measured before putting it to the neonate then we measured again after 12 hours. The difference in grams was converted in millilitre and then calculated in terms of ml/kg/hour, or by putting a neonatal urobag and measure the amount of urine collected.
- The presence or absence of seizures; when a seizure occurred, the neonate was treated with anticonvulsants available and underlying cause investigated like hypocalcemia (defined for both term and preterm with BW> 1500g , total serum calcium <8 mg/dl (2mmol/L) or an ionised calcium <4.4 mg/dl (1.1mmmol/L) or, VLBW infants with BW < 1500g , total serum calcium < 7mg/dl (1.75 mmol/L) or an ionised calcium <4 mg/dl (1mmmol/L) or hypoglycaemia. Capillary blood glucose was sampled randomly once using glucometer and strips (commercially available), in case of hypoglycaemia (We defined as RBG<45mg/dl) or, it was corrected accordingly and one or more RBGs were taken until a normal glucose level was achieved.
- Condition of baby after 12 hours of intervention, whether worsens, same or improved.

SNAPPE II score was calculated as the sum of scores recorded during period of 12 hours for the following:

Lowest temperature.

Multiple versus single or absence of seizures.

Urine output (ml/kg/hour).

Birth weight.

5th minute APGAR score.

severe Small for gestational age (BW<3rd centiles).

Data analysis

1. Simple descriptive statistics

Was used to measure baseline mothers and neonates variables as follow

a. Mean and standard deviation was used for continuous, normally distributed variables.

b. Frequency (by proportions) was used for categorical variables.

2. Logistic regression analysis

a. Logistic function model

This was used to find SNAP-ll &SNAPPE II best cut off score to predict neonatal mortality.

b. Univariate analysis

Variables reported in the literature which significantly predict neonatal mortality were entered in the model. P values were used to measure whether or not there was significant association with neonatal mortality. The level of significance was <0.05 for P value.

Results

Table 1: Gender distribution

Gender	Discharged N (%)	Expired N (%)	Total N (%)
MALE	175(56.3)	25(8)	200(64.3)
FEMALE	99(31.8)	12(3.9)	111(35.7)
TOTAL	274	37	311(100%)

Out of total 311 neonates enrolled in study, 64.3 % are male and 35.7% are female. Higher mortality is seen among males 8% and in females 3.9%, and (p = 0.570) shows no significant correlation with outcome.

Table 2: Place of delivery

Inborn (at BRD Medical College)	**120 (38.6)**	**20 (6.4)**	**140 (45)**
Out born – government hospital	91 (29.3)	6 (1.9)	97 (31.2)
Out born – home	11 (3.5)	1(0.3)	12 (3.9)
Outborn – private hospital	52 (16.7)	10 (3.2)	62 (19.9)
			311 (100 %)

Out of total 311, 45% new born are delivered at B.R.D. Medical College, 31.2% delivered at peripheral government hospitals (PHCs, CHCs, Block hospitals, District hospitals), 19.9% delivered at private hospitals and rest 3.9% delivered at home. The mortality compared shows, 6.4% among inborn babies, 1.9% outborn government hospital,3.2% among private hospital, 0.3% among home born babies. Maximum mortality was seen among newborn delivered at BRD Medical College, and p = 0.394 shows no significant relation between place of delivery and outcome.

Table 3: Maturity (as per gestation weeks)

Maturity	**Dichargedn (%)**	**Expired N (%)**	**Total N (%)**
Post Term (Pt)	1 (0.3)	0 (0)	1(.3)
Term (T)	165 (53.1)	16 (5.1)	181 (58.2)
Late Preterm (Lpt)	48(15.4)	4 (1.3)	52 (16.7)
Early Preterm (Eapt)	57(18.3)	13(4.2)	70 (22.5)
Extremely Preterm (Expt)	3(1)	4(1.3)	7(2.3)
			311(100%)

Out of 311, 58.2 % are Term new-borns, 22.5% are Early preterm, 16.7% are Late preterm,2.3% are Extremely preterm and 0.3% are Post term newborn, with highest mortality among term neonates .maximum mortality seen in 5.1% among term, 4.2% were early preterm, 1.3% each late preterm, extremely preterm. (P= 0.422) shows that there is no significant correlation between maturity (as per gestation weeks) and outcome.

Table 4: APGAR at 5 min and mode of delivery

Apgar Score	**Discharge N (%)**	**Expired N (%)**	**Total N (%)**
>7	259(83.3)	21(6.8)	280(90)
<7	15(4.8)	16(5.1)	31(10)
			311(100%)

90% of newborns had APGAR score of >7 at 5min of life, rest 10% had APGAR score at 5 min of <7, among all 311 newborns . Among expired babies, 6.8% died having APGAR of >7 and 5.1% having APGAR <7. (P= 0.905) shows no significant correlation between values of APGAR at 5 minutes and outcome.

Table 5: Mean arterial pressure (MAP)

Mean Arterial Pressure (MAP) MmHg	**Discharged N (%)**	**Expired N (%)**	**Total N (%)**
>30	261(83.9)	23(7.4)	284(91.3)
20-29	12(3.9)	14(4.5)	26(8.4)
<20	1(0.3)	0(0)	1(0.3)
			311 (100%)

Out of 311, mostly 91.3% of newborns have MAP of >30mmHg, 8.4% have 20-29 mmHg and 0.3% have MAP of <20 mmHg, and with mortality percentage, 7.4% among newborn with MAP of >30mmHg and 4.5 % among 20-29 mmHg. (p = 0.892) shows no significant correlation between lowest recorded mean arterial pressure (MAP) and outcome.

Table 6: PaO2/FiO2 ratio

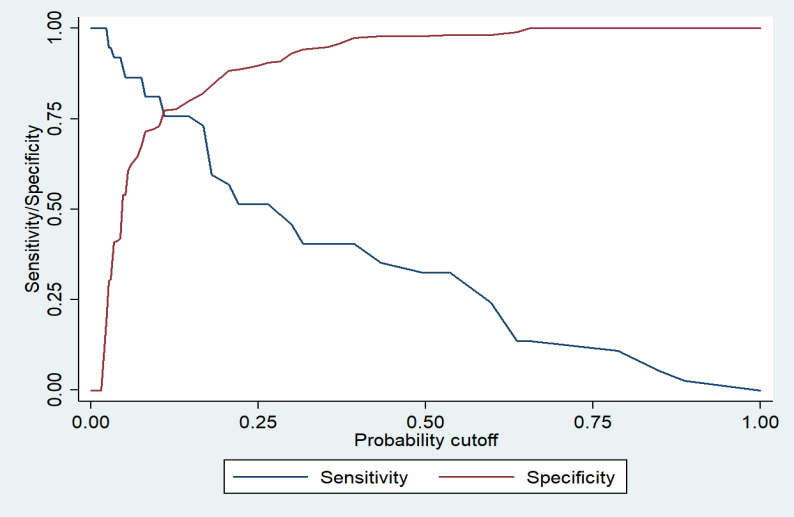
PaO2/FiO2	**Discharged N (%)**	**Expired N (%)**	**Total N (%)**
>2.5	127(40.8)	2(0.6)	129(41.5)
1-2.49	118(37.9)	15(4.8)	133(42.8)
0.3-0.99	29(9.3)	19(6.1)	48(15.4)
<0.3	0(0)	1(2.7)	1(2.7)
			311(100%)

Among all 311, 42.8% had PaO2/FiO2 ratio of 1-2.49, 41.5 % had >2.5, 15.4% had in between 0.3-0.99 and 2.7% had <0.3 with higher mortality 6.1% seen among babies with ratio of 0.3-0.99, 4.8% among 1-2.49 ratio , 2.7% had ratio < 0.3 and 0.6% had ratio of > 2.5. There was a significant correlation between lowest PaO2/FiO2 ratio calculated in first 12 hours and outcome.

Table 7: Logistic regression

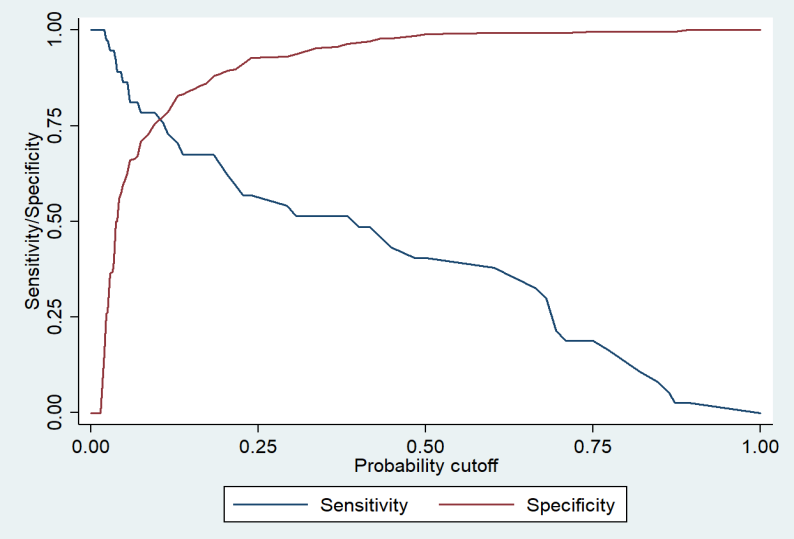
	B	S.E.	Wald	d f	Sig.	Exp(B)
Sex	0.407	0.716	0.323	1	0.570	1.502
Birth weight	-0.002	0.001	6.199	1	0.013	0.998
Delivery at	0.240	0.281	0.726	1	0.394	1.271
Maturity 1	-0.359	0.514	0.487	1	0.485	0.699
Maturity 2	-0.370	0.461	0.644	1	0.422	0.691
APAGR at 5min	0.126	1.059	0.014	1	0.905	1.134
Mode of delivery	0.011	0.769	0.000	1	0.989	1.011
Lowest temp	0.400	.454	0.774	1	0.379	1.492
Lowest MAP	-0.143	1.050	0.018	1	0.892	0.867
PaO2FiO2	1.424	0.566	6.330	1	0.012	4.153
Lowest pH	0.881	0.595	2.196	1	0.138	2.414
Multiple seizure	1.743	0.886	3.873	1	0.049	5.717
Urine output	-2.245	1.294	3.012	1	0.083	0.106
Hospital stay	-0.137	0.045	9.054	1	0.003	0.872
Status after12hrs	3.295	0.682	23.345	1	0.000	26.987

Logistic regression was done between all variables and outcome and results came out as that Birth weight, PaO2/FiO2 ratio, multiple seizures, duration of hospital stay and status after 12 hours of admission significant correlation ($p<0.005$).



Graph 1: SNAP-II

Above graph produce a significant cut-off value of 27, with sensitivity of 75% and specificity of 79%.



Graph 2: SNAPPE-2

This graph gives a cut – off of 39 with sensitivity 67% and specificity 87%.

Discussion

The concept of illness severity scoring has been around for long and is currently being utilized in many neonatal intensive care unit (NICU). [18] Scoring systems that help to quantify mortality risks on the basis of clinical conditions not only help in estimating prognosis, but also help clinicians in making decisions particularly in situations presenting with dilemmas. [19] Some of the scoring systems that are globally used include: CRIB (Clinical Risk Index of Babies), CRIB-II (Clinical Risk Index of Babies-II), SNAP (Score for Neonatal Acute Physiology), SNAP-II (Score for Neonatal Acute Physiology-II), SNAPPE (Score for Neonatal Acute Physiology-Perinatal Extension) and SNAPPE-II (Score for Neonatal Acute Physiology-Perinatal Extension-II). One of these scores is the SNAPPE-II scoring system, established by Richardson et al. which uses neonatal illness severity indices to forecast the rate of mortality and the length of the stay of newborns in NICU.

Out of total 311 neonates enrolled in study, 64.3 % are male and 35.7% are female. Higher mortality is seen among males 8% and in females 3.9%, and (p = 0.570) shows no significant correlation with outcome. Out of total 311, 45% new born are delivered at B.R.D. Medical College, 31.2% delivered at peripheral government hospitals (PHCs, CHCs, Block hospitals, District hospitals), 19.9% delivered at private hospitals and rest 3.9% delivered at home. In a study conducted by Mia RA et al [20] a score of 30 and above, Study by Suksham Jain and Anuradha Bansa [21] scores of 40 and above, Ramirez et al [22] score of 40 and above, study done by Ucar et al [23] scores of 33 and above, study by Olaf Dammann et al [24] a score of 30 and above, study by James Thimoty et al [25] 51 and above were associated with higher mortality. A similar study conducted by Kadivar M et al [26] concluded that SNAPPE-II score can be used to predict mortality among the NICU patients.

The mortality compared shows, 6.4% among inborn babies, 1.9% outborn government hospital, 3.2% among private hospital, 0.3% among home born babies. There was no significant correlation between maturity (as per gestation weeks) and outcome. The result showed no significant correlation between values of APGAR at 5 minutes and outcome. The graph produce a significant cut-off value of 27, with sensitivity of 75% and specificity of 79%. The graph gives a cut – off of 39 with sensitivity 67% and specificity 87%. In this study, SNAPPE-II category III (>40) was found to be the strongest predictor of mortality, with a sensitivity of 40% and a specificity of 98.7%. One research study found that SNAPPE-II had a sensitivity of 78.8% and a specificity of 47% [27], while another study reported a sensitivity and specificity of 94% and 83%, subsequently. [28]

Conclusion

SNAP-II and SNAPPE-II both are the good predictor of severity of disease and of mortality with cut-off value for SNAP-II being 27 (sensitivity 75% and specificity 79%) and for SNAPPE-II is 39 (sensitivity 67% and specificity 87%) and may help in prioritizing the treatment of sick as well counselling of parents about disease severity. But, there is no significant difference between SNAP-II and SNAPPE-II in prediction of mortality, both can work equally better. Higher the SNAP-II and SNAPPE-II scores, higher is the risk of mortality, morbidity and longer the hospital stay.

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