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Original Research Article

Clinical risk index of babies-II versus score for neonatal acute physiology-II in predicting mortality and morbidity in preterm babies

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ABSTRACT

Background: The measurement of severity of illness using scoring systems is an important aspect in predicting mortality and morbidity in intensive care units which in turn can help in optimizing the limited healthcare resources in developing countries. The primary objective was to determine the correlation between clinical risk index of babies-II (CRIB-II) and score for neonatal acute physiology-II (SNAP-II) scores while the secondary objective was to identify which among them is superior in predicting mortality and morbidity in preterm neonates.
Methods: The components of CRIB-II and SNAP-II scores were recorded prospectively over a period of 1 year in preterm very low birth weight (VLBW) babies and receiver-operating-characteristics (ROCs) were plotted for comparison. Correlation between CRIB-II and SNAP-II was examined by Pearson technique. The ability of CRIB-II and SNAP-II scores to correctly predict mortality, was assessed by calculating ROCs and their associated area under the curve (AUC).
Results: Thirty nine neonates with a mean birth weight of 994.10 grams (SD±273.45 grams) and mean gestational age of 28.07 weeks (SD±2.29 weeks) were included in this study. The mean value of CRIB-II score and SNAP-II score was 8.54 (SD±4.67) and 9.82 (SD±8.93) respectively with a Pearson coefficient of 0.483 showing a modest correlation. CRIB-II (AUC 0.909) showed greater discrimination than SNAP-II (0.869) as a predictor of mortality. However, both the scores have poor discrimination when it comes to predicting neonatal morbidity.
Conclusions: CRIB-II with its simplicity, need for uncomplicated variables and minimal time to generate a score for prediction of mortality and morbidity could be a useful tool in a busy neonatal intensive care unit (NICU).

Keywords: CRIB-II, SNAP-II, Mortality, Morbidity, Prediction, Preterm babies

INTRODUCTION

The measurement of severity of illness using scoring systems is a very important aspect of intensive care. These scoring systems help in predicting mortality and morbidity and thereby can guide us in optimizing the limited healthcare resources available in our country.[1] Preterm infants constitute a unique group for the assessment of neonatal intensive care unit (NICU) performance due to their high mortality risk. In 1993, three scores were described for measuring illness severity and neonatal mortality among new born babies admitted to NICUs: score for neonatal acute physiology (SNAP); SNAP-perinatal extension (SNAP-PE); and clinical risk index for babies (CRIB).[2] Both SNAP and CRIB were further simplified in order to render the system more feasible and minimize treatment interference in 2001 and 2003 respectively.[3,4]

Although these scores are the most commonly used, both scores have their limitations and were developed almost a decade ago before widespread use of surfactant and antenatal steroids, when mortality was higher.[5] While there are multiple studies comparing these scores for predicting mortality, there are few with a focus on long term morbidity. While there is evidence to suggest that SNAP-II is a good independent predictor of mortality and long term morbidities such as chronic lung disease (CLD) and intraventricular hemorrhage (IVH) there is conflicting evidence with regards to whether it is superior to CRIB-II and studies reflecting the same in India are lacking.[6]

These morbidities not only increase NICU hospitalization costs, but also increase the risk of long-term chronic illness, re-hospitalization, and developmental delay, and thus have lifelong economic consequences for society at large.[7] We conducted this study to determine the correlation between SNAP-II and CRIB-II. We have also looked into the utility of using SNAP-II and CRIB-II in predicting neonatal mortality and morbidity in preterm babies.

METHODS

This prospective cohort study was conducted at an NICU of a referral hospital in Maharashtra, a central state of India, over a period of one year from 01 January 2015 to 31 December 2015 after obtaining institutional ethical committee approval and consent from the parents. The study population comprised of preterm very low birth weight babies (gestational age <37 weeks and birth weight <1500 grams) while babies with major congenital malformations and those who died within first 24 hours of life were excluded. Sample size was calculated using formula for correlation coefficient using Z transformation. From previous studies in literature the correlation co-efficient between CRIB and SNAP score performed at same time varies from 0.37 to 0.70. Assuming alpha error of 0.05 and beta error of 0.2 (power 90%) and assuming R value of 0.5 estimated sample size was 38.

There are 6 variables in SNAP-II namely: mean blood pressure, lowest temperature, PO_2/FiO_2 ratio, lowest serum pH, presence of multiple seizures, and urine output over the initial 12 hours of the study period. CRIB-II has a total of 4 variables namely: sex, admission temperature, gestational age and, base deficit.

Gestational age was calculated from the first day of last menstrual period (LMP). In cases where LMP was not known, obstetric ultrasonography was used to assess the gestational age. In cases where both of the above were missing a gestational age assessment was made by using the expanded new Ballard score. Weight, temperature and blood pressure reading were taken before shifting the neonate under a warmer. Weight was measured using an electronic scale having a sensitivity of 10 grams. We recorded the temperature using an axillary thermometer at the time of admission and followed it every 4 hours in first 12 hours to identify lowest recorded temperature. Blood pressure was measured by oscillometric method. The maximum and minimum fraction of inspired oxygen (FIO_2) required by the baby for maintaining the oxygen saturation between 90-95% in the first 12 hours were recorded and this was performed using the air-oxygen blender or the ventilator as the case may be. Blood gas was recorded at birth and further as dictated by the clinical requirements of each infant except babies whose saturation monitoring readings were normal throughout and who were not distressed. Arterial blood gas analysis was performed in all preterm babies at admission and then as dictated by the clinical condition of the baby. At the end of 12 hours presence or absence of multiple seizures and total urine output in ml/kg/hour was calculated and documented. The above collected data was entered into a case record form which included baseline characteristics in addition to the originally published scoring systems. To minimise errors in data collection, original values were recorded by author, and the SNAP-II and CRIB-II scores were calculated by the computer. The master chart required for the study was auto generated by the said web page and could be retrieved later for analysis. Our protocol specified that none of the treating physicians would see any neonates' SNAP or CRIB score while the neonate was still at the hospital. This precaution was taken to ensure that patient care was not affected.

Statistical analysis

Baseline characteristics, SNAP-II and CRIB-II scores were calculated within 12 hours of admission for all neonates, were recorded electronically to be retrieved later for analysis. For baseline maternal and infant characteristics, values are expressed as mean (±SD) or median (IQR) depending on normality of the data. Data of categorical type is expressed as number and percentage. Correlation between CRIB-II and SNAP-II was examined by Pearson technique. Ability of CRIB-II and SNAP-II in discrimination—that is, the ability of the scores to correctly predict life or death, was assessed by calculating receiver operating characteristic curve (ROC) and their associated area under the curve (AUC). An AUC value of 0.5 indicates no ability to discriminate, and larger values indicate increasing ability. All calculations were carried out with the statistical package for the social sciences (SPSS) 18.

RESULTS

There were a total of 44 neonates which were eligible for the study. Five neonates were excluded; two because of congenital heart disease, one because of multiple congenital anomalies and the remaining two because of death within the first 24 hours of admission. Thus 39 neonates were part of the study. Pregnancy induced hypertension (PIH), oligohydramnios, gestational diabetes mellitus (GDM) and ante-partum hemorrhage (APH) was present in 23.1% (n=9), 2.6% (n=1), 12.8% (n=5) and 7.7% (n=3) of the mothers respectively. Antenatal steroid was received by 76.9% (n=30) of the mothers and 69.2% (n=27) delivered by caesarean section (LSCS). Mean birth weight, mean gestational age, mean length of hospital stay and mean base excess was 994 grams (SD±273.45 grams), 28.07 weeks (SD±02.29 weeks), 43.56 days (SD ± 28.72

days) and 02.38mmol/L (SD±1.04mmol/L) respectively. Out of 39 neonates, 15% (n=6) expired while 61.5% (n=24) neonates developed at least one of the 6 predefined morbidities. Among predefined morbidities, 48.7% of the enrolled babies had patent ductus arteriosus (n=19), 23.1% had retinopathy of prematurity (n=9), 20.5% developed intraventricular hemorrhage (n=8), 7.7% developed chronic lung disease (n=3), 5.1% had periventricular leukomalacia (n=2) and 2.6% had necrotizing enterocolitis (n=1).

Our primary objective was to find a correlation between CRIB-II and SNAP-II and the same is shown in Figure 1 and Table 1. With a Pearson correlation coefficient (R) of 0.483, SNAP-II and CRIB-II scores show a modest correlation.

Table 1: Comparison of CRIB-II and SNAP-II.

Scoring system	Range	Mean (±SD)	SE
CRIB-II (N=39)	0–17	8.54±4.67	0.749
SNAP-II (N=39)	0–31	9.82±8.93	1.431

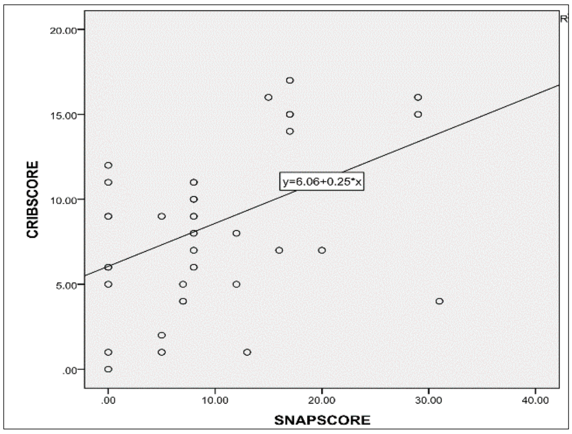

Figure 1: Correlation between CRIB II score and SNAP II score.

The predictive accuracy of SNAP-II score, CRIB-II score in addition to birth weight and gestational age were expressed as area under the ROC curve and the results were compared (Figure 2). CRIB-II [AUC 0.909] showed greater discrimination than SNAP-II [0.869). Birth weight and gestational age were poor predictors of mortality in ROC analysis in comparison to CRIB-II.

While comparing the 2 scores to determine which one better predicts the overall neonatal morbidity, CRIB-II (AUC=0.556) showed greater discrimination than SNAP-II (AUC=0.404). However the area under the curve was still not substantial indicating that both have poor discrimination when it comes to predicting neonatal morbidity (Figure 3).

In predicting patent ductus arteriosus (PDA), gestational age (AUC=0.512) seems to be superior than both the scores and between the scores, CRIB-II (AUC=0.459) is superior to SNAP-II (AUC=0.376). However the area under the curve is still not substantial indicating that all have poor discrimination when it comes to predicting PDA (Figure 4).

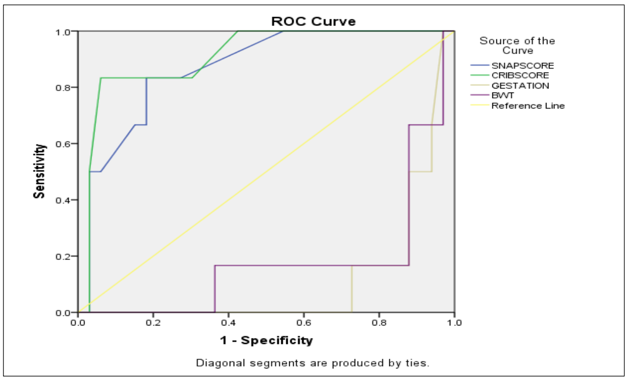

Figure 2: ROC-mortality.

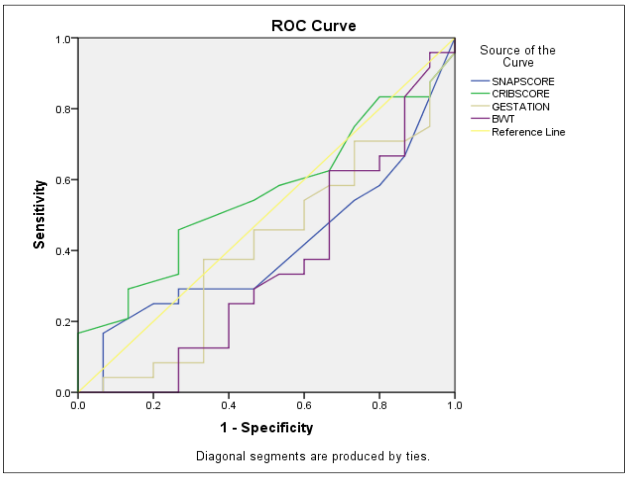

Figure 3: ROC – overall morbidity.

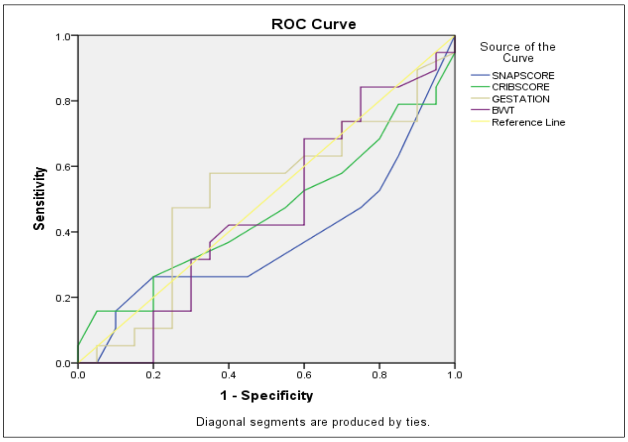

Figure 4: ROC – patent ductus arteriosus.

CRIB-II (AUC=0.496) appears to be superior to SNAP-II (0.485) in predicting retinopathy of prematurity (ROP). However the area under the curve is still not substantial indicating that both have poor discrimination when it comes to predicting ROP (Figure 5).

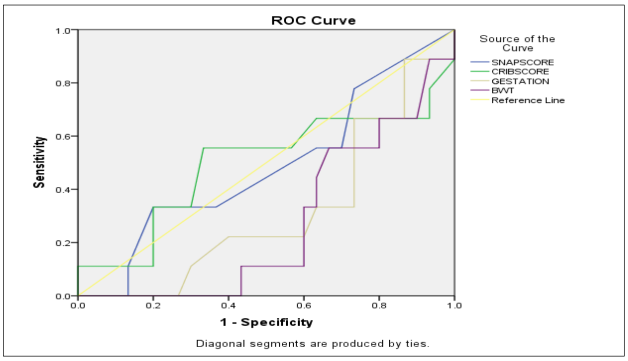

Figure 5: ROC-retinopathy of prematurity.

CRIB-II (AUC=0.730) was superior to SNAP-II (AUC=0.603) with a moderate to good AUC indicating that it has a good discrimination in predicting intraventricular hemorrhage (IVH) (Figure 6).

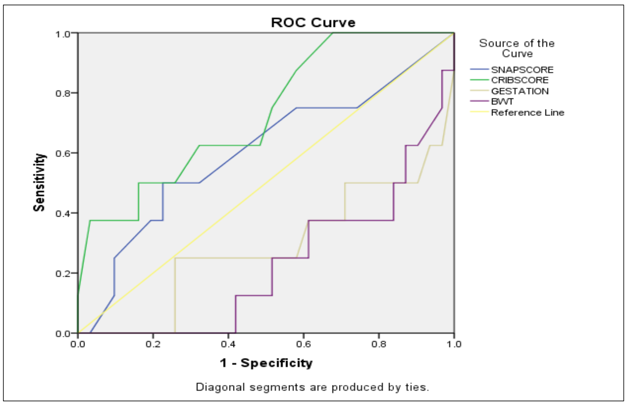

Figure 6: ROC-intraventricular hemorrhage.

Although ROC curve was plotted but only one neonate had developed necrotizing enterocolitis (NEC), therefore the ROC interpretation becomes difficult. However solely based on AUC, SNAP-II (AUC=0.947) appear to be superior to CRIB-II (AUC=0.868) (Figure 7).

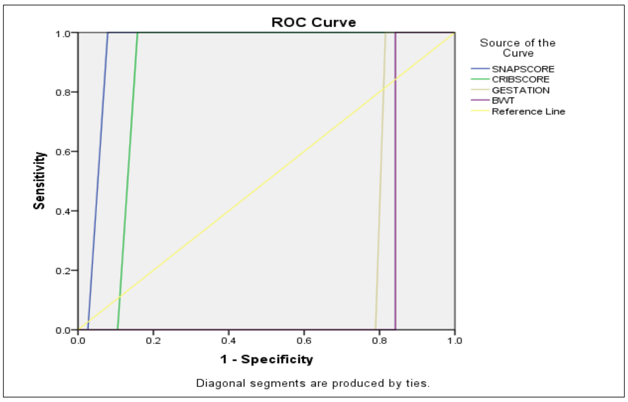

Figure 7: ROC-necrotizing enterocolitis.

Periventricular leukomalacia (PVL) was seen in two neonates, therefore ROC analysis was difficult; however CRIB-II (AUC=0.986) was superior to SNAP-II (AUC=0.791) in predicting PVL (Figure 8).

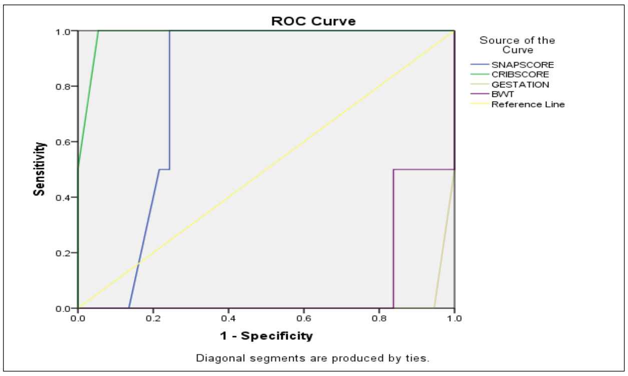

Figure 8: ROC-periventricular leukomalacia.

Only three babies developed chronic lung disease (CLD), therefore ROC curve was difficult to interpret. However solely based on AUC, CRIB-II (AUC=0.889) was superior to SNAP-II (AUC=0.579) in predicting the babies at risk of developing CLD (Figure 9).

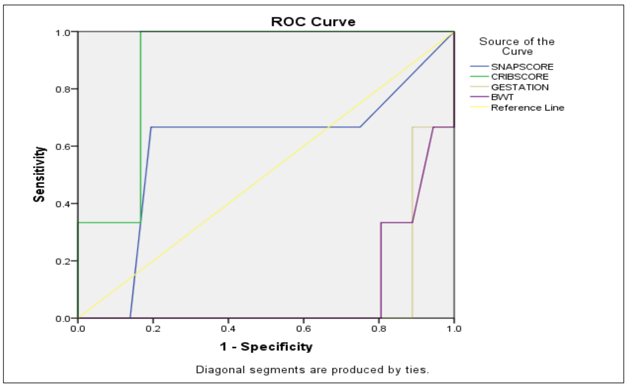

Figure 9: ROC- chronic lung disease.

DISCUSSION

In our study of 39 preterm neonates, the correlation between CRIB-II and SNAP-II was of modest value. In prediction of mortality, CRIB-II was found to be superior with larger AUC (area under the curve). With respect to overall morbidity, CRIB-II was better than SNAP-II but AUC was not substantial.

With improving quality of neonatal care, we have to recognize that mortality can no longer be used as the only valid endpoint for making comparisons. In a country like India where cost of treatment is a limiting factor, parents of these babies will be eager to know the severity of the illness and also the duration of stay and approximate cost of treatment even before admission. Individual predictive scores may aid in assessing severity at admission and this has resulted in creation of simple predictive scores like the

"I5 score" by Murthy et al.[8]. While studies comparing SNAP-II and CRIB-II were limited, the conflicting results have ensured that neither scores have been adjudged superior to the other. Reviewing literature we find that of the 5 studies that have compared SNAP-II and CRIB-II in predicting neonatal mortality, two were in favour of CRIB-II, two in favour of SNAP-II and the last one showed similar discriminating ability.

The first study in favour of CRIB-II was a Finnish study based in Helsinki which observed that the CRIB scores were significantly better for assessing risk of mortality than SNAP (p=0.017) or SNAP-PE (p<0.001), areas under receiver operating characteristic curves being 0.89, 0.82 and 0.79, respectively. Male sex was independently associated with poor prognosis after taking the CRIB score into account with a risk ratio of 2.75.[9] A study by Gagliardi et al in Italy also concluded that CRIB and CRIB-II had greater discriminatory ability than SNAPPE-II. They noted that although risk adjustment using all scores is imperfect as other perinatal factors significantly influence the survival of VLBW babies, CRIB-II seemed to be less confounded by these factors.[5] Another study, involving 476 VLBW infants from eight neonatal units in United States, found non-significant differences between the two scores, with SNAPPE being slightly better although discrimination of both was found to be excellent. Surprisingly, birth weight performed much better than in previous analyses, with an AUC of 0.869.[10] An Iranian prospective cohort study involving 404 neonates, observed a significant difference in scoring systems among babies who survived in comparison to those who expired. The authors concluded that SNAP was superior to CRIB with a much more substantial AUC and better positive and negative predictive value.[11] Very few studies have compared both these scoring systems and looked at which one was better at predicting certain neonatal morbidities. A study by Sameer et al attempted to compare the ability of SNAP-II and CRIB-II in predicting IVH in VLBW neonates and found that not only was SNAP-II superior but also found it to correlate better with the severity of IVH. However, the AUC for both the scores were modest at best [SNAP-II (0.69) and CRIB-II (0.60)].[12]

The strengths of our study is that the data for the study was collected in a prospective manner with the sample size calculated a priori based on available literature. This is the only study to date from India to our knowledge that compared SNAP-II and CRIB-II to identify which would be a superior predictor of not only mortality, but also several predefined morbidities. The limitations of the study is that it is not sufficiently powered for constructing ROC analysis of individual morbidities such as NEC, PVL and CLD in particular.

Implications of this study for practice seem to suggest that use of CRIB-II in house is superior overall. The fact that CRIB-II was far easier as far as data collection is concerned was known. Studies in this regard had indicated that it took a mere five minutes per infant to calculate vis-à-vis the twenty minutes it took for more complicated scores like SNAP, which had far more variables in question.[13]

CONCLUSION

Assessing the disease severity at admission with the help of a reliable score may help to predict the duration of hospital stay and approximate cost of treatment. Moreover, with the improvement in NICU care, there is a need to shift focus to short and long term morbidities. CRIB-II with its simplicity, need for uncomplicated variables and minimal time to generate a score for prediction of mortality and morbidity could be a useful tool in a busy NICU. Further studies with large sample size are needed to confirm the findings observed in this study.

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Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

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