RESEARCH PAPER

Validation of CRIB II for Prediction of Mortality in Premature Babies

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Objective: Validation of Clinical Risk Index for Babies (CRIB II) score in predicting the neonatal mortality in preterm neonates ≤32 weeks gestational age.

Design: Prospective cohort study.

Setting: Tertiary care neonatal unit.

Subjects: 86 consecutively born preterm neonates with gestational age ≤32 weeks.

Methods: The five variables related to CRIB II were recorded within the first hour of admission for data analysis. The receiver operating characteristics (ROC) curve was used to check the accuracy of the mortality prediction. H-L Goodness of fit test was used to see the discrepancy between observed and expected outcomes.

Results: A total of 86 neonates (males 59.6%; mean birthweight: 1228± 398 grams; mean gestational age: 28.3 ± 2.4 weeks) were enrolled in the study, of which 17 (19.8%) left hospital against medical advice (LAMA) before reaching the study end point. Among 69 neonates completing the study, 24 (34.8%) had adverse outcome during hospital stay and 45 (65.2%) had favorable outcome. CRIB II correctly predicted adverse outcome in 90.3% (Hosmer–Lemeshow goodness-of-fit test *P*=0.6). Area under curve (AUC) for CRIB II was 0.9032. In intention to treat analysis with LAMA cases included as survivors, the mortality prediction was 87%. If these were included as having died then mortality prediction was 83.1%.

Conclusion: The CRIB II score was found to be a good predictive instrument for mortality in preterm infants ≤32weeks gestation.

Key Words: CRIB II, India, Neonatal Mortality, Preterm.

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A variety of risk adjustment scores have been derived and advocated for use in assessing neonatal mortality(1). Clinical use index for babies (CRIB) score was created to predict mortality for infants born at less than 32 weeks gestation at birth and based upon 6 variables for predicting mortality(2). CRIB with contemporary data has been questioned because it needs data up to 12 hours after admission thus introducing a factor of early treatment bias. It also utilizes FiO_2 which is not a true physiological measure because it is determined by the care team. CRIB II, an improved version of CRIB, was published recently. The new score is meant to improve predictions for smaller, very premature infants and to exclude variables that could be influenced by care given to the infants(3).

We conducted this study to validate the efficacy of CRIB II in predicting pre-discharge neonatal mortality in preterm neonates needing intensive care.

METHODS

The prospective cohort study was conducted at a tertiary care center between October 2005 and June 2006. Study protocol was approved by hospital ethical committee and written informed consent was taken from parents before enrolment in the study. All preterm newborns ≤32 weeks of gestation, born in

the hospital and admitted to the NICU were eligible for inclusion and were enrolled. Exclusion criteria were gestation <23 weeks, birth weight <500 grams, lethal congenital malformations, delivery room deaths and admission after 12 hours of birth.

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(4). Birthweight was recorded for each baby as soon as they arrived in the nursery or NICU for admission. This was done using an electronic scale having a sensitivity of 10 grams. Arterial blood gas analysis was done in all preterm babies at admission and then as dictated by the clinical condition of the baby. Temperature was recorded using a digital thermometer. All these parameters along with the sex of the baby were assigned scores according to the CRIB II. The final CRIB II score was obtained by the arithmetic sum of the individual scores assigned. The primary outcome measured was in-hospital mortality. Predicted mortality was compared with observed mortality.

Logistic model was used to analyze the prediction of mortality by the CRIB II score at admission. Discrimination – that is, the ability of the score to correctly predict survival or death – was assessed by calculating receiver operating characteristic curves 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. A value of 0.8 is considered good(5).

Babies discharged against medical advice (LAMA) were also taken into account. Data were analyzed in three ways (*i*) cases with known outcomes included in the analysis and excluding those to left against medical advice (LAMA); (*ii*) a comprehensive analysis of all neonates including those who left (LAMA) and assuming all those who left would have died if they stayed back; and (*iii*) after including neonates who left and assuming all those who left would have survived if they had stayed back.

Separate ROC curves were generated for all the three scenarios and analyzed. The Hosmer-Lemeshow Chi-square test was performed to look for any statistically significant difference between predicted and observed mortality. STATA 9.1 was used for data analysis.

RESULTS

There were 88 infants admitted to NICU at or below 32 weeks gestational age during the study period. Two babies were excluded, one because of congenital heart disease and the other because of mistaken dates. Thus, 86 neonates (males: 51(59.3%), birthweight: 1228 ± 398 g, gestation: 28.3± 2.4 weeks) were enrolled, of which 17 (19.8%) left hospital against medical advise (LAMA). Among 69 neonates completing the study, 24 (34.8%) died and 45 (65.2%) had a favourable outcome. The mean CRIB II score was 8.29 ± 4.35 (median 8, inter quartile range 5-12).

ROC curve analysis shows the area under curve (AUC) was 0.9032 (SE 0.0345, 95% CI: 0.83553-0.97096) suggesting that mortality prediction was 90% accurate for 69 babies who stayed up to the study end point **(*Fig.*1).** When the analysis was done assuming all those who left were survivors up to discharge, the AUC was 0.8703 (SE 0.0394, 95% CI: 0.7931- 0.9474) suggesting mortality prediction was correct in 87%. In the analysis which included

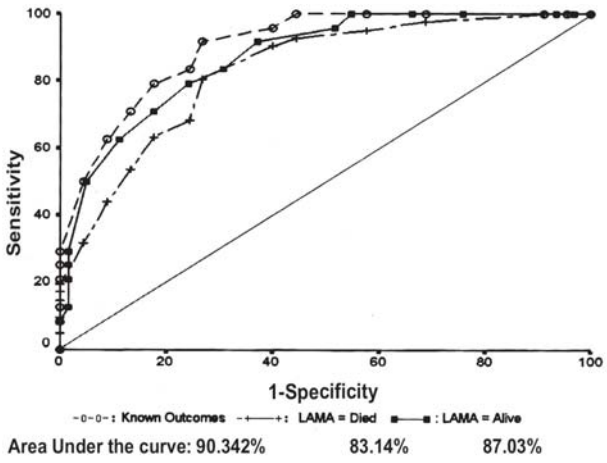

FIG.1 *Mortality prediction on ROC curve for different outcomes.*

LAMA cases as died, the area under ROC curve was 0.8314 (SE 0.043, 95% CI: 0.7468 – 0.9158) suggesting mortality prediction was 83.1% correct.

HL goodness of fit test was applied to test the difference between observed and expected outcome. There was no significant difference between expected and observed outcome (P=0.62).

DISCUSSION

In our study, the area under ROC curve for mortality prediction by CRIB-II was 0.9 and there was no significant difference between predicted and observed mortality. This is similar to the study by Gagliardi, *et al.*(6), who showed AUC of 0.907. In our study mortality prediction was better than the development study for CRIB II(3), probable reason for this difference was related to higher mortality (33% *vs* 9%) and small sample size in our study.

CRIB has previously been evaluated at our center, the area under ROC curve was 0.823(7). The CRIB II has performed better than CRIB in our center. A study by Christoph, *et al.*(8) showed prediction with CRIB II (AUC of 0.69) was less than CRIB (0.82), birthweight (0.74) and gestational age (0.71). The reason for the low prediction of CRIB II in their study is not clear.

None of the babies in our study received surfactant immediately after birth. The fact that the prediction of survival/mortality was excellent using CRIB II suggests that survival depends primarily on the condition of the baby at birth rather than the intervention used. This validates the primary premise of the workers who have developed this severity of illness score. Although CRIB II score is less affected by perinatal factors(6) and despite good mortality prediction, we need further studies to document the influence of various pre and perinatal factors. A study having controlled for variables like antenatal steroids, maternal illness, multiple pregnancy, APGAR score at birth and use of surfactant is needed.

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