ORIGINAL ARTICLE

IMPORTANCE OF CLINICAL RISK INDEX FOR BABIES SCORE FOR PREDICTING MORTALITY AMONG NEONATES

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Background: High mortality among premature and very low birth weight (VLBW) babies necessitates the need to formulate and use scoring systems like CRIB score to predict the mortality in this vulnerable group. Objective of the study was to determine the strength of Clinical Risk Index For Babies (CRIB) score in detecting neonatal mortality in babies presenting with very low birth weight so that timely intervention can be done. It was a cross-sectional study, conducted at NICU, Children Hospital, Pakistan Institute of Medical Sciences Islamabad (PIMS) in nine months starting from First July 2017. **Methods:** A total of two hundred and fifty-four (n=254) new-borns with birth weight of between 500–1500 grams and gestational age lesser than 35 weeks were included in the study. CRIB score was calculated in all neonates and its association was assessed with mortality during NICU stay. Recorded data was analysed for demographic variables. Means and standard deviation was calculated for numeric variables. Chi-square test was applied to find p-value for the correlation between the main variables. **Results:** 54.3% (n=138) patients were males and 45.7% (n=116) were females. Mean gestational age was 33.3 weeks±1.04 SD and mean birth weight of study population was 1129.9 grams±210.6 SD. Mean CRIB score among the study population was 6.3±3.1SD and overall mortality was found to be 54.7% (n=139). Mean CRIB score was found to be 8.27±2.1 SD among mortality group and it was 3.87±3.4 SD among new-borns who were discharged (p<0.05). Mortality was present in 4.3% (n=4) of neonates with CRIB score between 1 to 5, 87.1% (n=121) who had CRIB score between 6 to 10 and 100% (n=14) of neonates who had CRIB score level 11–15 (p<0.05), so a significantly higher percentage mortality was noted among neonates with higher CRIB scores. **Conclusion:** According to our study mean CRIB score is a significant predictor of neonatal mortality.

Keywords: CRIB score; Neonatal mortality; Pre-mature birth

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INTRODUCTION

In order to anticipate clinical outcome of premature and VLBW babies admitted to NICU, intensive care units use various Scoring systems and risk predictors to understand severity and complexity of patient's illness.[1] Some of commonly utilized scores are Clinical Risk Index for Babies (CRIB), CRIB II (CRIB's updated version), Score for Neonatal Acute Physiology (SNAP), SNAP Perinatal Extension (SNAP-PE), SNAP II, and SNAPPE-II.[2] Using data derived from babies admitted to four UK tertiary care NICU's from 1988 to 90, the CRIB score was created to predict mortality in premature (<32 weeks gestation) babies and was first published in 1993 by the International Neonatal Network (Figure-1). The final score was then formulated on a combination of these six variables.[3] The score includes a combination of birth and clinical signs/symptoms having four levels, purpose being to create a simple and easy score for routine clinical use to predict outcome. This score is based solely on data collected in the immediate twelve hours following birth.[4] CRIB score succeeded in detecting 21.0% mortality rate in an earlier study.[5] The main advantage of CRIB is simplicity and ease of data collection. The calculation takes at most five minutes for each new-born in comparison with the twenty to thirty minutes required for the more complex scores e.g. Score for Neonatal acute physiology (SNAP), Score for Neonatal acute physiology perinatal extension (SNAP-PE), and the neonatal therapeutic intervention scoring system (NTISS). Another advantage of CRIB is early assessment over the first twelve hours of life.[6,7]

Early neonatal deaths account for about 50 percent of the worldwide annual six million perinatal deaths and comprise more than 75 percent of total deaths which occur in neonatal period.[3,8] VLBW causes 76% of mortality in early neonates followed by HIE in 16.0% and infections in 6% of the total deaths.

Keeping in mind these high mortality rates in preterm and VLBW babies it is very important to assess these babies with special attention and utmost care. If the outcome is predicted within first few hours after

birth, the clinicians can intervene timely and with proper management serious morbidity and mortality rates may be reduced.

MATERIAL AND METHODS

This study was conducted at NICU of PIMS hospital Islamabad after approval from hospital ethical and scientific committee. A total of two hundred and fifty four (n=254) new-borns (sample size was calculated through 'WHO sample size calculator 1.1' taking confidence level of 95%, anticipated population proportion [mortality rate] of 21%[5] and absolute precision of 5%) with birth weight of between 500 to 1500 grams and gestational age of lesser than 35 weeks were included in the study.

CRIB score was calculated by using standardized charts in all patients (Table-1). Demographic variables were gender and age. Means along with standard deviations were calculated using SPSS version 18. CRIB score was obtained through a prospective way in all neonates and it was categorized into three ranges, i.e., from 1 to 5, from 6 to 10 and from 11 to 15. Association of CRIB score was then assessed with mortality during Neonatal Intensive Care Unit (NICU) stay and *p*-value was calculated to find the significance of this score as a predictor of neonatal mortality.

Table-1: CRIB Score*

Factor	Score
Birthweight (g)	
>1350	0
851-1350	1
701-850	4
≤700	7
Gestational age (wk)	
>24	0
≤24	1
Congenital malformation **	
None	0
Not acutely life-threatening	1
Acutely life-threatening	3
Maximum base excess in first 12h	
>-7.0	0
-7 to -9.9	1
-10 to -14.9	2
≤-15.0	4
Minimum appropriate FiO_2 in first 12h	
<0.40	0
0.41-0.80	2
0.81-0.90	3
0.91-1.00	4
Maximum appropriate FiO_2 in the first 12h	
<0.40	0
0.41-0.80	1
0.81-0.90	3
0.91-1.00	5

*CRIB – "Clinical Risk Index for Babies".
**Excluding inevitable lethal malformations.
FiO_2:- Fraction of inspired oxygen.

RESULTS

Out of total two hundred and fifty four (n=254) new-borns, 54.3% (n=138) were males with mean age of gestational age of 33.3 weeks±1.03 SD and 45.7% (n=116) were females with mean gestation being 33.4 weeks±1.05 SD. Cumulative mean of gestational age was 33.3 weeks±1.04 SD. Mean birth weight among males was 1107.8 grams±223.4 SD and mean birth weight among females was 1156.1 grams±192.1 SD. Cumulative mean birth weight of study population was 1129.9 grams±210.6 SD. In the study group FiO_2 (Fraction of inspired oxygen) and B.E (base excess) is shown in Table-2.

Table-2: Minimums and maximums for FiO2 and maximum BE in first 12 hours) (n=254)

Mortality	Min Appropriate FiO_2 (Mean±SD)	Max Appropriate FiO_2 (Mean±SD)	Max Base Excess (Mean±SD)
Present	0.86±0.12	0.88±0.11	-13.7±-0.8
Absent	0.37±0.12	0.34±0.18	-6.6±-1.7

Mean CRIB score among males was 6.8±3.4 SD and mean CRIB score among females was 5.6±2.4 SD. Cumulative mean CRIB score among whole of the study population was 6.3±3.1SD. 36.2% (n=92) new-borns had CRIB score between 1–5, 58.3% (n=148) had CRIB score between 6–10 and 5.5% (n=14) had CRIB score between 11–15.

Overall mortality was found to be 54.7% (n=139) during NICU stay. Mean CRIB score was found to be 8.27± 2.1 SD among mortality group and it was 3.87±3.4 SD among new-borns who were discharged (p=0.001), implying mean CRIB score was significantly higher in mortality group.

Percentage mortality was calculated among new-borns with different CRIB score levels. Among new-borns who had CRIB score between 1–5 mortality was present in 4.3% (n=4) of neonates. Among new-borns who had CRIB score between 6–10 mortality was present in 87.1% (n=121) of neonates and among new-borns who had CRIB score between 11–15 mortality was present in 100% (n=14) of neonates (*p*=0.001), implying significantly higher percentage mortality among neonates with higher CRIB scores (Table-3). A ROC (receiver operating characteristic) curve was generated. Best cut-off value of CRIB score came out to be 7.5 (Figure-2), where it can predict mortality with 66.2% sensitivity and 96.5% specificity. Area under the curve (AUC) was calculated as 0.953. Association of ROC of CRIB with different gestational age (Figure-3) revealed mortality was higher in lower gestational age groups (AUC of 0.527and 0.548 gestational age 32 and 33 weeks respectively) as compared to higher gestational age groups (AUC of 0.457 and 0.459 for gestational age 34 and 35weeks respectively).

Table-3: Percentage mortality in different levels of CRIB score.

CRIB score levels	Mortality		*p*-value Chi-square
	Present	Absent	
1–5	4	88	
	4.3%	95.7%	
6–10	121 (87.1%)	27 (18.2%)	0.000
11–15	14 (100%)	0 (0%)	(<0.05)
Total	139 (54.7%)	115 (45.3%)	

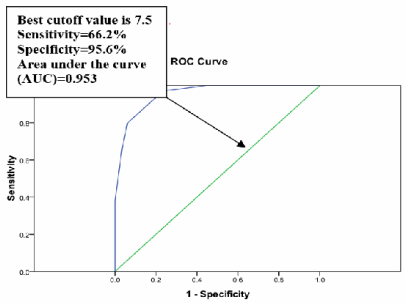

Figure-2: ROC between CRIB score and mortality

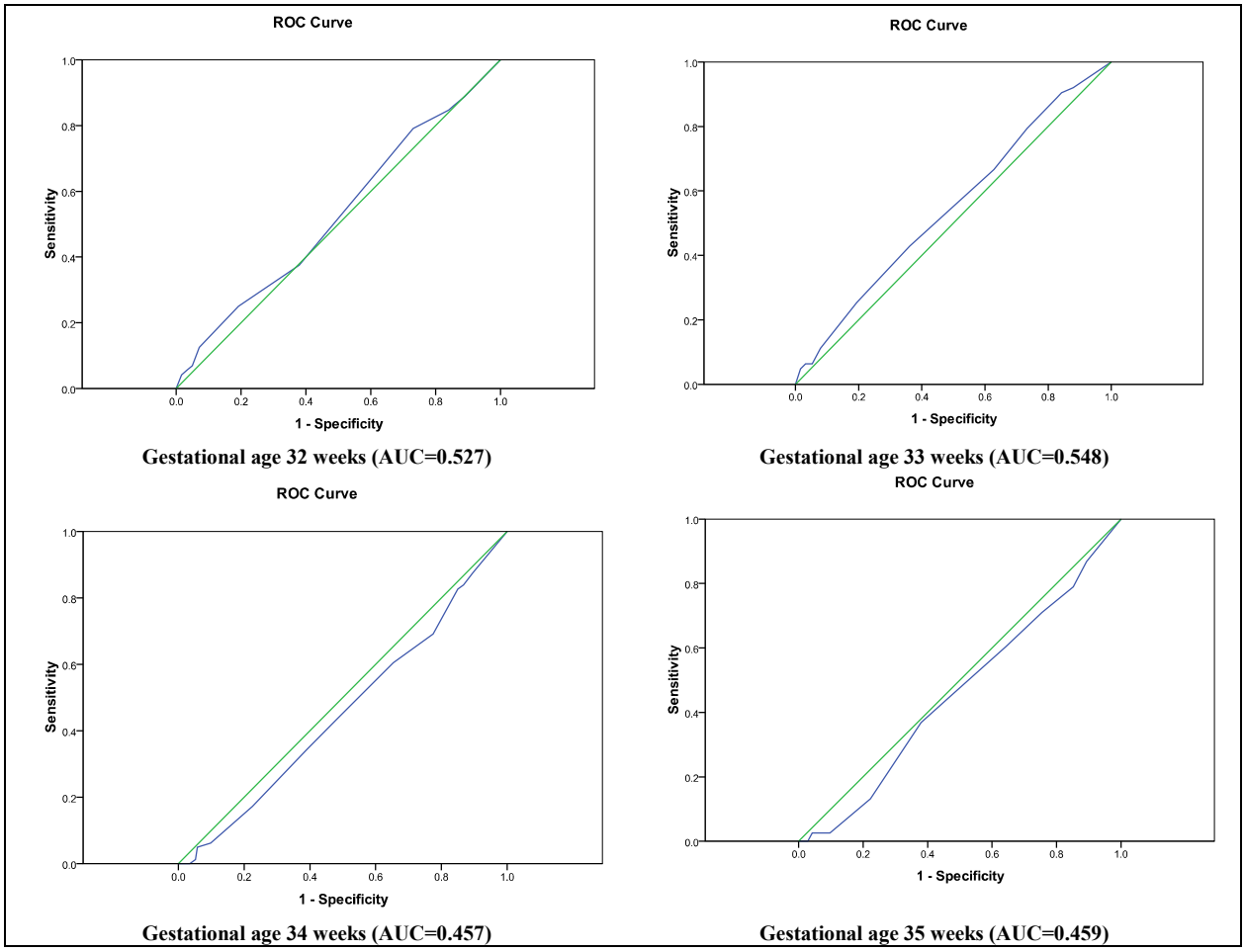

Figure-3: ROC between CRIB score and mortality

DISCUSSION

Rationale of our study was to gather data about finding strength of CRIB score in predicting the outcome. As the outcome is predicted within first few hours after birth, the clinicians may intervene timely and with proper management serious morbidity and mortality rates may be reduced.

A total of two hundred and fifty-four (n=254) new-borns with birth weight of between 500–1500 g and gestational age ≤35 weeks were enrolled. We chose very low to extremely low birth weight neonates (500–1500 g) as they have the highest mortality rate (approximately 50 percent) and if they survive, are at the greatest risk for long-term morbidity. CRIB score was obtained in all the admitted neonates. The significance of its association with mortality during NICU stay was then calculated. Current study was conducted as a thesis, which is a part of postgraduate degree requirement. It was

spanned over a period of six months and principal investigator measured the CRIB scores in all the enrolled subjects. This has reduced the chances of inter-rater variability to almost negligible. Our results showed that 54.3% (n=138) patients were males. Mean gestational age was 33.3 weeks±1.04 SD and mean birth weight of study population was 1129.9 grams±210.6 SD. In a similar study, Brito A.S, *et al* found mean of birth weight was 1,148±248 g (median=1,180), mean for age of gestation was 30.2±2.4 weeks (median=30.0). In both studies birth weights are approximately same but mean gestational age is higher in our study. The lower birth weight in our study is due to ethnic, geographical and maternal nutritional status differences in both areas. In our study mortality was present in 4.3% (n=4) of neonates with CRIB score between 1–5, 87.1% (n=121) who had CRIB score between 6–10 and 100% (n=14) of neonates who had CRIB score level 11–15 (p<0.05). Mean for CRIB score was found to be 8.27±2.1 SD among mortality group and it was 3.87±3.4 SD among new-borns who were discharged (p<0.05).

Overall mortality was found to be 54.7%. In study of Brito A.S, et al mean for CRIB score was 3.8 +/- 4.4 (median=2.0). (n=139) and mortality rate was 23.2% 13and 29.6%. The mortality rate observed in the current study is seemingly higher. There are several reasons for the higher mortality observed in the current study. The most important one is the fact that our study population comprised of very low to extremely low birth weight neonates. The reported mortality in this cohort is around 50%. In a population-based British study (EPI Cure 2 study), the survival to discharge for all live births was 51 percent among extremely preterm infants.[10] In the present study, more than 90% of neonates had respiratory distress as the time of admission to NICU, which could be another reason of higher mortality. The NICU at PIMS is comprised of 20 beds and 14 ventilators were available. PIMS is serving as a tertiary care centre and drains a wide geographical region including Azad Jammu and Kashmir and Khyber Pakhtunkhwa province. The bed occupancy rate is extremely high in our NICU and it is extremely difficult for us to provide standard of care to all reporting patients. Moreover, we had significant number of patients reporting from rural areas where they had been exposed to injudicious use of steroids and antibiotics. This could be another reason of higher mortality rate in our study.

In the study of Brito AS, *et al* mortality is 79.4% in babies with CRIB score >10 compared to ours of 100% (n=14) of neonates who had CRIB score level 11–15.[9] This difference in mortality is significant and related to specialized neonatal care and nursing services at their centres. In another study Matsuoka OT, *et al* mortality rate for babies with CRIB score above 10 was 100% which are the same as in our study.[11]

Sarquis AL reported that for the groups 1, 2 1nd 3 the mortality rates were 6.6%, 87.5% and 100.0% respectively, which is also comparable to our study.[12]

In study done by Vakrilova L, the mortality increased gradually with the increase in CRIB score. In babies within CRIB score of between 0–5 mortality being 2.9–2.6% which increased to 78.6–90% when the CRIB score was greater than 15. Our study showed same rising trend of mortality with increasing CRIB scores. Whereas, a CRIB score of more than 4 was shown to be better at predicting mortality when compared to birth weight and age of gestational. These studies concluded that the benefits of using CRIB score were its simplicity, lesser time required and its useful predictive value. Study done by Vakrilova L used CRIB score to assess severity of illness plus its prognostic value for life and risk of development of permanent disabilities among low gestational age and VLBW babies. This study concluded that babies with permanent disabilities had significantly higher CRIB scores and that CRIB score was useful and had additional benefit of being able to apply early and easily thus suggesting it's use as a basis for comparing the results obtained from variousNICUs.[13]

However, in an Indian study done to assess the usefulness of the CRIB score as a predictor of neonatal mortality in extremely premature neonates in reference to their birth weights and ages of gestation it was concluded that the CRIB score was not helpful in predicting neonatal mortality.[14]
Another study aimed at finding any significant correlation between PI (perfusion index) and CRIB score to assess the severity of new-born illness, correlation was found significant and usefulness of CRIB score in predicting severity of illness in sick new-borns was recommended.[15]

Importance of Obstetric and prenatal care can't be denied in order to avoid premature birth or if premature birth is imminent, to find the optimal time and assistance for delivering. With ongoing improvements in technology, understanding of neonatal physiology and improvement in risk prediction score systems it is possible to predict the high-risk neonates at an earlier time and to reduce the morbidity and mortality among them. CRIB score is helpful and has additional benefit of being easy to apply earlier and in defining criteria about the risk of early neonatal death and permanent disabilities among VLBW babies. Thus, it can be used as a base for comparing the outcomes of the various NICUs.

We recommend its routine use in clinical settings. We also intend to compare CRIB and SNAPE scoring systems in future studies at our setup.

CONCLUSION

Mean CRIB score was significantly higher in mortality group and significantly higher percentage mortality was noted among neonates with higher CRIB scores and so was a good predictor of neonatal mortality.

Suggestions: Further large-scale trials are needed to validate its role in clinical settings. In comparison to birth weight or gestational age alone neonatal scores (CRIB, SNAP, SNAPPE etc.) for assessing the illness severity and the initial risk are more reliable tools for assessing the risk and comparing the results among different NICUs.

We recommend that due to ease of application and lesser time required and as in our study it was a good predictor so it should be used to predict mortality in new-borns.

AUTHORS' CONTRIBUTION

SN: Literature search, compiling, final discussion, proof-reading. EH: Conceptualization, data collection, data analysis, literature search, write-up. MAR: Write-up, proof-reading. SS: Literature search, discussion, proof-reading. SG: Literature search, final discussion, write-up, proof reading. RUA: Final discussion, proof-reading. HA: Data collection and analysis, write-up. IMK: Data collection and analysis, discussion, write-up.

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