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Prediction Value of CRIB-II in Outcome of Preterm and Low Birth Weight Infants: a Prospective Cohort Study

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Abstract

***Background*:** One of the most common methods of identifying mortality risk is the Clinical Risk Index for Babies scoring system (CRIB- II). The aim of this study was assessing the value of CRIB- II in predicting mortality risk in preterm and low birth weight infants in East Azerbaijan- Iran.

***Materials and Methods*:** This prospective cohort study was carried out in 2013-2014 during 6 months in NICUs of Alzahra, Taleqani and Children hospitals of Tabriz-Iran. All infants ≤ 32 weeks' gestational age or ≤ 1500gr birth weight were included in the study using consecutive method. After calculating CRIB- II score, the infants were followed up at 3 months of age and their outcome was determined. The data was analyzed using SPSS-13, t- test, receiver operating characteristics (ROC) and area under curve (AUC) and relative risk (RR).

Results: Of total 215 infants, 64 infants (29.7%) died in the hospital and one infant (0.4%) died after discharging from the hospital. 150 (68.8%) infants, were alive at 3 months age follow up. The mean of CRIB- II score in the group of dead infants was higher and statistically significant compared to the group of alive infants (P<0.05). The prediction power of CRIB- II was determined at 8.5 cut off point regarding the outcome of infants. Based on AUC, the CRIB- II score predicted 83% of mortality rate in infants (confidence interval =76-90).

***Conclusion*:** Findings indicated the notable power of CRIB- II in predicting infants' mortality, so it can be used as a simple and reliable tool to prioritize the interventions in Newborn Intensive Care Units (NICUs).

***Key Words*:** Low birth weight infant, Mortality, Newborn Intensive Care Units, Premature infant.

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1- INTRODUCTION

Neonatal period is a high risk period in which development of settings out of uterine takes place. The rate of mortality is higher during this period due to fragility and vulnerability, as two third of infants' death during first year of life take place in this period (1). In spite of developments in the field of medical care, the rate of mortality among preterm and very low birth weight infants is still high (2). As demonstrated in studies, 50% of mortality rate in infants occurs in very low birth weight infants while they comprise about 1% of whole infant population (3). Significant increase in number of preterm and low birth weight made doctors and researchers identify the risk rate for each of these infants based on their clinical condition and through estimating the possibility of death and certain complications, take the necessary treatment steps.

The results of some studies showed that the rate of mortality in preterm infants especially infants less than 25 weeks, was predictable by the rate of treatment interventions in different centers (4). Therefore, a tool which recognizes disease's patient at the time of admission can be beneficial in assessing the results of the treatment team's function (5) and an ideal way to evaluate the activity of NICUs (6). Low birth weight and low gestational age are two major factors which cause several complications in the infants and also is the main cause of their death during neonatal period and first year after birth (7); therefore, in the past, these two factors were used to predict the survival probability of infants. However, today there are several information banks around the world to evaluate the effect and success rate of neonatal intensive cares (8). Today, it is claimed that in addition to gestational age and birth weight, other prenatal factors and physiological condition of each infant has effect on the severity of the illness (9). Some scales for assessing the severity of illness that are different from each other in terms of the number of variables and the method of scoring have been developed during two past decades. For example, Score for neonatal acute physiology(SNAP) can be used in all gestational ages and birth weights but the scoring system of Clinical Risk Index for Babies (CRIB) is only used in infants ≤ 1500gr (10). One of the most common methods of identifying mortality risk in infants less than 32 weeks of gestation or birth weight less than 1500gr is the revised index of mortality risk in very low birth weight infants (CRIB-II), which determines the severity of illness in these infants. In this score, 5 variables including gender, birth weight, gestational age, infant's body temperature at the time of admission and the rate of base excess deficiency during first 12 hours after birth are determined and the total score of CRIB-II is calculated (11). Recently, remarkable steps have been taken to decrease mortality rate in preterm infants in our country, so it is necessary to do more studies on the quality of delivered services. This study was carried out with the aim of assessing the value of CRIB-II in predicting mortality risk in preterm and low birth weight infants in East Azerbaijan-Iran.

2- MATERIALS AND METHODS

This is a prospective cohort study that was carried out from October 2013 to March 2014 (for 6 months) in NICUs of Alzahra, Taleqani and Children hospitals of Tabriz, North West of Iran. After submitting the study in pediatric health research center and getting permission from ethics committee to do the study in vulnerable groups (ID number: 5-4-12258), informed written consent was taken from the parents and the qualified infants who were hospitalized in NICUs were included the study through consecutive method. Based on the results

from Fuladinejad's study (8) in Gorgan-Iran in which the mortality rate was 37% and considering d=7.4 and confidence interval (CI)=95%, the needed sample size was at least 164 cases, while in our study 218 infants were included during 6 months. The inclusion criteria were: gestational age ≤ 32 weeks or birth weight ≤ 1500gr. Exclusion criteria consisted of gestational age lower than 23 weeks or birth weight lower than 500gr, severe fatal malformations, and death during first 12 hours of life. The general characteristics of infants such as gender, type of birth and Apgar scores of first and fifth minutes, were extracted from the infants' cases and recorded in data collection forms. The parameters of CRIB-II were measured and recorded in data forms as follows: The infants were weighed at the moment of admission with digital scale of ±10 precision based on gram unit. The infants' body temperature was measured axillary at the moment of admission in neonatal intensive care unit with digital thermometer of Welech allyn. The exact gestational age of infants was determined by the educated nurse using Ballard table. Base excess was extracted and recorded from blood gases test, which is a common test done at the time of admission. Infants' sex was determined through observing phenotype of genital. To collect the data in the similar way in different hospitals, before the study started, the accuracy of sets (such as blood gas analyzer, scale and digital thermometer) was compared to each other and made sure of their calibration. It was taught to researcher's assistant nurses how to use Ballard table and determine the gestational age in a session before the study started and it was made sure of the similar way of determining it in three hospitals by using written guidelines. The inter rater reliability was achieved as 0.87, following determining the gestational age of an infant by 10 researchers' assistant nurses using Ballard table. After measuring mentioned parameters, CRIB-II score (ranged 0-27) was calculated for each infant and the prediction rate of it about infants' outcome was found based on CRIB-II. The studied infants were followed up at 3 months of age and their outcome (dying or staying alive) was recorded in data collection form. To determine the relationship between measured parameters in both group of alive and dead infants, t-test and to determine the relationship between CRIB-II score and infants' outcome, receiver operating characteristics curve (ROC) was used and so the sensitivity and specificity of CRIB-II was identified using Area Under the Curve analysis (AUC).

To assess the death probability, we calculated the relative risk (RR) with 95% confidence interval at 8.5 cut off point using Center for Evidence-Based Medicine website (CEBM.State.Calculator). In all tests $P<0.05$ was considered as significant. The study steps are shown in (Figure.1).

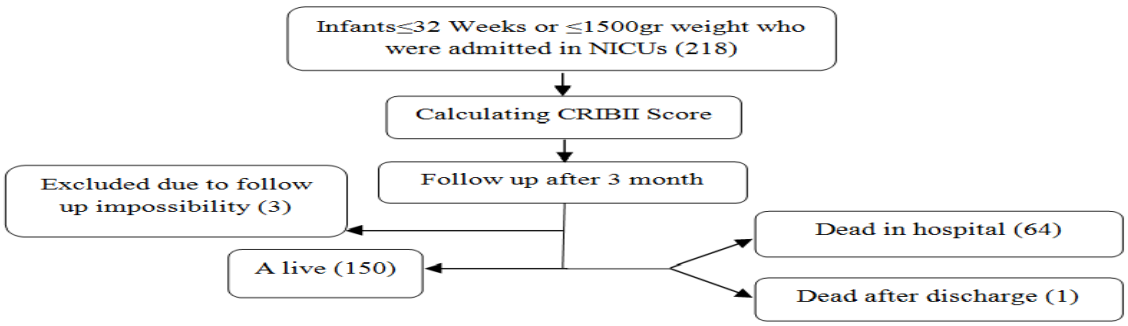

Fig.1: Study flow diagram

3- RESULTS

In this study, 218 infants were studied among whom 3 infants were not included in analysis due to follow up impossibility at 3- month of age. 28 infants were born in other centers and they were referred to the study NICUs in first 12- hour of birth. The information about infants' sex, type of birth, referring from other centers and their outcome has been outlined in (Table.1).

The mean of gestational age, weight, body temperature and base excess was significantly lower in the group of dead infants compared to infants who stayed alive (P<0.05). The mean of CRIB-II was higher in dead group than alive group and this difference was statistically significant (P<0.05) (Table.2).

CRIB-II was able to predict 83% of mortality in preterm and low birth weight infants using Receiver Operating Characteristics and calculating area under curve (CI=76-90).

Sensitivity and specificity of CRIB-II at 8.5 cut off point is shown in (Figure.2) and (Table-3) in details. Calculating Relative Risk with 95% confidence interval indicated that the death probability in infants with CRIB-II score more than 8.5 was 5.5 times higher than infants with CRIB-II score less than 8.5 (CI=3.5-8.7).

Table 1: Gender, type of delivery, birth place and outcome of infants

Gender		Type of delivery		Referred from other centers		Outcome*		
Number (%)		Number (%)		Number (%)		Number (%)		
Male	Female	NVD	C/S	Yes	No	DIH**	DAD†	A‡
111	107	74	144	28	190	64	1	150
50.9%	49.1%	33.5%	66%	12.8%	87.2%	29.7%	0.4%	68.8%

* Three infants weren't followed up; ** Dead in hospital; † Dead after discharge; ‡ Alive in 3 month age.

Table 2: Mean and standard deviation (SD) of weight, gestational age, base excess, body temperature and CRIB-II score of dead and alive infants

Variable	Mean (SD)		Max		Min		P-value	
Groups	Alive	Dead	Alive	Dead	Alive	Dead	Alive	Dead
Weight (g)	1243.4±196.8	945.1±251.5	1500	1500	700	520	0.001	
Gestational age (week)	29.5±1.6	27.6±2.2	32	33	25	23	0.001	
Base excess (mEq/L)	-5.9±4.7	-9.6±9.2	9.8	4.2	-18.2	-75	0.003	
Body temperature (°C)	36.6±0.1	36.5±0.3	37	36.9	36	35	0.001	
CRIB-II Score	5.9±2.3	9.4±2.8	12	14	1	2	0.001	

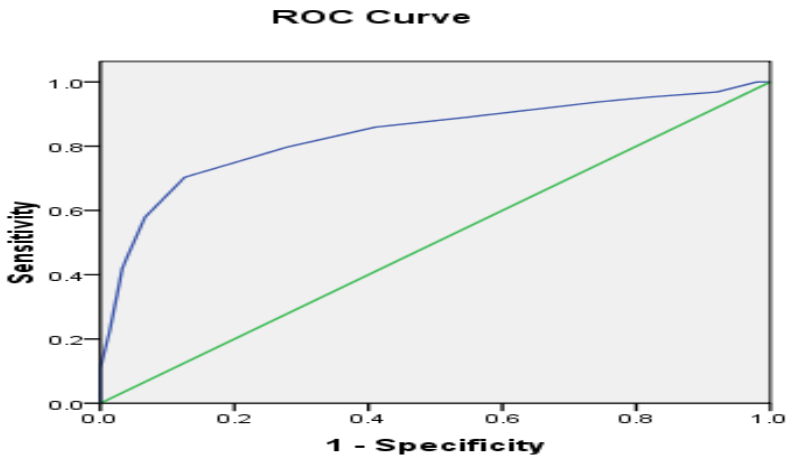

Fig.2: Sensitivity and specificity of CRIB-II in ROC

Table 3: Sensitivity and specificity of CRIB-II in details

Variables	Estimate	95% CI
Sensitivity	0.70	0.58-0.80
Specificity	0.87	0.81-0.91
PPV	0.70	0.58-0.80
NPV	0.87	0.81-0.91
LR+	5.55	3.54-8.70
LR-	0.34	0.23-0.49

4- DISCUSSION

The preterm and low birth weight infants' survival is primarily related to their condition at the moment of birth rather than treatment interventions (12); therefore, it is of a great importance to prioritize the interventions among this group of infants. In our study, which was done on predicting mortality risk in preterm and low birth weight infants, there was a significant difference between CRIB-II score in two groups of dead and alive infants and CRIB-II at 8.5 cut off point could predict about 83% of mortality rate in infants ≤ 32 weeks gestation or ≤ 1500gr birth weight. Our study's limitation was that the value of some parameters such as base excess could be affected by blood sampling method since the study was carried out in 3 hospitals. To solve this problem we taught the sampling method to researchers' assistants of three hospitals in one session before collecting the data and made sure to collect similar data in all 3 centers by delivering similar guidelines to them. The results of studies show that, when comparing predicting power of different tools, CRIB index is more capable than traditional methods of birth weight or gestational age in predicting mortality rate in hospitals (8, 13). Whereas, in some studies it is stated that CRIB score does not have more informative value than birth weight and gestational age (14, 15). Revised index of mortality risk in very low birth weight infants (CRIB-II) is a simple scoring system to predict mortality of low birth infants (16). The purpose of this tool is to improve prediction of outcome in preterm little infants through excluding the variables which may be affected by the type of care (17). In a study by Babaee et al. (5), which was carried out in descriptive-analytical method in Kermanshah- Iran, 85% of mortality rate was predicted by CRIB-II index which was

similar to our study. Also in a study by Rastogi (12), 90% of mortality rate in infants ≤ 32 weeks was predicted by CRIB-II index which was better compared to present study. Manktelow (18) stated in a study, in which he compared 3 versions of predicting mortality indices in preterm and low birth weight infants, that CRIB-II with or without the variable of body temperature at the moment of birth has beneficial predicting features. Also, a study by Gagliardi et al. on comparing the predicting power of various indices in infants showed that CRIB-II was more powerful and accurate since it is less influenced by other factors affecting infant's survival (19). Comparing birth weight and gestational age showed that CRIB-II index was the efficient predictor of mortality rate in less than 32 weeks gestational age and very low birth weight infants (20-22). However, some studies claimed that CRIB-II index has no superiority over traditional methods such as birth weight or gestational age and these simple variables, whose results are almost similar to mortality risk indices, can be used to predict mortality risk as well (23, 24). Although some studies in our country such as a cohort study by Mohkam et al. (25), which was carried out during 3- year in Tehran, did not indicate a remarkable superiority of CRIB-II index over other indices considering its area under the curve, sensitivity and specificity; however, the results of most studies have indicated that CRIB-II is a valuable tool in predicting outcomes of preterm and low birth weight infants (5, 18, 19, 26) since, beside having high capability of prediction, the parameters used in this tool are measured routinely in NICUs and also determining these variables are easy and convenient and is not much affected by human errors (5). In this study we found a significant difference between CRIB-II score of alive and dead infants and CRIB-II could predict high percentage of mortality rate in preterm and low birth weight infants. Considering the fact that predicting vulnerable infants' outcome especially in centers with limited facilities and equipments is of great importance, CRIB-II can be used as a simple and reliable tool to prioritize the cares and to constantly evaluate the quality of delivered cares in NICUs of the province. However, further studies are needed to evaluate other elements such as prenatal and perinatal factors which affect preterm and low birth weight infants' condition.

5- CONCLUSION

CRIB-II has notable power in predicting preterm and low birth weight infants' mortality; therefore, it can be beneficial in prioritizing the cares, especially in NICUs with limited facilities and equipments.

6- CONFLICT OF INTEREST: None.

7- ACKNOWLEDGMENT

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