

THE CRIB II (CLINICAL RISK INDEX FOR BABIES II) SCORE IN PREDICTION OF NEONATAL MORTALITY

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ABSTRACT

Predicting the outcome of neonatal critical patients remains elusive. The multiple factors of maternal state of health (infections, diabetes, gestosis), the placental situation (premature rupture of membranes) as well as multiple factors from the baby (small for gestational age, low Apgar score, low birth infections, mechanical ventilation, hypoglycaemia hyperglycaemia) render the approach to treatment of each patient individual and the outcome uncertain. Several approaches and scales are developed in order to assess the mortality risk in those rather complicated situations.

We used the CRIB-II scale to assess the mortality risk in 80 patients delivered in a large tertiary level hospital with more than 4,000 deliveries yearly. The patients were stratified according to all the neonatal risk factors and comorbidities. The CRIB-II scale identified well the mortality rates, but not the outcomes. A large and well-balanced cohort of patients followed for a longer period is required to discern in detail the importance of CRIB-II scale in predicting outcomes in high-risk new-borns. This could serve as an assistance to personalized approach to severely sick children. In addition, it is a valuable method in comparing outcomes in different NICUs and outcomes in different times in the same NICU, thus rendering possible improvements in the same unit and among several NICU departments.

Keywords: neonatal mortality, high-risk babies, CRIB-II score

INTRODUCTION

Neonatal mortality is high in countries with lower socioeconomic status (Burstein et al. 2019 [1], Howell et al. 2018 [2]). One of the most important factors is the prematurity: moderate to late preterm babies (32-36 weeks), very preterm babies (28-31 weeks) and extremely preterm babies (<28 weeks). Birth weight, especially children with low and very low weight are also new-borns with increased risk. The presence or absence of maternal factors of risk

(diabetes, maternal infections, eclampsia...) is also influencing the outcome and mortality. The same goes for hypoxic-ishaemic syndrome and various types of infections in newborns. The way of delivery, vaginal versus caesarean, is also of significance. The neonatal mortality depends on sociodemographic, obstetrical, psychological, and genetic factors. Paternal and environmental factors are also involved. Pregnancy complications and the context of delivery

also have an impact on the neonatal outcomes. All those factors contribute not only for the high mortality rates in neonates but also for a significant numbers of children with neurological problems and mental retardation. Several scales – SNAPPE, SNAPPE-II [3, 4, 5] and CRIB-II [6, 7, 8] have been developed in order to determine the outcome and mortality in high-risk babies. This would add to personalizing their treatment and possibly improve the outcome.

PATIENTS AND METHODS

We investigated 80 newborns delivered at the Clinic for Gynecology and Obstetrics (~4,000 deliveries yearly). The institutional ethics committee approved the study. We excluded children with congenital malformations and polycythemia. We assessed the gestational age, weight and length, Apgar score, delivery mode, children with infections (pneumonia, sepsis...), children with hypoxic ischemic syndrome, children whose mothers have toxemia, addictions, diabetes, or chorioamnionitis. Blood biochemistry (electrolytes, blood glucose, liver probes and enzymes, urea and creatinine), inflammatory markers (white blood cell counts, CRP), acid-base balance were

also recorded. Microbiological investigations (tracheal swabs, urine and blood cultures), ultrasound of the head and/or kidneys, X-rays of the chest were also performed as indicated. The ABL700 analyzation (Radiometer Medical A/S, Copenhagen, Denmark) was used for blood biochemistry analysis.

To assess the risk in newborns we used the CRIB-II scale [3-8]. The scale uses five parameters: gender, body weight, the worst basis excess, body temperature and referral.

The statistical analysis through Excel and SPSS with standard descriptive and analytical methods was used. The paired samples statistics and the paired samples test (T-test) assessed the differences on the CRIB-II scale.

RESULTS

In this study we investigated 80 babies (M:F=60:40) delivered at the Clinic of Gynecology and Obstetrics in the period 2018-2020. Low birth weight was found in all children. Very low birth weight (<1,500gr) was found in 36 children (45%), low birth weight (1,500-2,500 g) in 44

Table 1. Patient characteristics

Birth weight	
Very low birth weight (<1,500gr)	36 (45,00%)
Low birth weight (1,500-2,500gr)	44 (55,00%)
Appropriate birth weight	None
High birth weight (>4,000 gr)	None
Gestational week	
20-25gn	None
26-30gn	25 (31.25 %)
31-35gn	52 (65%)
36-40gn	2 (2.5%)
Comorbidities	
HIE	5 (6.25%)
HIC	5 (6.25%)
Sepsis, Pneumonia	22 (27.5%)
Delivery	
Cesarean section	52 (65%)
Presentatio capitis	56 (70%)
Presentatio caudae	11 (13.75%)
Presentatio pedis	4 (5%)
Situs transverses (Cesarean section)	9 (11.25%)
Risk factors from mother	
Colpitis / infection	10 (12.5%)
DM gestational	1 (1.25%)
Preeclampsia/Eclampsia	8 (10%)
Placental factors	
Placental abruption	6 (7.5%)
Umbilical cord draped around neck	8 (10%)

(55%). There were no children born appropriate for gestational age or large for gestational age.

Low birth age children dominated: twenty five babies (31.25%) were born between 26-30 gestational week (GW), while 52 (65 %) were born between 31-35 GW and two babies (1.6%) between 36-40 GW. There were no babies delivered between 20-25 GW.

Caesarean section was observed in 52 (65%) babies and vaginal delivery in 28 (35%). Ten mothers (12.5%) had various infections during pregnancy, while five of them (6.25%) had tox-aemia and one diabetes mellitus (1.25%). There were six placental abruptions (7.5%).

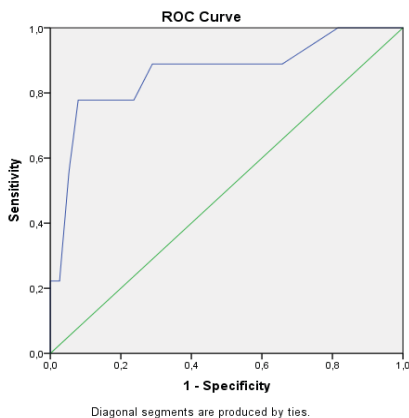
Comorbidities were also frequent: five babies (6.25%) had hypoxemic-ischaemic encephalopathy, 22 (27.5%) had infections, 5 (6.25%) intracranial bleeding, and 7 (8.75%) low calcium levels. Hypoglycaemia (HG) was found in 80 (100%) children, and symptomatic HG with seizures in 3 (2.4%). Nine children (11.25%) died.

Neonatal mortality significantly correlated with the gestational age ($p>0.01$), maternal comorbidities ($p>0.05$), but not with the birth weight ($p>0.05$). The lowest Apgar score was in positive correlation with the gestational age ($p>0.01$), but not with the birth weight ($p>0.05$).

The initial mortality risk assessed with CRIB II in low birth weight new-borns resulted in

ROC curve (Receiver Operating Characteristic) with high sensitivity (true positives) and specificity (false positives) (the hugging curve). In contrast, curves with low sensitivity and specificity should be near the 45 degrees line (Fig. 1) [9]. Therefore, CRIB II functions well in determining which babies are going to succumb or survive the critical state.

Figure 1. ROC curve (Receiver Operating Characteristic) for CRIB II sensitivity and specificity



The Area Under the Curve (AUC) is an indicator of how well the model distinguishes between positive and negative outcomes [10]. Our logistic regression result of 0.861 points out that the CRIB II model functions well in foreseeing whether a certain child is going to survive or not.

When looking at the gestational age as a mortality risk in children with low birth weight the AUC value is 0.923, which again points toward the reliability of CRIB II as a prediction tool. The form of the ROC curve confirms the same conclusion.

Figure 2. ROC curve (Receiver Operating Characteristic) for CRIB II for new-borns with low gestational age and low birth weight

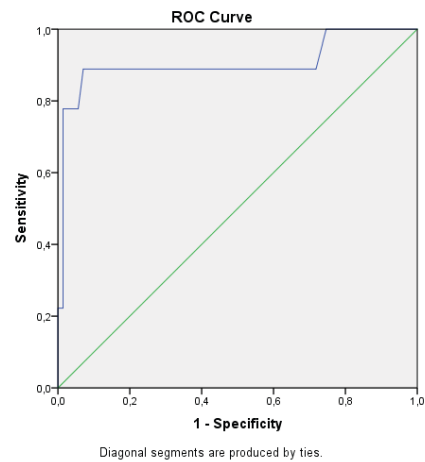


Table 3. Area Under the Curve (AUC) for CRIB II and gestational age, birth weight and hypoglycaemia

Gestational age	0,923
Birth weight	0,904
Crib II	0,861
Hypoglycaemia	0,545

Therefore, gestational age and birth weight have an excellent mortality predictive value (AUC 0.923 and 0.904). They are better in predicting lethality than the CRIB II score which has, however a good value of 0.861. Hypoglycaemia with the AUC value of 0.545 has poor individual lethality predictive value.

DISCUSSION

Several groups of new-borns are high-risk babies [1, 2, 11]. They include large for gestational age (LGA), small for gestational age (SGA),

new-borns under the 10th percentile, neonates with intrauterine growth restriction (23-32), gestational age under 37 weeks, neonates with sepsis, children of mothers with eclampsia or chorioamnionitis or diabetes.

There are several neonates sickness scores for assessment of disease severity, outcome and mortality [5]. Good predictive values of CRIB II were found in several studies in the neonatal intensive care units [7, 12]. Among 3,268 infants 317 (9.7%) CRIB II (-T; without admission temperature) had excellent predictive characteristics: the overall $p=0.53$ [8]. In Kenia NICY 135 patients with: birth weight < 1,500 g, base excess < -12 mmol/l, gestational age < 30 weeks, temperature at admission > 37.5 or < 35 (all components of CRIB II) – were all found to be significantly associated with neonatal mortality [13]. In this report, the CRIB II score had a sensitivity of 80.6%, specificity of 75.3%, and a predictive value of 77.7% [13].

In a systematic review and meta-analysis [6] of six neonatal illness severity scores (CRIB, CRIB II, SNAP, SNAP II, SNAP-PE, and SNAP-PE II), birthweight (BW), and gestational age (GA) the authors used PubMed, EMBASE, and Scopus as data sources published before January 2019. It is of note that only 24 out of 1,659 studies satisfied the inclusion criteria (McLeod et al. 2020) [6]. The CRIB index was the most accurate in predicting the pre-discharge mortality [AUC 0.88 (0.86–0.90)], while the GA was the least discriminate [AUC 0.76 (0.72–0.80)] [6].

In 564 infants with extremely low birth weight, the GA, BW, Apgar score, CRIB II score and serum albumin levels were the best predictors for mortality during ≤ 7 th and > 7 th postnatal days [14].

Buhrer et al. 2000 [15] found that for combined poor outcome CRIB, the minimum and maximum FIO₂ were independent predictors. Interestingly, out of 1,485 consecutive VLBW CRIB-II did not result in improved estimation of mortality risk in VLBW infants as compared to the CRIB, gestational age or birth weight [16].

The CRIB II score is a valid tool of initial risk assessment in LBW, predicting outcome more accurately than birth weight or gestational age alone [17]. The CRIB-II scores were also found to have the advantage of being simpler to collect and to calculate [18].

It is of note that scores are also useful in comparative quality assessment when comparing data in different NICU [3].

In our patients, the gestational age and birth weight have an excellent mortality predictive value (AUC 0.923 and 0.904). They are better in predicting lethality than the CRIB II score which has, however a good value of 0.861. Although the use of neonatal scores is still a subject of many discussions [19] CRIB II has a well-established value in predicting neonatal outcomes. It is therefore possible to use CRIB II as a tool for following the outcomes in one NICU and combining the same tool in observing and ameliorating outcomes in different NICUs.

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Резиме

ВРЕДНОСТА НА CRIB-II (КЛИНИЧКИ РИЗИК КАЈ БЕБИЊА) ВО ПРЕДИКЦИЈА НА МОРТАЛИТЕТОТ КАЈ НОВОРОДЕНЧИЊАТА

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Прогнозата на исходот кај критично болните неонатални пациенти останува да биде дефинирана. Многубројните фактори, од страна на здравјето на мајката (инфекции, дијабетес, гестози), плацентарните фактори (предвременно кинење на мембраните), како и многубројните фактори од страна на бебето (мали за гестациската возраст, низок Апгар-скор, механичка вентилација, хипогликемија, хипергликемија, инфекции) ја отежнуваат процената за исходот на болеста кај пациентите.

Постојат неколку методи, скали за проценка на ризикот кај болното новороденче. Ние ја иследивме скалата CRIB-II за да го процениме ризикот од смрт кај 80 пациенти иследени во голема болница со околу 4000 раѓања годишно. Пациентите беа стратифицирани според сите фактори за ризик и коморбидитет кај новородени деца. Алатката CRIB-II се покажа дека добро го проценува морталитетот. Очигледно е дека е потребна студија на поголем број пациенти со урамнотежена распределба на ризиците и факторите на болеста за да се утврди корисноста на алатката CRIB-II во претскажувањето на исходот на ризичните новородени деца. Овој пристап би бил користен за персонализиран пристап за секој пациент. Исто така, методата би имала значителна вредност за споредба на исходите на лекување во иста единица на интензивна нега, како и за споредување на резултатите меѓу различни единици на неонатална интензивна нега.

Клучни зборови: неонатална смртност, бебиња со висок ризик, CRIB