Clinical and laboratory signs of multiple organ dysfunction in newborns with intraamniotic infection: prospective observational study

Клинико-лабораторные признаки полиорганной дисфункции у новорожденных с внутриамниотической инфекцией: проспективное наблюдательное исследование

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Abstract

INTRODUCTION: Assessment of the severity of the condition of newborns with intra-amniotic infection is extremely important for neonatal intensive care. **OBJECTIVE:** To study signs of multi-organ dysfunction in newborns with intra-amniotic infection. **MATERIALS AND METHODS:** 165 newborns who are being treated in the NICU were examined. The weight of the children was 1870 (1480–2550) g, the Apgar score at the first minute was 7 (6–7), at the fifth — 8 (7–8) points. Depending on the gestation period, the children were divided into 4 groups: I — 26–29, II — 30–33, III — 34–37 and IV — 38–40 weeks. In groups I–III, children with respiratory distress syndrome and intraamniotic infection prevailed, and in groups IV — with asphyxia. **RESULTS:** The maximum score on the NEOMOD scale of the ball is typical for children of groups I and IV: 4 (3–5) and 3 (1–4) points, respectively. The number of leukocytes in group IV newborns on the first day of treatment was statistically significantly higher than in groups II and III: 19.6 (8.5–43.7) *vs* 12.4 (5.8–33.1) and 12.5 (6.4–32.5), respectively ($p = 0.003$). Base excess indicators in group I were statistically significantly lower than in group IV: –7.2 *vs* –4.2 ($p < 0.001$). The minimum concentration of C-reactive protein was typical for group I children — 1.7 (1.3–2.2) mg/l, which was significant compared to the indicators of other groups ($p < 0.001$). **CONCLUSIONS:** The most pronounced multiple organ dysfunction was observed in newborns with a gestation period of 26–29 and 38–40 weeks, which is confirmed by high scores on the NEOMOD scale, an increase in the number of leukocytes and neutrophil index indicators. Hemodynamic disorders in newborns with a gestation

Реферат

АКТУАЛЬНОСТЬ: Оценка тяжести состояния новорожденных и раннее выявление инфекций являются крайне важной проблемой интенсивной терапии. **ЦЕЛЬ ИССЛЕДОВАНИЯ:** Изучить клинико-лабораторные признаки полиорганной дисфункции у новорожденных с внутриамниотической инфекцией при поступлении в отделение реанимации и интенсивной терапии. **МАТЕРИАЛЫ И МЕТОДЫ:** Обследовано 165 новорожденных, находящихся на лечении в отделении реанимации и интенсивной терапии (ОРИТ). Масса детей составила 1870 (1480–2550) г, оценка по шкале Апгар на 1-й мин — 7 (6–7), на 5-й — 8 (7–8) баллов. В зависимости от срока гестации дети были разделены на 4 группы: I группа — 26–29, II — 30–33, III — 34–37, IV — 38–40 нед. В I–III группах преобладали дети с респираторным дистресс-синдромом и внутриамниотической инфекцией, в IV — с асфиксией. Длительность неинвазивной искусственной вентиляции легких составила 96 (2–600) ч, инвазивной — 120 (24–720) ч. **РЕЗУЛЬТАТЫ:** Максимальная оценка по шкале NEOMOD (Neonatal Multiple Organ Dysfunction) была характерна для детей I и IV групп: 4 (3–5) и 3 (1–4) балла соответственно. Количество лейкоцитов у новорожденных IV группы в 1-е сут лечения было статистически значимо выше, чем во II и в III группах: 19,6 (8,5–43,7) *vs* 12,4 (5,8–33,1) и 12,5 (6,4–32,5) соответственно ($p = 0,003$). Дефицит оснований (BE) в I группе были статистически значимо выше, чем в IV группе: –7,2 *vs* –4,2 ммоль/л ($p < 0,001$). Минимальная концентрация С-реактивного белка была характерна для детей I группы — 1,7 (1,3–2,2) мг/л, что явилось значимым по сравнению с показателями других

period of 26–29 weeks are the main factor determining the severity of the child's condition and the NEOMOD score.

групп ($p < 0,001$). Новорожденные I группы нуждались в максимально длительной гемодинамической поддержке. **ВЫВОДЫ:** Наиболее выраженная полиорганная дисфункция отмечалась у новорожденных со сроком гестации 26–29 и 38–40 нед., что подтверждается высокими оценками по шкале NEOMOD, увеличением количества лейкоцитов и показателей нейтрофильного индекса. Гемодинамические нарушения у новорожденных со сроком гестации 26–29 нед. являются основным фактором, определяющим тяжесть состояния ребенка, оценку по шкале NEOMOD и длительность лечения в ОРИТ.

KEYWORDS: newborns, infection, multiorgan dysfunction, critical state, NICU

КЛЮЧЕВЫЕ СЛОВА: новорожденные, инфекция, полиорганная недостаточность, критическое состояние, отделение интенсивной терапии новорожденных

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Introduction

Assessment of the severity of the critical condition of newborns and early detection of infections is an extremely important task of modern intensive care [1].

The progression of infection specific to the neonatal period is the most common cause of the progression of multiple organ dysfunction and the admission of newborns to intensive care units (NICU). It is the course of infection that determines the severity of the patients' condition and the features of the clinical and laboratory status on the first day of treatment in the NICU [1–4].

In most cases, intraamniotic infection occurs in premature newborns whose mothers suffer from chorioamnionitis and have a burdened obstetric and gynecological history [5, 6].

There is no doubt that the high frequency of neonatal infections is due to the immaturity of the child's immune system, especially in premature infants and children with low and extremely low body weight, which contributes to an increase in susceptibility to infection, a high probability of developing multiple organ dysfunction syndrome and adverse outcomes [7, 8].

Clinical manifestations of multiple organ dysfunction of infectious genesis in newborns vary significantly depending on the degree of maturity of the defense mechanisms and virulence of the pathogenic microorganism [9].

Opportunities for early diagnosis of infections in children are extremely limited, due to both a wide range of opportunistic microbes that cause infections of the neonatal period, which are often associated with medical care, and the absence of specific clinical and laboratory manifestations, which is associated with the anatomical and functional characteristics of a newborn child [10].

In most cases, the total number of leukocytes, the absolute number of neutrophils and the ratio of immature neutrophils to the total number of neutrophils (I/T) are evaluated for the diagnosis of neonatal infections. Although this analysis does not require a large volume of blood, which is an advantage in neonatal practice, it has an extremely low diagnostic value for detecting the infectious process and early neonatal sepsis [11]. Since these parameters have extremely low sensitivity and specificity, they often react in response to any adverse effects, among which stress, hypothermia, hypoglycemia, aspiration, a long anhydrous interval, etc. should be noted [12–15].

The available data suggest that the diagnostic value of assessing the total number of leukocytes, the absolute number of neutrophils, as well as the I/T ratio increases significantly when using age-related reference values, but even in this case, the absence of highly sensitive and specific clinical and laboratory signs of early neonatal infection is the reason for delayed correction of therapy, which significantly increases the likelihood of multiple organ failure syndrome, an unfavorable outcome, and indicates the need for further search for reliable markers of infection in the neonatal period [10, 16].

The aim of the study was to study clinical and laboratory signs of multiple organ dysfunction in newborns with intraamniotic infection upon admission to the NICU.

Materials and methods

The study was approved by the local Ethics Committee of the St.Petersburg State Pediatric Medical University of the Ministry of Health of the Russian Federation (Protocol No. 04/11 of November 11, 2021) and was performed on the basis of the Departments of Anesthesiology-Resuscitation and Emergency Pediatrics, Neonatology with courses of Neurology and Obstetrics-Gynecology of the Faculty of Postgraduate and Additional Professional Education of the St.Petersburg State Medical University of the Ministry of Health Russia — Department of Anesthesiology, Intensive Care and Intensive Care of St.Petersburg State Medical Institution "Children's City Hospital No. 17 of St.Nicholas". A total of 165 newborns were examined, in whom, at the time of admission to the NICU, the main diagnosis was intraamniotic infection, no one was diagnosed with early neonatal sepsis. The parents of the children included in the study signed a voluntary informed consent to perform all therapeutic and diagnostic manipulations.

Children's body weight was 1870 (1480–2550) g, the Apgar score at the first minute was 7 (6–7), and at the fifth — 8 (7–8) points. All patients were taken to the ICU on the 1st (1–2) day of life. Depending on the gestation period, all children were divided into IV groups. Group I (n = 18) included patients with a gestation period of 26–29 weeks, in II (n = 74) — 30–33 weeks, in III (n = 51) — 34–37 weeks and in IV (n = 22) — 38–40 weeks. In children of groups I–III, the main concomitant diagnosis was respiratory distress syndrome, and IV — perinatal hypoxia (Table 1).

Table 1. Characteristics newborn at the time of admission to the NICU

Indicators	Groups			
	I (n = 18)	II (n = 74)	III (n = 51)	IV (n = 22)
Apgar score at 1 minute	6 (5–7)	7 (6–7)	7 (7–7)	7 (6–8)
Apgar score at 5 minute	7 (6–7)	7 (7–8)	8 (7–8)	8 (7–8)
Weight, g	1190 (1120–1260)	1630 (1460–1880)	2490 (2140–2690)	3430 (2800–3650)
Intraamniotic infection, n (%)	18 (100)	74 (100)	51 (100)	22 (100)
Respiratory distress syndrome of newborns, n (%)	18 (100)	68 (92)	45 (88)	5 (23)
Perinatal hypoxia, n (%)	10 (55)	40 (54)	22 (43)	17 (78)

All newborns underwent antibacterial therapy, medications were administered through a central venous catheter. Depending on the severity of respiratory insufficiency, noninvasive or invasive artificial lung ventilation (ventilator) was performed. The duration of noninvasive ventilation was 96 (2–600) hours, and invasive — 120 (24–720) hours. In the presence of arterial hypotension, a drug correction was carried out, the duration of which was 24 (0–240) hours. Upon admission to the NICU of the hospital, a clinical and laboratory examination was carried out, including clinical and biochemical blood analysis, analysis of the gas composition and acid-base state. To assess the severity of the condition and the invasiveness of intensive care measures, the NTISS scale (Neonatal Therapeutic Intervention Scoring System) was used, the severity of multiple organ dysfunction was assessed on the NEOMOD scale (Neonatal Multiple Organ Dysfunction).

All patients were discharged from the hospital with recovery, there were no deaths.

Statistical analysis

The null hypothesis of the absence of differences between several independent groups was tested using the Kraskel-Wallis rank analysis of variations, for dependent groups — using the Friedman criterion, the level of statistical significance for this criterion was taken to be $p < 0.05$. If, as a result of calculations, the null hypothesis was rejected, then the next step was a posteriori pairwise comparisons using the Mann-Whitney criterion for independent samples, the Wilcoxon criterion for dependent ones. To correct for multiple comparisons, the Bonferroni correction was applied and the critical significance level was changed to $p < 0.0085$. Spearman's coefficient was used for correlation analysis.

Results

It was found that the NEOMOD score was the highest in children of group I and amounted to 4 (3–5) points, which was statistically significant compared to the indicators of the second ($p = 0.001$) and third ($p < 0.001$) groups. There were no statistically significant differences with the indicator of group IV. In order to identify organ systems that have a significant impact on the integral assessment on the NEOMOD scale, a comparison of subscales was carried out depending on the gestation period. Statistically significant differences were obtained only for the subcale of the cardiovascular system. A posteriori comparisons showed that the score on the subscale of the cardiovascular system in patients of group III was statistically significantly lower compared to the indicators of group I — $p = 0.004$ (Table 2).

Table 2. Clinical and laboratory status on the first day of treatment in the NICU

Indicators	Groups			
	I (n = 18)	II (n = 74)	III (n = 51)	IV (n = 22)
NEOMOD score on admission, points	4 (3–5)	3[a] (2–4)	2[a] (1–4)	3 (1–4)
Assessment by cardiovascular dysfunction subscale	1 (1–1)	1 (0–1)	0[b] (0–1)	0 (0–1)
Hemoglobin, g/l	187 (166–205)	192 (129–242)	193 (134–243)	183 (145–243)
Red blood cells, $\times 10^{12}$/l	4.81 (3.91–6.12)	5.33 (3.47–7.7)	5.4 (3.74–7.7)	5.34 (3.91–6.9)
Leukocytes, $\times 10^{9}$/l	13.6 (6.7–41.4)	12.4 (5.8–33.1)	12.5 (6.4–32.5)	19.6[c] (8.5–43.7)
The ratio of immature neutrophils to the total number	0.06 (0.03–0.15)	0.04 (0.01–0.21)	0.05 (0.01–0.14)	0.08[d] (0.02–0.4)
Indicators of the gas composition and acid-base state of capillary blood				
pH	7.34 (7.18–7.43)	7.38 (7.19–7.53)	7.37 (7.24–7.59)	7.41[e] (7.31–7.6)

End of the table 2

Indicators	Groups			
	I (*n* = 18)	**II (*n* = 74)**	**III (*n* = 51)**	**IV (*n* = 22)**
Carbon dioxide voltage, mmHg.	34.9 (24.9–55.7)	29.8 (17.5–50.1)	32.2 (11.9–49.6)	31.6 (23.0–44.5)
Oxygen voltage, mmHg	42.8 (32.3–57.3)	46.6 (27.4–67.9)	45.9 (31.2–76.9)	51.4[f] (39.2–73.5)
Base deficiency, mmol/l	–7.2 (–16 … –4.8)	–5.4 (–11.8 … +16.1)	–5.1[g] (–9.6 … +1.5)	–4.2[h] (–9.3 … +5.2)
Metabolic indicators				
Glucose, mmol/l	4.7 (3.2–7.9)	4.2 (2.1–6.5)	4.3 (2.7–6.9)	4.4 (2–6.8)
Bilirubin, mmol/l	80.5 (27–212)	100.5 (36–295)	116 (46–284)	72.5 (20–310)[i]
Alanineaminotransferase, IU/L	8 (3–20)	8 (3–80)	12[j,k] (5–93)	22[l] (9–311)
Aspartateaminotransferase, IU/L	42 (19–94)	42 (8–115)	51 (21–145)	58[m] (32–235)
Natrium, mmol/l	138 (121–145)	138 (122–147)	136 (119–144)	135[n] (122–139)
C-reactive protein, mg/l	1.7 (1.3–2.2)	9.2[o] (6.2–12.6)	7.9[o] (5.75–17.5)	15.9[o] (9.6–22)
NTISS score, points	26.0[p] (24.0–28.0)	20.0 (18.0–24.0)	18.0[q] (16.0–20.0)	18.5 (16.0–21.0)

[a] The differences are statistically significant compared to the indicators of group I ($p < 0.001$).

[b] The differences are statistically significant compared to the indicators of group I ($p = 0.004$).

[c] The differences are statistically significant compared to the indicators of group II ($p = 0.001$) and group III ($p = 0.003$).

[d] The differences are statistically significant compared to the indicators of group II ($p < 0.001$) and group III ($p = 0.005$).

[e] The differences are statistically significant compared to the indicators of groups I ($p = 0.002$).

[f] The differences are statistically significant compared to the indicators of group I ($p < 0.001$) and group IV ($p = 0.005$).

[g] The differences are statistically significant compared to the indicators of group I ($p < 0.001$).

[h] The differences are statistically significant compared to the indicators of group I ($p < 0.001$).

[i] The differences are statistically significant compared to the indicators of group III ($p = 0.003$).

[j] The differences are statistically significant compared to the indicators of group I ($p < 0.001$).

[k] The differences are statistically significant compared to the indicators of group II ($p = 0.002$).

[l] The differences are statistically significant compared to the indicators of groups I–III ($p < 0.001$).

[m] The differences are statistically significant compared to the indicators of group I ($p = 0.005$).

[n] The differences are statistically significant compared to the indicators of group II ($p = 0.001$).

[o] The differences are statistically significant compared to the indicators of group I ($p < 0.001$).

[p] The differences are statistically significant compared to the indicators of group II ($p < 0.001$).

[q] The differences are statistically significant compared to the indicators of group II ($p < 0.004$).

It was found that the number of leukocytes in infants of group IV on the 1st day of treatment in the ICU was statistically significantly higher than in children of groups II and III. Statistically significant differences between groups I and IV were also characteristic of the neutrophil index. pH, pO_2, and BE values in group I children were statistically significantly lower than in group IV newborns. The concentration of aspartate aminotransferase was

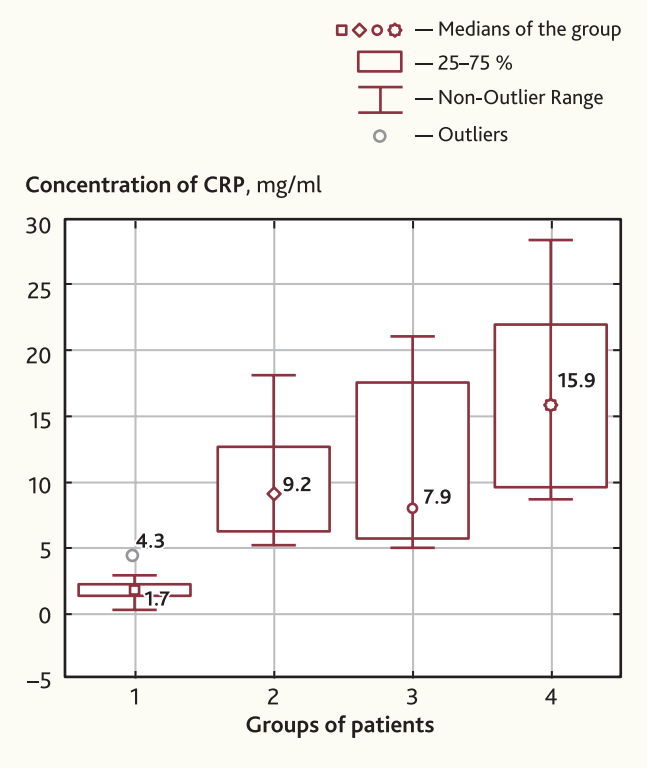

Fig. 1. The concentration of C-reactive protein depending on the gestation period

out to be comparable: AUC = 0.71; 95% confidence interval = 0.62–0.79; AUC = 0.7; 95% confidence interval = 0.61–0.79, respectively (Figure 3).

Discussion

In the first group of patients, upon admission to the NICU, there was a rather pronounced deficiency of bases, which statistically significantly higher in children with a gestation period of 38–40 weeks. A posteriori comparisons showed that the concentration of C-reactive protein in group I newborns was statistically significantly lower compared to the rest of the patients (Figure 1). The NTISS score, reflecting the invasiveness of intensive care measures, was maximum in group I children and amounted to 26 (24.0–28.0) points, which was statistically significant compared with the indicators of other groups ($p < 0.001$) (Table 3).

The revealed correlations between the indicators of clinical and laboratory status in newborns are presented in Table 4, however, most of them were very weak. The only correlation that deserves attention is the positive relationship between NEOMOD/NTISS scores in group IV children ($R = 0.62$; $p = 0.002$).

When assessing the immediate outcomes of critical conditions, it was found that group I newborns needed longer invasive ventilation and hemodynamic support, which was statistically significant.

With an increase in the gestation period, the duration of treatment in the ICU significantly decreased, while statistically significant differences were characteristic of groups I, II and IV (Table 4).

Using ROC analysis, it was found that the NEOMOD scale has a greater value for predicting the duration of artificial lung ventilation compared to the NTISS scale (Figure 2, Table 5).

When predicting the duration of treatment in the ICU, the value of the NEOMOD and NTISS scales turned was most likely due to both the morphofunctional immaturity of newborns and the course of the infectious and inflammatory process, which is confirmed by studies of other authors [17–19]. In addition, children of this group also had leukocytosis and an increase in the level of I/T in the group, which also indicates the development of an infectious process. Similar results were obtained by O.V. Ionov and co-authors, but currently there are no works confirming the sensitivity and specificity of these indicators [20].

Table 3. Correlations between indicators of clinical and laboratory status

Indicators	*R*	*p*
Leukocyte count / neutrophil index	0.398	0.001
Rating on the NEOMOD scale/pH	0.21	0.006
Rating on the NEOMOD scale / neutrophil index	0.15	0.04
Rating on the NEOMOD scale/ NTISS in group II children	0.25	0.03
Rating on the NEOMOD scale/ NTISS in children of group III	0.38	0.006
Rating on the NEOMOD scale/ NTISS in group IV children	0.62	0.002

R — Spearman's rank correlation coefficient.

Table 4. Outcomes of treatment of newborns in the NICU depending on the gestation period

Indicators	Groups			
	I (*n* = 18)	II (*n* = 74)	III (*n* = 51)	IV (*n* = 22)
Duration of the ventilator, hours	204 (168–324)	120[a] (96–144)	96[a] (72–144)	84[a] (48–120)
Duration of hemodynamic support, hours	168 (72–168)	24[b] (0–72)	0[b] (0–24)	0[b] (0–24)
Duration of antibacterial therapy, day	21.5 (14.0–29.0)	13.5[c] (11–17)	12[c] (10–14)	10[c,d] (8–14)
Duration of treatment in the ICU, day	21.5 (14.0–29.0)	13.5[e] (11–17)	12[e] (10–14)	10[e,f] (8–14)

[a] The differences are statistically significant compared to the indicators of group I ($p < 0.001$).

[b] The differences are statistically significant compared to the indicators of group I ($p < 0.001$).

[c] The differences are statistically significant compared to the indicators of group I ($p < 0.001$).

[d] The differences are statistically significant compared to the indicators of group II ($p = 0.004$).

[e] The differences are statistically significant compared to the indicators of group I ($p < 0.001$).

[f] The differences are statistically significant compared to the indicators of group II ($p = 0.004$).

Table 5. The prognostic value of the NEOMOD and NTISS scales for predicting the duration of ventilation

Indicators	NEOMOD	NTISS
Area under the ROC curve (AUC)	0.832 (0.766–0.886)	0.656 (0.578–0.728)
Root-mean-square error	0.0310	0.0440
95 % confidence interval	0.77–0.89	0.57–0.74
z-statistics	10.707	3.543
Significance level p	< 0.0001	0.0004
Yuden Index J	0.5429	0.2548
Cut-off point	> 3	> 23
Sensitivity	73.33	41.67
Specificity	80.95	83.81
Comparison of ROC curves		
Area difference	0.176 (0.085–0.267)	
Root-mean-square error	0.0464	
z-statistics	3.791	
Significance level	0.0002	

A premature newborn has imperfect immunity and is incapable of an adequate immune response, therefore, secondary immunodeficiency against the background of a critical condition is almost always associated with severe infection and sepsis, up to a fatal outcome [21].

A separate discussion deserves the fact that newborns with a gestation period of 26–29 weeks have a lower level of C-reactive protein compared to full-term children. In particular, K.Macallister et al. (2019) obtained similar results in newborns with negative blood culture, how-

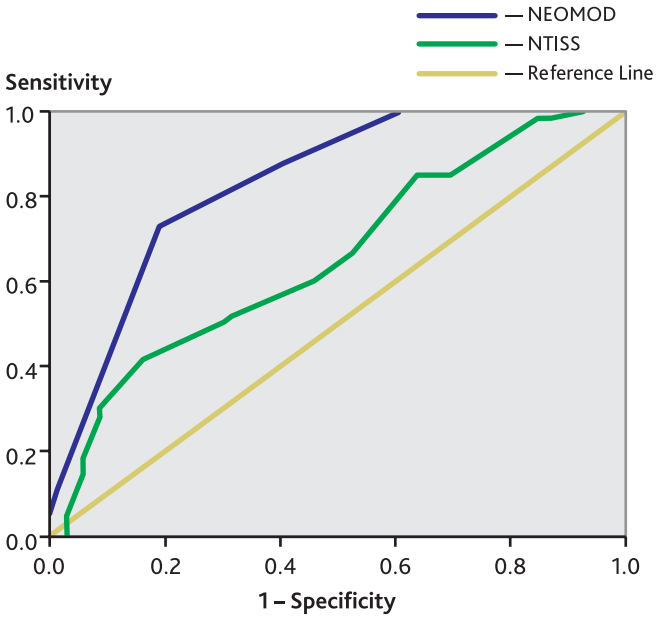

Fig. 2. Prognostic significance of the NEOMOD (Neonatal Multiple Organ Dysfunction) and NTISS (Neonatal Therapeutic Intervention Scoring System) scales for determining the duration of ventilation

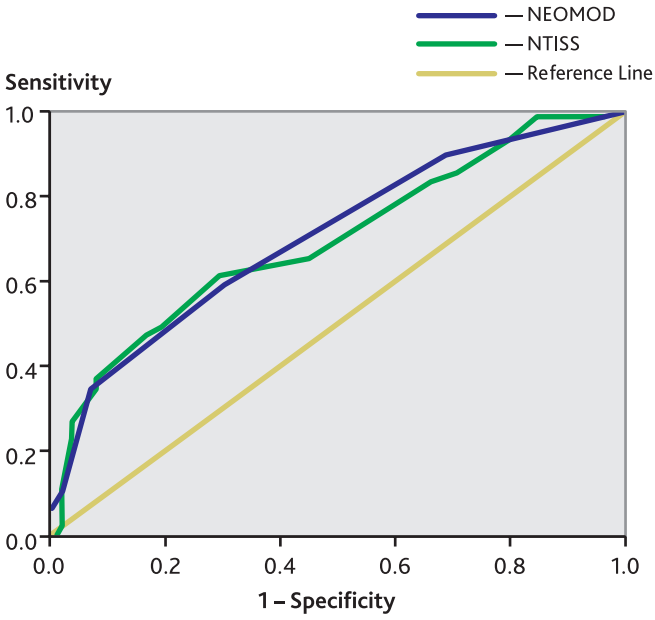

Fig. 3. Prognostic significance of the NEOMOD (Neonatal Multiple Organ Dysfunction) and NTISS (Neonatal Therapeutic Intervention Scoring System) scales for determining the duration of treatment in the NICU

ever, S.D. Shah et al. (2015) demonstrated that the level of CRP is comparable in newborns of different gestational ages, which indicates the absence of an unambiguous interpretation of this indicator [22, 23]. According to numerous data, CRP should be evaluated in combination with the clinical status of the newborn and other markers of the inflammatory process [24, 25]. Many authors believe that the level of C-reactive protein is not the only and absolute criterion for the presence of an infectious process and early neonatal sepsis, since it does not have sufficient specificity and sensitivity, although it is undoubtedly useful for diagnosing the infectious process in newborns in countries with limited resources, where there are no opportunities for blood culture and the study of other markers of inflammatory reaction [25, 26]. In addition, premature infants of group I had higher scores on the NEOMOD scale, which is comparable with the results of other authors [27, 28].

It is noteworthy that E.G. Furman et al. (2019) revealed a decrease in the number of red blood cells in newborns with a higher score on the NEOMOD scale, which, according to the authors, is associated with a decrease in the adaptive reserves of the body against the background of infection, although there were no such patterns in our study. Higher NEOMOD scores in premature infants with a gestation period of 26–29 weeks were associated with an increase in the duration of treatment in the NICU and hospital [28].

We believe that the pronounced differences in laboratory parameters of newborns with a gestation period of 26–29 and 38–40 weeks are due to many factors. The presence of leukocytosis and an increase in the neutrophil index in children of the first group indicates the presence of a response of the child's body aimed at neutralizing the causative agent of infection and preventing the generalization of the infectious process [8].

Lower rates of C-reactive protein at low gestational age are most likely due to the low content of adaptive immune response factors, in particular, immunoglobulin G, since it reaches the fetus from the mother starting only from the thirty-second week of gestation, which also reduces the ability of humoral immunity to resist pathogenic microorganisms [29, 30].

A decrease in the effectiveness of the immune response is also associated with apoptosis of immune system cells. In particular, neutrophil apoptosis, unlike other blood cells, occurs more slowly, so there are a large number of immature forms in the systemic bloodstream, which explains the high neutrophil index values obtained in this study [31].

It is noteworthy that the strongest direct statistically significant correlation in the estimates on the NEOMOD and NTISS scales was characteristic of children with a gestation period of 38–40 weeks, while in the first group it was absent altogether. Most likely, this is due to the fact that the NTISS scale was originally proposed for use in full-term newborns and has greater prognostic value in this group of patients, although according to E.N. Serebryakova and D.K. Volosnikov, both scales can be used in children with any gestation period and body weight [32].

At the same time, a number of authors note that the prognostic value of the NEOMOD scale in newborns with ex-

tremely low and very low body weight is more significant [33–35]. This is confirmed by the data of our study. It was found that the NEOMOD scale has greater significance in predicting the duration of ventilation in newborns in critical condition, although the value of the NEOMOD and NTISS scales was comparable when assessing the likelihood of long-term treatment in the ICU. It can be assumed that the use of the NEOMOD scale contributes to a more objective assessment of the severity of the newborn baby's condition, the effectiveness of therapy methods and further outcome.

The undoubted prognostic value and wide availability of the NEOMOD scale, as well as laboratory markers presented in the study, indicate the possibility of their use in routine clinical practice for early diagnosis of infectious diseases of the neonatal period. At the same time, it should be noted that it is necessary to conduct further multicenter studies in order to assess the sensitivity, specificity and search for threshold values of the considered markers that clearly indicate the presence or absence of infection in a newborn in critical condition.

Conclusion

The most pronounced multiple organ dysfunction was observed in newborns with a gestation period of 26–29 and 38–40 weeks, which is confirmed by high scores on the NEOMOD scale, an increase in the number of leukocytes and neutrophil index indicators.

The NEOMOD scale has a greater prognostic value for assessing the likelihood of prolonged artificial lung ventilation in newborns in critical condition.

Verification of the infectious process in premature newborns with a gestation period of 26–29 weeks only on an isolated assessment of the concentration of C-reactive protein in blood plasma without taking into account other indicators of clinical and laboratory examination is not justified.

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Author contribution. All authors according to the ICMJE criteria participated in the development of the concept of the article, obtaining and analyzing factual data, writing and editing the text of the article, checking and approving the text of the article.

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