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Comparative Assessment of the Critical Condition of Newborns with Congenital Anomalies on the Basis of Different Scales

Narmin Akif Azizova[1], Ismayil Adil Gafarov[2], Naila Jalil Rahimova[3], Omer Erdeve [4]

[1]Department of Pediatics, Azerbaijan Medical University, Scientific Research Institute of Pediatrics named after K. Farajova, Baku, Azerbaijan
[2]Head of Department of Medical and Biological Physics of Azerbaijan Medical University, Baku, Azerbaijan
[3]Scientific Research Institute of Pediatrics named after K. Farajova, Baku, Azerbaijan
[4]Department of Pediatrics, Ankara University Faculty of Medicine, NICU, Ankara, Türkiye

What is already known on this topic?

- *Various scoring systems, such as SNAPPE II, CRIB, NTISS, and MINT, have been developed to assess the severity of critically ill neonates in the NICU and predict outcomes, including mortality, length of stay, and complications. These prognostic tools typically focus on general neonatal conditions, but they often exclude congenital anomalies from their assessment criteria. Despite being a major cause of NICU admissions and neonatal mortality, congenital anomalies are not adequately reflected in existing scoring systems, which fail to fully account for their severity, systemic impact, or surgical requirements.*

ABSTRACT

Objective: Various assessment scales have been developed to evaluate the severity of critical conditions in patients admitted to neonatal intensive care units (NICUs), predicting the length of stay, likelihood of complications, and death. Congenital anomalies, though a significant portion of NICU admissions, are often excluded from such studies. The aim of our study was to compare the informativeness of different scoring systems in the assessment of critical patients with congenital anomalies treated in the NICU, as well as their applicability in predicting complications and fatal outcomes.

Materials and Methods: Between 2019 and 2022, we evaluated the severity of the critical condition of 921 newborns diagnosed with congenital anomalies at the Scientific Research Pediatric Institute named after K. Farajova using the National therapeutic intervention evaluation system (NTISS), scores for neonatal acute physiology (SNAPPE II), clinical risk index for babies (CRIB), and the mortality index for neonatal transportation score (MINT) scales.

Results: Of the 921 neonates with congenital anomalies admitted to the NICU in critical condition, 271 (29.4%) were preterm (≤37 weeks) and 650 (70.6%) were term. In 921 patients diagnosed with congenital anomalies, the mean NTISS score according to the scales was 18.6; SNAPPE II 14.2; CRIB 4.6; MINT 6.9. In these patients, when the mean score of preterm and term births was compared according to gestational week, the SNAPPE II and MINT points were statistically significantly higher in preterm babies than terms. In the comparative analysis between the patients of the surviving and lethal groups, it was found that all the scales (SNAPPE II, NTISS, CRIB, MINT) were statistically significant.

Conclusion: National therapeutic intervention evaluation system, SNAPPE II, CRIB, and MINT scales are useful in predicting mortality in newborns with congenital anomalies. However, these scales do not account for the severity of the congenital anomalies, system damage relationships, complication effects, or treatment needs (need for surgical intervention). Tailored scale usage corresponding to medical service levels in different countries would improve affordability and predictability.

Keywords: Congenital anomalies, critical condition, scales, scores

Corresponding author:
Narmin Akif Azizova
✉ dr.narmin.azizova@gmail.com
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INTRODUCTION

Congenital anomaly is a primary defect resulting from structural or functional disorders occurring during intrauterine development in any body system, an organ, or part of it during embryogenesis or morphogenesis. Congenital anomalies are seen in 3%–6% of newborns. It is reported that 15.5% of the causes of death in the neonatal intensive care unit (NICU) are due to congenital anomalies.[1] In particular, major congenital anomalies, metabolic and genetic

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What this study adds on this topic?

- *This study offers a comparative evaluation of four commonly used scoring systems (SNAPPE II, CRIB, NTISS, and MINT) in critically ill neonates with congenital anomalies. The findings reveal that while these tools are useful for mortality prediction, they do not comprehensively capture the complexity of congenital anomalies, including their severity and need for surgical intervention. The study underscores the need for tailored assessment tools that incorporate anomaly-specific factors, thereby enhancing prognostic accuracy and supporting clinical decision-making in the NICU.*

diseases are included in the high-risk category (levels 3-4) group of the NICU.[2] Congenital anomalies may in many cases be the primary cause of a newborn being in critical condition from the prenatal period.

Different evaluation (scale) systems have been designed to evaluate the severity of critical condition of newborns treated in NICUs, to predict the course of the disease, the duration of stay in the intensive care unit (ICU), and the likelihood of complications.

In the first scoring systems, birth weight, gestational age, and Apgar scale were mentioned as the main parameters used to predict the course of disease and death. Multiple complex parameters over the decades: Clinical risk index for babies (CRIB), CRIB II, Berlin scale, neonatal mortality prognostic index, neonatal critical illness score, national therapeutic intervention evaluation system (NTISS), scale of neonatal acute physiology (SNAP), SNAP-II, scores for neonatal acute physiology (SNAPPE), SNAPPE-II, the mortality index for neonatal transportation score (MINT), etc. scales with perinatal extension were developed and applied.[3]

Although the large number of clinical and laboratory parameters increases the value of the scale, they are difficult to complete and require more cost, time and skill. Also, scales should be generally functional. So, many of the laboratory analyzes cannot be applied in all countries.[4] This situation makes it difficult to use the prepared scales.

Although congenital anomalies are common among NICU admissions, they have been specified as an exclusion criterion in many prognostic scale systems used so far. In the literature we have obtained, the presence of anomalies is mentioned as one of the indicators for evaluating the prognosis in critically ill newborns only in the CRIB II, MINT scale systems. However, these scales do not take into account the severity of the anomaly, which system it covers, the degree to which it affects vital functions, and whether it requires surgical operation.

Therefore, the prognostic information value of the 4 most widely used assessment systems for seriously ill newborns and children under 1 year of age with a diagnosis of congenital anomalies was studied. The aim of our study was to compare the informativeness of different scoring systems in the assessment of critical patients with congenital anomalies treated in the NICU, as well as their applicability in predicting complications and fatal outcomes.

MATERIALS AND METHODS

Patients

Our research is a methodological study designed to investigate the reliability and validity of scales used to assess the severity of critically ill newborn patients diagnosed with congenital anomalies. This study included newborns diagnosed with congenital anomalies in the ICU of the Scientific Research Pediatric Institute named after K. Farajova during 2019-2022. In the first 28 days of life, 921 babies with a diagnosis of congenital anomaly were admitted to the NICU: 569 (61.8%) boys, 352 (38.2%) girls. In the study, anomalies that could be eliminated due to development (e.g., PDA (ICD-10: Q20) in premature babies who did not have congenital anomalies, whose intensive care stay was less than 24 hours, whose condition was not critical, who were older than 28 days, were accepted as exclusion criteria and were not included to the study.

Of the 921 newborns with congenital anomalies admitted to the NICU in critical condition, 271 (29.4%) were born preterm (≤37 weeks) and 650 (70.6%) were born on time. The mean birth weight was 2849.2 ± 22.5. The gestational week was 36.9 ± 0.1. Mean age at diagnosis collected 4.2 ± 0.2 (min:1-max:28).

In the article, the evaluation of the most common and critical congenital anomalies according to the systems: cardiovascular system, gastrointestinal system and nervous system anomalies are presented according to SNAPPE II, NTISS, CRIB, and MINT scales.

Anomalies of the cardiovascular system were found in 412 (44.7%) patients: ASD—233, VSD—200, transposition of the great vessels—22, hypoplastic aortic arch—16, coarctation of the aorta—16, aortic stenosis—7, pulmonary stenosis—42, tetralogy of fallot—27, single ventricle heart defects—9, epstein's anomaly—5, atrioventricular septum defect—14, and Taussig Bing—6 (a higher total number is due to the possibility of several anomalies in 1 patient).

Anomalies of the gastrointestinal system were found in 397 (43.1%) patients: anal atresia—110, rectal atresia—30, esophageal atresia—99, Hirschsprung's disease—31, intestinal atresia—107, Ladd's syndrome—22, Meckel's diverticulum—2, biliary atresia—2, and diaphragmatic hernia—44 (a higher total number is due to the possibility of several anomalies in 1 patient).

Anomalies of the nervous system were found in 104 (11.3 %) patients: hydrocephalus—48, agenesis of the corpus callosum—37, spina bifida—13, meningomyelocele—14, and Dandy–Walker syndrome—12.

Applied Examinations

Newborns were first stabilized in the ICU and evaluated in the first 24 hours according to SNAPPE II, CRIB, MINT scales. In our study, we evaluated the critical status of the NTISS scale in the first 24 hours, 7, 14, and 21-30 days after admission to intensive care. The final score was calculated as the arithmetic sum of the points given for each item. The research type is a comparative analysis of clinical and laboratory indicators according to the score systems obtained as a result of the patient's examination.

To measure the parameters for compiling data of the scale included in our study, the patients' gestational age, birth weight, Apgar score, time of admission to the ICU, temperature, mean arterial pressure, blood gas composition, respiratory support parameters (intubation, FiO_2), drug therapy parameters, nutrition, seizures, diuresis, procedures performed on the patient (major surgery, thoracentesis, pericardiocentesis), monitoring parameters, transfusions, and drug therapy (diuretics, steroids, anticonvulsants, treatment of metabolic acidosis, surfactant, cardiovascular drugs) were taken into account.

To measure the parameters for compiling data of the SNAPPE II scale birth weight, Apgar score, temperature, mean artherial pressure, blood gas composition, FiO_2, multiple seizures, urine output, and small for gestational age procedures performed on the patient were taken into account.

To compile the data of the CRIB II scale, the parameters such as birth weight, gestational week, maximum base excess in the first 12 hours (mmol/L), minimum appropriate FiO2 in the first 12 hours, maximum appropriate FiO2 in the first 12 hours, presence or absence of congenital malformation and, if present, whether it was life-threatening were taken into consideration.

To measure the parameters for compiling data of the NTISS scale respiratory: supplemental oxygen, Continuous Positive Airway Pressure, mechanical ventilation with muscle relaxation, high-frequency ventilation, surfactant administration, endotracheal intubation, tracheostomy care, tracheostomy placement, extracorporeal membrane oxygenation; Drug therapy: antibiotic administration (≤2 agents), antibiotic administration (>2 agents), diuretic administration (enteral), diuretic administration (parenteral), anticonvulsant therapy, aminophylline administration, other unscheduled medication, steroid administration (postnatal), potassium binding resin administration, treatment of metabolic acidosis; Metabolic/nutrition: gavage feeding, phototherapy, intravenous fat emulsion, intravenous amino acid solution, insulin administration, potassium infusion; Procedural: transport of patient, dialysis, single chest tube in place, multiple chest tubes in place, thoracentesis, pericardial tube in place, pericardiocentesis, minor operation, major operation; Cardiovascular: indomethacin administration, volume expansion (≤15 mL/kg), volume expansion (>15 mL/kg), vasopressor administration (1 agent), vasopressor administration (>1 agent), cardiopulmonary resuscitation, pacemaker on standby, pacemaker used; Monitoring: frequent vital signs, phlebotomy (5-10 blood draws), extensive phlebotomy (>10 blood draws), cardiorespiratory monitoring, thermoregulated environment, noninvasive oxygen monitoring, arterial pressure monitoring, central venous pressure monitoring, urinary catheter, quantitative intake and output; Transfusion: intravenous gamma globulin, double volume exchange transfusion, partial volume exchange transfusion, red blood cell transfusion (≤15 mL/kg), red blood cell transfusion (>15 mL/kg), platelet transfusion, white blood cell transfusion; Vascular access: peripheral intravenous line, arterial line, central venous line procedures performed on the patient were taken into account.

In order to evaluate the MINT scale in the patient, the parameters used in compiling the data such as birth weight, Apgar score, blood gas composition, time of admission to the ICU, body temperature, whether the patient was intubated, and whether the patient had a congenital anomaly were taken into consideration.

Statistical Analysis

To describe the categorical quality indicators derived from the research, frequencies and their corresponding percentages (%) within the group were presented. Discriminant analysis (Chi-square test, Pearson's χ^2 test) was employed to compare these indicators. For the analysis of quantitative variables, the normality of the distribution was assessed using the Shapiro–Wilk test. Descriptive statistics, including mean (M), standard deviation (SD), 95% CI, as well as the minimum and maximum values, are provided in the tables. Between-group comparisons were performed using analysis of variance (ANOVA, *F*-test). Given the discrete nature of the data, it was also summarized using median (Me), interquartile range (IQR, Q1-Q3), and average structural indicators. Intergroup comparisons were conducted using the Mann–Whitney *U* test, while intragroup comparisons were reassessed using the Wilcoxon test. Receiver operating characteristic (ROC) analysis was carried out to determine the sensitivity (Sn) and specificity (Sp) of the variables under study. The cutoff point (COP) was defined as the value that maximized the sum of Sn and Sp. All calculations were performed using MS Excel 2019 and IBM SPSS Statistics version 26. A *P*-value of <.05 was considered statistically significant, and the "0" hypothesis (H_0) was rejected.[5]

Ethical Considerations

The principles of the Declaration of Helsinki were considered at all stages of the study. In order to carry out the research, permission was obtained from the Ethics Committee of Azerbaijan Medical University to take additional blood analysis from patients diagnosed with congenital heart defects (approval number: 2024/35, date: October 18, 2024). Written and verbal consent was obtained from the parents of the patients participating in the study.

RESULTS

Overview of Study Selection Process

Seven hundred fourteen (77.5%) of the patients had a single anomaly, and 188 (20.4%) had multiple anomalies. Because 19 patients had functional anomalies, we recorded them separately. One hundred sixty-five (17.9%) had bilateral, 22+1 (2.4%) triple, and 1 quadruple system damage. Five hundred thirty (57.5%) of the patients were born surgically and 391 (42.5%) were born physiologically.

According to the classification of anomalies, 891 (96.7%) structural forms, 19 (2.1%) functional forms and 11 (1.2%) structural+functional forms were detected in the patients. Surgical intervention was performed in 424 (46%) patients. Fatal outcome was observed in 61 (22.5%) of patients born before ≤37 weeks and in 78 (12%) of patients born after >37 weeks.

Based on the scale evaluation of 921 patients admitted to the ICU in the first 28 days of life and diagnosed with critical congenital anomalies, the mean score NTISS was 18.6 ± 2.7; SNAPPE II 14.2 ± 12.9; CRIB 4.6 ± 2.4; MINT was noted to be 6.9 ± 3.2. Also, in our study, we evaluated and compared the NTISS scale on days 7, 10-14, 21-30 according to the duration of the patient's stay in the ICU (Table 1).

Baseline Data

In addition, a comparative analysis of the mean score values of critical conditions of newborns according to gestational week including premature and term babies was performed. In our study, the mean score of premature (≤37 weeks) and term patients (>37 weeks), surviving and lethal groups patients diagnosed with congenital anomalies was evaluated based on the scales, and statistically compared between these groups was analyzed (Table 2).

As can be seen from the table, in premature babies (271), NTISS value was Me = 19.0 (IQR Q1-Q3: 17.0-21.0); SNAPPE 18.0 (IQR: 5.0-27.0); CRIB 4.0 (IQR: 3.0-7.0); MINT 5.0 (IQR: 5.0-11.0) score was recorded. In term infants (650), NTISS value Me = 18.0 (IQR: 17.0-21.0); SNAPPE 9.0 (IQR: 5.0-18.0); CRIB 4.0 (IQR: 3.0-6.0); MINT 5.0 (IQR: 5.0-9.0) were observed.

Also, in our study, we conducted a comparison of mean scores according to grading systems between surviving and lethal groups in preterm and term patients (Table 3, 4).

As can be seen from the table, the surviving group of premature babies (271) had NTISS 18.0 (IQR: 17.0-19.0); SNAPPE 16.0 (IQR: 5.0-23.0); CRIB 4.0 (IQR 3.0-6.0); MINT 5.0 (IQR 5.0-8.0) and the lethal group NTISS 22.0 (IQR: 20.0-23.0); SNAPPE 27.0 (IQR: 18.0-37.0); CRIB 7.0 (IQR: 5.0-8.0) and MINT 11.0 (IQR: 7.0-11.0) scores had recorded (Table 3).

As can be seen from the table, the surviving group of term babies (650) had NTISS 18.0 (IQR: 17.0-20.0); SNAPPE 9.0 (IQR: 3.5-18.0); CRIB 4.0 (IQR 3.0-5.0); MINT 5.0 (IQR 5.0-7.0) and the lethal group NTISS 21.0 (IQR: 19.0-23.0); SNAPPE 18.0 (IQR: 7.0-32.0); CRIB 7.0 (IQR: 5.0-8.0) and MINT 11.0 (IQR: 5.0-11.0) scores had recorded (Table 4).

Intergroup Comparison Results—Cluster Analysis Between Survived and Mortality Groups

Comparison between survived and mortality groups according to score ranges was noted (Table 5).

A comparative analysis between the groups of 782 surviving and 139 lethal patients of the total patients diagnosed with

Table 1. Evaluation of Newborns Diagnosed with Congenital Anomalies According to NTISS Scales

	n	Mean	SD	Standard Error	95% CI for Mean		Minimum	Maximum	Dynamics by Days			P_W
					Lower Bound	Upper Bound			Negative Ranks	Positive Ranks	Ties	
NTISS	921	18.6	2.7	0.1	18.4	18.8	7	25				
NTISS 7 days	425	17.7	2.2	0.1	17.5	18.0	8	25	339	75	11	<.001*
NTISS 10-14 days	295	16.9	2.6	0.2	16.6	17.2	5	24	238	46	11	<.001*
NTISS 21-30 days	113	16.9	3.2	0.3	16.3	17.5	8	25	84	22	7	<.001*

** The null hypothesis(H0) was rejected.* P_W—statistical significance of difference compared to baseline (W—Wilcoxon test).

Table 2. Evaluation of Newborns Diagnosed with Congenital Anomalies Using Scales According to Gestational Week

		n	Mean	SD	Standard Error	95% CI for Mean Lower Bound		Minimum	Maximum	P_U
NTISS	Preterm	271	18.9	2.6	0.2	18.6	19.2	12	25	.081
	Term	650	18.5	2.7	0.1	18.3	18.7	7	25	
SNAPPE II	Preterm	271	17.9	13.7	0.8	16.3	19.6	0	59	<.001*
	Term	650	12.6	12.2	0.5	11.7	13.6	0	77	
CRIB	Preterm	271	4.9	2.5	0.2	4.6	5.2	1	15	.009*
	Term	650	4.5	2.4	0.1	4.3	4.7	1	22	
MINT	Preterm	271	7.5	3.3	0.2	7.1	7.9	0	20	<.001*
	Term	650	6.7	3.1	0.1	6.4	6.9	0	22	

Statistical completeness of the difference in comparison between indicators of groups (P_U—by Mann–Whitney *U* test). *-The null hypothesis (H_0) was rejected.

Table 3. Comparison of Mean Scores According to Scoring Systems Between Surviving and Lethal Groups in Preterm Patients

		n	Mean	SD	Standard Error	95% CI for Mean Lower Bound		Minimum	Maximum	P_U
NTISS	Survived	210	18.2	2.3	0.2	17.9	18.5	12	24	<.001*
	Lethal	61	21.3	2.2	0.3	20.7	21.8	14	25	
SNAPPE II	Survived	210	15.7	12.2	0.8	14.1	17.4	0	57	<.001*
	Lethal	61	25.5	15.8	2.0	21.5	29.6	0	59	
CRIB	Survived	210	4.3	2.3	0.2	4.0	4.6	1	15	<.001*
	Lethal	61	7.0	2.0	0.3	6.5	7.5	3	12	
MINT	Survived	210	6.8	3.0	0.2	6.4	7.2	0	17	<.001*
	Lethal	61	10.0	3.3	0.4	9.1	10.8	5	20	

*-The null hypothesis (H_0) was rejected.

Table 4. Comparison of Mean Scores According to Scoring Systems Between Surviving and Lethal Groups in Term Patients

		n	Mean	SD	Standard Error	95% CI for Mean Lower Bound		Minimum	Maximum	P_U
NTISS	Survived	572	18.2	2.5	0.1	18.0	18.4	9	25	<.001*
	Lethal	78	20.5	2.9	0.3	19.8	21.2	7	25	
SNAPPE II	Survived	572	11.5	11.1	0.5	10.6	12.4	0	77	<.001*
	Lethal	78	20.7	16.3	1.8	17.0	24.4	0	62	
CRIB	Survived	572	4.2	2.2	0.1	4.0	4.4	1	22	<.001*
	Lethal	78	6.7	2.6	0.3	6.1	7.2	1	12	
MINT	Survived	572	6.3	2.8	0.1	6.1	6.5	0	15	<.001*
	Lethal	78	9.3	3.5	0.4	8.6	10.1	3	22	

Statistical completeness of the difference in comparison between indicators of groups (P_U—by Mann–Whitney *U* test). *-The null hypothesis (H_0) was rejected.

congenital anomalies was evaluated on the basis of scales (Figure 1).

According to the result of ROC analysis:

For NTISS scale: COP—19.5 points, Sp—72.5 ± 1.6%; Sn—72.7 ± 3.8%; general diagnostic value (GDV)—72.5 ± 1.5%. Predictive positive value (pPV)—32.0 ± 2.6%; predictive negative value (nPV)—93.7 ± 1.0%; odds ratio (OR) = 7.0; 95% CI: 4.7-10.5; P < .05. Error Influence Factor (EIF) 13.1 (p_{FS} < 0.001).

For the SNAPPE II scale: COP—16.5 points, Sp—65.5 ± 1.7%; Sn—65.5 ± 4.0%; GDV—65.5 ± 1.6%. pPV—25.2 ± 2.3%; nPV—91.4 ± 1.2%; OR = 3.6; 95% CI: 2.5-5.3; P < .05. EIF 5.4 (p_{FS} < 0.001).

Table 5. Comparison of Scores of Congenital Anomalies Survived and Mortality Groups

Scores	Points	Survived Group n = 782 Count	Survived Group n = 782 Column n %	Mortality Group n = 139 Count	Mortality Group n = 139 Column n %	$P\chi^2$
NTISS	≤14	49	6.3	3	2.2	.053
	>14	733	93.7	136	97.8	
SNAPPE II grad	≤38	756	96.7	114	82.0	<.001*
	>38	26	3.3	25	18.0	
CRIB grad	≤10	774	99.0	132	95.0	.001*
	>10	8	1.0	7	5.0	
MINT grad	≤10	626	80.1	48	34.5	<.001*
	>10	156	19.9	91	65.5	

The statistical integrity of the difference between the indicators of the groups (by $P\chi^2$–χ^2-Pearson test). *- The null hypothesis (H_0) was rejected.

For CRIB scale: COP—4.5 points, Sp—76.9 ± 1.5%; Sn—69.1 ± 3.9%; GDV—75.7 ± 1.4%. pPV—34.7 ± 2.9%; nPV—93.3 ± 1.0%; OR = 7.4; 95% CI: 5.0-11.0; P < .05. EIF 14.7 (p_{FS} < 0.001).

For the MINT scale: COP—8.5 points, Sp—80.1 ± 1.4%; Sn—66.2 ± 4.0%, GDV—78.0 ± 1.4%. pPV—37.1 ± 3.1; nPV—93.0 ± 1.0%; OR = 7.9; 95% CI: 5.3-11.6; P < .05. EIF 16.2 (p_{FS} < 0.001).

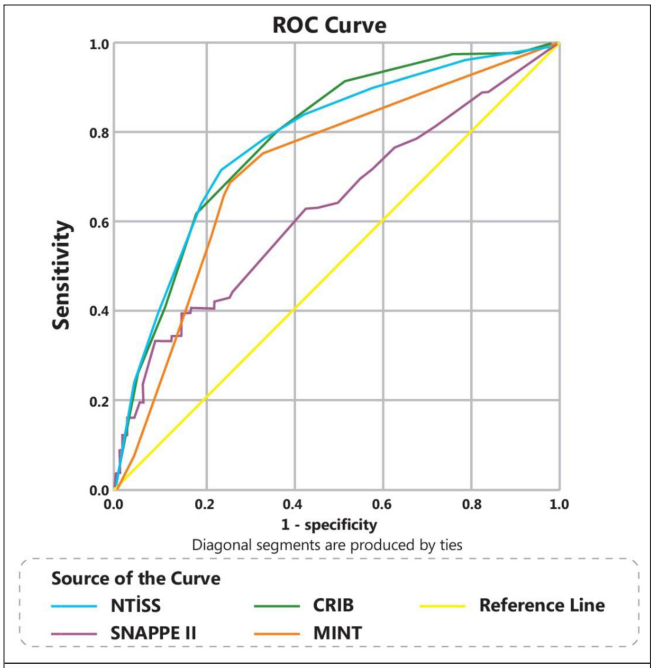

Figure 1. Comparison of scores according to grading systems between surviving and lethal groups with congenital anomalies.

Table 6. Comparison of Values According to Scales in Premature and Term Patients with According to the System Damaged by the Congenital Anomaly

Scores	Gest. Week	Congenital Cardiovascular Anomalies			Congenital Gastrointestinal Anomalies			Congenital Nervous System Anomalies		
		Patient No.	Mean ± SD	P_U	Patient No.	Mean ± SD	P_U	Patient No.	Mean ± SD	P_U
NTISS	Preterm	125	18.9 ± 2.6	.322	115	20.2 ± 2.6	.007*	45	18.2 ± 2.4	.706
	Term	287	18.5 ± 2.7		282	19.4 ± 2.5		59	17.9 ± 2.5	
SNAPPE II	Preterm	125	19.6 ± 13.8	<.001*	115	18.3 ± 14.2	<.001*	45	20.2 ± 13.4	.169
	Term	287	14.4 ± 12.8		282	11.8 ± 11.7		59	16.9 ± 13.6	
CRIB	Preterm	125	5.0 ± 2.6	.112	115	5.7 ± 2.3	.012*	45	4.6 ± 2.5	.703
	Term	287	4.6 ± 2.7		282	5.1 ± 2.4		59	4.3 ± 2.0	
MINT	Preterm	125	7.7 ± 3.3	.024*	115	8.3 ± 3.6	.039*	45	7.1 ± 3.0	<.001*
	Term	287	7.0 ± 3.3		282	7.5 ± 3.2		59	5.1 ± 2.0	

The statistical integrity of the difference in comparison between the indicators of the groups (P_U—with the Mann–Whitney *U* test). *-The null hypothesis (H_0) was rejected.

Outcomes—A Comparative Result According to the System of the Most Common Congenital Anomalies

Statistical significance was examined by determining the mean score based on system damage in patients diagnosed with cardiovascular congenital anomalies born prematurely and at term. Cardiovascular system anomaly 412 (single—254, multiple—158), gastrointestinal system anomaly 397 (single—294, multiple—103) and nervous system anomaly 104 (single—63, multiple—41) were observed.

Statistical significance was examined by determining the mean score between premature and on-term of patients with cardiovascular system, gastrointestinal system anomalies and nervous system anomalies (Table 6).

In our study, the critical condition of the newborns in the survived and lethal group was evaluated by ROC analysis according to the systems affected by the most common congenital anomalies (Figure 2).

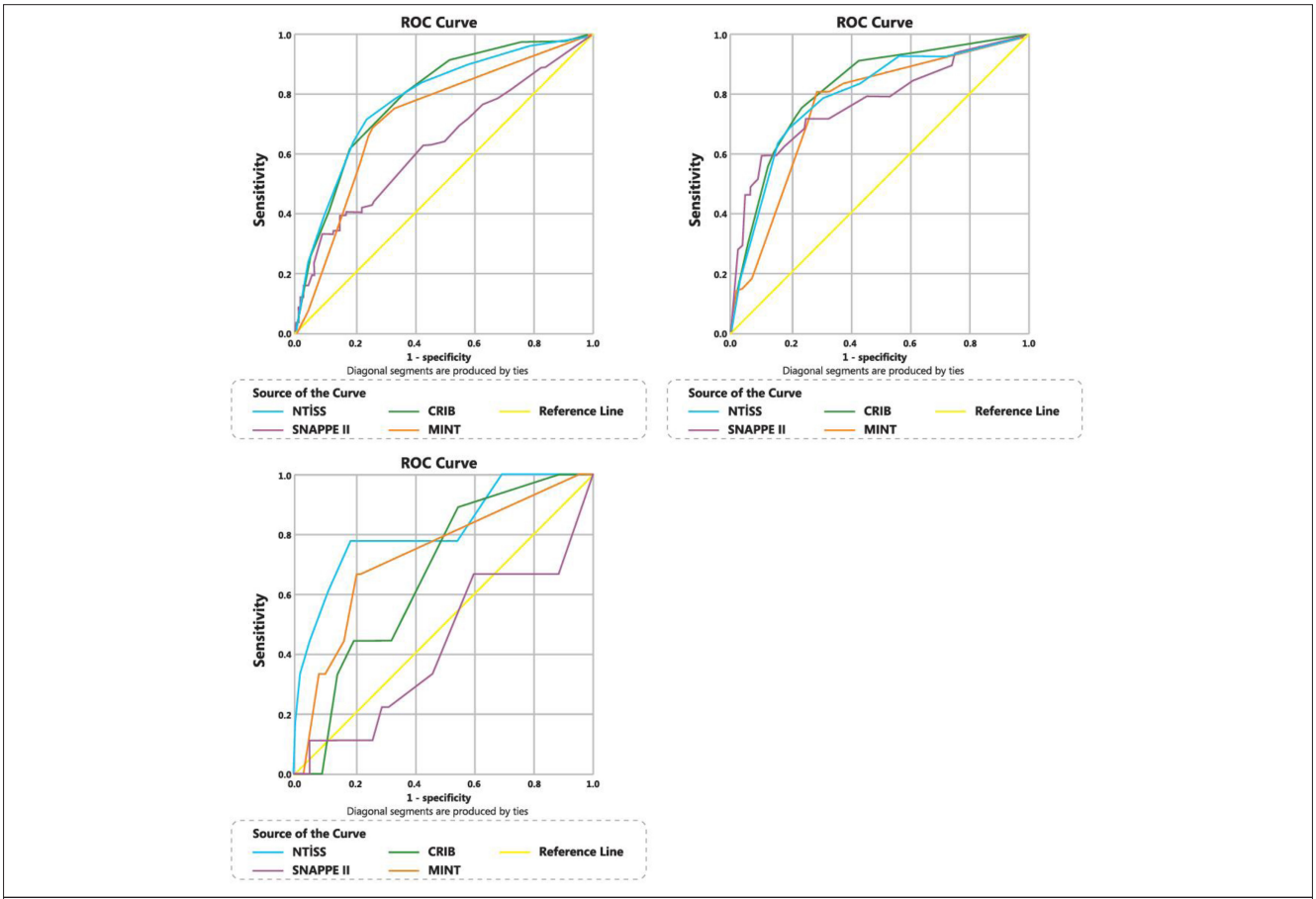

Figure 2. Assessment of critical condition congenital anomalies of newborn between surviving and dead groups by systems ROC analysis.

The results of the ROC analysis between 331 surviving patients and 81 deceased patients with cardiovascular anomalies indicated a statistically significant difference for all scales (P < .001). The area under the curve (AUC) values were noted as follows: NTISS—0.784 ± 0.029, SNAPPE—0.634 ± 0.037, CRIB—0.788 ± 0.027, and MINT—0.724 ± 0.031 (Figure 2A).

The results of ROC analysis according to scales between surviving (330) and deceased (67) patients with gastrointestinal system abnormalities were calculated P < .001 for all scales, also AUC for NTISS 0.790 ± 0.032; SNAPPE 0.769 ± 0.036; CRIB 0.817 ± 0.027; MINT 0.758 ± 0.031 was noted (Figure 2B).

According to the results, the integral value of Sn and Sp in patients diagnosed with cardiovascular system and gastrointestinal anomalies in the comparative analysis of the lethal survived group according to the systems damaged by congenital anomalies was found to be P < .001.

The results of ROC analysis according to the scales between 95 surviving and 9 deceased patients with nervous system anomalies NTISS P = .002; SNAPPE II P = .481; CRIB P = .101; MINT P = .025, also AUC for NTISS 0.816 ± 0.083; SNAPPE 0.429 ± 0.105; CRIB 0.666 ± 0.077; MINT 0.727 ± 0.091 was noted (Figure 2C).

DISCUSSION

The main purpose of creating the scales is to predict the degree of severity, risk of complications, and mortality of patients admitted to the NICU in critical condition and to help to choose adequate treatment measures accordingly. For this reason, various assessment scales have been developed based on obstetric, physiological, clinical, and some laboratory test data obtained during the patient's first examination. Although major congenital anomalies in newborns are always considered a high-risk group, data on their role among the causes of critical condition are limited. Many studies examining critically ill children according to scoring systems have used congenital anomalies as an exclusion criterion, which results in not all neonates treated in the ICU being included in the study.[7]

In one of the studies, a comparative analysis of the CRIB II and SNAPPE II scales was performed to predict mortality in infants with a gestational age of ≤32 weeks and it was shown that CRIB II was more informative than SNAPPE II.[8]

In the study conducted by Muktan et al,[7] the SNAPPE II scale was used to evaluate the risk of neonatal death in the NICU. Of the 255 newborns included in the study, 92 (36.1%) were premature, 163 (63.9%) were term, 45 (17.6%) died, and 210 survived. When SNAPPE II was evaluated, mortality was 36.7% in those with 40-60 points, 55.1% in those with ≥40 points, and 100% in those with ≥60 points. The Me (IQR) SNAPPE II score was significantly higher in infants who died, with a Me score of 57 compared with a Me score of 22 in survivors (P < .001).

It seems more appropriate to use the 38 score of the SNAPEE II scale used in mortality prediction as the COP. In the evaluation of total mortality, the Sn of ≥38 points is 84.4%, the Sp is 91%, the pPV is 66.7%, and the nPV is 96.5%. However, in this study, there is no information about the diagnosis of congenital anomalies of the patients and the effect of this pathology on the prediction of the scale.[7]

In our study, the SNAPPE II scale was statistically significant (P < .001) in 921 preterm and term patients diagnosed with congenital anomalies admitted in critical condition in the first 28 days of life. The area of the ROC curve was P < .001 in the comparative analysis of the surviving patients who died of cardiovascular system and gastrointestinal anomalies, and P = .481 in the ROC analysis of the SNAPPE II scale among the survived and died group with nervous system anomalies.

In the NTISS scale, information about babies is collected under categories such as respiratory, drug therapy, metabolic/nutrition, procedure, cardiovascular, follow-up, transfusion, and vascular intervention. The NTISS scale is used to assess the severity of a newborn's illness. This scale is not based on pathophysiological values as in the SNAP, SNAPPE-II, and CRIB-II scales, but is based on the patient's current condition and treatments and interventions such as respiratory, cardiovascular, medication, vascular access, nutrition, metabolic, and monitoring.[9]

In a pilot study conducted at a University Hospital in Brazil, 129 infants admitted to the NICU during a 6-week prospective period were assessed daily up to 31 days using the NTISS scale. In this study, patients born extremely preterm, patients with congenital anomalies, and babies diagnosed with early respiratory dysfunction, who stayed in the hospital for up to 31 days, had above mean NTISS values from the time of admission to the 27th day.[10]

In a study involving 108 premature babies, in which the predictive evaluation of mortality and length of stay in the ICU was made in a rural country, it was stated that the NTISS scale could be used to predict mortality.[11]

In the analysis of the lethal group and the surviving group according to scales, it was seen that all scales showed significant differences in cardiovascular and gastrointestinal anomalies, but only NTISS was significantly higher in patients with nervous system anomalies. However, we did not find significant differences in the results of other scoring systems.

In our study, NTISS was studied in 425 patients on the first day, and NTISS on the seventh day; the score decreased in 339 patients and increased in 75 patients. P_W < .001. NTISS 10-14 days decrease was observed in 238 of 295 patients and an increase was observed in 46 patients, P_W < .001. NTISS 21-30 days a decrease in the score was observed in 84 of 113 patients and an increase in the score in 22 days, P_W < .001. As a result of the ROC analysis, it was determined that the NTISS scale was P < .001 in the comparative analysis of the surviving patients with cardiovascular system and gastrointestinal anomalies, and the NTISS scale was P = .002 in the comparative analysis of the surviving patients with the nervous system anomalies.

In another study conducted to evaluate the clinical risk index for predicting death and disease in newborns admitted to the NICU, the CRIB scale was retrospectively examined on 145 newborns between 2014 and 2017.(12) In this study, neural tube defects, one of the congenital anomalies, were evaluated. It

has been found that the CRIB scale provides a more accurate assessment than CRIB II in determining prognosis in neural tube defects. This indicates a score >11 on the CRIB Scale, varying by 5%-28%.[12]

In our study, CRIB score was found that there was a statistically significant difference of $P < .001$ in the comparison between the surviving and lethal groups of patients born preterm and term with the anomaly. The result of the ROC analysis was that the CRIB scale $P < .001$ in the comparative analysis of patients who survived and died with cardiovascular system and gastrointestinal anomalies. CRIB scale $P = .101$ was found in the comparative analysis of patients who survived and died of nervous system anomalies.

A pilot study of the MINT scale during discharge to the NICU and ICU also found that MINT scale scores were more appropriate in predicting mortality within 1 week after discharge in term newborns in the NICU (13) In our study, when we compared living and dying premature and term babies, it was seen that $P < .001$. As a result of ROC analysis, in the comparative analysis of surviving and lethal group patients with cardiovascular system and gastrointestinal anomalies, MINT scale was $P < .001$. In a comparative analysis of patients who survived and lethal due to nervous system abnormalities, $P = .025$ for the MINT scale.

A limitation of our study is that some of the procedures used to score the NTISS scale were not implemented in the clinic where our study was conducted. Thus, parameters such as Extracorporeal Membrane Oxygenation application and leukocyte transfusion were not included in our study group because they were not implemented.

Finally, in our study according to gestational week, the SNAPPE II score system was statistically significant in assessing the critical condition of cardiovascular and gastrointestinal anomalies in preterm and term newborns, and the MINT scoring system was statistically significant in assessing nervous system anomalies. In additionally, we would like to note that all scoring systems investigated in groups with cardiovascular and gastrointestinal anomalies to assess the risk of mortality in critically ill infants are statistically significantly informative. However, in infants with nervous system anomalies, only the scoring system based on NTISS data has a statistically significant difference.

CONCLUSION

The scales (NTISS, SNAPPE II, CRIB, MINT) used in our study can be used in mortality prediction for newborns diagnosed with congenital anomalies. However, none of the applied scales take into account the degree of severity of the anomaly, the critical situation created by the damaged systems, the effect of the anomaly on the complications that occur, and the necessary treatment measures (necessity of surgical intervention and its degree of severity). We believe that a universal scale should be developed that takes into account the presence of anomalies, which system they involve, their severity, and the degree of impact on the prognosis in order to assess the condition of critically ill infants based on the scale and increase their prognostic value. Also, it would be more appropriate to use scales that correspond to the level of development of medical services in different countries.

Availability of Data and Materials: The data that support the findings of this study are available on request from the corresponding author.

Ethics Committee Approval: This study was approved by the Ethics Committee of Azerbaijan Medical University University (approval no. 36; date: 18.10.2024).

Informed Consent: Verbal and written informed consent were obtained from the parents of the patients who agreed to take part in the study.

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