Biochemical and Hematological Profiles of Newborns Admitted to an NICU During the COVID-19 Pandemic

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ABSTRACT

Objective: To evaluate the hematological and biochemical profiles of newborns admitted to the Neonatal Intensive Care Unit (NICU) during the COVID-19 pandemic.

Material and Methods: This descriptive, retrospective study involves a quantitative analysis of secondary data on hematological and biochemical parameters of newborns admitted to a NICU in São Luís, MA, during the COVID-19 pandemic. A convenience sample was used.

Results: The study included 96 patients. Fifty-seven percent of the admitted newborns were diagnosed with respiratory system problems. Significant correlations were found between maternal COVID-19 infection and newborns' erythrocyte values, hematocrit, hemoglobin, basophils, calcium, and potassium levels. Additionally, significant correlations were observed between gestational age and newborns' red blood cell count and calcium levels. Most children were hospitalized for up to five days. Four children tested positive for COVID-19: one at 6 hours of age and the other three after 72 hours of hospitalization.

Conclusions: Maternal COVID-19 infection affects some hematological and biochemical parameters in newborns. Therefore, it is recommended to evaluate laboratory parameters, particularly baseline tests such as a complete blood count and biochemical analyses (including calcium, sodium, potassium, magnesium, and capillary glucose), to reduce unnecessary invasive procedures and contribute to shorter NICU stays for newborns.

Keywords: Pandemic, Coronavirus, Newborn, Hematology, Biochemistry, COVID-19.

INTRODUCTION

The Neonatal Intensive Care Unit (NICU) is a specialized environment for managing premature newborns (those born before 37 weeks of gestation) who are at higher risk for NICU admissions, as well as full-term newborns (those born at 37 weeks of gestation or later) who experience birth-related issues such as severe respiratory distress, malformations, or congenital diseases[1]. NICU admissions represent a significant public health issue, impacting neonatal morbidity and mortality. Newborns admitted to intensive care units often face a range of complications, including respiratory distress, apnea, bronchopulmonary dysplasia, ineffective thermoregulation, intraventricular hemorrhage, hyperbilirubinemia, and infections[2].

Social determinants can exacerbate the incidence of NICU admissions. In this context, we will address the impact of the novel coronavirus pandemic, known as SARS-CoV-2 according to the International Committee on Taxonomy of Viruses[3]. At the same time, the respiratory syndrome associ-

ated with the virus was named COVID-19[3-5]. Although there is no evidence of intrauterine infection caused by vertical transmission, other factors, such as preterm birth, can contribute to an increased number of admissions of newborns to the NICU [6-7].

Case reports, primarily from the initial epicenter of the epidemic in China, suggest that, unlike adults, children—especially newborns—tend to experience a milder clinical course. Most cases with positive RT--PCR (Real-Time Polymerase Chain Reaction) for SARS-CoV-2 have shown either asymptomatic or mild symptoms[8-9].

A complete blood count (CBC) encompasses the enumeration of peripheral blood cells—red blood cells, white blood cells, and platelets—as well as the differential count of the five types of leukocytes: eosinophils, basophils, neutrophils, lymphocytes, and monocytes. It also includes the measurement of hemoglobin and hematocrit values (the percentage of red blood cell volume relative to total blood volume) and the calculation of hematocrit indices[10]. The CBC focuses on peripheral blood, providing measurements in both absolute and percentage values. It includes an assessment of the morphological appearance of the three cellular populations—white blood cells, red blood cells, and platelets—as well as a biochemical analysis of calcium, potassium, sodium, and blood glucose levels obtained from serum[11].

This study addresses the lack of consensus on the hematological and biochemical profiles of newborns born during the COVID-19 pandemic. There are also no reports on the specific consequences of SARS-CoV-2 infection for newborns, particularly those requiring admission to NICUs. Thus, the present study aimed to determine the average values of hematological cells and the biochemical profiles of newborns

during the COVID-19 pandemic, regardless of their infection status. This is especially pertinent given that, in the early days of the pandemic, only severely symptomatic individuals were tested, and newborns were not comprehensively screened for COVID-19[12], The objective was to evaluate the hematological and biochemical profiles of newborns admitted to the NICU during the COVID-19 pandemic to establish diagnostic evaluation parameters.

MATERIALS AND METHODS

This is a descriptive, retrospective study based on the quantitative analysis of secondary data regarding the hematological and biochemical profiles of newborns admitted to a Neonatal Intensive Care Unit (NICU) during the COVID-19 pandemic in São Luís, MA. The study employed a convenience sample of newborns admitted to intensive care units in two maternity hospitals—one private and one public—between April and August 2020, comprising a total of 96 newborns.

Hematological and biochemical data, including results from hemograms and biochemical tests, were extracted from electronic medical records or hospital histories and organized using Microsoft Office Excel 2017. Pearson's Correlation test was used to analyze the variables, with the analyses conducted using GraphPad Prism 8 software.

The variables included hematological data such as red blood cells (erythrocytes), white blood cells (leukocytes), and platelets, as well as biochemical data including calcium, potassium, sodium, and capillary blood glucose values obtained from tests performed within the first 24 hours of life.

Obstetric, pediatric, and sociodemographic data were also collected through

chart reviews. Newborns without test results in their medical records and those whose guardians did not provide consent were excluded from the study. The Research Ethics Committee approved the study under Protocol No. 4.310.608.

RESULTS

The obstetric and pediatric characteristics are summarized in Table 1. The majority of the children were born full-term (57%), with appropriate weight, and were male. Upon admission, 53% of the children exhibited temperature disturbances: 26% had hypothermia, and 27% had hyperthermia. Respiratory system pathologies were diagnosed in 57% of the admitted children. Most of the children were hospitalized for up to five days. Of the total, only four newborns tested positive for COVID-19—one within the first 6 hours of life and the remaining three after 72 hours of hospitalization. The primary maternal comorbidities were hypertension and diabetes.

Table 1. Obstetric and Pediatric Profile of Newborns Admitted to a Neonatal Intensive Care Unit in a Private Maternity Hospital in São Luís - MA During the COVID-19 Pandemic, 2020.

Variables	Values	*n*	%
Gestational age (weeks)	29 to 30	5	5
	31 to 33	14	14
	34 to 36	20	21
	≥ 37	57	6
Weight (g)	1,000 to 1,500	7	7
	1,501 to 2,000	12	13
	2,001 to 3,000	59	61
	≥ 3,001	18	19
Sex	Male	61	64
	Female	35	36
Axilar Temperature on admission (ºC)	≤ 36	8	8
	≥ 36.1 to 36.4	17	18
	≥36.5 to 37.5	45	47
	≥ 37.6	26	27
Admission Diagnosis	TTRN	15	16
	Respiratory discomfort syndrome	39	41
	Hypoglycemia	14	14
	Icterical	7	7
	Other causes	21	22
Length of stay in the NICU (days)	1 to 5	33	34
	6 to 10	28	29
	11 to 20	23	24
	≥ 21	12	13
Mother with Covid-19	Yes	44	46
	No	52	54

Newborn with Covid-19	Sim	4	4
	Não	92	96
Maternal comorbities	Hypertension	39	41
	Diabetes	11	11
	Thrombophilia	6	6
	Other causes	8	8
	No comorbidities	32	34
Saturation of the newborn on admission	80 to 85%	14	14
	86 to 100%	82	86
Total		**96**	**100**

Table 2. Hematological and Biochemical Profile of Newborns Admitted to a Neonatal Intensive Care Unit in a Private and Public Maternity Hospital in São Luís - MA, and Their Correlations with Mothers who had COVID-19, 2020.

Variables		Mother with Covid-19 correlation	*p*	Gestational age correlation	*P*
Erythrocytes/mm³	4.49	**0.613**	**0.027**	**0.736**	**0.004**
Hemoglobin g/dL	15.69	**0.685**	**0.011**	**0.701**	**0.007**
Hematocrit%	44.73	**0.684**	**0.012**	**0.707**	**0.006**
Platelets/mm³	275,595.4	0.018	1	-0.383	0.176
Leucocytes/mm³	13,663.45	0.314	0.298	0.323	0.258
Neutrophils %	49.48	0.314	0.298	**0.731**	**0.004**
Neutrophils/mm³	7,265.71	0.388	0.190	0.492	0.076
Lymphocytes/mm³	4,736.7	-0.259	0.381	**-0.696**	**0.007**
Lymphocytes %	4,581.2	-0.203	0.518	-0.421	0.135
Monocytes %	12.18	0.092	0.797	-0.377	0.184
Monocytes/mm³	1,680.46	0.166	0.606	-0.093	0.751
Eosinophils %	4.59	-0.390	0.180	-0.239	0.405
Eosinophils/mm³	553.65	-0.130	0.672	-0.043	0.883
Basophils %	0,68	**0.676**	**0.014**	**0.721**	**0.005**
Basophils/mm³	98	**0.693**	**0.012**	**0.798**	**0.001**
C-reactive protein (mg/dL)	0,82	-0.472	0.117	-0.345	0.245
Calcium (mg/dL)	9.59	**0.228**	**0.05**	**0.647**	**0.026**
Sodium (mmol/L)	138.31	0.222	0.528	-0.011	0.927
Potassium (mmol/L)	4.6	**0.232**	**0.054**	-0.030	0.978
Magnesium (mg/dL)	2.2	-0.198	0.08	0.290	0.567
Capillary glucose (mg/dL)	90.35	0.037	0.778	0.178	0.171

Statistical significance = p≤0.05.

DISCUSSION

Hematological and biochemical dysfunctions are part of the clinical evaluation of many newborns admitted to the NICU[13-14]. To address these conditions, invasive procedures such as peripheral or central venous access punctures are required for intravenous hydration, parenteral nutrition, medication administration, or blood product infusion. Additionally, multiple blood collections are necessary to monitor clinical or laboratory status, along with intubations, the use of nasal catheters, protective eyewear, and other interventions.

Laboratory results were analyzed based on gestational age groups, weight, and maternal comorbidities. A positive correlation was observed between maternal COVID-19 infection and the levels of erythrocytes, hemoglobin, basophils, calcium, potassium, and child oxygen saturation (Tables 1 and 2).

It is noteworthy that SARS-CoV-2 infection in patients with anemia and variations in iron metabolism was associated with more severe cases, longer hospital stays, and elevated CRP levels, as reported by Bellmann-Weiler et al[15]. Therefore, newborns admitted with anemia should undergo a more in-depth investigation to prevent late complications.

Furthermore, electrolyte disturbances of calcium and potassium, also correlated with maternal infection by the novel coronavirus (Table 2), can pose significant risks to the newborn's health. Romano et al.[16] observed that hypoxia, hypercapnia, and respiratory discomfort are more severe with decreased levels of these electrolytes in circulation.

A non-invasive approach that could improve newborn electrolyte levels is the early introduction of breast milk into their diet or immune system stimulation (colostrum therapy). It is known that minerals such as sodium, potassium, magnesium, and zinc present in human milk are sufficient for nutritional needs[17]. Additionally, antibodies like IgA contribute to better outcomes regarding respiratory, digestive, food allergies, and chronic disease infections[18].

However, the COVID-19 pandemic strongly encouraged social isolation and restricted access to public and private spaces. Although there is no evidence in the literature confirming vertical transmission of SARS-CoV-2 to newborns through breastfeeding, there was a significant decrease in breast milk supply at milk banks. This decline was largely due to people's fear of exposure to environments, especially healthcare settings, and the lack of consistent information, as ongoing discussions often led to easily refutable claims[5].

Therefore, it is suggested that healthcare managers enhance recruitment practices for lactating women to ensure that more newborns admitted to NICUs have access to human milk rather than relying on nutritional formulas. Another critical aspect observed was the reduction in visiting times for parents at healthcare facilities or complete restrictions lasting 14 days if they tested positive for the novel coronavirus. Beyond socio-affective concerns, this situation highlighted the risk of extended hospital stays for infants, as they missed out on the benefits of kangaroo care, which is essential for the well-being of premature babies. According to Almeida and Forti[19], It was observed that axillary temperature and peripheral oxygen saturation significantly increased, while tachypnea significantly decreased, when comparing measurements taken before and after positioning[20].

Furthermore, the kangaroo position contributes to better laboratory results by being an effective and safe method to promote decolonization in newborns colonized by multidrug-resistant bacteria[20]. Additionally, it indicates that colonization of the baby with germs from the mother increases the production of antibodies against nosocomial pathogens and favors the establishment of microbiota and microbiome[20-21].

CONCLUSIONS

Given the observed correlations with COVID-19 infection, it is recommended to evaluate laboratory parameters with a focus on baseline tests such as a complete blood count and biochemical analyses including calcium, sodium, potassium, magnesium, and capillary blood glucose. This approach aims to reduce unnecessary invasive procedures and potentially shorten NICU stays for newborns.

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