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PROGNOSTIC VALUE OF BIOMARKERS FOR THE DURATION OF INPATIENT TREATMENT IN CHILDREN WITH COVID-19

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ABSTRACT

Introduction. COVID-19 in children usually has a mild or moderate course, but in some patients, it is associated with a prolonged clinical course and requires longer hospitalization. Identification of early prognostic biomarkers may improve clinical assessment and prognostic stratification of the disease.

Aim. The aim of the study was to determine the prognostic significance of the biomarkers NSE, S100, IFABP, NGAL, and E-selectin for the duration of inpatient treatment in children with COVID-19 to facilitate individualized treatment strategies.

Materials and methods. This retrospective comparative observational study included 88 children with laboratory-confirmed COVID-19 who were hospitalized in 2022-2023. Patients were divided into two groups according to the duration of hospitalization: ≤5 days (n=47) and >5 days (n=41). Serum levels of NSE, S100, IFABP, NGAL, and E-selectin were determined by ELISA during hospitalization. Statistical analysis was performed using the licensed statistical software EZR (version 1.54), including the Mann–Whitney U test, Pearson's χ^2 test, Spearman's correlation analysis, and ROC analysis with determination of the area under the curve (AUC), sensitivity, and specificity. The statistical significance level was set at $p<0.05$.

Results. Children hospitalized for more than 5 days had higher levels of IFABP and NGAL than those with a shorter hospital stay ($p<0.05$). According to the ROC analysis, the highest predictive value for prolonged hospitalization was demonstrated by IFABP (AUC=0.791) and NGAL (AUC=0.719), whereas E-selectin showed moderate predictive performance (AUC=0.663), and NSE and S100 showed limited predictive performance (AUC=0.591 and AUC=0.582, respectively). Correlation analysis confirmed statistically significant positive associations between the duration of hospitalization and the levels of IFABP ($\rho=0.623$; $p=0.009$), NGAL ($\rho=0.611$; $p=0.01$), and E-selectin ($\rho=0.408$; $p=0.004$).

Conclusions. IFABP and NGAL are the most informative predictors of the duration of inpatient treatment in children with COVID-19. E-selectin has additional moderate prognostic value, whereas NSE and S100 have limited prognostic value. Elevated levels of IFABP, NGAL, and E-selectin are associated with longer hospitalization and may potentially serve as predictors of a prolonged disease course; however, these findings require further confirmation in prospective multicenter studies.

Keywords: COVID-19, biomarker, NSE, S100, E-selectin, IFABP, NGAL, children, duration of hospitalization, bed days.

INTRODUCTION

Coronavirus disease (COVID-19) remains a relevant topic of scientific research. As of June 2026, more than 779 million laboratory-confirmed cases of COVID-19 had been reported worldwide, with more than 7 million deaths. In Ukraine, more than 5.5 million laboratory-confirmed cases and over 109000 deaths had been registered during this period [1].

COVID-19 in children is characterized by a predominantly mild or moderate course; however, some patients have a prolonged clinical course requiring longer hospitalization and more intensive observation. Although severe forms of COVID-19 occur less frequently in children than in adults, this group of patients is not homogeneous in terms of the risk of complications. Therefore, there is a need to identify early methods for predicting the course of the disease [2, 3].

Available studies demonstrate that the course of COVID-19 is determined not only by respiratory

system damage but also by a systemic inflammatory response involving the endothelium, intestines, nervous system, cardiovascular system, and excretory system [4, 5]. In this context, biomarkers of organ and system damage that can reflect the degree of systemic inflammation and predict the clinical dynamics of the disease are of particular interest [6, 7].

Potentially informative markers include intestinal fatty acid-binding protein (IFABP) as an indicator of intestinal barrier damage, neutrophil gelatinase-associated lipocalin (NGAL) as a marker of neutrophil activation and early kidney injury, E-selectin as an indicator of endothelial dysfunction, and neuron-specific enolase (NSE) and S100 protein as markers of neuronal damage [8-12].

Intestinal barrier dysfunction in COVID-19 may contribute to the translocation of microbial components and the persistence of systemic inflammation, which may be associated with a more severe and prolonged course of infection. This is supported by the study by Onuk et al. (2025), in which the authors emphasize the association between higher IFABP levels and COVID-19 severity [13]. NGAL levels are also associated with early manifestations of organ dysfunction and worse clinical outcomes in patients with severe infectious processes [14, 15].

E-selectin levels are also associated with increasing disease severity and longer hospital stays. According to Shi et al. (2022), E-selectin is associated with endothelial activation in COVID-19, including increased expression of adhesion molecules and induction of endothelial dysfunction, which may reflect a more pronounced systemic inflammatory response and a more severe course of the disease [16].

In contrast, NSE and S100 are considered markers of neuronal damage and glial cell activation. Several studies have associated these biomarkers mainly with severe forms of COVID-19 and the development of neurological complications [9, 17-19].

Despite the available evidence regarding the potential role of individual biomarkers of systemic inflammation and organ dysfunction, their prognostic value for the duration of inpatient treatment in children remains poorly understood and requires further investigation. In this regard, a comprehensive assessment of NSE, S100, IFABP, NGAL, and E-selectin levels as potential predictors of the duration of hospitalization in children with COVID-19 is warranted.

Considering the current literature indicating an association between systemic inflammation, endothelial and intestinal barrier damage, organ dysfunction, and COVID-19 severity, we hypothesized that biomarker levels would be associated with the duration of inpatient treatment in children.

AIM

The aim of the study was to determine the prognostic significance of the biomarkers NSE, S100, IFABP, NGAL, and E-selectin on the duration of inpatient treatment in children with COVID-19 to improve individualized treatment.

MATERIALS AND METHODS

The study had a retrospective, comparative, and observational design and was conducted in the Kyiv City Children's Clinical Infectious Diseases Hospital during 2022-2023. The study included 88 children aged 0 to 18 years with laboratory-confirmed COVID-19.

All patients were divided into two groups based on the duration of inpatient treatment: short-term hospital stay ≤5 days (n=47) and long-term >5 days (n=41). This division was used to further analyze the association of biomarker levels with the duration of hospitalization as a clinically significant indicator of the severity of the disease.

Clinical and laboratory examination included assessment of the general condition of patients, analysis of clinical manifestations and comorbidities. The severity of COVID-19 corresponded to mild and moderate forms. Critical cases of the disease were not included in the study.

The laboratory stage of the study involved venous blood sampling during hospitalization with subsequent determination of the concentrations of biomarkers NSE, S100, IFABP, NGAL and E-selectin in blood serum by enzyme-linked immunosorbent assay (ELISA). The study was performed in the immunology laboratory of the Research Institute of Experimental and Clinical Medicine of the Bogomolets National Medical University using certified commercial test systems in accordance with the manufacturer's instructions. The characteristics of the diagnostic kits used (measurement range and analytical sensitivity) are given in Table 1. The test systems used provided high analytical accuracy and reproducibility of the results.

The inclusion criteria were children under 18 years of age with confirmed COVID-19 whose parents or legal guardians provided informed consent. The exclusion criteria were the absence of laboratory confirmation of infection; refusal to participate in the study by the child or their parents or legal representatives; and the presence of comorbidities affecting the nervous, cardiovascular, respiratory, or excretory systems, as well as hematological or oncological diseases, as these conditions could affect

Table 1. Characteristics of scientific kits for biomarker research

Biomarker	Set (manufacturer, country)	Measurement range	Sensitivity
IFABP	Fine Test, China	0.156-10 ng/ml	0.094 ng/ml
NGAL	BT-LabKit, China	5-600 ng/ml	2.01 ng/ml
NSE	Fujirebio, Sweden	1-150 µg/l	0.04 µg/l
S100	Fujirebio, Sweden	1-3500 ng/l	0.05 ng/l
E-selectin	BT-Lab Kit, China	0.1-40 ng/ml	0.055 ng/ml

the levels of the studied biomarkers. Participants who withdrew from the study at any stage were also excluded.

The study was conducted in accordance with the principles of the Declaration of Helsinki, evidence-based medicine, bioethics, and good clinical practice. The study protocol was approved by the local ethics committee of the hospital (Protocol No. 13, dated February 14, 2022). All patients or their legal representatives provided written informed consent. The study involved no additional risks.

Statistical data processing was performed using the licensed software EZR (version 1.54), a graphical user interface for R statistical software (version 4.0.3; R Foundation for Statistical Computing, Vienna, Austria). The normality of the data distribution was assessed using the Shapiro–Wilk test. Quantitative variables with a normal distribution were presented as M±SD, whereas variables with a non-normal distribution were presented as Me [Q1; Q3]. Categorical variables were presented as absolute numbers and percentages (n, %).

For comparison of groups, Student's t-test or the Mann–Whitney U test was used, depending on the distribution of the data. For categorical variables, Pearson's χ^2 test or Fisher's exact test was used. Relationships between variables were assessed using Spearman's rank correlation coefficient. The predictive value of biomarkers for the duration of hospitalization was assessed using ROC analysis, with determination of the area under the curve (AUC), sensitivity, specificity, and 95% confidence intervals (CIs). The significance level was set at 5% ($p<0.05$), and 95% CIs were used.

RESULTS

The clinical and demographic characteristics of the patients are shown in Table 2.

The mean age of children in the groups did not differ statistically significantly and was 5.7±1.13 and 5.3±0.82 years, respectively (p=0,07). The gender distribution was also comparable between the groups: the proportion of boys was 65.9% in the shorter hospitalization group and 46.3% in the longer stay group (p=0.06). The frequency of comorbidities did not differ statistically significantly between the groups (14.9% and 29.3%, respectively; p=0.20). Among the comorbidities, atopic dermatitis, urticaria, infectious mononucleosis and influenza were the most frequently recorded.

The results obtained indicate the comparability of the groups in the terms of basic clinical and demographic characteristics and comorbidities.

To assess the impact of the studied biomarkers on the inpatient treatment duration, all patients were divided into two groups depending on the duration of hospitalization: ≤5 days and >5 days. The threshold value of 5 days was chosen according to the median duration of stay of children in the hospital. The results are presented in Table 3.

Patients who were hospitalized for more than 5 days had higher median values of all studied biomarkers compared to children who were hospitalized for less than 5 days (Table 3). At the same time, statistically significant differences between the groups were

Table 2. Clinical and demographic characteristics of patients

Indicator	Hospitalization ≤5 days (n=47)	Hospitalization >5 days (n=41)	p
Age, years, M ± SD	5.7±1.13	5.3±0.82	>0.05*
Gender, n (%)			
Boys	31 (65.9%)	19 (46.3%)	>0.05**
Girls	16 (34.1%)	22 (53.7%)	
Duration of hospitalization, days, Me [min–max]	4 [2-5]	7 [6-11]	<0.05***
Comorbidity, n (%)	7 (14.9%)	12 (29.3%)	>0,05**

Note: *Student's t-test, **Pearson's x^2-test or Fisher's exact test, ***Mann–Whitney test.

Table 3. Biomarkers levels depending on the duration of hospitalization in children with COVID-19

Biomarkers	Hospitalization ≤5 days (n=47)	Hospitalization >5 days (n=41)	p*
NSE, μg/l	12.71 [8.24; 18.87]	15.19 [8.46; 22.24]	>0.05
S100, ng/l	163.49 [146.41; 180.61]	173.14 [141.16; 190.84]	>0.05
IFABP, ng/ml	16.42 [11.65; 38.98]	17.42 [12.99; 42.04]	<0.05
NGAL, ng/ml	80.59 [55,45; 288.24]	104.91 [58.11; 307.33]	<0.05
E-selectin, ng/ml	12.02 [7.23; 22.16]	15.06 [8.63; 26.83]	>0.05

Note: *Mann–Whitney test

found only for IFABP and NGAL markers. The level of IFABP in the long-term hospitalization group was 17.42 [12.99; 42.04] ng/ml versus 16.42 [11.65; 38.98] ng/ml in the shorter-stay group (p=0.02), that may be associated with more pronounced damage to the intestinal barrier in children with a longer course of the disease. A similar trend was observed for NGAL, which was higher in children with a hospital stay of >5 days (104.91 [58.11; 307.33] ng/ml vs. 80.59 [55.45; 288.24] ng/ml; p=0.04), which is associated with a more active systemic inflammatory response and involvement of renal/neutrophil mechanisms. NSE, S100, and E-selectin also tended to increase with longer hospital stays, but these differences did not reach statistical significance (p>0.05), which may indicate their less pronounced predictive value for the duration of inpatient treatment in this sample.

To assess the prognostic value of the studied biomarkers regarding the duration of hospitalization, ROC analysis was performed with determination of AUC, sensitivity and specificity of optimal threshold values. The results are presented in Table 4.

According to the results of the ROC analysis (Table 4), the highest predictive value for the duration of hospitalization was demonstrated by IFABP (AUC=0.791; 95% CI: 0.599-0.861), indicating good discriminatory ability. NGAL also demonstrated good predictive performance (AUC=0.719; 95% CI: 0.512-0.890). E-selectin demonstrated satisfactory discriminatory ability (AUC=0.663; 95% CI: 0.511-0.771). Low discriminatory ability was observed for NSE and S100 (AUC=0.591; 95% CI: 0.431-0.690 and AUC=0.582; 95% CI: 0.459-0.722, respectively).

Thus, the most promising biomarkers for the early prediction of hospitalization lasting more than 5 days in children with COVID-19 are IFABP and NGAL. They demonstrated the highest AUC values and the best discriminatory performance among the biomarkers studied. E-selectin also showed moderate prognostic value and can be considered an additional marker for assessing the risk of prolonged inpatient treatment.

Spearman's correlation analysis was performed to assess the relationship between biomarker levels and the duration of inpatient treatment. The results are presented in Table 5 and Figure 1.

Table 5. Correlation analysis between the biomarker levels and duration of hospitalization in patients with COVID-19

Biomarkers	Spearman's ρ	p
NSE	0.129	>0.05
S100	0.281	0.05
IFABP	0.623	<0.05
NGAL	0.611	<0.05
E-selectin	0.408	<0.05

Statistically significant positive correlations were established between the duration of hospitalization and the levels of IFABP (ρ=0.623; p=0.009), NGAL (ρ=0.611; p=0.01), and E-selectin (ρ=0.408; p=0.004), indicating moderate correlations (Table 5, Fig. 1). For S100 (ρ=0.281; p=0.05), a weak correlation at the borderline of statistical significance was observed,

Table 4. ROC analysis of the predictive value of biomarkers for length of hospitalization (>5 days)

Biomarkers	Threshold level	Sensitivity (%)	Specificity (%)	AUC	95% CI
NSE, μg/l	16.347	63.2%	77.3%	0.591	0.431-0.690
S100, ng/l	158.024	59.7%	81.2%	0.582	0.459-0.722
IFABP, ng/ml	30.814	74.2%	66.5%	0.791	0.599-0.861
NGAL, ng/ml	79.699	57.9%	80.6%	0.719	0.512-0.890
E-selectin, ng/ml	15.013	78.8%	81.4%	0.663	0.511-0.771

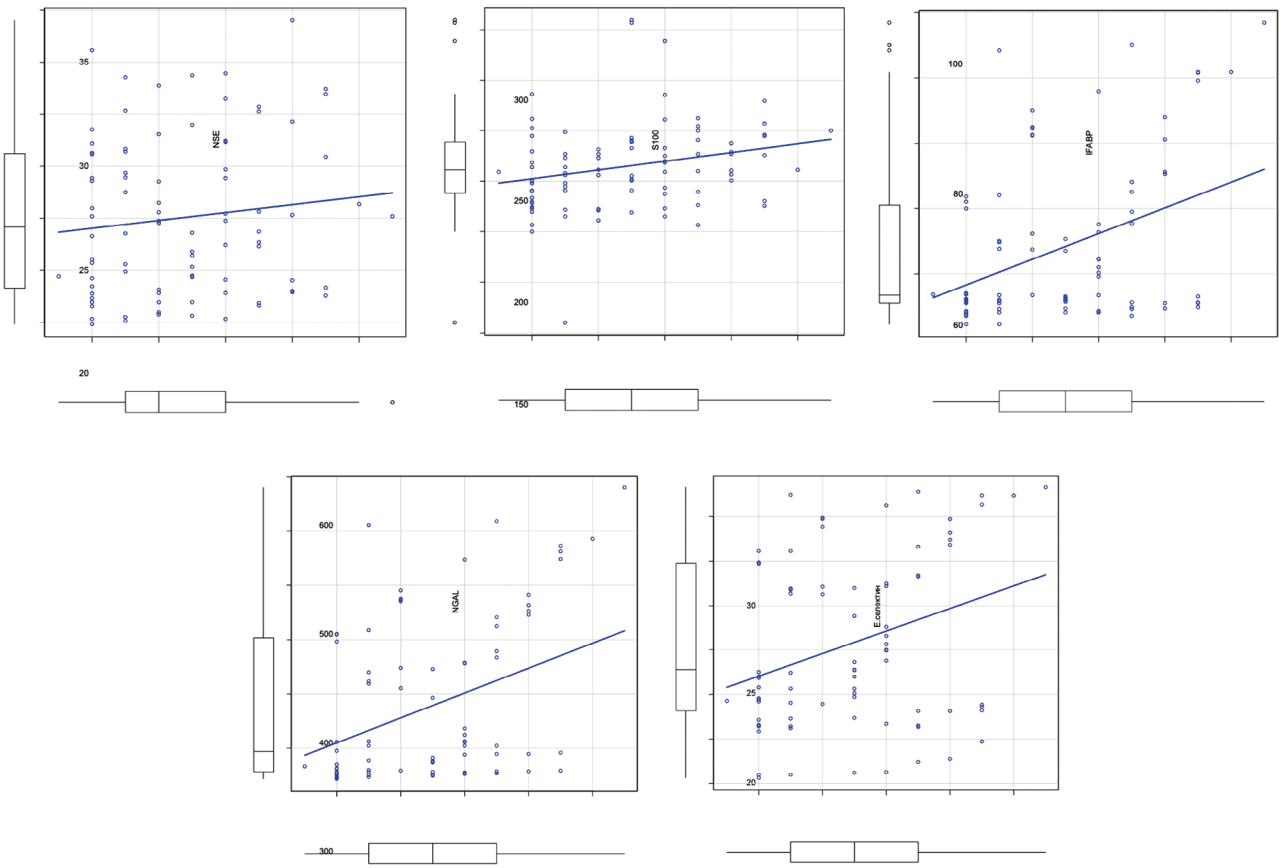

Fig. 1. Correlation analysis between the biomarker levels and duration of hospitalization in patients with COVID-19

whereas no statistically significant correlation was found for NSE (ρ=0.129; p=0.06).

Thus, the results of the correlation analysis confirm that IFABP and NGAL are the most informative biomarkers with regard to the duration of inpatient treatment in children with COVID-19, demonstrating the strongest correlations and showing results consistent with those of the ROC analysis.

DISCUSSION

The study demonstrated that IFABP and NGAL had the greatest prognostic value with regard to the duration of inpatient treatment in children with COVID-19. Patients hospitalized for more than 5 days had significantly higher levels of IFABP and NGAL, as demonstrated by comparative analysis, ROC analysis, and correlation analysis. These findings are consistent with those of Tyszko et al. (2022), who investigated IFABP levels in patients with COVID-19 and demonstrated an association between elevated IFABP levels, adverse clinical outcomes, and higher mortality. Similar findings were reported by Saia et al. (2021), who found that IFABP concentrations increased with increasing disease severity and may serve as a potential predictor of an unfavorable clinical course, which was associated with longer hospitalization [8, 20].

The finding of significantly elevated IFABP levels in children with prolonged hospital stays is particularly noteworthy. IFABP is a marker of enterocyte injury and reflects the degree of intestinal barrier damage. In the present study, this biomarker not only demonstrated statistically significant differences between the groups but also had the highest discriminatory performance (AUC=0.791) and showed a strong correlation with the duration of hospitalization (ρ=0.623; p=0.009). These results suggest a possible association between intestinal barrier damage and a prolonged course of COVID-19 in children. This finding is consistent with the results of Tsounis et al. (2023), who identified intestinal barrier dysfunction as one of the potential mechanisms underlying severe COVID-19. The authors noted that increased intestinal permeability promotes the translocation of microbial products into the systemic circulation and sustains a systemic hyperinflammatory response, which may contribute to adverse clinical outcomes [21].

Similar patterns were observed for NGAL, a marker of neutrophil activation and early renal injury. The increase in NGAL levels in children hospitalized for more than 5 days (p=0.04), its positive correlation with the duration of treatment (ρ=0.611; p=0.01),

and the ROC analysis results (AUC=0.719; 95% CI: 0.512–0.890) suggest an association between systemic inflammation, possible subclinical kidney injury, and a prolonged disease course. These findings are consistent with the available literature, in which NGAL is considered a sensitive marker of early organ dysfunction and has been associated with acute kidney injury, shock, longer hospitalization, and higher in-hospital mortality in patients with COVID-19 [22, 23].

E-selectin demonstrated a moderate correlation with the duration of hospitalization (ρ=0.408; p=0.004) and satisfactory discriminatory ability (AUC=0.663; 95% CI: 0.511–0.771), reflecting the potential role of endothelial activation in the pathogenesis of COVID-19. An increase in E-selectin levels may indicate involvement of the vascular component of the inflammatory response, although its prognostic value was lower than that of IFABP and NGAL. This finding is consistent with published studies demonstrating an association between E-selectin levels, a more severe course of COVID-19, and more pronounced endothelial dysfunction [24, 25].

In contrast, NSE and S100 did not demonstrate a statistically significant association with the duration of inpatient treatment. Weak or borderline correlations were observed (ρ=0.129 and ρ=0.281, respectively), indicating the limited prognostic value of these biomarkers for predicting the length of hospitalization. These findings may be explained by the predominance of mild and moderate forms of COVID-19 in the studied cohort, in which neuronal damage may be less pronounced and may have a limited impact on the clinical course and the need for prolonged inpatient treatment. This is consistent with the literature; in particular, studies by Sahin et al. (2022) and Kokkoris et al. (2022) emphasize the role of these biomarkers primarily in severe COVID-19 and neurological complications [17, 26].

It is important to note that the results of the ROC analysis were generally consistent with those of the correlation analysis. IFABP and NGAL, which had the highest correlation coefficients with the duration of hospitalization (ρ=0.623 and ρ=0.611, respectively), also demonstrated the best discriminatory performance for predicting prolonged inpatient treatment. At the same time, E-selectin, despite its moderate AUC value, showed a statistically significant positive correlation with the duration of hospitalization, supporting its potential role as a marker of endothelial activation associated with a prolonged course of COVID-19 in children. These findings indicate the potential utility of these biomarkers for early clinical assessment of the risk of prolonged hospitalization.

This study had several limitations, including the relatively small sample size (n=88) for the simultaneous assessment of five biomarkers using multiple statistical approaches, its single-center design, and its retrospective nature.

The results suggest that the combined assessment of IFABP and NGAL may provide the most informative approach for predicting the duration of inpatient treatment in children with COVID-19. Additional assessment of E-selectin may improve risk stratification by reflecting the degree of endothelial activation and systemic inflammation. This approach may facilitate the early identification of patients at increased risk of a prolonged disease course and help optimize monitoring and treatment strategies.

CONCLUSIONS

1. The duration of inpatient treatment in children with COVID-19 is associated with increased levels of biomarkers IFABP, NGAL, and E-selectin, which may reflect the involvement of the intestinal barrier, systemic inflammation, and endothelial dysfunction in shaping the protracted course of the disease.

2. The most significant prognostic value for the duration of hospitalization (>5 days) was demonstrated by IFABP (AUC=0,791) and NGAL (AUC=0,719), which also had statistically significant correlations with the duration of treatment.

3. E-selectin is characterized by moderate prognostic significance and a weaker, but statistically significant correlation with the duration of hospitalization, which is consistent with the possible role of endothelial activation of COVID-19 in children.

4. Biomarkers IFABP and NGAL, as well as E-selectin, may be considered as predictors of a prolonged course of the disease, which require further confirmation in prospective multicenter studies.

Article Declarations

Prospects for further research. Further studies should be aimed at validating IFABP, NGAL, and E-selectin in prospective multicenter studies with a larger sample of patients, as well as at creating a combined prognostic model for early prediction of the duration of hospitalization and prolonged course of COVID-19 in children.

Study limitations. The authors of the manuscript acknowledge that the limitations of this study are related to the retrospective design, single-center nature of the study, and relatively small sample size, which requires further

validation of the results in prospective multicenter studies. The search strategy covered PubMed (https://pubmed.ncbi.nlm.nih.gov/).

Primary data and materials. The study was based on retrospective analysis of anonymized clinical data obtained from medical records of pediatric patients with laboratory-confirmed COVID-19 treated at Kyiv City Children's Clinical Infectious Hospital during 2022–2023. The dataset included clinical characteristics, laboratory results, and instrumental examination findings. All data were de-identified prior to analysis to ensure patient confidentiality.

Research ethics. The researchers followed all protocols and procedures prescribed by the Biomedical Research Ethics Committee, as well as the requirements of Ukrainian health legislation and the provisions of the Declaration of Helsinki (2000).

Declaration of AI use. Artificial intelligence tools were not used in the preparation of this work.

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Conflict of Interest. The authors declare that there is no conflict of interest related to the preparation, conduct, and publication of this study. None of the authors has any financial, commercial, or other personal relationships that could influence the interpretation of the results. The study was conducted in accordance with the principles of academic integrity and objectivity. All authors approved the final version of the manuscript.

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ПРОГНОСТИЧНА ЦІННІСТЬ БІОМАРКЕРІВ ЩОДО ТРИВАЛОСТІ СТАЦІОНАРНОГО ЛІКУВАННЯ ДІТЕЙ ІЗ COVID-19

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РЕЗЮМЕ

Вступ. COVID-19 у дітей зазвичай перебігає у легкій або середньотяжкій формі, однак у частини пацієнтів характеризується затяжним перебігом і потребує тривалішої госпіталізації. Виявлення ранніх прогностичних біомаркерів може підвищити ефективність оцінювання клінічного перебігу захворювання.

Мета. Метою дослідження було визначити прогностичну значущість біомаркерів NSE, S100, IFABP, NGAL та E-селектину щодо тривалості стаціонарного лікування дітей із COVID-19 для сприяння індивідуалізації лікувальної тактики.

Матеріали та методи. У ретроспективне порівняльне обсерваційне дослідження було включено 88 дітей із лабораторно підтвердженим COVID-19, які перебували на стаціонарному лікуванні у 2022–2023 роках. Пацієнтів розподілили на дві групи залежно від тривалості госпіталізації: ≤5 діб (n=47) та >5 діб (n=41). Рівні біомаркерів NSE, S100, IFABP, NGAL та E-селектину в сироватці крові визначали методом ІФА при госпіталізації. Статистичний аналіз проводили за допомогою ліцензованого програмного забезпечення EZR (version 1.54) та включав критерій Манна–Уїтні, χ^2-критерій Пірсона, кореляційний аналіз Спірмена та ROC-аналіз із визначенням площі під кривою (AUC), чутливості та специфічності. Рівень статистичної значущості становив $p<0,05$.

Результати. Встановлено, що у дітей, госпіталізованих на понад 5 діб, рівні біомаркерів IFABP та NGAL були статистично значуще вищими порівняно з пацієнтами з коротшим перебуванням у стаціонарі ($p<0,05$). За результатами ROC-аналізу найвищу прогностичну цінність щодо тривалості госпіталізації продемонстрували IFABP (AUC=0,791) та NGAL (AUC=0,719), тоді як E-селектин продемонстрував помірну дискримінаційну здатність (AUC=0,663), а NSE та S100 — низьку дискримінаційну здатність (AUC=0,591 та AUC=0,582 відповідно). Кореляційний аналіз підтвердив наявність статистично значущих позитивних зв'язків між тривалістю госпіталізації та рівнями IFABP ($\rho=0,623$; $p=0,009$), NGAL ($\rho=0,611$; $p=0,01$) та E-селектину ($\rho=0,408$; $p=0,004$).

Висновки. Біомаркери IFABP та NGAL є найбільш інформативними предикторами тривалості стаціонарного лікування дітей із COVID-19. E-селектин має додаткову помірну прогностичну цінність, тоді як NSE та S100 характеризуються обмеженою прогностичною цінністю. Підвищені рівні IFABP, NGAL та E-селектину асоціюються з більшою тривалістю госпіталізації та потенційно можуть розглядатися як предиктори затяжного перебігу захворювання, однак це потребує подальшого підтвердження у проспективних багатоцентрових дослідженнях.

Ключові слова: COVID-19, біомаркер, NSE, S100, E-селектин, IFABP, NGAL, діти, тривалість госпіталізації, ліжкодні.

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