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Neutralizing Antibody Titers In Post-Covid-19 Patients And Post-Covid Pneumonia: Prognostic Value And Clinical Course

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Summary
Pneumonia and delayed inflammatory processes observed in the post-COVID period are associated with multiple pathophysiological mechanisms. Neutralizing antibody (NAb) titers represent a key component of the immune response to the virus, and their levels may influence disease severity, duration, and the course of post-COVID syndrome. This article analyzes the relationship between NAb titers, hematological parameters (Hb, erythrocytes, leukocytes, color index, ESR), and the clinical progression of post-COVID pneumonia in a cohort of unvaccinated patients examined after recovering from COVID-19 pneumonia.

Keywords: children, pneumonia, post-COVID syndrome, Neutralizing antibody (NAb)

Титры Нейтрализующих Антител У Перенёсших Covid-19 Пациентов И Постковидная Пневмония: Прогнозирование И Клиническое Течение

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Резюме
Пневмония и отсроченные воспалительные процессы, наблюдаемые в пост-COVID периоде, связаны с множеством патофизиологических механизмов. Титры нейтрализующих антител (NAb) являются одним из ключевых компонентов иммунного ответа на вирус, и их уровень может влиять на тяжесть заболевания, его продолжительность и особенности течения пост-COVID синдрома. В данной статье проанализирована взаимосвязь между титрами NAb, гематологическими показателями (Hb, эритроциты, лейкоциты, цветовой показатель, СОЭ) и клиническим течением пост-COVID пневмонии у группы невакцинированных пациентов, обследованных после перенесённой COVID-19 пневмонии.
Ключевые слова: дети, пневмония, Нейтрализующее антитело, Пост-COVID синдром.

Covid-19 O‘Tkazgan Bemorlarda Nab Titrlari Va Postkovid Pnevmoniya: Prognoz, Klinik Kechish.

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Summary
COVID-19 dan keyingi davrda (post-COVID) kuzatiladigan pnevmoniya va kechikkan yallig‘lanish jarayonlari ko‘plab patofiziologik mexanizmlar bilan bog‘liq. Neytrallovchi antitanachalar (NAb) titrlari

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virusga immun javobning asosiy komponentlaridan biri bo‘lib, ularning darajasi kasallikning og‘irligi, davomiyligi va post-COVID sindromning kechishiga ta’sir qilishi mumkin. Ushbu maqolada COVID-19 o‘tkazgan pnevmoniya bilan kasallangan bolalarda NAb titrlari, gematologik ko‘rsatkichlar (HB, eritrositlar, leykotsitlar, rang indeksi, ESR) hamda post-COVID pnevmoniya kechishi o‘rtasidagi bog‘liqlik tahlil qilindi. ru va eng tiliga tarjima.

Keywords: bolalar, zotiljam, postCOVID sindrom, neytrallovchi antitanacha

Introduction.

Post-COVID pneumonia and prolonged inflammatory processes observed in the period following COVID-19 are associated with numerous complex pathophysiological mechanisms. Neutralizing antibody (NAb) titers — one of the key indicators of the humoral immune response against SARS-CoV-2 — are considered an important biomarker that determines disease severity, as they block the virus from entering host cells. Low or inconsistent NAb levels may be linked to delayed viral neutralization, prolonged activity of inflammatory mediators, and recurrent airway damage [1,2,7] (Cao Y. et al., Nature, 2020; Garcia-Beltran W. et al., Cell, 2021).

Post-COVID pneumonia encompasses persistent alveolar–interstitial inflammation, microcirculatory thrombosis, endothelial dysfunction, and an imbalanced immune response. Recent studies have documented that in a subset of patients, even 6–12 months after acute infection, respiratory insufficiency, fibrosis-like changes, and mild-to-moderate persistent inflammatory biomarkers may remain detectable [2,6,8] (Nalbandian A. et al., Nature Medicine, 2021; Sonnweber T. et al., Radiology, 2021).

NAb titers have particular clinical significance in unvaccinated patients, as their immune protection is formed solely through natural infection. The intensity of this immune response depends on age, comorbid conditions, disease severity, and viral load during the acute phase [4,5,8] (Legros V. et al., JCI Insight, 2021). Low NAb titers after infection may be associated with prolonged inflammation, elevated ESR, alterations in the color index, and laboratory findings such as leukocytosis or leukopenia.

Objective of the study:

The aim of this investigation was to study the level of NAb in relation to clinical-laboratory indices in patients who have been cured of COVID-19 pneumonia without prior vaccination. According to the data obtained in 56 patients, the levels of NAb in the blood were analyzed and the degree of their correlation with hematological parameters - hemoglobin, erythrocytes, leukocytes, color index, ESR - as well as coagulation markers was assessed for the purpose of establishing their prognostic value in the development and severity of post-COVID pneumonia.

Research objectives:

1. To evaluate the neutralizing antibody (NAb) titers in who previously had COVID-19 pneumonia and to determine their association with the severity and persistence of post-COVID pulmonary manifestations.
2. To investigate coagulation profile markers and identify possible links between hemostatic disturbances and prolonged post-COVID respiratory dysfunction.

Material and methods of the study:

Material: blood of 56 young children pneumonia.

To evaluate the neutralizing antibody (NAb) titers in patients who previously had COVID-19 pneumonia

Statistical analysis of the obtained data.

Blood plasma samples from 56 children (37 boys and 19 girls) diagnosed with community-acquired pneumonia (CAP) were used in this study. All patients tested negative for SARS-CoV-2 mRNA by reverse transcription polymerase chain reaction (RT-PCR). The level of IgG antibodies to the RBD domain of neutralizing antibodies (NAb) against SARS-CoV-2 was measured using an automated immunoassay analyzer MAGLUMI 800 (Snibe Co. Ltd., China) and SARS-CoV-2 RBD IgG reagent kits (Snibe Diagnostics, China), following the manufacturer’s instructions. Antibody levels ≥1.0 AU/ml were considered positive. Patients were distributed by year of birth as follows:

2017 – 2 children, 2018 – 2 children, 2019 – 4 children, 2020 – 11 children, 2021 – 11 children, 2022 – 26 children.

As a result of the analysis, IgG antibodies against NAb SARS-CoV-2 were detected in 80.36% (45/56) of children. In the remaining 19.64% (11/56) of patients, the IgG antibody level was <1.0 AU/ml, indicating

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the absence of detectable NAb SARS-CoV-2 antibodies. Among these seronegative children, 72% (8/11) were born in 2022, including 8 boys and 3 girls.

Plasma IgG antibody titers against NAb SARS-CoV-2 were distributed as follows:	
13 patients	1.0–5.0 AU/ml
5 patients	5.0–10.0 AU/ml
22 patients	10.0–65.0 AU/ml
6 patients	>100 AU/ml

Integrated Clinical Analysis of Neutralizing Antibody (NAb) Levels and Post-COVID Pneumonia Severity in Children. In this study, blood plasma samples of 56 pediatric patients (37 boys, 19 girls) diagnosed with community-acquired pneumonia (CAP) were analyzed to evaluate the clinical relevance of neutralizing SARS-CoV-2 antibodies (NAb IgG) during the post-COVID state. All patients were SARS-CoV-2 PCR-negative at the time of enrolment, indicating absence of active viral replication and reflecting a post-infectious immunological phase. NAb IgG levels were quantified using the MAGLUMI 800 automated immunochemiluminescent analyzer (Snibe Diagnostics, China) with SARS-CoV-2 RBD IgG reagent kits; a result of ≥1.0 AU/ml was considered positive according to manufacturer specifications.

Age distribution included: 2017 (n=2), 2018 (n=2), 2019 (n=4), 2020 (n=11), 2021 (n=11), and 2022 (n=26). Detectable NAb IgG was identified in 80.36% (45/56) of children, whereas 19.64% (11/56) exhibited <1.0 AU/ml. Notably, 72% of NAb-negative cases (8/11) were infants born in 2022, suggesting reduced or absent immunological exposure to SARS-CoV-2. Among seronegative children, 8 were male and 3 female.

Clinical Course by NAb Stratification

Group 1 — No or Minimal NAb (<1.0 AU/ml)

Children with absent or extremely low antibody levels predominantly demonstrated more prolonged pneumonia, recurrent cough, moderate hypoxia, and radiological interstitial changes persisting beyond 3–6 weeks. A portion of this group experienced elevated ESR, mild leukocytosis, and reduced hemoglobin, reflecting sustained inflammatory activity and delayed viral-induced tissue recovery. The lack of immunological neutralization likely contributed to slower clearance of residual viral proteins and enhanced inflammatory persistence.

Group 2 — Low NAb Levels (1.0–5.0 AU/ml)

Patients within this range exhibited subacute pneumonia with recurrent inflammation, periodic wheezing, and moderate respiratory compromise. Fever episodes were shorter than in Group 1, but ESR levels remained mildly elevated. Radiology often revealed patchy alveolar-interstitial lesions, suggesting partial but insufficient immune neutralization. Clinical recovery occurred, yet at a slower pace compared to higher-antibody cohorts, indicating that low NAb response does not fully prevent prolonged post-COVID lung involvement.

Group 3 — Moderate Antibody Levels (5.0–10 AU/ml)

Children with moderately elevated NAb titers generally displayed milder disease progression, earlier resolution of dyspnea, and faster radiographic regression of infiltrates. Hematological markers were more stable, with ESR values trending toward normal. These findings support the assumption that moderate neutralizing immunity provides partial protection, limits inflammation, and accelerates pneumonia recovery.

Group 4 — High and Very High Titers (>10–100+ AU/ml)

Patients with NAb levels above 10 AU/ml, particularly those exceeding 100 AU/ml, demonstrated the most favorable clinical outcomes. Symptoms regressed rapidly, respiratory insufficiency was minimal, hospitalization duration was shorter, and follow-up radiology showed early clearing of infiltrates. Hemoglobin levels remained within normal ranges, leukocyte fluctuations were minimal, and ESR normalized significantly faster than other categories. These observations indicate that strong neutralizing immunity is directly associated with reduced post-COVID inflammatory load and faster pulmonary recovery.

Conclusion

Across all four titer groups, higher NAb levels correlated with milder pneumonia, reduced inflammatory persistence, and more rapid post-COVID recovery, while antibody-deficient children (<1.0 AU/ml) displayed the most prolonged and complicated respiratory course. These findings highlight the prognostic

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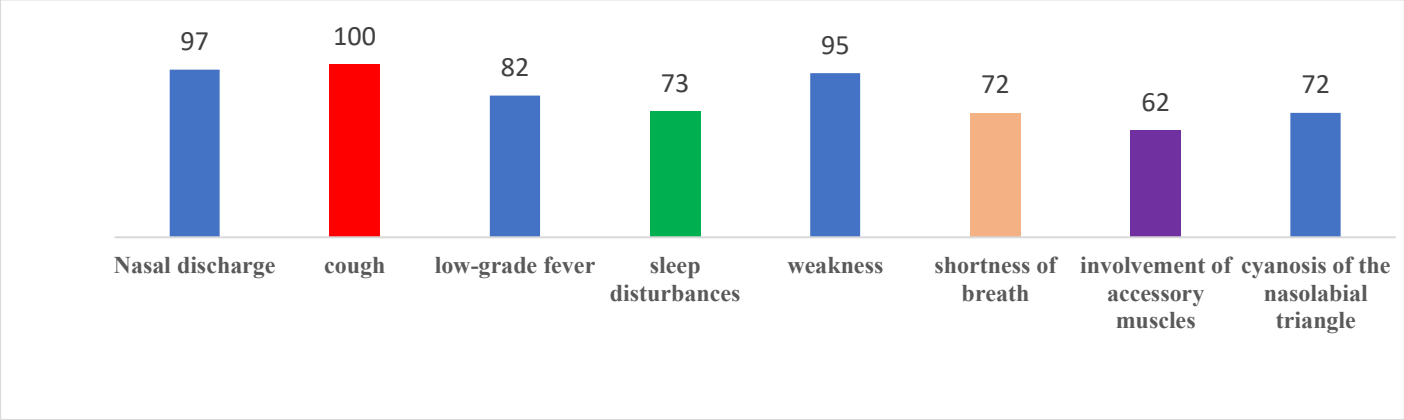
value of neutralizing antibodies in pediatric post-COVID pneumonia and reinforce the importance of immune competence in mitigating long-term pulmonary sequelae.

Figure 2.

Hemoglobin	101,6	0.05
Eritrocite	3,5	0.05
Leukocytes	5,4	0.02
Color index	0.83	0.01
ESR	5,5	0.03

General characteristics of children with acute pneumonia.



In the examined cohort of post-COVID community-acquired pneumonia (CAP) in children, clinical manifestations demonstrated a high prevalence of respiratory and general infectious symptoms. The most frequently reported sign was cough (100%), indicating universal involvement of the respiratory tract and confirming its central role in disease presentation. Nasal discharge was noted in 97% of cases, reflecting active upper airway inflammation consistent with viral and post-viral mucosal damage. Systemic manifestations included weakness (95%) and low-grade fever (82%), both of which correspond to ongoing inflammatory response and post-infectious systemic reactivity. Sleep disturbances were recorded in 73% of children, likely secondary to nocturnal cough, hypoxia-associated discomfort, or persistent neuro-immune dysregulation described in post-acute COVID-19 inflammatory states. Markers of respiratory distress were also present at significant rates: shortness of breath (72%) and cyanosis of the nasolabial triangle (72%), suggesting episodes of transient or sustained hypoxemia, while involvement of accessory muscles (62%) indicates an increased work of breathing and reduced pulmonary reserve. Together, these symptoms reflect not only residual parenchymal injury but also manifestations of ongoing alveolar inflammation, reduced gas exchange capacity, and potential development of early fibrotic remodeling in post-COVID pneumonia.

Clinical interpretation of complete blood count (CBC) results in post-COVID pneumonia

In patients with post-COVID pneumonia, changes in the complete blood count strongly reflect the severity of the inflammatory process and respiratory impairment. Elevated leukocyte counts and neutrophilia typically indicate an ongoing or secondary bacterial infection, whereas lymphopenia corresponds to weakened antiviral immune response and is often associated with more severe clinical progression. Reduced hemoglobin levels and erythrocyte counts may contribute to tissue hypoxia, intensifying dyspnea and fatigue. An increased ESR reflects persistent systemic inflammation, correlating with prolonged recovery, weakness, sleep disturbances, and extended respiratory symptoms.

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