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ЕЖЕМЕСЯЧНЫЙ НАУЧНЫЙ ЖУРНАЛ

Медицинские новости Грузии

საქართველოს სამედიცინო სიახლენი

GEORGIAN MEDICAL NEWS

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GMN: Georgian Medical News is peer-reviewed, published monthly journal committed to promoting the science and art of medicine and the betterment of public health, published by the GMN Editorial Board since 1994. GMN carries original scientific articles on medicine, biology and pharmacy, which are of experimental, theoretical and practical character; publishes original research, reviews, commentaries, editorials, essays, medical news, and correspondence in English and Russian.

GMN is indexed in MEDLINE, SCOPUS, PubMed and VINITI Russian Academy of Sciences. The full text content is available through EBSCO databases.

GMN: Медицинские новости Грузии - ежемесячный рецензируемый научный журнал, издаётся Редакционной коллегией с 1994 года на русском и английском языках в целях поддержки медицинской науки и улучшения здравоохранения. В журнале публикуются оригинальные научные статьи в области медицины, биологии и фармации, статьи обзорного характера, научные сообщения, новости медицины и здравоохранения. Журнал индексируется в MEDLINE, отражён в базе данных SCOPUS, PubMed и ВИНИТИ РАН. Полнотекстовые статьи журнала доступны через БД EBSCO.

GMN: Georgian Medical News – საქართველოს სამედიცინო სიახლენი – არის ყოველთვიური სამეცნიერო სამედიცინო რეცენზირებადი ჟურნალი, გამოიცემა 1994 წლიდან, წარმოადგენს სარედაქციო კოლეგიისა და აშშ-ის მეცნიერების, განათლების, ინდუსტრიის, ხელოვნებისა და ბუნებისმეტყველების საერთაშორისო აკადემიის ერთობლივ გამოცემას. GMN-ში რუსულ და ინგლისურ ენებზე ქვეყნდება ექსპერიმენტული, თეორიული და პრაქტიკული ხასიათის ორიგინალური სამეცნიერო სტატიები მედიცინის, ბიოლოგიისა და ფარმაციის სფეროში, მიმოხილვითი ხასიათის სტატიები.

ჟურნალი ინდექსირებულია MEDLINE-ის საერთაშორისო სისტემაში, ასახულია SCOPUS-ის, PubMed-ის და ВИНИТИ РАН-ის მონაცემთა ბაზებში. სტატიების სრული ტექსტი ხელმისაწვდომია EBSCO-ს მონაცემთა ბაზებიდან.

WEBSITE

www.geomednews.com

К СВЕДЕНИЮ АВТОРОВ!

При направлении статьи в редакцию необходимо соблюдать следующие правила:

1. Статья должна быть представлена в двух экземплярах, на русском или английском языках, напечатанная через **полтора интервала на одной стороне стандартного листа с шириной левого поля в три сантиметра**. Используемый компьютерный шрифт для текста на русском и английском языках - **Times New Roman** (**Кириллица**), для текста на грузинском языке следует использовать **AcadNusx.** Размер шрифта - **12**. К рукописи, напечатанной на компьютере, должен быть приложен CD со статьей.

2. Размер статьи должен быть не менее десяти и не более двадцати страниц машинописи, включая указатель литературы и резюме на английском, русском и грузинском языках.

3. В статье должны быть освещены актуальность данного материала, методы и результаты исследования и их обсуждение.

При представлении в печать научных экспериментальных работ авторы должны указывать вид и количество экспериментальных животных, применявшиеся методы обезболивания и усыпления (в ходе острых опытов).

4. К статье должны быть приложены краткое (на полстраницы) резюме на английском, русском и грузинском языках (включающее следующие разделы: цель исследования, материал и методы, результаты и заключение) и список ключевых слов (key words).

5. Таблицы необходимо представлять в печатной форме. Фотокопии не принимаются. **Все цифровые, итоговые и процентные данные в таблицах должны соответствовать таковым в тексте статьи**. Таблицы и графики должны быть озаглавлены.

6. Фотографии должны быть контрастными, фотокопии с рентгенограмм - в позитивном изображении. Рисунки, чертежи и диаграммы следует озаглавить, пронумеровать и вставить в соответствующее место текста **в tiff формате**.

В подписях к микрофотографиям следует указывать степень увеличения через окуляр или объектив и метод окраски или импрегнации срезов.

7. Фамилии отечественных авторов приводятся в оригинальной транскрипции.

8. При оформлении и направлении статей в журнал МНГ просим авторов соблюдать правила, изложенные в «Единых требованиях к рукописям, представляемым в биомедицинские журналы», принятых Международным комитетом редакторов медицинских журналов - http://www.spinesurgery.ru/files/publish.pdf и http://www.nlm.nih.gov/bsd/uniform_requirements.html
В конце каждой оригинальной статьи приводится библиографический список. В список литературы включаются все материалы, на которые имеются ссылки в тексте. Список составляется в алфавитном порядке и нумеруется. Литературный источник приводится на языке оригинала. В списке литературы сначала приводятся работы, написанные знаками грузинского алфавита, затем кириллицей и латиницей. Ссылки на цитируемые работы в тексте статьи даются в квадратных скобках в виде номера, соответствующего номеру данной работы в списке литературы. Большинство цитированных источников должны быть за последние 5-7 лет.

9. Для получения права на публикацию статья должна иметь от руководителя работы или учреждения визу и сопроводительное отношение, написанные или напечатанные на бланке и заверенные подписью и печатью.

10. В конце статьи должны быть подписи всех авторов, полностью приведены их фамилии, имена и отчества, указаны служебный и домашний номера телефонов и адреса или иные координаты. Количество авторов (соавторов) не должно превышать пяти человек.

11. Редакция оставляет за собой право сокращать и исправлять статьи. Корректура авторам не высылается, вся работа и сверка проводится по авторскому оригиналу.

12. Недопустимо направление в редакцию работ, представленных к печати в иных издательствах или опубликованных в других изданиях.

При нарушении указанных правил статьи не рассматриваются.

REQUIREMENTS

Please note, materials submitted to the Editorial Office Staff are supposed to meet the following requirements:

1. Articles must be provided with a double copy, in English or Russian languages and typed or compu-ter-printed on a single side of standard typing paper, with the left margin of **3** centimeters width, and **1.5** spacing between the lines, typeface - **Times New Roman** (**Cyrillic**), print size - **12** (referring to Georgian and Russian materials). With computer-printed texts please enclose a CD carrying the same file titled with Latin symbols.

2. Size of the article, including index and resume in English, Russian and Georgian languages must be at least 10 pages and not exceed the limit of 20 pages of typed or computer-printed text.

3. Submitted material must include a coverage of a topical subject, research methods, results, and review.

Authors of the scientific-research works must indicate the number of experimental biological species drawn in, list the employed methods of anesthetization and soporific means used during acute tests.

4. Articles must have a short (half page) abstract in English, Russian and Georgian (including the following sections: aim of study, material and methods, results and conclusions) and a list of key words.

5. Tables must be presented in an original typed or computer-printed form, instead of a photocopied version. **Numbers, totals, percentile data on the tables must coincide with those in the texts of the articles.** Tables and graphs must be headed.

6. Photographs are required to be contrasted and must be submitted with doubles. Please number each photograph with a pencil on its back, indicate author's name, title of the article (short version), and mark out its top and bottom parts. Drawings must be accurate, drafts and diagrams drawn in Indian ink (or black ink). Photocopies of the X-ray photographs must be presented in a positive image in **tiff format**.

Accurately numbered subtitles for each illustration must be listed on a separate sheet of paper. In the subtitles for the microphotographs please indicate the ocular and objective lens magnification power, method of coloring or impregnation of the microscopic sections (preparations).

7. Please indicate last names, first and middle initials of the native authors, present names and initials of the foreign authors in the transcription of the original language, enclose in parenthesis corresponding number under which the author is listed in the reference materials.

8. Please follow guidance offered to authors by The International Committee of Medical Journal Editors guidance in its Uniform Requirements for Manuscripts Submitted to Biomedical Journals publication available online at: http://www.nlm.nih.gov/bsd/uniform_requirements.html
http://www.icmje.org/urm_full.pdf
In GMN style for each work cited in the text, a bibliographic reference is given, and this is located at the end of the article under the title "References". All references cited in the text must be listed. The list of references should be arranged alphabetically and then numbered. References are numbered in the text [numbers in square brackets] and in the reference list and numbers are repeated throughout the text as needed. The bibliographic description is given in the language of publication (citations in Georgian script are followed by Cyrillic and Latin).

9. To obtain the rights of publication articles must be accompanied by a visa from the project instructor or the establishment, where the work has been performed, and a reference letter, both written or typed on a special signed form, certified by a stamp or a seal.

10. Articles must be signed by all of the authors at the end, and they must be provided with a list of full names, office and home phone numbers and addresses or other non-office locations where the authors could be reached. The number of the authors (co-authors) must not exceed the limit of 5 people.

11. Editorial Staff reserves the rights to cut down in size and correct the articles. Proof-sheets are not sent out to the authors. The entire editorial and collation work is performed according to the author's original text.

12. Sending in the works that have already been assigned to the press by other Editorial Staffs or have been printed by other publishers is not permissible.

Articles that Fail to Meet the Aforementioned Requirements are not Assigned to be Reviewed.

ავტორთა საყურადღებოდ!

რედაქციაში სტატიის წარმოდგენისას საჭიროა დავიცვათ შემდეგი წესები:

1. სტატია უნდა წარმოადგინოთ 2 ცალად, რუსულ ან ინგლისურ ენებზე,დაბეჭდილი სტანდარტული ფურცლის 1 გვერდზე, 3 სმ სიგანის მარცხენა ველისა და სტრიქონებს შორის 1,5 ინტერვალის დაცვით. გამოყენებული კომპიუტერული შრიფტი რუსულ და ინგლისურენოვან ტექსტებში - **Times New Roman (Кириллица)**, ხოლო ქართულენოვან ტექსტში საჭიროა გამოვიყენოთ **AcadNusx.** შრიფტის ზომა – 12. სტატიას თან უნდა ახლდეს CD სტატიით.

2. სტატიის მოცულობა არ უნდა შეადგენდეს 10 გვერდზე ნაკლებს და 20 გვერდზე მეტს ლიტერატურის სიის და რეზიუმეების (ინგლისურ, რუსულ და ქართულ ენებზე) ჩათვლით.

3. სტატიაში საჭიროა გაშუქდეს: საკითხის აქტუალობა; კვლევის მიზანი; საკვლევი მასალა და გამოყენებული მეთოდები; მიღებული შედეგები და მათი განსჯა. ექსპერიმენტული ხასიათის სტატიების წარმოდგენისას ავტორებმა უნდა მიუთითონ საექსპერიმენტო ცხოველების სახეობა და რაოდენობა; გაუტკივარებისა და დაძინების მეთოდები (მწვავე ცდების პირობებში).

4. სტატიას თან უნდა ახლდეს რეზიუმე ინგლისურ, რუსულ და ქართულ ენებზე არანაკლებ ნახევარი გვერდის მოცულობისა (სათაურის, ავტორების, დაწესებულების მითითებით და უნდა შეიცავდეს შემდეგ განყოფილებებს: მიზანი, მასალა და მეთოდები, შედეგები და დასკვნები; ტექსტუალური ნაწილი არ უნდა იყოს 15 სტრიქონზე ნაკლები) და საკვანძო სიტყვების ჩამონათვალი (key words).

5. ცხრილები საჭიროა წარმოადგინოთ ნაბეჭდი სახით. ყველა ციფრული, შემაჯამებელი და პროცენტული მონაცემები უნდა შეესაბამებოდეს ტექსტში მოყვანილს.

6. ფოტოსურათები უნდა იყოს კონტრასტული; სურათები, ნახაზები, დიაგრამები - დასათაურებული, დანომრილი და სათანადო ადგილას ჩასმული. რენტგენოგრამების ფოტოასლები წარმოადგინეთ პოზიტიური გამოსახულებით **tiff** ფორმატში. მიკროფოტოსურათების წარწერებში საჭიროა მიუთითოთ ოკულარის ან ობიექტივის საშუალებით გადიდების ხარისხი, ანათალების შეღებვის ან იმპრეგნაციის მეთოდი და აღნიშნოთ სურათის ზედა და ქვედა ნაწილები.

7. სამამულო ავტორების გვარები სტატიაში აღინიშნება ინიციალების თანდართვით, უცხოურისა – უცხოური ტრანსკრიპციით.

8. სტატიას თან უნდა ახლდეს ავტორის მიერ გამოყენებული სამამულო და უცხოური შრომების ბიბლიოგრაფიული სია (ბოლო 5-8 წლის სიღრმით). ანბანური წყობით წარმოდგენილ ბიბლიოგრაფიულ სიაში მიუთითეთ ჯერ სამამულო, შემდეგ უცხოელი ავტორები (გვარი, ინიციალები, სტატიის სათაური, ჟურნალის დასახელება, გამოცემის ადგილი, წელი, ჟურნალის №, პირველი და ბოლო გვერდები). მონოგრაფიის შემთხვევაში მიუთითეთ გამოცემის წელი, ადგილი და გვერდების საერთო რაოდენობა. ტექსტში კვადრატულ ფჩხილებში უნდა მიუთითოთ ავტორის შესაბამისი N ლიტერატურის სიის მიხედვით. მიზანშეწონილია, რომ ციტირებული წყაროების უმეტესი ნაწილი იყოს 5-6 წლის სიღრმის.

9. სტატიას თან უნდა ახლდეს: ა) დაწესებულების ან სამეცნიერო ხელმძღვანელის წარდგინება, დამოწმებული ხელმოწერითა და ბეჭდით; ბ) დარგის სპეციალისტის დამოწმებული რეცენზია, რომელშიც მითითებული იქნება საკითხის აქტუალობა, მასალის საკმაობა, მეთოდის სანდოობა, შედეგების სამეცნიერო-პრაქტიკული მნიშვნელობა.

10. სტატიის ბოლოს საჭიროა ყველა ავტორის ხელმოწერა, რომელთა რაოდენობა არ უნდა აღემატებოდეს 5-ს.

11. რედაქცია იტოვებს უფლებას შეასწოროს სტატია. ტექსტზე მუშაობა და შეჯერება ხდება საავტორო ორიგინალის მიხედვით.

12. დაუშვებელია რედაქციაში ისეთი სტატიის წარდგენა, რომელიც დასაბეჭდად წარდგენილი იყო სხვა რედაქციაში ან გამოქვეყნებული იყო სხვა გამოცემებში.

აღნიშნული წესების დარღვევის შემთხვევაში სტატიები არ განიხილება.

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IMMUNOLOGICAL CRITERIA FOR PREDICTING SEVERE AND COMPLICATED FORMS OF VARICELLA ZOSTER IN CHILDREN

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Abstract.

Aim of the study: To evaluate immunological markers associated with the risk of severe and complicated forms of varicella zoster virus (VZ) in children in order to determine prognostic criteria for disease severity.

Materials and methods: The study included 120 children with VZ, divided into groups with complicated (n=63) and uncomplicated (n=57) disease. All patients underwent assessment of interferon alpha markers, complement components (C3, C4), antibodies to MAG, TGF, as well as analysis of complete blood count and C-reactive protein (CRP). Statistical analysis included binary logistic regression and 5-fold cross-validation.

Selection criteria: Children aged 0 to 18 years inclusive with a verified diagnosis of varicella

Results: The most significant predictors of complicated disease were elevated levels of CRP (OR = 10.05; $p < 0.001$), platelets (OR = 9.69; $p = 0.04$), and C3 component (OR = 2.77; $p = 0.006$), as well as reduced levels of C4 component (OR = 0.036; $p = 0.005$). The logistic regression model showed high discriminatory ability (AUC = 0.7857).

Conclusion: Immunological parameters such as CRP, C3, C4 and platelets can be used as prognostic markers of complicated varicella in children. Early assessment of immune status contributes to the timely identification of patients at risk and optimization of treatment tactics.

Key words. Varicella, immunological markers, children, CRP, compliment, prognosis of complications.

Introduction.

Varicella-zoster virus (VZV) is one of eight known herpesviruses that cause human infection and is distributed worldwide. VZV infection causes two clinically distinct forms of disease: chickenpox (varicella) and herpes zoster (HZ) [1-8]. While primary VZV infection is typically benign, HZ is often accompanied by postherpetic neuralgia (PHN) and is an important cause of uveitis and vasculitic stroke. Both the highly cell-associated nature of VZV and the strict barrier between virus species have hampered studies of VZV pathogenesis [6].

Varicella-zoster virus (VZV) is a highly infectious, nearly ubiquitous pathogen that infects all human populations. However, the epidemiology of VZV infection varies by geographic location. In temperate climates, most children acquire primary VZV infection during school age, with a marked seasonal increase in cases of chickenpox in the spring, and less than 1–3% of individuals remain susceptible to infection beyond age 20 years [8].

VZV is highly contagious, with an incubation period of 14–16 days after infection, and is spread through the air and direct contact with skin lesions. In the absence of a universal varicella (UVV) vaccination program, most cases of infection occur in childhood [9-14].

Primary infection with VZV results in chickenpox, a usually benign childhood illness characterized by fever and an itchy vesicular rash. However, complications such as bacterial skin infections, pneumonia, and encephalitis may occur and can cause significant morbidity and mortality, especially if primary infection occurs in adults or immunocompromised individuals [5,13].

The pathogenesis of the disease has been studied using smallpox and SCID-hu mouse models, although its exact mechanism remains unclear. The role of humoral immunity in VZV infection is well described, as antibodies are known to be involved in the development of varicella zoster [10,3].

The immune system plays an important role in protection against varicella. Patients with a history of malignancy, steroid use, immunosuppressive therapy, HIV infection, or organ transplantation are susceptible to disseminated varicella and its reactivation with or without neurological complications. Moreover, varicella vaccines, which induce strong and durable B- and T-cell immunity, effectively protect children and adults from infection [1,7].

The relevance of this study is due to the need for a deeper understanding of the immune mechanisms underlying the variability of the clinical course of VZV, which is key to the development of effective prevention and therapy strategies. Studying the interaction of the VZV virus with the human immune system allows us to clarify the pathogenetic links of the disease and identify the factors that determine its severity. The results of this work can significantly enrich the epidemiological data on VZV and contribute to the formation of new approaches to controlling its spread. The aim of the study was to assess the immunological parameters associated with the risk of developing complicated forms of chickenpox in children to determine prognostic criteria for the severity of the disease.

Materials and Methods.

The immunological markers were assessed in 120 children divided into 2 groups: 1 - children with complicated form of VZV - 63 children and uncomplicated - 57 children, aged 0 to 18 years. Of these, 43 were girls and 77 were boys. Severe form of the disease was noted in 5 patients (4%), moderate - 58 (48%) in humans. C4, C3 compliment, TGF, interferon alfa, Anti-MAG were determined by ELISA on Cloud Clo, Vector Vest kits. CRP and OAC (complete blood count) with leukocyte formula were also studied. Although Anti-MAG has traditionally been associated with peripheral neuropathy, its use in this study was aimed at exploring possible links between autoimmune activation and neurological complications of varicella.

The diagnosis of VZV was established on the basis of clinical and anamnestic data (increased temperature, vesicular rashes on the head, trunk, limbs, some children had systemic enlargement of the lymph nodes).

In 18 children, the disease was complicated by viral-bacterial pneumonia. The diagnosis of pneumonia was established on the basis of clinical and laboratory (cough, shortness of breath, moist rales, dullness of percussion sound, inflammatory reaction of the blood) and radiological data (infiltrative changes in the lung tissue). In 5 children out of 63, the condition was assessed as severe, they received treatment in the intensive care unit.

The study was approved by the local bioethics committee of the NJSC "Karaganda Medical University". Written and signed informed consent was obtained from all patients participating in the study (or their legal representatives, if necessary).

Statistical processing.

For categorical variables with expected frequencies (e.g., gender), differences between groups were assessed using the Pearson χ^2 test. For categorical variables with small expected frequencies (<5 per cell), the Fisher exact test was used. For numerical variables, presented as median and interquartile range (Me [Q1–Q3]), comparisons between two independent groups were performed using the nonparametric Mann–Whitney test.

Binary logistic regression was used to identify independent predictors of complicated disease (Diagnos = Y). Variables with $p < 0.1$ according to the results of univariate analysis were included in the multivariate model. Odds ratios (OR) with 95% confidence intervals (CI) were calculated. 5-fold cross-validation was used to assess the accuracy of the model; the average accuracy was 74.17% (±4.86), the average AUC ROC value was 0.7857 (±0.056), which indicates good discriminatory ability of the model. In addition, precision and recall were analyzed for both classes.

Results.

The data collection was conducted at the hospital of the IC "OKB" (Kazakhstan, Karaganda) in the period from 03.2024 to 05.2025 in children with a verified diagnosis of VZV.

Of the 120 children, complications from the central nervous system accounted for 24%, from the respiratory system 33%, generalized systemic inflammation (sepsis) 5%, and from the skin 38%.

Complications from the respiratory system: pneumonia of viral and bacterial etiology. The causative agents of which were Staphylococcus aureus10^5, Staphylococcus hominis 10^6, Staphylococcus salivarius 10^6. As well as acute simple and acute obstructive bronchitis, associated with Enterobacter aerogenes 10^6, Staphylococcus aureus10^6, Staphylococcus haemolyticus 10^6, Streptococcus pneumonia 10^6, Candida albicans 10^4, Klebsiella pneumoniae 10^6.

Inflammatory diseases of the skin and subcutaneous tissue manifested themselves in the form of pyoderma (streptoderma), phlegmon. Lesions of the central nervous system due to: meningococcal meningitis, hepatic encephalopathy. There were also children with cerebral palsy (ataxic cerebral palsy), obstructive hydrocephalus, epilepsy, congenital progressive hydrocephalus).

Table 1 presents the demographic and laboratory parameters of patients with complicated and uncomplicated forms of VZV. Statistically significant differences between the groups were found for a number of immunological parameters. In particular, the levels of CRP, complement component C3 and C4, and platelets were significantly higher in patients with complicated disease ($p < 0.05$).

An assessment was made of the prevalence of background (concomitant) diseases and individual clinical characteristics in children with complicated and uncomplicated VZV. The analysis included the frequency of anemia, lymphadenitis, acute otitis, purulent tonsillitis, acute intestinal infections (AII) and urinary tract infections (UTI), as well as distribution by gender and age.

Univariate analysis revealed no statistically significant differences in the frequency of the above conditions between the groups ($p > 0.05$). Anemia was more common in patients with complicated disease (31.7% vs. 15.8%), but the difference did not reach statistical significance ($p = 0.0679$). Gender distribution also did not differ between the groups ($p = 0.4630$). The median age of children with complicated disease was statistically significantly lower than in the group without complications ($p = 0.0207$).

The lower median age found among children with complicated varicella zoster may indicate a greater susceptibility of younger age groups to severe or complicated disease. This may be due to the immaturity of the adaptive immune response, less “immunological experience” with herpesvirus infections, and/or limited compensatory capabilities of the body in younger children. The data obtained are consistent with literature indicating a higher risk of complications in preschoolers and young children [12,16].

The day of the appearance of the rash varied from the onset of the disease: 1st day in 87 children, 2nd day in 17 children, 3rd day in 1 child, 4th day in 4 children, 5th day-1, 6th day in 4 children, 7th day in 2 children, 9th day in 1 child, unknown in 2 children due to late referrals.

The duration of the rash period was different, in 8 patients the duration could not be determined for various reasons: transfer to another hospital, late referral and unauthorized premature withdrawal.

The data are presented in Table 3.

The duration of the rash did not differ statistically between patients with complicated and uncomplicated forms of VZV ($p = 0.339$). The median duration of the rash in both groups was 6 days. The content of immune indicators was studied in patients with complicated and uncomplicated forms of varicella zoster virus. The most significant signs were: Complement C3, complement C4, CRP (C-reactive protein), platelets. The level of Anti-mag and hematocrit were close to the known ones.

Gender, age, TGF-b, interferon, leukocytes, segmented neutrophils (s/n) lymphocytes did not have a significant effect in patients with VZV. The data are shown in Table 4.

Interpretation of coefficients, OR, 95% CI and p-values

Each feature is assessed by its impact on the probability of Diagnos = Y (presence of diagnosis) compared to Diagnos = N (baseline, no diagnosis). The significance of the effect is determined by the p-value (< 0.05), and the magnitude is determined by the OR and 95% CI.

Significant features ($p < 0.05$):

Complement C3: Elevated levels of the complement component C3 were significantly associated with the risk of developing

Table 1. *Demographic and laboratory characteristics of children with varicella.*

Parameter	Complicated (n=63)	Uncomplicated (n=57)	p-value
CRP (mg/L)	7.05 [5.00–9.85]	1.10 [1.00–3.00]	0.0000
Complement C3	196.67 [158.12–291.44]	215.35 [154.21–350.00]	0.8079
Complement C4	706.17 [641.14–804.67]	781.86 [701.35–838.15]	0.0451
Anti-MAG	2.93 [1.62–26.08]	1.98 [0.81–4.37]	0.0605
TGF	11.70 [9.26–14.26]	14.62 [10.24–18.97]	0.0132
Interferon alfa	8.49 [6.87–11.92]	7.10 [6.02–9.26]	0.0489
Leukocytes	10.15 [7.42–13.45]	6.30 [4.90–9.40]	0.0000
Segmented neutrophils (%)	50.50 [30.75–62.75]	59.00 [41.00–69.00]	0.0726
Lymphocytes (%)	40.00 [28.25–60.00]	35.00 [23.00–50.00]	0.3051
Hematocrit (%)	33.50 [31.75–37.00]	34.00 [32.00–39.00]	0.6454
Monocytes (%)	5.50 [4.00–8.00]	5.00 [3.00–8.00]	0.3097
Platelets (×10⁹/L)	295.50 [215.50–406.75]	263.00 [224.00–299.00]	0.0426

Table 2. *Comorbidities and demographic characteristics in children with complicated and uncomplicated varicella zoster.*

Parameter	Complicated form (n = 63)	Uncomplicated form (n = 57)	p-value
Sex (M:F)	38 / 25	39 / 18	0.4630*
Age (years), median [IQR]	5.0 [2.0–9.0]	9.0 [4.0–15.0]	0.0207
Anemia, n (%)	20 (31.7%)	9 (15.8%)	0.0679
Lymphadenitis, n (%)	3 (4.8%)	2 (3.5%)	1.0000
Acute otitis, n (%)	1 (1.6%)	0 (0.0%)	1.0000
Purulent tonsillitis, n (%)	1 (1.6%)	1 (1.8%)	1.0000
Acute intestinal infection (AII), n (%)	3 (4.8%)	0 (0.0%)	0.2456
Urinary tract infections (UTI), n (%)	5 (7.9%)	2 (3.5%)	0.4433

Table 3. *Duration of rash in children with VZV.*

Parameter	Complicated form (O)	Uncomplicated form (H)	p-value
Duration of rash (days)	6.0 [5.0–9.0]	6.0 [4.0–7.0]	0.3392

Table 4. *Laboratory statistical data.*

Feature	Coefficient	Odds Ratio	95% CI Lower	95% CI Upper	p-value
Gender	0.541	1.718	0.595	4.962	0.317
Age	-0.072	0.930	0.614	1.410	0.733
Complement C3	1.017	2.765	1.348	5.674	0.006
Anti -mag	0.618	1.856	0.945	3.645	0.073
Complement C4	-3.328	0.036	0.003	0.367	0.005
TGF	-0.266	0.766	0.315	1.861	0.557
Interferon alfa	0.026	1.026	0.414	2.546	0.955
CRB	2.308	10.053	3.888	25.993	0.000
Leic	0.496	1.642	0.191	14.129	0.652
CJ	-0.220	0.802	0.375	1.714	0.570
Limfocit	0.293	1.341	0.030	59.358	0.879
Hematocrit	1.374	3.952	0.781	19.991	0.097
Monocit	-1.126	0.324	0.034	3.057	0.325
Trombocit	2.271	9.693	1.090	86.172	0.042

complicated varicella zoster virus in children (OR = 2.77; 95% CI: 1.35–5.67; p = 0.006). This indicates a significant role of complement activation in the pathogenesis of severe forms of the disease, probably due to an increase in the inflammatory response. **Complement C4:** Unlike C3, an increase in C4 levels had the opposite effect — a protective effect. According to the analysis results, an increase in C4 levels reduced the likelihood of a complicated course by almost 28 times (OR = 0.036; 95% CI: 0.003–0.367; p = 0.005). This confirms the hypothesis about the important role of C4 in regulating anti-inflammatory mechanisms during infection. **C-reactive protein:** The level of C-reactive protein demonstrated the greatest prognostic power among all the studied markers. According to the results of logistic regression, an increase in the concentration of CRP is significantly associated with a more than tenfold increase in the risk of complicated disease (OR =

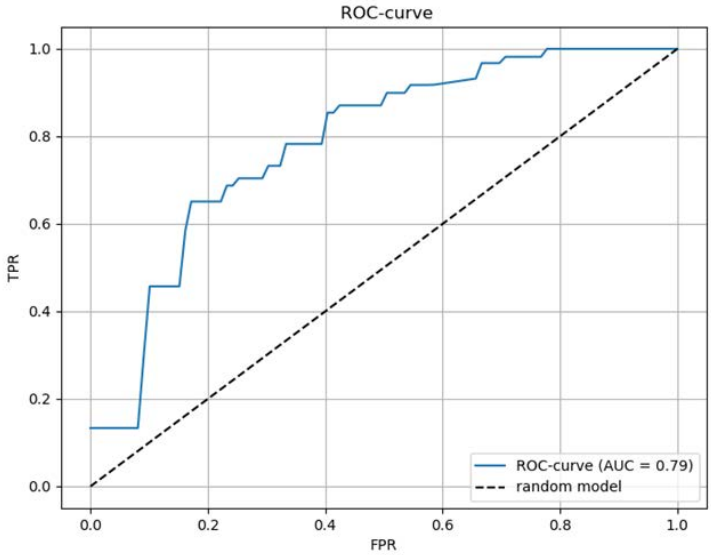

Figure 1. *Diagnostic ability of the model.*

10.05; 95% CI: 3.89–25.99; p < 0.001).

A narrow confidence interval and high statistical significance indicate the stability and reliability of this predictor. This confirms the key role of systemic inflammation in the pathogenesis of severe forms of chickenpox and emphasizes the clinical value of CRP as a screening marker.

Platelets:

The predictive role of platelets requires cautious interpretation. Although the model demonstrated an almost tenfold increase in the risk of complications, the wide confidence interval (1.09–86.17) indicates the instability of this estimate. The presence of outliers, as well as clinical heterogeneity of subgroups, may have contributed to this effect. Larger-scale studies are needed to confirm the relevance of the platelet response. This may be related to the heterogeneity of clinical conditions influencing platelet dynamics—for example, inflammation, infectious stress, or concomitant hemostatic disorders. Nevertheless, statistical significance was maintained, suggesting that platelets may represent a potentially important prognostic biomarker, particularly in the context of an integrated assessment of the patient's immune profile.

Signs close to significance (p < 0.1):

Hematocrit.

Interpretation:

An increase in hematocrit is associated with an increase in the probability of complicated VZV by almost 4 times (OR = 3.95). However, this effect has borderline statistical significance (p = 0.097), and a wide confidence interval, including one, indicates possible instability of the estimate.

However, the tendency for association may reflect a compensatory response to inflammation, dehydration or hypovolemia, especially in children with severe intoxication or prolonged fever. Given the biological plausibility and proximity of the p-value to the significance threshold, hematocrit may be considered as a potential marker requiring additional validation in larger cohort studies.

Anti-MAG:

The presence of antibodies to myelin-associated glycoprotein (Anti-MAG) demonstrated a tendency toward statistical significance (OR = 1.86; 95% CI: 0.94–3.64; p = 0.073), which may indicate a possible association with the activation of autoimmune mechanisms. However, given the wide confidence interval and borderline p value, this marker requires additional research on a larger sample.

A number of variables included in the model did not demonstrate a statistically significant effect on the risk of developing complicated varicella zoster (significance level p ≥ 0.1). This may indicate either a weak association with the clinical outcome or insufficient sample power to detect the effect. These variables and their corresponding indicators are presented below:

Gender: OR = 1.72; 95% CI: 0.60–4.96; p = 0.317

No gender differences in the risk of complicated course were found.

Age: OR = 0.93; 95% CI: 0.61–1.41; p = 0.733

The age factor did not have a significant effect on the outcome, which may be due to the wide age range of the included patients.

TGF-β: OR = 0.77; 95% CI: 0.32–1.86; p = 0.557

The level of TGF-β was not associated with the severity of the infection, despite the known immunoregulatory role of this cytokine.

Interferon alfa: OR = 1.03; 95% CI: 0.41–2.55; p = 0.955

The lack of effect may be due to the phase of the disease (in some patients, samples were taken during the convalescence period) in which the samples were collected.

Leukocytes: OR = 1.64; 95% CI: 0.19–14.13; p = 0.652

The number of leukocytes did not correlate with the risk of complications, which may indicate their non-specificity in this clinical situation.

CJ (segmented neutrophils): OR = 0.80; 95% CI: 0.38–1.71; p = 0.570

The level of neutrophils did not show a predictive value for complicated course.

Lymphocytes: OR = 1.34; 95% CI: 0.03–59.36; p = 0.879

Despite high variability (wide confidence interval), no significant effect was found.

Monocytes: OR = 0.32; 95% CI: 0.03–3.06; p = 0.325

Monocyte levels were also not associated with disease severity.

The diagnostic ability of the model was assessed using 5-fold cross-validation. The average accuracy of the model was 74.17% (±4.86), the average AUC ROC (Area Under the Receiver Operating Characteristic Curve) was 0.7857 (±0.056), indicating a good ability of the model to distinguish between complicated and uncomplicated disease. The accuracy and recall indicators were also calculated: precision for the "complicated course" class was 78%, recall— 71%, indicating the reliability of the model in predicting adverse outcomes.

Discussion.

In the present study, we demonstrated that elevated levels of C-reactive protein (CRP), platelets, and complement component C3, as well as reduced C4 levels, were significantly associated with the development of complicated varicella in children. Among these markers, CRP was the strongest predictor, with elevated levels increasing the risk of complications more than tenfold. This highlights the pivotal role of systemic inflammation in the pathogenesis of severe forms of the disease. Our findings are consistent with international research. Shah et al. (2023) reported in a systematic review and meta-analysis that severe varicella cases are frequently accompanied by pronounced inflammatory changes, including increased CRP levels [11]. Similarly, Guo et al. (2024) identified CRP >30 mg/L as an independent risk factor for visceral disseminated varicella [4]. In addition, Zhang et al. (2025) demonstrated that inflammation-derived hematological indices, such as platelet-to-lymphocyte ratio (PLR) and neutrophil-to-lymphocyte ratio (NLR), have predictive value in patients with VZV meningitis, further supporting the role of inflammatory responses in disease severity [15]. The complement system also warrants attention. In our cohort, elevated C3 and reduced C4 were linked to complicated courses of infection. This finding is consistent with earlier studies suggesting that hypo-C4-emia reflects depletion of anti-inflammatory mechanisms, whereas increased C3 may indicate overactivation of pro-inflammatory pathways [2]. In contrast, cytokine parameters such as TGF and interferon-alpha, as well as leukocyte counts, did not demonstrate prognostic value in our analysis. This observation is consistent with reports from Russian studies, where impaired interferon responses and reduced cytokine regulation were noted in severe cases of varicella [9]. Such findings may reflect the complexity of host–virus interactions and the heterogeneity of immune responses across populations. Previous studies have shown that the IL-10 polymorphism (rs1800872) may be associated with severe varicella and its complications in adult patients, although the findings are not always reproducible, and null effects have been reported for certain genotypes [17]. Overall, our data support the prognostic utility of routine and widely accessible laboratory markers — CRP, complement components C3 and C4, and platelet counts — for the early identification of children at risk for complicated varicella. Incorporating these parameters into clinical practice could improve risk stratification and enable timely therapeutic interventions, thereby reducing the burden of complications associated with this common pediatric infection.

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Conflict of interest.

The authors declare no conflicts of interest to report.

Further research.

In this study, the complication group encompassed a broad spectrum of pathologies, ranging from central nervous system to respiratory, dermatological, and systemic forms. The combined evaluation of all complications may obscure the identification of more specific predictors for individual clinical outcomes. Therefore, in future research, it would be advisable to perform subgroup analyses of complications or, at the very least, to acknowledge this heterogeneity as an important limitation when interpreting the findings.

Authors' contribution.

O.A. Zolotareva R. Kh. Begaydarova – concept and design of the study, editing.

Z. E. Alshimbayeva, B.K. Koichubekov – writing the text, statistical processing.

G. K. Alshinbekova, R. Kh. Begaydarova – analysis of case histories, editing.

Z. E. Alshimbayeva, O.A. Zolotareva – collection and processing of material, article design.

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Иммунологические критерии прогнозирования тяжелых и осложненных форм ветряной оспы у детей

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Аннотация

Цель. Оценить иммунологические маркеры, ассоциированные с риском развития тяжелых и осложненных форм ветряной оспы у детей, с целью определения прогностических критериев тяжести заболевания.

Материалы и методы. В исследование включены 120 детей с ветряной оспой, разделённые на группы с осложненным (n=63) и неосложнённым (n=57) течением заболевания. У всех пациентов проводилась оценка уровня маркеров интерферон альфа, компонентов комплемента (C3, C4), антител к MAG, TGF, а также анализ показателей общего анализа крови и С-реактивного белка (СРБ). Статистический анализ включал бинарную логистическую регрессию и 5-фолд кросс-валидацию.

Критерии выбора: дети от 0 до 18 лет включительно с верифицированным диагнозом ветряная оспа.

Результаты. Наиболее значимыми предикторами осложнённого течения заболевания стали повышенные уровни CRP (OR = 10.05; p < 0.001), тромбоцитов (OR = 9.69; p = 0.04), и C3-компонента (OR = 2.77; p = 0.006), а также сниженные уровни C4-компонента (OR = 0.036; p = 0.005). Модель логистической регрессии показала высокую дискриминационную способность(AUC=0.7857).

Заключение. Иммунологические показатели, такие как СРБ, C3, C4 и тромбоциты, могут быть использованы в качестве прогностических маркеров осложнённого течения ветряной оспы у детей. Ранняя оценка иммунного статуса способствует своевременному выявлению пациентов из группы риска и оптимизации лечебной тактики.

Ключевые слова: ветряная оспа, иммунологические маркеры, дети, СРБ, комплемент.

ანოტაცია

მიზანი. იმუნოლოგიური მარკერების შეფასება, რომლებიც ასოცირებულია ბავშვებში ვარიოლას მძიმე და გართულებულ ფორმებთან, დაავადების სიმძიმის პროგნოზირების კრიტერიუმების განსაზღვრის მიზნით.

მასალები და მეთოდები. კვლევაში ჩართული იყო 120 ბავშვი ვარიოლათი, რომლებიც დაყოფილ იქნენ გართულებული (n=63) და არაგართულებული (n=57) მიმდინარეობის მქონე ჯგუფებად. ყველა პაციენტს ჩაუტარდა ინტერფერონ-ალფას, კომპლემენტის კომპონენტების (C3, C4), Anti-MAG ანტისხეულების, TGF-ის, აგრეთვე სისხლის საერთო ანალიზისა და C-რეაქტიული პროტეინის (CRP) შეფასება. სტატისტიკური ანალიზი მოიცავდა ბინარულ ლოგისტიკურ რეგრესიას და 5-ნაკადოვან კროს-ვალიდაციას.

ჩართვის კრიტერიუმები: 0-18 წლის ასაკის ბავშვები ვარიოლას დადასტურებული დიაგნოზით.

შედეგები. გართულებული მიმდინარეობის ყველაზე მნიშვნელოვანი პროგნოზული ფაქტორები იყო CRP-ის მომატებული დონე (OR = 10.05; p < 0.001), თრომბოციტების რაოდენობა (OR = 9.69; p = 0.04) და C3 კომპონენტი (OR = 2.77; p = 0.006), აგრეთვე C4 კომპონენტის დაქვეითებული დონე (OR = 0.036; p = 0.005). ლოგისტიკურმა მოდელმა აჩვენა კარგი დისკრიმინაციული უნარი (AUC = 0.7857).

დასკვნა. იმუნოლოგიური პარამეტრები, როგორიცაა CRP, C3, C4 და თრომბოციტები, შეიძლება გამოყენებულ იქნას ბავშვებში ვარიოლას გართულებული მიმდინარეობის პროგნოზირებისთვის. იმუნური სტატუსის ადრეული შეფასება ხელს უწყობს მაღალი რისკის პაციენტების დროულ იდენტიფიკაციას და თერაპიული ტაქტიკის ოპტიმიზაციას.

საკვანძო სიტყვები: ვარიოლა, იმუნოლოგიური მარკერები, ბავშვები, CRP, კომპლემენტი