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IMMUNOHEMATOLOGICAL INDICES AS MARKERS OF INFLAMMATION, CELLULAR AND NONSPECIFIC IMMUNOLOGICAL DEFENSE IN CHILDREN WITH ACUTE OTITIS MEDIA

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Acute otitis media (AOM) ranks among the most common childhood illnesses worldwide, impacting millions of children annually and representing a considerable public health concern. Although the fundamental immunological pathways involved in AOM are relatively well understood, the role of non-specific immune responses in the disease's pathogenesis remains underexplored.

***Objective** – to evaluate immune-hematological indices as integral indicators of cellular and general immunological reactivity and nonspecific anti-infective protection in children with AOM depending on the ear discharge (catarrhal vs purulent).*

***Material and methods.** Prospective cohort study included 95 children diagnosed with AOM, aged between 7 and 18 years: 34.74% (n=33) were girls and 65.26% (n=62) were boys. The study was carried out in accordance with the principles of Good Clinical Practice, Good Laboratory Practice, and established ethical standards for biomedical research involving human subjects. Participants were categorized based on the type of mucosal inflammation: catarrhal in 52.63% (n=50) and purulent in 47.37% (n=45) of cases. The control group consisted of 50 generally healthy children: 20 girls (40.0%) and 30 boys (60.0%). Cellular and general immunological reactivity and resistance, neutrophil reactive response were assessed on the basis of a complete blood cell count with subsequent calculation of the integral indices. Statistical analysis was conducted using Statistica 7.0 (StatSoft Inc, USA) software and Excel® 2016™. The differences between groups for independent samples were verified using the unpaired Student's t-test (if the data distribution were close to normal according to the Kolmogorov-Smirnov tests and the Shapiro-Wilk W-test), or the Wilcoxon-Mann-Whitney U-test (for an uneven data distribution). Differences were considered significant at P values <0.05.*

***Results.** Immuno-haematological indices certify two conditional clinical and laboratory variants of the AOM course in the examined children. The first variant (purulent AOM) is characterized by moderate neutrophilosis (+II), pronounced hyporegenerative nuclear shift due to rod-shaped neutrophils, eosinophilic granulocytes and a significant increase in intoxication indices. Such blood changes indicate the predominance of the bacterial component (purulent process in the middle ear), pronounced severity of inflammation against the background of increased cellular and immune reactivity, corresponding activation of resistance and sensitization of the organism with a predominance of immediate-type hypersensitivity. In these children, a specific humoral immune response begins to form. The second variant of the AOM course (catarrhal) is characterized by relative and absolute rod-shaped neutrophilosis (less pronounced than in the purulent AOM), higher lymphocytosis and monocytosis, with an increase in nonspecific and immune resistance indices, which prove sensitization of the organism with the development of delayed-type hypersensitivity, against the background of moderately pronounced intoxication. The revealed pattern indicates the predominance of lymphocytic activation with the development of specific cellular defence.*

***Conclusions.** AOM in children is characterized by laboratory manifestations of endotoxicosis (more severe in purulent AOM) caused by endointoxication at the level of peripheral blood and exointoxication of infectious origin.*

Key words:
Acute Otitis Media; inflammation; catarrhal and purulent Otitis; children; cellular and nonspecific immunological defense; nonspecific and immune resistance.

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ІМУНО-ГЕМАТОЛОГІЧНІ ІНДЕКСИ ЯК МАРКЕРИ ЗАПАЛЕННЯ, КЛІТИННОГО І НЕСПЕЦИФІЧНОГО ІМУНОЛОГІЧНОГО ЗАХИСТУ У ДІТЕЙ ІЗ ГОСТРИМ СЕРЕДНІМ ОТИТОМ

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Гострий середній отит (ГСО) займає передові позиції серед найбільш розповсюджених захворювань дитячого віку, щорічно вражаючи мільйони дітей та створюючи значну проблему для громадського здоров'я. Незважаючи на те, що фундаментальні імунологічні шляхи, що беруть участь у розвитку ГСО, відносно добре вивчені, роль неспецифічних імунних реакцій у патогенезі захворювання залишається досліджена недостатньо.

Ключові слова:
катаральний та гнійний гострий середній отит, діти, клітинний та неспецифічний імунологічний захист, неспецифічна та імунна резистентність.

Клінічна та експериментальна патологія 2025. Т.24, №2 (92). С. 27-35.

Метароботи *– оцінити імуногематологічні індекси як інтегральні показники клітинної, загальної імунологічної реактивності та неспецифічного протиінфекційного захисту у дітей із ГСО залежно відхарактеру виділень із вуха (катаральні чи гнійні).*

Матеріали та методи. *Проспективним когортним дослідженням охоплено 95 дітей із діагнозом ГСО віком від 7 до 18 років: 34,74% (n=33) – дівчатка та 65,26% (n=62) – хлопчики. Дослідження проводили відповідно до принципів належної клінічної та лабораторної практики і встановлених етичних стандартів для біомедичних досліджень за участі людей. Учасників класифікували за типом запалення слизової оболонки середнього вуха: катаральне у 52,63% (n=50) та гнійне у 47,37% (n=45) випадків. Контрольну групу становили 50 практично здорових дітей: 20 дівчаток (40,0%) та 30 хлопчиків (60,0%). Клітинну та загальну імунологічну реактивність і резистентність, реактивну відповідь нейтрофілів оцінювали на основі загального аналізу крові з подальшим розрахунком інтегральних індексів. Статистичний аналіз проводили з використанням програмного забезпечення Statistica 7.0 (StatSoft Inc, США) та Excel® 2016™. Відмінності між групами для незалежних вибірок перевіряли за допомогою непарного t-критерію Стьюдента (якщо розподіл даних був близьким до нормального згідно з тестами Колмогорова-Смірнова та W-критерієм Шапіро-Вілка) або U-критерія Вілкоксона-Манна-Вітні (для нерівномірного розподілу даних). Відмінності вважали достовірними при значеннях P < 0,05.*

Результати. *Імуногематологічні показники засвідчують два умовні клініко-лабораторні варіанти перебігу ГСО в обстежених дітей. Перший варіант (гнійний ГСО) характеризується помірним нейтрофільозом (+II), вираженим гіпорегенеративним ядерним зсувом за рахунок паличкоядерних нейтрофілів, еозинофільних гранулоцитів та значним підвищенням показників інтоксикації. Такі зміни крові засвідчують про переважання бактеріального компонента (гнійний середній отит), виражену тяжкість запалення на тлі підвищеної клітинної та імунної реактивності, відповідну активацію резистентності та сенсибілізацію організму з переважанням гіперчутливості негайного типу. У цих дітей починає формуватися гуморальна специфічна імунна відповідь. Другий варіант перебігу ГСО (катаральний) характеризується відносним та абсолютним паличкоядерним нейтрофільозом (менш вираженим, ніж при гнійному ГСО), вищим лімфоцитозом та моноцитозом, зі збільшенням показників імунної та неспецифічної резистентності, що засвідчує про сенсибілізацію організму з розвитком гіперчутливості уповільненого типу на тлі помірно вираженої інтоксикації. Виявлена закономірність вказує на переважання лімфоцитарної активації з розвитком специфічного клітинного захисту.*

Висновки. *Гострий середній отит у дітей характеризується лабораторними проявами ендотоксикозу (більш тяжчого за гнійного варіанту), спричиненого ендоінтоксикацією на рівні периферичної крові та екзоінтоксикацією інфекційного походження.*

Introduction

Acute otitis media (AOM) is one of the most prevalent infectious conditions in paediatric populations globally, with millions of new cases reported each year [1, 2]. This high incidence positions AOM as a significant concern for public health systems, particularly due to its association with antimicrobial resistance and recurrent morbidity in early childhood. Acute otitis media involves inflammation of the mucosal lining throughout the middle ear cavity, including the lining of the tympanic cavity and the tympanic membrane [3]. While core immunological mechanisms underlying the onset of AOM have been extensively characterized, the contribution of non-specific immune factors, including innate and inflammatory responses, remains insufficiently studied and is often underestimated in both clinical and research settings. Greater attention to these mechanisms may improve early diagnostic markers and therapeutic strategies.

Among possible early diagnostic markers, the various hematologic indices, such as absolute counts of neutrophils, lymphocytes, monocytes, and platelets, along with derived indices like the neutrophil-to-lymphocyte ratio (NLR), monocyte-to-lymphocyte ratio (MLR), and platelet-to-lymphocyte ratio (PLR), have been suggested as useful tools for diagnosing infections, providing early warning of disease progression, and stratifying patient risk [4]. The NLR is a fundamental inflammatory marker derived from the complete blood count (CBC), with a typical range of 0.78 to 3.58 [5]. Elevated NLR values have been identified as a useful indicator in various otolaryngological conditions, including otitis media with effusion [6], virus induced facial palsy [7], and as a positive prognostic factor in idiopathic sudden sensorineural hearing loss [8].

NLR has proven to be a valuable indicator for both diagnosing and gauging the severity of community acquired pneumonia and bacteremia [9, 10]. Similarly, MLR and PLR have been validated as surrogate biomarkers for identifying influenza virus infection in patients with respiratory tract illnesses [11], rheumatoid arthritis [12]. However, there remains a paucity of research evaluating the diagnostic utility of these hematologic indices specifically in otitis media in children [13].

Therefore, this study aimed to examine the absolute and relative number of the main populations of immunocompetent cells of a complete blood cell count (CBC) (neutrophils, lymphocytes, monocytes, platelets, etc, with following calculation of immuno-hematological

indices and ratio NLR, MLR, PLR, etc) in children with AOM to determine their diagnostic value and explore their relationship with disease severity.

The aim of the study

To evaluate immune-hematological indices as integral indicators of cellular and general immunological reactivity and nonspecific anti-infective protection in children with AOM depending on the ear discharge (catarrhal vs purulent).

Research material and methods

Clinical data for the study were collected at the Municipal Non-profit Enterprise «Multidisciplinary Hospital of Intensive Care» in Kitsman between 2023 and 2024. The prospective study enrolled 100 children diagnosed with acute otitis media (AOM). After screening, 95 participants aged 7 to 18 years met the inclusion criteria. Informed consent was obtained from their parents or legal guardians. Each participant underwent a comprehensive evaluation, including medical history, clinical examination, laboratory testing, and instrumental diagnostics.

The research adhered to ethical standards outlined in the Council of Europe Convention on Human Rights and Biomedicine, the principles of Good Clinical Practice (GCP, 1996), and the Declaration of Helsinki by the World Medical Association. The study protocol received approval from the Biomedical Ethics Commission of Bukovinian State Medical University (BSMU).

Diagnosis and assessment of AOM severity were conducted according to the National Unified Clinical Protocol for Acute Otitis Media, authorized by the Ministry of Health of Ukraine (Order № 688, April 9, 2021), alongside relevant national clinical guidelines (2021) [14, 15] and international standards [1, 3, 16]. When indicated, additional radiographic imaging – including X-rays of the mastoid bones, paranasal sinuses, and chest – was performed in two standard projections.

The children were categorized by age into two groups: 7-11 years (n = 81) and 12-18 years (n = 14). Based on the severity of AOM, 43 cases (45.26%) were classified as severe, while 52 (54.74%) were non-severe. In terms of the inflammatory type of the mucous membranes and ear discharge, 50 children (52.63%) had catarrhal inflammation and 45 (47.37%) had purulent forms. When classified by tympanic membrane condition, 77 patients (81.05%), presented with a pre-perforative stage, and 18 (18.95%) had a perforative stage.

Among the study group, 33 participants (34.74%) were girls and 62 (65.26%) were boys. The control group consisted of 50 clinically healthy children with a similar age and sex distribution (20 girls and 30 boys), who had no signs of inflammatory diseases at the time of the study or during the previous six months. No statistically significant differences in age were found between the study and control groups.

Cellular reactivity and resistance, neutrophil (NEU) reactive response and general immunological reactivity of children with AOM were assessed on the basis of a complete blood cell count (CBC) – the absolute and relative number of the main populations of immunocompetent cells (ICC) with subsequent calculation of the integral indices given in Table 1. Extended CBC was performed on the CELL-DYN 3700 SL hematological analyzer (manufacturer – «Abbott Laboratories», USA). The evaluation of the immuno-hematological indices for other diseases was analyzed in our former publications [17-19].

Table 1

Immuno-hematological indices [13, 20, 21]

Indices of inflammation, cellular reactivity and cellular resistance		
1	Lleukocytes Intoxication Index (LII) after Kalf-Kalif	(2 RNEU + SNEU) / (LYM + Mono) x (EOS+1)
2	LII after R. A. Reys	(RNEU+SNEU) / Mono+LYM+EOS
3	Intoxication Index	(LII x Leu x ESR) / 100
4	Index of Endotoxicosis degree (Neutrophil shift index)	RNEU / SNEU
5	Cellular reactivity index	(WBC / (LII x age-year)) x 100
6	Cellular resistance index	WBC / LII Kalf-Kalif
7	Nonspecific resistance index (Harkavi)	LYM / SNEU
Reactive response of Neutrophils		
1	Lymphocyte-to-granulocytic index	LYM x 10 / EOS + NEU
2	Neutrophil-to-lymphocyte ratio (NLR)	NEU / LYM
3	Leukocyte shift index	(BASO+EOS+NEU) / (Mono+LYM)
4	Neutrophil-to-monocyte ratio (NMR)	NEU / Mono
5	Leukocyte-ESR ratio	(WBC x ESR) / 100
6	Nonspecific reactivity index	(LYM x 100) / SNEU
General immunological reactivity		
8	Immune reactivity index	(LYM + EOS) / Mono
9	Immune resistance index	LYM / (Age-year x LII Kalf-Kalif)
10	Index of immunological reactivity growth	Immune reactivity index / Immune resistance index
11	Allergy index	(LYM + (EOS+1) x 10) / (NEU + Mono + BASO)
12	Lymphocyte index	LYM / NEU
13	Lymphocyte-to-monocyte ratio (LMR)	LYM / Mono
14	Lymphocytes-to-eosinophils ratio	LYM / EOS
15	Agranulocytes-to-ESR ratio	(LYM + Mono) / ESR

Notes: LII-Leukocytes Intoxication Index; NEU – neutrophil; BASO – basophil; RNEU – rod-shaped neutrophil; SNEU – segmented neutrophil; LYM – lymphocyte; Mono – monocyte; EOS – eosinophil; WBC (leukocytes) – white blood cell; ESR – erythrocyte sedimentation rate; NLR – Neutrophil-to-lymphocyte ratio; NMR – Neutrophil-to-monocyte ratio; LMR – Lymphocyte-to-monocyte ratio

Statistical analysis was conducted using Statistica 7.0 (StatSoft Inc, USA) software and Excel® 2016™. The differences between groups for independent samples were verified using the unpaired Student's t-test (if the data distribution were close to normal according to the Kolmogorov-Smirnov tests and the Shapiro-Wilk W-test), or the Wilcoxon-Mann-Whitney U-test (for an uneven data distribution). Differences were considered significant at P values <0.05.

Results and Discussion

The course of AOM is generally accompanied by leukocytosis, higher in the purulent process (Table 2). In children with purulent AOM hemoglobin level was lower than in the catarrhal process 14.68% (p=0.046). Relative granulocytopenia due to neutropenia (mature forms – segmented neutrophils – SNEU) was found in children with serous AOM – 8.36% (p=0.042) and 16.59% (p=0.009), respectively, with compensatory rod-nuclear neutrophilosis (RNEU), both relative and absolute – 2.1 and 3.14 times (p<0.001). Relative neutropenia due to SNEU was also found in purulent AOM – 11.77% (p = 0.016). The RNEU level (relative and absolute) in children with purulent AOM exceeded that in catarrhal otitis – 55.36% (p=0.003) and 70.45% (p=0.006). The lymphocytes level in children with catarrhal AOM exceeded the reference values – 23.87% (p=0.017) and 76.16% (p=0.004). The relative content of monocytes was, on the contrary, lower than in the control group: in serous AOM – 17.76% (p=0.024), in purulent – 50.09% (p=0.001), respectively. ESR in children with AOM exceeded that in the control group: in serous AOM – 2.21 times (p<0.001), somewhat more in purulent AOM – 3.04 times (p<0.001), with a significant difference between the groups with AOM – 37.11% (p<0.001).

Table 2

Laboratory findings based on complete blood cell count in children with acute otitis media depending on the ear discharge

Laboratory findings		Control, n=50	Catarrhal AOM, n=50	Purulent AOM, n=45
Erythrocytes, $\times10^{12}$/L		4.25±0.15	4.36±0.20	4.29±0.16
Hemoglobin, g/L		128.94±5.42	139.50±6.07	119.02±6.10 p_1=0.046
WBC (leukocytes), $\times10^9$/L		5.80±0.14	8.50±0.65 p<0.001	9.20±0.56 p<0.001
Granulocytes	%	66.35±0.53	60.80±3.40 p=0.042	66.77±3.61
	$\times10^9$/L	3.85±0.17	5.17±0.27 p=0.001	6.14±0.38 p<0.001; p_1=0.021
NEU	%	64.71±0.88	57.11±2.65 p=0.004	63.03±3.03
	$\times10^9$/L	3.75±0.26	4.85±0.22 p<0.001	5.80±0.41 p=0.002
RNEU	%	2.50±0.18	5.22±0.58 p<0.001	8.11±0.30 p<0.001; p_1=0.003
	$\times10^9$/L	0.14±0.06	0.44±0.08 p<0.001	0.75±0.09 p<0.001; p_1=0.006
SNEU	%	62.21±1.05	51.89±4.23 p=0.009	54.89±3.15 p=0.016
	$\times10^9$/L	3.62±0.34	4.41±0.45	5.05±0.36 p=0.003
EOS, %		1.60±0.10	1.94±0.15	3.44±0.30 p, p_1<0.001
Agranulocytes	%	34.09±0.21	39.20±2.52 p=0.023	33.23±1.75 p_1=0.027
	$\times10^9$/L	2.0±0.16	3.33±0.18 p=0.001	3.06±0.23 p=0.004
LYM	%	28.74±0.20	35.60±2.57 p=0.017	30.33±1.52 p_1=0.045
	$\times10^9$/L	1.68±0.15	3.03±0.35 p=0.004	2.79±0.41 p=0.009
Mono	%	5.35±0.18	4.40±0.44 p=0.024	2.67±0.53 p=0.001; p_1=0.007
	$\times10^9$/L	0.31±0.03	0.37±0.04	0.23±0.03 p=0.031; p_1=0.003
ESR, mm/h		5.78±0.12	12.80±0.27 p<0.001	17.55±0.39 p, p_1<0.001

Notes: AOM – acute otitis media; NEU – neutrophil; BASO – basophil; RNEU – rod-shaped neutrophil; SNEU – segmented neutrophil; LYM – lymphocyte; Mono – monocyte; EOS – eosinophil; WBC (leukocytes) – white blood cell; ESR – erythrocyte sedimentation rate; P – significance of differences with control group; p_1 – significance of differences with group of children with Catarrhal AOM

Leukocyte intoxication indices (LII) after Kalf-Kalif and R. A. Reys (Table 3), as well as the intoxication index and the nuclear index of the Endotoxicosis degree are high in both study groups and indicate an active inflammatory process, but at the same time these indexes are significantly higher in children with purulent course of AOM, than in catarrhal – 34.61% (p=0.048) and 22.92% (p=0.025) and 2 times (p<0.001) and 14.29% (p=0.05), respectively. The cellular reactivity index increased in both groups, more in purulent AOM, but not significantly. While cellular resistance prevailed in children with purulent AOM course over that with catarrhal – 27.96% (p<0.001). And the adaptive stress index of (ASI) after L. H. Harkavi (nonspecific reactivity index, resistance coefficient, Harkavi stress index), on the contrary, was higher in patients with serous AOM – 24.14% (p=0.049).

The reactive response of NEU, as a marker of nonspecific anti-infective protection, in patients with purulent AOM is lower (due to a lower lymphocytic-granulocytic index and index of nonspecific reactivity) than in the catarrhal process – 22.51% (p=0.012) and 20.33% (p=0.006), against the background of a higher neutrophil-lymphocyte ratio – 23.20% (p=0.042), the shift index of leukocytes and neutrophils – 22.09% (p=0.012) and 14.29% (p=0.05), the ratio of neutrophils to monocytes and leukocytes to ESR – 35.98% (p=0.002) and 26.02% (p=0.01), respectively (Table 3).

The general immunological reactivity (Table 3) increases more strongly in children with purulent AOM (after immune reactivity indices) than with catarrhal AOM – 26.97% (p=0.009) and 29.96% (p=0.03), respectively. The lymphocytes to monocytes ratio reflects the activity of the humoral (effectors) and cellular (affectors) links of the immune system and prevails in children with purulent AOM – 36.46% (p=0.03) and indicates the dominance of the effector / humoral immune response activity.

Table 3

Cellular and general immunological reactivity and resistance, reactive response of neutrophils in children with acute otitis media depending on the ear discharge

N	Immuno-hematological indices, unit	Catarrhal AOM, n=50	Purulent AOM, n=45
Indices of inflammation, cellular reactivity and cellular resistance			
1	Leukocytes Intoxication Index (LII) after Kalf-Kalif	0.52±0.06	0.70±0.09 p=0.048
2	LII after R. A. Reys	1.44±0.14	1.77±0.09 p=0.025
3	Intoxication Index	0.71±0.07	1.42±0.10 p<0.001
4	Index of Endotoxicosis degree (Neutrophil shift index)	0.14±0.01	0.16±0.01 p=0.05
5	Cellular reactivity index	139.80±8.55	150.94±12.54
6	Cellular resistance index	18.31±0.45	23.43±0.70 p<0.001
7	Nonspecific resistance index (Harkavi)	0.72±0.07	0.58±0.05 p=0.049
Reactive response of Neutrophils			
1	Lymphocyte-to-granulocytic index	6.13±0.52	4.75±0.28 p=0.012
2	Neutrophil-to-lymphocyte ratio (NLR)	1.81±0.12	2.23±0.19 p=0.042
3	Leukocyte shift index	1.72±0.10	2.10±0.13 p=0.012
4	NEU shift index, yo	0.14±0.01	0.16±0.01 p=0.05
5	Neutrophil-to-monocyte ratio (NMR)	17.98±0.81	24.45±1.33 p=0.002
6	Leukocyte-ESR ratio	1.23±0.09	1.55±0.10 p=0.01
7	Nonspecific reactivity index	73.18±5.26	58.30±2.40 p=0.006
General immunological reactivity			
8	Immune reactivity index	11.31±0.58	14.76±1.16 p=0.009
9	Immune resistance index	6.23±0.21	5.38±0.29 p=0.021
10	Index of immunological reactivity growth	2.27±0.22	2.95±0.26 p=0.03
11	Allergy index	1.34±0.07	1.17±0.06 p=0.034
12	Lymphocyte index	0.64±0.06	0.45±0.06 p=0.048
13	Lymphocyte-to-monocyte ratio (LMR)	10.01±0.64	13.66±1.80 p=0.03
14	Lymphocytes-to-eosinophils ratio	25.60±2.45	17.28±1.71 p=0.004
15	Agranulocytes-to-ESR ratio	4.80±0.53	3.25±0.39 p=0.011

Notes: AOM – acute otitis media; LII-Leukocytes Intoxication Index; NEU – neutrophil; BASO – basophil; RNEU – rod-shaped neutrophil; SNEU – segmented neutrophil; LYM – lymphocyte; Mono – monocyte; EOS – eosinophil; WBC (leukocytes) – white blood cell; ESR – erythrocyte sedimentation rate; NLR – Neutrophil-to-lymphocyte ratio; NMR – Neutrophil-to-monocyte ratio; LMR – Lymphocyte-to-monocyte ratio; p – significance of differences with group of children with Catarrhal AOM

In children with catarrhal AOM, the activity of nonspecific anti-infective defence factors increases, which generally forms an increased resistance of the body (after elevating the immune resistance index – 15.80% (p=0.021)). At the same time, the allergisation index increased – 14.53% (p=0.034), as well as the lymphocytes-to-eosinophils ratio – 48.15% (p=0.004). That indirectly indicates the predominance of immediate-type hypersensitivity processes with the additional allergic mechanisms of the immune response formation and sensitization of children with catarrhal AOM. Lymphocytes-to-monocytes ratio decrease 26.72% (p=0.03), lymphocyte index increase 42.22% (p=0.048) as well as agranulocytes-to-ESR ratio 37.14% (p=0.011) indicates the predominance of macrophage system activity and cellular immune response stimulation.

CBC is a rapid, straightforward, and cost-effective test routinely performed in clinical practice. It delivers comprehensive data on blood components – white blood cells, neutrophils, lymphocytes, monocytes, and platelets – as well as calculated indices like the NLR, MLR and PLR. In recent years, these hematologic parameters have gained prominence as potential tools for diagnosing conditions, offering early warning signs, and stratifying patient risk in a variety of infections (e.g., sepsis, bacteremia, urinary tract infections) and noninfectious diseases (e.g., liver cirrhosis, coronary artery disease, solid tumors, chronic pancreatitis, nasal polyposis) [4, 23-26].

Numerous studies have shown that during severe infections or systemic inflammatory responses, the NLR rises in parallel with worsening clinical status and outcomes [9, 10]. Moreover, NLR has been recognized as a fundamental marker in ENT practice, having applications in conditions such as otitis media, facial paralysis, idiopathic sudden sensorineural hearing loss, and head and neck malignancies [5-8, 28]. Few investigations to date have evaluated the NLR in individuals with otitis media [13], therefore, it needs further research.

Thus, the diagnostic value of hematologic markers for different infection-related diseases, like AOM, deserves more studies.

Conclusions

Immuno-haematological indices certify two conditional clinical and laboratory variants of the acute otitis media (AOM) course in the examined children. The first variant (purulent AOM) is characterized by moderate neutrophilosis (+II), pronounced hyporegenerative nuclear shift due to rod-shaped neutrophils, eosinophilic granulocytes and a significant increase in intoxication indices. Such blood changes indicate the predominance of the bacterial component (purulent process in the middle ear), pronounced severity of inflammation against the background of increased cellular and immune reactivity, corresponding activation of resistance and sensitization of the organism with a predominance of immediate-type hypersensitivity. In these children, a specific humoral immune response begins to form.

The second variant of the AOM course (catarrhal) is characterized by relative and absolute rod-shaped neutrophilosis (less pronounced than in the purulent AOM), higher lymphocytosis and monocytosis, with an increase

in nonspecific and immune resistance indices, which prove sensitization of the organism with the development of delayed-type hypersensitivity, against the background of moderately pronounced intoxication. The revealed pattern indicates the predominance of lymphocytic activation with the development of specific cellular defence.

Prospects for further research

To study the immunological mechanisms of nonspecific anti-infective protection in AOM children, taking into account the age.

The study was conducted as part of the comprehensive research project of the Family Medicine Department of BSMU, titled «Improvement of Diagnosis and Prediction of Hypertensive-Mediated Target Organ Damage and Symptom Control in Comorbid Pathology Considering Clinical-Metabolic and Molecular-Genetic Predictors» (State Registration Number 0124U002524, implementation period: 01.01.2024-31.12.2028).

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