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PATHOGENETIC ASPECTS OF ALLERGIZATION OF THE BODY OF CHILDREN WITH ATOPIC DERMATITIS AND ECZEMA

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The presented article examines the differences in the pathogenesis of atopic dermatitis and infantile eczema, which are mainly determined by the specific features of the immune response. It is shown that IgE – dependent mechanisms play a key role in the development of pathological processes in atopic dermatitis, whereas infantile eczema demonstrates a distinct immunological pattern. The difference in allergization mechanisms determines the varying spectrum of skin reactivity in these groups of patients, manifested by diverse clinical symptoms and variations in disease progression. Particular attention is given to the level of sensitization as an important diagnostic and prognostic marker that should be considered when designing individualized therapeutic and dietary strategies. The findings highlight the need for a differentiated approach to managing children with atopic dermatitis and infantile eczema, taking into account the immunological, clinical, and allergological characteristics of each patient.

Key words: atopic dermatitis, childhood eczema, allergization.

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ПАТОГЕНЕТИЧНІ АСПЕКТИ АЛЕРГІЗАЦІЇ ОРГАНІЗМУ ДІТЕЙ ІЗ АТОПІЧНИМ ДЕРМАТИТОМ ТА ЕКЗЕМОЮ

У поданій статті розглянуто відмінності у патогенезі атопічного дерматиту та дитячої екземи, що зумовлені переважно особливостями імунної відповіді організму. Показано, що ключову роль у формуванні патологічного процесу при атопічному дерматиті відіграють IgE-залежні механізми, тоді як при дитячій екземі спостерігається інша імунологічна динаміка. Саме різниця в механізмах алергізації визначає різний спектр шкірної реактивності у цих груп пацієнтів, що проявляється неоднаковими клінічними симптомами та варіабельністю перебігу захворювань. Окрему увагу приділено значенню рівня сенсибілізації як важливого діагностичного та прогностичного критерію, який слід враховувати при формуванні індивідуального лікувально-дієтичного підходу. Результати аналізу підкреслюють необхідність диференційованого підходу до ведення дітей з атопічним дерматитом і дитячою екземою, з урахуванням імунологічних, клінічних та алергологічних особливостей кожного пацієнта.

Ключові слова: атопічний дерматит, дитяча екзема, алергізація.

The study is a fragment of the research project "Structural reorganization of the organs of the immune, respiratory and excretory systems under the influence of various exogenous factors (sodium glutamate, sodium nitrite, ethanol, methacrylate)", state registration No. 0121U108234.

Allergic diseases are among the most common illnesses in the general population, and especially among children, posing a significant medical and social problem [1]. Among allergic dermatoses, the highest incidence is attributed to atopic dermatitis (AD) and childhood eczema [4].

An analysis of the pathogenesis of these diseases reveals commonalities in genetic (HLA) and immunological (IgE) disturbances, though with different manifestations of skin inflammation [3, 8, 11]. According to current concepts, atopy is characterized by an imbalance between Th1 and Th2 cells, and consequently, by different cytokines produced by these cells, leading to increased IgE synthesis. Typically, this imbalance lies in the fact that Th2 – type cytokines (IL – 4, IL – 5, IL – 13) are produced in higher concentrations than Th1 – type cytokines (interferon – γ) [12]. During the intrauterine period, a shift of immune response towards the Th2 phenotype is typical, suggesting that allergic sensitization may begin at this stage [7]. It is also important to highlight the role of environmental factors (ecological conditions, dietary habits, living conditions, exposure to infectious agents, etc.), especially at an early age, in altering the balance of Th2-type cytokine production. Under the influence of antigenic stimulation – primarily by T-effectors – the cellular metabolism of lymphocytes and macrophages intensifies, leading to increased synthesis of cAMP and prostaglandins [2] and reduced phagocytic activity of macrophages toward antigens. Persistence of the antigenic factor increases the number of circulating immune complexes, which deposit on the venular endothelium and are inadequately phagocytosed.

To date, more than 20 genes have been identified that are typically responsible only for certain allergic symptoms and determine whether the clinical picture of the disease is dominated by skin or, for instance, respiratory pathology.

Moreover, most children with AD and childhood eczema show a stage-wise development of sensitization and clinical manifestations depending on age – a phenomenon known as the atopic march. In early childhood, AD predominates, and by the age of 5-6, bronchial asthma may develop. Several key markers of atopy are known (family history, elevated levels of total and allergen-specific IgE, cytokine profile produced by T cells, interferon ratio, skin tests with various allergen groups, etc.), the assessment of which through regular monitoring of at–risk children can support the development of differentiated strategies for preventing exacerbations. The aim of this work was to confirm the atopic nature of AD and childhood eczema by conducting specific diagnostics to identify causative allergens – household, epidermal, foodborne, pollen – and analyze the corresponding nosology.

The purpose of the study was to determine the level of IgE in children with atopic dermatitis and eczema.

Materials and methods. A study was conducted to measure the level of specific IgE in the blood serum of 87 in children with atopic dermatitis and eczema, who had been suffering from the condition for at least one year and were undergoing inpatient treatment at the dermatology and venereology center of the M.V. Sklifosovsky Poltava Regional Clinical Hospital, under the Poltava Regional Council, from 2021 to 2024. The study was approved by the Bioethics and Ethical Issues Committee of Poltava State Medical University, March 24, 2021, protocol number 192. The parents of all patients signed an informed consent form to participate in the study.

Under our observation were 87 children and adolescents diagnosed with allergic dermatoses: 44 patients with atopic dermatitis (of which 25 are girls and 19 are boys) and 43 with childhood eczema (of which 27 are girls and 16 are boys). The age range of the examined patients was from 2 to 5 years

Inclusion Criteria:

Participants were included in the study if they met all of the following criteria:

1. Children aged 2-5 years at the time of examination.

2. Confirmed diagnosis of atopic dermatitis or childhood eczema, established based on clinical criteria, anamnesis, and dermatological assessment.

3. For atopic dermatitis: diagnosis additionally confirmed by elevated serum IgE levels according to reference values.

4. For childhood eczema: diagnosis confirmed by clinical presentation and immunological testing.

5. Availability of complete medical records, including allergological history and previous treatments.

6. Parental/guardian consent for participation in clinical and allergological testing.

Exclusion Criteria:

Participants were excluded from the study if any of the following conditions were present:

1. Age below 2 years or above 5 years.

2. Presence of acute infectious diseases or exacerbation of chronic illnesses at the time of testing.

3. Use of systemic corticosteroids or immunosuppressive therapy within 4 weeks prior to skin testing.

4 Any dermatological condition that could interfere with interpretation of skin tests (e.g., extensive skin infection, severe dermatoses).

5. Immunodeficiency disorders or conditions affecting IgE production.

6. Previous anaphylactic reactions to allergen testing materials.

7. Refusal or inability of parents/guardians to provide informed consent.

The level of specific IgE in blood serum was determined using an enzyme-linked immunosorbent assay (ELISA) with test systems, including cellulose discs with applied allergens, produced by Dr. Fooke (Germany). The optical density of the tested samples was measured using the “Stat Fax 303 plus” ELISA reader (USA). The diagnosis of childhood eczema was based on anamnesis, clinical presentation of dermatosis, and immunological testing results. For specific allergological testing, the following groups of allergens were used – pollen allergens: trees (mix), grasses (mix), weeds (mix); household allergens: house dust (mix), pillow feathers, library dust; epidermal allergens: mite, cat, dog; food allergens: milk (protein), milk (casein), egg (white), egg (yolk), chicken meat, beef, pork, rice groats, buckwheat groats, oat groats, barley groats, semolina, carrot, cabbage, tomato, beetroot, pea, bean, wheat flour, rye flour, carp. Allergen test kits produced by LLC “Immunolog” (Vinnytsia, Ukraine) were used. Skin tests were conducted no earlier than 4 weeks after exacerbation (refractory period). Scarification tests were chosen for their high specificity and good tolerance even in young children. A small amount of antigen was applied to the patient's skin after a shallow scratch up to 5 mm was made, provoking a miniature allergic reaction. The

reaction was evaluated after 20 minutes by measuring the diameter of the hyperemic area (in mm). A skin test was used to determine antigens precisely because it is fast, safe, and painless (especially for children), allows for simultaneous testing of multiple allergens, is highly accurate when used by an experienced specialist, its sensitivity reaches 97 %, and is less expensive than a blood test.

Results of the study and their discussion. All children in the observation group underwent clinical examination, hereditary and allergological history collection, serum IgE level determination, and scarification skin testing. The mean age of patients with atopic dermatitis was 4.2±0.7 years, and for those with childhood eczema – 4.6±0.3 years.

It was found that the level of IgE in the group of children with atopic dermatitis is 8 times higher than in the group of children with eczema, which proves the presence of atopy and confirms the correctness of the diagnosis (Table 1).

Table 1

IgE levels in children with atopic dermatitis and childhood eczema

Parameters studied	Atopic Dermatitis Group (n=44)	Childhood Eczema Group (n=43)	Reference value
Immunoglobulin E concentration (IU/ml)	592.05±90.29	72.12±9.81	<60

Note: *p<0.05

The obtained results indicate significant immunological differences between children with atopic dermatitis and those with infantile eczema. The eightfold increase in IgE levels in the group of children with atopic dermatitis demonstrates the involvement of IgE – mediated mechanisms in the pathogenesis of this condition. Such an elevation is a characteristic marker of atopy, reflecting an exaggerated immune response to allergen exposure.

In contrast, children with infantile eczema show normal or only slightly elevated IgE levels, which may suggest a predominance of non – atopic mechanisms – particularly inflammatory or microbial factors – in the development of skin lesions.

An analysis of the skin test results by allergen groups reveals certain differences between patients with atopic dermatitis and those with infantile eczema (Table 2).

All children had a 100 % reaction to histamine and a negative response to the control solution, confirming adequate skin reactivity and validity of skin test results.

Children with atopic dermatitis were more likely to have positive skin tests to pollen allergens (trees, grasses, weeds) and household allergens (house dust, feather pillow, library dust).

Somewhat different results were observed with epidermal allergens. Among the groups of allergens tested, household allergens were the most common cause of sensitization.

An analysis of skin test indicators for food allergens showed a high frequency of sensitization among patients with atopic dermatitis. The highest frequency was observed for allergens such as: cow's milk proteins (75.6 %–78.3 %), chicken meat (95.65 %), carrots (76.95 %), tomatoes (78.26 %), egg white and yolk (75.65 % and 65.2 %, respectively).

The lowest sensitization rates were found for: beef (4.35 %), cabbage (4.35 %), rice (13 %), and beans and peas (20 % each).

These results are consistent with the literature and can currently be used to develop dietary recommendations for children with atopic dermatitis.

It is noteworthy that the rate of positive skin test results was significantly higher among children with atopic dermatitis. These findings support the concept of the central role of IgE – dependent sensitization in the pathogenesis of atopic dermatitis [14]. At the same time, the development of infantile eczema is mostly associated with non – IgE – dependent sensitization. From this perspective, the presence of comorbid conditions was analyzed in children with atopic dermatitis: 33 children had bronchial asthma (>50 %), 18 children had allergic rhinitis (~40 %). This not only confirms the atopic history but also reflects the presence of the so-called “atopic march” [5].

Recent evidence highlights that impaired skin barrier function driven by type 2 inflammatory responses contributes to the pathogenesis of atopic dermatitis by facilitating increased allergen penetration and microbial colonization, particularly Staphylococcus aureus, which further amplifies local inflammation and immune activation. Type 2 cytokines such as IL – 4 and IL – 13 not only perpetuate Th2 – mediated immunity but also adversely affect barrier integrity by altering structural proteins and promoting bacterial colonization on the skin surface [6, 13]. In contrast, childhood eczema without predominant IgE elevation has been associated with a distinct innate immune response pattern and microbiome dysbiosis, suggesting

that non – IgE – dependent mechanisms, including gut and skin microbial influences on innate immunity, may also play significant roles in disease onset and progression [10, 9]. Taken together, these studies support the view that atopic dermatitis and infantile eczema represent immunopathogenetically distinct entities, underscoring the importance of personalized diagnostic and therapeutic approaches based on underlying immune and barrier dysfunction profiles. Therefore, these findings allow for a clearer distinction between the two conditions based on immunopathogenetic criteria, which is crucial for accurate diagnosis and the selection of appropriate therapeutic strategies.

Table 2

Skin test reactivity in children with atopic dermatitis and infantile eczema

Allergens	Atopic dermatitis group (n=44)	Infantile eczema group (n=43)
Pollen:		
Trees (mix)	13 %	0 %
Grasses (mix)	8.7 %	0 %
Weeds (mix)	13 %	4 %
Household:		
House dust (mix)	47.83 %	32 %
Feather pillow	42 %	17 %
Library dust	34.78 %	28 %
Epidermal:		
Mite	13 %	0 %
Cat	4.35 %	8 %
Dog	4.35 %	4 %
Food:		
Milk (protein)	78.3 %	14.2 %
Egg white	75.65 %	16 %
Egg yolk	65.2 %	24 %
Chicken meat	95.65 %	48 %
Beef	4.35 %	0 %
Pork	21.74 %	14 %
Rice	13 %	4 %
Buckwheat	56.7 %	14 %
Oatmeal	60.85 %	22 %
Barley	43.48 %	26 %
Semolina	68 %	12 %
Carrot	76.95 %	14 %
Cabbage	4.35 %	20 %
Tomatoes	78.26 %	20 %
Beetroot	30.43 %	14 %
Beans	20 %	2 %
Peas	20 %	10 %
Wheat flour	47.83 %	18 %
Rye flour	34.78 %	16 %
Carp	34.78 %	12 %
Histamine	100 %	100 %
Control (negative)	100 %	100 %

Elevated IgE levels in patients with atopic dermatitis may also explain the more pronounced skin reactivity and tendency toward polyvalent sensitization observed in this group. This highlights the need for an individualized treatment approach that takes into account the patient's allergic profile, as well as the relevance of including hypoallergenic diets and anti – allergic medications in the comprehensive management plan.

Overall, the study results confirm the validity of a differentiated diagnostic approach to atopic dermatitis and infantile eczema and demonstrate that assessing IgE levels can serve as an important laboratory marker for diagnostic clarification and prognosis of disease progression.

Conclusion

Children with atopic dermatitis demonstrated a significant increase in IgE levels – on average, eight times higher than in patients with infantile eczema – indicating the presence of an IgE – mediated mechanism in the pathogenesis of the disease.

The obtained results confirm the atopic nature of atopic dermatitis and distinguish it from infantile eczema, in which non – atopic (inflammatory or microbial) factors predominate.

Measurement of IgE levels is an important diagnostic criterion that allows for differentiation between these two clinical conditions and facilitates more accurate diagnosis in children with chronic dermatoses.

Elevated IgE levels in patients with atopic dermatitis may serve as a prognostic marker of a predisposition to polyvalent sensitization and a more severe course of the disease.

The findings emphasize the importance of an individualized approach to the treatment of children with atopic dermatitis, taking into account their allergic profile, and support the inclusion of hypoallergenic diets and anti – allergic agents in comprehensive therapy.

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