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Evaluation of hemogram parameters in patients with atopic dermatitis

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ABSTRACT

Aims: This study aimed to evaluate the hemogram parameters of patients with atopic dermatitis (AD) and contribute to the existing literature.

Methods: This cross-sectional study retrospectively analyzed data from pediatric patients diagnosed with AD, who presented to the Pediatric Allergy and Immunology outpatient clinic at Ümraniye Training and Research Hospital between January 1, 2024, and August 15, 2024. The sociodemographic characteristics, hemogram parameters, total IgE values, allergy history, and allergy test results of the patients were evaluated. Neutrophil/lymphocyte ratio (NLR), platelet/lymphocyte ratio (PLR), systemic immune-inflammation index (SII), systemic inflammatory response index (SIRI), neutrophil/lymphocyte/platelet ratio (NLPR), and pan-immune-inflammation value (PIV) were calculated. Allergen-specific IgE measurements were performed using the ImmunoCAP method, and skin prick tests were conducted for food and inhalant allergens. The severity of AD was classified as mild or moderate-to-severe based on the potency of the topical corticosteroids used by the patients. Statistical analyses were performed using SPSS version 29.0.

Results: A total of 346 patients diagnosed with AD were included in the study. Among the patients, 53.8% were male, and the median age was 32.5 months. Mild AD was identified in 46.5% of the patients, while 53.5% had moderate-to-severe AD. Although sensitization to house dust mites, cats, eggs, and nuts was more frequent in patients with moderate-to-severe AD, no statistically significant difference was found between allergen sensitization and AD severity. Eosinophil count and eosinophil-lymphocyte ratio (ELR) were significantly higher in moderate-to-severe AD patients compared to those with mild AD ($p=0.008$ and $p=0.004$, respectively). No significant difference was found for other hemogram parameters and inflammatory markers. Patients with allergen sensitization had significantly higher WBC, basophil, eosinophil counts, and total IgE levels ($p<0.05$).

Conclusion: This study evaluated the relationship between hematological parameters and allergen sensitization in AD patients. Eosinophil count and ELR were significantly elevated with increasing AD severity. However, NLR, SII, SIRI, NLPR, and PIV were not associated with AD severity. Patients with allergen sensitization had significantly higher WBC, eosinophil, basophil counts, and total IgE levels. Our findings suggest that eosinophil count and total IgE levels may serve as predictive markers for AD severity and allergen sensitization. Routine measurement of these parameters could offer a practical approach in determining AD severity and allergen sensitization. Further research is needed to clarify the clinical significance of other hematological parameters.

Keywords: IgE, eosinophil, inflammation

INTRODUCTION

Atopic dermatitis (AD) is the most common chronic inflammatory skin disease characterized by inflammation.[1] It is a multifactorial disease influenced by genetic and environmental factors.[2] While 80% of cases are seen in infancy or childhood, it can also appear during adolescence. The prevalence in children ranges from 2.7% to 20.1%, while in adults, it varies between 2.1% and 4.9%.[3,4] AD is characterized by itching, eczema, and sensitive, dry skin.[5] The acute phase is predominantly mediated by the Th2 pathway, while both Th1 and Th2 pathways are involved in the chronic phase. Though its exact cause is not fully understood, genetic and environmental factors are believed to play a role.[6,7] AD is

often associated with other allergic conditions such as food allergies, allergic asthma, and rhinoconjunctivitis.[8] Treatment options include topical corticosteroids, calcineurin inhibitors (tacrolimus and pimecrolimus), and phosphodiesterase 4 inhibitor crisaborole. In more severe cases, cyclosporine A, methotrexate, azathioprine, mycophenolate mofetil, and JAK inhibitors are recommended.[9] Disruption of the skin barrier plays a crucial role in the disease's pathophysiology, with IL-4, IL-5, IL-12, and IFN-gamma released in response to Th2 and Th1 activation.[10-13] Studies have shown elevated levels of total IgE, eosinophils, neutrophil/lymphocyte ratio (NLR), platelet/lymphocyte ratio (PLR), and eosinophil/lymphocyte ratio (ELR) in AD patients compared to control groups.[14] In AD, an increase in the number of eosinophils in the blood and tisses may be observed.[15]

Systemic immune-inflammation index (SII), systemic inflammatory response index (SIRI), and pan-immune-inflammation value (PIV) are new markers used to evaluate inflammation.[16,17] The neutrophil-lymphocyte-platelet ratio (NLPR) was calculated as (neutrophilx100)/(lymphocyte×platelet). The pan-immune inflammation value was also calculated as (neutrophil×platelet×monocyte)/lymphocyte. The SIRI=(neutrophil count×monocyte count)/lymphocyte count, reflecting increased inflammation and decreased immune response. SII and SIRI have been studied as markers and predictors in other diseases and conditions, such as different types of cancer or cardiovascular events.[18,19] The pan-immune inflammation value has mostly been studied in malignant patients and is considered a prognostic biomarker.[20]

This study aims to examine the relationship between hemogram parameters, AD severity, total IgE, specific IgE, and skin prick tests in patients with AD.

METHODS

Ethics

The study was conducted with the permission of the Scientific Researches Evaluation and Ethics Committee of Ümraniye Training and Research Hospital (Date: 03.12.2024, Decision No: 327). All procedures were carried out in accordance with ethical rules and the principles of the Declaration of Helsinki.

AD diagnosis was based on the Hanifin-Rajka criteria, and severity was determined using clinical and treatment.[21]

Study Design and Sample

A total of 346 patients have been included in the study. This is a retrospective, cross-sectional study. Data from pediatric patients diagnosed with AD who presented to the Pediatric Allergy and Immunology outpatient clinic at Ümraniye Training and Research Hospital between January 1, 2024 and August 15, 2024, were retrospectively reviewed.

Patients with primary immune deficiencies, autoimmune diseases, chronic inflammatory conditions such as Crohn's disease, rheumatoid arthritis, or systemic lupus erythematosus, malignancies, and those using systemic corticosteroids or immunosuppressants in the past six months were excluded.

Measurements

Sociodemographic characteristics (age, gender), hemogram parameters (neutrophils, eosinophils, lymphocytes, platelets), total IgE levels, allergy history, and allergy test results were evaluated. Hemogram values such as NLR, PLR, SII, SIRI, neutrophil/lymphocyte/platelet ratio (NLPR), and PIV were calculated. Allergen-specific IgE levels were measured using the ImmunoCAP method, and skin prick tests were conducted for food and inhalant allergens. A specific IgE level of 0.35 kU/L or higher was classified as positive. The skin prick test was performed on patients using food allergens (milk, egg, hazelnut, peanut, walnut, pistachio) and inhalant allergens [house dust mites (Dermatophagoides), cat, pollen]. A test result showing an induration of 3 mm or more, in the absence of induration or dermatographism in the negative control, was considered positive. Those with positive skin prick tests and/or allergen-specific IgE were considered sensitized to the allergen.

Assessment of Atopic Dermatitis Severity

The severity of AD was determined according to clinical and treatment parameters. Patients using low-potency topical corticosteroids were classified as having mild AD, while those using medium-to-high-potency topical corticosteroids were classified as having moderate-to-severe AD.

Statistical Analysis

Data were analyzed using IBM SPSS version 29 software. Descriptive data were presented as number (n), percentage (%), median, and minimum-maximum values. Fisher's exact test or chi-square test was used for categorical variables, and Mann-Whitney U test for continuous variables. Significance level was set at $p<0.05$.

RESULTS

In this study, a total of 346 patients with AD were evaluated for their demographic, clinical, and laboratory characteristics. Among the patients, 53.8% (n=186) were male. The median age was 32.5 months (min: 1.0, max: 207.0) (**Table 1**).

Table 1. Demographic characteristics and severity of atopic dermatitis

Age (years), median (min-max)		32.5 (1.0-207.0)
Gender, n (%)	Female	160 (46.2)
	Male	186 (53.8)
Severity of atopic dermatitis	Mild	161 (46.5)
	Moderate-severe	185 (53.5)

Min: Minimum, Max: Maximum

The frequency of allergen sensitivity was evaluated according to the severity of AD. Sensitivities to house dust mite, cat dander, egg, and nuts were more prevalent in moderate to severe AD patients. However, there was no statistically significant difference in allergen sensitivity frequencies based on the severity of AD (**Table 2**).

Table 2. Allergen sensitivity frequencies according to atopic dermatitis severity

	Atopic dermatitis severity				
	Mild (n=161)		Moderate-severe (n=185)		p
	n	%	n	%	
House dust	29	18.0	39	21.1	0.474
Cat	14	8.7	18	9.7	0.741
Pollen	7	4.3	8	4.3	0.991
Milk	12	7.5	11	5.9	0.574
Egg	22	13.7	33	17.8	0.219
Nuts	2	1.2	4	2.2	0.689

When comparing laboratory parameters of mild and moderate-severe AD patients, the eosinophil count was significantly higher in moderate and severe AD patients compared to mild AD patients (330.0 [0-2860] vs. 260.0 [10-2780]; p=0.008). The eosinophil-lymphocyte ratio (ELR) was also significantly higher in moderate and severe AD patients (0.08 [0-1.01] vs. 0.06 [0-1.01]; p=0.004). No significant differences were found in other hemogram parameters, SII, SIRI, NLPR, and PIV between the groups (p>0.05) (Table 3).

Table 3. Comparison of laboratory parameters according to atopic dermatitis severity

	AD severity		
	Mild (n=161)	Moderate-severe (n=185)	p
	Median (min-max)	Median (min-max)	
WBC	8520.0 (3540-20530)	8660.0 (4410-18280)	0.241
NEU	2970.0 (730-10530)	3170.0 (550-16680)	0.054
BASO	40.0 (10-150)	40.0 (10-140)	0.322
EOS	260.0 (10-2780	330.0 (0-2860	0.008
EOS (%)	3.3 (0.1-20.0)	3.9 (0-21.0)	0.085
LYM	4090 (1610-15410)	4130 (1520-12270)	0.681
MONO	560 (66-1280)	530 (40-1690)	0.263
PLT	346 (33-773)	348 (38-623)	0.855
Total IgE	43.0 (1.0-7892.0)	63.0 (0-7503.0)	0.323
NLR	0.70 (0.12-5.72)	0.85 (0.09-9.22)	0.105
PLR	83.33 (8.81-230.56)	86.23 (6.52-242.74)	0.748
ELR	0.06 (0-1.01)	0.08 (0-1.0)	0.004
SII	218.99 (22.97-1831.3)	275.58 (9.39-2654.06)	0.102
PIV	134.33 (1.61-952.28)	136.87 (6.38-1259.92)	0.409
SIRI	0.41 (0.03-2.98)	0.43 (0.03-2.72)	0.279
NLPR	0.21 (0.03-3.36)	0.25 (0.02-5.03)	0.124

AD: Atopic dermatitis, Min: Minimum, Max: Maximum, WBC: White blood cell, NEU: Neutrophils, BASO: Basophil, EOS: Eosinophil, LYM: Lymphocyte, MONO: Monocyte, PLT: Platelets, IgE: Immunoglobulin E, NLR: Neutrophil/lymphocyte ratio, PLR: Platelet/lymphocyte ratio, ELR: Eosinophil/lymphocyte ratio, SII: Systemic immune-inflammation index, PIV: Pan-immune-inflammation value, SIRI: Systemic inflammatory response index, NLPR: Neutrophil-lymphocyte-platelet ratio

In the study, 137 patients had allergen sensitivity. When comparing laboratory parameters between AD patients with and without allergen sensitivity, WBC, basophils, eosinophils, and total IgE values were significantly higher in patients with allergen sensitivity (p<0.05). The ELR was also significantly higher in patients with allergen sensitivity (p<0.001). No significant differences were found in other hemogram parameters and inflammatory indicators (p>0.05) (Table 4).

Table 4. Comparison of laboratory parameters based on allergen sensitivity

	Allergen sensitivity		
	None (n=209)	Present (n=137)	p
	Median (min-max)	Median (min-max)	
WBC	8390.0 (3540-20530)	9210.0 (4410-19430)	0.021
NEU	3000.0 (550-16680)	3180.0 (730-8840)	0.561
BASO	40.0 (10-120)	40.0 (10-150)	0.005
EOS	260.0 (10-2860)	450.0 (60-2030)	<0.001
EOS (%)	2.9 (0-21.0)	4.6 (0.3-16.8)	<0.001
LYM	3940.0 (1610-15410)	4170.0 (1520-13300)	0.052
MONO	550.0 (40-1690)	550.0 (70-1570)	0.685
PLT	341.0 (35-642)	359.0 (33-773)	0.118
Total IgE	33.00 (0.0-7892.0)	142.5 (0-7503.0)	<0.001
NLR	0.81 (0.09-9.22)	0.82 (0.12-3.47)	0.538
PLR	85.98 (7.75-242.74)	83.85 (6.52-235.53)	0.478
ELR	0.06 (0-1.01)	0.1 (0.01-0.6)	<0.001
SII	251.25 (21.47-2654.06)	266.73 (9.39-1522.43)	0.993
PIV	136.87 (6.48-1259.92)	134.38 (1.61-1090.26)	0.771
SIRI	0.41 (0.03-2.98)	0.42 (0.03-2.50)	0.821
NLPR	0.24 (0.02-5.03)	0.23 (0.03-2.06)	0.550

Min: Minimum, Max: Maximum, WBC: White blood cell, NEU: Neutrophils, BASO: Basophil, EOS: Eosinophil, LYM: Lymphocyte, MONO: Monocyte, PLT: Platelets, IgE: Immunoglobulin E, NLR: Neutrophil/lymphocyte ratio, PLR: Platelet/lymphocyte ratio, ELR: Eosinophil/lymphocyte ratio, SII: Systemic immune-inflammation index, PIV: Pan-immune-inflammation value, SIRI: Systemic inflammatory response index, NLPR: Neutrophil-lymphocyte-platelet ratio

DISCUSSION

This study aimed to investigate the association between clinical and laboratory parameters in patients with AD based on the severity of the condition and allergen sensitivity. The significant findings indicate that moderate to severe AD patients exhibited higher eosinophil counts and ELRs compared to those with mild AD. In one study, there was no significant relationship between patients' peripheral eosinophil counts and disease severity.[22] Another study also could not detect a difference in peripheral blood eosinophil counts and percentages based on AD severity.[23] However, another study found that the severity of AD was proportional to the eosinophil/lymphocyte ratio.[24] In our study, eosinophil count and ELR ratio may provide predictive data related to the severity of AD disease. In a study conducted in our country, although no difference was found between the patient and control groups, the neutrophil-to-lymphocyte ratio was found to be significantly higher in patients with severe AD.[25] Another study suggested that the NLR could be used as a new marker.[26] In our study, no difference was found in the neutrophil/lymphocyte count and percentage in the blood according to the severity of AD. First of all, AD shows a complex pathogenesis, and many factors contribute to the severity of this disease. Although the NLR is a parameter that reflects the general inflammatory state, it may vary in different phases (acute, chronic) of AD and in each patient. NLR and PLR are considered indicators of systemic inflammation, yet in our study, these parameters did not show an association with AD severity, which may be attributed to several factors. First, AD is typically a localized inflammatory condition, and markers such as NLR and PLR, which reflect systemic inflammation, may not accurately capture the localized inflammation characteristic of AD. Additionally, the patients included in our study may have been in the mild or moderate stages of AD, where systemic inflammation is less pronounced. Finally, the association of NLR and PLR with this condition could be complex, and the clinical significance of these parameters may be better understood through further studies involving larger patient groups. More comprehensive studies are needed, especially those considering factors such as disease stages, individual differences in the inflammatory response, and genetic factors.

When comparing the laboratory parameters of patients with mild AD and moderate-to-severe AD, no significant difference was detected between the groups in terms of SII, SIRI, NLPR, and PIV. In a study conducted with febrile seizure patients, SII, SIRI, PIV, and NLPR values were found to be significantly higher in the FS group compared to the healthy control group.[27] In our study, the fact that inflammatory parameters such as SII, SIRI, NLPR, and PIV did not show a significant

difference between patients with mild and moderate-to-severe AD suggests that the inflammatory processes are not directly related to the severity of the disease. We believe that the localized inflammatory nature of AD and the fact that the patients evaluated were not in the severe stage of the disease contributed to these findings. These markers are generally more sensitive to systemic inflammation and may not accurately reflect the more localized inflammation associated with AD. It also suggests that these parameters may have limited value in reflecting the severity of AD or may be insufficient to represent the clinical characteristics of AD patients. More research is needed to clarify the potential roles of such parameters in determining AD severity.

House dust mite, cat, egg, and nut sensitivities were observed at higher rates in patients with moderate-to-severe AD. This is related to the immune system's overreaction to such allergens. In AD patients, the disruption of the skin barrier allows allergens to penetrate more easily, causing an exaggerated immune response. This is especially evident when exposed to common allergens such as house dust mites and animal dander. These findings suggest that severe AD patients tend to develop sensitivities to multiple allergens. In one study, the severity of AD was not associated with the presence of food sensitivity.[23] This contradiction highlights the complex nature of AD, which does not solely develop based on allergen sensitivity. The severity of AD may result from the combined effects of genetic, environmental factors, and immune system regulation.

When comparing the laboratory parameters of AD patients with and without allergen sensitivity, WBC, basophil, eosinophil, and total IgE values were significantly higher in patients with allergen sensitivity ($p<0.05$). The ELR was also significantly higher in patients with allergen sensitivity ($p<0.001$). No significant difference was observed in terms of NLR, PLR, and other hemogram parameters and inflammatory markers ($p>0.05$). In a study from Turkiye, while no significant differences were found in WBC, basophil, or NLR, the ELR and PLR were higher in patients with allergen sensitivity, although not statistically significant. However, total IgE was found to be significantly higher in patients with allergen sensitivity ($p<0.001$). Eosinophil, total IgE, and lymphocyte values were significantly higher in patients compared to the control group.[28] The differences between the two studies suggest that laboratory parameters alone may not be sufficient to determine allergen sensitivity in AD patients, and a multifaceted evaluation is required. It can be concluded that parameters such as eosinophil, ELR, and total IgE may be more reliable indicators of allergen sensitivity, whereas further studies are needed for other parameters.

Limitations

The severity of AD was determined based on clinical and treatment parameters. Due to the irregular maintenance of retrospective SCORAD records, an observational prospective study based on consistent records could yield better results. Also our study has a retrospective design, which has some limitations. In particular, the use of clinical records may introduce biases in the data collection process. Additionally, the retrospective approach may not fully reflect the variability encountered in clinical practice or the details of patients' treatment processes. Therefore, prospective studies are needed to enhance the accuracy of our findings.

CONCLUSION

Evaluating hematological parameters may assist in the clinical management of patients with AD. The ease of assessing hemogram parameters in many centers is extremely important for physicians working in this field. The routine measurement of eosinophil and total IgE levels, in particular, can provide a practical approach in determining the severity of AD and detecting allergen sensitivity. The findings of our study suggest that eosinophil count and total IgE levels are associated with AD severity and allergen sensitization. These parameters may be clinically useful in the management of AD. Specifically, patients with high eosinophil counts and total IgE levels may have a more severe disease course, which could guide treatment strategies. For example, elevated IgE levels and eosinophil counts may indicate the need for immunomodulatory therapies or biologic treatments. Additionally, these parameters can be used to monitor treatment response. Routine measurements could provide a practical approach for individualizing treatment plans and optimizing patient management. Future studies in this area will help us better understand the clinical significance of other laboratory parameters and inflammatory markers.

ETHICAL DECLARATIONS

Ethics Committee Approval

The study was conducted with the permission of the Scientific Researches Evaluation and Ethics Committee of Ümraniye Training and Research Hospital (Date: 03.12.2024, Decision No: 327).

Informed Consent

Because the study was designed retrospectively, no written informed consent form was obtained from patients.

Referee Evaluation Process

Externally peer-reviewed.

Conflict of Interest Statement

The authors have no conflicts of interest to declare.

Financial Disclosure

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Author Contributions

All of the authors declare that they have all participated in the design, execution, and analysis of the paper, and that they have approved the final version.

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My name is Halil Alkaya. I work as a subspecialty assistant in the Department of Pediatric Allergy and Immunology at Ümraniye Training and Research Hospital. I have a lovely wife and a daughter.