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Relationships between C-reactive protein, systemic immune inflammation index, and inflammatory markers related to hemograms in children diagnosed with acute otitis media

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ABSTRACT

Aims: The relationships between C-reactive protein (CRP), the systemic immune inflammation index (SII), and inflammatory markers derived from the hemogram are unknown in children with acute otitis media (AOM) infections. This study investigated the correlations between CRP, SII, and inflammatory markers in pediatric patients with AOM.

Methods: This retrospective study included pediatric cases diagnosed with AOM at the Pediatric Emergency Service of the Gülhane Training and Research Hospital between November 2016 and January 2019. The SII (neutrophil x platelet/lymphocyte), neutrophil-to-lymphocyte ratio (NLR), neutrophil-to-monocyte ratio (NMR), lymphocyte-to-monocyte ratio (LMR), platelet-to-lymphocyte ratio (PLR), mean platelet volume (MPV)-to-lymphocyte ratio (MPVLR), and lymphocyte-to-CRP ratio (LCR) values of the patients were analyzed. Correlations between CRP level, hemogram parameters and inflammatory markers were studied.

Results: Among the 252 cases, the median age was 2.0 (1-5) years, and 140 (55.6%) were male. There were no significant differences between the boys and the girls in terms of age, CRP, hemogram parameters, or related inflammatory markers ($p>0.05$). Significant correlations were found between CRP and SII ($r=0.375$, $p=0.001$), leukocyte count ($r=0.300$, $p=0.001$), neutrophil count ($r=0.459$, $p=0.001$), lymphocyte count ($r=-0.174$, $p=0.006$), NLR ($r=0.407$, $p=0.001$), NMR ($r=0.257$, $p=0.001$), LMR ($r=-0.393$, $p=0.001$), PLR ($r=0.137$, $p=0.03$), MPVLR ($r=0.173$, $p=0.006$), and LCR ($r=-0.881$, $p=0.001$). There were no correlations between CRP or SII and PLT or MPV.

Conclusions: High CRP, SII, and inflammatory markers calculated using the routine hemogram parameters correlate in pediatric patients with AOM.

Introduction

Acute otitis media (AOM) is a common childhood disease caused by middle ear inflammation and accompanied by middle ear effusion with acute signs and symptoms (1). AOM may present with an earache in older children and non-specific symptoms such as fever, irritability, or pulling or rubbing of the ear in younger children (1).

Middle ear inflammation begins with the early and intense bacterial colonization of the nasopharynx, and early-onset AOM is caused by acute ongoing inflammation in the middle ear due to continued exposure to infective agents (2). Viral infections of the epithelia of the nasopharynx and Eustachian tube underlie AOM. After viruses initiate the inflammatory process in the nasopharynx, bacteria and viruses induce middle ear inflammation, and otopathogen bacteria colonizing the nasopharynx begin causing damage (3).

Various markers are used to evaluate inflammation. One of these markers is C-reactive protein (CRP) which is widely

used in acute and chronic inflammatory conditions. CRP is an important marker in determining the cause of infection, and bacterial infections can increase its level significantly (4).

The distributions and counts of inflammatory and proinflammatory cells such as neutrophils, lymphocytes, and platelets (PLT) in the peripheral blood are altered by the release of inflammatory mediators (5,6). Parameters such as the neutrophil-to-lymphocyte ratio (NLR), the platelet-to-lymphocyte ratio (PLR), and the systemic immune inflammation index (SII) can be calculated using routine values in the hemogram, which can be used as inflammatory markers (7,8). As was emphasized in many recent studies, inflammatory markers such as NLR, PLR, and SII have both prognostic and diagnostic value in some diseases (9-11).

Although many studies are conducted on children with various infectious diseases regarding inflammatory markers such as CRP, NLR, and SII (4,9-11), there are no studies on these inflammatory markers in children with AOM.

In this study, we investigated the relationship between hemogram parameters, CRP, SII, and inflammatory markers related to hemogram parameters in AOM cases.

Methods

The patient group of this retrospective study included pediatric outpatients diagnosed with AOM between November 2016 and January 2019 at the Emergency Service of the Gülhane Training and Research Hospital (Ankara, Türkiye). Findings of the moderate-to-severe bulging of the tympanic membrane, the mild bulging of the tympanic membrane, and recent (<48 h) onset of ear pain or intense erythema of the tympanic membrane, air-fluid level behind the tympanic membrane, perforation of the tympanic membrane, and/or discharge in the ear canal not caused by otitis externa were considered AOM (12). The inclusion criteria for patients were as follows: the completion of relevant laboratory tests, being aged between 1 month and 18 years, not having used any antiplatelet drugs in the last 30 days and having no hematological or chronic diseases. We excluded subjects with missing relevant clinical or laboratory tests, and those with other acute or chronic infectious and hematological diseases accompanying acute AOM.

Laboratory test results were retrieved retrospectively from the hospital's information system. The SII (neutrophil x platelet/lymphocyte), NLR, neutrophil-to-monocyte ratio (NMR), lymphocyte-to-monocyte ratio (LMR), PLR, mean platelet volume (MPV) -to-lymphocyte ratio (MPVLR), and lymphocyte-to-CRP ratio (LCR) values of the patients were calculated from their hemogram results and analyzed. The patients were classified according to their CRP levels, where serum CRP results were <5.0 mg/L in Group 1 and >5.0 mg/L in Group 2. Correlation analyses of the CRP levels, complete blood parameters, and related inflammatory markers of the patients were performed.

The University of Health Sciences Türkiye, Gülhane Training and Research Hospital Local Ethics Committee approved the study (date: 26.02.2019, decision no: 66).

We obtained complete blood counts (CBC) measured with an automated device (Beckman Coulter UniCel® DxH 800 Cellular Analysis System Hematology Analyzer, Miami, FL, USA). CRP values were also obtained using an automated device (Beckman Coulter AU680® analyzer, Miami, FL, USA). The DxH 800 is a fully automated analyzer that provides a CBC, white blood cell (WBC) differential, and reticulocyte percentage and count and has an improved reportable range using advanced signal-to-noise algorithms.

Statistical Analysis

Statistical analyses were performed with the Statistical Package for the Social Sciences (SPSS) software (ver.22, IBM Corp., Armonk, NY, USA). The Kolmogorov-Smirnov test was used to evaluate whether the data were normally distributed. The non-normally distributed numeric data were compared using the Mann-Whitney U test, and the results are summarized in terms of medians and interquartile ranges. The categorical data are presented with n and % values. We analyzed the correlations of CRP levels, hemogram parameters, and related inflammatory markers using Pearson's correlation test or Spearman's correlation test. Differences were considered statistically significant at $p<0.05$.

Results

The study included 252 patients with acute AOM. The age range was 1 month and 18 years (median: 2.0 years). Most patients were in the 2-4 age group (n=73, 29%). Males comprised 55.6% (n=140) of the sample. There were no significant differences between the female and male patients in terms of their age, CRP, WBC, neutrophil count, lymphocyte count, PLT, or MPV values ($p>0.05$). Table 1 shows the demographic characteristics, CRP, WBC, neutrophil counts, lymphocyte counts, PLT values, MPV values, and inflammatory markers.

There were no significant differences between the female and male patients in terms of their inflammatory markers (NLR, NMR, LMR, PLR, LCR, MPVLR, SII) ($p>0.05$). Table 2 shows the results of inflammatory markers in different age groups by sex.

We classified the patients using a cut-off for CRP level. Subjects with a CRP <5.0 mg/L formed Group 1, and subjects with a CRP >5.0 mg/L formed Group 2 (Table 3). Age, PLT, and MPV values were similar in both groups. Female sex ratio was higher in Group 2 than in Group 1 ($p<0.001$). Group 1 had significantly lower median values of WBC (8800/μL vs. 11550/μL; $p<0.001$), neutrophil (3600/μL vs. 6550/μL; $p<0.001$), NLR (0.9 vs. 2.4; $p<0.001$), NMR (4.7 vs. 6.0; $p<0.001$), PLR (85.9 vs. 112.9; $p=0.005$), MPVLR (2.1 vs. 2.9; $p=0.002$), and SII (323.0 vs. 710.2; $p<0.001$) compared to Group 2.

Moreover, Group 1 had significantly higher lymphocyte (3990/μL vs. 2800/μL; p=0.002), LMR (5.1 vs. 2.7; p<0.001), and LCR (2.1 vs. 0.1; p<0.001) values compared with Group 2.

CRP positively correlated with WBC (r=0.300, p=0.001), neutrophil count (r=0.459, p=0.001), NLR (r=0.407, p=0.001), NMR (r=0.257, p=0.001), PLR (r=0.137, p=0.03), MPVLR (r=0.173, p=0.006), and SII (r=0.375, p=0.001), and negatively correlated with lymphocyte counts (r=-0.174, p=0.006), LMR (r=-0.393, p=0.001), and LCR (r=-0.881, p=0.001). Similarly, SII positively correlated with WBC (r=0.445, p=0.001), neutrophil count (r=0.837, p=0.001), NLR (r=0.948, p=0.001), NMR (r=0.763, p=0.001), PLR (r=0.780, p=0.001), and MPVLR (r=0.600, p=0.001), and negatively correlated with lymphocyte counts (r=-0.629, p=0.001), LMR (r=-0.760, p=0.001), and LCR (r=-0.564, p=0.001) (Table 4). However, there was no correlation between the CRP and SII values of the patients and their PLT or MPV values (p>0.05).

Discussion

To the best of our knowledge, there is no study on the relationships of CRP, SII, and inflammatory markers related to hemogram parameters in children with AOM.

We performed the current study to emphasize the value of CRP, NLR, NMR, LMR, PLR, LCR, MPVLR, and SII in pediatric AOM infections as inflammatory biomarkers as fast, simple, easily accessible and useful in early diagnosis. We provided evidence of correlations between CRP and SII values and inflammatory markers related to CBC parameters in our study.

Biomarkers used in the differential diagnosis of infections in clinical practice are diverse, and the most commonly used acute-phase reactants are CRP, leukocyte counts, and platelet counts (13). As an inflammatory marker, CRP is a non-specific acute phase protein with highly accurate and easily reproducible results. Although leukocyte counts alone are not specific for the diagnosis of bacterial infections, they are widely used together with CRP to diagnose patients with acute bacterial infections and predict their prognosis (14).

Recently, NLR has been widely used in almost all medical disorders as a reliable and easily accessible marker of inflammation against various infectious and non-infectious conditions (15). NLR is considered an excellent indicator of inflammation, reflecting the harmony between innate and adaptive immune responses (15). Normal range values need to be defined to identify whether an NLR value is high. To this end, several studies have investigated normal values of NLR in healthy adult populations (16,17). Generally, NLR values greater than 5 are considered pathological in adults (15). Although different NLR values have been reported in different infections, a few studies in children have reported different

Table 1. Demographic characteristics, CRP, WBC, neutrophil, lymphocyte, PLT values, and inflammatory markers of the sample

	Female	Male	Total
N (%)	112 (44.4)	140 (55.6)	252 (100)
Age (years), median (IQR)	2.0 (1-5)	2.0 (1-6)	2.0 (1-5)
1-12 months, n (%)	18 (7.1)	16 (6.4%)	34 (13.5)
13-24 months, n (%)	28 (11.1)	42 (16.7)	70 (27.8)
2-4 years, n (%)	33 (13.1)	40 (15.9)	73 (29.0)
5-9 years, n (%)	24 (9.5)	32 (12.7)	56 (22.2)
10-18 years, n (%)	9 (3.6)	10 (3.9)	19 (7.5)
CRP (mg/L), median (IQR)	11.2 (4.7-34.1)	9.8 (3.2-5-29.0)	10.1 (4.0-31.6)
WBC (/μL), median (IQR)	11360 (8252-15325)	10300 (7710-13250)	10700 (8100-14150)
Neutrophil (/μL), median (IQR)	6450 (3600-9625)	4980 (3600-7600)	5600 (3600-9000)
Lymphocyte (/μL), median (IQR)	3025 (2025-4865)	3240 (1900-4900)	3200 (1900-4900)
PLT (/μL), median (IQR)	349000 (263500-412500)	313000 (254500-374000)	328000 (258000-394500)
MPV (/fL), median (IQR)	7.8 (7.1-8.8)	8.0 (7.1-8.9)	7.9 (7.1-8.9)
NLR, median (IQR)	2.2 (1-4.0)	1.5 (0.8-3.1)	1.8 (0.8-3.6)
NMR, median (IQR)	5.9 (3.8-9.3)	5.3 (3.9-8.3)	5.6 (3.9-8.8)
LMR, median (IQR)	3.0 (2.0-5.0)	3.5 (2.0-5.5)	3.2 (2.0-5.3)
PLR, median (IQR)	103.4 (69.4-160.1)	97.8 (70.3-150.3)	100.8 (70.3-152.4)
MPVLR, median (IQR)	2.6 (1.6-4.1)	2.4 (1.6-4.2)	2.5 (1.6-4.2)
LCR, median (IQR)	0.3 (0.1-1.0)	0.4 (0.1-1.5)	0.3 (0.1-1.2)
SII, median (IQR)	679.1 (303.5-1481.1)	525.4 (270.0-899.8)	570.0 (278.6-1033.6)

CRP: C-reactive protein, WBC: White blood cell, PLT: Platelet, MPV: Mean platelet volume, NLR: Neutrophil-to-lymphocyte ratio, NMR: Neutrophil-to-monocyte ratio, LMR: Lymphocyte-to-monocyte ratio, PLR: Platelet-to-lymphocyte ratio, MPVLR: Mean platelet volume-to-lymphocyte ratio, LCR: Lymphocyte-to-CRP ratio, SII: Systemic immune inflammation index

values of the normal range of NLR values in children according to age (18). It has been shown that NLR can be a useful inflammatory parameter for some diseases (19,20). High NLR values have been associated with severe inflammation and may indicate a worsening prognosis of the examined disease (15). NLR was investigated as an inflammation biomarker in association with bacterial infections and sepsis compared with CRP, and it was shown that both the NLR and significant lymphopenia were better predictors of bacteremia than CRP levels and total WBC counts (21).

In a study in which PLR was also studied as an inflammatory marker, it was determined that hemodialysis had a significant relationship with NLR, PLR, and CRP in patients with end-stage renal disease (22). In the novel Coronavirus disease-2019 (COVID-19), higher NLR and PLR and lower LMR values were observed in patients compared to healthy individuals (23). Higher PLR values were associated with an increased risk of serious illness in COVID-19 patients (23).

SII allows the simultaneous evaluation of platelets, lymphocytes, and neutrophils, which are markers of the hemostatic system involved in the inflammatory process (24). In COVID-19, SII values were found to be significantly higher in patients in intensive care units (ICU) compared with non-ICU patients (11). A statistically significant relationship was shown

Table 2. Comparison of inflammatory markers by age groups and sex

Parameter	Age	Female	Male	p value
NLR	1-12 months	0.69 (0.30-1.92)	0.75 (0.53-1.59)	0.91
	13-24 months	1.63 (0.64-2.61)	1.22 (0.76-2.42)	0.83
	2-4 years	3.00 (1.16-4.92)	1.51 (0.78-3.89)	0.14
	5-9 years	3.64 (2.19-7.69)	2.56 (1.43-5.04)	0.09
	10-18 years	3.00 (1.93-9.00)	2.21 (1.26-9.51)	1.62
NMR	1-12 months	3.29 (2.48-5.06)	3.57 (2.06-5.37)	0.87
	13-24 months	4.74 (3.25-6.55)	4.63 (3.58-6.61)	0.97
	2-4 years	6.66 (4.69-10.63)	5.17 (3.93-8.68)	0.13
	5-9 years	8.16 (5.97-10.68)	7.04 (5.26-9.49)	0.37
	10-18 years	6.10 (5.73-10.14)	7.37 (6.31-10.89)	0.56
LMR	1-12 months	5.28 (3.94-7.49)	4.86 (3.07-5.59)	0.35
	13-24 months	3.66 (2.24-5.41)	4.00 (2.14-5.83)	0.79
	2-4 years	2.71 (2.07-4.19)	3.24 (2.08-5.75)	0.48
	5-9 years	2.34 (1.23-3.40)	2.28 (1.80-4.44)	0.28
	10-18 years	2.00 (1.18-3.89)	3.04 (1.22-4.71)	0.41
PLR	1-12 months	59.68 (51.07-78.95)	51.09 (41.54-76.73)	0.11
	13-24 months	85.94 (58.31-127.93)	87.67 (70.03-130.29)	0.51
	2-4 years	137.27 (77.06-189.05)	96.84 (66.41-135.68)	0.08
	5-9 years	162.40 (114.07-210.64)	138.89 (99.41-156.25)	0.21
	10-18 years	113.91 (98.80-187.35)	160.39 (100.84-222.06)	0.56
LCR	1-12 months	1.24 (0.17-3.72)	1.35 (0.23-2.31)	0.91
	13-24 months	0.27 (0.06-0.94)	0.42 (0.16-1.59)	0.12
	2-4 years	0.35 (0.04-0.86)	0.45 (0.05-1.37)	0.10
	5-9 years	0.19 (0.06-0.26)	0.26 (0.09-0.77)	0.15
	10-18 years	0.09 (0.04-0.36)	0.23 (0.08-4.95)	0.22
MPVLR	1-12 months	1.30 (1.07-1.59)	1.18 (0.96-1.60)	0.51
	13-24 months	1.84 (1.29-2.63)	2.26 (1.71-3.13)	0.19
	2-4 years	2.92 (2.17-4.45)	2.29 (1.59-4.52)	0.33
	5-9 years	3.85 (2.94-6.17)	4.07 (2.24-5.40)	0.47
	10-18 years	4.82 (3.19-6.66)	4.77 (2.76-7.31)	0.87
SII	1-12 months	176.11 (127.56-622.79)	308.47 (165.93-554.10)	0.77
	13-24 months	431.88 (275.99-870.68)	414.09 (267.44-751.47)	0.73
	2-4 years	683.64 (432.32-1852.41)	474.17 (246.56-934.34)	0.069
	5-9 years	1024.28 (679.29-2321.97)	751.12 (463.85-1554.73)	0.10
	10-18 years	787.50 (534.23-1822.50)	698.39 (446.38-2690.61)	0.98

Data are presented as median (interquartile range).
NLR: Neutrophil-to-lymphocyte ratio, NMR: Neutrophil-to-monocyte ratio, LMR: Lymphocyte-to-monocyte ratio, PLR: Platelet-to-lymphocyte ratio, MPVLR: Mean platelet volume-to-lymphocyte ratio, LCR: Lymphocyte-to-CRP ratio, SII: Systemic immune inflammation index

between SII and sepsis, and the mean SII value was significantly higher in patients with sepsis (25).

Various studies have investigated inflammatory biomarkers to determine inflammatory processes, and these biomarkers have been evaluated along with the diagnosis and prognosis of AOM, including its bacterial and viral forms. Concentrations of interleukin (IL) 1β and lactate dehydrogenase in nasopharyngeal secretions were associated with an increased risk of developing AOM after a viral upper respiratory tract infection (26). While increased serum IL-10 concentrations were found in pneumococcal AOM (27), a biomarker risk score including serum cytokines was developed to aid in the diagnosis of AOM caused by non-typeable Haemophilus influenzae and predict its prognosis (28).

In our study, consistent with the literature, WBC, neutrophil count, NLR, NMR, PLR, MPVLR, and SII values were found to be higher in the group that we considered to have a high CRP value compared to the group with a low CRP value, while

Table 3. Demographic characteristics, complete blood count parameters, and inflammatory markers by CRP

	Group 1 (CRP <5 mg/L)	Group 2 (CRP >5 mg/L)	p value
N (%)	91 (36.1)	161 (63.9)	
Sex (female), n (%)	28 (30.8)	84 (50.2)	**<0.001**
CRP (mg/L), median (IQR)	1.89 (0.6-3.27)	24.6 (11.45-5-46.68)	
Age (years), median (IQR)	2.00 (1-4)	2.00 (1-5)	0.09
WBC (/μL), median (IQR)	8800 (6600-12100)	11550 (8850-14845)	**<0.001**
Neutrophil (/μL), median (IQR)	3600 (2530-5960)	6550 (4725-9700)	**<0.001**
Lymphocyte (/μL), median (IQR)	3990 (2300-6070)	2800 (1800-4400)	**0.002**
PLT (/μL), median (IQR)	342000 (265000-395000)	318000 (241000-397000)	0.25
MPV (/fL), median (IQR)	7.9 (7.2-8.7)	8.0 (7.1-8.9)	0.78
NLR, median (IQR)	0.85 (0.55-1.89)	2.35 (1.31-4.13)	**<0.001**
NMR, median (IQR)	4.68 (3.01-7.40)	6.02 (4.31-9.17)	**<0.001**
LMR, median (IQR)	5.14 (3.17-7.35)	2.69 (1.83-4.09)	**<0.001**
PLR, median (IQR)	85.85 (59.02-132.41)	112.87 (77.28-156.78)	**0.005**
MPVLR, median (IQR)	2.13 (1.34-3.42)	2.90 (1.72-4.29)	**0.002**
LCR, median (IQR)	2.06 (0.93-7.02)	0.12 (0.05-0.26)	**<0.001**
SII, median (IQR)	322.97 (163.44-665.17)	710.18 (420.15-1424.96)	**<0.001**

CRP: C-reactive protein, WBC: White blood cell, PLT: Platelet, MPV: Mean platelet volume, NLR: Neutrophil-to-lymphocyte ratio, NMR: Neutrophil-to-monocyte ratio, LMR: Lymphocyte-to-monocyte ratio, PLR: Platelet-to-lymphocyte ratio, MPVLR: Mean platelet volume-to-lymphocyte ratio, LCR: Lymphocyte-to-CRP ratio, SII: Systemic immune inflammation index

Table 4. Correlation analysis of CRP levels and SII scores with complete blood count parameters and inflammatory markers

	CRP	SII
Parameter	r (P)	r (P)
WBC count	**0.300 (0.001)**	**0.445 (0.001)**
Neutrophil count	**0.459 (0.001)**	**0.837 (0.001)**
Lymphocyte count	**-0.174 (0.006)**	**-0.629 (0.001)**
PLT count	-0.101 (0.11)	0.090 (0.155)
MPV	0.034 (0.59)	-0.035 (0.582)
NLR	**0.407 (0.001)**	**0.948 (0.001)**
NMR	**0.257 (0.001)**	**0.763 (0.001)**
LMR	**-0.393 (0.001)**	**-0.760 (0.001)**
PLR	**0.137 (0.03)**	**0.780 (0.001)**
MPVLR	**0.173 (0.006)**	**0.600 (0.001)**
LCR	**-0.881 (0.001)**	**-0.564 (0.001)**
SII	**0.375 (0.001)**	

CRP: C-reactive protein, WBC: White blood cell, PLT: Platelet, MPV: Mean platelet volume, NLR: Neutrophil-to-lymphocyte ratio, NMR: Neutrophil-to-monocyte ratio, LMR: Lymphocyte-to-monocyte ratio, PLR: Platelet-to-lymphocyte ratio, MPVLR: Mean platelet volume-to-lymphocyte ratio, LCR: Lymphocyte-to-CRP ratio, SII: Systemic immune inflammation index

lymphocyte, LMR, and LCR values were found to be lower in the former than the latter. Additionally, we found that CRP was positively correlated with WBC, neutrophil count, NLR, NMR, PLR, MPVLR, and SII and negatively correlated with lymphocyte count, LMR, and LCR values. These results showed that as inflammation increases, CRP elevation is seen as an indicator of this increase, and the increase in inflammation is associated with high neutrophil counts and decreased lymphocyte counts.

Although differences in CRP levels and NLR were found between men and women in viral upper respiratory tract infections in different age groups (29), there was no difference between the sexes in terms of CRP, NLR, or other inflammatory parameters in our study, and this result suggested that sex is not a significant predictor of inflammation in AOM infection cases.

In comparison to previous studies, our study is the first original study conducted by comparing the clinical use of NLR and other inflammatory markers related to hemogram parameters to the use of CRP levels in pediatric AOM infections.

Study Limitations

Some limitations of our study were that 1) the small sample size of our study may have been insufficient in the evaluation of CRP, SII, and inflammatory markers related to hemogram parameters in children with AOM infections; 2) the study was a single-center, retrospective study, and detailed demographic data could not be obtained; 3) the follow-up examination and laboratory test results of these children diagnosed with AOM were not known because they were not followed up; 4) the tests for the etiological causes of children with AOM were limited; 5) there may be variables that affect the results of CBC values such as types of CBC analysis devices, analysis-related errors, arterial blood pressure, body mass index, serum lipids, seasonal differences, and time between venipuncture and measurement, but since the study was retrospective, we did not have the opportunity to intervene with these variables, and 6) a healthy control group was not included in the study for comparison to patients with AOM.

Conclusion

In conclusion, inflammatory markers related to hemogram parameters and SII scores may aid decision-making in treatment and disease severity in children with AOM. Further studies of these inflammatory markers in patients with AOM are needed to demonstrate whether the changes in their values persist later.

Ethics

Ethics Committee Approval: The University of Health Sciences Türkiye, Gülhane Training and Research Hospital Local Ethics Committee approved the study (date: 26.02.2019, decision no: 66).

Informed Consent: Retrospective study.

Peer-review: Externally peer-reviewed.

Authorship Contributions

Surgical and Medical Practices: A.T., Concept: H.Ö.Ş., Design: A.B., A.T., Data Collection or Processing: A.B., Analysis or Interpretation: A.B., Literature Search: A.B., Writing: A.B.

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