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Comparison of C-Reactive Protein and Hematological Inflammation Indices in Head and Neck Abscesses: A Retrospective Study

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Abstract

Purpose

This study aimed to identify inflammation indices that can be used to monitor treatment response and predict the length of hospital stay in patients treated for abscesses in the head and neck region.

Methods

This retrospective study included patients who were treated for head and neck abscesses as the study group. The study group consisted of 50 patients, while the control group included 100 patients. Statistical analyses were performed regarding age, sex, complete blood count results, C-reactive protein levels, abscess localization, length of hospital stay, pan-immune-inflammation value, systemic inflammatory response index, systemic immune-inflammation index, neutrophil-to-lymphocyte ratio, platelet-to-lymphocyte ratio, plateletcrit, and infection discrimination index.

Results

There were no statistically significant differences between the groups in terms of age ($p = 0.351$) and sex ($p = 1.000$). The most frequent diagnosis in this group was submandibular space abscess (36%). In comparisons of complete blood count and index values between the two groups, all parameters had statistically significant differences ($p < 0.001$), except for mean platelet volume ($p = 0.060$). A statistically significant positive correlation was found between the rate of change in C-reactive protein levels during hospitalization and the rate of change in the systemic inflammatory response index ($p = 0.031$). Additionally, there were significant positive correlations between the length of hospital stay with the initial C-reactive protein ($p = 0.003$) and mean platelet volume ($p = 0.005$) at admission.

Conclusion

The correlation between the systemic inflammatory response index and C-reactive protein suggests that this index may serve as a more comprehensive and C-reactive protein-compatible inflammation marker for head and neck abscesses.

1. Introduction

Abscesses that occur following bacterial infections of the fascial planes in the head and neck region can lead to significant morbidity and mortality. These pathologies constitute a substantial portion of emergency cases managed and treated in otorhinolaryngology clinics. Early diagnosis, effective treatment, and appropriate follow-up play critical roles in patient prognosis. Drainage of the abscess is the initial step for treatment. Following drainage, patients are often hospitalized and closely monitored

with intravenous antibiotic therapy. The most commonly used blood tests to assess systemic infectious status at the time of admission are the complete blood count and C-reactive protein (CRP) levels. These two tests are also frequently repeated at regular intervals during treatment to evaluate the therapeutic response [1, 2].

In recent years, the use of inflammation indices calculated using parameters derived from the complete blood count has gained popularity. The roles of these indices were investigated in a wide range of conditions, including infectious diseases, malignancies, and autoimmune disorders. Since the formulas of these indices incorporate multiple parameters, they are considered to provide a more comprehensive representation of inflammatory pathways. Additionally, as they are calculated based on complete blood count results, they are low-cost and easily accessible. The pan-immune-inflammation value (PIV), systemic inflammatory response index (SIRI), systemic immune-inflammation index (SII), neutrophil-to-lymphocyte ratio (NLR), platelet-to-lymphocyte ratio (PLR), plateletcrit (PCT), and infection discrimination index (IDI) are among indices frequently studied in the field of otorhinolaryngology [3–6].

This study aimed to identify inflammation indices that can be used to monitor treatment response and predict the length of hospital stay in patients treated for abscesses in the head and neck region.

2. Materials and Methods

This retrospective study was initiated after obtaining approval from the Subcommittee of the Ethics Committee of Health Sciences at Süleyman Demirel University (approval number 59, dated 25.03.2025). The study was conducted in accordance with the ethical principles outlined in the Declaration of Helsinki and was carried out at the Department of Otorhinolaryngology, Faculty of Medicine, Süleyman Demirel University. Given the retrospective nature of the study, the requirement for informed consent was waived; therefore, informed consent was not obtained.

The study group consisted of patients who were hospitalized and treated for head and neck abscesses in the Department of Otorhinolaryngology between 01.01.2018 and 01.01.2025. The control group included patients who underwent septoplasty in the same clinic during the same period. Inclusion criteria for the study group were: being 18 years of age or older, having both a complete blood count and CRP test performed at the time of initial admission due to abscess, having these tests repeated during antibiotic treatment and prior to discharge, being treated in accordance with the clinic's standard treatment protocol for head and neck abscesses (drainage followed by intravenous ampicillin-sulbactam unless contraindicated), and not having received any antibiotic therapy for the infection prior to admission. Inclusion criteria for the control group were: being 18 years of age or older and having undergone complete blood count testing during preoperative preparation for septoplasty.

Exclusion criteria for both groups included: having inflammatory, autoimmune, or malignant diseases that could affect inflammatory markers; having an additional active infectious pathology; history of medication use that could alter complete blood count results; or incomplete access to the parameters examined in the study in medical records. Additional exclusion criteria for the control group included

undergoing septoconchoplasty due to obstructive sleep apnea syndrome or due to an infectious rhinologic pathology.

Once patients who met the inclusion and exclusion criteria for the study group between 01.01.2018 and 01.01.2025 were identified, two patients were selected for the control group for each study patient, matched by age and sex, and included chronologically from the same time frame and under the same criteria. The aim was to ensure that the number of patients in the control group was twice that of the study group and that both groups were parallel in terms of age and sex, allowing for a more isolated evaluation of the studied parameters.

From the archived records, data were obtained as follows: for the study group – age, sex, diagnosis, medical history, complete blood count results, CRP levels, abscess localization, treatment details, and length of hospital stay; and for the control group – age, sex, medical history, and complete blood count results from the preoperative evaluation. In both groups, the following inflammation indices were calculated from the complete blood count results: PIV, SIRI, SII, NLR, PLR, PCT, and IDI. These indices were calculated as follows:

PIV: (Neutrophil × Monocyte × Platelet) / Lymphocyte

SIRI: (Neutrophil × Monocyte) / Lymphocyte

SII: (Neutrophil × Platelet) / Lymphocyte

NLR: Neutrophil / Lymphocyte

PLR: Platelet / Lymphocyte

IDI: Neutrophil / (Lymphocyte + Monocyte)

PCT: (Platelet × Mean Platelet Volume) / 10,000

Statistical Analysis

Statistical analyses were performed using SPSS software version 29.0.0.0 (IBM SPSS Corp., Armonk, NY, USA). Categorical variables are presented as percentages, while continuous variables are expressed as means and standard deviations. The chi-square test was used to compare categorical variables, and the independent samples t-test was used for continuous variables. Correlation analyses were conducted using Pearson correlation analysis. A p-value of less than 0.05 was considered statistically significant.

3. Results

The study group consisted of 50 patients, and the control group included 100 patients. No statistically significant differences were found between the study and control groups in terms of age and sex (p = 0.351 and p = 1.000, respectively) (Table 1).

Table 1
Comparison of the Study and Control Groups in Terms of Age and Sex

		Study Group (n = 50)	Control Group (n = 100)	*p*
Gender	Female	27 (54%)	54 (54%)	1.000*
	Male	23 (46%)	46 (46%)	
Age Mean (± SD)		39.90 (± 16.71)	38.89 (± 14.46)	0.351**
*: Chi-square Test **: Independent samples t-test				

The mean length of hospital stay for patients in the study group was 7.88 (± 3.43) days. The distribution of abscess localizations among these patients is presented in Table 2.

Table 2
Localization of Abscesses in Patients in the Study Group

Localization of Abscesses	**n (%)**
Submandibular Region	18 (36%)
Submandibular Region + Parapharyngeal Space	12 (24%)
Peritonsillar Space + Parapharyngeal Space	9 (18%)
Peritonsillar Space	3 (6%)
Submandibular Region + Parapharyngeal Space + Retropharyngeal Space	2 (4%)
Parapharyngeal Space	1 (2%)
Retropharyngeal Space	1 (2%)
Submandibular Region + Retropharyngeal Space	1 (2%)
Paratracheal Space + Superior Mediastinum	1 (2%)
Buccal Region	1 (2%)
Buccal Region + Parapharyngeal Space	1 (2%)

In the statistical analyses comparing the complete blood count and index results between patients in the study group and those in the control group, no statistically significant difference was found for mean platelet volume ($p = 0.060$). However, all other parameters had statistically significant differences between the groups ($p < 0.001$ for all parameters; Table 3).

Table 3
Comparison of Complete Blood Count and Inflammation Index Results Between the Study and Control Groups

Parameter	Study Group (n = 50) Mean (± SD)	Control Group (n = 100) Mean (± SD)	*p*
Leukocyte	13.13 (± 4.76)	7.92 (± 1.59)	< 0.001
Neutrophil	10.55 (± 4.46)	4.76 (± 1.30)	< 0.001
Lymphocyte	1.48 (± 0.57)	2.32 (± 0.63)	< 0.001
Monocyte	0.99 (± 0.41)	0.61 (± 0.17)	< 0.001
MPV	8.29 (± 0.78)	8.54 (± 0.74)	0.060
Platelet	309.88 (± 82.12)	258.23 (± 64.26)	< 0.001
PIV	2940.46 (± 3428.40)	347.25 (± 195.90)	< 0.001
SIRI	9.17 (± 8.52)	1.38 (± 0.95)	< 0.001
IDI	4.66 (± 2.66)	1.70 (± 0.62)	< 0.001
PCT	0.25 (± 0.06)	0.21 (± 0.05)	< 0.001
SII	2729.42 (± 2342.32)	561.93 (± 238.39)	< 0.001
NLR	8.78 (± 6.67)	2.22 (± 1.11)	< 0.001
PLR	249.25 (± 144.94)	117.53 (± 36.43)	< 0.001

PIV: Pan-Immune-Inflammation Value, SIRI: Systemic Inflammatory Response Index, SII: Systemic Immune-Inflammation Index, NLR: Neutrophil-to-Lymphocyte Ratio, PLR: Platelet-to-Lymphocyte Ratio, PCT: Plateletcrit, IDI: Infection Discrimination Index, MPV: Mean Platelet Volume

As a result of the correlation analysis comparing the ratio of CRP levels at discharge to those at admission with the corresponding ratios of inflammation indices, a statistically significant correlation was found between the SIRI ratio and the CRP ratio (p = 0.031). There was a moderate positive correlation between CRP ratio and SIRI ratio (Table 4).

Table 4
Correlation Analysis Between the Ratio of CRP Levels at Discharge to Admission and the Ratios of Inflammation Indices at Discharge to Admission in the Study Group

	Correlation Analysis with CRP Ratio (0.18 ± 0.28)		
	Mean ± SD	**r**	***p***
PIV Ratio	0.27 ± 0.30	0.244	0.088
SIRI Ratio	0.24 ± 0.27	0.305	**0.031**
IDI Ratio	0.42 ± 0.25	0.100	0.488
PCT Ratio	1.12 ± 0.27	-0.161	0.263
SII Ratio	0.37 ± 0.28	0.161	0.264
NLR Ratio	0.32 ± 0.23	0.238	0.095
PLR Ratio	0.79 ± 0.30	0.167	0.246

PIV: Pan-Immune-Inflammation Value, SIRI: Systemic Inflammatory Response Index, SII: Systemic Immune-Inflammation Index, NLR: Neutrophil-to-Lymphocyte Ratio, PLR: Platelet-to-Lymphocyte Ratio, PCT: Plateletcrit, IDI: Infection Discrimination Index, MPV: Mean Platelet Volume, r: Pearson Correlation Coefficient

Statistically significant relationships were found between the length of hospital stay with CRP and mean platelet volume values at admission in the study group ($p = 0.003$ and $p = 0.005$, respectively). The length of hospital stay was moderately and positively correlated with CRP and mean platelet volume values at the time of admission (Table 5).

Table 5
Identification of Parameters Correlated with Length of Hospital Stay in the Study Group

	Length of Hospital Stay (7.88 ± 3.43)		
	Mean ± SD	**R**	***p***
Age	39.90 ± 16.71	0.105	0.469
CRP	143.70 ± 97.02	0.414	**0.003**
Leukocyte	13.13 ± 4.76	0.030	0.839
Neutrophil	10.55 ± 4.46	0.057	0.693
Lymphocyte	1.48 ± 0.57	-0.272	0.056
Monocyte	0.99 ± 0.41	0.114	0.430
MPV	8.29 ± 0.78	0.389	**0.005**
Platelet	309.88 ± 82.12	-0.122	0.398
PIV	2940.46 ± 3428.40	0.078	0.592
SIRI	9.17 ± 8.52	0.167	0.248
IDI	4.66 ± 2.66	0.062	0.668
PCT	0.25 ± 0.06	0.039	0.790
SII	2729.42 ± 2342.32	0.051	0.725
NLR	8.78 ± 6.67	0.113	0.435
PLR	249.25 ± 144.94	0.089	0.541

PIV: Pan-Immune-Inflammation Value, SIRI: Systemic Inflammatory Response Index, SII: Systemic Immune-Inflammation Index, NLR: Neutrophil-to-Lymphocyte Ratio, PLR: Platelet-to-Lymphocyte Ratio, PCT: Plateletcrit, IDI: Infection Discrimination Index, MPV: Mean Platelet Volume, r: Pearson Correlation Coefficient

Discussion

In this study, we evaluated the inflammation indices calculated from complete blood count parameters—namely PIV, IDI, PCT, SII, NLR, PLR, and SIRI—in patients with head and neck abscesses. As anticipated, all indices were found to be significantly higher in the study group compared to the control group. This result is consistent with previous studies in the literature that investigated these indices in bacterial infectious diseases [3–5]. Additionally, our study is noteworthy for being the first to evaluate SIRI specifically in head and neck abscesses.

We also examined the relationship between these systemic inflammation indices and CRP levels in patients diagnosed with head and neck abscesses. While no significant correlation was observed between CRP and indices such as PIV, IDI, PCT, SII, NLR, and PLR, a significant correlation was detected only between SIRI and CRP. This finding may be explained by the equation used to calculate SIRI and the immunological characteristics it represents. SIRI is calculated using the formula: (neutrophil × monocyte) / lymphocyte. Unlike many other indices, the monocyte value is included in the numerator exclusively in SIRI. Additionally, platelet count—which can vary significantly among patients even within the normal range—is not included in this calculation. As a result, the influence of monocyte count becomes more pronounced in the final index value. It was reported that monocytic cytokines such as IL-1 and IL-6 play critical roles in CRP production [7]. Therefore, SIRI, which incorporates monocyte count as a key determinant, is expected to show a stronger correlation with CRP. Our findings suggest that while other indices may reflect the general inflammatory status in patients with head and neck abscesses, they do not correlate with CRP levels, which are primarily influenced by monocytic inflammatory responses.

Moreover, similar to many other infectious pathologies, head and neck abscesses often exhibit a biphasic immune response involving both acute neutrophilic infiltration and chronic monocyte/macrophage-mediated inflammation [8, 9]. In such cases—particularly in patients with extensive soft tissue involvement or prolonged symptom duration—SIRI may provide a more accurate representation of the systemic inflammatory environment by incorporating both neutrophil and monocyte values in its numerator. This perspective is consistent with previous studies suggesting that SIRI may be superior to other markers in reflecting disease severity and systemic inflammatory burden in both infectious and neoplastic conditions [10–12].

In our study, significant positive correlations were found between the initial mean platelet volume value with CRP level at admission and the length of hospital stay in patients with head and neck abscesses. However, no statistically significant difference in mean platelet volume was observed between the study and control groups. This finding suggests that mean platelet volume may reflect the severity and clinical course of the disease rather than its mere presence. Mean platelet volume is a hematological parameter that reflects the average volume of platelets, and it can vary in inflammatory processes due to platelet activation and production. Especially under the influence of proinflammatory cytokines, changes in megakaryopoiesis may result in the release of larger, more reactive platelets into circulation [13–16]. Therefore, mean platelet volume may provide indirect information about the duration and severity of inflammation.

The main limitations of this study are its retrospective design, the limited number of patients included, and the absence of simultaneous cytokine-based analyses to assess inflammatory pathways.

Conclusion

In conclusion, the finding that only SIRI was correlated with CRP suggests that this index may serve as a more comprehensive and CRP-consistent marker of inflammation in head and neck abscesses. Further

studies are needed to validate this relationship and to investigate its prognostic value in head and neck abscesses.

Declarations

Competing Interests: The authors declare that they have no conflict of interest, financial or non-financial.

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Human Ethics and Consent to Participate Statements: This study was conducted in the Department of Otorhinolaryngology, Faculty of Medicine, Süleyman Demirel University, following approval from the Subcommittee of the Health Sciences Ethics Committee of Süleyman Demirel University Rectorate (Approval No: 59, dated 25.03.2025).

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