

The effect of nasal septum deviation type on the systemic inflammatory index and blood markers of inflammation

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Cite this article as: Kandemir S, Pamuk G. The effect of nasal septum deviation type on the systemic inflammatory index and blood markers of inflammation. *J Health Sci Med.* 2023;6(5):1069-1073.

Received: 15.08.2023

Accepted: 11.09.2023

Published: 28.09.2023

ABSTRACT

Aims: The aim of this study was to identify the changes in blood markers of inflammation and the systemic immune inflammatory index in patients with nasal septum deviation (NSD). An additional aim was to determine if there was a significant difference in the findings according to septum deviation type.

Methods: This retrospective study included 321 patients diagnosed with NSD via physical examination and CT (NSD group), and 101 healthy controls. Standard complete blood count was performed. Main blood parameters and mean platelet volume (MPV), the neutrophil-to-lymphocyte ratio (NLR), the platelet-to-lymphocyte ratio (PLR), and the systemic immune inflammatory index (SII) were recorded. NSD was classified as 3 types according to Dreher classification, and the types were compared to each other and the control group.

Results: The hemoglobin level, and platelet and neutrophil counts were significantly higher in the NSD group than in the control group ($P < 0.001$ for each). The MPV, NLR, PLR, and SII were also significantly higher in the NSD group ($P < 0.001$ for each). There was a significant increase in all blood markers of inflammation as the degree of septum deviation increased ($P < 0.001$ for each).

Conclusion: Blood markers of inflammation are significantly elevated in patients with NSD. The SII value can indicate an inflammatory condition in these patients. The degree of septum deviation can affect the degree of inflammation.

Keywords: Nasal septum, nasal obstruction, mean platelet volume

INTRODUCTION

Nasal obstruction is among the most common complaints in otolaryngology practice. It is thought that 80% of the Turkish population has breathing problems.¹ Nasal septum deviation (NSD) is the most common cause of nasal obstruction. The nose is responsible for ~50% of total respiratory resistance; therefore, when there is nasal obstruction lung ventilation capacity decreases, and hypoxia and hypercapnia occur. Increased intrathoracic pressure causes lung and heart problems, and also negatively affects activation of the sympathetic and parasympathetic systems.² Hypoxia-induced erythropoiesis occurs due to chronic hypoxia and, therefore, diseases that cause chronic hypoxia increase the hemoglobin (Hb), hematocrit (Htc), and red blood cell (rbc) levels. Inflammation increases mean platelet volume (MPV), which is a potential risk for arterial thrombosis.³ Research shows that there is an increase in MPV in patients with hypertension, hypercholesterolemia, diabetes mellitus, and acute ischemic attack.⁴ Chronic inflammation causes an increase

in the neutrophil to lymphocyte ratio (NLR) and the platelet to lymphocyte ratio (PLR).⁵

The systemic immune inflammation index (SII) is a novel marker calculated as the platelet count \times NLR and includes 3 cell types. It provides information about the clinical outcome in patients with cancer and inflammatory diseases. A high SII in patients with acute myocardial infarction and heart failure is indicative of a poor prognosis. In recent years research on SII has been increasing, especially in patients with gastrointestinal and gynecological cancers.⁶

Studies show that these parameters increase significantly in cases of many diseases in which chronic hypoxia and inflammation occur. The present study aimed to determine if chronic inflammation due to NSD changes these parameters. In addition, patients with NSD were evaluated according to septum deviation type to determine whether there is a significant relationship between the degree of septum deviation and inflammation.

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METHODS

The study was carried out with the permission of Kırıkkale University Non-interventional Clinical Researches Ethics Committee (Date: 08.06.2022, Decision No: 2022.05.24). All procedures were carried out in accordance with the ethical rules and the principles of the Declaration of Helsinki.

This retrospective chart review study examined patient demographics, medical examination reports, and blood parameters. The NSD group included 321 patients that presented to Kırıkkale Yüksek İhtisas Hospital, Department of Otorhinolaryngology, and were diagnosed with NSD via anterior rhinoscopy, nasal endoscopy and paranasal CT between January 2018 and December 2022. The control group included 101 age-matched healthy individuals that presented to the otolaryngology department and did not have NSD based on otolaryngologic examination and paranasal CT.

NSD was classified according to Dreher et al.⁷ as follows: type 1: mild deviation (deviation <50% of the distance from the midline septum to the lateral wall); type 2: moderate deviation (deviation >50% of the distance from the midline septum to the lateral wall); type 3: severe deviation (deviation touching the lateral wall) (Figure 1-3). NSD type was determined by evaluating paranasal CT scans. Paranasal CT scans were evaluated by the 2 authors separately. All participants underwent complete otorhinolaryngologic examination, including the nasopharynx, oropharynx, and larynx. Those with other possible causes of upper airway obstruction, such as concha hypertrophy, nasal polyposis, and adenotonsillar hypertrophy, were excluded from the study. Other exclusion criteria were as follows: active or chronic infection, cancer, systemic inflammatory disease, autoimmune disease, cardiac and lung disease, hypothyroidism, hyperthyroidism, hematological disease, and chronic renal or hepatic disease. Due to personal identity concealment and the retrospective nature of the study, written informed consent was not obtained.

Blood samples were collected before any treatment (surgical or non-surgical). The complete blood count was evaluated in both groups. The hemoglobin level, platelet, neutrophil, and lymphocyte counts, as well as the MPV, NLR, PLR, and SII were compared between the study and control groups, and between NSD types. All of the parameters examined in this study were measured in blood samples and were included in the complete blood count. As such, it is a method that can be used both to determine the severity of the disease and to evaluate the effectiveness of the surgery.



Figure 1. Type 1 nasal septum deviation (mild deviation: <50% of the distance from the midline septum to the lateral wall) (classified according to NSD, Dreher et al.)⁷



Figure 2. Type 2 nasal septum deviation (medium deviation: deviation >50% of the distance from the midline septum to the lateral wall) (classified according to NSD, Dreher et al.)⁷



Figure 3. Type 3 nasal septum deviation (severe deviation touching the side wall) (classified according to NSD, Dreher et al.)⁷

Data were entered into Microsoft Excel (Microsoft Corp., Redmond, WA, USA). Statistical analysis was performed using IBM SPSS Statistics for Windows v.25.0 (IBM Corp., Armonk, NY, USA). Descriptive analysis was performed, and the normality of the distribution of data was tested using the Kolmogorov-Smirnov normality test and normal distribution parameters. Categorical variables were compared using the chi-square test and Fisher's exact test for small-sample data (n<5). The Kruskal-Wallis test was used for non-normally distributed independent variables in multiple groups. The level of statistical significance was set at p<0.05; all reported p values are 2-sided.

RESULTS

The NSD group included 321 patients with NSD and the control group included 101 patients without NSD. In all, 42% of the control group were male and 58% were female, and 43.3% and 56.7% of the NSD group were male and female, respectively; there wasn't a significant difference in the distribution of genders between the 2 groups (p=0.76). In addition, there wasn't a significant difference in mean age between the 2 groups (p=0.11).

The mean hemoglobin level in the NSD group was 14.59±1.6 g dL-1, versus 13.8±1.6 g dL-1 in the control group; the difference was significant (p<0.001). The platelet and neutrophil counts, and the MPV, NLR, PLR, and SII differed significantly between the NSD and control groups (p<0.001 for all) (Table 1). These parameters were also compared between NSD types and between each NSD type and the control group. The parameters differed significantly between all NSD types and the control group, but they did not differ significantly difference between NSD types 2 and 3 (Table 2). The lymphocyte count was 2.42±0.64 10³/μL in the NSD group, versus 2.5±0.6 10³/μL in the control group; the difference was not significant (p=0.113).

Table 1. Comparison of the NSD group and control group

	NSD Group	Control Group	pa
Age, years	28.19±8.7	30.44±10.1	0.116
Hb	14.59±1.6 g/dl	13.8±1.6 g/dl	<0.001*
Platelet count	287.4±64.3 10 ³ /μl	254±48.4 10 ³ /μl	<0.001*
Neutrophil count	3.98±1.24 10 ³ /μl	3.3±0.9 10 ³ /μl	<0.001*
Lymphocyte count	2.42±0.64 10 ³ /μl	2.5±0.6 10 ³ /μl	0.113
MPV	10.4±0.82 fl	8.2±0.2 fl	<0.001*
SII	482.4±156.8	331.7±57.3	<0.001*
NLR	1.71±0.56	1.32±0.2	<0.001*
PLR	124.6±37.5	104.9±32.1	<0.001*

a Wilcoxon signed ranks test; *p< 0.05

DISCUSSION

The nose is responsible for ~50% of airway resistance. In cases of nasal obstruction respiratory resistance increases, lung ventilation decreases, and hypoxia and hypercapnia occur. Activation of the sympathetic and parasympathetic systems increases the risk of cardiac and pulmonary disease.² NSD is the most common cause of nasal obstruction. The literature includes multiple NSD classification systems. The shape of the deviation or the level of closure of the passage, and other concomitant nasal cavity pathologies are evaluated with these classification systems.⁸ In the present study NSD was classified according to Dreher et al.⁷ who classified NSD type according to the level of obstruction, as follows: type 1: the nasal cavity is <50% occluded; type 2: the nasal cavity is >50% occluded; type 3: the septum touches the lateral wall.

Erythropoiesis is stimulated in response to chronic hypoxia, with acceleration of platelet turnover, and increases the platelet count and volume. This increases the risk of arterial thrombosis. The parameter used to evaluate this response to hypoxia is the MPV. Unlu et al.⁹ observed that there is a significant increase in MPV in patients with NSD. In the present study MPV was also significantly higher in the NSD group than in the control group. Ulu et al.³ compared the Hb, Hct and Rbc values in patients with NSD, and reported a significant

Table 2. Comparison of NSD types and the control group

	NSD Type 1	NSD Type 2	NSD Type 3	Control	pa
Hb	14.27±1.59	14.57±1.74	15.03±1.7	13.88±1.62	<0.001*
Platelet	271±58.7	297±61.6	300±69.6	254±48.4	<0.001*
Neutrophil	3.7±1.1	4.1±1.2	4.1±1.2	3.3±0.9	<0.001*
Lymphocyte	2.5±0.6	2.3±0.6	2.3±0.5	2.5±0.6	0.023*
MPV	9.7±0.7	10.8±0.4	10.9±0.5	8.2±0.2	<0.001*
SII	410.7±144.8	524.2±150.3	540.5±140.7	331.7±57.3	<0.001*
NLR	1.54±0.5	1.8±0.5	1.85±0.5	1.32±0.2	<0.001*
PLR	112.6±33.1	131±37.7	134.8±38.7	104.9±32.1	<0.001*

a Wilcoxon signed ranks test; *p< 0.05

difference, as compared to the normal controls. Similarly, there was a significant difference in the Hb level between the NSD patients and controls. Varol et al.⁴ reported that MPV is higher in patients with obstructive sleep apnea (OSA) than in controls, and that MPV increases as the apnea/hypopnea index and desaturation index increase. Importantly, they also reported the risk of cardiovascular disease is also increased in OSA patients.

In the case of chronic inflammation, an increase in the neutrophil, basophil, and platelet counts is observed, while there is a decrease in the lymphocyte count.¹⁰ NLR and PLR are used by many medical disciplines as markers of inflammation. Karatas et al.¹¹ noted that there is a significant decrease in NLR after septoplasty in patients with NSD. In the present study there wasn't a significant difference in the lymphocyte count between the NSD patients and controls; however, NLR and PLR did differ significantly between the 2 groups. Hu et al.¹² described a novel marker of inflammation-SII. This marker has become very popular in recent years, as it evaluates 3 cell types simultaneously. SII is calculated as the platelet count \times NLR and is used in the follow-up of patients with coronary atherosclerosis and chronic inflammatory diseases. Yang et al.¹³ and Zhong et al.¹⁴ showed in their meta-analyses that SII can be used as a prognostic indicator in patients with hepatocellular and gastrointestinal cancers.

Otolaryngologists have used SII for determining the prognosis in studies on oral cavity cancers, Bell's palsy, and chronic otitis media. In patients with oral cavity cancers it was observed that the SII is high before treatment, it significantly decreases after treatment, and it can be used to determine the prognosis.¹⁵ Bell's palsy is another disease in which inflammation occurs, and it was reported that the SII is high in Bell's palsy patients.¹⁶ A study that compared the SII in patients with mucosal chronic otitis media and squamous chronic otitis media noted that the SII was significantly higher in those with mucosal chronic otitis media (characterized by predominant inflammation) than in those with chronic otitis media originating from cholesteatoma.¹⁷ The researchers concluded that the SII is an inexpensive and useful tool for differentiating the 2 diseases. To the best of our knowledge the literature is devoid of any reports on the relationship between NSD and the SII. In the present study the SII was compared between NSD patients and controls, and the difference was significant, suggesting that there is an increase in inflammation in patients with NSD. Many studies have shown that there is a relationship between NSD and cardiopulmonary diseases; however, the methods used to assess the risk of cardiopulmonary disease are costly and time consuming. In CT, the patient is exposed to high doses of radiation. Frequent CT is not

appropriate during the follow-up period. In the present study the complete blood count, which is an inexpensive and easy method, was used and significant results were noted.

The present study has some limitations. Although the control group and the NSD group were similar in terms of age and gender, the control group was smaller; however, the similarity in age and gender in the 2 groups strengthens the reliability of the findings. The markers of inflammation used in the present study are also elevated in the presence of inflammation or oncological disease, and the presence or absence of such conditions could not be definitively excluded in the participants. Nevertheless, we think that the size of the NSD group minimizes this limitation. In addition, whether there was a significant change in values after septoplasty surgery in the NSD patients was not investigated. For this, a prospective study will be planned and long-term follow-up will make our hypothesis more meaningful.

In the present study patients with NSD were classified according to NSD type and compared to each other and to the control group. There was a significant difference in all the studied parameters, except the lymphocyte count, between those with type 1 and type 2 NSD, whereas there weren't any significant differences in any of the parameters between those with type 2 and type 3 NSD. Based on these findings, we think that the level of septum deviation has an effect on chronic hypoxia in patients with NSD. When the degree of septum deviation is $>50\%$ there is a significant increase in the level of inflammation; as such, not only the presence of NSD, but also the level of deviation is important in terms of cardiopulmonary diseases.

CONCLUSION

NSD causes chronic hypoxia, which leads to cardiopulmonary diseases and stimulation of erythropoiesis. The present findings show that there is an increase in markers of inflammation in patients with NSD, as compared to controls. The present findings indicate that chronic hypoxia is more likely and inflammation is higher in patients with NSD type 2 and 3, than in those with NSD type 1. The SII is a marker that can be used to determine the risk of cardiopulmonary disease in patients with NSD.

ETHICAL DECLARATIONS

Ethics Committee Approval: The study was carried out with the permission of Kırıkkale University Non-interventional Clinical Researches Ethics Committee (Date: 08.06.2022, Decision No: 2022.05.24).

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: The authors declared that this study has received no financial support.

Author Contributions: All 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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