

Neutrophil-to-lymphocyte and basophil-to-lymphocyte ratios in children with adenoid vegetation: Can they be prognostic markers?

 Mumtaz Taner Torun

Clinic of Otorhinolaryngology, Bandirma State Hospital, Balikesir, Turkey

Copyright © 2020 by authors and Annals of Medical Research Publishing Inc.

Abstract

Aim: Adenoid vegetation often causes open-mouth sleeping, snoring, breathing difficulties and it is also associated with many inflammatory diseases. In the treatment, adenoidectomy is performed to get rid of these symptoms and to prevent the future complications. In recent years, it has been reported that the neutrophil-to-lymphocyte ratio (NLR) is a prognostic factor in various diseases. Researches on the basophil-to-lymphocyte (BLR) ratio have been increasing. The aim of our study is to compare NLR and BLR before and after adenoidectomy and to determine whether these markers can be used as prognostic factors.

Material and Methods: The patients 2 to 16 years old who underwent adenoidectomy in our clinic from January 2016 to June 2019 were included in our study. The postoperative hospital application data of them were analyzed. Routine hemograms for surgery and postoperative hemograms (except inflammatory conditions) were used for calculating the NLR and BLR.

Results: One hundred and twelve patients were included in the study. When the preoperative and postoperative NLR values (1.3335 and 1.1152, respectively) were compared, there was a statistically significant decrease in the postoperative period ($p = 0.02$). However, when the BLR values were compared preoperatively and postoperatively (0.0054 and 0.0050, respectively), there was no statistically significant difference in the postoperative period ($p = 0.59$).

Conclusion: There are very few studies in the literature that evaluates NLR before and after adenoidectomy. To our knowledge, our research is the first study to evaluate BLR before and after adenoidectomy. In contrast to the literature, a significant difference in NLR was found out in our study. It has been determined that NLR can be used as a prognostic marker in adenoidectomy. More researches are needed for BLR in this area.

Keywords: Adenoidectomy; basophil-to-lymphocyte ratio; neutrophil-to-lymphocyte ratio

INTRODUCTION

Adenoid hypertrophy is one of the causes of obstruction in the upper respiratory tract, especially in the pediatric population. Adenoidectomy is the surgical removal of adenoid tissue from the nasopharynx. If adenoid vegetation is not treated, it can cause nocturnal hypoxia and sleep apne. In addition, inflammatory conditions are observed frequently in patients with adenoid vegetation. Oxidative stress in the obstructive conditions is associated with low-level inflammatory processes (1). It has been found out that systemic inflammatory markers and the proinflammatory cytokines increase in childhood lymphoid tissues (2).

The most important marker of inflammation in peripheral blood is the increase of the leukocytes. Neutrophils are the

first defense cells of the immune system and contribute to phagocytosis and apoptosis through mediators secreted by them (3). Lymphocytes constitute the protective and regulating part of immunity. While basophils are associated with allergic reactions like eosinophils, they are predominant in some other inflammatory reactions. It both carries a variety of soluble chemoreactant receptors like neutrophils and lymphocytes and secretes proinflammatory molecules such as histamine (4). This confirms that they can play a role in non-allergic inflammation. In recent years, it has been reported in the literature that neutrophil-to-lymphocyte ratio (NLR) is associated with inflammatory processes and it is used as an important predictor in diseases such as coronary artery diseases, acute coronary syndrome and diabetic nephropathy (5-8). NLR has started to be used as more

Received: 27.04.2020 **Accepted:** 09.06.2020 **Available online:** 24.06.2020

Corresponding Author: Mumtaz Taner Torun, Clinic of Otorhinolaryngology, Bandirma State Hospital, Balikesir, Turkey

E-mail: mumtaztanertorun@gmail.com

reasonable and accessible systemic inflammation marker (9). There are very few studies in the literature evaluating NLR before and after adenoidectomy. In the literature, there is no study revealing the relation of basophil-to-lymphocyte ratio (BLR) with adenoid vegetation.

The aim of our study is to investigate the use of NLR and BLR in patients undergoing adenoidectomy and to determine whether these markers can be used as prognostic factors.

MATERIAL and METHODS

A retrospective study was planned and after the ethical committee approval (Bandırma University non-interventional ethical committee number: 2019-12-01), patients 2 to 16 years old who underwent adenoidectomy in our clinic from January 2016 to June 2019 were included in the study. The postoperative hospital application data of them were evaluated. Demographic data of patients were also recorded. The patients who didn't undergo any other surgery 3 months after adenoidectomy and who were not in the inflammatory process were included in the study. These hemogram data were obtained from the files by examining the hospital admissions of the patients. Preoperative and postoperative hemogram tests (from peripheral venous blood) recorded in the system were evaluated. Lymphocyte, basophil and neutrophil values were noted, statistical evaluation was made by calculating NLR and BLR. In addition, patients' pathology reports were examined and their malignancy or benign status and were recorded. Patients under the age of 2 and over 16, the patients that had systemic diseases such as diabetes, hypertension, obesity, bleeding diathesis, the patients with suspected malignancy or malignancy (in their pathology reports) and the patients without postoperative hemogram data were excluded from the study. The patients with signs of inflammatory disease on the postoperative hemogram and the patients who had a hemogram data before 3 months postoperatively were also excluded. All blood samples were examined in the laboratory of our hospital.

Adenoid vegetation is diagnosed by endoscopic examination routinely and lateral nasal radiography is applied to patients who cannot tolerate endoscopy. The patients who have symptoms with over 50% adenoid volume are operated in our clinic. In all cases, adenoidectomy was performed by the same surgical technique (Curettage method). The results were evaluated statistically. The study was conducted in accordance with the principles of the Helsinki Declaration.

Statistical analyzes

The data were analyzed by using IBM SPSS Statistics 23.0 software (Armonk, NY: IBM Corp). Frequency, mean and standard deviation were used to analyze the data. The Kolmogorov-Smirnov goodness-of-fit test was used for the normality analysis of the data. Paired simple t-test was used to compare the means of the 2 groups because of the data showed normal distribution. A p value of <0.05 was considered statistically significant.

RESULTS

One hundred and twelve patients who had applied to our ear, nose and throat diseases clinic from January 2016 to June 2019 were included in the study. The pathology reports of them were benign. In the study, 63 (56.3%) of the patients were male, 49 (42.7%) were female and their mean age was 8.92 ± 3.02 . While the minimum and maximum NLR in the preoperative period were 0.53 and 3.19, respectively, the minimum and maximum NLR in the postoperative period were 0.05 and 2.42, respectively. While the minimum and maximum BLR in the preoperative period were 0 and 0.03, respectively, the minimum and maximum BLR in the postoperative period were 0 and 0.04, respectively. Preoperative mean NLR and BLR ratios were 1.3335 ± 0.56 and 0.0054 ± 0.007 , respectively. Postoperative mean NLR and BLR rates were 1.1152 ± 0.4718 and 0.0050 ± 0.0072 , respectively. When preoperative and postoperative NLR was compared, postoperative NLR was found statistically and significantly lower ($p = 0.02$). There was no statistically significant difference between preoperative and postoperative BLR ($p = 0.59$). The findings are given in Table 1.

Table 1. Preoperative and postoperative NLR and BLR data

		Minimum value	Maximum value	Mean	Standard deviation	Statistical value
NLR	Preoperative	0.53	3.19	1.3335	0.5600	*t=3.139
	Postoperative	0.05	2.42	1.1152	0.4718	p=0.02
BLR	Preoperative	0	0.03	0.0054	0.0070	*t=0.541
	Postoperative	0	0.04	0.0050	0.0072	p=0.590

* Paired Simple t test

NLR: Neutrophil Lymphocyte Ratio, BLR: Basophil Lymphocyte Ratio

DISCUSSION

Adenoid is an organized mucosa associated lymphoid tissue protecting the mucous of the nasopharynx through the secretory immune system. It begins to enlarge in early childhood and reaches its maximum size at the age of 4-6 (10). As the adenoid is the first tissue, which contacts to the various microorganisms in the inhaled air, it has an important function in the immune system. Adenoid hypertrophy can cause open-mouth sleeping, snoring and sleep apnea episodes. There are studies reporting that adenoid causes nocturnal hypoxia and sleep apnea when it is untreated for a long time (11,12). Hyperplastic adenoid tissue may also be a source of recurrent infection (13). In particular, excision of the symptomatic adenoid can lead to a decrease in secondary inflammatory conditions. Intermittent hypoxia and sleep fragmentations can cause inflammatory conditions and oxidative responses (7). In addition, adenoid can lead to various autological and rhinological inflammatory conditions. While adenoidectomy and / or tonsillectomy are frequently performed at early ages with the indication of obstruction, chronic infection is added to it in later ages. Haapaniemi reported that adenoid size decreased with increasing age in the study of 687 pediatric patients, and found that adenoid sizes in the age group of 7 were 3 times larger than the age group of 14 (14). If the obstruction is not treated, respiratory problems associated with sleep disorders may occur in adulthood, which may lead to diseases cardiovascular. Primary wound healing and epithelialization is completed in approximately 3 weeks. As secondary wound healing takes longer time than primary wound healing depending on the size of the wound, we evaluated the hemogram results after 3 months postoperatively. So, we waited until the end of the inflammatory recovery process in our study.

Neutrophil and lymphocyte count correlates with systemic inflammatory response. In recent years, the number of studies to reveal the relationship between NLR and inflammatory processes has increased and it's reported that NLR expresses subclinical inflammation (15). There are studies reporting that NLR is an inflammatory marker and a prognostic factor in diseases such as brucella, heart diseases, cystic fibrosis, nasal polyposis recurrence and inverted papilloma (16-18). The first studies about NLR were on the cardiovascular diseases. Neutrophilia and relative lymphocytopenia are reported to be independent predictors of mortality in patients with acute heart failure (19,20). NLR may be associated with both percutaneous coronary procedures and coronary artery bypass mortalities (21,22). It is reported that the increase of NLR in different types of solid cancer affects negatively overall survival (23). Systemic inflammation is one of the important factors in cancer-related survival, but its mechanism is still unclear. In the English literature, there has been two studies examining adenoidectomy and NLR. In these studies, it was reported that there was no significant difference in preoperative and postoperative

NLR between the adenoid hypertrophy and adenotonsillar hypertrophy groups (8,24). Yenigün reported that NLR was an effective auxiliary method in determining the necessity and timing of tonsillectomy in patients with chronic tonsillitis (24). Contrary to the literature, it was found out that preoperative NLR decreased in the postoperative period and this was statistically significant in our study. The other inflammatory markers such as IL-6, TNF- α and IFN- γ are not easy accessible and cost effective, NLR is more reasonable and accessible method since it can be obtained from a routine hemogram.

Basophils are less than 1% of leukocytes in peripheral blood and their increase points out parasitic infections or allergic conditions. Since basophils secrete proinflammatory molecules like histamine, they may be thought to play a role in chronic inflammation. Basophil accumulation in tissues can lead to exacerbation of some diseases. There are a limited number of studies about BLR in the literature. In particular, a decrease in BLR has been observed in some autoimmune diseases (25). Brescia et al. reported that BLR played a role in chronic sinusitis with nasal polyposis recurrence (17). Kokoğlu et al. reported that BLR could be used to predict patient satisfaction and to select patients after septoplasty and inferior turbinate reduction (26). Basophils play a role in allergic airway inflammation by participating to Th2 immune responses and basophil ratios are reported to have prognostic significance in various types of cancer (27,28). In the English literature, there are no studies evaluating the relationship between BLR and adenoidectomy. In our study, there was no statistically significant difference in terms of BLR in the preoperative and postoperative periods. It may be difficult to detect the small amount of basophils in peripheral blood for the devices so this may affect the results. It is also known that there is a negative correlation between adenoid vegetation and allergic rhinitis, so this inflammatory process is expected to be non-allergic (29). Since basophils are closely related to allergic conditions, there may be no significant difference in BLR after adenoidectomy.

In our study, the absence of eosinophilia in the hemogram data supports that patients are not in the allergic inflammation process. The limitation of our study is not dividing the patients allergic and non-allergic groups.

CONCLUSION

In conclusion, contrary to the other two studies in the literature, a statistically significant NLR difference was demonstrated after adenoidectomy in our study. Thus, adenoidectomy was thought to reduce the inflammatory processes. NLR, which is inexpensive and easily accessible data, is thought to be a promising prognostic factor for adenoidectomy. Our study is the first study investigating BLR with adenoidectomy in the literature, but no significant result has been obtained. With these results, it was thought that BLR would not be a prognostic marker for the adenoidectomy. New studies with large

series may clarify these conflicting results. In addition, NLR and BLR in different inflammatory processes such as sleep apnea, hypertension, obesity can be examined. Also, the relationship of these markers with adenoid volume may be a new research topic.

Competing interests: The authors declare that they have no competing interest.

Financial Disclosure: There are no financial supports.

Ethical approval: Bandirma University non-interventional ethical committee number: 2019-12-01.

REFERENCES

1. Korkmaz M, Korkmaz H, Kucuker F, et al. Evaluation of the association of sleep apnea-related systemic inflammation with CRP, ESR, and neutrophil-to-lymphocyte ratio. *Med Sci Monit* 2015;13:477-81.
2. Kim J, Bhattacharjee R, Dayyat E, et al. Increased cellular proliferation and inflammatory cytokines in tonsils derived from children with obstructive sleep apnea. *Paediatr Res* 2009;66:423-28.
3. Aksakal C, Sahin M. Evaluation of neutrophil/lymphocyte ratio and platelet/lymphocyte ratio in recurrent epistaxis in childhood: Case controlled study. *Pan Afr Med J* 2019;2;32:154.
4. Hartnell A, Heinemann A, Conroy DM, et al. Identification of selective basophil chemoattractants in human nasal polyps as insulin-like growth factor-1 and insulin-like growth factor-2. *J Immunol* 2004;173:6448-57.
5. Tamhane UU, Aneja S, Montgomery D, et al. Association between admission neutrophil to lymphocyte ratio and outcomes in patients with acute coronary syndrome. *Am J Cardiol* 2008;102:653-7.
6. Huang W, Huang J, Liu Q, et al. Neutrophil-lymphocyte ratio is a reliable predictive marker for early-stage diabetic nephropathy. *Clin Endocrinol (Oxf)* 2015;82:229-33.
7. Bhat T, Teli S, Rijal J, et al. Neutrophil to lymphocyte ratio and cardiovascular diseases: A review. *Expert Rev Cardiovasc Ther* 2013;11:55-9.
8. Derin S, Erdogan S, Sahan M, et al. Neutrophil-lymphocyte ratio in patients with adenoidectomy. *Journal of Clinical and Diagnostic Research* 2016;10:3-5.
9. Zahorec R. Ratio of neutrophil to lymphocyte counts—rapid and simple parameter of systemic inflammation and stress in critically ill. *Bratisl Lek Listy* 2001;102:5-14.
10. Cho JH, Lee DH, Lee NS, et al. Size assessment of adenoid and nasopharyngeal airway by acoustic rhinometry in children. *J Laryngol Otol* 1999;113:899-905.
11. Izu SC, Itamoto CH, Pradella-Hallinan M, et al. Obstructive sleep apnea syndrome (OSAS) in mouth breathing children. *Braz J Otorhinolaryngol* 2010;76:552-6.
12. Muzumdar HV, Sin S, Nikova M, et al. Changes in heart rate variability after adenotonsillectomy in children with obstructive sleep apnea. *Chest* 2011;139:1050-9.
13. Potsic WP. Assessment and treatment of adenotonsillar hypertrophy in children. *Am J Otolaryngol* 1992;13:259-64.
14. Haapaniemi JJ. Adenoids in school-aged children. *J Laryngol Otol* 1995;109:196-202.
15. Bozkus F, Dikmen N, Samur A, et al. Does the neutrophil-to-lymphocyte ratio have any importance between subjects with obstructive sleep apnea syndrome with obesity and without obesity? *Tuberk Toraks* 2018;66:8-15.
16. Wongrakpanich S, George G, Chaiwatcharayut W, et al. The prognostic significance of neutrophil-to-lymphocyte and platelet- to-lymphocyte ratios in patients with multiple myeloma. *J Clin Lab Anal* 2016;30:1208-13.
17. Brescia G, Barion U, Zanotti C, et al. Pre- and postoperative blood neutrophil-to-lymphocyte and eosinophil-to-lymphocyte ratios in patients with sinonasal polyps: A preliminary investigation. *Allergy Asthma Proc* 2017;1;38:64-9.
18. Celik M. The value of blood parameters as a diagnostic inflammatory biomarker for inverted papilloma. *Ann Med Res* 2019;26:2386-90.
19. Arruda-Olson AM, Reeder GS, Bell MR, et al. Neutrophilia predicts death and heart failure after myocardial infarction: A community-based study. *Circ Cardiovasc Qual Outcomes* 2009;2:656-62.
20. Rudiger A, Burckhardt OA, Harpes P, et al. The relative lymphocyte count on hospital admission is a risk factor for long-term mortality in patients with acute heart failure. *Am J Emerg Med* 2006;24:451-4.
21. Duffy BK, Gurm HS, Rajagopal V, et al. Usefulness of an elevated neutrophil to lymphocyte ratio in predicting long-term mortality after percutaneous coronary intervention. *Am J Cardiol* 2006;97:993-6.
22. Gibson PH, Croal BL, Cuthbertson BH, et al. Preoperative neutrophil-lymphocyte ratio and outcome from coronary artery bypass grafting. *Am Heart J* 2007;154:995-1002.
23. Templeton AJ, McNamara MG, Šeruga B, et al. Prognostic role of neutrophil-to-lymphocyte ratio in solid tumors: A systematic review and meta-analysis. *J Natl Cancer Inst* 2014;106:124.
24. Yenigun A. The efficacy of tonsillectomy in chronic tonsillitis patients as demonstrated by the neutrophil-to-lymphocyte ratio. *J Laryngol Otol* 2015;129:386-91.
25. Yang Z, Zhang Z, Lin F, et al. Comparisons of neutrophil-, monocyte-, eosinophil-, and basophil- lymphocyte ratios among various systemic autoimmune rheumatic diseases. *APMIS* 2017;125:863-71.
26. Kokoglu K, Sahin MI. Use of neutrophil, eosinophil, basophil, and platelet to lymphocyte ratio to predict patient satisfaction after septoplasty plus inferior turbinate reduction. *J Craniofac Surg* 2019;30:1022-6.

27. Zhong W, Su W, Zhang Y, et al. Basophils as a primary inducer of the T helper type 2 immunity in ovalbumin-induced allergic airway inflammation. *Immunology* 2014;142:202-15.
28. De Monte L, Wörmann S, Brunetto E, et al. Basophil recruitment into tumor-draining lymph nodes correlates with Th2 inflammation and reduced survival in pancreatic cancer patients. *Cancer Res* 2016;76:1792-803.
29. Ameli F, Brocchetti F, Tosca MA, et al. Adenoidal hypertrophy and allergic rhinitis: is there an inverse relationship? *Am J Rhinol Allergy* 2013;27:5-10.