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The Relationship Between the Preoperative Neutrophil-to-Lymphocyte Ratio and Postoperative Nausea and Vomiting in Patients Undergoing Septorhinoplasty Surgery

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Abstract

Background Postoperative nausea and vomiting (PONV) is one of the most common complications during the postoperative period. In the literature, there are many factors associated with PONV risk, but it is claimed that inflammation increases this risk. The neutrophil-to-lymphocyte ratio (NLR) is a cheap parameter to use in the diagnosis and follow-up of systemic inflammatory diseases. In this study, we aimed to investigate whether the preoperative NLR was a marker for PONV and to determine its relation with antiemetic use.

Methods Eighty patients who were planned to undergo elective septorhinoplasty and were in ASA I–II were prospectively included in the study. The NLR value was calculated by dividing the number of neutrophils by the number of lymphocytes obtained from the preoperative complete blood count. The patients were divided into two groups of 40 patients: patients with an NLR < 2 (group 1) and patients with an NLR > 2 (group 2). Nausea and vomiting during the first 24 h in the recovery room and in the related clinic and antiemetic requirement were recorded.

Results The rate of nausea–vomiting in the recovery room and in the postoperative 24-h period in group 1 was significantly lower than in group 2 ($p < 0.05$). The rate of use of antiemetics in the recovery room and in the postoperative 24-h period in group 1 was significantly lower than in group 2 ($p < 0.05$).

Conclusion NLR values above 2 calculated in the preoperative period may be an indicator of PONV risk. Antiemetic prophylaxis may be given according to this value.

Level of Evidence IV This journal requires that authors assign a level of evidence to each article. For a full description of these evidence-based medicine ratings, please refer to the Table of Contents or the online Instructions to Authors www.springer.com/00266.

Keywords Postoperative nausea and vomiting · Neutrophil-to-lymphocyte ratio · Antiemetic

Introduction

Postoperative nausea and vomiting (PONV) is defined as gagging or nausea–vomiting in the post-anesthesia care unit (PACU) and in the postoperative 24-h period [1]. Although PONV is one of the most common complications observed in the PACU, untreated PONV can lead to a prolonged stay in the PACU, patient dissatisfaction, unexpected re-hospitalization, and increased hospital costs in parallel [2]. Although the incidence of PONV is reported between 38 and 48% after maxillofacial surgery, the incidence varies depending on the type of surgery and may reach up to 80% in high-risk patients [3, 4]. It is reported that the risk of PONV in head and neck surgery including nasal surgery is high, and that the incidence of PONV in this group is 34–65% [5, 6]. Although PONV is almost always self-limited and is not fatal, dehydration, electrolyte imbalance, suture stretch and separation, venous hypertension and bleeding, esophageal rupture, and life-threatening airway obstruction due to PONV may cause

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significant morbidity [7]. For this reason, prophylaxis and ultimately management of PONV are very important for optimal patient outcomes, success of health care workers, and a reduction in the cost of the entire hospital.

The first step in PONV prophylaxis is to identify risk factors and high-risk patient populations. There are a large number of anesthetic risk factors including the anesthetic techniques used, volatile anesthetic agent use, nitrous oxide use, duration of anesthesia, opioid use, and types of surgery that are associated with PONV [8]. However, there are many factors associated with patients that also increase the risk of PONV. Among these, female sex (2.6 times more than male sex) is considered to be the strongest determinant for PONV among all risk factors. Prior PONV history is the second strongest determinant for PONV, and it is also important to note that the risk of PONV in first-degree relatives of these patients is thought to be high [9]. Being a nonsmoker, having a history of motion sickness, and being aged below 50 years are other risk factors for PONV. The simplified Patel score (sex, history of motion sickness or PONV, smoking status, and postoperative opioid use) and *Koivuranta's* score (sex, history of motion sickness or PONV, smoking status, age, and duration of surgery) are appropriate choices for assessing the risk of PONV [9]. According to the Apfel score, the existence of 0, 1, 2, 3, or 4 risk factors is related with a 10%, 20%, 40%, 60%, and 80% incidence of PONV, respectively. In this scoring system, 0–1 is classified as low, 2 as moderate, and 3–4 as high risk of developing PONV [10]. For low-risk patients, an approach based on the patient's choice, cost effectiveness, and benefit-to-risk ratio seems to be reasonable in the management of PONV. The use of dual antiemetic agents in PONV prophylaxis in patients with moderate risk is recommended. The use of 2–3 antiemetics and taking into account the anesthesia technique is recommended in high-risk patients [11]. However, the development of clinically useful parameters for the evaluation and prediction of PONV with multifactorial origin is also important in terms of patient satisfaction and economic aspects.

A correlation between the neutrophil-to-lymphocyte ratio (NLR) and systemic inflammatory conditions, cardiovascular diseases, neoplastic diseases, and metabolic syndrome has been reported in various studies, and the NLR is used as a simple and inexpensive index for the diagnosis and follow-up of these conditions [12]. A relationship between hyperemesis gravidarum, which is characterized by severe nausea and vomiting during pregnancy, and the NLR has been shown [13]. However, few studies have investigated the possible relationship between PONV and the NLR in the literature.

In this study, we aimed to investigate whether preoperative NLR was a marker for PONV and to determine its relation with antiemetic use.

Materials and Methods

This prospective observational study was approved by the local ethics committee before its initiation (2018–2014). Eighty patients aged 18–65 years in the I–II risk group of the American Society of Anesthesiologists (ASA) who underwent elective septorhinoplasty in the plastic surgery clinic were included in the study. Patients with (a) preoperative blood transfusion, (b) uncontrolled systemic diseases, (c) gastrointestinal system disorders, (d) antiemetic and anticholinergic drug use history, (e) adverse effects related with surgery, and (f) patients in whom a pharyngeal buffer could not be placed because nausea and vomiting rates might vary were excluded from the study. All patients were deprived of solid food and liquid intake 6 h and 2 h prior to surgery, respectively. All surgeries were performed by the same surgeon, and surgical incisions were allowed after intraoperative pharyngeal buffer placement in all patients.

The NLR value was calculated by dividing the number of neutrophils by the number of lymphocytes obtained from the preoperative complete blood count. The cutoff value of NLR calculated in the preoperative period was accepted as 2 [12], and patients were divided into two groups of 40 patients based on values above and below 2.

Patients with preoperative NLR < 2 were included in group 1 ($n = 40$).

Patients with preoperative NLR > 2 were included in group 2 ($n = 40$).

Age, sex, height, weight, body mass index (BMI), duration of surgery, and accompanying diseases were recorded for all patients. Electrocardiography (ECG), noninvasive blood pressure, peripheral oxygen saturation (SpO_2), end-tidal carbon dioxide ($ETCO_2$), and body temperature monitoring were performed in all patients. Anesthesia induction in all patients was performed with 2–3 mg/kg^{-1} propofol (Propofol® 1% I.V. injectable emulsion, 200 mg/20 mL ampule, Fresenius Kabi Pharma Trading Co Ltd, Istanbul), 0.6–0.8 mg/kg^{-1} rocuronium bromide (Myocron® 50 mg/5 mL I.V. Vem, Pharma Trading Co Ltd, Istanbul, Turkey), and 1 μg/kg^{-1} remifentanil (Ultiva® 5 mg/5 mL, GlaxoSmithKline, Istanbul, Turkey). In maintenance of anesthesia, 2–2.5% sevoflurane (Sevorane® liquid 100%, 250 mL solution, Abbvie, Istanbul, Turkey) was given with a 50% air/O_2 mixture, and 0.05–0.2 μg kg^{-1} min^{-1} remifentanil infusion and rocuronium bromide as muscle relaxant as needed were used. After the surgical procedure, for postoperative analgesia, 1 g metamizole sodium (Novalgin®, 1 g/2 mL I.M./I.V. ampule, Sanofi Aventis Pharma Trading Co Ltd, Istanbul, Turkey) was used and all patients in whom sugammadex (Bridion® 200 mg/2 mL, Merck Sharp and Dohme Corp, USA) was used to reverse neuromuscular

blockade, and the patients were transferred to the PACU after extubation. Nausea and vomiting in patients during the first 24 h in the PACU and in the related clinic and antiemetic requirement were recorded. Patients with nausea and vomiting scores of 1 and higher (0 = no nausea, 1 = nausea, 2 = retching, 3 = vomiting) were treated with metoclopramide (Metpamid®, 10 mg, Şifar Pharma, Istanbul, Turkey) as an antiemetic.

The relationship between the NLR obtained from preoperative complete blood counts and PONV and postoperative antiemetic use were statistically analyzed.

Statistical Analysis

Sample size: When a power analysis was performed at an 80% power and 0.05 significance level for the recovery time, it was calculated that each group should have a minimum of twelve and the optimum thirty cases.

The Kolmogorov–Smirnov test was used to determine whether data were normally distributed. For the statistical analysis, the Chi-square test, Mann–Whitney *U* test, and independent samples *t* tests were used as appropriate. *P* values < 0.05 were considered statistically significant. The demographic data are expressed as mean ± standard deviation (SD) and range and categorical data as n and percentage (%). Statistical analysis was performed using the SPSS version 21.0 software package (IBM SPSS Statistics for Windows, Armonk, NY, USA).

Results

Eighty patients were included in the study. There were no statistically significant differences between groups 1 and 2 in terms of age, sex, smoking status, BMI, and duration of surgery ($p > 0.05$) (Table 1).

The preoperative mean NLR was significantly higher (1.47 ± 0.30) in group 1 than in group 2 (3.09 ± 1.08) ($p < 0.05$) (Fig. 1).

The rate of nausea–vomiting in the recovery room and in the postoperative 24-h period in group 1 was significantly lower than in group 2 ($p < 0.05$) (Table 2, Figs. 2, 3).

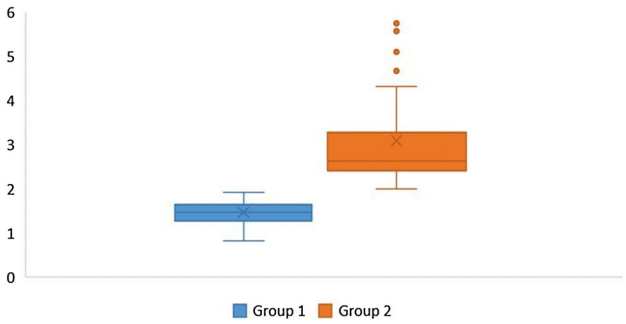

Fig. 1 Neutrophil-to-lymphocyte ratio

The rate of use of antiemetics in the recovery room and in the postoperative 24-h period in group 1 was significantly lower than in group 2 ($p < 0.05$) (Table 2, Fig. 4).

Discussion

One of the most common postoperative complications after nasal surgery, PONV, can extend the duration of stay in the PACU in parallel with a prolonged recovery time of patients [14]. There are studies, showing that each nausea–vomiting attack extends the discharge time from the PACU by 20 min [15, 16]. Although PONV prophylaxis was shown to increase hospital costs, its cost was lower than that of treating PONV and associated complications, and it was reported that a nausea attack costs an extra $82 and a vomiting attack costs an extra $305 [17]. Therefore, the development of evidence-based parameters in the determination of patients who need nausea and vomiting prophylaxis during the preoperative period is important to reduce hospital costs.

History of motion sickness or PONV, smoking status, volatile anesthetic agent or nitrous oxide use, intraoperative or postoperative opioid use, long duration of surgery, and certain surgical procedures are known to increase the risk of PONV in adults [18]. Severe bleeding may occur during surgery in the head and neck region because of the good vascular network, and it is believed that this blood causes PONV as a result of entering the stomach. For this reason, a pharyngeal buffer is placed during nasal surgery to absorb

Table 1 Demographic data of the patients

	Age (years)	Sex (F/M)	Smoking (Yes/No)	ASA (I/II)	BMI	Duration of surgery
Group 1 NLR < 2 ($n = 40$)	30.93 ± 10.93	25/15	26/14	17/23	22.30 ± 2.38	153.13 ± 27.97
Group 2 NLR ≥ 2 ($n = 40$)	26.90 ± 07.84	31/9	29/11	22/18	21.61 ± 2.68	147.00 ± 34.11

Table 2 Nausea and vomiting rates in the PACU and postoperative 24-h period

	Recovery nausea–vomiting (no/nausea/retching/ vomiting)	Recovery antiemetic (not used/used)	Postoperative nausea–vomiting (no/nausea/retching/vomiting)	Antiemetic use in 24 h (mg)
Group 1 NLR < 2 ($n = 40$)	32/5/1/2*	32/8*	23/2/0/15*	9.00 ± 11.27*
Group 2 NLR ≥ 2 ($n = 40$)	20/13/4/3*	20/20*	10/4/2/24*	15.75 ± 11.52*

*$p < 0.05$

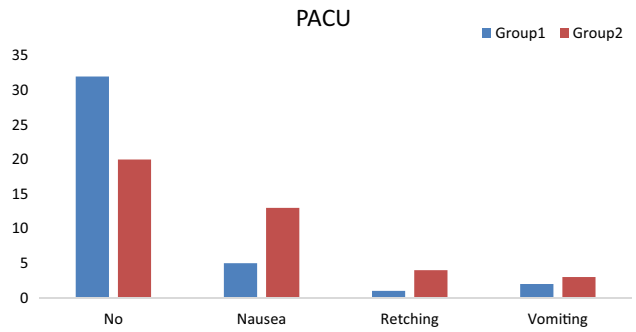

Fig. 2 Nausea, retching, and vomiting rate in the PACU

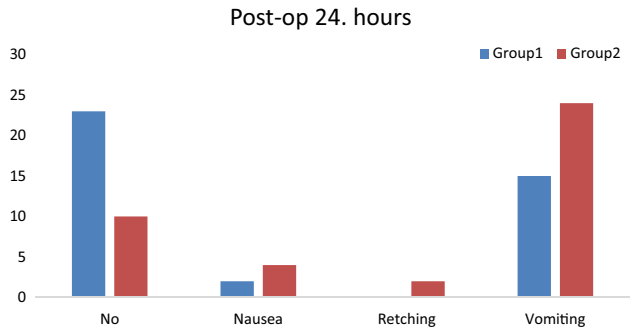

Fig. 3 Nausea, retching, and vomiting rate in the postoperative 24-h period

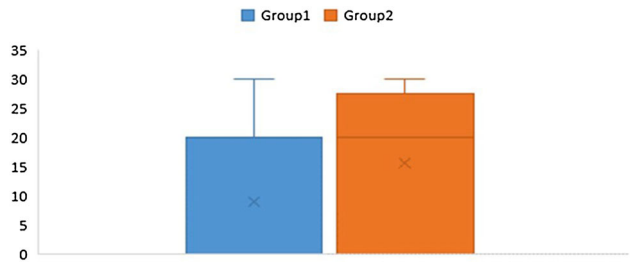

Fig. 4 Antiemetic use in the postoperative 24-h period

perioperative bleeding [19]. However, in their study, Korkut et al. [14] reported that the pharyngeal buffer placed during septorhinoplasty had no effect on PONV and that PONV was seen in the early period in about 59% of patients. Thus, we aimed to determine whether there was a relationship between NLR levels and PONV in nasal surgery by including patients with pharyngeal buffers in the study.

NLR is a parameter for the diagnosis and follow-up of inflammatory diseases and surgical diseases, which can be easily calculated from the whole blood count [12]. NLR values were shown to be high in patients with hyperemesis gravidarum, and increased NLR was reported to be a response to potential inflammation and to cause metabolic changes [13, 20]. It is thought that inflammatory mediators may influence the nausea and vomiting center by joining the circulation [1]. Eftekharian and Roozbahany [21] reported that a single-dose intravenous steroid given during anesthesia induction reduced postoperative nausea and vomiting by reducing inflammatory mediators. In the literature, there are many studies in which the threshold value of NLRs is evaluated as > 2 in determining the prognosis of some types of cancer and for monitoring inflammatory diseases such as systemic lupus erythematosus and fibromyalgia [12]. Arpacı et al. [12] investigated the relationship between NLR and postoperative nausea and vomiting in patients undergoing maxillofacial surgery, and they reported that PONV risk significantly increased in patients with NLR > 2. Therefore, we accepted 2 as the cutoff value in this study. The incidence of nausea and vomiting and antiemetic use in the first postoperative 24 h and in the PACU were significantly lower in patients with NLR < 2 than in patients with NLR > 2. This difference between the two groups is in line with the literature.

The two groups had similar characteristics in terms of sex, age, BMI, concomitant diseases, and history of susceptibility to nausea–vomiting, which are considered as risk factors for postoperative nausea and vomiting, and we found no statistically significant difference between the groups in regard to these factors.

There was no difference between the groups in terms of anesthetic drugs and anesthesia method used. A nonsteroidal anti-inflammatory drug (Novalgin® 1 g) was used for postoperative analgesia, and no additional opioid was given. There were no complications associated with anesthesia or surgery during the perioperative and postoperative

period (e.g., hypoxia, hypercapnia, increased intracranial pressure, postoperative bleeding).

Although there was no difference in terms of PONV etiology between the groups, we found a statistically significantly higher PONV ratio in patients in group 2 with NLR > 2 compared with group 1 patients with NLR < 2.

As a result, although routine antiemetic prophylaxis does not eliminate the risk of PONV in elective operations, it can significantly reduce the incidence of PONV [22]. Prophylaxis is recommended only in patients with a high risk of PONV [21]. We believe that the NLR value calculated during the preoperative period may be a marker for postoperative nausea and vomiting. However, further studies with larger numbers of patients are needed to reach a clearer conclusion.

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Compliance with Ethical Standards

Conflict of interest The authors declare that they have no conflict of interest.

Ethical Approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

Informed Consent Informed consent was obtained from all patients.

References

1. Jahromi HE, Gholami M, Rezaei F (2013) A randomized double-blinded placebo controlled study of four interventions for the prevention of postoperative nausea and vomiting in maxillofacial trauma surgery. J Craniofac Surg 24(6):e623–e627
2. Williams KS (2005) Postoperative nausea and vomiting. Surg Clin North Am 85:1229–1241
3. Gan TJ, Meyer T, Apfel CC, Chung F, Davis PJ, Eubanks S, Kovac A, Philip BK, Sessler DI, Temo J, Tramèr MR, Watcha M (2014) Consensus guidelines for the management of postoperative nausea and vomiting. Anesth Analg 118:85–113
4. Steely RL, Collins DR, Cohen BE, Bass K (2004) Postoperative nausea and vomiting in the plastic surgery patient. Aesth Plast Surg 28:29–32
5. Van den Berg AA (1996) The prophylactic antiemetic efficacy of prochlorperazine and ondansetron in nasal septal surgery: a randomized double-blind comparison. Anaesth Intensive Care 24:538–545
6. Jin HJ, Kim S, Hwang SH (2019) Can pharyngeal packing prevent postoperative nausea and vomiting in nasal surgery? Laryngoscope 129(2):291–298
7. Apfel CC, Kranke P, Katz MH, Goepfert C, Papenfuss T, Rauch S, Heineck R, Greim CA, Roewer N (2002) Volatile anaesthetics may be the main cause of early but not delayed postoperative vomiting: a randomized controlled trial of factorial design. Br J Anaesth 88(5):659–668
8. Phillips C, Brookes CD, Rich J, Arbon J, Turvey TA (2015) Postoperative nausea and vomiting following orthognathic surgery. Int J Oral Maxillofac Surg 44(6):745–751
9. Apfel CC, Heidrich FM, Jukar-Rao S, Jalota L, Hornuss C, Whelan RP, Zhang K, Cakmakkaya OS (2012) Evidence-based analysis of risk factors for postoperative nausea and vomiting. Br J Anaesth 109(5):742–753
10. Gan TJ, Diemunsch P, Habib AS, Kovac A, Kranke P, Meyer TA, Watcha M, Chung F, Angus S, Apfel CC, Bergese SD, Candiotti KA, Chan MT, Davis PJ, Hooper VD, Lagoo-Deenadayalan S, Myles P, Nezat G, Philip BK, Tramèr MR (2014) Society for Ambulatory Anesthesia. Consensus guidelines for the management of postoperative nausea and vomiting. Anesth Analg 118(1):85–113
11. Apfel CC, Korttila K, Abdalla M, Kerger H, Turan A, Vedder I, Zernak C, Danner K, Jokela R, Pocock SJ, Trenkler S, Kredel M, Biedler A, Sessler DI, Roewer N (2004) IMPACT Investigators. A factorial trial of six interventions for the prevention of postoperative nausea and vomiting. N Engl J Med 10(350): 2441–2451
12. Arpaci AH, Işik B, Ilhan E, Erdem E (2017) Association of postoperative nausea and vomiting incidence with neutrophil-lymphocyte ratio in ambulatory maxillofacial surgery. J Oral Maxillofac Surg 75(7):1367–1371
13. Tayfur C, Burcu DC, Gulten O, Betul D, Tugberk G, Onur O, Engin K, Orcun O (2017) Association between platelet to lymphocyte ratio, plateletcrit and the presence and severity of hyperemesis gravidarum. J Obstet Gynaecol Res 43(3):498–504
14. Korkut AY, Erkalp K, Erden V, Teker AM, Demirel A, Gedikli O, Saidoglu L (2010) Effect of pharyngeal packing during nasal surgery on postoperative nausea and vomiting. Otolaryngol Head Neck Surg 143(6):831–836
15. Caroll NV, Miederhoff PA (1994) Costs incurred by outpatient surgical centers in managing postoperative nausea and vomiting. J Clin Anesth 6:364–369
16. Dexter F, Tinker JH (1995) Analysis of strategies to decrease postanesthesia care unit costs. Anesthesiology 82:94–101
17. Mehernoor F, Watcha M (2001) Economics of antiemetics in anesthesia. Curr Opin Anaesthesiol 14:563–567
18. D'Angelo R, Philip B, Gan TJ, Kovac A, Hantler C, Doblar D, Melson T, Minkowitz H, Dalby P, Coop A (2005) A randomized, double-blind, close-ranging, pilot study of intravenous granisetron in the prevention of postoperative nausea and vomiting in patients abdominal hysterectomy. Eur J Anaesthesiol 22:774–779
19. Sexton J, Dohlman L (1989) Benefits of the pharyngeal pack. J Oral Maxillofac Surg 47:891
20. Caglayan EK, Engin-Ustun Y, Gocmen AY, Sarı N, Seckin L, Kara M, Polat MF (2016) Is there any relationship between serum sirtuin-1 level and neutrophil-lymphocyte ratio in hyperemesis gravidarum? J Perinat Med 44(3):315–320
21. Eftekharian A, Roozbahany NA (2013) Use of intravenous steroids at induction of anesthesia for septoplasty to reduce postoperative nausea and vomiting and pain: a double-blind randomized controlled trial. Indian J Otolaryngol Head Neck Surg 65:216–219
22. Kizilcik N, Bilgen S, Menda F, Türe H, Aydın B, Kaspar EC, Koner O (2017) Comparison of dexamethasone-dimenhydrinate and dexamethasone-ondansetron in prevention of nausea and vomiting in postoperative patients. Aesthetic Plast Surg 41(1):204–210