

Emergence agitation in open rhinoplasty operations neutrophil/lymphocyte and platelet/lymphocyte ratio as a predictive marker

Agitación de emergencia en operaciones de rinoplastia abierta: cocientes neutrófilos/linfocitos y plaquetas/linfocitos como marcadores predictivos

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Abstract

Objective: We aimed to evaluate the relationship between emergence agitation and pre-operative neutrophil-to-lymphocyte ratio (NLR) and platelet-to-lymphocyte ratio (PLR) after rhinoplasty. **Methods:** Our study included 104 patients. All patients underwent surgery under standard general anesthesia. In the pre-operative period, receiver operating curve analysis was performed to determine the cutoff values of NLR and PLR for the risk of emergence agitation and pre-operative anxiety. A correlation analysis was performed between NLR and PLR, the State-Trait Anxiety Inventory scale, and the body image disturbance scale. **Results:** While the area under the curve (AUC) value of NLR for emergence agitation was not significant ($p = 0.76$), the cutoff value for PLR was 113.37 (AUC = 0.624, sensitivity = 80.65%, specificity = 45.21%, $p = 0.046$). Median PLR values were higher in patients with emergence agitation ($p = 0.046$). The AUC value for pre-operative anxiety was not significant. There was no correlation between NLR and PLR and the scales assessed. **Conclusions:** We suggest that PLR may be a predictive biomarker in evaluating the risk of pre-operative emergence agitation in patients scheduled for rhinoplasty.

Keywords: Emergence agitation. Neutrophil-lymphocyte ratio. Platelet-lymphocyte ratio. Anxiety. Body dysmorphic disorder.

Resumen

Objetivo: Evaluar la relación entre la agitación de emergencia y los cocientes preoperatorios neutrófilos/linfocitos (NLR) y plaquetas/linfocitos (PLR) tras una rinoplastia. **Métodos:** En el estudio participaron 104 pacientes, todos ellos sometidos a cirugía bajo anestesia general estándar. En el periodo preoperatorio se realizó un análisis de curva operativa del receptor para determinar los valores de corte de NLR y PLR para el riesgo de agitación de emergencia y de ansiedad preoperatoria. Se realizó un análisis de correlación entre NLR y PLR, la Escala de Ansiedad Estado-Rasgo y la Escala de Alteración de la Imagen Corporal. **Resultados:** Mientras que el valor del área bajo la curva (AUC) de NLR para la agitación de emergencia no fue significativo ($p = 0.76$), el valor de corte para PLR fue de 113.37 (AUC = 0.624, sensibilidad del 80.65% y especificidad del 45.21%; $p = 0.046$). Los valores medios de PLR fueron mayores en los pacientes con agitación de emergencia ($p = 0.046$). El valor del AUC para la ansiedad preoperatoria no fue significativo. No hubo correlación entre NLR y PLR y las escalas evaluadas. **Conclusiones:** Sugerimos que el PLR puede ser un biomarcador predictivo en la evaluación del riesgo de agitación de emergencia preoperatoria en pacientes programados para rinoplastia.

Palabras clave: Agitación de emergencia. Cociente neutrófilos/linfocitos. Cociente plaquetas-linfocitos. Ansiedad. Trastorno dismórfico corporal.

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Date of reception: 07-12-2023

Date of acceptance: 12-01-2025

DOI: 10.24875/CIRUE.M25000887

Cir Cir (Eng). 2025;93(5):548-554

Contents available at PubMed

www.cirugiaycirujanos.com

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Introduction

Emergence agitation is defined as a state of psychomotor excitement that occurs before full emergence of consciousness after general anesthesia and is self-limiting within 5-15 min¹. Its incidence has been reported to reach approximately 50% after facial surgeries such as ear-nose-throat and orthognathic procedures^{2,3}.

Pathophysiologically, it has been reported that it may occur as a result of sympathetic activation secondary to inadequate analgesia or mental disorders that trigger neuroinflammation^{2,4}. Etiologic factors include post-operative pain, pre-operative anxiety, young age, type of surgery, anesthetic agent used, and psychic problems^{5,6}.

Especially recently, rhinoplasty has become the main esthetic operation performed by half a million people a year to improve the appearance of the nose⁷. In a literature review, a history of plastic surgery was found to be associated with a high level and incidence of anxiety⁸. In rhinoplasty surgery, which is not only a technical procedure, body dysmorphic disorder (BDD) is one of the factors that are important in determining the person's mood and affect post-operative satisfaction⁹. Even if the existing defect is small, obsession and anxiety about it are excessive¹⁰.

Neuroinflammation is emphasized as the main factor in the pathophysiology of emergence agitation, anxiety disorders, and obsessive-compulsive-related disorders. The neutrophil-to-lymphocyte ratio (NLR) and platelet-to-lymphocyte ratio (PLR), which are neurobiological markers, are accepted as easily measurable and low-cost parameters reflecting the inflammatory state¹¹.

NLR and PLR are affected by the presence of systemic pathologies, including malignancies and various diseases such as mood disorders¹². An association between NLR and PLR and diseases in which neuroinflammation plays a role in pathophysiology, such as mood disorders, anxiety disorders, and schizophrenia, has been demonstrated¹³⁻¹⁶. Although there are studies in the literature on the relationship between NLR and PLR with neuropsychiatric disorders such as major depressive disorder, schizophrenia, and obsessive-compulsive disorder (OCD), no study was found to be related to emergence agitation, pre-operative anxiety, State-Trait Anxiety Inventory (STAI) scale, and BDD scale.

The primary aim of our study was to investigate the relationship between NLR and PLR levels, which are neurobiological markers, and emergence agitation in adult patients with post-operative emergence agitation. The secondary aim was to evaluate the relationship between neurobiological markers (NLR and PLR) and pre-operative anxiety, STAI scale, and BDD scale scores.

Methods

Our study was prospectively conducted on a total of 104 patients with American Society of Anesthesiologists (ASA) risk classification I and II, 18-45 years of age, who underwent open rhinoplasty surgery by Plastic Reconstructive and Esthetic Surgery after approval of the local ethics committee of Karadeniz Technical University Faculty of Medicine (protocol number: 2021/374), and whose written and verbal informed consent was obtained after verbal information about the study.

Body mass index > 30 kg/m², allergy to induction agent(s) and opioid, chronic pain medication, active infection, autoimmune, cardiovascular, gastrointestinal and neurological diseases, renal or hepatic insufficiency, chronic respiratory pathology, malignancy diagnosis (colorectal, gastric, pancreatic, esophageal, lung, gynecologic, etc.), history of chronic systemic diseases (hypertension and diabetes mellitus), hematologic (leukocyte and platelet) diseases, non-cooperative patients and patients with physical and verbal comparison.), patients with a history of chronic systemic diseases (hypertension and diabetes mellitus), patients with hematologic (leukocyte and platelet) diseases, patients who were unable to cooperate, and patients who were physically and verbally incapable of comparison were excluded.

In our study, demographic data (age, gender, ASA score, presence of surgical history, duration of surgery, and duration of anesthesia), pre-operative measurements (STAI-I and II scale) scores, body image disturbance questionnaire (BIDQ) score, presence of pre-operative anxiety, laboratory variables (NLR and PLR), and post-operative emergence agitation were recorded.

NLRs and PLRs were manually calculated using absolute values from the patient's complete blood count (absolute and relative values of leukocytes, neutrophils, lymphocytes, and platelets) requested by the relevant branch before the operation.

After an adequate pre-operative fasting period, patients who came to the operating room were

monitored non-invasively for arterial pressure, heart rate (HR), electrocardiogram, peripheral oxygen saturation, end-tidal carbon dioxide, and bispectral index values (BIS) during anesthesia monitoring. Anesthesia induction was performed with intravenous (IV) 1 µg/kg fentanyl, 3 mg/kg propofol, and 0.6 mg/kg rocuronium for muscle relaxation in all patients included in our study. Anesthesia maintenance was achieved by inhalation anesthesia with sevoflurane (minimum alveolar concentration 1-1.5) and 1:1 O₂/Air with a BIS value of 40-60 and remifentanyl infusion (0.01-0.2 µg/kg/min). Near the end of the operation, all patients received IV 1 g paracetamol and 50 mg tramadol for post-operative analgesia as standard.

Open rhinoplasty surgeries performed on all patients participating in the study were performed by the same Plastic Reconstructive and Esthetic Surgery specialist, and the same internal nasal splints (Eon Meditech internal nasal airway splint standard, silicone, double hole) were used.

Emergence agitation after extubation and in the post-anesthesia care unit was evaluated with the Richmond agitation sedation scale (RASS) (+ 1 to + 4: anxiety or agitation, 0: calm and awake, -1 to -5: sedated, -5: not arousable). Patients with a RASS score ≥ 2 were considered to have developed emergence agitation¹⁷.

Pre-operative anxiety was considered to be present in patients with an STAI-I score of 30 and above, which was used to evaluate the level of state anxiety in the pre-operative period¹⁸.

Patients' concerns about their general body image and bodily concerns in social life were evaluated with the body image disorder scale questionnaire (1: none, 2: mild, 3: moderate, 4: severe, and 5: extreme)¹⁹. High values indicated a negative body perception and a severe negative effect of this perception on psychosocial functions, whereas low values were interpreted as no disturbing problem in body image.

Statistical analysis

The data were analyzed using IBM Statistical Package for the Social Sciences Statistics v23. Compliance with normal distribution was examined by the Shapiro-Wilk and Kolmogorov-Smirnov tests. Categorical data by groups were compared using the χ^2 , Yates' correction, and Fisher's exact tests. An Independent two-sample t-test was used to compare normally distributed data, and the Mann-Whitney U-test was used to compare non-normally distributed data.

The relationship between non-normally distributed quantitative data was analyzed by Spearman's ρ correlation. The point biserial correlation coefficient was used to examine the relationship between quantitative data and two-group categorical data. Receiver operating characteristic (ROC) analysis was performed to determine the cutoff value of the parameters for agitation and pre-operative anxiety. The analysis results were presented as mean $\pm$ SD and median (minimum-maximum) for quantitative data and frequency (percentage) for categorical data. The significance level was taken as $p < 0.05$.

Results

One hundred four patients who underwent open rhinoplasty surgery and met the inclusion criteria were included in the study. The patients' demographic data and clinical characteristics are shown in table 1.

Pre-operative anxiety (STAI-I ≥ 30) was detected in 85.58% (n: 85) of the participants, whereas emergence agitation (RASS $\geq + 2$) was observed in 29.81% (n: 31) in the post-operative period.

ROC analysis was performed to determine the usefulness of NLR and PLR as predictive markers in determining emergence agitation and pre-operative anxiety (Table 2).

While the AUC value of NLR cutoff value for emergence agitation was not statistically significant ($p = 0.76$), the cutoff value for PLR was 113.37 (AUC = 0.624, sensitivity = 80.65%, specificity = 45.21%, positive predictive value (PPV): 38.46%, negative predictive value (NPV): 84.62%, $p = 0.046$) (Fig. 1). The change in PLR values according to the presence of emergence agitation is shown in Fig. 2. The median PLR values were statistically significantly higher in patients with emergence agitation than those without (135.9 vs. 120.97, $p = 0.046$), respectively.

The AUC value of NLR and PLR cutoff value for pre-operative anxiety was not statistically significant ($p = 0.08$; 0.33) (Fig. 3).

The relationship between NLR and PLR, and STAI I-II and BIDQ is shown in table 3, and no statistically significant difference was found ($p > 0.050$).

Discussion

As a result of our study, PLR in the pre-operative period is a predictive biomarker in assessing the risk of emergence agitation. In addition, NLR and PLR

Table 1. Demographic data and laboratory parameters

Variables	Total (n = 104)
Gender	
Female	65 (62.5)
Male	39 (37.5)
Age	28.18 ± 9.14
ASA score	
ASA 1	58 (55.8)
ASA 2	46 (44.2)
Education level	
Primary school	10 (9.6)
High school	39 (37.5)
University	55 (52.9)
Duration of anesthesia (min)	66.39 ± 15.00
Duration of surgery (min)	53.47 ± 14.34
Neutrophil count (× 10 ³ /μL)	4.25 ± 1.50
Lymphocyte count (× 10 ³ /μL)	2.25 ± 0.63
Platelet count (× 10 ³ /μL)	272.89 ± 59.65
NLR	1.99 ± 0.82
PLR	129.60 ± 47.00
STAI-I score	37.21 ± 8.32
STAI-II score	39.03 ± 7.88

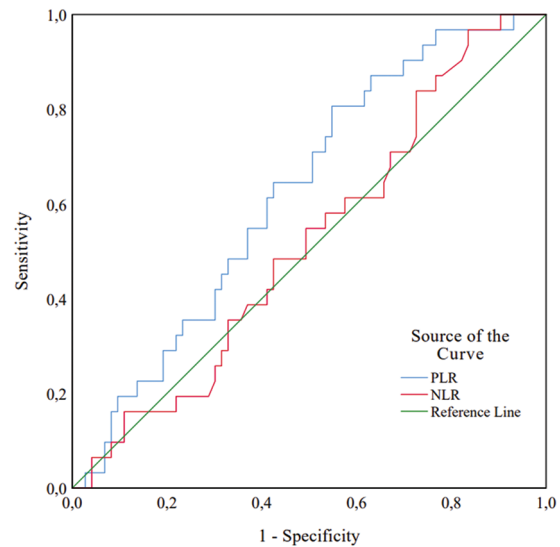
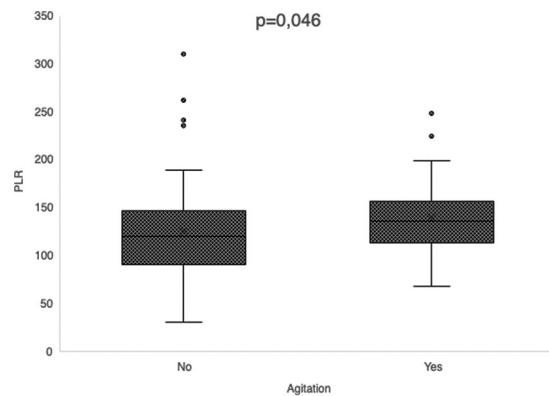
Frequency (percentage), mean ± SD.

ASA: American Society of Anesthesiologists; NLR: neutrophil-to-lymphocyte ratio; PLR: platelet-to-lymphocyte ratio; STAI-I: state anxiety scale; STAI-II: trait anxiety scale; Min: minute.

were not associated with pre-operative anxiety, STAI scale score, and BDD scale score.

Emergence agitation is a state of hyperactivity that occurs during recovery of consciousness during awakening from general anesthesia. Two mechanisms are generally emphasized in its pathophysiology. The first is sympathetic activation secondary to stimuli due to inadequately treated nociception, and the second is neuroinflammatory mechanisms because it is more common postoperatively in patients with higher inflammatory mediators (interleukin-6, tumor necrosis factor- α , and T and B lymphocytes) and endogenous catecholamine levels^{1,20,21}.

Stress and severe diseases may increase cortisol levels, activating neutrophil count and increasing lymphocyte apoptosis due to hypothalamic-pituitary-adrenal (HPA) axis activation²². While neutrophil production from the bone marrow increases, lymphopenia occurs²³. This leads to an increase in NLR. Similarly, both stress and inflammatory factors increase platelet

**Figure 1. ROC curve of PLR and NLR values for emergence agitation state****Figure 2. Change in PLR values according to the presence of emergence agitation**

count, leading to high PLR levels in a lymphopenic environment²⁴.

NLR and PLR are frequently used to determine the severity of inflammation because of their low cost and easy applicability. Various cutoff values of NLR and PLR have been determined as prognostic or predictive biomarkers²⁵⁻²⁷.

A study conducted in open rhinoplasties found that NLR > 2.1 was associated with severe post-operative edema, and NLR > 1.5 was associated with severe post-operative ecchymosis²⁸. In this study, only a cutoff value for NLR was obtained, and PLR was not used as a prognostic or predictive biomarker, which can be considered a study limitation.

Table 2. ROC analysis result of NLR and PLR values for emergence agitation and pre-operative anxiety

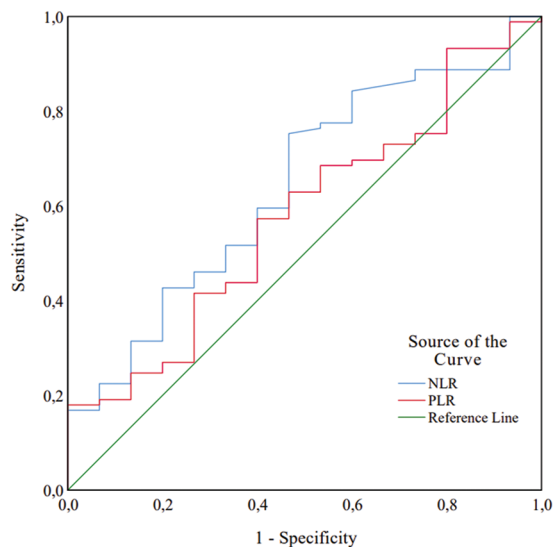
Variables	Cutoff value	AUC (95% CI)	p	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)
Emergence agitation							
NLR		0.519 (0.402-0.636)	0.763				
PLR	≥ 113.37	0.624 (0.513-0.735)	0.046*	80.65	45.21	38.46	84.62
Pre-operative anxiety							
NLR		0.641 (0.494-0.787)	0.082				
PLR		0.578 (0.428-0.727)	0.338				

*p < 0.05. AUC: area under curve; CI: confidence interval; NLR: neutrophil-to-lymphocyte ratio; PLR: platelet-to-lymphocyte ratio; PPV: positive predictive value; NPV: negative predictive value.

Table 3. Relationship between NLR and PLR, and STAI I-II and BIDQ

Variables	NLR		PLR	
	r	p	r	p
STAI-I score	0.130	0.189	0.104	0.291
STAI-II score	-0.034	0.733	0.086	0.384
BIDQ score	0.129	0.192	0.004	0.972

r: spearman's ρ correlation coefficient; NLR: neutrophil-to-lymphocyte ratio; PLR: platelet-to-lymphocyte ratio; STAI-I: state anxiety scale; STAI-II: trait anxiety scale; BIDQ: body image disorder questionnaire.

**Figure 3. ROC curve of NLR and PLR values for preoperative anxiety status.**

The role of autoimmunity and inflammation in neurocognitive pathophysiology has been the subject of many studies^{29,30}. Dysregulated cognitive activation contributes to systemic inflammation in relation to HPA axis dysregulation³¹. In a review, anxiety disorders were found to be associated with chronic systemic inflammation³².

In the central nervous system, serotonin is involved in the pathophysiology of anxiety disorders and the regulation of platelet function³³. It is also known that peripheral platelets reflect serotonergic function when the central nervous system is inaccessible³⁴. In addition, platelet activation stimulated by serotonin plays an active role in neurocognitive pathophysiology, leading to anxiety^{35,36}.

Experimental studies have shown that triggered stress causes inflammation and that inflammation may occur, especially in anxiety disorders secondary to acute stress^{37,38}. At the same time, different studies on animals have shown that inflammation activates the limbic regions of the brain and leads to anxiety and avoidance behaviors^{39,40}.

In a study conducted on adolescents, it was reported that PLR (> 127.5) may indicate an increased risk of suicidality⁴¹. It has been reported that PLR may be more significant than NLR in patients with major depressive disorder and suicide attempts⁴². In addition, PLR was associated with the severity of major depressive disorder, especially with the psychotic process⁴³. In another study, PLR was found to be an independent predictor of manic episodes⁴⁴.

In a study evaluating the risk of post-operative delirium in patients scheduled for vascular surgery, cutoff values of NLR > 3.57 and PLR > 139.2 were associated with an increased incidence of post-operative delirium⁴⁵. High PLR values (>100) in patients admitted to the intensive care unit were reported as an independent risk factor for delirium and found to be associated with a high incidence of delirium⁴⁶.

In the literature, we did not find any study investigating the relationship between NLR and PLR and emergence agitation, pre-operative anxiety, STAI scale scores, and BDD scale scores.

Our study investigated whether pre-operative NLR and PLR are predictive markers secondary to neuroinflammation in determining the risk of post-operative

emergence agitation. As a result of our data analysis, the PLR cutoff value (113.37) was found for emergence agitation but not for NLR. Our results were consistent with the studies in the literature investigating the relationship between different psychiatric disorders and neurobiological markers. It was concluded that the significant elevation of PLR in our study was due to neuroinflammatory mechanisms in the development of emergence agitation and stress-induced HPA axis dysregulation.

BDD was included in the obsessive-compulsive and related disorders section of the Diagnostic and Statistical Manual of Mental Disorders-5 due to similarities with OCD, including repetitive behaviors⁴⁷. In the literature, it was observed that patients with BDD who wanted to undergo cosmetic surgery were more depressed and anxious and showed frequent compulsive behaviors, resulting in excessive mental activity⁴⁸.

In a study, it was observed that chronic inflammation caused neuronal activity changes in the anterior cingulate cortex and prefrontal cortex associated with OCD⁴⁹. In another study, it was observed that NLR and PLR values were significantly higher in adolescents with OCD and anxiety disorders compared to those with OCD alone, and it was stated that this may be the result of increased inflammatory response secondary to more irregular cognitive actions⁵⁰.

In our study, no correlation was detected between BDD scale scores and NLR, PLR, and trait anxiety scores. We attribute this to the fact that the participants were less obsessed with the nasal structures due to the region-specific nasal anatomy and, as a result, did not trigger sufficient inflammatory processes. In addition, the results of the diagnostic tests applied in the pre-operative period and used to determine both STAI level and BDD may vary according to the intellectual characteristics of the participants. As a result, the relationship between scoring systems and neurologic biomarkers cannot be determined effectively. For this reason, it may be more appropriate to use a biomarker such as PLR, which is frequently used in the literature and has high reliability in evaluating emergence agitation.

Limitations

The current study has some limitations. Regarding the current study, emergence agitation risk factors were not primarily evaluated. Concomitant proinflammatory mediators were not examined. The current

study used self-report scales and was completed over a long period of time. Participants were not subjected to additional psychiatric evaluation. In addition, it can be considered a limitation that participants with a history of smoking and antidepressant use, which affect biomarker rates, should not be excluded from the study as a limitation.

Conclusions

Our study shows that $PLR > 113.37$ is associated with emergence agitation in patients undergoing open rhinoplasty. Clinicians can use pre-operative PLR as a predictive neurobiological marker to evaluate emergence agitation risk in patients scheduled for open rhinoplasty surgery. This way, the risk of emergence agitation can be reduced by taking necessary precautions. Additional prospective studies should be conducted to confirm our findings.

Funding

The authors declare that they have not received funding.

Conflicts of interest

The authors declare no conflicts of interest.

Ethical considerations

Protection of humans and animals. The authors declare that the procedures followed complied with the ethical standards of the responsible human experimentation committee and adhered to the World Medical Association and the Declaration of Helsinki.

Confidentiality, informed consent, and ethical approval. The authors have followed their institution's confidentiality protocols, obtained informed consent from patients, and received approval from the Ethics Committee.

Declaration on the use of artificial intelligence. The authors declare that no generative artificial intelligence was used in the writing of this manuscript.

References

1. Tolly B, Waly A, Peterson G, Erbes CR, Prielipp RC, Apostolidou I. Adult emergence agitation: a veteran-focused narrative review. *Anesth Analg*. 2021;132:353-64.
2. Demir CY, Yuzkat N. Prevention of emergence agitation with ketamine in rhinoplasty. *Aesthetic Plast Surg*. 2018;42:847-53.

3. Ham SY, Kim JE, Park C, Shin MJ, Shim YH. Dexmedetomidine does not reduce emergence agitation in adults following orthognathic surgery. *Acta Anaesthesiol Scand*. 2014;58:955-60.
4. McGuire JM. The incidence of and risk factors for emergence delirium in U.S. military combat veterans. *J Perianesth Nurs*. 2012;27:236-45.
5. Vlakovic GP, Sindjelic RP. Emergence delirium in children: many questions, few answers. *Anesth Analg*. 2007;104:84-91.
6. Radtke FM, Franck M, Hagemann L, Seeling M, Wernecke KD, Spies CD. Risk factors for inadequate emergence after anesthesia: emergence delirium and hypoaesthetic emergence. *Minerva Anestesiologica*. 2010;76:394-403.
7. American Society for Aesthetic Plastic Surgery. *Cosmetic Surgery National Data Bank—2012 Statistics*. New York: American Society for Aesthetic Plastic Surgery; 2013.
8. Stamenkovic DM, Rancic NK, Latas MB, Neskovic V, Rondovic GM, Wu JD, et al. Preoperative anxiety and implications on postoperative recovery: what can we do to change our history. *Minerva Anestesiologica*. 2018;84:1307-17.
9. de Brito MJ, Nahas FX, Cordás TA, Tavares H, Ferreira LM. Body dysmorphic disorder in patients seeking abdominoplasty, rhinoplasty, and rhytidectomy. *Plast Reconstr Surg*. 2016;137:462-71.
10. American Psychiatric Association. *Diagnostic and Statistical Manual of Mental Disorders—Text Revision*. 4th ed. Washington DC: American Psychiatric Association; 2000.
11. Velasco A, Rodríguez-Revelueta J, Olié E, Abad I, Fernández-Peláez A, Cazals A, et al. Neutrophil-to-lymphocyte ratio: a potential new peripheral biomarker of suicidal behavior. *Eur Psychiatry*. 2020;63:e14.
12. Bozkurt H, Arac D, Cigdem B. Effect of preoperative uric acid level and neutrophil/lymphocyte ratio on preoperative and postoperative visual analogue pain scores in patients with lumbar disc herniation: a cross-sectional study. *Turk Neurosurg*. 2019;29:705-9.
13. Ekinci O, Ekinci A. The connections among suicidal behavior, lipid profile and low-grade inflammation in patients with major depressive disorder: a specific relationship with the neutrophil-to-lymphocyte ratio. *Nord J Psychiatry*. 2017;71:574-80.
14. Bustan Y, Drapisz A, Ben Dor DH, Avrahami M, Schwartz-Lifshitz M, Weizman A, et al. Elevated neutrophil to lymphocyte ratio in non-affective psychotic adolescent inpatients: evidence for early association between inflammation and psychosis. *Psychiatry Res*. 2018;262:149-53.
15. Mazza MG, Lucchi S, Tringali AG, Rossetti A, Botti ER, Clerici M. Neutrophil/lymphocyte ratio and platelet/lymphocyte ratio in mood disorders: a meta-analysis. *Prog Neuropsychopharmacol Biol Psychiatry*. 2018;84:229-36.
16. Özdin S, Sarisoğlu G, Böke Ö. A comparison of the neutrophil-lymphocyte, platelet-lymphocyte and monocyte-lymphocyte ratios in schizophrenia and bipolar disorder patients - a retrospective file review. *Nord J Psychiatry*. 2017;71:509-12.
17. Sessler CN, Gosnell MS, Grap MJ, Brophy GM, O'Neal PV, Keane KA, et al. The Richmond Agitation-Sedation Scale: validity and reliability in adult intensive care unit patients. *Am J Respir Crit Care Med*. 2002;166:1338-44.
18. Facco E, Stellini E, Bacci C, Manani G, Pavan C, Cavallin F, et al. Validation of visual analogue scale for anxiety (VAS-A) in preanesthesia evaluation. *Minerva Anestesiologica*. 2013;79:1389-95.
19. Cash TF, Phillips KA, Santos MT, Hrabosky JI. Measuring "negative body image": validation of the body image disturbance questionnaire in a nonclinical population. *Body Image*. 2004;1:363-72.
20. Kim JA, Ahn HJ, Yang M, Lee SH, Jeong H, Seong BG. Intraoperative use of dexmedetomidine for the prevention of emergence agitation and postoperative delirium in thoracic surgery: a randomized-controlled trial. *Can J Anaesth*. 2019;66:371-9.
21. Ma XD, Li BP, Wang DL, Yang WS. Postoperative benefits of dexmedetomidine combined with flurbiprofen axetil after thyroid surgery. *Exp Ther Med*. 2017;14:2148-52.
22. Zierath D, Tanzi P, Shibata D, Becker KJ. Cortisol is more important than metanephrines in driving changes in leukocyte counts after stroke. *J Stroke Cerebrovasc Dis*. 2018;27:555-62.
23. Guo Z, Zhang Z, Prajapati M, Li Y. Lymphopenia caused by virus infections and the mechanisms beyond. *Viruses*. 2021;13:1876.
24. Schafer AI. Thrombocytosis and thrombocythemia. *Blood Rev*. 2001;15:159-66.
25. Larmann J, Handke J, Scholz AS, Dehne S, Arens C, Gillmann HJ, et al. Preoperative neutrophil to lymphocyte ratio and platelet to lymphocyte ratio are associated with major adverse cardiovascular and cerebrovascular events in coronary heart disease patients undergoing non-cardiac surgery. *BMC Cardiovasc Disord*. 2020;20:230.
26. Bonaventura A, Carbone F, Liberale L, Mach F, Roth A, Burger F, et al. Platelet-to-lymphocyte ratio at the time of carotid endarterectomy is associated with acute coronary syndrome occurrence. *J Cardiovasc Med (Hagerstown)*. 2020;21:80-2.
27. Yuce E. Neutrophil-to-lymphocyte ratio (NLR) and platelet-to-lymphocyte ratio (PLR) can predict spontaneous preterm birth? *J Inflamm Res*. 2023;16:2423-9.
28. Beşir A, Tugcuil E, Akdoğan A, Livaoglu M. Neutrophil/lymphocyte ratio as a predictor of severe postoperative edema and ecchymosis in open rhinoplasty surgery. *Cukurova Med J*. 2022;47:1568-77.
29. Spemer-Unterweger B. Immunological aetiology of major psychiatric disorders: evidence and therapeutic implications. *Drugs*. 2005;65:1493-520.
30. Mitchell RH, Goldstein BI. Inflammation in children and adolescents with neuropsychiatric disorders: a systematic review. *J Am Acad Child Adolesc Psychiatry*. 2014;53:274-96.
31. Michopoulos V, Powers A, Gillespie CF, Ressler KJ, Jovanovic T. Inflammation in fear- and anxiety-based disorders: PTSD, GAD, and beyond. *Neuropsychopharmacology*. 2017;42:254-70.
32. Renna ME, O'Toole MS, Spaeth PE, Lekander M, Mennin DS. The association between anxiety, traumatic stress, and obsessive-compulsive disorders and chronic inflammation: a systematic review and meta-analysis. *Depress Anxiety*. 2018;35:1081-94.
33. Marazziti D, Rossi A, Dell'Osso L, Placidi GP, Giannaccini G, et al. Decreased platelet 3H-paroxetine binding in untreated panic disorder patients. *Life Sci*. 1999;65:2735-41.
34. Camacho A, Dimsdale JE. Platelets and psychiatry: lessons learned from old and new studies. *Psychosom Med*. 2000;62:326-36.
35. Zafar MU, Paz-Yepes M, Shimbo D, Vilahur G, Burg MM, Chaplin W, et al. Anxiety is a better predictor of platelet reactivity in coronary artery disease patients than depression. *Eur Heart J*. 2010;31:1573-82.
36. Wachowicz B. Blood Platelet as a Peripheral Cell in Oxidative Stress in Psychiatric Disorders, *Studies on Psychiatric Disorders*. Berlin: Springer; 2015. p. 327-53.
37. Hoge EA, Brandstetter K, Moshier S, Pollack MH, Wong KK, Simon NM. Broad spectrum of cytokine abnormalities in panic disorder and posttraumatic stress disorder. *Depress Anxiety*. 2009;26:447-55.
38. Hamer M, Gibson EL, Vuononvirta R, Williams E, Steptoe A. Inflammatory and hemostatic responses to repeated mental stress: individual stability and habituation over time. *Brain Behav Immun*. 2006;20:456-9.
39. Costa-Pinto FA, Basso AS, Britto LR, Malucelli BE, Russo M. Avoidance behavior and neural correlates of allergen exposure in a murine model of asthma. *Brain Behav Immun*. 2005;19:52-60.
40. Tonelli LH, Katz M, Kovacsics CE, Gould TD, Joppy B, Hoshino A, et al. Allergic rhinitis induces anxiety-like behavior and altered social interaction in rodents. *Brain Behav Immun*. 2009;23:784-93.
41. Zheng Q, Liu J, Ji Y, Zhang Y, Chen X, Liu B. Elevated levels of monocyte-lymphocyte ratio and platelet-lymphocyte ratio in adolescents with non-suicidal self-injury. *BMC Psychiatry*. 2022;22:618.
42. Turkmen K, Erdur FM, Ozcicek F, Ozcicek A, Akbas EM, Ozbicer A, et al. Platelet-to-lymphocyte ratio better predicts inflammation than neutrophil-to-lymphocyte ratio in end-stage renal disease patients. *Hemodial Int*. 2013;17:391-6.
43. Kayhan F, Gündüz Ş, Ersoy SA, Kandeğer A, Annagür BB. Relationships of neutrophil-lymphocyte and platelet-lymphocyte ratios with the severity of major depression. *Psychiatry Res*. 2017;247:332-5.
44. Fusar-Poli L, Natale A, Amerio A, Cimpoesu P, Grimaldi Filioli P, Aguglia E, et al. Neutrophil-to-lymphocyte, platelet-to-lymphocyte and monocyte-to-lymphocyte ratio in bipolar disorder. *Brain Sci*. 2021;11:58.
45. Pasqui E, de Donato G, Brancaccio B, Casilli G, Ferrante G, Cappelli A, et al. The predictive role of inflammatory biochemical markers in post-operative delirium after vascular surgery procedures. *Vasc Health Risk Manag*. 2022;18:747-56.
46. Jiang X, Shen Y, Fang Q, Zhang W, Cheng X. Platelet-to-lymphocyte ratio as a predictive index for delirium in critically ill patients: a retrospective observational study. *Medicine (Baltimore)*. 2020;99:e22884.
47. American Psychiatric Association. *Diagnostic and Statistical Manual of Mental Disorders*. 5th ed. Washington, DC: American Psychiatric Association; 2013.
48. Veale D, De Haro L, Lambrou C. Cosmetic rhinoplasty in body dysmorphic disorder. *Br J Plast Surg*. 2003;56:546-51.
49. Rosenkranz MA, Busse WW, Johnstone T, Swenson CA, Crisafi GM, Jackson MM, et al. Neural circuitry underlying the interaction between emotion and asthma symptom exacerbation. *Proc Natl Acad Sci U S A*. 2005;102:13319-24.
50. Özyurt G, Binici NC. The neutrophil-lymphocyte ratio and platelet-lymphocyte ratio in adolescent obsessive-compulsive disorder: does comorbid anxiety disorder affect inflammatory response? *Psychiatry Res*. 2019;272:311-5.