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Annals of Clinical and Analytical Medicine
Original Research

Sleeve gastrectomy improves cardiovascular risk without direct correlation to weight loss

Cardiometabolic impact of sleeve gastrectomy

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Abstract

Aim: This study aimed to evaluate changes in mean platelet volume (MPV), platelet count (PLT), and 10-year cardiovascular risk scores after laparoscopic sleeve gastrectomy (LSG), and to investigate whether these hematologic changes were associated with postoperative weight loss.

Methods: This retrospective study included 196 patients who underwent laparoscopic sleeve gastrectomy between January 2016 and December 2018. Preoperative and one-year postoperative clinical, laboratory, and anthropometric data were analyzed. Cardiovascular risk was estimated using the Framingham Risk Score (FRS) and Systematic Coronary Risk Evaluation (SCORE). Paired comparisons were performed using the Wilcoxon signed-rank test, and correlations were assessed with Spearman analysis.

Results: Median body weight and BMI decreased significantly one year after surgery ($P < .001$). Total cholesterol levels declined, whereas high-density lipoprotein cholesterol increased. MPV significantly increased (8.30 [7.40–9.10] vs. 9.10 [8.40–9.60], $P < .001$), while PLT decreased (308.5×10^9/L vs. 254.0×10^9/L, $P < .001$). Both FRS and SCORE values were significantly reduced postoperatively ($P < .001$). However, changes in MPV and PLT were not correlated with the amount of weight loss or improvements in lipid parameters.

Conclusion: Laparoscopic sleeve gastrectomy leads to favorable reductions in cardiovascular risk and distinct hematologic remodeling, characterized by increased MPV and decreased PLT. These alterations occur independently of weight loss magnitude, suggesting adaptive hematologic responses to improved metabolic and inflammatory status rather than a direct effect of adipose reduction.

Keywords

bariatric surgery, sleeve gastrectomy, obesity, systematic coronary risk evaluation, Framingham risk score

DOI: 10.4328/ACAM.50048 Ann Clin Anal Med 2026;17(11):1182-1185
Received: 23.01.2026 Accepted: 08.04.2026 Published Online: 14.04.2026 Printed: 01.11.2026
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Introduction

Obesity is a complex and chronic disease characterized by excessive accumulation of adipose tissue and associated with numerous metabolic and cardiovascular complications.[1] Bariatric surgery, particularly laparoscopic sleeve gastrectomy, has emerged as one of the most effective treatments for achieving sustained weight loss and improving obesity-related comorbidities such as diabetes mellitus, dyslipidemia, and hypertension.[2] In addition to metabolic improvements, bariatric surgery has been shown to reduce cardiovascular risk by favorably modifying blood pressure, lipid profile, and glucose metabolism.[1,3] Recent studies have suggested that obesity is also associated with hematologic alterations, particularly changes in platelet morphology and function. Mean platelet volume (MPV), a marker of platelet (PLT) size and activity, has been proposed as an indirect indicator of thrombotic and inflammatory processes.[4] Cardiovascular risk estimation in clinical practice commonly relies on risk scoring systems that integrate demographic and metabolic parameters. The Framingham Risk Score (FRS) and the Systematic Coronary Risk Evaluation (SCORE) are widely validated tools for estimating the 10-year probability of cardiovascular events.[5] Both models include traditional risk factors such as age, sex, blood pressure, total and high-density lipoprotein cholesterol (HDL) levels, diabetes, and smoking status. These risk scores provide quantitative measures of cardiovascular risk reduction after bariatric surgery and allow assessment of whether changes in hematologic indices, such as MPV and PLT, parallel the improvement in calculated cardiovascular risk. However, data on the effects of bariatric surgery on platelet indices and their relationship to cardiovascular risk reduction remain limited and inconsistent. Understanding these changes may help clarify whether hematologic alterations after significant weight loss are adaptive or contribute to cardiovascular risk. The present study aimed to evaluate the changes in MPV, PLT, and cardiovascular risk scores (FRS and SCORE) in patients undergoing sleeve gastrectomy, and to investigate whether the observed hematologic changes were associated with postoperative weight loss and cardiovascular risk reduction.

Materials and Methods

This study was designed as a retrospective analysis of prospectively collected data. The medical records of patients who underwent laparoscopic sleeve gastrectomy between January 2016 and December 2018 at the Department of General Surgery, Derince Training and Research Hospital were reviewed. All patients 18 years or older who met the eligibility criteria and had complete preoperative and one-year postoperative clinical and laboratory data were included in the analysis. Patients who did not attend the one-year postoperative control visit were excluded from the study.

Preoperative data, including vital signs, medical history, and routinely obtained laboratory results, were obtained from the patient's records. Based on these data, the 10-year cardiovascular event risk was calculated using the FRS. Similarly, follow-up data collected during the routine one-year postoperative visit were retrieved from the hospital records, including weight loss achieved during this period. Framingham risk scores, MPV levels, platelet counts, and one-year weight loss were compared between the preoperative and postoperative periods. Body mass index was calculated for each patient using the formula weight (kg) / height^2 (m^2). According to BMI, patients were classified as normal weight (18.5–24.9 kg/m^2), overweight (25.0–29.9 kg/m^2), class I obesity (30.0–34.9 kg/m^2), class II obesity (35.0–39.9 kg/m^2), and class III obesity (≥40 kg/m^2). Using demographic and clinical data (age, sex, systolic blood pressure, total cholesterol, and smoking status), the SCORE cardiovascular risk levels were calculated for each case. The presence of diabetes, systolic and diastolic blood pressure, total and HDL cholesterol levels, and BMI were used to determine whether the patients met the criteria for metabolic syndrome. The relationships between obesity class and MPV were evaluated. Additionally, correlations were analyzed between MPV and the parameters included in the SCORE model, as well as the components of metabolic syndrome, to determine whether MPV was associated with cardiovascular risk factors.

Ethical Approval

This study was approved by the Ethics Committee of Derince Training and Research Hospital (Date: 10.06.2021, Decision No: 2021/87).

Statistical Analysis

Continuous variables were expressed as median (interquartile range; IQR), and categorical variables were presented as number (percentage). The normality of data distribution was evaluated using the Shapiro–Wilk test and visual methods (histograms, Q–Q plots). As most continuous variables were not normally distributed, non-parametric tests were used for comparisons. The Wilcoxon signed-rank test was used to compare paired preoperative and postoperative values of continuous variables (e.g., weight, BMI, HDL, cholesterol, MPV, PLT, Framingham, and SCORE). Correlations among preoperative and postoperative hematologic and metabolic parameters were evaluated using the Spearman rank correlation test because the data were not normally distributed. Correlation coefficients (ρ) and *P* values were calculated for each pair of variables and visualized in a correlation heatmap. Weight loss (ΔWeight) and changes in platelet indices (ΔMPV and ΔPLT) were also assessed using Spearman correlation analysis. Scatter plots with regression trend lines were generated to illustrate these associations. A two-sided *P* value <0.05 was considered statistically significant. Statistical analyses were performed using Python version 3.11 (Python Software Foundation, USA) and R version 4.2.1 (https://www.r-project.org/), where appropriate.

Reporting Guidelines

This study is reported in accordance with the STROBE guidelines.

Results

A total of 196 patients who underwent sleeve gastrectomy were included in the analysis. The median age was 39 years (20–66), and the majority were female (84.7%). Among participants, 35.2% were current smokers, 24.5% were receiving antihypertensive medication, and 51.0% were on antidiabetic treatment preoperatively. According to baseline BMI, 94.4% of patients were classified as class III obese, and 5.6% as class II obese (Supplementary Table 1). The median preoperative Framingham risk score was 5.28 (2.24–10.25), and the median SCORE value was 0.26 (0.23–0.29). After one year of follow-up, significant improvements were observed in anthropometric and biochemical parameters. Median body weight decreased from 122.1 kg (109.9–135.0) to 83.35 kg (72.9–93.0) (*P* < .001), and BMI from 45.12 (42.06–50.33) to 30.84 (27.03–36.18) (*P* < .001). Total cholesterol decreased from 193.0 (171.8–217.0) to 184.0 (154.0–206.0) (*P* < .001), whereas HDL cholesterol increased from 47.0 (41.0–54.0) to 55.0 (47.0–62.0) (*P* < .001). Regarding hematologic indices, MPV significantly increased from 8.30 (7.40–9.10) to 9.10 (8.40–9.60) (*P* < .001), while platelet count (PLT) significantly decreased from 308.5 × 10^9/L (260.8–368.5) to 254.0 × 10^9/L (213.5–302.0) (*P* < .001). Both Framingham and SCORE

cardiovascular risk scores significantly declined postoperatively: Framingham risk score decreased from 5.28 (2.24–10.25) to 4.10 (1.89–7.89) ($P < .001$), and SCORE from 0.26 (0.23–0.29) to 0.26 (0.23–0.28) ($P < .001$) (Supplementary Table 2). Spearman's correlation analysis was performed to explore relationships among preoperative and postoperative anthropometric, biochemical, and hematologic parameters (Supplementary Figure 1). The correlation heatmap demonstrated strong positive associations between corresponding preoperative and postoperative measurements, including body weight and BMI. HDL and total cholesterol values also showed positive intra-parameter correlations between baseline and 1-year follow-up. In contrast, platelet indices revealed a moderate inverse relationship between MPV and platelet count (PLT), both preoperatively (ρ=–0.25) and postoperatively (ρ = –0.43). This negative correlation suggests that higher MPV values were generally associated with lower PLT counts within the same individuals. No significant correlations were found between MPV or PLT and lipid parameters (HDL, total cholesterol), or between platelet indices and body composition measures (weight and BMI), either before or after surgery. The effect of weight loss on platelet parameters was evaluated by comparing changes in MPV and PLT with the magnitude of postoperative weight reduction (Supplementary Figure 2). Spearman correlation analysis revealed no significant association between the amount of weight lost and the change in either platelet parameter (ΔPLT vs weight loss: ρ=0.06, $P = .417$; ΔMPV vs weight loss: ρ=0.09, $P = .207$). The scatter plots confirmed the absence of a linear or monotonic trend between these variables. Together, these analyses indicate that while platelet morphology changed significantly after sleeve gastrectomy (increased MPV and reduced PLT), these hematologic alterations occurred independently of the extent of weight loss and were not directly related to metabolic or lipid parameters.

Discussion

In this study, we investigated the changes in MPV, PLT, and cardiovascular risk scores (Framingham and SCORE) in patients who underwent laparoscopic sleeve gastrectomy and evaluated whether these hematologic alterations were associated with postoperative weight loss and cardiovascular risk reduction. Our findings demonstrated a significant increase in MPV and a decrease in PLT one year after surgery, accompanied by a marked improvement in anthropometric and metabolic parameters and a reduction in both cardiovascular risk scores. However, the changes in platelet indices were not correlated with the magnitude of weight loss or improvements in metabolic variables, suggesting that these hematologic shifts occur independently of body mass reduction. The increase in MPV and the concomitant decrease in platelet count observed in our cohort are consistent with previous studies examining hematologic changes after bariatric surgery. Raoux et al. [6] reported similar trends, attributing the findings to enhanced platelet turnover and bone marrow remodeling following the reduction of systemic inflammation and metabolic stress. MPV reflects platelet activation potential; therefore, larger platelets are generally more reactive and prothrombotic. However, postoperative increases in MPV may not necessarily indicate heightened thrombotic risk, but rather a physiological adaptation to the reduced inflammatory state after substantial weight loss.[7] The lack of correlation between MPV/PLT changes and weight loss in our study supports the hypothesis that these hematologic modifications are not a direct function of adipose tissue reduction. Instead, they may represent qualitative improvements in platelet physiology driven by metabolic and endocrine normalization following surgery. Complications related to obesity—especially thromboembolic events—contribute to higher cardiovascular morbidity and mortality. The condition involves a complex interaction among endothelial dysfunction, hypercoagulability, altered megakaryopoiesis and platelet formation, enhanced platelet reactivity, inflammation, and excessive adipose tissue accumulation.[8]

In our study, both FRS and SCORE risk scores significantly decreased after surgery, consistent with prior research demonstrating the potential positive impact of bariatric procedures on long-term cardiovascular risk. Compared with preoperative values, the estimated 10-year risks for overall cardiovascular disease and its subtypes—including atherosclerotic cardiovascular disease, coronary heart disease, stroke, and heart failure—declined by 22% to 56% one year after surgery and by 15% to 47% two years postoperatively. The greatest reduction was observed in heart failure risk, although the magnitude of improvement varied with patient demographics, the degree of weight loss, and the presence of metabolic comorbidities.[9] The dissociation between platelet indices and these risk models suggests that, although bariatric surgery improves classical cardiovascular risk factors (lipid levels, blood pressure, glycemic control), platelet-related changes may operate through distinct mechanisms not fully captured by conventional risk scores.[10] This distinction highlights the potential value of MPV and PLT as complementary biomarkers reflecting the hematologic and vascular effects of metabolic surgery beyond standard risk models. Several mechanisms could explain the observed postoperative increase in MPV. The normalization of leptin and adiponectin levels after surgery may modulate platelet production and size distribution.[10,11] Additionally, improvements in endothelial function and nitric oxide bioavailability may alter platelet reactivity.[7]

Limitations

This study has some limitations. Its retrospective design may introduce selection bias. Moreover, cardiovascular events were not directly assessed; therefore, conclusions regarding clinical outcomes remain indirect. Nevertheless, the relatively large sample size and the use of two validated cardiovascular risk models strengthen the reliability of the findings.

Conclusion

In conclusion, sleeve gastrectomy resulted in significant improvements in metabolic and cardiovascular risk profiles, along with distinct hematologic changes characterized by increased MPV and decreased PLT. These alterations were independent of the magnitude of weight loss, suggesting that hematologic remodeling after bariatric surgery reflects an adaptive, potentially beneficial response rather than a direct consequence of adipose reduction. Future prospective studies incorporating inflammatory and endothelial markers are warranted to elucidate the mechanistic pathways linking platelet dynamics with cardiovascular outcomes after bariatric surgery.

Declarations

Animal and Human Rights Statement

All procedures performed in this study were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Declaration of Helsinki and its later amendments, or comparable ethical standards.

Informed Consent

Due to the retrospective nature of the study and the use of anonymized clinical data, the ethics committee waived the requirement for informed consent.

Data Availability

The datasets used and/or analyzed during the current study are not publicly available due to patient privacy reasons, but are available from the corresponding author on reasonable request.

Conflict of Interest

The authors declare no conflict of interest.

Funding

None.

Author Contributions (CRediT Taxonomy)

Conceptualization: G.N.T.Y., N.Ç.A.
Methodology: C.A., M.C., A.Y.
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Validation: G.N.T.Y., N.Ç.A.
Formal analysis: C.A., M.C., A.Y.
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Visualization: G.N.T.Y., N.Ç.A.
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AI Usage Disclosure

The authors declare that no AI-assisted technologies were used.

Abbreviations

BMI: Body mass index
FRS: Framingham risk score
HDL: High-density lipoprotein
IQR: Interquartile range
LSG: Laparoscopic sleeve gastrectomy
MPV: Mean platelet volume
PLT: Platelet count
SCORE: Systematic coronary risk evaluation
STROBE: Strengthening the reporting of observational studies in epidemiology

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How to Cite

Gonca Nergiz Taylan Yıldız, Nuray Çolapkulu Akgul, Caner Akgul, Murat Coşkun, Adem Yuksel, Hamdi Taner Turgut, Mehmet Aslan. Sleeve gastrectomy improves cardiovascular risk without direct correlation to weight loss. Ann Clin Anal Med 2026;17(11):1182-1185. doi:10.4328/ACAM.50048