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Original Article *Özgün Araştırma*

EVALUATION OF LABORATORY AND IMAGING PARAMETERS IN PATIENTS UNDERGOING OPEN HEART SURGERY

Açık Kalp Cerrahisi Geçiren Hastalarda Laboratuvar ve Görüntüleme Parametrelerinin Değerlendirilmesi

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ABSTRACT

Objective: Coronary artery bypass grafting (CABG) remains a widely performed surgical intervention for coronary artery disease. Despite advances in perioperative care and preoperative risk stratification, postoperative complications and mortality continue to pose significant clinical challenges. This study aimed to investigate the prognostic value of platelet related parameters specifically, mean platelet volume (MPV) and platelet count (PLT) in predicting postoperative outcomes and 30-day mortality in patients undergoing CABG.

Material and Methods: This retrospective, single-center study included 406 adult patients who presented to the emergency department with acute coronary syndrome and subsequently underwent isolated CABG between 2019 and 2023. Demographic characteristics, preoperative EuroSCORE II and logEuroSCORE values, laboratory parameters and echocardiographic findings were recorded. Postoperative outcomes included 30-day mortality, major adverse cardiac events (MACE) and composite poor outcomes. Hematologic and biochemical parameters were analyzed at admission and on postoperative day 30 or the day of death. Associations between these variables and clinical outcomes were assessed using ROC and regression analyses.

Results: Among the 406 patients (mean age: 63.5±8.6 years; 76.1% male), the 30-day mortality rate was 4.7%, with MACE and poor outcomes occurring in 9.4% and 10.1% of cases, respectively. Postoperative MPV and PLT were significantly associated with all outcome groups ($p<0.05$). MPV demonstrated the highest predictive accuracy for mortality (AUC: 0.791 95% CI: 0.748-0.830), whereas PLT exhibited the strongest performance for predicting MACE (AUC: 0.691 95% CI: 0.644-0.736). Multivariate analysis confirmed that postoperative MPV was an independent predictor of mortality (OR: 2.738; 95% CI: 1.842-4.072; $p<0.001$).

Conclusion: Routine postoperative monitoring of MPV and PLT may enhance early detection of high-risk patients following CABG, particularly among those initially classified as low-risk. These simple, accessible markers could support clinical decision-making and improve outcomes in the early postoperative period.

Keywords: *Coronary artery bypass grafting, mean platelet volume, platelet count, prognosis*

ÖZ

Amaç: Koroner arter bypass greftleme (KABG), koroner arter hastalığının tedavisinde yaygın olarak uygulanan bir cerrahi girişimdir. Perioperatif bakım ve preoperatif risk sınıflamasındaki ilerlemelere rağmen, postoperatif komplikasyonlar ve mortalite önemli klinik sorunlar olmaya devam etmektedir. Bu çalışmada, trombosit ile ilişkili parametrelerden ortalama trombosit hacmi (MPV) ve trombosit sayısının (PLT), KABG uygulanan hastalarda postoperatif sonuçlar ve 30 günlük mortaliteyi öngörmedeki prognostik değerleri araştırıldı.

Gereç ve Yöntemler: Bu retrospektif, tek merkezli çalışmaya 2019-2023 yılları arasında akut koroner sendrom ile acil servise başvuran ve izole KABG uygulanan 406 erişkin hasta dâhil edildi. Hastaların demografik özellikleri, preoperatif EuroSCORE II ve logEuroSCORE değerleri, laboratuvar parametreleri ve ekokardiyografik bulguları kaydedildi. Postoperatif sonuçlar; 30 günlük mortalite, majör kardiyak olaylar (MACE) ve kötü klinik sonuçlar olarak tanımlandı. Hematolojik ve biyokimyasal parametreler başvuru anında ve postoperatif 30. günde veya ölüm gününde analiz edildi. Bu değişkenler ile klinik sonuçlar arasındaki ilişkiler ROC ve regresyon analizleri ile değerlendirildi.

Bulgular: Çalışmaya dâhil edilen 406 hastanın (ortalama yaş: 63.5±8.6 yıl; %76.1 erkek) 30 günlük mortalite oranı %4.7, MACE oranı %9.4 ve kötü sonuç oranı %10.1 olarak saptandı. Postoperatif MPV ve PLT tüm sonuçlarla anlamlı ilişkili bulundu ($p<0.05$). MPV, mortalite için en yüksek öngörü doğruluğunu gösterdi (AUC: 0.791; %95 GA: 0.748-0.830), PLT ise MACE'i öngörmede en güçlü parametreydi (AUC: 0.691; %95 GA: 0.644-0.736). Çok değişkenli analizde postoperatif MPV, mortalitenin bağımsız bir prediktörü olarak saptandı (OR: 2.738; %95 GA: 1.842-4.072; $p<0.001$).

Sonuç: Postoperatif dönemde MPV ve PLT'nin rutin takibi, özellikle başlangıçta düşük riskli olarak sınıflandırılan hastalarda yüksek riskli grupların erken dönemde belirlenmesine katkı sağlayabilir. Bu basit ve erişilebilir biyobelirteçler, klinik karar sürecini destekleyerek postoperatif hasta sonuçlarını iyileştirebilir.

Anahtar Kelimeler: *Koroner arter bypass greftleme, ortalama trombosit hacmi, trombosit sayıs, prognoz*

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INTRODUCTION

Coronary artery disease remains a major global cause of morbidity and mortality. CABG is a well-established surgical method aimed at restoring myocardial perfusion by bypassing stenotic coronary vessels using arterial or venous grafts.[1] While CABG was initially focused on improving survival, it now primarily aims to relieve symptoms and enhance quality of life.

Despite advances in perioperative care, postoperative complications remain unpredictable. Although risk models like the EuroSCORE integrate demographic and clinical variables to estimate surgical risk, they cannot fully capture individual patient variability or unanticipated postoperative events.[2-5] Recent interest has shifted toward hematological markers, particularly platelet indices, as potential prognostic tools.[6,7] MPV, an indicator of platelet activation, has been associated with various cardiovascular conditions including myocardial infarction, heart failure and stroke.[8-10]

Platelet count is also important; thrombocytopenia, common after CABG, has been linked to higher morbidity and mortality.[11] Additionally, low platelet levels may impair immune function and increasing infection risk.[12] It has been associated with increased morbidity and mortality in this population.[13,14]

This retrospective study aimed to assess the prognostic utility of MPV and platelet count in predicting 30-day mortality and adverse outcomes following CABG. Laboratory and clinical data obtained at initial emergency department admission were compared with those collected at discharge or at the time of death. The primary objective was to determine the association between these hematological parameters and postoperative prognosis. We hypothesized that, particularly when assessed in combination, MPV and platelet count could offer valuable prognostic information beyond conventional preoperative risk assessment tools.

MATERIALS AND METHODS

Study Plan and Setting

This single-center, retrospective observational study was carried out in the emergency department between January 2019 and December 2023. This study was conducted at Süleyman Demirel University Faculty of Medicine Hospital in accordance with the Declaration of Helsinki. Since the study involved the use of anonymized data extracted from existing medical records without direct patient interaction or intervention, individual informed consent was not required.

Study Population

A total of 406 consecutive patients diagnosed with acute coronary syndrome in the emergency department and subsequently hospitalized for isolated CABG were included. Eligible participants were between 18 and 80 years of age and had complete data available in the hospital's electronic medical record system.

All patients received standard intraoperative transfusion therapy (2 units of erythrocyte suspension and 2 units of fresh frozen plasma), per the institutional protocol. Only patients routinely initiated on acetylsalicylic acid were included, while those requiring additional antiplatelet therapy (e.g., clopidogrel) were excluded. Other exclusion criteria were: primary hematologic disease, off-pump surgery and presence of acute infections. A flowchart summarizing the inclusion and exclusion process is presented in Figure 1.

Sample Size

The sample size was estimated through power analysis, incorporating an expected small-to-moderate effect size (Cohen's $d = 0.35$), a significance level (α) of 0.05, and a power of 95%, indicating that approximately 380 participants would be sufficient to detect a statistically meaningful difference. This estimation was based on previous studies reporting variability in the prognostic impact of platelet indices after cardiac surgery.

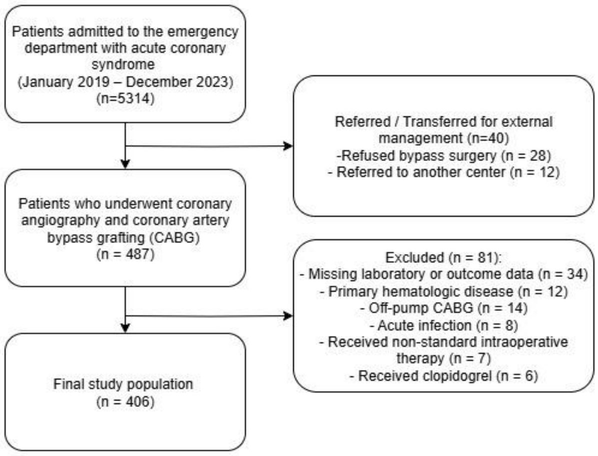

Figure 1: Flowchart of study

Data Collection

Laboratory tests -including complete blood count (neutrophils, lymphocytes, monocytes, hemoglobin, hematocrit, leukocytes, platelets, and mean platelet volume) -were performed using a Beckman Coulter DXH 800 hematology analyzer (Beckman Coulter Inc., USA) on EDTA-anticoagulated venous blood samples. Left ventricular ejection fraction (LVEF) was assessed via transthoracic echocardiography. MPV, platelet count, troponin, and ejection fraction values were recorded both at baseline and at follow-up (i.e., postoperative day 30 for survivors or the day of death for non-survivors). Preoperative EuroSCORE II and logistic EuroSCORE values were also documented. Patients were subsequently categorized according to clinical outcomes, with 30-day mortality defined as the primary endpoint. Secondary outcomes included the development of MACE and a composite poor outcome, as further defined below.

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Score Definitions

Major Adverse Cardiac Events (MACE)

Defined as the occurrence of at least one of the following: postoperative myocardial infarction requiring reoperation due to hemodynamic instability, early repeat revascularization (percutaneous or surgical) or in-hospital mortality. Postoperative MI was defined as a troponin I level >15 ng/mL on postoperative day 1 or >35 ng/mL on day 2, and/or new electrocardiographic changes.

Poor Outcome

Defined as the presence of one or more of the following: postoperative MACE, mechanical ventilation requirement >24 hours, new-onset renal failure, sepsis, or death.

Statistical Analysis

The normality of continuous variables was assessed using the Kolmogorov-Smirnov test. Categorical variables were presented as counts and percentages, while continuous variables were expressed as mean ± standard deviation or median with interquartile range, depending on data distribution. For group comparisons, the independent samples t-test and one-way ANOVA were used for normally distributed data, whereas the Mann-Whitney U and Kruskal-Wallis tests were applied to non-normally distributed variables. Paired comparisons of laboratory values from the first and last time points were analyzed using the Wilcoxon signed-rank test or the paired samples t-test, depending on distribution characteristics. Receiver operating characteristic (ROC) curve analysis was employed to assess the discriminative performance of laboratory parameters in predicting mortality, MACE and poor outcomes. Optimal cutoff values were determined using the Youden index. The area under the curve (AUC), sensitivity, specificity were reported for each outcome. Logistic regression analysis was performed to identify independent predictors of 30-day mortality. For the prediction of MACE and poor outcome, binary logistic regression analysis was conducted. Survival curves were constructed using the Kaplan-Meier method for 30-day mortality analysis.

All statistical analyses were performed using IBM SPSS Statistics version 27.0 (IBM Corp., Armonk, NY, USA), RStudio (version 2023.06.1+524, R Foundation for Statistical Computing, Vienna, Austria) and GraphPad Prism version 10.2.2. A p-value <0.05 was considered statistically significant. The study protocol was approved by the Süleyman Demirel University Clinical Research Ethics Committee (Date: 29.12.2023; No:72867572-050.01.04-685821).

RESULTS

A total of 406 patients (mean age: 63.5±8.6 years; 76.1% male) were included. MACE occurred in 9.4%, poor outcomes in 10.1% and 30-day mortality in 4.7% of cases. Adverse outcomes were observed more frequently in males and were associated with lower preoperative hemoglobin, hematocrit, ejection fraction, and renal function. Significant differences were also observed in most postoperative hematologic parameters between outcome groups ($p<0.05$), except for monocyte count. Detailed characteristics by outcome status are summarized in Table 1.

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Table 1: Comparison of laboratory findings and demographic and clinical features between groups

			MACE			OUTCOME			30-DAY MORTALITY		
		Overall	Negative	Positive	**p value**	Favorable Outcome	Poor Outcome	**p value**	Living	Exitus	**p value**
Sex (n, %)	Female	97 (23.9%)	89 (91.8%)	8 (8.2%)	0.667	86 (88.7%)	11 (11.3%)	0.783	92 (88.7%)	5 (5.2%)	0.855
	Male	309 (76.1%)	280 (90.6%)	29 (9.4%)		279 (90.3%)	30 (9.7%)		295 (95.5%)	14 (4.5%)	
Age		63.51±8.60	63.06±0.46	65.86±1.02	**0011**	63.12±0.47	65.25±0.98	**0.032**	63.26±0.45	65.57±1.26	0.093
Laboratory											
HB (D1) (g/dL)*		13.27±1.75	13.37±0.09	12.72±0.21	**0.004**	13.44±0.09	12.51±0.20	**<0.001**	13.38±0.08	12.36±0.28	**<0.001**
HTC (D1) (%)*		39.21±4.99	39.52±0.26	37.61±0.61	**0.003**	39.69±0.26	37.10±0.57	**<0.001**	39.55±0.25	36.84±0.78	**<0.001**
WBC (D1) (10³/uL)*		7.58±2.52	7.52±0.13	7.92±0.32	0.286	7.45±0.12	8.14±0.38	0.469	7.50±0.13	8.26±0.41	**0.039**
NE (D1) (10³/uL)*		4.66±2.43	4.62±0.13	4.89±0.32	0.530	4.54±0.11	5.19±0.39	0.628	4.60±0.12	5.23±0.42	0.101
LYM (D1) (10³/uL)*		2.00±0.70	1.99±0.03	2.05±0.08	0.578	2.00±0.03	1.99±0.07	0.800	2.00±0.03	2.01±0.11	0.995
PLT (D1) (10³/uL)*		230±69.13	228±3.62	237±9.95	0.768	228±3.67	238±9.01	0.527	227±3.46	249±13.51	0.234
MPV (D1) (fL)*		9.04±0.98	9.01±0.05	9.18±0.11	0.189	9.00±0.05	9.19±0.10	0.084	9.02±0.05	9.19±0.14	0.333
TROP (ng/L)		0.15±0.41	0.14 ±0.02	0.16±0.04	**0.012**	0.14±0.02	0.16±0.03	**0.006**	0.14±0.02	0.20±0.06	**<0.001**
CREA (mg/dL)		1.00±0.70	0.96±0.03	1.20±0.12	**<0.001**	0.96±0.03	1.20±0.12	**0.003**	0.96±0.03	1.31±0.18	**0.001**
eGFR		81.76±20.16	83.31 ±1.03	73.59±2.94	**<0.001**	83.47±1.02	74.18±2.81	**0.002**	83.05±1.00	71.13±3.83	**0.003**
HB (D2) (g/dL)**		11.44±0.09	11.61±0.10	10.56±0.21	**<0.001**	11.62±0.10	10.68±0.19	**<0.001**	11.62±0.09	9.99±0.25	**<0.001**
HTC (D2) (%)**		34.92±1.07	35.53±1.27	31.70±0.60	**<0.001**	35.58±1.31	32.02±0.55	**<0.001**	35.49±1.20	30.24±0.71	**<0.001**
WBC (D2) (10³/uL)**		9.74±0.19	9.36±0.16	11.74±0.82	**0.018**	9.34±0.16	11.50±0.72	**0.010**	9.36±0.15	12.88±1.15	**0.004**
NE (D2) (10³/uL)**		6.89±0.17	6.49±0.13	9.03±0.80	**0.011**	6.47±0.14	8.77±0.70	**0.006**	6.49±0.13	10.22±1.12	**0.003**
LYM (D2) (10³/uL)**		1.76±0.03	1.80±0.03	1.59±0.08	**0.006**	1.80±0.03	1.59±0.07	**0.007**	1.79±0.03	1.52±0.10	**0.003**
PLT (D2) (10³/uL)**		417.41±8.23	434.94±8.53	345.78±20.13	**<0.001**	435.87±8.72	353.56±18.15	**<0.001**	436.02±8.21	294.36±22.57	**<0.001**
MPV (D2) (fL)**		8.84±1.03	8.73±0.04	9.44±0.17	**<0.001**	8.73±0.05	9.35±0.15	**<0.001**	8.72±0.04	9.86±0.21	**0.001**
Ecocardiography											
LVEF (%)		54.06±9.01	54.41±0.49	52.23±0.96	**0.003**	54.41±0.05	52.53±0.96	**0.003**	54.36±0.47	51.59±1.20	**0.005**
Scores											
EuroSCORE II		2.16±1.55	2.09±0.8	2.52±0.21	0.083	2.08±0.8	2.52±0.18	**0.041**	2.01±0.07	2.61±0.29	0.090
log EuroSCORE		5.38±9.42	5.1±0.48	6.85±1.46	**0.021**	5.18±0.49	6.23±1.29	0.054	5.01±0.45	8.35±2.12	0.123
Hospitalization											
ICU stay duration (days)		3.78±4.45	2.99±0.06	7.28±0.83	**<0.001**	2.89±0.05	7.13±0.73	**<0.001**	3.15±0.08	8.00±1.17	<**0.001**
Total stay Duration (days)		7.91±5.18	7.11 ±0.13	11.46±1.03	**<0.001**	6.87±0.11	11.92±0.91	**<0.001**	7.55±0.19	9.93±1.14	0.124

*MACE: Major adverse cardiac events, HB: Hemoglobin, HCT: Hematocrit, WBC: White blood cell, NE: Neutrophils, LYM: Lymphocytes, PLT: Platelets, MPV: Mean platelet volume, TROP: Troponin, CREA: Creatinine, eGFR: Estimated glomerular filtration rate, EuroSCORE: European system for cardiac operative risk evaluation, log EuroSCORE: Logistic european system for cardiac operative risk evaluation, LVEF: Left ventricular ejection fraction, ICU: Intensive care unit, µ: Median values, *D1:Sample at the day of admission, **D2:Sample at the 30th day/exitus.

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ROC analysis revealed that postoperative MPV had the highest predictive accuracy for 30-day mortality (AUC: 0.791; sensitivity: 94.7%, specificity: 74.1% at >8.6 fL). Platelet count showed the greatest specificity (87.8%) for mortality at ≤253×10³/μL (AUC: 0.752), and demonstrated acceptable discrimination for MACE and poor outcomes. Log EuroSCORE showed moderate predictive performance across all endpoints (AUC: 0.642-0.695). Hemoglobin had moderate specificity but low sensitivity, while LVEF exhibited the lowest predictive value. Full results are presented in Table 2 and Figure 2.

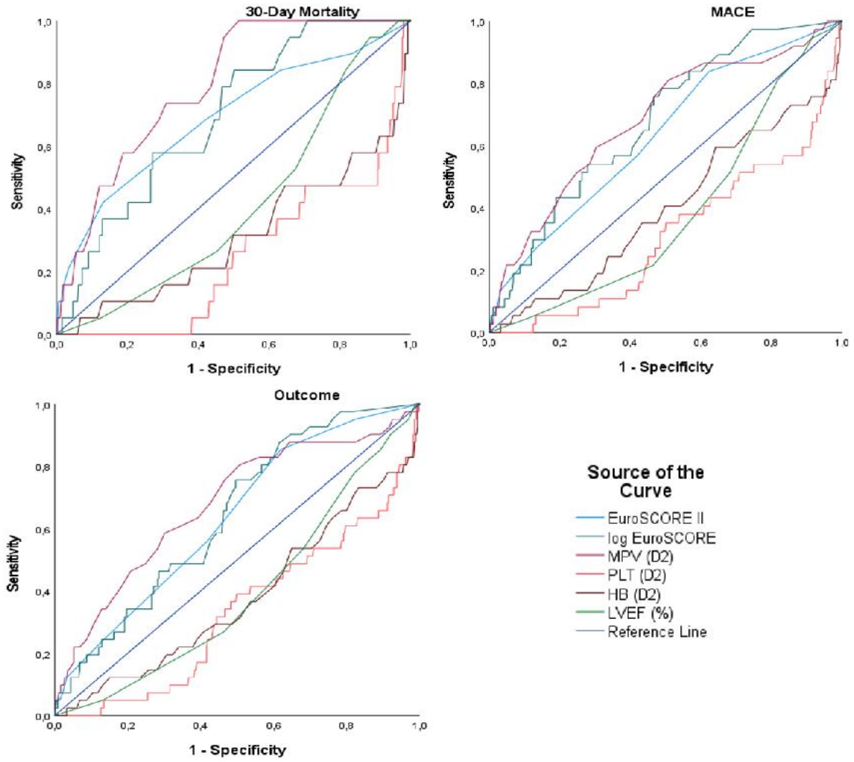

Figure 2: ROC curve analyses of groups
MACE: Major adverse cardiac effect, EuroSCORE: European system for cardiac operative risk evaluation, log EuroSCORE: Logistic european system for cardiac operative risk evaluation, MPV (D2): Last day mean platelet volume value, PLT (D2): Last day platelets, HB (D2): Last day hemoglobin, LVEF: Left ventricular ejection fraction

Table 2: Results of ROC curve analysis

	Cut-off	Sensitivity	Spesificity	AUC (95% CI)	p value
			MACE		
EuroSCORE II	>1	83.8	37.7	0.631 (0.582-0.678)	**0.005**
Log EuroSCORE	>2.04	78.4	50.9	0.677 (0.629-0.722)	**<0.001**
MPV (D2)	>8.6	81.1	49.1	0.681 (0.634-0.726)	**<0.001**
HB (D2) (g/dL)	≤9.3	24.3	95.4	0.602 (0.553-0.650)	**0.050**
PLT (D2)	≤253	43.2	88.9	**0.691 (0.644-0.736)**	**<0.001**
LVEF (%)	≤55	78.4	46.6	0.616 (0.566-0.663)	**0.006**
			OUTCOME		
EuroSCORE II	>1	85.4	38.1	0.633 (0.504-0.643)	**0.001**
Log EuroSCORE	>1.51	87.8	38.4	0.642 (0.503-0.639)	**<0.001**
MPV (D2)	>8.6	80.5	49.3	**0.678 (0.565-0.706)**	**<0.001**
HB (D2)	≤11.4	68.3	51.1	0.622 (0.541-0.689)	**0.012**
PLT (D2)	≤253	36.5	88.4	0.666 (0.568-0.711)	**<0.001**
LVEF (%)	≤55	73.2	46.3	0.606 (0.346-0.480)	**0.012**
			MORTALITY		
EuroSCORE II	>3	42.1	86.8	0.689 (0.641-0.734)	**0.007**
Log EuroSCORE	>2.04	84.2	49.9	0.695 (0.648-0.740)	**<0.001**
MPV (D2)	>8.6	94.7	74.1	**0.791 (0.748-0.830)**	**<0.001**
HB (D2)	≤10.2	52.6	80.1	0.688 (0.640-0.733)	**0.009**
PLT (D2)	≤253	52.6	87.8	0.752 (0.707-0.793)	**<0.001**
LVEF (%)	≤55	73.7	45.2	0.587 (0.537-0.635)	0.131

*AUC: Area under the curve, MACE: Major adverse cardiac effect, EuroSCORE II: European system for cardiac operative risk evaluation, log EuroSCORE: Logistic european system for cardiac operative risk evaluation, MPV (D2): Last day mean platelet volume value, LVEF: Left ventricular ejection fraction

To further investigate predictors of adverse outcomes, a multivariate model was constructed using variables with the strongest univariate associations with mortality: EuroSCORE II, LVEF and postoperative levels of Hb, MPV and PLT. To avoid multicollinearity, hemoglobin was retained over hematocrit and parameters already incorporated into EuroSCORE II (such as age, gender, and log EuroSCORE) were excluded. Among the evaluated variables, MPV emerged as the strongest independent predictor of 30-day mortality (OR: 2.738, 95% CI: 1.842-4.072, p<0.001), as well as for MACE (OR: 1.728, 95% CI: 1.312-2.276, p<0.001) and overall outcome (OR: 1.629, 95% CI: 1.257-2.111, p<0.001). Hb were also significantly associated with increased risk of mortality (OR: 0.698, 95% CI: 0.555-0.876, p=0.002), indicating a protective effect of higher hemoglobin values. Similarly, PLT demonstrated a significant inverse association with 30-day mortality (OR: 0.994, 95% CI: 0.991-0.997, p<0.001). Regression model results are presented in Figure 3.

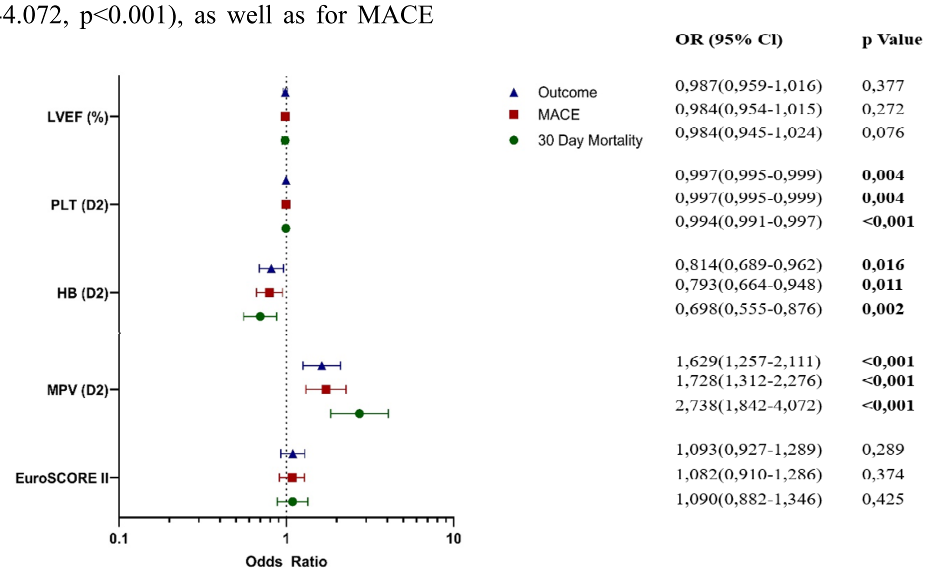

Figure 3: Regression analysis
MACE: Major adverse cardiac effect, LVEF: Left ventricular ejection fraction, PLT (D2): Last day platelets, HB (D2): Last day hemoglobin, MPV (D2): Last day mean platelet volume value, EuroSCORE II: European system for cardiac operative risk evaluation

Patients with an MPV >8.6 fL exhibited significantly lower 30-day survival rates compared to those with MPV ≤ 8.6 fL (log-rank $p < 0.001$). The cumulative survival probability at day 30 was visibly decreased in the high-MPV group, with divergence in the survival curves occurring as early as day 5. Similarly, patients with PLT ≤253×10³/μL had significantly worse survival compared to those with higher platelet counts (log-rank $p < 0.001$). Survival differences emerged within the first week, and by day 30, the survival probability was notably lower in the thrombocytopenic group. The life table confirmed a higher proportion of deaths in this group, with fewer censored cases, indicating more complete observation of events. The impact of MPV and PLT levels on 30-day survival is visualized through Kaplan-Meier curves in Figure 4.

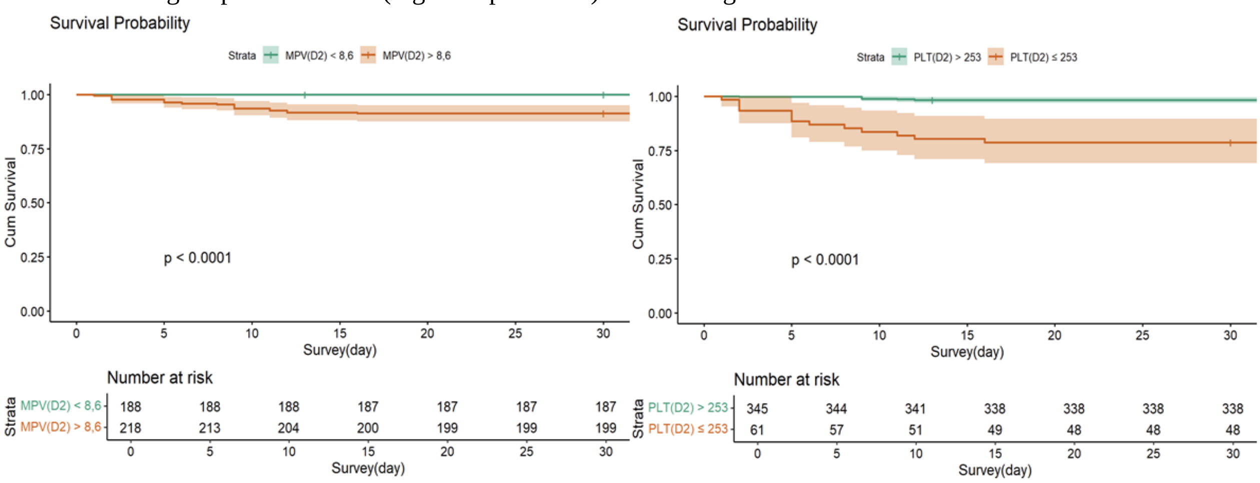

Figure 4: Kaplan-Meier analysis
PLT (D2): Last day platelets, MPV (D2): Last day mean platelet volume value

DISCUSSION

Morbidity and mortality after cardiac surgery have long been investigated using various clinical risk scores.[5,15] Hematological markers such as MPV, PLT and HB have been linked to CABG outcomes and may help predict mortality.[15,16] In this study, patients were stratified by postoperative MACE, composite poor outcomes and 30-day mortality.

While optimizing preoperative risk factors can improve outcomes, adverse events may still occur, highlighting the need for postoperative surveillance. However, few studies have focused on postoperative changes.[15,17,18] Westenbrink et al. reported that each 1% decrease in Hb increases the risk of cardiovascular events and all-cause mortality, while Loor et al. found hematocrit levels below 30% to be significantly associated with worse outcomes.[19,20] In line with these findings, we observed that lower preoperative Hb and Htc values were significantly associated with MACE, poor outcomes and mortality.

Cardiac surgery induces thrombocytopenia through excessive platelet consumption, prompting a thrombopoietic response and the release of immature platelets.[21,22] MPV, which reflects platelet activation and is responsive to inflammatory and thrombotic stimuli, has been reported to increase during thrombotic events.[9,23] In our study, elevated postoperative MPV and reduced PLT levels were stronger predictors of poor outcomes compared to other hematologic parameters. Aydınlı et al. reported that a combination of RDW, NLR and MPV predicted mortality in 52% of bypass patients[5], while Choi et al. found MPV>8.2 and NLR>2.8 associated with higher MACE and reduced survival in CABG patients.[9] Similarly, our study found that an MPV>8.6 combined with a platelet count<253 was significantly associated with reduced survival, increased MACE incidence or poor clinical outcomes.[9]

Among the markers assessed, postoperative MPV showed the strongest predictive value for 30-day mortality (AUC: 0.791; sensitivity: 94.7%; specificity: 74.1%). These results are supported by studies from Gasparyan and Bath et al., which also identified elevated MPV as a risk factor for adverse cardiovascular and surgical outcomes.[24-26] Platelet count further demonstrated high specificity for mortality (87.8%) with a moderate AUC of 0.752, consistent with prior reports linking thrombocytopenia to poor prognosis and longer ICU stays.[27] Collectively, these studies underscore the value of incorporating readily available and cost-effective hematological markers into early postoperative risk assessment protocols to enhance clinical decision-making and optimize resource allocation in cardiac surgical care.

Multivariate logistic regression analysis demonstrated the independent prognostic value of postoperative hematological parameters for MACE, poor outcomes and 30-day mortality. Among them, MPV was the strongest predictor across all endpoints, with elevated levels significantly increasing the odds of MACE (OR:1.728), poor outcomes (OR:1.629) and mortality (OR:2.738) all $p < 0.001$. These results align with prior studies identifying MPV as a marker of platelet activation and systemic inflammation associated with cardiovascular risk.[26] Likewise, lower postoperative hemoglobin was independently associated with worse outcomes, especially 30-day mortality (OR: 0.698, $p = 0.002$), highlighting the impact of perioperative anemia on tissue oxygenation and hemodynamic stability.[28] Platelet count also emerged as a protective factor (OR: 0.994, $p < 0.001$), supporting evidence that postoperative thrombocytopenia predicts poor prognosis in cardiac surgery patients.[29] These results suggest that simple, routinely measured blood parameters such as MPV, PLT and Hb levels may offer valuable prognostic insights in cardiac surgery patients, and could complement traditional risk models to enhance early identification of patients at high risk of adverse outcomes.

Kaplan-Meier survival analysis confirmed these findings: patients with MPV >8.6 fL or PLT $\leq 253 \times 10^3/\mu L$ had significantly reduced 30-day survival ($p < 0.0001$ for both). These markers likely reflect underlying inflammation, platelet consumption, and coagulopathy, aligning with previous reports that associate elevated MPV with poor surgical outcomes [25,30], while low platelet counts have been linked to increased bleeding risk and mortality in critically ill populations.[31]

In summary, routine postoperative monitoring of MPV and PLT, irrespective of preoperative risk stratification, may facilitate the early identification of complications and support timely clinical interventions. Our findings highlight the potential of these simple, cost-effective hematological parameters to enhance risk assessment and contribute to improved outcomes following CABG.

In conclusion, we demonstrated that postoperative platelet parameters are valuable predictors of 30-day mortality and adverse outcomes following CABG surgery. The combined use of MPV and PLT thresholds enhanced prognostic accuracy, particularly in patients who were assessed as low-risk preoperatively. While traditional risk scores such as EuroSCORE II remain useful for preoperative assessment, they may fail to capture unforeseen complications that arise postoperatively. Our findings suggest that close monitoring of platelet indices in the early postoperative period may aid in the timely identification of thrombotic complications and contribute to improved patient outcomes. These results underscore the potential clinical utility of integrating routine hematologic monitoring into postoperative care protocols for CABG patients.

This study has several limitations. First, its retrospective and single-center design may limit the generalizability of the findings. In addition, the definition of the D2 measurement point as either postoperative day 30 or the day of death may have introduced heterogeneity between patient groups, potentially influencing the comparability of laboratory values. This limitation should be considered when interpreting the results. Finally, although all patients received standardized intraoperative management, potential unmeasured confounders such as perioperative fluid balance, undetected infections or bleeding complications could not be entirely excluded. Further prospective, multicenter studies with serial postoperative measurements are warranted to validate and expand upon our findings.

Conflict of Interest: The authors have no conflicts of interest to declare.

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