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RESEARCH ARTICLE

Beyond Anatomy: The Combined Power of SYNTAX Score and Inflammatory Biomarkers in CABG Outcomes

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ABSTRACT

Objectives: To investigate the relationship between the SYNTAX score and inflammatory markers (CRP, RDW, PDW) in patients undergoing coronary artery bypass grafting (CABG) and to evaluate their independent predictive roles in in-hospital mortality.

Methods: This retrospective, single-center study included 160 consecutive patients who underwent elective isolated CABG between January 2024 and April 2025. Preoperative SYNTAX scores were calculated, and inflammatory markers (CRP, RDW, PDW) were measured within 24 hours before surgery. The primary endpoint was in-hospital mortality. Correlation analyses, subgroup comparisons, and multivariate logistic regression were performed.

Results: CRP, RDW, and PDW levels significantly increased across higher SYNTAX categories. Positive correlations were observed between SYNTAX and CRP (ρ=0.27, p=0.003), RDW (ρ=0.24, p=0.006), and PDW (ρ=0.22, p=0.010). Multivariate logistic regression analysis demonstrated that SYNTAX (OR=1.12, p=0.014), CRP (OR=1.06, p=0.021), RDW (OR=1.09, p = 0.029), and PDW (OR=1.18, p=0.028) were independent predictors of in-hospital mortality. The combined model yielded the highest discriminative performance (AUC=0.88) compared with the SYNTAX score alone (AUC=0.71).

Conclusion: The combined evaluation of the SYNTAX score with inflammatory markers (CRP, RDW, PDW) provides complementary prognostic value and significantly improves the prediction of in-hospital mortality in CABG patients. This integrated approach may enhance preoperative risk stratification and aid in the early identification of high-risk individuals.

Keywords: C-reactive protein (CRP), coronary artery bypass grafting (CABG), in-hospital mortality, red cell distribution width (RDW), SYNTAX score

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Introduction

Coronary artery disease (CAD) remains one of the leading causes of morbidity and mortality in both developed and developing countries, affecting millions of individuals each year.[1] The clinical course of CAD is not only associated with the degree of coronary artery stenosis but also closely linked to the extent and complexity of the lesions. Therefore, several scoring systems have been developed to assess the anatomical dimension of the disease. Among these, the SYNTAX score is one of the most widely accepted, providing an objective measure of CAD complexity by taking into account the number, location, and morphological characteristics of coronary lesions.[2] Initially developed as part of the large-scale SYNTAX trial comparing percutaneous coronary intervention (PCI) with coronary artery bypass grafting (CABG), this score is now widely used for determining surgical strategies and predicting patient prognosis.[3]

In recent years, studies have demonstrated that CAD is not only associated with anatomical complexity but also strongly linked to systemic inflammation.[4] Inflammation plays a central role in the initiation, progression, and complications of atherosclerosis.[4] Among surgically treated patients, the severity of the inflammatory state has been directly

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associated with postoperative morbidity and mortality.[5] In this context, biomarkers reflecting inflammation are gaining increasing importance in clinical decision-making.[6]

Commonly used inflammatory parameters in clinical practice include C-reactive protein (CRP), red cell distribution width (RDW), and platelet distribution width (PDW). CRP, an acute-phase reactant released from the liver, has been identified as a strong predictor of cardiovascular events.[7] RDW, a simple hematological parameter reflecting the variability in erythrocyte volumes, has recently been associated with mortality and complications in patients undergoing cardiac surgery.[8] PDW, which reflects platelet activation and heterogeneity, has attracted attention due to its potential role in thrombotic and inflammatory processes.[9] These three parameters provide practical and economic advantages since they are easily measurable and readily available in routine blood tests.

The prognostic significance of the SYNTAX score in patients undergoing CABG has been highlighted in an increasing number of studies.[10] However, studies investigating the relationship between the SYNTAX score and inflammatory markers remain limited.[11] A better understanding of this relationship may allow for more accurate identification of high-risk patient groups and improve preoperative risk assessment.

The aim of this study was to investigate the relationship between the SYNTAX score and inflammatory markers (CRP, RDW, and PDW) in patients undergoing CABG, and to evaluate the independent predictive roles of these parameters in mortality.

Methods

Data Collection

Study Design

This study was designed as a retrospective, observational, single-center analysis. It was conducted at the Department of Cardiovascular Surgery, Mersin University Faculty of Medicine Hospital. A total of 160 consecutive patients who underwent elective coronary artery bypass grafting (CABG) between January 2024 and April 2025 were included.

Inclusion criteria were defined as: complete preoperative coronary angiography data allowing calculation of the SYNTAX score, availability of comprehensive biochemical and hematological parameters, and undergoing isolated CABG.

Only patients who underwent isolated elective CABG procedures were included. Exclusion criteria were: concomitant cardiac surgical procedures in the same session (e.g., valve replacement or repair, aortic surgery), incomplete or poor-quality preoperative coronary angiography recordings that precluded SYNTAX score calculation, presence of active systemic infection, chronic inflammatory diseases such as rheumatoid arthritis, systemic lupus erythematosus, or vasculitis, history of malignancy or hematological disorders affecting hematological parameters, and missing or inadequate preoperative laboratory data.

Data Collection

Data of all included patients were retrospectively obtained from the electronic medical record system and archived files of Mersin University Faculty of Medicine Hospital.

Demographic variables included age, sex, and body mass index. Clinical features assessed were comorbidities such as diabetes mellitus (DM) and hypertension (HT). Left ventricular systolic function was evaluated using ejection fraction (EF) values obtained from preoperative transthoracic echocardiography.

To assess renal function, blood urea levels, serum creatinine levels, and estimated glomerular filtration rate (GFR) were recorded. Routine preoperative laboratory tests were used for hematological and biochemical analyses. Inflammatory biomarkers included in the study were C-reactive protein (CRP), red cell distribution width (RDW), and platelet distribution width (PDW). These values were obtained from laboratory results measured within the last 24 hours before surgery.

The primary surgical outcome was in-hospital mortality. Mortality data were confirmed using intensive care unit follow-up forms, patient charts, and discharge summaries.

Data Analysis

Statistical Analysis

The sample size was determined retrospectively, with a total of 160 patients included in the analysis. The primary endpoint, in-hospital mortality, was found to be 11.2%. A post-hoc power analysis showed that with this sample size, moderate effects in logistic regression models (OR≈1.5–1.8) could be detected with >80% power. Additionally, correlation analyses between the SYNTAX score and inflammatory markers (CRP, RDW, PDW) demonstrated that relationships of $\rho \geq 0.22$ could be detected with 80% power. For group comparisons across the three SYNTAX categories, statistical power was sufficient to detect moderate effect sizes.

All data were checked before statistical analysis. The normality of distribution for continuous variables was assessed using the Kolmogorov–Smirnov test and histogram inspection. Normally distributed continuous variables were reported as mean ± standard deviation (SD),

whereas non-normally distributed variables were reported as median (minimum–maximum). Categorical variables were presented as counts and percentages (%).

Patients were classified into three groups according to their SYNTAX score: low (<23), intermediate (23–32), and high (>32). For comparisons between groups, one-way analysis of variance (ANOVA) was used for normally distributed continuous variables, and the Kruskal–Wallis test was applied for non-normally distributed variables. For pairwise comparisons, Student's t-test or the Mann–Whitney U test was used where appropriate. Differences in categorical variables were assessed using the chi-square test or Fisher's exact test when cell frequencies were low.

Correlations between the SYNTAX score and inflammatory markers (CRP, RDW, PDW) were assessed using Spearman's rank correlation due to distribution characteristics. Correlation coefficients (ρ) and p-values were reported.

Logistic regression analysis was performed to identify independent risk factors associated with mortality. Initially, univariate analyses were performed for all variables, and those with p<0.10 were entered into the multivariate model. A stepwise backward likelihood ratio method was used to construct the optimal multivariate logistic regression model. The models were evaluated in three steps:

- Model 1: SYNTAX score, age, and sex,
- Model 2: Model 1 + clinical parameters (EF, DM, HT, GFR),
- Model 3: Model 2 + inflammatory markers (CRP, RDW, PDW).

For each model, odds ratios (ORs), 95% confidence intervals (CIs), and p-values were reported. Model discrimination was assessed using receiver operating characteristic (ROC) curve analysis, and the area under the curve (AUC) values were calculated. ROC curves were also presented to visually compare the SYNTAX score alone versus combined models.

A p-value <0.05 was considered statistically significant. Statistical analyses were performed using IBM SPSS Statistics for Windows, Version 25.0 (IBM Corp., Armonk, NY, USA). Graphical analyses, including ROC curves, were conducted using MedCalc Statistical Software (version 20.1, MedCalc Software Ltd, Ostend, Belgium). Datasets generated and/or analyzed during the current study are available from the corresponding author upon reasonable request.

Ethical Approval

Ethical approval for the study was obtained from the Mersin University Ethics Committee with the decision numbered 2025/456 and dated 30/04/2025. The study and the writing of the article were prepared in accordance with the Declaration of Helsinki. Informed written consent was obtained in the surgical consent form before the subjects were included in the study.

Table 1. Distribution of socio-demographic and clinical characteristics in patients undergoing CABG (n=160)

Characteristic	Mean±SD	Median (min-max)
Age (years)	62.4±9.9	62 (41–82)
EF (%)	52.7±6.5	53 (35–65)
GFR (ml/min/1.73m^2)	92.5±21.3	91 (55–124)
CRP (mg/L)	9.8±8.7	7.9 (1.2–42.5)
RDW (%)	41.2±4.3	41 (35–52)
PDW (fL)	13.1±2.3	13 (9–19)
Urea (mg/dL)	34.9±12.1	34 (18–65)
Creatinine (mg/dL)	0.86±0.38	0.83 (0.45–2.1)
Characteristic	**Count (n)**	**Percentage (%)**
Gender		
Male	115	71.9
Female	45	28.1
Diabetes mellitus (DM)		
No	90	56.3
Yes	70	43.7
Hypertension (HT)		
No	95	59.4
Yes	65	40.6
Mortality		
Alive	142	88.8
Characteristic	**Mean±SD**	**Median (min-max)**
Exitus	18	11.2

Statistical tests applied include Student's t-test for continuous variables and the Chi-Square test for categorical variables. Data are presented as mean±standard deviation (SD) or median (minimum–maximum) for continuous variables and as counts and percentages for categorical variables. Values that are statistically significant in subsequent analyses are marked in bold. The p-value indicates the level of statistical significance, where values less than 0.05 are considered significant. EF: Ejection fraction; GFR: Glomerular filtration rate; CRP: C-reactive protein; RDW: Red cell distribution width; PDW: Platelet distribution width.

Results

In this study, a total of 160 patients undergoing CABG were analyzed, and the distribution of their socio-demographic, clinical, and laboratory characteristics, as well as the relationship between the SYNTAX score, inflammatory markers, and in-hospital mortality, were comprehensively evaluated through descriptive statistics, subgroup comparisons, correlation analyses, and logistic regression models.

The data in Table 1 show that the mean age of the patients was 62.4 years with a standard deviation of 9.9, ranging from 41 to 82 years. The mean left ventricular ejection

Table 2. Baseline demographic characteristics and inflammatory markers according to SYNTAX score categories

Variable	Low (<23) (n=109)	Intermediate (23–32) (n=55)	High (>32) (n=10)	p
Age (years)	62.3±10.3	61.1±9.8	62.9±6.8	0.757
EF (%)	52.8±6.2	52.2±7.7	53.5±6.3	0.882
GFR (ml/min/1.73m^2)	96.4±95.3	88.8±19.1	82.8±16.9	0.470
CRP (mg/L)	7.1±5.6	10.8±8.3	15.4±10.2	**0.018**
RDW (%)	39.8±3.1	42.1±4.5	44.5±5.2	**0.006**
PDW (fL)	11.9±1.8	13.6±2.2	15.1±2.5	**0.012**
Urea (mg/dL)	34.5±13.4	35.4±12.4	34.0±7.9	0.631
Creatinine (mg/dL)	0.85±0.59	0.85±0.49	0.87±0.23	0.573
Male sex (%)	71.6	74.5	70.0	0.908
DM (%)	44.0	58.2	70.0	0.099
HT (%)	60.6	63.6	70.0	0.806
Mortality (%)	5.5	9.1	30.0	**0.015**

Statistical tests applied include one-way ANOVA or the Kruskal–Wallis test for continuous variables and the Chi-Square test for categorical variables. In the table, statistical values that are significant are marked in bold. The p-value indicates the level of statistical significance, where values less than 0.05 are considered significant. EF: Ejection fraction; GFR: Glomerular filtration rate; CRP: C-reactive protein; RDW: Red cell distribution width; PDW: Platelet distribution width; DM: Diabetes mellitus; HT: Hypertension.

fraction (EF) was 52.7%, with values ranging from 35% to 65%. Renal function measured by glomerular filtration rate (GFR) had a mean of 92.5 ml/min/1.73m^2, with a minimum of 55 and a maximum of 124. The mean CRP level was 9.8 mg/L, with values ranging from 1.2 to 42.5. The mean RDW was 41.2%, ranging from 35% to 52%, and the mean PDW was 13.1 fL, ranging from 9 to 19 fL. The mean urea level was 34.9 mg/dL, and the mean creatinine level was 0.86 mg/dL. Among the 160 patients, 115 were male (71.9%) and 45 were female (28.1%). Diabetes mellitus was present in 70 patients (43.7%), and hypertension was recorded in 65 patients (40.6%). The overall in-hospital mortality rate was 11.2%, with 18 deaths out of 160 patients.

The data in Table 2 demonstrate that the mean age of the patients was 62.3 years in the low SYNTAX group, 61.1 years in the intermediate group, and 62.9 years in the high group, with no significant difference between the groups (p=0.757). The mean left ventricular ejection fraction (EF) was 52.8%, 52.2%, and 53.5% across the three groups, respectively (p=0.882). Renal function as measured by glomerular filtration rate (GFR) showed values of 96.4, 88.8, and 82.8 ml/min/1.73m^2 in the low, intermediate, and high groups, respectively, without a significant difference (p=0.470). Inflammatory markers, however, were significantly different across the SYNTAX categories. The mean CRP levels were 7.1 mg/L, 10.8 mg/L, and 15.4 mg/L, respectively, with a statistically significant difference (p=0.018). Similarly, RDW values increased progressively from 39.8% in the low group to 42.1% in the intermediate group and 44.5% in the high group (p=0.006). PDW values also showed a rising trend across the groups, with means of 11.9 fL, 13.6 fL, and 15.1 fL, respectively (p=0.012). No significant differences were observed for blood urea nitrogen or creatinine levels. The distribution of male sex was 71.6%, 74.5%, and 70.0% in the three groups (p=0.908). The prevalence of diabetes mellitus was 44.0%, 58.2%, and 70.0%, respectively (p=0.099), while hypertension was present in 60.6%, 63.6%, and 70.0% (p=0.806). Importantly, the in-hospital mortality rate was significantly higher in the high SYNTAX group (30.0%) compared to the intermediate (9.1%) and low (5.5%) groups (p=0.015).

Table 3. Correlation between SYNTAX score and inflammatory markers (spearman analysis)

Variable	Spearman ρ	p
CRP (mg/L)	0.27	**0.003**
RDW (%)	0.24	**0.006**
PDW (fL)	0.22	**0.010**

Statistical tests applied include Spearman's rank correlation coefficient for continuous variables. In the table, statistical values that are significant are marked in bold. The p-value indicates the level of statistical significance, where values less than 0.05 are considered significant. CRP: C-reactive protein; RDW: Red cell distribution width; PDW: Platelet distribution width.

The data in Table 3 demonstrate that the SYNTAX score was significantly correlated with all three inflammatory markers. A positive correlation was observed between SYNTAX score and CRP levels (ρ=0.27, p=0.003), between SYNTAX score and RDW values (ρ=0.24, p=0.006), and between SYNTAX score and PDW values (ρ=0.22, p=0.010).

The logistic regression analysis presented in Table 4 shows that in Model 1, which included SYNTAX score, age, and sex, the SYNTAX score was independently

Table 4. Independent predictive value of SYNTAX score and inflammatory markers for in-hospital mortality (logistic regression analysis)

Model	Variable	OR	95% CI	p
Model 1 (n=160)	SYNTAX (continuous)	1.13	1.04–1.25	**0.008**
	Age	1.03	0.97–1.10	0.280
	Sex	1.15	0.33–3.96	0.820
	AUC=0.71			
Model 2 (n=160)	SYNTAX	1.12	1.02–1.24	**0.015**
	EF	0.96	0.88–1.05	0.420
	DM	1.38	0.35–5.50	0.620
	HT	4.60	0.51–42.0	0.170
	GFR	0.97	0.95–1.00	0.059
	AUC=0.83			
Model 3 (n=160)	SYNTAX	1.12	1.02–1.25	**0.014**
	CRP	1.06	1.01–1.12	**0.021**
	RDW	1.09	1.01–1.17	**0.029**
	PDW	1.18	1.02–1.36	**0.028**
	GFR	0.97	0.95–1.00	0.066
	AUC=0.88			

Statistical tests applied include multivariate logistic regression analysis. Odds ratios (OR) with 95% confidence intervals (CI) are presented. In the table, statistical values that are significant are marked in bold. The p-value indicates the level of statistical significance, where values less than 0.05 are considered significant. OR: Odds ratio; CI: Confidence interval; AUC: Area under the curve; EF: Ejection fraction; DM: Diabetes mellitus; HT: Hypertension; GFR: Glomerular filtration rate; CRP: C-reactive protein; RDW: Red cell distribution width; PDW: Platelet distribution width.

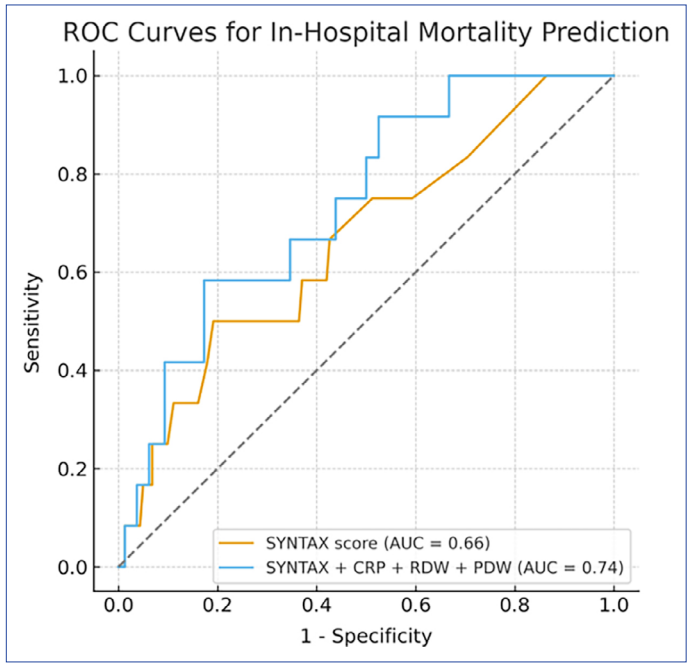

Figure 1. ROC curves for prediction of in-hospital mortality in CABG patients. The blue line represents the ROC curve of the SYNTAX score alone (AUC=0.71), while the orange line shows the combined model including SYNTAX, CRP, RDW, and PDW (AUC=0.88). The diagonal line indicates the reference line (AUC=0.50). The combined model demonstrated superior discriminative ability compared to the SYNTAX score alone.

ROC: Receiver operating characteristic; CABG: Coronary artery bypass grafting CRP: C-reactive protein; RDW: Red cell distribution width; PDW: Platelet distribution width; AUC: Area under the curve.

associated with in-hospital mortality (OR=1.13, 95% CI: 1.04–1.25, p=0.008), with an AUC of 0.71. In Model 2, after adjustment for EF, DM, HT, and GFR, the SYNTAX score remained a significant predictor of mortality (OR=1.12, 95% CI: 1.02–1.24, p=0.015), and the model performance improved (AUC=0.83). In Model 3, which included inflammatory markers in addition to clinical covariates, SYNTAX (OR=1.12, 95% CI: 1.02–1.25, p=0.014), CRP (OR=1.06, 95% CI: 1.01–1.12, p=0.021), RDW (OR=1.09, 95% CI: 1.01–1.17, p=0.029), and PDW (OR=1.18, 95% CI: 1.02–1.36, p=0.028) were all identified as independent predictors of mortality, while GFR showed a borderline association (p=0.066). The discriminative power of this model was the highest, with an AUC of 0.88.

Figure 1 illustrates the receiver operating characteristic (ROC) curves for the prediction of in-hospital mortality in CABG patients. The ROC curve for the SYNTAX score alone (blue line) demonstrated a moderate discriminative ability with an AUC of 0.71. In contrast, the combined model incorporating the SYNTAX score together with CRP, RDW, and PDW (orange line) showed a markedly improved discriminative performance, yielding an AUC of 0.88. The diagonal line represents the reference line (AUC=0.50), indicating no discriminative ability. Comparison of the two curves highlights that the integrated model provides superior prognostic accuracy over the SYNTAX score alone, supporting the incremental value of inflammatory markers when combined with anatomical risk assessment.

Discussion

In this study, we evaluated the relationship between the SYNTAX score and inflammatory markers (CRP, RDW, PDW) as well as their association with in-hospital mortality in 160 patients undergoing isolated CABG. Our findings demonstrated that CRP, RDW, and PDW values significantly increased across higher SYNTAX categories, with positive and statistically significant correlations observed between the SYNTAX score and each of these markers. Multivariate logistic regression analysis revealed that SYNTAX, CRP, RDW, and PDW were all independent predictors of mortality, and the discriminative ability of the combined model (AUC=0.88) was markedly superior to that of the SYNTAX score alone (AUC=0.71). This relationship remained significant even after adjustment for clinical covariates such as age, sex, EF, DM, HT, and GFR. Collectively, these findings suggest that while the SYNTAX score reflects anatomical complexity, the

addition of CRP, RDW, and PDW provides complementary prognostic information regarding systemic inflammation and hematologic response.

The prognostic value of the SYNTAX score in CABG outcomes was originally derived from evidence comparing PCI and CABG, and subsequent studies have confirmed its association with mortality and major adverse events in surgical cohorts.[12] High SYNTAX scores have been particularly linked to early morbidity, bleeding/transfusion requirements, and prolonged ICU or hospital stay.[10] However, by design, the SYNTAX score only captures anatomical information and does not directly reflect pathophysiological activity, especially systemic inflammation.[13] The central role of inflammation in cardiovascular disease has long been established, and numerous studies have suggested that acute-phase reactants such as CRP, erythrocyte heterogeneity indices like RDW, and platelet activation parameters such as PDW may be linked to prognosis.[7,14] CRP reflects heightened preoperative inflammation and has been associated with infarct size, tissue injury, and the surgical stress response.[15] RDW has been correlated with short- and mid-term mortality as a biological marker of oxidative stress, disordered iron metabolism, and subclinical inflammation, with consistent findings in cardiac surgical cohorts.[16] Evidence regarding PDW has been more heterogeneous; while some series have demonstrated an association with adverse outcomes through platelet heterogeneity and activation, others have failed to confirm this relationship.[17,18] Such variability may be attributed to differences in measurement timing, analytical techniques, and comorbidity burden.[18]

When compared with existing literature, our findings align with prior studies in several respects. CRP has consistently demonstrated a strong association with early morbidity and mortality in surgical populations, while RDW has been shown to predict short- and mid-term mortality in both surgical and PCI cohorts, albeit with variable effect sizes across studies.[14–18] Findings for PDW remain less consistent, but significant associations are typically observed in studies with standardized preoperative measurement (within 24 hours) and rigorous exclusion of hematological or infectious conditions.[16] Furthermore, previous publications highlighting the prognostic value of combined inflammatory scores suggest that a multidimensional inflammatory profile may improve risk stratification.[19] Nonetheless, the clinical applicability of such scores remains limited by issues of measurement standardization and variation in cut-off values.

Our study adds to the literature in three important ways. First, simultaneous evaluation of SYNTAX and CRP–RDW–PDW demonstrated that anatomical and inflammatory markers are independent yet complementary, underscoring the limitations of relying solely on anatomical risk stratification. Second, the standardized timing of preoperative measurements (within 24 hours) and exclusion of patients with active infection or chronic inflammatory conditions likely minimized some methodological heterogeneity, particularly relevant for PDW. Third, the significant improvement in AUC from 0.71 for SYNTAX alone to 0.88 in the combined model suggests that integrated risk scoring may offer superior clinical utility in preoperative decision-making.[14–19] This finding supports the concept that an "anatomical complexity + systemic inflammation" approach could enhance risk stratification and facilitate proactive planning of ICU and monitoring strategies in high-risk patients.

Two aspects of our results deserve emphasis. The first is independence: even when included together in the model, SYNTAX, CRP, RDW, and (in our study) PDW each retained independent predictive value for mortality, suggesting that they capture distinct but interrelated biological axes. The second is discriminative ability: the observed improvement in AUC highlights the added clinical value of integrating biomarkers with anatomical scores, rather than using them in isolation. From a practical standpoint, the combined use of readily available and inexpensive tests such as CRP, RDW, and PDW with the routinely reported SYNTAX score appears to be a feasible and clinically applicable strategy.

In conclusion, our findings demonstrate that both anatomical complexity (SYNTAX) and systemic inflammation/hematologic response (CRP, RDW, PDW) are significantly and independently associated with mortality in CABG patients, and that their integration substantially improves discriminative ability. This combined approach has the potential to refine preoperative risk stratification and to guide early planning of intensive monitoring and optimization strategies for high-risk patients. Validation in prospective, multicenter studies with external cohorts and evaluation of long-term outcomes will be essential to translate this biomarker–anatomical score integration into routine clinical practice.

Limitations

This study has several limitations. First, it was conducted as a retrospective, single-center analysis, which carries the risk of potential selection bias and incomplete control of residual confounding factors. Second, the sample size was relatively limited, and the number of mortality events was comparatively low (approximately 11.2%, 18 patients). As a result, the number of variables that could be included in

the multivariate logistic regression analysis was restricted, and some potentially relevant clinical parameters had to be excluded from the analysis.

Third, the study assessed only in-hospital mortality, without evaluating mid- or long-term mortality or other clinical outcomes such as major adverse cardiac and cerebrovascular events (MACCE). Therefore, the findings should be interpreted as applicable solely to early postoperative outcomes. Fourth, biomarkers were measured only once in the preoperative period, and postoperative changes or dynamic trends were not assessed. However, elevations in inflammatory markers such as CRP during the postoperative period may also have important prognostic implications.

Fifth, the study focused exclusively on CRP, RDW, and PDW, without including other parameters such as neutrophil-to-lymphocyte ratio (NLR), platelet-to-lymphocyte ratio (PLR), or the systemic immune-inflammation index (SII). This limited the ability to capture the full spectrum of the inflammatory response. Finally, variations in laboratory equipment and measurement techniques may have influenced the results, particularly with regard to PDW, which is known to exhibit inter-laboratory variability.

Despite these limitations, the study provides valuable evidence that the combined evaluation of the SYNTAX score and inflammatory markers offers independent and complementary contributions to the prediction of early mortality following CABG surgery.

Conclusion

This study demonstrated that the SYNTAX score, reflecting the anatomical complexity of coronary artery disease, is significantly associated with inflammatory markers such as CRP, RDW, and PDW in patients undergoing CABG. Importantly, all three markers, together with the SYNTAX score, were identified as independent predictors of in-hospital mortality. Moreover, the combined model incorporating these parameters provided superior discriminative ability compared with the SYNTAX score alone. These findings suggest that the integration of anatomical and inflammatory parameters may improve preoperative risk stratification and facilitate the identification of high-risk patients in routine surgical practice. The combined use of the SYNTAX score with simple and readily available inflammatory markers (CRP, RDW, PDW) represents a practical and complementary approach to mortality prediction in CABG patients. Future prospective, multicenter studies with larger cohorts and long-term follow-up are required to validate and expand the generalizability of these results.

Disclosures

Ethics Committee Approval: The study was approved by the Mersin University Ethics Committee (no: 2025/456, date: 30/04/2025).

Informed Consent: Informed written consent was obtained in the surgical consent form before the subjects were included in the study.

Conflict of Interest Statement: The authors declare that there is no conflict of interest.

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References

1. Toprak B, Bilgiç A. Post-coronary artery bypass: the power of prognostic nutritional index in determining mortality. Anatol J Cardiol 2025;29:331–8.
2. Takahashi K, Serruys PW, Fuster V, Farkouh ME, Spertus JA, Cohen DJ, et al. Redevelopment and validation of the SYNTAX score II to individualise decision making between percutaneous and surgical revascularisation in patients with complex coronary artery disease: secondary analysis of the multicentre randomised controlled SYNTAXES trial with external cohort validation. Lancet 2020;396:1399–412.
3. Gallo M, Blitzer D, Laforgia PL, Doulamis IP, Perrin N, Bortolussi G, et al Percutaneous coronary intervention versus coronary artery bypass graft for left main coronary artery disease: A meta-analysis. J Thorac Cardiovasc Surg 2022;163:94–105.e15.
4. Bora R, Kılıç AT, Toprak B. Atherosclerosis and inflammation: are the rules of the game changing with biological therapies? J Inflamm Res 2025;18:9811–22.
5. Bilgiç A, Toprak B, Kaya H. Delta neutrophil index in coronary artery bypass surgery: an innovation in postoperative mortality assessment. J Inflamm Res 2025;18:1497–508.
6. Kushner I, Mackiewicz A. The acute phase response: an overview. In: Mackiewicz A, Kushner I, Baumann H, editors. Acute phase proteins: molecular biology, biochemistry, and clinical applications. Boca Raton (FL): CRC Press; 2020. p.3–19.
7. Kandelouei T, Abbasifard M, Imani D, Aslani S, Razi B, Fasihi M, et al. Effect of statins on serum level of hs-CRP and CRP in patients with cardiovascular diseases: a systematic review and meta-analysis of randomized controlled trials. Mediators Inflamm 2022;2022:8732360.

8. Wu H, Liao B, Cao T, Ji T, Huang J, Ma K. Diagnostic value of RDW for the prediction of mortality in adult sepsis patients: A systematic review and meta-analysis. Front Immunol 2022;13:997853.
9. Poudineh M, Mansoori A, Sadooghi Rad E, Hosseini ZS, Salmani Izadi F, Hoseinpour M, et al. Platelet distribution widths and white blood cell are associated with cardiovascular diseases: data mining approaches. Acta Cardiol 2023;78:1033–44.
10. Gikandi A, Habertheuer A, Stock EM, Hirji S, Kinlay S, Tsao A, et al. Anatomical SYNTAX score and major adverse cardiac events following CABG in the REGROUP trial. J Cardiol 2024;83:348–50.
11. Li H, Meng S, Chen W, Lei X, Kong X, Zhu H. Comparison of different systemic inflammatory markers in predicting clinical outcomes with syntax score in patients with Non-ST segment elevation myocardial infarction: a retrospective study. Int J Gen Med 2023;16:2595–607.
12. Kawashima H, Takahashi K, Ono M, Hara H, Wang R, Gao C, et al. Mortality 10 years after percutaneous or surgical revascularization in patients with total coronary artery occlusions. J Am Coll Cardiol 2021;77:529–40.
13. Askin L, Tanriverdi O. The clinical value of SYNTAX scores in predicting coronary artery disease outcomes. Cardiovasc Innov Appl 2022;6:197–208.
14. Ainiwaer A, Kadier K, Abulizi A, Hou WQ, Rehemuding R, Maimaiti H, et al. Association of red cell distribution width (RDW) and the RDW to platelet count ratio with cardiovascular disease among US adults: a cross-sectional study based on the National Health and Nutrition Examination Survey 1999-2020. BMJ Open 2023;13:e068148.
15. Rathee A, Chaurasia MK, Singh MK, Singh V, Kaushal D. Relationship between Pre- and Post-Operative C-Reactive Protein (CRP), Neutrophil-to-Lymphocyte Ratio (NLR), and Platelet-to-Lymphocyte Ratio (PLR) with post-operative pain after total hip and knee arthroplasty: an observational study. Cureus 2023;15:e43782.
16. Frentiu AA, Mao K, Caruana CB, Raveendran D, Perry LA, Penny-Dimri JC, et al. The prognostic significance of red cell distribution width in cardiac surgery: a systematic review and meta-analysis. J Cardiothorac Vasc Anesth 2023;37:471–9.
17. Izzi B, Gialluisi A, Gianfagna F, Orlandi S, De Curtis A, Magnacca S, et al. Platelet distribution width is associated with P-selectin dependent platelet function: results from the moli-family cohort study. Cells 2021;10:2737.
18. Zheng YY, Wang L, Shi Q. Mean platelet volume (MPV) and platelet distribution width (PDW) predict clinical outcome of acute ischemic stroke: A systematic review and meta-analysis. J Clin Neurosci 2022;101:221–7.
19. Zheng X, Jiang M, Ren X, Han L. Combined influence of depressive symptoms and systemic inflammation on cardiovascular diseases in China. J Psychosom Res 2023;174:111480.