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Predicting New-Onset Atrial Fibrillation in Patients with Coronary Artery Bypass Graft: the Precise-Dapt Score

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Abstract

Aim: Postoperative new-onset atrial fibrillation (POAF) after isolated coronary artery bypass graft surgery (CABG) is associated with adverse events. The Predicting bleeding complications in patients undergoing stent implantation and subsequent dual antiplatelet therapy (PRECISE-DAPT) score is used to predict the bleeding risk after dual antiplatelet therapy and has been associated with arrhythmias in recent years. Therefore, the present study sought to investigate the association between the PRECISE-DAPT score and POAF after coronary artery bypass graft surgery.

Materials and methods: 350 patients who underwent CABG were retrospectively screened. After exclusion criteria, 135 patients were included in the study. A total of 135 patients who underwent on-pump CABG were divided into two groups: patients with POAF and those without POAF. The PRECISE-DAPT score was calculated for each patient, and intergroup comparisons of the calculated scores were performed.

Results: POAF was detected in 66 patients out of 135. Patients with POAF had longer hospital stays. PRECISE-DAPT score was higher in the patients with POAF compared to the patients without POAF ($p<0.001$). PRECISE-DAPT score was determined to be a predictor of POAF after CABG (odds ratio [OR]: 1.305; 95% confidence interval [CI]: 1.268–2.030; $p<0.001$). The PRECISE-DAPT score for POAF risk had a sensitivity of 60% and a specificity of 79% at cut-off values of 14.5 and above.

Conclusion: An increased PRECISE-DAPT score may be used as a predictive score for POAF that may develop during hospital stay after on-pump CABG.

Keywords: PRECISE-DAPT score, atrial fibrillation, coronary artery disease, hospital stay

Introduction

Coronary artery bypass grafting (CABG) is the preferred treatment over risk percutaneous coronary intervention in cases of advanced triple vessel disease or severe left main disease [1]. However, CABG may be associated with postoperative cardiac or noncardiac complications such as cognitive impairment, mortality, prolonged hospital stay, and arrhythmias [2].

Postoperative new-onset atrial fibrillation (POAF) is commonly observed arrhythmia after isolated CABG [3]. POAF is associated with prolonged hospital duration, stroke, repeated hospitalizations, and early or late mortality. In addition, similar to nonvalvular atrial fibrillation (AF), POAF poses a thromboembolic risk [4]. The complications that may be noted in patients with AF do not vary between short-term or permanent forms of AF [5].

The predicting bleeding complications in patients undergoing stent implantation and subsequent dual antiplatelet therapy (PRECISE-DAPT) score is designed to predict bleeding complications in patients undergoing stent implantation who are subsequently treated with dual antiplatelet therapy [6]. Previous studies have shown that the PRECISE-DAPT score is related to mortality, arrhythmic complications, and thrombus [7-9].

Based on the above information, POAF may have clinical significance after CABG. The PRECISE-

DAPT score, which includes parameters known to be linked with AF, such as age and kidney failure, is likely associated with POAF after CABG. As far as we know, the relationship between the PRECISE-DAPT score and POAF in patients undergoing CABG has not been investigated yet. Therefore, this study aimed to investigate this relationship.

Material and methods

Study population

We retrospectively screened every consecutive isolated CABG surgery patients at a tertiary healthcare center, between January 2013 to February 2022. Local ethics committees approved the study (dated: March 02, 2022, project number: 2011-KAEK-27/2022-2200038254). Helsinki Declaration was followed at all stages of the study. The retrospective design of this study did not permit the participants to provide written informed consent up front.

We screened 350 patients (CABG or combined valve replacement and CABG) within the study period. Patients' CABG procedures were performed in our center, and patients who came for regular check-ups for at least 6 months after discharge were included in the study. 215 patients were excluded due to not meeting the inclusion criteria. Group 1 consists of 66 patients with POAF and Group 2 is composed of 69 patients without POAF. POAF was defined as atrial arrhythmia that did not exist before CABG and that lasted at least 30 min with the absence of visible P waves and presence of irregular RR intervals on 12-lead electrocardiography after CABG. Each patient with POAF was anticoagulated and received cardioversion (electrical or medical) to restore the sinus rhythm.

The PRECISE-DAPT score for patient was determined using the following online tool: http://www.precisedaptscore.com. The score was calculated using five clinical parameters (i.e., age, white blood cell count [WBC], hemoglobin level, history of spontaneous bleeding and creatinine clearance) [10].

The exclusion criteria were having a history of CABG or valve surgery, left ventricular ejection fraction ≤40%, history of stroke, renal failure (eGFR < 30 ml g/1.73m2), active infection, a diagnosis of malignity, chronic pulmonary embolism, a diagnosis of pulmonary hypertension, regular alcohol consumption (>20 g/day), a diagnosis of chronic obstructive pulmonary disease, permanent pacemakers, moderate to severe heart valve disease, history of AF, flutter history or history of successful ablation, thyroid dysfunction; undergoing surgery because of failed percutaneous coronary intervention; and being younger than 18 years.

Left ventricular ejection fraction (LVEF) ≤ 40% were classified as having heart failure with reduced left ventricular function [11]. Patients who were diagnosed with COPD as defined in the literature [12], were in the stable phase of the disease, and received the same treatment for the last 3 months were defined as COPD patients. Active bleeding is defined as bleeding beyond 1.5 ml/kg/hour for six consecutive hours in the first 24 hours [13].

An experienced cardiologist performed the coronary angiography (GE Healthcare Innova 2100, New Jersey, USA). The angiographic images were reviewed by an experienced cardiologist and cardiovascular surgeon. To identify surgical indications, the current guidelines were followed [14].

All patients were taken to operating room and monitored a complete hemodynamic monitoring system including five-lead electrocardiography, central venous catherization and peripheral oxygen saturation. Midazolam, sevoflurane and fentanyl were used for anestesia protocol. All patients underwent on-pump CABGs through a median full sternotomy. Patients were heparinized with 300-400 IU/kg intravenously to achieve an activated clotting time 400-450 s before cannulation. We performed traditional ascending aortic cannulation and 2-stage right atrium venous cannulation. After clamping nonpulsatile roller pump maquet hl 30 aorta antegrade warm cardioplegia were used. all anastomosis were performed after cardiopulmonary bypass. On-pump surgery was performed with the use of nonpulsatile HL 30 roller pump (Maquet, Rastatt, Germany) and membrane oxygenator (Medtronıc TRILLIUM AFFINITY NT, Hollow Fıber Oxygenator, USA). Surgery was performed in hypothermia at 28 to 32 C with the use of anterograde warm blood cardioplegia. Maintenance cardioplegia was repeated every 20 minutes as antegrade cardioplegia (5 ml/kg). Proximal anastomosis was performed under side-clamp in all patients. After distal anastomoses cardiopulmonary bypass terminated. After decanulation heparin was neutralized with 1 mg protamine sulfate. In all patients, two drainage tubes were placed with a 28 F drain in the anterior mediastinum and a 30 F drain in the left thoracic cavity. In order to ensure the patency of the drains after surgery intensive care unit (ICU), a continuous suction pressure of 20 mmHg was applied and the drains were removed intermittently. Continuous follow-up was provided during the two-day period that the patients were followed in the ICU, and rhythm problems were recorded using a standard 12-lead electrocardiogram in patients who developed rhythm problems.

Statistical analysis

We conducted power analysis using G-Power 3.1.9.7, determining a minimum requirement of 128 subjects based on an effect size of 0.50, a margin of error of 0.05, and a desired power of 0.80 (80%) (t tests were analyzed for the difference between two independent means (two groups) from the main component). Data were analyzed with SPSS 19.0 (SPSS Inc., Chicago, IL, USA). Kolmogorov–Smirnov test was performed to assess the distribution of continuous variables. The continuous variables obtained in the analysis were expressed as means ± standard deviations; the categorical variables were expressed as percentages and numbers. To compare normally distributed and nonnormally distributed parameters, Student's t-test and Mann-Whitney U test were utilized, respectively. Chi-square tests compared probability ratios of categorical variables. For correlation analysis, Pearson's test was used. A univariate logistic regression analyzed independent predictors of POAFThe variables that showed statistical significance were further analyzed using multivariate logistic regression. A Youden Index was used to find the cutoff value of PRECISE-DAPT score. Receiver operating characteristic (ROC) curve analysis was employed to predict POAF using the PRECISE-DAPT score and its individual components. Significant P-values were considered to be less than 0.05.

Results

135 patients were included in our study. Antiarrhythmic drug treatment to prevent arrhythmia was not started in all patient groups before the procedure. Statistical differences were detected between groups in triglyceride levels (p=0.048) and red cell dist ribution width (RDW) (p=0.020) (Table 1).

Table 1 Comparison of baseline clinical and demographic characteristics of groups

Variables	POAF (+) (n=66)	POAF (-) (n=69)	P value
PRECISE-DAPT score	16 (12-24.75)	12.5 (6-19)	<0.001
Age (years)	64.14±9.45	61.01±9.92	0.064
Gender (n) (%)			0.540
Male	50 (75.8)	48 (69.6)	0.920
Female	16 (24.2)	21 (30.4)	0.511
BMI (kg/m^2)	25.09±1.45	24.93±1.62	0.537
Smoking (n) (%)	31 (47)	30 (43.5)	0.684
Hypertension (n) (%)	41 (62.1)	40 (58)	0.623
Diabetes mellitus (n) (%)	21 (31.8)	18 (26.1)	0.586
History of CAD (n) (%)	13 (19.7)	9 (13)	0.416
COPD (n) (%)	10 (15.2)	8 (11.6)	0.723
Dyslipidemia (n) (%)	10 (15.2)	7 (10.1)	0.537
Prior bleeding (n) (%)	3 (4.5)	1 (1.4)	0.358
SBP (mmHg)	106.66 ±18.26	110.56±14.58	0.174
DBP (mmHg)	80.62±7.68	80.79±7.96	0.896
Heart rate (beats/min)	85.80±13.59	87.05±15.92	0.623
Laboratory Data			
Glucose (mg/dl)	113 (94.5-166)	119 (92-170)	0.417
Creatinine (mg/dl)	0.84±0.15	0.83±0.16	0.870
Glomerular filtration rate (mL/m)	90.26±25.19	90.66±25.54	0.928
Sodium (mmol/L)	139.45±3.65	138.49±3.13	0.103
Potassium (mmol/L)	4.13±0.40	4.03±0.47	0.208
AST (U/L)	24.48±7.74	22.43±12.16	0.247
ALT (U/L)	22.71±8.56	20.49±7.30	0.107
Triglyceride (mg/dl)	114 (90.8-169.2)	140.25 (108.5-179.6)	0.048
HDL cholesterol (mg/dl)	44.0 (36.45-52.32)	43.20 (35.25-50.20)	0.614
LDL cholesterol (mg/dl)	114.70 (77.97-160)	119.10 (91.5-151.7)	0.617
Hemoglobin (g/dl)	12.89±2.15	13.34±1.31	0.132
WBC (µ x 103/µL)	8.21±2.09	8.24±2.18	0.930
Platelets (µ x 103/µL)	246.8±77.3	264.9±60.4	0.125
RDW (%)	14.72±1.29	13.90±2.62	0.020
Postoperative cardiac hsTnI, ng/L	62.25 (13.60-425.20)	48.5 (25.0-132.65)	0.237

CAD, coronary artery disease; BMI, body mass index; SBP, systolic blood pressure; DBP, diastolic blood pressure; COPD, chronic obstructive pulmonary disease; hsTnI, hihg-sensitivity troponin I; AST, aspartate aminotransferase; ALT, alanine aminotransferase; WBC, white blood cell; RDW, red cell distribution width; PRECISE-DAPT, predicting bleeding complications in patients undergoing stent implantation and subsequent dual anti platelet therapy; LAD, left anterior descending coronary artery; LCX, left circumflex artery; LDL-C, low-density lipoprotein cholesterol; RCA, right coronary artery; ACE, angiotensin-converting enzyme; ARB, angiotensin receptor blocker; POAF, postoperative new-onset atrial fibrillation

Most patients had three-vessel disease. There were no patients with urgent diagnosis of CABG in the cohort. The mean duration of arrhythmia in Group 1 was 21.94 ± 5.73 hours. There was one patient with active bleeding and the patient was re-operated (Table 2). There was correlation between the duration of POAF duration times and the PRECISE-DAPT score ($r = 0.596$; $p < 0.001$).

Table 2 Echocardiography and procedural characteristics of groups

Variables	POAF (+) (n=66)	POAF (-) (n=69)	P value
Echocardiography Data			
LVEF (%)	48.66±5.57	50.55±6.52	0.039
LVEDD (mm)	40.74±9.05	39.21±8.70	0.567
LVESD (mm)	38.06±6.35	38.05±5.47	0.954
LA diameter (mm)	44.84±8.00	45.02±8.61	0.925
Previous medications			
Asprin	33 (50.0)	28 (40.6)	0.272
Statin	14 (21.2)	11 (15.9)	0.571
Beta-blocker	13 (19.7)	18 (26.1)	0.498
ACE inhibitors/ARB	41 (62.1)	40 (58)	0.623
Culprit lesions			
3-vessel disease	52 (78.8)	47 (68.1)	0.227
Left main disease	6 (9.1)	4 (5.8)	0.464
Intra-op and post-op data			
Total pump time	123.0±18.04	116.44±13.57	0.018
Aortic cross-clamp time	91.66±17.07	84.04±14.77	0.007
Duration of ICU	5.11±2.55	3.88±1.76	0.001
Ventilation time	25.0±1.84	23.60±1.98	<0.001
Duration of hospital stay	16.84±6.45	14.36±5.51	0.021
Postoperative iv inotrope	5 (7.6)	2 (2.9)	0.267
Duration of POAF (hours)	21.94±5.73	-	-
In-hospital bleeding	5 (7.6)	2 (2.9)	0.267
Bleeding requiring revision	1 (1.5)	(0)	0.489

LVEF, left ventricular ejection fraction; LVEDD, left ventricular end-diastolic diameter; LVESD, left ventricular end-systolic diameter; LA, left atrium; ACE, angiotensin-converting enzyme; ARB, angiotensin receptor blocker; ICU, intensive care unit; POAF, postoperative new-onset atrial fibrillation

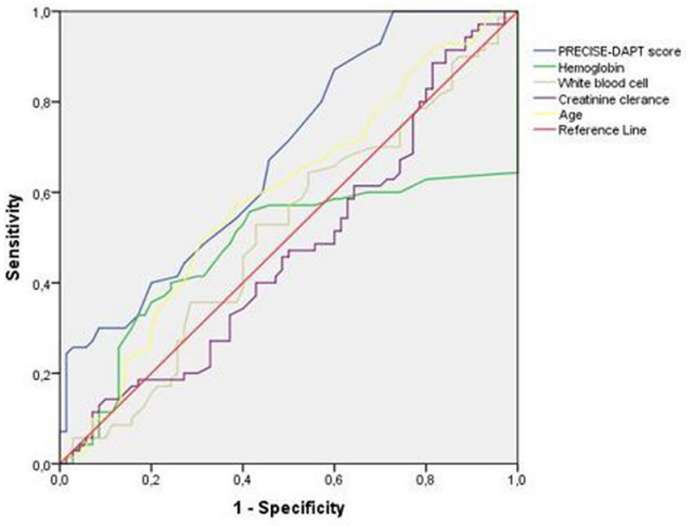
Univariate regression analysis identified RDW, postoperative cardiac hihg-sensitivity troponin I (hsTnI) level, aortic cross-clamp time, total pump time, and PRECISE-DAPT score significant predictors of POAF. In the multivariate analysis, postoperative cardiac hsTnI level and PRECISE-DAPT score were significant predictors of POAF (Table 3).

Table 3 Logistic regression analysis of new-onset AF-related clinical parameters

Variables	Univariable OR (95% CI)	p-value	Multivariable OR (95% CI)	P value
Age	0.967 (0.933-1.002)	0.066		
Diabetes mellitus	0.756 (0.359-1.595)	0.463		
Hypertension	0.841 (0.422-1.677)	0.623		
Dyslipidemia	0.632 (0.225-1.773)	0.384		
Smoking status	0.868 (0.441-1.712)	0.684		
LVEF	1.053 (0.995-1.115)	0.076		
LA diameter	1.002 (0.962-1.044)	0.924		
RDW	0.768 (0.590-0.999)	0.049	0.855 (0.652-1.121)	0.257
Triglyceride	1.001 (0.997-1.006)	0.522		
Postoperative cardiac hsTnI	0.997 (0.995-0.999)	0.006	0.984 (0.991-0.997)	0.018
Aortic cross-clamp time	0.969 (0.947-0.992)	0.009	0.975 (0.935-1.016)	0.226
Total pump time	0.974 (0.952-0.996)	0.022	0.995 (0.954-1.038)	0.812
PRECISE-DAPT score	0.995 (0.954-1.038)	<0.001	1.305 (1.268-2.030)	<0.001

Abbreviations are given in tables 1 and 2.
OR, odds ratio; CI, confidence interval

The area under the curve values of the PRECISE-DAPT score and its components (hemoglobin, WBC, creatinine clearance, and age) were 0.68 (95% confidence interval or CI 0.59–0.76) for POAF (+) (Figure 1). In patients undergoing CABG, the PRECISE-DAPT score was better at predicting POAF than all components combined (hemoglobin 0.47, 95% CI 0.37–0.57; WBC count 0.51, 95% CI 0.41–0.60; creatinine clearance 0.47 (0.37–0.56).and age 0.58, 95% CI 0.49-0.68). HsTnI level was 0.55 (95% confidence interval or CI 0.45–0.65) for POAF (+) (p = 0.237).



	AUC	95% CI	P-value
PRECISE-DAPT score	0.68	0.59-0.76	Reference
Hemoglobin	0.47	0.37-0.57	0.629
White blood cell	0.51	0.41-0.60	0.845
Creatinine clearance	0.47	0.37-0.56	0.567
Age	0.58	0.49-0.68	0.068

Figure 1 – Receiver operating curves (ROC) to predict POAF in patients with CABG

The PRECISE-DAPT score for POAF risk had a sensitivity of 60% and a specificity of 79% at cut-off values of 14.5 and above.

Discussion

Our study's has significant findings: (1) Group 1 had significantly higher PRECISE-DAPT scores than Group 2; (2) POAF duration time strongly correlated with the PRECISE-DAPT score; (3) the postoperative cardiac Tn level and PRECISE-DAPT score were found to be the predictors of the development of POAF after CABG.

The PRECISE-DAPT score independently predicts arrhythmias such as ventricular tachycardia, atrial fibrillation (AF), and new-onset AF [8,15]. POAF is a common arrhythmia after CABG and is associated with complications such as disability and mortality. Although it is affected by various factors such as age, obesity, diabetes mellitus, and hypertension, its pathophysiology remains unclear [2]. POAF developing after CABG may be associated with left atrium dilatation; its incidence is often higher in men. Increased sympathetic activation is an important trigger for POAF [16] and beta blockers were used in equal percentage in both groups before the surgery, our results vary from those available in the literature.

A correlation has already been identified between POAF after CABG and aortic cross-clamp time. POAF develops due to ischemia-reperfusion injury triggered by increased cross-clamp time and ectopic activity induced by the increased inflammatory infiltrates in the atrial tissue [17]. In our study, group 1 exhibited significantly longer aortic cross-clamp times. Although univariate analysis identified aortic clamp duration as a predictor of POAF, similar results were not obtained in multivariate regression analysis. Our results differ from those reported in the literature; this deviation may be because our study population comprised patients who underwent isolated CABG, not CABG or valve surgery.

In a study investigating inflammatory processes, increased RDW values in patients with acute coronary syndrome have been reported to predict new-onset AF [18]. In our study, Group 1 had significantly higher RDW than Group 2. Based on the demographic data of the cohort, the younger age range of the patients in this study might have led to results inconsistent with those reported in the literature (of nearly 70 years). In light of the abovementioned information, it can be said that the etiology of POAF remains unclear and the clinical parameters remain uncertain.

In our study, the PRECISE-DAPT score identified patients with a risk of developing POAF after CABG. Moreover, patients with high PRECISE-DAPT scores require closer follow-up as the higher scores in these patients are associated with poor clinical outcomes such as increased ventilation time, longer stay in the intensive care, and longer hospital stay.

Our study has some limitations, which primarily include the single-center design of the study and the small cohort size. In addition, all our patients underwent on-pump CABG and there were no off-pump CABG cases.

Conclusion

Patients who developed postoperative atrial fibrillation (POAF) after on-pump CABG tended to have higher PRECISE-DAPT scores. This suggests that an increased score could independently predict the development of POAF in these patients undergoing on-pump CABG.

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