

Determining the Predictors of Temporary Epicardial Pacing Wires Use After Isolated Coronary Artery Bypass Grafting Surgery

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Background: Coronary artery bypass grafting (CABG) is frequently associated with postoperative arrhythmias, often necessitating temporary cardiac pacing (TCP). The routine placement of temporary epicardial pacing wires (PWs) remains controversial due to potential complications. This study aimed to identify predictors for TCP after isolated CABG to guide selective PW use and improve perioperative outcomes.

Methods: A retrospective analysis was conducted on 1,395 patients who underwent isolated CABG with cardiopulmonary bypass (CPB) at King Abdullah University Hospital, Jordan, between 2004 and 2022. Patients undergoing redo surgeries or presenting with high-grade atrioventricular block, ischemic ventricular septal defect, or missing data were excluded. Patients were grouped based on PW placement, and predictors for TCP were assessed using univariate and multivariate logistic regression.

Results: Among the 1,395 patients, 887 received PWs, and 127 required TCP. Significant predictors for TCP included preoperative bundle branch block (BBB), intraoperative blood transfusion, prolonged vasoactive support, and mechanical ventilation exceeding 12 hours postoperatively. Preoperative beta-blocker use was associated with reduced risk of TCP. Demographics, comorbidities, and prolonged CPB or aortic cross-clamp times were not significant.

Conclusion: Preoperative BBB and postoperative complications were associated with increased TCP risk, while beta-blocker use was protective. These findings support a risk-based strategy for PW placement after CABG to reduce complications and improve resource allocation. Prospective studies are needed to validate these predictors and refine perioperative protocols.

Keywords: CABG, pacing, coronary surgery

Introduction

Coronary artery bypass grafting (CABG) remains one of the most commonly performed and life-saving cardiac surgeries for patients with severe coronary artery disease. Despite significant advancements in surgical techniques and perioperative care, CABG is still regarded as a high-risk procedure due to its association with a broad range of postoperative complications. Among these, cardiac arrhythmias represent one of the most frequent and clinically significant concerns. Postoperative arrhythmias can lead to hemodynamic instability, prolonged intensive care unit (ICU) stays, and increased morbidity, often necessitating the use of temporary cardiac pacing (TCP) to restore and maintain adequate heart rate and rhythm following surgery.¹

Temporary epicardial pacing wires (PWs) were first introduced in the 1960s and have since evolved into a fundamental component of perioperative management in cardiac surgery. These wires, which are placed directly onto the epicardial surface of the heart, were initially inserted in nearly all patients undergoing cardiac surgical procedures. Over the decades, their utility has been well established, serving both therapeutic and diagnostic roles in

the immediate postoperative setting.² Specifically, PWs are used to provide temporary pacing support in patients who develop bradyarrhythmias or conduction abnormalities following surgery. They play a vital role in maintaining hemodynamic stability, particularly in patients who exhibit life-threatening arrhythmias such as malignant atrial or ventricular tachyarrhythmias.² By allowing for immediate and direct control of the heart's rhythm and rate, PWs contribute significantly to patient stabilization during the critical recovery period after cardiac surgery.

Although the routine use of epicardial pacing wires has declined in recent years—largely due to advancements in surgical techniques, improved perioperative monitoring, and better preoperative risk stratification—their selective application remains essential. In particular, their use is indispensable in scenarios involving significant conduction disturbances, including third-degree atrioventricular (AV) block and AV junctional tachycardia. These arrhythmias are not uncommon in the postoperative period, especially in patients who have undergone procedures involving cardiopulmonary bypass, where myocardial manipulation and ischemia-reperfusion injury can disrupt the cardiac conduction system.³ In such cases, temporary pacing not only supports cardiac function but can also be life-saving.

Numerous patient- and surgery-related factors have been identified as contributors to the need for temporary pacing after cardiac surgery. Advanced age, pre-existing comorbidities such as diabetes mellitus and chronic kidney disease, and left ventricular dysfunction are known to predispose patients to postoperative conduction abnormalities.⁴ Similarly, intraoperative variables such as the duration of cardiopulmonary bypass, cross-clamp time, and the number of grafts performed may influence the incidence of arrhythmias requiring pacing.⁴ As such, the decision to insert PWs should be carefully tailored to each patient's individual risk profile.

Despite their clinical utility, the insertion and presence of PWs are not without risk. Though complications are relatively rare, they can be life-threatening when they occur. Potential adverse events include hemorrhage, cardiac tamponade, infection, wire fracture, and severe arrhythmias induced by wire manipulation.⁵ Furthermore, retained pacing wires pose additional concerns, as they may act as a nidus for infection or contribute to thromboembolic events, particularly in immunocompromised or elderly patients.⁵ Therefore, identifying the subset of patients who would most benefit from PW placement without exposing low-risk patients to unnecessary procedural risks remains a priority in optimizing surgical care.

In our previous research, we systematically examined the factors associated with the need for temporary cardiac pacing (TCP) following valve surgery and identified several key predictors that significantly correlated with its requirement.⁴ Based on those findings, we proposed a more targeted and judicious approach to the use of temporary epicardial pacing wires, suggesting that their routine placement may not be necessary for all patients undergoing valve procedures. Instead, we advocated for limiting their use to individuals who exhibit specific, identifiable high-risk features—such as pre-existing conduction abnormalities, complex surgical anatomy, or prolonged cardiopulmonary bypass time.⁴ This selective strategy demonstrated clear benefits, including improved perioperative efficiency, reduced resource utilization, and a lower incidence of pacing-related complications such as infection, wire dislodgement, or cardiac perforation.

Building upon the insights gained from that foundational work, the present study is designed to explore the specific predictors of TCP requirement in a different surgical population—namely, patients undergoing coronary artery bypass grafting (CABG) surgery. By focusing on this cohort, we aim to identify perioperative clinical and procedural factors that are associated with an increased likelihood of requiring temporary pacing support. Through this investigation, our objective is to enhance clinical decision-making by providing evidence-based criteria for pacing wire placement in CABG patients. Ultimately, we seek to refine operative planning, optimize resource allocation, and improve postoperative outcomes by avoiding unnecessary interventions in low-risk individuals while ensuring adequate support for those at higher risk.

Methods

Patients

This study is a retrospective review of the clinical, operative, and outcome data that is part of the prospectively recorded cardiac intensive care unit (CICU) database. We excluded patients who underwent redo surgery, patients with preoperative

high-degree atrioventricular block (AVB) (5 patients), 8 patients with ischemic ventricular septal defect (VSD), and 12 patients with missing data. A total of 1395 patients who underwent isolated CABG surgery on cardiopulmonary bypass (CPB) at King Abdullah University Hospital (KAUH), Jordan, between January 2004 and December 2022, were included in the analysis. Lately, it is our clinical practice, and upon the surgeon's discretion based on patient's individual characteristics to selectively insert PWs in CABG surgery patients. According to insertion or avoidance of PWs, two groups of patients were identified: group 1; which did not have PWs inserted and never needed to be paced and group 2; which had PWs inserted. Group 2 was subdivided into patients who needed TCP and those who did not need TCP. This study was approved by the ethical committee at KAUH. The patient groups distribution is shown in Figure 1.

Variables

The need for postoperative TCP (if patients were paced at the time of chest closure or at any time before hospital discharge) was the outcome variable of interest. We identified the demographic, clinical, preoperative (including drugs directly affecting the conduction system), and intraoperative variables as potential predictors of TCP, including Prolonged vasoactive drug support (*the use of vasoactive/inotropic support for more than 12 hours postoperatively*) which was considered for patients who need for vasoactive or inotropic drugs exceeding 12 hours postoperatively. Preoperative arrhythmias were defined as atrial fibrillation (AF), low grade AVB, or a bundle branch block diagnosed by electrocardiogram (ECG). Preoperative sinus bradycardia was not considered to be a preoperative arrhythmia because many patients (66%) were taking beta blockers preoperatively.

Operative Technique

All patients had median sternotomy with CPB perfusion maintained at 2.0 to 2.4 L/min/m², and systemic perfusion pressure was kept at 60–80 mmHg without active venous drainage used. Myocardial protection was achieved by hypokalemic cold crystalloid antegrade cardioplegia (10–12 mL/kg) at a rate of 200–250 mL/min, in addition to 300 mL repeated every 10 to 15 minutes.

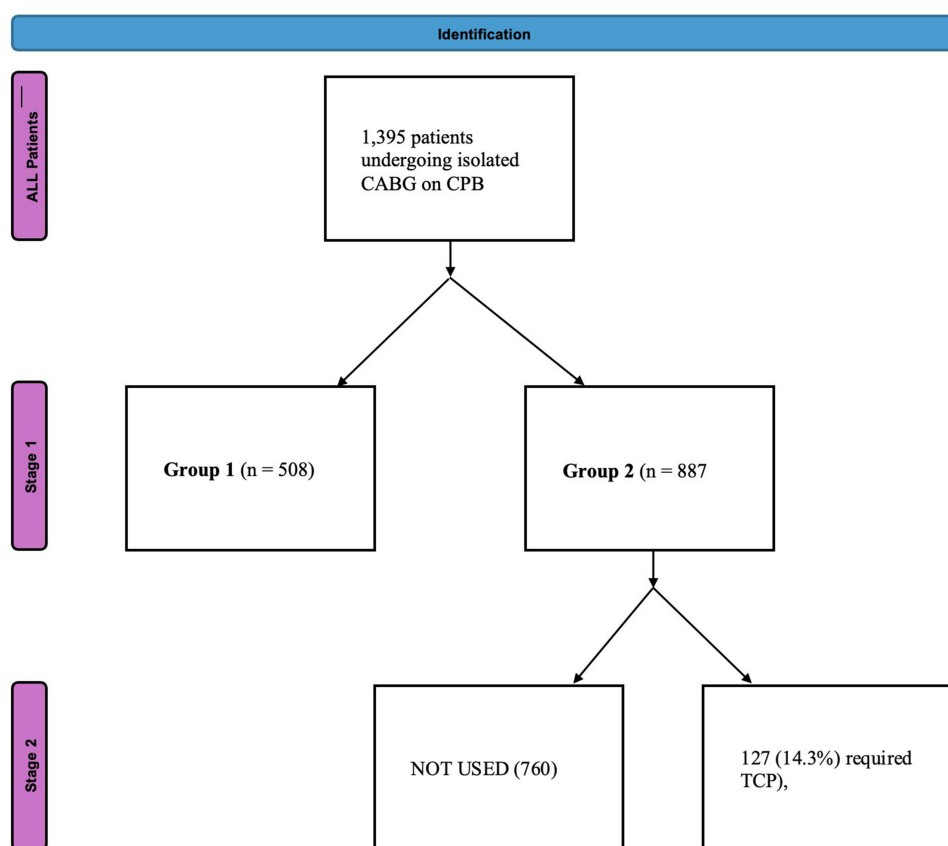


Figure 1 Distribution of patients and stages of analysis.

Patients were cooled down to 28–32°C. Cold saline was used to cool the surface of the heart. Patients were evaluated on an individual basis to determine if TCP is required. Patients who received PWs had ventricular wires on the anterior surface of the right ventricle. Atrial wires were additionally placed when AVB occurred after separation from CPB. Postoperatively, inotropes were used only if required. After surgery all patients were transferred to CICU on mechanical ventilation. Continuous ECG monitoring was used in all patients. 12-lead ECG was performed for all patients upon CICU admission and daily till discharge from hospital.

Statistical Analysis

Continuous variables were summarized as mean $\pm$ standard deviation (SD) for normally distributed data, or as median with interquartile range [IQR] for non-normally distributed data, as determined by appropriate normality tests. Categorical variables were presented as absolute frequencies and percentages.

Comparative analyses involving categorical variables were expressed using odds ratios (ORs) along with 95% confidence intervals (CIs). A two-tailed p -value < 0.05 was considered indicative of statistical significance for all tests.

All statistical computations and analyses were performed using R software (version 3.4.0; R Foundation for Statistical Computing, Vienna, Austria).

Results

A total of 1,395 patients undergoing isolated CABG on CPB were included in the analysis. These patients were divided into two groups: Group 1 ($n = 508$), comprising patients who did not receive PWs and never required TCP, and Group 2 ($n = 887$), comprising patients who received PWs.

Patient Demographics and Preoperative Characteristics

The majority of the patients were male (77.5%), with no significant difference in sex distribution between the groups ($p = 0.724$). The mean age of the cohort was 59.3 years (± 9.98), and patients aged ≥ 70 years constituted 15.9% of the total, with similar distribution across the two groups ($p = 0.898$). Comorbidities, including hypertension (66.7%), diabetes mellitus (45.7%), and hyperlipidemia (54.9%), were evenly distributed between the groups, with no significant differences noted ($p > 0.05$). However, preoperative bundle branch block (BBB) was significantly more common in Group 2 (5.2%) compared to Group 1 (1.6%) ($p < 0.001$).

Operative and Postoperative Variables

Emergency or urgent surgery was more frequent in Group 1 (18.1%) compared to Group 2 (13.8%) ($p = 0.030$). Prolonged aortic cross-clamp time (>90 minutes) and CPB time (>120 minutes) were not significantly different between the groups ($p = 0.188$ and $p = 0.107$, respectively). The use of antiarrhythmics upon leaving the operating room was significantly higher in Group 2 (7.4%) compared to Group 1 (4.7%) ($p = 0.047$). Similarly, exploration for postoperative bleeding was significantly more common in Group 1 (7.9%) compared to Group 2 (5.2%) ($p = 0.045$).

Clinical Outcomes

The need for mechanical ventilation lasting more than 12 hours postoperatively occurred in 18.0% of patients in Group 2 and 18.3% in Group 1, with no significant difference ($p = 0.900$). Prolonged inotropic and vasoactive drugs use, was not significantly different between the groups ($p > 0.05$). Table 1 shows detailed characteristics of total patients and by group according to demographic, preoperative, and intraoperative data.

Among the 887 patients in Group 2 who had PWs inserted, 127 (14.3%) required TCP. The univariate analysis comparing patients who required TCP with those who did not, revealed several significant findings.

Preoperative Variables

Preoperative RBBB was significantly more prevalent in the TCP group compared to the non-TCP group (9.4% vs 4.5%, $p = 0.019$). Other preoperative characteristics, such as atrial fibrillation, low-grade atrioventricular (AV) block, and renal impairment, showed no statistically significant differences ($p > 0.05$).

Table 1 Characteristics of Total Patients and by Group According to Demographic, Preoperative, and Intraoperative Data

		Total (1395)	Group 1(508)	Group 2 (887)	P-value
Sex	Male	1081 (77.5%)	391 (77.0%)	690 (77.8%)	0.724
	Female	314 (22.5%)	117 (23.0%)	197 (22.2%)	
Age (yrs)**		59.3 (9.98)	59.2 (9.96)	59.5 (10.0)	0.536
BMI**		26.4 (4.90)	26.2 (4.30)	26.6 (5.80)	0.224
Numbers of patients ≥70 (yrs)		222 (15.9%)	80 (15.7%)	142 (16.0%)	0.898
Recent MI <30 days		284 (20.4%)	90 (17.7%)	194 (21.9%)	0.064
Smoking		796 (57.1%)	293 (57.7%)	503 (56.7%)	0.725
COPD/Asthma		176 (12.6%)	64 (12.6%)	112 (12.6%)	0.988
Hypertension		930 (66.7%)	339 (66.7%)	591 (66.6%)	0.969
Hyperlipidemia		766 (54.9%)	279 (54.9%)	487 (54.9%)	0.995
DM		637 (45.7%)	219 (43.1%)	418 (47.1%)	0.147
History of CAD		564 (40.4%)	217 (42.7%)	347 (39.1%)	0.188
History of Stroke/TIA		120 (8.6%)	53 (10.4%)	67 (7.6%)	0.065
NYHA III,IV		289 (20.7%)	119 (23.4%)	170 (19.2%)	0.059
History of PVD		213 (15.3%)	88 (17.3%)	125 (14.1%)	0.107
Preop Atrial Fibrillation		106 (7.6%)	40 (7.9%)	66 (7.4%)	0.769
Pre-op BBB		54 (3.9%)	8 (1.6%)	46 (5.2%)	<0.001*
Preop low grade AV block		33 (2.4%)	10 (2.0%)	23 (2.6%)	0.460
Preop Renal Impairment		101 (7.2%)	40 (7.9%)	61 (6.9%)	0.489
LM >70%		180 (12.9%)	67 (13.2%)	113 (12.7%)	0.810
EF	EF>50%	831 (59.6%)	286 (56.3%)	545 (61.4%)	0.109
	EF40-49%	346 (24.8%)	134 (26.4%)	212 (23.9%)	
	EF30-39%	189 (13.5%)	80 (15.7%)	109 (12.3%)	
	EF<30%	29 (2.1%)	8 (1.6%)	21 (2.4%)	
Pre-Op PCI		110 (7.9%)	38 (7.5%)	72 (8.1%)	0.671
PeriOp. IABP		12 (0.9%)	4 (0.8%)	8 (0.9%)	0.824
HCT Preop**		39.2 (5.87)	39.3 (5.88)	39.2 (5.87)	0.806
Emergency/Urgent		214 (15.3%)	92 (18.1%)	122 (13.8%)	0.030*
CPB Time (>120min):		297 (21.2%)	120 (23.6%)	177 (20.0%)	0.107
Aorta Cx Clamp (>90min):		114 (8.1%)	48 (9.4%)	66 (7.4%)	0.188
Cardioversion required in OR		378 (27%)	134 (26.4%)	244 (27.5%)	0.648
Antiarrhythmics leaving OR		90 (6.4%)	24 (4.7%)	66 (7.4%)	0.047*

(Continued)

Table 1 (Continued).

		Total (1395)	Group 1(508)	Group 2 (887)	P-value
IntraOp. Bld Transf		730 (52.3%)	266 (52.4%)	464 (52.3%)	0.985
Exploration for Post op bleeding		86 (6.1%)	40 (7.9%)	46 (5.2%)	0.045*
Prolonged Vaso P. Support		125 (8.9%)	36 (7.1%)	89 (10.0%)	0.064
Vent. Duration>12Hrs:		253 (18.1%)	93 (18.3%)	160 (18.0%)	0.900

Notes: *BOLD: Statistically significant. **: Data presented with mean (SD) and analysis was done with Student *T* test.

Abbreviations: BMI, Body Mass Index; CAD, Coronary Artery Disease; CVA/TIA, Cerebrovascular Accident / Transient Ischemic Attack; NYHA, New York Heart Association; AMI, Acute Myocardial Infarction; AV, Atrioventricular; EF, Ejection Fraction; LM, Left Main; PCI, Percutaneous Coronary Intervention; CABG, Coronary Artery Bypass Grafting; BSA, Body Surface Area; COPD, Chronic Obstructive Pulmonary Disease; DM, Diabetes Mellitus; HTN, Hypertension; HR, Heart Rate; OR, Operating Room; IABP, Intra-Aortic Balloon Pump; CPB, Cardiopulmonary Bypass; BB, Beta Blocker; ICU, Intensive Care Unit; bpm, Beats Per Minute.

Operative and Postoperative Variables

Patients requiring intraoperative blood transfusions were significantly more likely to require TCP (61.4% vs 50.8%, $p = 0.026$). Prolonged vasoactive support in the postoperative period was more common in the TCP group compared to the non-TCP group (29.9% vs 6.7%, $p < 0.001$).

The need for prolonged mechanical ventilation (>12 hours) was also significantly higher in the TCP group (26.0% vs 16.7%, $p = 0.012$).

Other Variables

Demographic variables, including sex, age, and BMI, did not show significant differences between the TCP and non-TCP groups ($p > 0.05$). Hematocrit levels, both pre-and postoperatively, were similar in both groups ($p > 0.05$). Emergency or urgent surgery and prolonged cardiopulmonary bypass or aortic cross-clamp times did not significantly impact the likelihood of requiring TCP ($p > 0.05$). Table 2 shows the detailed results of univariate analysis (group 2) for the use of temporary pacing according to demographic, and preoperative variables.

Table 2 Univariate Analysis (Group 2) for the Use of Temporary Pacing According to Demographic and Preoperative Variables

		PWs USED (127)	NOT USED (760)	P-value
Sex	Male	92 (72.4%)	598 (78.7%)	0.117
	Female	35 (27.6%)	162 (21.3%)	
Age (yrs)**		60.2 (9.03)	59.0 (10.1)	0.204
BMI**		26.7 (4.28)	26.2 (4.30)	0.199
Numbers of patients ≥ 70 (yrs)		20 (15.7%)	122 (16.1%)	0.931
Recent MI <30 days		22 (17.3%)	172 (22.6%)	0.180
Smoking		71 (55.9%)	432 (56.8%)	0.844
COPD/Asthma		16 (12.6%)	96 (12.6%)	0.992
Hypertension		85 (66.9%)	506 (66.6%)	0.938
Hyperlipidemia		64 (50.4%)	423 (55.7%)	0.270
DM		62 (48.8%)	356 (46.8%)	0.680

(Continued)

Table 2 (Continued).

		PWs USED (127)	NOT USED (760)	P-value
History of CAD		50 (39.4%)	297 (39.1%)	0.950
History of Stroke/TIA		6 (4.7%)	61 (8.0%)	0.192
NYHA III,IV		28 (22.0%)	142 (18.7%)	0.373
History of PVD		16 (12.6%)	109 (14.3%)	0.601
Preop Atrial Fibrillation		7 (5.5%)	59 (7.8%)	0.371
Pre-op BBB		12 (9.4%)	34 (4.5%)	0.019*
Preop low grade AV block		4 (3.1%)	19 (2.5%)	0.670
Preop Renal Impairment		7 (5.5%)	54 (7.1%)	0.511
LM >70%		15 (11.8%)	98 (12.9%)	0.735
Pulmonary Hypertension		8 (6.3%)	40 (5.3%)	0.633
EF	EF>50%	79 (62.2%)	466 (61.3%)	0.757
	EF40-49%	33 (26.0%)	179 (23.6%)	
	EF30-39%	13 (10.2%)	96 (12.6%)	
	EF<30%	2 (1.6%)	19 (2.5%)	
Pre-Op PCI		9 (7.1%)	63 (8.3%)	0.646
PeriOp. IABP		3 (2.4%)	5 (0.7%)	0.060
HCT Preop		39.4 (6.11)	39.2 (5.84)	0.838
HCT postOP		29.6 (4.71)	29.9 (4.25)	0.378
Emergency/Urgent		17 (13.4%)	105 (13.8%)	0.896
CPB Time (>120min):		21 (16.5%)	156 (20.5%)	0.298
Aorta Cx Clamp (>90min):		7 (5.5%)	59 (7.8%)	0.371
Cardioversion required in OR		33 (26.0%)	211 (27.8%)	0.678
Antiarrhythmics leaving OR		13 (10.2%)	53 (7.0%)	0.195
IntraOp. Bld Transf		78 (61.4%)	386 (50.8%)	0.026*
Exploration for Post op bleeding		7 (5.5%)	39 (5.1%)	0.858
Prolonged Vaso P. Support		38 (29.9%)	51 (6.7%)	<0.001*
Vent. Duration>12Hrs:		33 (26.0%)	127 (16.7%)	0.012*

Notes: * BOLD: Statistically significant. **: Data presented with mean (SD) and analysis was done with Student T test.

Abbreviations: BMI, Body Mass Index; CAD, Coronary Artery Disease; CVA/TIA, Cerebrovascular Accident / Transient Ischemic Attack; NYHA, New York Heart Association; AMI, Acute Myocardial Infarction; AV, Atrioventricular; EF, Ejection Fraction; LM, Left Main; PCI, Percutaneous Coronary Intervention; CABG, Coronary Artery Bypass Grafting; BSA, Body Surface Area; COPD, Chronic Obstructive Pulmonary Disease; DM, Diabetes Mellitus; HTN, Hypertension; HR, Heart Rate; OR, Operating Room; IABP, Intra-Aortic Balloon Pump; CPB, Cardiopulmonary Bypass; BB, Beta Blocker; ICU, Intensive Care Unit; bpm, Beats Per Minute.

Table 3 shows a multivariate logistic regression analysis identifying several factors independently associated with the need for TCP. Preoperative bundle branch block (BBB) was significantly associated with an increased likelihood of requiring TCP, with an odds ratio (OR) of 2.22 (95% confidence interval [CI]: 1.121–4.428, $p = 0.022$). Preoperative

Table 3 Multivariate Analysis of Factors Associated with Temporary Cardiac Pacing

		Odds Ratio	Lower	Upper	p-value
Sex- male		0.71	0.465	1.091	0.118
Age (yrs)		1.01	0.9932	1.032	0.204
≥70 (yrs)		0.97	0.584	1.636	0.931
BMI		1.02	0.9852	1.074	0.199
Recent MI <30ds:		0.71	0.439	1.169	0.182
Smoking		0.96	0.659	1.406	0.844
COPD/Asthma		0.99	0.566	1.756	0.992
Hypertension		1.01	0.682	1.514	0.938
Hyperlipidemia		0.80	0.556	1.179	0.27
Diabetes M		1.08	0.743	1.576	0.68
Family Hx of CAD:		1.01	0.689	1.487	0.95
Hx of Stroke/TIA:		0.56	0.24	1.343	0.198
NYHA III,IV:		1.23	0.779	1.945	0.373
Hx PVD		0.86	0.491	1.51	0.601
Preop Atrial Fibrillation		0.69	0.309	1.553	0.373
Pre-op BBB		2.22	1.121	4.428	0.022
Preop low grade AV block:		1.26	0.424	3.791	0.671
Preop Renal Impairment:		0.76	0.339	1.716	0.512
B- Blockers		0.29	0.181	0.491	<0.001*
Pulmonary hypertension		1.21	0.553	2.649	0.633
LM >70%:		0.90	0.507	1.614	0.735
EF					
	EF>50%	Ref.			
	EF40-49%	1.08	0.699	1.691	0.71
	EF30-39%	0.79	0.427	1.494	0.482
	EF<30%	0.62	0.142	2.717	0.527
Pre-Op PCI		0.84	0.409	1.743	0.646
PeriOp. IABP		3.65	0.862	15.479	0.079
HCT Preop		1.00	0.9717	1.036	0.837
Emergency/Urgent:		0.96	0.556	1.672	0.896
CPB Time (>120min):		0.76	0.465	1.265	0.299
Aorta Cx Clamp (>90min):		0.69	0.309	1.553	0.373
Cardioversion required in OR:		0.91	0.596	1.4	0.678

(Continued)

Table 3 (Continued).

		Odds Ratio	Lower	Upper	p-value
Antiarrhythmics leaving OR:		1.52	0.804	2.879	0.198
IntraOp. Bld Transf.:		1.54	1.05	2.266	0.027*
Exploration for Post op bleeding:		1.07	0.471	2.467	0.858
Prolonged Vaso P. Support:		5.93	3.694	9.538	<0.001*
Vent. Duration>12Hrs:		1.75	1.127	2.717	0.013*

Note: * BOLD: Statistically significant.

Abbreviations: BMI, Body Mass Index; CAD, Coronary Artery Disease; CVA/TIA, Cerebrovascular Accident / Transient Ischemic Attack; NYHA III/IV, New York Heart Association Class III or IV, PVD: Peripheral Vascular Disease; BBB, Bundle Branch Block; AV, Atrioventricular; LM, Left Main; EF, Ejection Fraction; PCI, Percutaneous Coronary Intervention; IABP, Intra-Aortic Balloon Pump; HCT, Hematocrit; CPB, Cardiopulmonary Bypass; OR, Operating Room; BSA, Body Surface Area; Vent. Duration, Ventilation Duration; Vaso P. Support, Vasopressor Support; Antiarrhythmias, Antiarrhythmic Medications; Blood Transf, Blood Transfusion.

beta-blocker use, on the other hand, was found to significantly reduce the likelihood of TCP, with an OR of 0.29 (95% CI: 0.181–0.491, $p < 0.001$).

Perioperative factors also played a critical role in predicting TCP. Patients who required intraoperative blood transfusions were more likely to need TCP (OR 1.54, 95% CI: 1.05–2.266, $p = 0.027$). Patients leaving the operating room on vasoactive drugs and needing them for a prolonged time postoperatively also were most likely to need TCP (OR 5.93, 95% CI: 3.694–9.538, $p < 0.001$). Patients who needed prolonged mechanical ventilation exceeding 12 hours were more likely to be paced (OR 1.75, 95% CI: 1.127–2.717, $p = 0.013$).

Several variables were not significantly associated with the need for TCP in the multivariate analysis. These included age ≥ 70 years (OR 0.97, 95% CI: 0.584–1.636, $p = 0.931$), preoperative atrial fibrillation (OR 0.69, 95% CI: 0.309–1.553, $p = 0.373$), and preoperative left main stenosis $>70\%$ (OR 0.90, 95% CI: 0.507–1.614, $p = 0.735$). Additionally, left ventricular ejection fraction (LVEF) did not show any significant association across its subgroups ($p > 0.05$).

Discussion

Patient Demographics and Preoperative Characteristics

Postoperative temporary cardiac pacing (TCP) is widely employed as both a diagnostic and therapeutic modality following cardiac surgery. Its utility lies in its ability to optimize hemodynamic performance, prevent clinically significant conduction disturbances, and mitigate the risk of sudden bradycardia cardiac arrest.⁶ In this study, we aimed to identify the predictors associated with the requirement for TCP following coronary artery bypass grafting (CABG) performed with cardiopulmonary bypass (CPB).

Our analysis revealed that general demographic variables, including age, sex, and body mass index (BMI), were not statistically significant predictors of postoperative pacing requirements. While a slightly higher proportion of males required TCP, this observation did not reach statistical significance and should not be interpreted as evidence of a causal relationship. Previous literature similarly suggests that demographic characteristics alone—such as age and sex—do not significantly impact the need for temporary pacing support following cardiac surgery.^{7–10}

Comorbid conditions commonly associated with cardiovascular disease, including hypertension, diabetes mellitus, and hyperlipidemia, also did not show a significant association with the need for TCP in our cohort. However, one important preoperative variable that did emerge as a statistically significant predictor was the presence of bundle branch block (BBB). Patients with preoperative BBB were more likely to require TCP following CABG. This finding aligns with previous studies and reflects the well-established pathophysiological association between BBB and impaired electrical conduction. BBB may result from underlying conditions such as ischemic or rheumatic heart disease, right ventricular

hypertrophy, pulmonary embolism, cardiomyopathy, congenital abnormalities, or degenerative conduction system disease.¹¹

Supporting our findings, Bethea et al demonstrated that patients with preoperative arrhythmias, including BBB, had a significantly increased likelihood of requiring postoperative pacing.¹² Similarly, Mishra et al identified preoperative conduction disturbances as important predictors for the use of temporary pacing post-surgery.¹³ The European Society of Cardiology (ESC) and the European Heart Rhythm Association (EHRA) also emphasize that pacing is often indicated for symptomatic or progressive forms of BBB—particularly in the context of bifascicular blocks, which carry a higher risk of progression to complete heart block.¹⁴ These findings reinforce the clinical relevance of BBB as a marker for increased TCP risk following CABG and support the consideration of conduction abnormalities in preoperative risk assessment.

Interestingly, other preoperative arrhythmias—such as atrial fibrillation (AF) and low-grade atrioventricular (AV) block—were not significantly associated with postoperative TCP in our study. This contrasts with several previous reports that identify AF as a major postoperative concern.¹⁵ One possible explanation for this discrepancy may be the high rate of preoperative beta-blocker use in our patient population, which is known to reduce arrhythmic burden and could have mitigated the risk associated with these arrhythmias.

Operative and Postoperative Variables

Findings indicate that emergency or urgent surgeries had the same prevalence in both groups. In the literature, PWs have been associated with an increased risk of ventricular arrhythmias.^{5,16} While prolonged CPB time and aortic cross-clamp time did not show significant differences between the two groups, the increased use of antiarrhythmics in the pacing group highlights an adaptive response to manage arrhythmias more aggressively in patients with PWs. Postoperative bleeding was also more common in the pacing group, suggesting that these patients may have had more complex intraoperative courses or complications that warranted additional interventions. Although rare, bleeding after PW removal is also a serious complication.¹⁷

Pacing group patients also showed no significant postoperative bleeding explorations differences. Shaw et al concluded that applying intra-operative blood transfusion shows no discernible benefits for the patients and significantly increases both operative and postoperative complications.¹⁸ This finding is consistent with other reports where transfusions are linked to increased morbidity following cardiac surgery.¹⁹

In a randomized controlled trial conducted by Nguyen et al, the use of temporary biventricular pacing during the early postoperative period was associated with a significant reduction in the vasoactive-inotropic score (VIS), a clinical index used to quantify the degree of pharmacologic cardiovascular support required after surgery.¹⁰ The VIS serves as an important surrogate marker for hemodynamic instability, reflecting the cumulative dosage of inotropic and vasoactive agents administered to maintain adequate cardiac output and blood pressure in the critical postoperative phase.

In contrast to the findings reported by Nguyen et al, our study demonstrated that patients in whom temporary epicardial pacing wires (PWs) were inserted and who ultimately required temporary cardiac pacing (TCP) exhibited significantly higher VIS levels postoperatively. This suggests that patients experiencing greater hemodynamic compromise—as indicated by prolonged and more intensive vasoactive support—are at increased risk for requiring TCP. These findings underscore the clinical utility of VIS not only as a marker of cardiovascular instability but also as a potential predictor of the need for temporary pacing support.

Furthermore, our analysis revealed that prolonged mechanical ventilation, defined as respiratory support extending beyond 12 hours postoperatively, was markedly more prevalent among patients with PWs who required TCP compared to those who did not. While the existing literature on the relationship between mechanical ventilation duration and TCP requirement remains limited, emerging evidence indicates that prolonged mechanical ventilation is associated with a higher incidence of adverse outcomes. These include systemic complications such as ventilator-associated pneumonia, impaired gas exchange, and hemodynamic stress, all of which may exacerbate myocardial dysfunction and increase the likelihood of conduction disturbances.^{20–22} Thus, our findings suggest that both high VIS and prolonged mechanical ventilation may serve as important clinical indicators of patients at elevated risk for requiring TCP in the postoperative period.

Implications for Practice

The findings of this study advocate for a selective approach for temporary epicardial pacing wires following CABG surgery rather than a routine application for all patients. Identifying preoperative risk factors such as right bundle branch block and beta-blocker use, intraoperative blood transfusions, and postoperative complications, including prolonged vasoactive support and mechanical ventilation, can enhance patient outcomes while minimizing unnecessary interventions. Also, it can improve intraoperative management strategies, including the selective placement of pacing wires, which might enhance morbidity and mortality.

Moreover, these findings support ongoing negotiations within the surgical community regarding best practices of the need for TCP or pacing wire placement, particularly in light of potential complications associated with their use, including perforation, infection, and myocardial damage.² The ability to predict patients who could benefit from TCP can lead to more tailored perioperative care strategies, ultimately improving the recovery course and best resource utilization. Future studies should explore whether targeted interventions can reduce the incidence of TCP and associated complications in these high-risk populations.

Strengths and Limitations

This study has several notable strengths. It is based on a large cohort of 1,395 patients undergoing isolated CABG over an 18-year period, providing robust statistical power and long-term observational insights. The data were drawn from a prospectively maintained intensive care database, ensuring consistency and minimizing recall bias. Additionally, the multivariate analysis accounted for a wide range of preoperative, intraoperative, and postoperative variables, allowing for the identification of independent predictors of temporary cardiac pacing (TCP) with clinical relevance.

However, this study also has limitations. As a retrospective, single-center analysis, the findings may be subject to selection bias and may not be generalizable to other institutions with different patient populations or surgical practices. Moreover, standardized preoperative risk scores such as EuroScore or STS were not consistently available across the entire cohort, which limited comparative risk stratification. Finally, while the study identified predictors of TCP, it did not evaluate long-term outcomes associated with pacing, such as late mortality or permanent pacemaker dependency, which warrants further prospective investigation.

Conclusion

This study identified key predictors for the need for TCP after CABG. Among these, preoperative BBB, intraoperative blood transfusion, and postoperative factors such as prolonged vasoactive support and mechanical ventilation were significantly associated with an increased likelihood of TCP. Notably, the use of preoperative beta-blockers demonstrated a protective effect against the need for pacing.

These findings highlight the importance of individualized risk stratification to guide the selective use of temporary epicardial pacing wires. Such an approach can optimize resource utilization and reduce the incidence of complications associated with pacing wire insertion. Future research should aim to validate these predictors in larger, prospective cohorts and explore tailored interventions to further improve patient outcomes.

Ethics Approval and Consent to Participate

The Institutional Review Board (IRB) of Jordan University of Science and Technology approved the study (Approval No. 519/2023). As this was a retrospective study, informed consent was waived by the IRB. The study was conducted in accordance with the ethical principles of the Declaration of Helsinki for medical research involving human subjects. All patient data were anonymized and handled with strict confidentiality to protect patient privacy.

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The authors declare no conflict of interest.

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