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Temporary epicardial pacing wires in isolated Coronary Artery Bypass Graft: Necessity or force of habit?

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Abstract

Objectives: To determine the frequency of Temporary epicardial pacing wires usage and its predictors in the immediate postoperative period in isolated coronary artery bypass graft surgery.

Method: The longitudinal study was conducted at the Aga Khan University Hospital, Karachi, from September 2019 to August 2020, and comprised adult patients of either gender who underwent isolated coronary artery bypass graft in the Department of Cardiothoracic Surgery. Demographic, peri-operative and post-operative Temporary Epicardial Pacing Wires use data was extracted from patient's files and the institutional electronic database. Logistic regression models were built to explore predictors of Temporary epicardial pacing wires usage. Data was analysed using SPSS 22.

Results: Of the 322 cases evaluated, 27(8.4%) required the use of Temporary Epicardial Pacing Wires. Mean age of the patients requiring temporary epicardial pacing wires was 66.3±8.9 years compared to 58.7±8.9 years in those who did not require it ($p<0.001$), while the left ventricular ejection fraction percentage was 44.1±12.8 and 48.9±12.8 respectively ($p=0.032$). After adjusting for clinically plausible demographics and peri-operative variables, increasing age and low left ventricular ejection fraction were significantly associated with the use of temporary epicardial pacing wires in post-operative period of isolated coronary artery bypass graft patients ($p<0.05$).

Conclusions: The frequency of temporary epicardial pacing wires usage in the post-operative period of coronary artery bypass graft was found to be low.

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Introduction

Temporary epicardial pacing wires (TEPWs) are placed routinely during coronary artery bypass graft (CABG) surgery for treating arrhythmias post-operatively.^{1,2} They are used peri-operatively to optimise cardiac output by maintaining the rate and rhythm of the heart. Arrhythmias are common post-CABG due to transient damage to conduction tissue during the operation,^{3,4} reported to be 4-58% in isolated CABG patients.⁵ TEPWs are implanted on the right atrium (RA) and/or the right ventricle (RV) of the heart to provide a low resistant pathway between external temporary pacemaker and heart's surface for pacing (Figure). Most common indication for the use of TEPWs is bradyarrhythmia i.e., heart rate <50/minute, and other indications include atrioventricular (AV) blocks, asystole, junctional tachycardia, ventricular tachycardia, Type-A atrial flutter and atrial fibrillation. TEPWs are removed prior to discharge by gentle trans-cutaneous traction.⁶

While TEPWs have life-saving advantages, its use also incorporates several risks. Literature has shown the incidence

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of major complications related to its use to be 0.04-0.4%,^{7,8} and these occur during the implantation or removal of the wires or when they are intentionally or unintentionally left inside.⁹ During implantation, they tend to increase both cost and duration of the surgery, additionally having the possibility to cause laceration of the heart chambers, leading to severe haemorrhage.¹ During the removal of these wires there can be major complications, like atrial or ventricular laceration and injury to conduit grafts, leading to cardiac tamponade, which can result in life-threatening situations.⁸ TEPWs, when unable to be removed, are cut flush with the skin, and, hence, a small part of it is intentionally left in the mediastinum that can lead to complications, like mediastinitis, arrhythmias and migration into nearby structures.¹⁰

Post-operatively, frequency of TEPW usage to pace the heart is very low. Bethea et al.¹ reported it to be 8.6%, while Asghar et al. found it to be 2.9%.¹¹ Both these studies identified some characteristics of the patients needing pacing wires, like increased age, diabetes mellitus, requirement of intra-operative pacing, anti-arrhythmic drugs and history of pre-operative arrhythmias.^{1,11} Multiple studies have emphasised on the selective placement of TEPWs in isolated CABG rather than prophylactic placement in all CABGs. Because of its low frequency of usage and its association with major

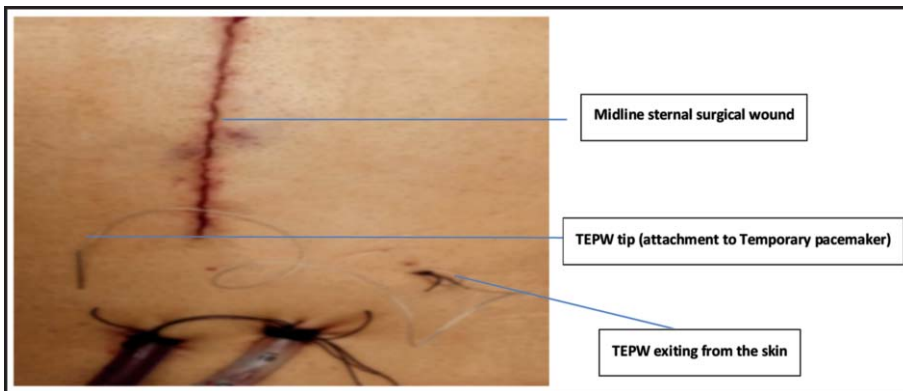


Figure: Temporary Epicardial Pacing Wire (TEPW) exit site post-operatively.

catastrophic complications, the placement of TEPWs in every isolated CABG is controversial. The current study was planned to determine the frequency and associated complications of TEPW usage in the post-operative period of isolated CABG patients, and to explore the predictors of TEPW usage.

Patients and Methods

The prospective observational study was conducted at the Aga Khan University Hospital (AKUH), Karachi, from September 2019 to August 2020. Since there was no direct interaction with the patients and all records were extracted from their files/electronic database, an exemption from ethical review committee was sought. The sample size was calculated using National Council for the Social Studies (NCSS) Power Analysis and Sample Size (PASS) version 17.0.3.^{12,13} To detect a change in R-Squared of 0.31 attributed to at least 10 independent variables using an F-Test, power was kept at 80% and significance level 0.05 to detect an odds ratio of 1.5.¹⁴ The sample was raised using non-probability consecutive sampling technique from among adult male and female patients undergoing either isolated elective or urgent CABG at the AKUH Department of Cardiothoracic Surgery. Those having pre-operative permanent pacemaker in place, undergoing off-pump, emergency or salvage CABG, and patients undergoing CABG in conjunction with some other procedures were excluded.

CABG was done via full median sternotomy and on cardiopulmonary bypass (CPB). Myocardial protection was achieved with antegrade blood cardioplegia and topical cooling of the heart. On CPB, 34 C systemic cooling was achieved, and mean arterial pressure (MAP) was kept between 70-80mmHg. All patients received RV pacing wire and additional RA pacing wire on surgeon's preference. Post-operatively, patients were kept on inotropic support as required, which were then weaned off slowly as tolerated.

During the post-operative period, patients were

individually evaluated for the need of pacing if they had bradycardia, taken as heart rate (HR) <50/min or asystole causing haemodynamic instability. Duration of pacing was also monitored.

Data was collected prospectively on a predesigned proforma from the patient's file, intra-operative record and electronic database. All subjects were assigned a unique identification number. Demographic, clinical and peri-operative variables included age, gender, co-morbidities,

like hypertension (HTN), diabetes mellitus (DM), chronic kidney disease (CKD), chronic obstructive pulmonary disease (COPD), congestive heart failure (CHF), presence of pre-operative arrhythmias, use of anti-arrhythmic medications, ejection fraction (EF) on echocardiography, history of recent myocardial infarction (MI) and presence of left main coronary artery stenosis. During their hospital stay, frequency of therapeutic use of TEPWs was recorded for the type and duration of arrhythmias. Any complications during its placement or removal, length of hospital stay (LOS) of the patients and their post-operative outcomes were also recorded.

Data was analysed using SPSS 22. Mean \pm standard deviation (SD) / median along with interquartile range (IQR) were calculated for quantitative variables, such as age, weight, height, body mass index (BMI), EF (%) and LOS (days). Frequencies and percentages were calculated for gender, presence of co-morbidities, history of recent MI, pre-operative arrhythmias, post-operative arrhythmias, in-hospital mortality and pacing requirement. Independent sample t-test was used to assess difference between continuous variables of those who require TEPWs and those who did not. Chi-square test was used to assess significant difference between qualitative variables. Univariate and multivariate logistic regression analysis was performed, and crude and adjusted odds ratios (AORs) were calculated to identify independent predictors of use of TEPWs in patients undergoing isolated CABG. $P < 0.05$ was considered statistically significant.

Results

Of the 322 cases evaluated, 27(8.4%) required the use of TEPWs. Mean age of the patients requiring temporary epicardial pacing wires was 66.3 ± 8.9 years compared to 58.7 ± 8.9 years in those who did not require it ($p < 0.001$), while the left ventricular EF (LVEF) percentage was 44.1 ± 12.8 and 48.9 ± 12.8 respectively ($p = 0.032$) (Table-1).

Table-1: Baseline characteristics (n=322).

Variable	TPW used		P value
	Yes, n=27	No, n=295	
Age in years \pm SD	66.3 \pm 8.9	58.7 \pm 8.9	<0.001
BMI (Kg/m ²) \pm SD	26.7 \pm 4.1	28.2 \pm 4.1	0.140
Gender			
Male n(%)	22 (81.5)	246 (83.4)	0.799
Female n(%)	5 (18.5)	49 (16.6)	
Diabetes n(%)	17 (63)	182 (61.7)	0.897
Hypertension n (%)	22 (81.5)	237 (80.3)	0.886
COPD n (%)	2 (7.4)	21 (7.1)	0.956
Chronic Renal Failure n (%)	1 (3.7)	12 (4.1)	0.927
NYHA class			
II-III n (%)	24 (88.9)	258 (87.5)	0.829
IV n (%)	3 (11.1)	37 (12.5)	
LVEF % \pm SD	44.1 \pm 12.8	48.9 \pm 12.8	0.032
Anti-arrhythmic used n (%)	2 (7.4)	19 (6.4)	0.846

BMI: Body mass index, COPD: Chronic obstructive pulmonary disease, NYHA: New York Heart Association functional classification, LVEF: Left ventricular ejection fraction.

Table-2: Peri-operative variables (n=322).

Variable	TEPW used		P value
	Yes, n=27	No, n=295	
Priority of Surgery			
- Elective n (%)	24 (88.9)	250 (84.7)	0.563
- Urgent n (%)	3 (11.1)	45 (15.3)	
IABP used in OR n (%)	3 (11.1)	17 (5.8)	0.270
Inotropes used in OR n (%)	25 (92.6)	270 (91.5)	0.848
Pacing in OR required n (%)	5 (18.5)	59 (20)	0.854
Type of Pacing wire used			
- Ventricular n (%)	1 (3.7)	51 (17.3)	0.005
- Atrial n (%)	2 (7.4)	3 (1.0)	
- AV Sequential n (%)	2 (7.4)	5 (1.7)	
Cardioplegia Type			
- Blood Cardioplegia n (%)	22 (81.5)	263 (89.2)	0.232
- Dilnido n (%)	5 (18.5)	32 (10.8)	
PPM required n (%)	3 (11.1)	0 (0.0)	<0.001
CCT (min) \pm SD	72 \pm 18.6	66.7 \pm 18.6	0.224
Bypass time (min) \pm SD	109.3 \pm 26.9	104.6 \pm 26.9	0.453
LOS (days) \pm SD	8.0 \pm 2.6	7.3 \pm 2.6	0.229
In Hospital Mortality n (%)	0 (0)	9 (3.1)	0.357

IABP: Intra-aortic balloon pump, PPM: Permanent pacemaker, CCT: Aortic cross-clamp time, LOS: Length of hospital stay.

TEPW: Temporary Epicardial Pacing Wires, OR: Odds ratio, SD: Standard deviation.

Among those who required TEPW post-operatively, 5(18.5%) required pacing in the operating room while coming off cardiopulmonary bypass. The type of pacing mode used in these patients was atrial and AV sequential in 2(40%) each, and ventricular pacing in 1(20%). Besides, 3(11.11%) patients needed a permanent pacemaker due to persistent complete AV block (Table-2).

After adjusting for clinically plausible demographics and peri-

Table-3: Univariate and multivariate logistic regression analysis (n=322).

Variables	Crude OR (95% CI)	P value	Adjusted OR* (95% CI)	P value
Age in years	0.91 (0.87,0.96)	<0.001	0.91 (0.86,0.96)	<0.001
Male gender	1.14 (0.41,3.16)	0.800	1.04 (0.34,3.13)	0.950
BMI Kg/m ²	1.07 (0.98,1.17)	0.139	1.00 (0.91,1.09)	0.976
Diabetes	1.06 (0.47,2.39)	0.897	1.09 (0.44,2.70)	0.850
Hypertension	1.08 (0.39,2.96)	0.886	1.15 (0.38,3.53)	0.806
COPD	1.04 (0.23,4.71)	0.956	1.03 (0.20,5.35)	0.976
NYHA class IV vs. II-III	1.15 (0.33,4.00)	0.829	2.08 (0.50,8.60)	0.313
Chronic Renal Failure	1.10 (0.14,8.82)	0.927	1.03 (0.11,9.42)	0.977
LVEF% (< 30%)	1.04 (1.0,1.07)	0.035	1.05 (1.01,1.09)	0.020
No Anti arrhythmic drugs	1.16 (0.26,5.28)	0.846	1.03 (0.18,6.12)	0.970
Urgent vs. Elective surgery	1.44 (0.42,4.98)	0.565	1.52 (0.39,5.9)	0.545
Bypass time (min)	1.00 (0.98,1.01)	0.452	1.01 (0.98,1.04)	0.488
Aortic Cross clamp time (min)	0.99 (0.97,1.01)	0.225	0.97 (0.94,1.01)	0.165

*Adjusting for all covariates in the model. COPD: Chronic obstructive pulmonary disease, NYHA: New York Heart Association functional classification, LVEF: Left ventricular ejection fraction. CI: Confidence Interval, OR: Odds ratio, BMI: Body mass index.

operative variables, increasing age and low EF were estimated as independent predictors of post-operative TEPW (Table-3).

Discussion

The practice of placing TEPWs in isolated CABG is controversial and no consensus yet exists amongst cardiac surgeons for their routine or selective placement. To our knowledge, the current study is one of the few in developing countries, such as Pakistan, to assess the frequency of TEPW usage in the post-operative period of CABG and its predictors. The current results support the selective approach in placing TEPWs in isolated CABG, with the selective groups including patients with advanced age and low pre-operative EF.

The guidelines issued by the American College of Cardiology (ACC), the American Heart Association (AHA) and the Heart Rhythm Society (HRS) in 2018 recommended that the routine placement of TEPWs was reasonable as it has been the standard surgical practice.¹⁵ However, over the recent years there has been a growing number of studies that have examined TEPW use and questioned their routine insertion.^{2,11,16} One such study found that routine placement of TEPWs had a negligible role and was associated with increased cost and potential complications.¹¹ Another study found that TEPW implantation is utilised a lot more frequently than needed in cardiac surgery and that it is important to identify independent predictors so that the placement of TEPW can be limited to selected patient populations.¹⁶ The current study also showed that TEPWs should only be placed in high-risk populations.

The patients in the current study had significant medical

co-morbidities, making this a diverse sample. The AKUH also has a good cardiac surgery turnover rate, as our one-year prospective study recruited 322 isolated CABG patients of which 85.1% were elective cases and 14.9% were urgent ones. The overall mean age of the patients was 59.3±9.1 years which coincided with data from international studies.¹

In the current study low rate of TEPW usage (8.4%) was found comparable to a study showing a usage rate of 8.6%. Other studies conducted showed as low as 2.9% while one study reported that only 1% of patients required TEPW if predictors for its use were controlled beforehand.¹¹

Interestingly, the current study found increasing age and low pre-operative EF as key independent risk factors for TEPW usage post-operatively after adjusting for multiple covariates. TEPW implantation was likely to increase by 9% with increase in every additional age year and by 5% with decrease in every EF percentage. Both these predictors are reasonable and intuitive, as increasing age is associated with increased risk of multiple co-morbidities that may increase the severity of coronary artery disease, while a low LVEF indicates heart failure and possible cardiomegaly which are all attributable risk of post-operative arrhythmias. The current study did not find any significant association between gender, DM, COPD, CKD, and previous anti-arrhythmic drug which was in line with literature.^{1,2,16,17}

Since the current study was conducted prospectively, there was greater accuracy of data without any missing information. Additionally, the sample size was adequate to run a multivariate regression model to make robust conclusions. However, the findings from this single-centre research might not be generalisable over other populations. The study was also limited in terms of using non-probability consecutive sampling technique.

Conclusion

There was a low frequency of TEPWs usage post-operatively, and increased age and low EF were found to be significant predictors for its use in isolated CABG patients.

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Conflict of Interest: None.

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