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Is Routine Use of Temporary Epicardial Pacing Wires Necessary after Either OPCAB or Conventional CABG/CPB?

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ABSTRACT

Objectives: Placement of temporary epicardial pacing wires (PWs) after coronary artery bypass graft (CABG) is routine procedure in many centers, despite infrequent but significant complications, including hemorrhage, tamponade, and death. The resurgence of off-pump CAB (OPCAB) prompted a reexamination of this practice.

Methods: Two hundred unselected coronary patients were prospectively randomized to undergo either OPCAB or conventional CABG on cardiopulmonary bypass (CABG/CPB). Three patients were excluded after randomization. Management, including placement or avoidance of PWs, followed unbiased, criteria-driven protocols. Patients requiring pacing immediately prior to chest closure (bradycardia with cardiac output <2.2 L/min per m^2, nodal or junctional arrhythmias, atrioventricular block) received PWs. In all other patients use of PWs was avoided. Duration of pacing and complications related to PW placement or avoidance were recorded.

Results: PWs were placed in 33 of 197 (17%) of patients, 23 of whom were paced after arrival in the intensive care unit and 10 of whom were never paced. Twelve OPCAB versus 21 CABG/CPB patients had PWs (P = .08). Patients with PWs were older, more commonly female, had more chronic obstructive pulmonary disease, and had longer hospital stays than those not requiring PWs. Preoperative beta blocker use, coronary anatomy, and number of grafts performed were not correlated with need for PWs. No patient without PWs required postoperative pacing by any means nor suffered any complication attributable to avoidance of PWs.

Conclusions: Need for pacing immediately prior to chest closure accurately and safely identifies coronary patients who will require postoperative pacing after OPCAB or CABG/CPB. Routine use of PWs is unnecessary. OPCAB may be associated with a reduced requirement for PWs.

INTRODUCTION

Temporary epicardial pacing wires (PWs) have been routinely employed in cardiac surgery since 1960 for therapeutic as well as diagnostic purposes [Hodman 1969, Mills 1973, Vitello-Cicciu 1987, Gundry 1997]. The pacing electrodes are implanted during surgery on the epicardium of the right ventricle and/or right atrium and brought to the skin through the anterior chest wall before chest closure. Temporary epicardial PWs may be especially helpful after valvular and pediatric heart operations in which the incidence of heart block or arrhythmia is increased [Waldo 1978].

However, there may be a lesser indication for routine use of PWs in coronary artery bypass grafting (CABG) procedures. Nonetheless, our institution and many others have historically used PWs in every cardiac surgical procedure that requires cardiopulmonary bypass.

The rediscovery and renewed popularity of off-pump coronary artery bypass (OPCAB) and the infrequent yet occasionally fatal complications of PW implantation and removal [Bolton 1992, Gentry 1993, Gal 1998, Matwiyoff 2000] led us to reevaluate the routine use of PWs and to attempt to identify a subpopulation(s) of CABG patients for whom PWs are appropriate.

PATIENTS AND METHODS

Two hundred unselected coronary patients were prospectively randomized to have either OPCAB or conventional coronary artery bypass grafting on cardiopulmonary bypass (CABG/CPB) [Puskas 2003]. There was no exclusion on the basis of coronary anatomy, number of grafts needed, ventricular function, or any cardiac or noncardiac comorbidity. Three patients required mitral valve repair or replacement and were excluded after randomization. Management, including placement or avoidance of PWs, followed unbiased, criteria-driven protocols. Patients requiring pacing immediately prior to chest closure for management of bradycardia with cardiac output <2.2 L/min per m^2, nodal or junctional arrhythmias, or atrioventricular block received PWs. PW placement was avoided in all other patients. Duration of

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Patient Demographic and Risk Profile

Characteristic	Paced Group A (n = 33)	Non-Paced Group B (n = 164)	Odds Ratio	*P*
Age, y ± SD	65 ± 9	62 ± 10	—	.050
Sex, no. of females (%)	16 (48%)	29 (18%)	4.39	<.001
Chronic obstructive pulmonary disease	6 (18%)	12 (7%)	2.84	.088
Diabetes	11 (33%)	55 (34%)	.99	1
Hypertension	27 (82%)	97 (59%)	3.12	.013
Renal failure, baseline > 2.0	1 (3%)	5 (3%)	1	1
Dialysis dependent	0	2 (1%)	—	—
Percent with ejection fraction ≤ 35%	4 (12%)	18 (11%)	1.1	.768
History of prior myocardial infarction	10 (30%)	55 (33%)	0.861	.839
Myocardial infarction 0-7 d pre-op	4 (15%)	22 (13%)	.907	1
No. distal anastomoses, mean ± SD	3.6 ± 0.9	3.3 ± 1.1	—	.185

pacing and complications related to PW placement, removal, or avoidance were recorded. Electrocardiograms (ECGs) performed pre- and postoperatively as well as preoperative cardiac catheterization were evaluated by independent blinded core labs to evaluate possible predictors of PW requirement.

RESULTS

The study population consisted of 197 patients, 99 CABG/CPB and 98 OPCAB. Thirty-three patients (16.75%) required epicardial pacing at the time of chest closure and therefore received PWs according to the protocol. Twenty-one (63.63%) of these were CABG/CPB patients and 12 (36.36%) were OPCAB patients (P = .08). Of those 33 patients who received PWs, 23 patients (69.69%) were paced after arrival in the intensive care unit (ICU) (group A); 10 (43.47%) of these were OPCAB patients. Ten (30.2%) of the patients who had PWs were never paced after arrival in the ICU (group B); 8 of these 10 were CABG/CPB patients.

In 164 patients (group C) epicardial pacing was not required prior to chest closure and therefore PWs were not implanted. Thus, 86 (87.75%) of 98 OPCAB patients and 78(78.78%) of 99 CABG/CPB patients (P = .09) avoided PW implantation. Patients with PWs were older (65 ± 9 versus 62 ± 10 years), were more likely to be female (16 [48%] versus 29 [18%]), and had more chronic obstructive pulmonary disease (COPD) (6 [18%] versus 12 [7%]) than those not requiring PWs (Table). Review of preoperative cardiac catheterization and perioperative ECGs failed to show any correlation between coronary anatomy or ECG findings and requirement for epicardial pacing.

The mean duration of pacing among those patients who received PWs was 13.6 ± 24.5 hours; the median was 8 hours. Among patients who were paced after arrival in the ICU, the mean duration of pacing was 9.7 ± 8.5 hours for OPCAB and 16.6 ± 31.9 hours for CABG/CPB. The primary reasons for which these 23 patients were paced included sinus bradycardia in 10 patients (30%), low cardiac output in 10 patients (30%), nodal or junctional rhythms in 2 patients (6%), and atrioventricular block of any degree in 6 patients (18%). In no case were PWs used for diagnostic purposes or for rapid atrial pacing. Temporary epicardial PWs were removed at the bedside by nursing staff, and a routine protocol of relative immobilization and heightened surveillance was applied for 4 hours after PW removal. There was no incidence of complication(s) attributable to PW insertion or removal in any patient. No patient in group C (n = 164), in which PWs were not implanted, required pacing by any means nor suffered any complication attributed to avoidance of PWs. No patient in either group required permanent pacemaker placement.

DISCUSSION

Temporary epicardial PWs have been routinely used in many institutions after all cardiac surgery operations. This practice has a compelling rationale in valvular and congenital procedures, because these procedures carry a higher risk of postoperative arrhythmias and atrioventricular blockade, which may develop or worsen in a delayed fashion [Waldo 1978]. Routine use of PWs in coronary artery bypass cases has a less compelling rationale, although it has been part of the standard management of all cardiac surgical patients at many institutions, including Emory University, for decades. Although the use of PWs for diagnostic evaluation has been reported [Mills 1973], in most published series these electrodes are used to augment cardiac output and/or to treat postoperative bradyarrhythmia [Del Nido 1989]. The recent rediscovery and popularization of OPCAB, as well as the small incidence of significant complications associated with placement and removal of PWs [Bolton 1992, Gentry 1993, Gal 1998, Matwiyoff 2000, Puskas 2003] led us to reevaluate our routine use of PWs in coronary patients.

The SMART (Surgical Management of Arterial Revascularization Therapies) trial [Puskas 2003], a prospective randomized study conducted at Emory Crawford Long Hospital comparing outcomes in unselected coronary patients randomized to OPCAB versus CABG/CPB, provided an opportunity to study the utility and safety of a protocol for selective PW use. This protocol was developed during the design of the SMART trial in order to avoid a bias in postoperative management between the OPCAB and CABG/CPB groups.

Clinical outcomes among several hundred OPCAB patients prior to the SMART trial suggested that need for pacing prior to chest closure was a safe indicator of need for postoperative pacing. Thus, the decision to insert PWs was made on the basis of requirement for pacing at the time of chest closure in both groups in the SMART trial.

The present results show that only 16.75 % of patients required PWs and that there were no complications associated with either use or avoidance of PWs in the 197 study patients. Interestingly, of the 33 patients who received PWs prior to chest closure, 21 (63.63%) were CABG/CPB patients and 12 (36.36%) were OPCAB patients (P = .08). On the other hand, although patients randomized to CABG/CPB were more likely to need PWs at the time of chest closure, many of these no longer required pacing after arrival in the ICU. Of the 23 patients who were paced after arrival in ICU, 13 were CABG/CPB and 10 were OPCAB patients. Thus, it seems that brief, transient conduction/rhythm disturbances may have been more common in the CABG/CPB group. Although the limited sample size prevented vigorous statistical correlation between pre- or postoperative ECG abnormalities and PW requirement, we did find a trend toward more new postoperative right bundle branch block (RBBB) in the CABG/CPB group (5/99 CABG/CPB versus 0/98 OPCAB, P = .059). These ECG changes are consistent with previous publications [Raichlen 1984, Wexelman 1986, Baerman 1987, Chu 1987] reporting up to a 60% incidence of postoperative conduction disturbances early after CABG/CPB, the most common being RBBB. Although patients requiring PWs tended to be older, more commonly female, and had more COPD, no correlation was found between need for PWs and coronary anatomy or number of grafts.

CONCLUSION

Although limited by sample size, the present results suggest that routine use of PWs after surgical coronary revascularization may be unnecessary. Need for pacing immediately prior to chest closure safely and accurately identified patients who would require postoperative pacing after either OPCAB or CABG/CPB. OPCAB may be associated with a lesser requirement for temporary epicardial PWs.

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REVIEW AND COMMENTARY

1. Editorial Board Member MB134 writes:

This is a subject revisited because of OPCAB and cost pressures, thus it is a subject of current interest to surgeons.

There is no specified incidence of postoperative atrial fibrillation. In my experience, the advantages of pacing wires extend beyond the intensive care unit. Postoperative atrial fibrillation is commonly associated with bradycardia and advanced atrioventricular block after loading with pharmacological agents. This is another time when pacing becomes invaluable. In such patients who fail drug therapy, electrocardioversion is safer when the wires remain in place. The authors may want to address these two issues

Author's Response by John D. Puskas, MD:

The incidence of postoperative atrial fibrillation was 16/98 OPCAB and 22/99 CABG/CPB, P = .37. According to the postoperative management protocols that were applied uniformly to both groups, the pacing wires were typically removed on postoperative day 1 or postoperative day 2. Atrial

fibrillation may occur after postoperative day 2, and as the reviewer correctly notes, pharmacological treatment of atrial fibrillation may produce bradycardia on occasion. Fortunately, no such event occurred during management of any of the patients in this randomized study, and no patient suffered any adverse event attributable to or avoidable by the presence or absence of temporary pacing wires. In general, it has never been our practice to leave pacing wires in place for a predetermined period of time. Rather, we try to remove them before the chest tubes are removed, to minimize the likelihood of undetected/undrained hemorrhage resulting from pacing-wire removal.