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Temporary Epicardial Pacing After Adult Cardiac Surgery

Erişkin Kalp Cerrahisi Sonrası Geçici Epikardiyal Pacemaker Kullanımı

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ABSTRACT

Introduction: *Temporary epicardial pacing wires (TEPW) have been routinely used in cardiac surgery in early postoperative period. Purpose of the study is to determine predictors for need of temporary pacing wires after surgery that will safely limit their usage and to document complications associated with the wires.*

Patients and Methods: *This prospective study involved 112 patients operated at our institution from April 2010 to October 2010, who received TEPW following surgery. Surgical procedures included 34 isolated coronary revascularization, 51 valve replacement, 11 revascularization with valve replacement, 14 mitral reconstruction, 2 ascending aorta replacement.*

Results: *Among 112 patients, 93 (83.1%) were never paced. Nineteen (16.9%) patients required pacing during weaning and 10 patients, required further pacing in intensive care unit. Indications for pacing included atrioventricular block in 7 (36.8%), sinus bradycardia in 2 (10.5%), junctional rhythm in 9 (47.4%) and low cardiac output in 1 (5.2%) patient. Atrioventricular block, junctional rhythm, postperfusion atrial fibrillation, inotropic agent requirement leaving the operating room, pacing requirement during weaning and mitral surgery are found to be the predictors for requirement of TEPWs. No complications were observed related with the use or removal of TEPWs.*

Conclusion: *Routine placement of TEPWs is not necessary after cardiac surgery. Patients having rhythm disturbances after procedure and requiring pacemacer support during weaning of cardiopulmonary by-pass, require further pacemaker support in intensive care unit with higher probability. Depending on our data, because of potential complications related with use of wires, selective use of TEPWs for patients with identified predictors can be recommended.*

Key Words: *Pacemaker, artificial; heart surgery; atrioventricular block; arrhythmias, cardiac.*

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ÖZET

Giriş: *Kalp cerrahisi sonrası erken dönemde geçici epikardiyal pacemaker desteği kullanılmaktadır. Bu çalışmanın amacı; erişkin kalp cerrahisi sonrası geçici pacemaker ihtiyacı oluşturabilecek faktörlerin tespiti ile kullanımlarının güvenli şekilde sınırlandırılması ve komplikasyonlarının tespit edilmesidir.*

Hastalar ve Yöntem: *Çalışmaya, Nisan 2010-Ekim 2010 tarihleri arasında hastanemizde opere edilen olgulardan geçici epikardiyal pacemaker teli yerleştirilen 112 hasta dahil edilmiştir. Cerrahi*

prosedür olarak 34 izole koroner baypas, 51 kapak replasmanı, 11 eş zamanlı koroner revaskülarizasyon ve kapak replasmanı, 14 mitral rekonstrüksiyon ve iki asendan aorta replasmanı uygulanmıştır.

Bulgular: *Epikardiyal pacemaker teli yerleştirilen hastaların 93 (%83.1)'ünde pacemaker desteğine ihtiyaç olmamıştır. Ondokuz (%16.9) hastaya perfüzyon sonlandırılırken ve bu hastaların 10'una yoğun bakım ünitesinde pacemaker desteği sağlanmıştır. Endikasyonlar, 7 (%36.8) hastada atriyoventriküler blok, 2 (%10.5) hastada sinüs bradikardisi, 9 (%47.4) hastada kavşak ritmi ve 1 (%5.2) hastada düşük kardiyak debi olarak tespit edilmiştir. Atriyoventriküler blok, kavşak ritmi, perfüzyon sonrası atriyal fibrilasyon, operasyon sonrası inotrop ajan ihtiyacı, perfüzyon sonlandırılırken pacemaker ihtiyacı oluşması ve mitral kapak cerrahisi, erken postoperatif dönemde pacemaker desteği ihtiyacını belirleyen faktörler olarak tespit edilmiştir. Epikardiyal pacemaker tellerinin kullanımı ve çekilmesi sonrasında herhangi bir komplikasyon oluşmamıştır.*

Sonuç: *Kalp cerrahisi sonrası epikardiyal pacemaker tellerinin rutin kullanımı gerekli değildir. Cerrahi sonrası ritim problemi gelişen ve perfüzyon sonlandırılırken pacemaker ihtiyacı duyulan hastaların yoğun bakım takiplerinde pacemaker kullanımı yüksek olasılıkla gerekmektedir. Sonuçlarımız doğrultusunda, neden olabileceği komplikasyonlar nedeniyle, geçici epikardiyal pacemaker tellerinin belirlenen hasta grubunda kullanılması önerilebilir.*

Anahtar Kelimeler: *Kalp pili, yapay; kalp cerrahisi; atriyoventriküler blok; aritmiler, kalp.*

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INTRODUCTION

Temporary epicardial pacing wires (TEPW) have been routinely used in cardiac surgery to overcome arrhythmias and improve hemodynamics in early postoperative period. Most of the indications for temporary pacing and extra safety they provide are universally accepted[1]. Their use is associated with a low morbidity. Complications assessed previously included bleeding from insertion site, cardiac laceration, pericardial effusion, cardiac tamponade and arrhythmias during removal. In recent years, accumulation of papers reporting rare but serious complications associated with retention of TEPWs such as sternobronchial fistula, ventricular tachycardia, bronchial foreign body, emerged the argument whether routine placement of wires is necessary[2-6]. Attempts to define predictors for use of TEPWs have been made in coronary artery revascularization surgery but not the rest of cardiac surgery[7-9]. Because of limited published data on this topic we prospectively evaluated our institutional experience with TEPWs aiming to determine predictors for need of temporary pacing wires after adult cardiac surgery that will safely limit their usage and to document complications associated with use and removal of the wires.

PATIENTS and METHODS

This prospective study involved 112 adult patients among 498 elective adult cardiac operations at our institution during a six month interval from April 2010 to October 2010, who received TEPW following surgery. The institutional review board of the hospital approved the study. Preoperative, intraoperative and postoperative data of patients who received TEPW were collected. Decision to implant and use TEPW in operating room (OR) and intensive care unit (ICU) was made by surgical teams who were not informed about the study. Surgical procedures included isolated coronary revascularization in 34 patients, valve replacement in 51 patients, revascularization with valve replacement in 11 patients, mitral reconstruction in 14 patients, asending aorta replacement in two patients. Three patients had replacement of asending aorta and aortic valve replacement and nine patients among coronanary revascularization cases had mitral reconstruction as concomitant procedures.

Surgical Technique

Median sternotomy was used for all patients. Cardiopulmonary by-pass was carried out using nonpulsatile flow to achieve a mean arterial pressure of 60 to 80 mmHg. except for four patients revascularized with off-pump technique. Moderate systemic hypothermia (28ºC to 32ºC), antegrade or combined antegrade and continous retrograde blood cardioplegia were used for myocardial protection. Ventricular wires were placed on anterior surface of right ventricle in 111 patients, only one patient received biventricular wires.

Statistical Methods

All analyses were performed using SPSS (Statistical Package for Social Sciences) for Windows 15.0. Data were analysed using descriptive statistical methods (mean, standard deviation, frequency), qualitative data were compared using Chi-square test, Fisher's Exact Chi-square test. Statistical significance was assessed with $p< 0.05$.

RESULTS

A total of 498 adult patients were operated during study period and 112 (22.4%) patients who received TEPWs were included in the study. Patient population had a mean age of 56.12 ± 14.44 (standard deviation) (22-84) years, 65 (58%) patients being males and 47 (42%) being females. Surgical procedures included 34 (30.3%) isolated coronary revascularization, 51 (45.5%) isolated valvular surgery, 11 (9.8%) combined valvular surgery and coronary revascularization, 14 (12.5%) mitral reconstruction and 2 (1.7%) ascending aorta replacement. De vega tricuspid annuloplasty was carried out as a concomitant procedure in 7 (6.2%) patients. Radiofrequency ablation was applied to 6 (5.3%) patients with preoperative atrial fibrillation. Preoperative and operative details for patients are summarized in Table 1.

In perioperative period, among 112 patients who received TEPW, 93 (83.1%) patients were never paced. Nineteen (16.9%) patients required pacing during weaning and 10 (52.6%) out of this 19 patients, required further pacing in ICU for various time periods. Among 34 patients who had isolated coronary revascularization, none required pacing either during weaning period or in ICU. Nine (17.6%) patients who had valvular surgery needed pacing during weaning and five of them were further paced in ICU. Five (35.7%) patients out of 14 mitral reconstructions required pacing during weaning and three of them were paced in ICU. The indications for pacing included atrioventricular block of any degree in 7 (36.8%) patients, sinus bradycardia in 2 (10.5%) patients, junctional rhythm in 9 (47.4%) patients and low cardiac output in 1 (5.2%) patient. Among six patients who had radiofrequeny ablation, only one experienced a temporary heart block and normal sinus rhythm was established after six hours of pacing in ICU. Of the 10 patients who were paced in postoperative period, only one, who had aortic valve replacement and coronary revascularization, received a permanent pacemaker because of persistent complete heart block.

Patients were divided into two groups as first group in whom placed wires were used and the second group in whom wires were never used. Univariate analysis, shown in Table 2, identified atrioventricular block, sinus bradycardia, junctional rhythm, postperfusion atrial fibrillation and mitral reconstruction as risk factors related to temporary pacing requirement during weaning from cardiopulmonary by-pass. Atrioventricular block, junctional rhythm, postperfusion atrial fibrillation, inotropic agent requirement leaving the operating room, pacing requirement at weaning from CBP and mitral valve replacement are found to be associated risk factors for pacemaker requirement in ICU (Table 3).

No complications were observed related with the use or removal of TEPWs. There were two mortalities in early postoperative period: one patient with preoperative left ventricular dysfunction and required pacing, died of mul-

Table 1. Patient preoperative and operative details

	n	%
Preoperative atrial fibrillation	29	25.9
Preoperative arrhythmia	6	5.4
Preoperative antiarrhythmics	3	2.7
Left ventricular dysfunction	19	17.0
Coronary artery by-pass grafting	45	40.2
Complete revascularization	36	32.1
Incomplete revascularization	9	8.0
Endarterectomy	4	3.6
On-CPB	41	36.6
Off-CPB	4	3.6
Aortic valve replacement	17	15.1
Mitral valve replacement	26	23.2
Mitral reconstruction	14	12.5
Double valve replacement	8	7.1
Tricuspid deVega annuloplasty	7	6.3
Ascending aorta replacement	2	1.7
Radiofrequency ablation	6	5.4
Postperfusion atrial fibrillation	36	32.1
Postperfusion pacing required	19	17.0
Antiarrhythmics leaving OR	15	13.4
Ventricular pacing	111	99.1
Bichamber pacing	1	0.9
Perioperative MI	3	2.7
Inotropes leaving OR	51	45.5
Intraaortic balloon pump	7	6.3
Atrioventricular block	8	7.1
Junctional rhythm	10	8.9
Sinus bradycardia	2	1.8
VES, AES	3	2.7
Permanent pacemaker	1	0.9
Morbidity	2	1.8
Mortality	2	1.8

AES: Atrial extrasystole, CPB: Cardiopulmonary by-pass, MI: Myocardial infarction, OR: Operating room, VES: Ventricular extrasystole.

Table 2. Univariate analysis of variables for epicardial pacing for weaning off-CPB

	Pacing required (n= 19)		Pacing not required (n= 93)		
	n	%	n	%	p
Preoperative atrial fibrillation+	6	31.6	23	24.7	0.575
Preoperative arrhythmia+	1	5.3	5	5.4	1.000
Left ventricular dysfunction+	5	26.3	14	15.1	0.311
CABG	5	26.3	40	43.0	0.176
Complete revascularization	5	26.3	31	33.3	0.551
Incomplete revascularization+	0	0	9	9.7	0.353
Endarterectomy+	0	0	4	4.3	1.000
On-CPB	5	26.3	36	38.7	0.307
Off-CPB+	0	0	4	4.3	1.000
Aortic valve replacement+	4	21.1	21	22.6	1.000
Mitral valve replacement+	7	36.8	22	23.7	0.257
Mitral reconstruction+	8	42.1	15	16.1	0.024*
Reoperation+	1	5.3	6	6.5	1.000
Radiofrequency ablation+	2	10.5	4	4.3	0.269
Postperfusion atrial fibrillation	17	89.5	19	20.4	0.001**
Atrioventricular block+	7	36.8	1	1.1	0.001**
Junctional rhythm+	9	47.4	1	1.1	0.001**
Sinus bradycardia+	2	10.5	0	0	0.028*
VES, AES+	0	0	3	3.2	1.000
Antiarrhythmics leaving OR+	3	15.8	12	12.9	0.717

Chi-square test
+ Fisher's Exact test
* p< 0.05
** p< 0.01
AES: Atrial extrasystole, CABG: Coronary artery by-pass grafting, CPB: Cardiopulmonary by-pass, MI: Myocardial infarction, OR: Operating room, VES: Ventricular extrasystole.

tiorgan system failure and the other patient, who was not paced, died of sepsis following acute renal insufficiency and prolonged ICU stay.

DISCUSSION

TEPWs have been placed as a routine practice in cardiac surgery. Conduction abnormalities such as prolonged atrioventricular delay, atrioventricular block and junctional tachycardia which are common after CBP, are the specific conditions known to benefit from temporary pacing[1]. With the improvements in surgical techniques and myocardial protection, incidence of these arrhythmias decreased and many centers started to limit utilization of pacing wires[7-9]. Incidence of conduction abnormalities was 20% in our study population and 16.9% of our patients required pacing. Preoperative atrial fibrillation, arrhythmia and antiarrhythmic treatment were not found to be directly related with pacing requirement unlike previous study of Bethea and collegues[7]. Atrial fibrillation, atrioventricular block, sinus bradycardia and junctional rhythm were the factors related to temporary pacing requirement during weaning from CPB in our study and this finding was compatible with Puskas and collegues who claimed that need for pacing prior to chest closure for indications such as bradycardia with low cardiac output, nodal and junctional arrhythmias or atrioventricular block, identifies the group of patients who are likely to require postoperative pacing[8]. Unlike previous studies with only CABG patients, our study included all surgical procedures including reoperations. Pacing requirement during weaning was not affected with the surgical procedure for CABG whether it was off-pump or conventional CABG or whether it was complete or incomplete revascularization. This finding did not support the previous study claiming off-pump CABG may be related with reduced requirement for

Table 3. Univariate analysis of variables for epicardial pacing in ICU

	Pacing required (n= 11)		Pacing not required (n= 101)		
	n	%	n	%	p
Preoperative atrial fibrillation	4	36.4	25	24.8	0.471
Preoperative arrhythmia	0	0	6	5.9	1.000
Left ventricular dysfunction	2	18.2	17	16.8	1.000
CABG	2	18.2	43	42.6	0.194
Complete revascularization	2	18.2	34	33.7	0.468
Incomplete revascularization	0	0	9	8.9	0.595
Endarterectomy	0	0	4	4.0	1.000
On-CPB	2	18.2	39	38.6	0.323
Off-CPB	0	0	4	4.0	1.000
Aortic valve replacement	2	18.2	23	22.8	1.000
Mitral valve replacement	6	54.5	23	22.8	0.033*
Mitral reconstruction	3	27.3	20	19.8	0.694
Reoperation	2	18.2	5	5.0	0.140
Radiofrequency ablation	1	9.1	5	5.0	0.470
Postperfusion atrial fibrillation	10	90.9	26	25.7	0.001**
Atrioventricular block	6	54.5	2	2.0	0.001**
Junctional rhythm	4	36.4	6	5.9	0.008**
Sinus bradycardia	1	9.1	1	1.0	0.188
VES, AES	0	0	3	3.0	1.000
Antiarrhythmics leaving OR	2	18.2	13	12.9	0.641
Pacing required for weaning CPB	10	90.9	9	8.9	0.001**
Perioperative MI	0	0	3	3.0	1.000
Inotropes leaving OR+	10	90.9	41	40.6	0.001**
Intraaortic balloon pump	1	9.1	6	5.9	0.525

Fisher's Exact test
+ Chi-square test
* p< 0.05
** p< 0.01
AES: Atrial extrasystole, CABG: Coronary artery bypass grafting, CPB: Cardiopulmonary bypass, MI: Myocardial infarction, OR: Operating room, VES: Ventricular extrasystole.

pacing wires[8]. Only mitral reconstruction and mitral valve replacement among surgical procedures, were found to be related with need for pacing during weaning and ICU in our study. The need for postoperative pacing because of rhythm disturbances likely arises by either mechanical trauma to conduction system, which is more common in valvular surgery, or by ischemic injury to conduction system that can be seen both in coronary and valvular surgery[10]. The reason why we did observe increased incidence in mitral surgery but not the aortic surgery, might be increased left atrium sizes and relatively increased incidence of atrial fibrillation in mitral valve patients.

Ten patients out of 19, required further pacing in ICU. Besides pacing support during coming off CPB, ongoing atrial fibrillation and inotropic agent requirement leaving the operating room were important parameters that affected pacing requirement in ICU. In cases of ongoing atrial fibrillation temporary pacing was used for hemodynamic stabilization untill normal sinus rhythm was established. Postoperative atrial fibrillation is a common complication after cardiac operations and is associated with serious adverse events[11]. Treatment of atrial fibrillation with antiarrhythmics may result in bradycardia and advanced atrioventricular block or some patients may not benefit

drug treatment, in such cases cardioversion will be safer if pacing wires remain in place. Unlike preoperative left ventricular dysfunction, postoperative myocardial infarction and intraaortic baloon pump requirement which were not found to be related with increased pacing requirement, inotropic support was found to be an important variable, and that is probably because of their positive chronotropic effect on supporting the rhythm disturbances as well as hemodynamic stabilization.

In our study, 22.4% of operated patients during study period received TEPW and 83.1% of them never required pacing in postoperative period. We found atrioventricular block, junctional rhythm, postperfusion atrial fibrillation, inotropic agent requirement leaving the operating room, pacing requirement during weaning from CBP and mitral valve surgery to be the predictors for requirement of TEPWs in early postoperative period. Although we did not observe any complications related with the wires implantation and removal, selective use of TEPWs mainly for patients who require pacing during weaning period and who experience rhythm disturbances can be recommended.

CONFLICT of INTEREST

None declared.

REFERENCES

1. *Reade MC. Temporary epicardial pacing after cardiac surgery: a practical review. Part 1: General considerations in the management of epicardial pacing. Anaesthesia 2007;62:264-71.*
2. *Sakellaridis T, Argiriou M, Panagiotakopoulos V, Charitos C. Bilateral sternobronchial fistula after coronary surgery-are the retained epicardial pacing wires responsible? A case report. J Cardiothorac Surg 2009;4:26.*
3. *Horng GS, Ashley E, Balsam L, Reitz B, Zamanian RT. Progressive dyspnea after CABG: complication of retained epicardial pacing wires. Ann Thorac Surg 2008;86:1352-4.*
4. *Meier DJ, Tamirisa KP, Eitzman DT. Ventricular tachycardia associated with transmyocardial migration of an epicardial pacing wire. Ann Thorac Surg 2004;77:1077-9.*
5. *Gentry WH, Hassan AA. Complications of retained epicardial pacing wires: an unusual bronchial foreign body. Ann Thorac Surg 1993;56:1391-3.*
6. *Imren Y, Zor H, Tasoglu I. Ventricular fibrillation following removal of temporary epicardial pacemaking wires. Cardiol Young 2005; 15:654-5.*
7. *Bethea BT, Salazar JD, Grega MA, Doty JR, Fitton TP, Alejo DE, et al. Determining the utility of temporary pacing wires after coronary artery by-pass surgery. Ann Thorac Surg 2005;79:104-7.*
8. *Puskas JD, Sharoni E, Williams WH, Petersen R, Duke P, Guyton RA. Is routine use of temporary epicardial pacing wires necessary after either OPCAB or conventional CABG/CPB? Heart Surg Forum 2003;6:E103-E106.*
9. *Imren Y, Benson AA, Oktar GL, Cheema FH, Comas G, Naseem T. Is use of temporary pacing wires following coronary by-pass surgery really necessary? J Cardiovasc Surg (Torino) 2008;49:261-7.*
10. *Gordon RS, Ivanov J, Cohen G, Ralph-Edwards AL. Permanent cardiac pacing after a cardiac operation: predicting the use of permanent pacemakers. Ann Thorac Surg 1998;66:1698-704.*
11. *Houge CW, Hyder ML. Atrial fibrillation after cardiac operation: risks, mechanisms, and treatment. Ann Thorac Surg 2000; 69:300-6.*