

The Evaluation of Right Atrial Temporary Pacing for Preventing Postoperative Atrial Fibrillation Following Coronary Artery Bypass Grafting Surgery: prospective observational study

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Abstract: Atrial fibrillation (AF) is the most frequent (arrhythmia) complication following coronary artery bypass grafting surgery (CABG). The present study is designed to evaluate the efficacy of temporary atrial pacing in the prevention of AF after off pump coronary artery bypass graft surgery. The patients who had first-time off-pump CABG were enrolled in the study. The exclusion criteria were that the patients had valve dysfunctions. The study group (n = 39) were paced electively and the control group (n = 40) were not paced, and both were monitored for 96 hours postoperative for the occurrence of AF. The end points of the study were occurrence of AF, death during postoperative period, and discharge from hospital. The data analyzed by t-test and chi-squared test for variables.

A total of 120 patients enrolled in the study. Forty-one patients were excluded from the study because of intraoperative dysrhythmia, tachycardia or failure of pacing, so the final study subjects consist of 79 patients. AF occurred in 13 of 39 paced group (33.33%) and 13 of 40 non-paced group (32.5%). No statically significant difference in the proportion of patients developing atrial fibrillation was observed between the study and the control group for incidence of AF. Old age (P=0.007), history of myocardial infarction (P=0.001), systolic dysfunction (P=0.003), ejection fraction (P=0.022) and atrial enlargement (P=0.001) were identified as AF predictors. The result of this study shows that prophylactic right atrial pacing had no significant effect on reducing the incidence of AF following off-pump CABG.

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1. Introduction

Atrial fibrillation (AF) is the most frequent (arrhythmia) complication following coronary artery bypass grafting surgery (CABG) and “The incidence of postoperative atrial fibrillation is approximately 30% after isolated coronary artery bypass grafting (CABG) surgery, 40% after valve replacements or repair, and increases to approximately 50% after combined procedures (1).” It is typically seen between the second and fourth postoperative days and the highest incidence

is in the second day after surgery (2). Initially it was thought that AF is harmless, but is now recognized as a dangerous postoperative condition (3). Although this complication is well tolerated in patients but Atrial fibrillation may lead to hemodynamic instability especially in those patients who have left ventricular diastolic dysfunction function (4).

Postoperative atrial fibrillation (PAF) is associated with prolonged hospital stay, and reduced in-hospital and long-term survival, an increased early stroke risk

and sometimes causes serious injuries in patients undergoing coronary artery bypass surgery (5).

Due to the disadvantages and the limited efficacy of pharmacological prophylaxis, there has been a great attempt in the development of nonpharmacologic techniques to prevent postoperative AF. With limited use of beta blockers and amiodarone as prevention of postoperative atrial fibrillation (6, 7), new methods have been proposed to avoid this complication furthermore they avoid the toxicity of antiarrhythmic drugs. Among non-pharmacological methods to prevent postoperative atrial fibrillation, right atrial pacing therapies have decreased the incidence of AF from 42% to 13% on average and in other study it has reported 31.1% to 5.2% (8). Some studies have shown that patients who get atrial or dual chamber pacemakers have fewer episodes of AF than those get ventricular pacemakers, but its impact is not definite yet (9, 10, 11).

The present study is designed to evaluate the efficacy of right atrial temporary pacing in the prevention of atrial fibrillation after off-pump coronary artery bypass surgery and to compare the incidence of postoperative AF between patients with and without right atrial temporary pacemakers.

2. Materials and Methods

Over a period of eight months (February 2011 –September 2011) a total of 120 patients who had first-time off-pump CABG were enrolled in this prospective observational study. All these patients were treated in the open-heart surgery ward at Imam Reza teaching hospital, the main referral hospital in north eastern Iran.

The trial was performed in accordance with the declaration of Helsinki and approved by ethic committee at Mashhad University of Medical Sciences. Written informed consents were obtained before entering into the study.

The inclusion criterion was that all the patients who had first-time off-pump CABG and the exclusion criteria was that patients had history of supraventricular (including atrial flutter or AF) or ventricular tachyarrhythmia, intraoperative AF, use of cardiopulmonary bypass for CABG, valve dysfunctions, and preoperative heart failure.

Forty-one patients were excluded from the study because of intraoperative dysrhythmia. Patients randomly divided into 2 groups. The study group (n = 39) consisted of patients who had been operated on by one surgeon and paced electively in the postoperative period. During the same period, patients with off-pump CABG operations carried out by the same surgeon and were not paced served as the control group. (n = 40). In the study group, before sternal closure, two temporary epicardial pacing wires (model 2500 Medtronic Inc) were fitted to the epicardium of the right atrium, one near the site of

sinus node and the other one, on the lateral wall of the right atrium; then, the right atrial (RA) pacing (AAI mode) was set at rate of 90/min-120/min and the sensitivity of 0.25mv after transferring the patient to intensive care unit. Pacing threshold and sensitivity were checked and reset as needed during each of the following 18 hours and the pacing was continued for 96 hours if the patient had a normal sinus rhythm. So both groups underwent continuous pacing and electrocardiographic monitoring for four days after surgery, and beta-blockers were administered on the first day after the CABG. The end points of the study were the occurrence of AF, the passing 96 hours after the surgery, the death during postoperative period, and discharge from hospital. In the control group, the operations were the same with the study group, but no atrial pacing wires were fitted in these patients. Considering the influence of electrolyte disturbances and hypoxia in incidence of atrial fibrillation, serum potassium and calcium, and oxygen saturation of arterial blood was daily measured in both groups.

Left ventricular diastolic and systolic dysfunctions, left atrial enlargement and a history of myocardial infarction were also recorded to consider in the results for incidence of atrial fibrillation.

The data was analyzed with SPSS version 13 (SPSS Inc., Chicago, IL, USA). Summary statistics were expressed by mean, frequency or numbers and percentages of the patients. The two groups were compared by standard t-test and Chi-squared test for variables. If some of the confounding variables in both groups were not homogeneous, we used logistic regression method for these variables. For all tests, a p-value value of <0.05 was considered significant.

3. Results

A total of 120 patients enrolled in the study. Forty-one patients were excluded from the study because of intraoperative dysrhythmia, so the final study subjects consist of 79 patients. 39 patients entered to the study group (right atrial pacing) and 40 patients were in the control group (no atrial pacing). According to preoperative characteristics of patients, no statically significant difference was observed between the study and the control group. There were no complications due to the placement or removal of the atrial electrodes and no patient died during the study period.

There was no significant difference in the proportion of patients developing atrial fibrillation in two groups. (Study group vs. control group adjusted OR=1.03, 95%CI; p=0.82) Incidence of AF was reported in 26 patients (Table 2). Average time to onset of atrial fibrillation was non-significantly shorter in the control group than the study group. (Study group= 41.0±10 h, control group 35.3±13 h; p=0.488)

Then we investigate the characteristics of patients with and without incidence of AF. (Table 3)

4. Discussion

The purpose of this study was to assess the efficacy of right atrial temporary pacing for the prevention of postoperative atrial fibrillation (AF). We found that there was no significant difference between the proportion of patients with right atrial (RA) pacemakers developing atrial fibrillation and the proportion of patients without right atrial pacemakers. In fact, our study shows that temporary right atrial pacing after CABG surgery does not reduce the occurrence of postoperative AF. However, other studies show the effectiveness of pacemakers in reducing the incidence of postoperative AF (12, 13).

Therefore, since 1960, epicardial pacing in cardiac surgery has been common as a method of counteraction or prevention of A few hours before, after, and while performing the surgery arrhythmias and this procedure has been used to maintain cardiac output and performance (14).

Based on the "prevention is better than the cure strategy," several methods for preventing postoperative AF have been proposed. These methods include the use of beta-blockers in the pre, intra, and postoperative periods alone or in combination (15, 16), statins administration before and after surgery, off-pump CABG operation, upper thoracic epidural anesthesia and rapid extubation after surgery (17, 18, 19).

Several clinical factors have been considered as factors that increase the incidence of postoperative AF, Age, hypertension, a history of AF, male gender, obesity, chronic obstructive pulmonary disease, prolonged cardiopulmonary bypass, left atrial with increased size, and left ventricular with decreased ejection fraction (20-26). In this study, we observed that underlying factors such as gender, right atrial pacemakers, hypertension, diastolic dysfunction, number of grafts, serum calcium and potassium level and oxygen saturation were not associated with the incidence of postoperative AF, However, old age ($P=0.007$), history of myocardial infarction ($P=0.001$), systolic dysfunction ($P=0.003$), ejection fraction ($P=0.022$) and atrial enlargement ($P=0.001$) were identified as the AF risk factors.

Banach et al. (27) selected twelve hundred patients to evaluate the risks factors of atrial fibrillation (AF) following coronary artery bypass grafting (CABG). Statistical analysis identified 5 risk factors of AF: advanced age, history of supraventricular arrhythmias, preoperative heart failure, operation with standard CABG technique and repeated revascularization and this trial also indicated that administration of beta-blockers and the OPCAB (off-pump CABG) operating technique were identified as protective factors.

All these risk factors except advanced age were considered as the exclusion criteria of our study.

The trials that investigated the use of RA pacing alone for controlling of AF after cardiac surgery have yielded mixed results.

Fan et al. (28) studied 137 patients, randomizing them to 4 groups, biatrial, right atrial, left atrial and a control group. They found that the incidence of AF in the RA, LA and control groups were 36%, 33% and 42% respectively, but the incidence in the biatrial pacing group was 12.5%. Thus they concluded that biatrial pacing was a better strategy in the controlling of postoperative AF. Incidence of AF in this study RA group (36%) was almost similar to our RA group (33.3%) and perhaps if we did BA on our patients, we might report the similar incidence of AF among them as well.

Chung et al. (29) studied 100 patients with and without post-CABG atrial pacing. The results demonstrated atrial fibrillation occurred by day 4 in 13 of 51 (25.5%) paced patients and in 14 of 49 (28.6%) Control patients ($p = 0.9$). Gerstenfeld et al. (30) conducted a study on 61 post-CABG patients who were randomly divided into three groups: control (NAP), right atrial pacing (RAP) and biatrial pacing (BAP). There was no significant difference in the proportion of patients developing AF in that trial three groups (NAP 5 33%; RAP 5 29%; BAP 5 37%; $p > 0.7$). But he suggested for further studies on the effect of combined beta-blocker drugs and pacing.

Avila Neto et al. (31) surveyed the effect of temporary right atrial pacing in prevention of AF after CABG on 160 patients. They find a reduced the incidence of atrial fibrillation after the surgery. The incidence of AF was 13.1% (12.5% in non-pacing and 0.6% in right atrial pacing group). They also indicated that older age and non-atrial pacing were the risk factors of post-CABG atrial fibrillation but in our study just the older age was similar as the risk factor. This conclusion about the effectiveness of pacemakers' prevention therapy is also confirmed by Singhal et al. (32) and Greenberg et al. (33).

Archbold and Schilling reviewed the literature regarding the efficacy of epicardial atrial pacing to prevent post-CABG AF during 13 studies. Overall, they conclude that biatrial epicardial pacing appears to be effective prophylaxis against post-CABG AF (34).

Any complication related to pacing wire removal didn't observed. Pacing was safe and well tolerated in patients, and did not increase hospitalization period.

In another study, Chavan et al. studied (35) Bachmann Bundle pacing as an alternative approach in prevention of AF after CABG. Results showed that incidence of AF were 0% in Bachmann Bundle pacing group whereas it was 16.6% in No pacing and 12.5% in RA pacing groups.

Considering the results of this study and of other studies, it seems that the use of right atrial pacemakers to control postoperative AF is debated. However, biatrial pacing seems to be more favorable in reducing the incidence of post-CABG AF (35).

The number of patients in this study is small. Therefore, for a more definite conclusion, it would be better to perform this study in a larger group. In this study, only the right atrium was paced, and it might be better if we studied on biatrial (BA) pacing as well. Although many trials regarding the evaluation of pacing for the prevention of postoperative AF following CABG

have been conducted, we did not find any trial investigating the relative benefits or risks of surgery to upgrade to a dual chamber pacemaker. Considering the results of the trials, we now believe that the more favorable efficacy of biatrial pacing as an AF prevention strategy is obvious, but we are not sure if the complications of this procedure are less in comparison with right atrial pacing. Therefore, the next step is to assess and compare the post-operative complications of BA and RA pacing following CABG.

Table 1. Characteristics of patients before off-pump CABG.

	Study group (n=39)	Control group (n=40)	p-value
Age (mean±SD, year)	63.7±7	61.6±9	NS
Gender (male/female)	26/13	25/15	NS
Hypertension (%)	74.4%	70%	NS
Recent MI* ¹ (%)	35.9%	30%	NS
Systolic dysfunction* ² (%)	51.3%	40%	NS
Diastolic dysfunction (%) ^{*3}	92.3%	82.5%	NS
Left atrial enlargement (%)	6 (15.4%)	3 (7.5%)	NS
Left ventricular ejection fraction (mean±SD)	45.0±9.07	45.7±9.47	NS

*1. MI: Myocardial infarction

*2. Systolic dysfunction: Refers to impaired left ventricular contraction.

*3. Diastolic dysfunction: Refers to decline in performance of left ventricles of the heart during the time phase of diastole.

Table 2. The incidence of atrial fibrillation, according to groups.

Group (n)	Postoperative AF*, n (%)
Total patients (79)	26 (32.9%)
Study group-with right atrial pacing (39)	13 (33.3%)
Control group-without atrial pacing (40)	13 (32.5%)

* AF= Atrial fibrillation is confirmed with an electrocardiogram (ECG or EKG) which demonstrates the absence of P waves together with an irregular ventricular rate.

Table 3. Comparison of with and without AF patients' characteristics

Groups (n)	Patients with AF (26)	Patients without AF (53)	p-value
Age (mean±SD, year)	67.0±9	60.6±9	P=0.007
Gender (male/female)	15/11	36/17	NS
Hypertension (%)	86.0%	66.0%	NS
Recent MI** (%)	61.5%	18.9%	P=0.001
Oxygen saturation (%)	95.1±2.4	94.5±2.6	NS
serum calcium level (mEq/L)	4.4±0.3	4.5±0.3	NS
serum potassium level (mEq/L)	4.0±0.5	3.9±0.4	NS
Systolic dysfunction (%)	69.2%	34.0%	P=0.003
Diastolic dysfunction (%)	92.3%	84.9%	NS
Left atrial enlargement (%)	23.1%	5.7%	P=0.022
The mean number of grafts	3.53	3.58	NS
Left ventricular ejection fraction (mean±SD)	39.8±7.3	48.2±8.8	P=0.001

*AF: atrial fibrillation

**MI: myocardial infarction

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