

Incidence and Risk Factors for Atrial Fibrillation after First Coronary Artery Bypass Grafting in Urumiyeh Imam Khomeini Hospital from 2006 to 2008

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Background: Atrial fibrillation (AF) is the most common arrhythmic complication following coronary artery bypass surgery (CABG). The incidence of postoperative AF ranges from %10 to %0 and it usually tends to occur within 2 to 4 days after operation. The etiology of AF after cardiac surgery is incompletely understood. Aggressive prophylactic intervention should be directed and limited to high risk patients who are most likely to benefit from such procedure. The aim of this study was to identify the frequency of AF and to determine risk factors by using available clinical predictors of postoperative AF after CABG.

Methods: The present study was a prospective observational investigation of 300 patients undergoing elective isolated CABG from 2006 to 2008 in Urumiyeh Imam Khomeini Hospital. Peri-operative risk factors were used to develop logistic regression equation in order to predict the development of post-operative AF.

Results: A total of 300 patients aged 58± 10 (221 male) were included in the study. The incidence of AF was %12/3(n=37). By univariate analysis, congestive heart failure (P=0.02), and low left ventricular ejection fraction (P=0.04) were associated with the development of post-CABG AF. However, in the logistic regression model CHF (OR: 4.87, 95%CI: 1.09-21.6, P=0.038) remained an independent predictor for the development of postoperative AF. On the other hand, patients with and without AF were similar regarding body mass index, preoperative heart rate, time of ventilation in ICU, pump time, grafting or absence of grafting on right coronary artery (RCA) and the prevalence of chronic lung diseases, previous myocardial infarction, and diabetes mellitus. Patients who developed AF had longer ICU stay (OR=4.92, P=0/000).

Conclusion: The results of the present study demonstrated that the combination of congestive heart failure, and low left ventricular ejection fraction can identify patients at high risk for occurrence of AF after CABG.

Keywords: Atrial Fibrillation, Coronary Artery Bypass Surgery, Arrhythmia

Introduction

Atrial fibrillation (AF) is the most common arrhythmic complication after coronary artery bypass surgery (CABG). The incidence of postoperative AF varies from %10 to %40 according to patient characteristics, type of surgical procedure and the method of heart rhythm monitoring. It usually tends to occur within 2 to 4 days after the operation, with less than %10 on the first postoperative day.¹⁻⁴ Owing to advances in surgical and

anesthetic techniques, and postoperative care, and despite its inherent higher risks, postoperative mortality and morbidity has remained low and even declined in recent years.^{5,6} In spite of the general decline in complications, the incidence of postoperative AF has not decreased and actually appears to be increasing. This is most likely attributed to the rising proportion of CABG procedures performed on elderly patients.^{7,8} AF after CABG is self-limited in most cases. Even in uncomplicated cases, it requires prolong hospitalization, additional medical treatment, and increasing costs. In some cases, it may result in inappropriate tachycardia, hypotension, heart failure, and possible increase in the risk of cerebrovascular accidents.⁸⁻¹¹ Because of the

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enormous clinical and economic impact presented by this complication, numerous attempts have been made to identify risk factors for postoperative AF in an effort to provide insight into its pathophysiology, and to allow better assessment of prophylactic management strategies.¹² Identifying patients who are at risk allows us to implement preventive or therapeutic interventions that can reduce the side effects of antiarrhythmic drugs and decrease the cost of prophylactic treatment.^{11,13}

The aim of this study was to identify the frequency of AF and to determine its risk factors by using available clinical predictors of post-CABG AF.

Patients and Methods

We conducted a prospective observational study of 300 patients undergoing elective and isolated CABG for the first time, between 2006 and 2008 in Urumiyeh Imam Khomeini Hospital. Exclusion criteria were preoperative chronic atrial fibrillation or atrial flutter, surgical procedures other than isolated CABG, preoperative critical conditions; (advanced atrioventricular heart block or severe conduction disturbance, impaired renal function (serum creatinin > 2mg/dl) and previous stroke or transient ischemic attack, intra- or post-operative death during hospital stay.

For each patient a form was completed which included preoperative, intra-operative, and post-operative data. In all patients, maintenance of anesthesia was conducted with propofol infusion at 150 μ g/kg/min combined with remifentanyl infusion at 0.2 to 1 μ g/kg/min and cisatracurium 0.2 to 1 μ g/kg/min. Air and oxygen (% 50) were used and normocapnia was achieved. Midline sternotomy with standard surgical technique was used for moderate hypothermia (28-30°C) cardiopulmonary bypass (CPB) for all the patients, and cardioplegia in cold crystalloid (modified St. Thomas solution) was administered for myocardial protection. After surgery, patients were admitted to cardiothoracic intensive care unit, and weaned off the ventilator as soon as they met the following criteria: hemodynamic stability, absence of major bleeding, normothermia, adequate consciousness, and pain control. Potassium and magnesium supplements were given as necessary to maintain electrolyte balance within the normal range. All patients were monitored daily by a certified nurse until discharge with continuous telemetry and standard 12-lead ECG. The major outcome measured was the development of postoperative AF. AF was detected by ECG monitoring and defined as any development of AF of more than 10

minutes or of any length of time requiring intervention. The relationship between post-operative AF and pre-, intra-, and post-operative parameters was assessed. A p value \leq 0.05 was considered significant. The association of pre-, intra-, and postoperative factors with the occurrence of postoperative AF was tested by using Student's *t*-test for continuous variables with normal distribution (expressed as means \pm SD), and Chi-square test and the Fisher's exact probability test (whenever appropriate) for categorical variables. Factors that proved significantly associated with postoperative AF by univariate analysis entered into logistic regression analysis (OR and 95% CI) to determine the independent characteristics associated with postoperative AF. Statistical analyses were done with a commercially available software SPSS version 16.

Results

A total of 300 patients, 221 (73.3%) males and 79 (26.3%) females with mean age of 58 \pm 10 years, participated in the study and underwent on-pump CABG. Postoperative AF developed in 37 (12.3%) of patients undergoing CABG. The postoperative AF peaked on day-3 with mean duration of 27 \pm 22 hours. The baseline characteristics of the study population are shown in Table 1.

There was no significant difference between groups in regard to the age, sex, left main coronary artery involvement, past history of hypertension, diabetes mellitus, myocardial infarction, chronic lung diseases, and pre-operative beta blocker consumption. However, the prevalence of congestive heart failure (CHF) was significantly higher in the AF group ($P=0.024$). There was no significant difference between method of anesthesia or surgery, the pump time, aortic cross clamp time, and duration of intubation in the ICU. Nevertheless, significant difference in left ventricular ejection fraction (LVEF) was found between two groups ($P=0.04$). On the other hand, the length of ICU stay was significantly ($P=0.00$) longer in the AF group than in the non-AF. Characteristics of the groups and p values by univariate analysis are shown in Table-2.

By using stepwise logistic multivariate regression model CHF (OR; 4.87, 95% CI: 1.09-21.6, $P=0.038$) remained an independent predictor for the development of post-operative AF.

Discussion

Postoperative AF remains the most common arrhythmia after cardiac surgery and occurs in up to 50% of patients after open-heart surgery. The

Table 1: Baseline Characteristics of the Patients

Characteristics	Total
No. at risk	300
Age	58±10
Body mass index(kg/m ²)	26.8±4
Males/Females (% Males)	221/79(73.7)
LVEF (%)	44±9
Concomitant beta blocker therapy	68
Hypertension (%)	69
Diabetes mellitus (%)	22
Chronic lung disease	12
Symptoms of heart failure (%)	3.3
Prior myocardial infarction (%)	42
No. LM involvement (%)	20
Pump time(min)	122±34
ACC time (min)	75±21
No. of coronary graft(median)	4
RCA-bypass graft	26
Time of ventilation in ICU (hours)	11± 7
No. of days in ICU	3±0.5

Acc=Aortic cross clamp time, NS= no significant, S=significant
 ICU= intensive care unit, RCA= right coronary artery, No=number
 min=minute, CHF=Congestive heart failure, RCA= right coronary artery,
 LVEF= left ventricular ejection fraction

incidence of post-operative AF has not changed despite major improvements in surgical and anesthetic techniques.¹ Mechanism of Postoperative AF is complex and still not well-understood. Recent experimental studies have suggested that AF is the result of multiple wavelets that wander around anatomical obstacles and areas of functional conduction block, randomly activating contiguous regions once they have recovered excitability from previous depolarization by another wavelet. The fibrillation process, therefore, is based on re-entry, with different simultaneous circuits that characteristically exhibit a notable variability in terms of number and dimensions.^{14,15,16} However, the reason for frequent episodes of arrhythmia following CABG surgery is still a matter of debate. Many pre-operative and post-operative factors have been suggested to increase the incidence of postoperative AF after conventional CABG including advanced age, hypertension, withdrawal of Beta-blocker drugs, right

coronary artery (RCA), stenosis, respiratory complications, and bleeding.^{17,18,19} Strategies directed toward reduction of post-operative AF have focused on several drugs given prophylactically, such as beta-blockers,^{20,21} calcium antagonists,²² and amiodarone,²³ with conflicting results. However, little is known about intra-operative mechanisms through which the incidence of post-operative AF could be reduced.²⁴

The AF incidence found in our study was 12.3%, which was lower than those of similar studies.^{25,25} These differences in the results may be due to notable differences in study population, methodology of studies, and methods of monitoring for the post-operative AF.

The main finding of the present study is congestive heart failure (CHF) which is the main independent predictor for development of post-operative AF.

In contrast to most of the previous reports,^{25,26} these results failed to demonstrate advanced age as an independent predictor of post-operative AF, although overall, a high percentage of AF was observed in older patients, and this finding was concordant with the results from Spodick DH et al.²⁶

Some studies,^{17,28} identified the males as an independent predictor of AF in the post-operative period, but data derived from our study did not support this finding which was similar to the results of Auer et al.²⁶

Aranki and colleagues,¹⁷ have identified hypertension as a predictor of AF in the post-operative period. Data from the present study confirm the results of most previous reports that hypertension is not predictor of post-operative AF.

The univariate analysis of the present study showed that low LVEF was a predictor of AF after CABG, however, when this factor was included in a stepwise logistic multivariate regression model, it did not appear to have an independent role.

On the other hand, majority of patients with and without AF had similar body mass index, pre-operative heart rate, time of ventilation in ICU, with Pump time histories and diabetes mellitus, and chronic lung diseases not being different in the two groups.

The development of post-operative AF is extremely important. It affects a large population of patients and imposes substantial costs. In our study, the mean length of stay in the ICU after bypass surgery increased from 3±0.5 days for patients without AF to 4±1 days for patients with AF. Similar results were reported by Magee MJ et al.²⁵

The administration of pre-operative beta-block-

Table2: Characteristics of Study Groups (with or without Post-operative AF) Univariate Analysis for Atrial Fibrillation

Variables	AF (N=37)	No AF (N=263)	P value
Age (years;mean±SD)	60±9	58±10	0.188(NS)
Gender (%male)	70%	74%	0.6(NS)
Body mass index (kg/m ²)	27.4±4	26.7±4	0.33(NS)
LVEF (%)	41±2	44±1	0.04(S)
Preoperative heart rate	77±3	76±1	0.77(NS)
Concomitant beta blocker use	62	69	0.38(NS)
RCA graft(%CABG)	13.5	27.4	0.07(NS)
History of hypertension (%)	76	68	0.32(NS)
Diabetes mellitus (%)	24	21	0.6(NS)
Chronic lung diseases (%)	27	39	0.15(NS)
Preoperative CHF (%)	11	2	0.02(S)
Prior myocardial infarction (%)	32	43	0.22(NS)
Pump time (min)	129±6	121±2	0.19(NS)
ACC time (min)	77±4	75±1	0.5(NS)
Time of ventilation in ICU (hours)	13±1	11±05	0.15(NS)
No. of days in ICU	4±1	3±0.5	0.00(S)

Acc=Aortic cross clamp time, NS= no significant, S=significant ICU= intensive care unit, RCA= right coronary artery, No=number min=minute, CHF=Congestive heart failure, RCA= right coronary artery, LVEF= left ventricular ejection fraction

er has been suggested to have a protective role against the development of post-operative AF.^{27,28} Findings of our study did not support this issue. There was no significant difference among 68% of our patients receiving beta-blockers pre-operatively, in regard to the development of post-operative AF.

Several finding in our study were concordant with similar previous studies. In the mean time, some of our results did not support those of previous studies. Particularly, incidence of post-operative AF in present study in comparison with other reports was relatively low. Such discrepancies are common among large epidemiologic studies^{8,28-30} and may reflect one or more of the following aspects. These include differences in patient characteristics and demographics surveyed, sample size, number of risk factors in the multivariate model, and monitoring techniques. Our observation suggested the need for more advanced studies on mechanism

of AF after CABG procedures. Although most would agree that, unlike low-risk group, the high-risk patients should receive prophylaxis either before or immediately after surgery. In addition, for intermediate-risk patients cost-benefit analysis of potential preventive or therapeutic strategies would provide evidence-based data in order to minimize drug related adverse effects and costs.^{31,32}

The results of the present study demonstrated congestive heart failure, and low left ventricular ejection fraction (LVEF) as predicting factors for the development of AF. Such high-risk patients may be proper candidates for the pre-operative implementation of prophylactic interventions.

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