

Investigating the prevalence of AF (atrial fibrillation) rhythm and its risk factors in patients undergone CABG (coronary artery bypass grafting) at Imam Khomeini Hospital from April 2006 to March 2009

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Abstract

AF is the most frequent arrhythmic complication after CABG. The aim of this study was to identify the incidence and risk factors of AF in a cross sectional study of the patients who underwent CABG surgery in Imam Khomeini hospital. Methods: Between April 2006 and March 2009, data of patients who underwent CABG in Imam Khomeini hospital were gathered. 545 patients were included in this study randomized .we had excluded the patients who didn't have complete data for our study or have a history of arrhythmia before surgery. we divided patients in two groups: the patients who developed post CABG, AF(AF group), and the other who didn't develop this complication(No AF group).Multivariate analysis(odds ratio, p value) was used to identify independent predictors of post CABG AF.

Some of Our major variables was preoperative like age, sex, BMI, history of diabetes, HTN, hyperlipidemia, COPD, smoking history ,family history of CAD, renal insufficiency and LVEF

Some was intraoperative like cross clamp time, perfusion time and some was post operative like prolonged ventilation (>24 hours), re-operative, bleeding and mortality

Result: post operative AF occurred in 48(8.8%) of patients. multivariate analysis identified age>65 years (p value=0.033, OR=1.97) as a predictor of post CABG AF. also hospital mortality was significantly higher in AF group(12.5% in AF group vs 4.4% in No AF group with p value=0.029, OR=3.08).other variables didn't have significant differences between two groups and didn't identify as risk factors of AF.

Conclusion: Although the incidence of AF in this study was not as many as other studies that may show lower incidence in Iranian patients compared with other nations, the higher mortality rate in AF group shows that we should improve our post-op surveillance to diagnose AF as an early complication specially in high -risk patients like old patients(>65 years)and treat the patients who need interventions to decrease the mortality of this complication after surgery.

Introduction

Atrial Fibrillation (AF) : Heart muscle experiences a kind of irregular contraction under certain conditions in which it completely blocks the blood movement. Such arrhythmia is called fibrillation which is involving atria and ventricles. Usually, fibrillation is caused by re-entry phenomenon in which impulses are branched in numerous irregular circuits (1). In AF, ventricles are not able to pump the blood, and they reduce efficiency of ventricles by 30-20%. In such situations, patient can do normal activities fully and live for many years, while overall efficiency of the heart is lower (2). AF is also created by multiple arterial parasystolic foci that each of these foci creates extremely high rate impulse. It also creates electrical stimulates, and irregular and weak waves emerge in ECG as result. Additionally, none of the stimulus is not transmitted, and only arterial depolarization wave reaches occasionally to ventricles through AV node, and it creates an irregular ventricular rhythm. In comparing AF waves with natural sine wave(SAN), it can be said that each sine pacemaker is in the form of concentric circles like waves created and expanded by dropping a stone in the water pond, while multiple irregular waves in atrial fibrillation is like raining and creation of multiple small waves on the surface of water pond (3). AF occurs in a variety of chronic heart diseases in which atria are essentially loose heart in each heart cycle and they do not participate in ventricular filling (4)..

AF rhythm is most common arrhythmia after CABG operation, that its prevalence is 10 to 40% according to various reports [8-5]. This arrhythmia occurs mainly during days 2 to 4 days after CABG operation that its peak incidence is in the second day after the operation [10,9, 7]. AF is characterized by irregular atrial activity . AF arrhythmia may occur in healthy individuals, especially due to emotional stress after operation, exercise, acute poisoning with alcohol or severe irritation of the vagus (vasovagal response) [11].

AF display in ECG

In AF, no P wave can be seen in ECG or small irregular waves with high frequency and very low voltage waves called f waves can be seen. However, they are unlike natural QRS-T complexes, but the time of complexes is irregular.

During AF, impulses reach from atria to AV node at high rate but irregularly. AV node is activated at those intervals, which can significantly vary from one cycle to another cycle. Therefore, no constant time interval occurs between QRS complexes or between successive ventricular contractions. QRS ventricular response is also irregular and random. As ventricular contractility depends on interval between beats, pulse volume and rhythm are also irregular.

Diagnosis: In fact, irregularity seen in ECG with varying intervals between pulses is one of the clinical findings, which it is used for AF diagnosis. As arterial fibrillation impulses have high rate, ventricles are usually stimulated at high rate.

Treatment: As digital reduces AV conduction and even it inhibits the AV node, it is used in AF to reduce rapid ventricular rate (3 and 4). Of course, as atria are contracted and expanded rhythmically in AF, blood clots tend to be formed in atria. Such clots may penetrate to general vascular intravenous beds, therefore, patients with AF are usually treated by anticoagulation drugs. AF can be returned to normal rhythm by drugs that prolong the refractory period (3).

CABG:

CABG (Coronary Artery Bypass Grafting) operation is a operation in coronary artery disease. In this operation, part of a vein (usually saphenous) is used to make connection between the aorta and coronary artery after the blocked area. Instead of vein, one or two Internal Mammary artery or a radial artery can be given to anastomosis blocked area. When operation is conducted by an experienced and skilled team in patients with normal left ventricular function, it is safe and mortality rate is lower than 1 [11]. Despite recent advances in cardiac operation, anesthetic techniques, and myocardial protections, there has been no reduction in the frequency of postoperative AF. [12] In fact, it seems that it has even increased [9,10]. In fact, recent developments and advances in cardiac operation, anesthesia, and postoperative have reduce deaths and complications resulting from operation in recent years. [14,13] AF is generally considered benign and self-limiting, but AF after CABG operation can lead to severe complications, including systemic embolization and hemodynamic instability [5]. It also leads to longer stays in hospital and increased cost of care and treatment and an increased risk of readmission in the ICU [10,15,16]. Due to the excessive clinical and economic impact AF after CABG operation, numerous efforts have been made known as risk factors for postoperative AF [17,18]. Therefore, most efforts are focused on the prevention of AF in patients with high risk [19]. Numerous studies have been conducted to find high risk groups so that demographic risky factors and predictors of postoperative AF to be identified [17].

In this study, we studied the incidence of AF in patients underwent CABG operation and factors affecting before, during, and after AF operation. Knowing rate and time of incidence of this complication and its relationship with other factors can help medical staff to make better decisions in order to reduce mortality and morbidity rate of patients.

Methods:

The study population: Our study population consisted of 545 patients who underwent CABG operation during April 2006 to March 2009 CABG in Imam Khomeini Hospital and met inclusion criteria and did not have the exclusion criteria. Inclusion criteria: patients who have undergone only CABG operation. Exclusion criteria: having any of the following led to exclusion of the person from the studied population: (1) a history of AF rhythm before operation 2 – another simultaneous heart operation such as congenital and valve operation 3 - Predisposing-arrhythmic drugs

This study was conducted in Imam Khomeini hospital and its time relates to patients underwent operation during April 2006 to March 2009. After collecting data and elimination of cases which did not meet the inclusion criteria and had exclusion criteria, based on previous studies in a similar study, AF incidence after CABG operation was shown 15%. Additionally, if confidence level of 95% ($\alpha = 0.05$) and accuracy (d) of 0.03 and P = .015 are considered, sample of 545 people will be achieved using the following formula (20):

$$n = \frac{Z_{1-\frac{\alpha}{2}}^2 pq}{d^2}$$

The method of data collection: this study was conducted by using cross-sectional way and by collecting files on patients who were undergone CABG operation in Imam Khomeini hospital, and required personal information and laboratory results were extracted from patients' files. Then, information of 545 patients were determined randomly among patients underwent CABG operation since April 2006 to March 2009. In addition, intraoperative information of patients was extracted from action report sheet by physician's assistants and it was recorded in forms. The dependent variable in this study included the incidence of postoperative AF rhythm in these patients taken by 12 EKG Lady during the first, second and fourth days in the ICU and checking radial pulse 4 times a day by nurses and physician's assistants, taking EKG examination in cases of suspected examination or symptomatic patient was proven.

Independent variables of this study include age (in years), gender, DM (fasting blood sugar 13 and higher), HTN (blood pressure sys \geq 140 and

Diastolic \geq 90) obesity (based on BMI \geq 130), smoking, family history of CAD (coronary artery disease in man under 55 years and woman under 60 years), COPD (chronic progressive lung disorder with reduced peak expiratory flow) preoperative renal failure (Cr \geq 1.5 mg / dl,) LV EF (percent of the blood volume ejected from the left ventricle of the heart per beat), hyperlipidemia (TG \geq 250 or total Chol \geq 200 ,) CPB time (duration when patient were pulmonary bypass) Cross-clamp time (duration of aortic clamp), reoperation due to bleeding or tamponade complications, Prolonged ventilation time (need for mechanical ventilation over 24 hours).

Ethical considerations: The identity of participants is protected in this study because the information obtained in the forms are without personal information and without an individual case number. And as patients are not involved directly, they faced with no ethical problem in this regard.

Data analysis: SPPS 19 was used to analyze data. After collecting data, they were given to SPSS and they were analyzed. As dependent variable (AF after operation) is a nominal qualitative variable, Chi square test was used to test qualitative independent variables and t-test was used to test quantitative independent variables.

Problems and Limitations: non-registration of information of all considered variables and thus reduction in the number of variables in the study.

Results

1. The main variable of study is AF incidence after CABG operation, which among 545 patients studied, 48 of them were affected with this disease. Accordingly, AF incidence in the population was obtained 8.8%.

2. In this study, 545 patients undergone CABG operation were examined, which 388 of them were male (71.2%) and 157 of them were female (28.8%). The mean age of the studied population was 59.8 in which the oldest patients was 83 years old and the youngest patients was 37 years old, in addition, 31.4% of population were higher than 65 years old and 68.6% of them were lower than 65 year old.. Considering the age, mean age was 62.52 in AF patients and it was 59.57 in No AF patients. Using independent T-Test, the p value was obtained 0.052 that it was not significant at the level of P \leq 0.05. However, the incidence of AF in two age groups of above 65 years and below 65 years had significant differences. Out of 171 patients over 65 years old, 22 patients (12.9%) had AF and out of 374 patients under 65 years old, 26 patients (7%) had AF obtained by chi square test with p value = 0.033 and (OR = 1.97), respectively, which represents the difference was not statistically significant.

3. In this study, the impact of gender of patients on incidence of AF was examined. In the No AF

patients group, 354 patients were males (71.2%) and 143 patients were females (28.8). in the AF patients group, 34 patients were male (70.8%) and 14 patients were female (29.2%) that there was no significant difference between the two groups using chi square test.

4. Considering the variable of smoking in both groups, in the AF group, 11 patients were smoker (22.9% and 37 people were non-smoker (77.1%) in the No AF group, 161 patients were smoker (32.4%) and 336 patients were non-smoker (67.6%) that there was no significant difference between the two groups based on P value=0.197, using chi square test.

5. Considering the variable of family history of CAD (coronary artery disease), in the AF group, 4 patients (8.3%) had a positive family history and 44 patients (91.7%) had no family history in this regard. In the No AF group, 32 patients (6.4%) had a positive family history and 465 patients (93.6%) had no family history that there was no significant difference between the two groups based on P value=0.546, using chi square test

6. Considering the variable of diabetes, in AF group, 161 patients were diabetic (33.3%) and 32 patients were non-diabetic (66.7%). In the No AF group, 166 patients were diabetic (33.4%) and 331 patients were non-diabetic (66.6%) that there was no significant difference between the two groups using chi square test.

7. Considering the variable of Hyperlipidemia in two AF and No AF groups, in the AF group, 18 patients (37.5%) had Hyperlipidemia and 30 patients (62.5%) had no Hyperlipidemia. In the No AF group, 158 patients (31.8%) had Hyperlipidemia and 339 patients (68.2%) had no problem in this regard, that there was no significant difference between the two groups based on P value=0.422, using chi square test.

8. Considering the variable of high blood pressure in two AF and No AF groups, in the AF group, 28 patients (58.3%) had high blood pressure and 220 patients (44.53%) had normal high blood pressure. In the No AF group, 220 patients (44.3%) had high blood pressure and 227 patients (55.7%) had normal high blood pressure, that there was no significant difference between the two groups based on P value=0.069, using chi square test.

9. Considering the variable of renal failure, in the AF group, 6 patients (12.5%) had h renal failure and 42 patients (87.5%) had no renal failure. In the No AF group, 50 patients (10.1%) had renal failure and 447 patients (89.9%) had no renal failure, that there was no significant difference between the two groups.

10. Considering the variable of obesity in the studied population, in the AF group, 15 patients (31.2%) were obese and 33 patients (68.8%) were not obese. In the No AF group, 113 patients

(22.7%) were obsess, and 384 patients (77.3%) were not obese, that there was no significant difference between the two groups based on P value=0.21, using chi square test.

11. Considering the variable COPD history, in the AF group, none of patients had COPD. In the No AF group, 8 patients (1.6%) had COPD that there was no significant difference between the two groups based on P value=0.1.00.

12. considering the variable of EF, the left ventricle measured before operation in all patients was $46.57\% \pm 10.28\%$ and in AF group, its mean was $44.06\% \pm 11.42\%$ and in group No AF group, its mean was $46.81\% \pm 10.15$, that there was no significant difference between the two groups based on P value=0.076, using t-test.

13 -considering the cardiopulmonary bypass time (CPB Time), it was 106.65 ± 39.29 in all patients, and in the AF group, the mean of this time was 109.23 ± 39.87 minutes and in the NO AF group, it was 106.41 ± 39.26 , that there was no significant difference between the two groups based on P value=0.635, using t-test.

14- considering the cross clamp time, it mean was 60.83 ± 26.31 in all patients, and in the AF group, the mean of this time was 62.66 ± 30.06 minutes and in the NO AF group, it was 60.65 ± 25.95 , that there was no significant difference between the two groups based on P value=0.614, using t-test.

15. Considering the need for mechanical ventilation 24 hours after operation, in AF group, 4 patients (8.3%) and in the No AF group, 16 patients (3.2%) needed mechanical ventilation for more than 24 hours. Considering the P value=0.090 obtained by using chi-square, it shows that the difference between two groups is not significant considering $p \le 0.05$.

16. considering the variable of reoperation, in AF group, 2 patients (4.2%) required reoperation, and in the No AF group, 22 patients (4.4%) required reoperation because of bleeding or cardiac tamponade that there was no significant difference between the two groups based on P value=1.00, using chi square.

17. Mortality rate in the studied population was 28 patients (5.1%), which it was 6 patients (12.5%) in AF group, and it was 22 patients (4.4%) in No AF group. According to p value = 0.029 and OR = 3.08 by obtained by chi square test, it showed that mortality rate in AF group was significantly higher than another group.

It is noteworthy that a total 31.6% of population were smokers, and 6.6% of them had family history of CAD. Diabetes incidence in the studied population was 33.4%, and prevalence of hyperlipidemia was 32.3%. Patients with HTN was 45.5%, 10.3 of people had renal failure (cr> 1.5) and the incidence of obesity in this population was 23.5.

Discussion

AF is one of the most common complications after cardiac operation, so that 10-40% of all patients undergone CABG experience postoperative AF. [5] In a study that was conducted in 2001 at the Gdnask University in Poland from 1999 to 2000, information of 906 patients undergone in the cardiac operation section of this university was collected. Information of 811 patients was complete and they had no history of arrhythmia. These patients were divided into three groups in terms of type of operation.. The first group: patients undergone common CABG (n=650). The second group: patients undergone off pump-CABG operation (n=118), and the third group: patients undergone CABG operation along with valve replacement (n=53).. Accordingly, the difference of AF prevalence in two groups of CABG and Off pump CABG was not significant (P = 0.9) [21]. In another study conducted at the University of Inonu in Turkey, information of 426 elderly patients undergone CABG at medical center of Targut Ozal between 2001 and 2005 as collected. Postoperative AF prevalence in these individuals was 21.4 (n=91) [7], Mean age of AF group was significantly higher than No AF group $(71.2\pm4.6 \text{ vs } 69.8\pm4.4 \text{ with P} =$ 0.007). In addition, preoperative renal failure history was significantly higher in AF group (4% in AF vs. 0.8% in No AF group with P = 0.04). No difference was found between the two groups in terms of gender distribution. In this study, there was no statistically significant difference between two groups in terms of HTN, hyperlipidemia, smoking and obesity. EF mean in two groups was not significantly different. In terms of intraoperative parameters, only Cross Clamp time was significantly higher in AF group (81.6 ± 22.1 min in group AF vs. 74.7 ± 21.4 in No AF group with P = 0.01 [22].

In another study conducted in Iran at Shahid Rajaee Cardiac Hospital of Tehran during the years 2005 to 2006, data of 302 patients undergone CABG were collected. Out of these patients, 282 patients underwent On pump CABG operation and 20 of them underwent Off pump CABG. AF prevalence in this study was 15% (n=46) that its peak was in the third day after operation [20]. AF patients were significantly older than NO AF group (63.5 \pm 8.5 years in the AF group vs 57.7 ± 9.9 years in no AF group with P < 0.001). The prevalence of AF was not significant between two groups. Variables of HTN, diabetes mellitus, hyperlipidemia, and smoking were not significantly different in groups. Based on EKG findings before operation, the size of left atria was significantly different in two groups (P <0.001). Abnormal P in EKG before operation was seen in 26% of patients affected with AF that this value in another group was 2% and this difference was significant with P <0.001. In this study, in terms of Cross Clamp time, there was no

significant difference between the two groups of AF and no AF [20].

The results of the present study show that the prevalence of AF (8.8%) in Imam Khomeini Hospital is lower than that of Gdnask University of Poland (9.8% and 10%) and University of Inonu in Turkey (21.4%) and Shahid Rrajaee Cardiac Hospital (15%).

While AF prevalence in the studied population with 8.8% was reported less than reported range of AF after CABG (10-40%), high percentage of AF in different studies could be due to the fact that in the atrial tachycardia, ventricular rate might be so high that reduces diastole and there is no enough opportunity to fill ventricles with blood between contractions. As a result, cardiac output reduces and cardiac failure symptoms emerge. Higher rate of mortality in AF patients in this study and another studies might be due to this fact.

Several studies have tried to identify predictive factors of AF after CABG operation that one of them is age. Considering the age factor and AF prevalence in this study, it can be said that age older than 65 years is a risk factor for AF prevalence. The relationship between AF prevalence and age factor in this study is in line with results of studies conducted at Inonu University and Shahid Rajaee Hospital (8,9,12,15, 20, 22, 23). Additionally, mortality rate in AF patients compared with No AF group was significantly higher (12.5% in AF vs 4.4% in No AF group with p value = 0.029, OR = 3.08), although this percentage is lower compared to other studies. Due to increased mortality in this regard, necessary steps should be taken to identify patients with AF after operation specially patients with high risk of AF prevalence (older patients) so that measures to be done to resolve and control this problem so that mortality rate to be reduced in patients after CABG operation. In this study, gender distribution had no impact on AF prevalence after CABG operation in patients that is in line with other studies (20, 22). In various studies, serum creatinine level before operation has been defined background rental failure as significant predictive factor in mortality rate in patients undergone CABG (24). In addition, Mathew in a study showed that serum creatinine level after CABG operation in patients (all ages) with AF after CABG is higher compared to patients without AF after CABG operation [16]. It is noteworthy that serum creatinine often increases in the first days after CABG operation, and this is when AF occurs.

However, some studies did not identified serum creatinine level as a predictive factor for AF after CABG operation [25]. In this study, a significant difference was not observed in creatinine levels of two groups, although recent Observational studies also showed the coincidence of increased serum creatinine and AF after CABG operation. Al Bahrani showed that there operation there is no relationship [26, 27].

In other studies, various factors were reported as a predictor of AF prevalence after CABG operation in adults in whole population, including: hypertension (HTN), diabetes mellitus (DM), obesity (BMI> 30), COPD, peripheral vascular disease, poor left ventricular function, CHF, strategy and the CPB time cardioplegia (cardiopulmonary bypass) (7,12, 16, 23, 27), but, in this study, the above-mentioned variables of smoking (p = 0.197), family history of CAD (p =0.546), the prevalence of diabetes in the two groups (p = 1.00), hyperlipidemia (p = 0.422), HTN (p =0.069), renal failure (p = 0.617), obesity (p =0.211), COPD (p = 1.00), LVEF (p = 0.076), prolonged mechanical ventilation (p = 0.090), CPB Time (p = 0.635), cross clamp time (p = 0.614) and reoperation (p = 1.00) had no significant relationship with AF prevalence, although different variables between AF and NO AF groups had no significant difference at the level of P ≤ 0.05 , but values of all the factors in patients with AF were more than others.

Some studies have shown that special factors of Post-Op including need for mechanical ventilation for more than 24 hours after operation or the need for inotropic factors after operation are related with postoperative AF [7,15,28] that in this study, the prevalence of AF had no significant correlation with mechanical ventilation more than 24 hours.

In other studies, many before and after operation factors were introduced as factors increasing the prevalence of AF after CABG operation such as: HTN, beta-blocker drugs interruption, the right coronary artery tightness, postoperative respiratory complications and bleeding [7,29]. Investigating the wide range of assumed factors requires further study. It seems that by conducting more studies on patients and close monitoring after the operation, we can identify greater number of AF cases and anothe variables as risk factors involved in AF prevalence.

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