# Atrial Fibrillation after Off-Pump versus On-Pump Coronary Artery Bypass Graft Surgery

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## Abstract

***Background***- Atrial fibrillation (AF) is the most common postoperative arrhythmic complication after coronary artery bypass graft surgery (CABG). The aim of the present study was to compare AF prevalence after off-pump versus on-pump CABG.

***Methods***- In this prospective study, performed between September 2008 and September 2009, 128 consecutive patients in our local cardiovascular surgery ward were allocated into two groups of off-pump (95 patients) and on-pump CABG (33 cases).We compared preoperative risk factors such as left ventricular ejection fraction (LVEF)<%40, hypertension (HTN), and Cr>2mg/dl, site of grafting such as the left coronary descending artery (LAD), right coronary artery (RCA), and left circumflex artery (LCX) in the two groups of surgery techniques (on-pump versus off-pump CABG) with/without postoperative AF after 24 hours of surgery in the Intensive Care Unit. Statistical power of the study was 80%, and a P-value less than 0.05 was considered significant.

***Results***-The prevalence of AF was 15 (15.8%) in the off-pump group versus 7 (21.2%) in the on-pump group (p=0.67) 24 hours after CABG. In the on-pump group, there was no difference between age categories (p=0.11). In the on-pump group, as opposed to the off-pump CABG group, there was no relationship between the surgery techniques with or without AF, LVEF<%40, and HTN. There was a significant relation with Cr more than 2 mg/dl in the on-pump CABG group (p= 0.001) versus the off-pump CABG group (p=0.057).There was no statistical relation between the type of vascular graft (LAD, RCA, and LCX) between the on-pump and off-pump CABG patients attributed to with or without AF.

***Conclusion***- There was no reduction in the AF rate in the on-pump CABG versus off-pump CABG. It seems that there was another predictive factor for AF in the off and on-pump CABG groups, so further prospective trials with larger sample sizes are recommended ***(Iranian Heart Journal 2011; 12 (4):48-53*)**.

**Keywords**: Atrial Fibrillation■Off versus On Pump■ Coronary Artery Bypass Graft Surgery

Atrial fibrillation (AF) is the most common postoperative arrhythmic complication after coronary arterial bypass graft surgery (CABG) and varies between 20% and 50%.[1-4] Some different factors are contributed to this prevalence, including duration of the observation period, technique of surgery, cardiac monitoring and clinical status of individuals, population under study, and criteria for the diagnosis of arrhythmia.[5]

Although AF is not defined as a threatening complication, it might induce hemodynamic disorders, thromboembolic disorders, respiratory distress, myocardial ischemia, pulmonary infection, heart failure, cardiogenic shock, and increment of treatment costs.[5-7]

CABG has always been conducted via the median sternotomy approach and cardiopulmonary bypass through cardiac arrest.

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This approach promised to be the most ideal operation method by providing a motionless and bloodless field by easy access to coronary arteries. Recently, a new alternative method for CABG has emerged. The off-pump method has been introduced as method with lower cardiopulmonary bypass related side effects and incidence of postoperative atrial fibrillation (AF) due to the elimination of different hypothesized causes.[8]

There have been increasing concerns about the rate of graft patency and lack of uniformity in technical approaches, and recent studies have reported contradictions aside from AF and significant decreases in short-term mortality and morbidity.[9] The aim of the present study was to compare the AF prevalence after off-pump versus on-pump CABG surgery.

## Material & Methods

Our study participants in the Cardiovascular Surgery Ward of Imam Reza Hospital, Mashhad University of Medical Sciences, Iran, were allocated to two groups between September 2008 and September 2009 via the simple randomization method. The study was approved by the Ethics Committee of Mashhad University of Medical Sciences. The condition of the study was completely explained to all the patients and informed consent was obtained. We recruited all the patients with elective CABG and willingness to be randomly assigned. Our exclusion criteria were concomitant operations like valve repair or replacement, myocardial infarction less than one month before surgery, sick sinus syndrome, history of AF and stroke or transient ischemic attack (TIA). Patients underwent elective off-pump (OPCABG) and elective on-pump CABG. Our studied sample size was determined due to a previous study by Al-Ruzzeh et al. based on AF incidence. The postoperative AF was considered 49% and 14% in the on-pump and OPCABG techniques, respectively with 95% of confidence interval and 80% power.[10] Consequently, we allocated 25 individuals minimally to each group. However, due to other arrhythmias, we allocated 95 and 33 individuals to the OPCABG versus on-pump CABG groups, respectively. We considered postoperative the AF prevalence after 24 hours of surgery and frequency of right coronary artery graft (RCA), left circumflex graft (LCX) and left main coronary artery graft (LAD) between the OPCABG and on-pump CABG groups. In addition, we evaluated risk factors such as hypertension (blood pressure more than 140/90 mmHg or consumption of anti-hypertensive medications), serum creatinine (Cr) level more than 2 mg/dl, and left ventricular ejection fraction (LVEF) less than 40% between the two groups.

### Statistical analysis

We used SPSS software version 11.5 (SPSS Inc., Chicago, IL, USA) for all the statistical procedures. Summary statistics are expressed as mean, frequency or numbers and percentages of the patients. The chi square test was used to compare the outcome and the studied variables. The Student t-test or equally non-parametric test was used for the interval scaled variables. For all the tests, a p-value less than 0.05 was considered significant.

## Result

This study included a total of 128 patients who underwent OPCABG (95 patients) and on-pump CABG (33 cases). The age of the patients assigned to the on-pump CABG group was significantly lower than of those in the OPCABG group (51.96±13.31 versus 58.82±9.54years; CI=1.77-11.92) (p=0.002). Also, there were statistical associations between the age categories with or without AF groups in the OPCABG group but not in the on-pump CABG group. Patients in the OPCABG group without AF were statistically older than the AF patients (Table I)

**Table 1: Age categories of patients in on-pump versus off-pump CABG of patients allocated to groups with/without AF**

| | | Age(Year) | | | | | | | | | | P value |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | <40 | | 41-50 | | 51-60 | | 61-70 | | >71 | | |
| | | N | % | N | % | N | % | N | % | N | % | |
| Off pump | With AF | 2 | 33.3 | 4 | 36.4 | 5 | 13.9 | 3 | 9.1 | 1 | 11.1 | 0.01 |
| | Without AF | 4 | 55.7 | 7 | 63.6 | 31 | 86.1 | 30 | 90.9 | 8 | 88.8 | |
| On pump | With AF | 3 | 33.3 | 1 | 16.7 | 1 | 12.5 | 1 | 12.5 | 1 | 50.0 | 0.11 |
| | Without AF | 6 | 66.7 | 5 | 83.3 | 7 | 87.5 | 7 | 87.5 | 1 | 50.0 | |

AF: Atrial Fibrillation

The prevalence of AF was 15 (15.8%) in the off-pump group versus 7 (21.2%) in the on-pump group (p=0.67) 24 hours after CABG. As regards left ventricular ejection fraction (LVEF) lower than 40% risk factor, the relation between AF/without AF in the on-pump (p=0.97) versus off- pump (p=0.53) CABG groups had no significant difference. Regarding HTN, between AF/without AF, there was no statistical difference between the on-pump (p=0.38) and off- pump (p= 0.79) CABG patients. In this study, there was a statistical association in preoperative Cr>2 mg/dl between AF/without AF patients in the off-pump group (p=0.001) but not in the on-pump group (p= 0.057) (Table II).

**Table II. LVEF, HTN, and renal Failure in on-pump versus off-pump CABG of patients allocated to groups with/without AF**

| | | With AF | | Without AF | | P value |
|---|---|---|---|---|---|---|
| | | N | % | N | % | |
| Off-pump | LVEF<%40 | 11 | 73.3 | 52 | 65.0 | 0.53 |
| | LVEF>%40 | 4 | 26.7 | 28 | 35.0 | |
| On-pump | LVEF<%40 | 4 | 57.1 | 15 | 57.7 | 0.97 |
| | LVEF>%40 | 3 | 42.9 | 11 | 42.3 | |
| Of- pump | HTN | 5 | 33.3 | 24 | 30.0 | 0.79 |
| | Without HTN | 10 | 66.7 | 56 | 70.0 | |
| On-pump | HTN | 1 | 14.3 | 8 | 30.8 | 0.38 |
| | Without HTN | 6 | 85.7 | 18 | 69.2 | |
| Off-pump | Renal dysfunction | 6 | 40.0 | 7 | 8.8 | 0.001 |
| | Without Renal failure | 9 | 80.0 | 73 | 91.3 | |
| On-pump | Renal Failure | 3 | 42.9 | 3 | 11.5 | 0.057 |
| | Without Renal Failure | 4 | 57.1 | 23 | 88.5 | |

LVEF: Left Ventricular Ejection Fraction ; HTN: Hypertension

Association between the AF rate and any grafted artery was not significant (p>0.05). In this study, there was no statistical association in the LAD graft between AF/without AF patients in the off-pump (p=0.07)and on-pump (p= 0.33) CABG patients. Also, the association of the RCA graft, between AF/without AF patients, was not significant in the off-pump (p=0.09) and on-pump (p= 0.35) CABG patients. Most of the patients in the RCA and LCX graft group had no AF rates. Moreover, the association of the LCX graft between AF/without AF patients was not statistically significant between the off-pump (p=0.08) and on-pump (p=0.41) CABG patients (Table III).

**Table III. Type of vascular graft in on-pump versus off-pump CABG of patients allocated to groups with/without AF**

| | | With AF | | Without AF | | P value |
|---|---|---|---|---|---|---|
| | | Count | Percent | Count | Percent | |
| Off-pump | LAD Graft | 8 | 53.3 | 59 | 73.8 | 0.07 |
| | Without LAD Graft | 7 | 46.7 | 21 | 26.3 | |
| On -pump | LAD Graft | 3 | 42.9 | 11 | 42.3 | 0.33 |
| | Without LAD Graft | 4 | 57.1 | 15 | 5.7 | |
| Off-pump | LCX Graft | 5 | 33.3 | 13 | 16.3 | 0.08 |
| | Without LCX Graft | 10 | 66.7 | 67 | 83.8 | |
| On-pump | LCX Graft | 1 | 14.3 | 5 | 19.2 | 0.41 |
| | Without LCX Graft | 6 | 85.7 | 21 | 80.8 | |
| Off-pump | RCA Graft | 4 | 26.7 | 9 | 11.3 | 0.09 |
| | Without RCA Graft | 11 | 73.3 | 71 | 88.8 | |
| On-pump | RCA Graft | 2 | 28.6 | 8 | 30.6 | 0.35 |
| | Without RCA Graft | 5 | 71.4 | 18 | 69.2 | |

AF: Atrial Fibrillation; LAD: Left Artery Descending Artery; RCA: Right Coronary Artery; LCX: Left Circumflex Artery.

## Discussion

Postoperative AF occurs frequently after cardiac surgery. It increases the risk of hemodynamic instability, thromboembolic events, ICU and hospital stay, and increment of the surgical expenses.[11, 12]

Recently, the complication of CABG has been reduced due to higher usage of OPCABG, but the risk of AF in OPCABG is still conflicting. There are several preoperative factors that predispose patients to AF risk. Previous studies have shown that old age is one of the most observed criteria that predispose individuals to postoperative AF.[13, 14, 15]

In the present study, although we did not evaluate the relation between AF incidence and age, the patients who underwent on-pump CABG were significantly younger than those in the OPCABG group. Accordingly, younger patients might be more suitable candidated for on-pump CABG than OPCABG. These results do not chimes in with those of the study by Stallwood et al.[16] in that their study participants in the OPCABG group were younger than those in the on-pump CABG group. They evaluated the patients who

underwent off and on-pump CABG in a retrospective study and concluded that cardiopulmonary bypass surgery was an adjacent factor in acute renal failure.[16-17] They found 1.4% and 2.4% of the patients with off and on-pump CABG, respectively, showed acute renal failure (p=0.031). We found that the prevalence of preoperative Cr>2 mg/dl in the patients with OPCABG was higher than that in the on-pump CABG group, but the difference was not significant (p>0.05).

Marasco et al.[5] evaluated AF in OPCABG. They found that OPCABG did not decrease the incidence of postoperative AF and an older age was a risk factor for postoperative AF; however, they recommended more randomized postoperative trials.

The evidence from both observational and randomized studies is conflicting about postoperative AF after OPCABG.[18] Postoperative AF is decreased by OPCABG, but more documentation is required.

Siebert et al. (2003) evaluated AF after CABG without cardiopulmonary bypass.[19] They concluded that AF was a common complication after myocardial revascularization performed via on-pump versus off-pump CABG procedures. Besides, they found that AF was not dependent on the technique of operation.

Enc et al.[8] compared AF after revascularization between on-pump versus off-pump CABG. They concluded that there was no decline in AF during myocardial revascularization without cardiopulmonary bypass. However, they found that prophylactic β-blocker consumption decreased the AF prevalence in both studied techniques. They measured the incidence of postoperative AF to be 16.1% and 14.6% after on and off-pump surgery, respectively. In contrast, in the current study, the incidence of postoperative AF for OPCABG (11.71%) was more than that in the on-pump (5.4%) surgery.

Al-Ruzzeh et al.[10] reported that patients who underwent OPCABG had similar patency of graft, better clinical outcome, shorter hospitalization, and better neurocognitive function than the patients who underwent on-pump CABG. We did not evaluate quality of life and other impacts, but we analyzed the relation between grafted coronary arteries and postoperative AF and found that there no statistically significant difference between the RCA or LCX graft and postoperative AF.

Previous studies reported lower LVEF (LVEF<40) as the predicting factor for patients who underwent OPCABG (5,8,19-20). In the present study, in contrast to the Place et al. study[21], we found no significant difference between individuals with postoperative AF rate and LVEF.

An important limitation of our study is the significant difference in terms of the age of

the study population. Another limitation was the calculated power of 80%, which was based on a high expected patency rate of 5%, which influenced the required sample size.

## Conclusion

In the present study, there was no reduction in AF in CABG without cardiopulmonary bypass. It seems that there is another unknown predictive factor for AF in off-pump versus on-pump CABG. As a result, further prospective trials with larger sample sizes are recommended.

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**Conflict Of Interest:** None declared

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