ORIGINAL REPORT

On Pump *versus* Off Pump Coronary Artery Bypass Surgery in Patients Over Seventy Years Old with Triple Vessels Disease and Severe Left Ventricle Dysfunction: Focus on Early Clinical Outcomes

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Abstract- Cardiovascular disease is the leading reason of morbidity in older people. Coronary artery bypass graft (CABG) surgery is the most common type of operations in world. This study was designed to characterize comparison of early clinical outcome following on pump *vs.* off pump in patients over 70 years old with triple vessels disease and severe left ventricle dysfunction. 80 patients were divided into two groups: In group A (n=40) on pump CABG was performed with hypothermic cardiopulmonary bypass and cold blood cardioplegic arrest and in group B (n=40) the patients had off pump coronary artery bypass (OPCAB) surgery. Exclusion criteria included emergency or urgent operation, combined valve surgery, history of renal insufficiency (Cr >2 mg/dl), stroke. Early postoperative complications such as occurrence, duration and frequency of recurrence of atrial fibrillation were recorded. All patients underwent Holter monitoring after ICU discharge during their hospital stay. The average age of patients was 79.5±7.5 years. Post operative atrial fibrillation (POAF) occurred in 24 cases (30%); 17 cases (42.5%) related to on pump CABG group and 7 cases (17.5%) related to OPCAB group (*P*=0.03). The frequency of the recurrence of AF in the on pump group was 3.8±1.3 days and in the off pump group was 2.4±1.1 days (*P*=0.02). ICU stay in on pump group was 3.6±1.80 days, while for the off pump was 2.5±0.6 days (*P*=0.001). Also hospital stay duration was 8.5±2.1 days for the on pump group compared to the other group that was 6.34±1.06 days. Off pump in patients over 70 years old with triple vessels disease and severe LV dysfunction is safer than on pump and can reduce POAF, ICU and hospital stay and some early surgical complications.

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Keywords: Off pump CABG; On pump CABG; Outcome; Patients over seventy years old

Introduction

Cardiovascular disease is the leading reason of morbidity in older people. Coronary artery bypass graft (CABG) surgery is the most common type of operations in world. Survival and relief of angina following conventional on pump CABG is better than off pump procedure, however, many studies indicated that on pump technique has postoperative morbidity, prolonged intensive care unit stay. Coronary artery bypass grafting with cardiopulmonary bypass causes an acute stress response, acute and sudden changes in the circulation (1,2). High age, male sex, low ejection fraction are the important factors in producing early complications following off pump CABG. For example, atrial fibrillation (AF) is the most important arrhythmia after CABG that occurs on the 2nd or 3rd day after surgery. Surgical complication following CABG including: hemodynamic instability, hypertension, pulmonary edema, heart failure, organ failure, as well as increase in therapy costs (3).

Previous studies reported that CABG in elderly patients is worse than among younger patients, however, this surgical procedure is better than for percutaneous coronary interventions or medical therapy alone when patients suffer from the extent of coronary involvement.

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Regarding that increasing of morbidity and mortality in ICU and hospital stay following CABG, unfortunately, elderly patients have been significantly underrepresented in the randomized trials of revascularization for coronary disease (4,5). This study was designed to characterize comparison of early clinical outcome following on *vs*. off pump in patients over 70 years old with triple vessel disease and severe left ventricle dysfunction.

Materials and Methods

This prospective cross sectional study was approved by regional committee in Afshar Cardiovascular Researches Center. After receiving the written consent from patients (n=80), they participated voluntarily for on pump *vs*. off pump CABG surgery in Afshar cardiac surgery hospital of Yazd, Iran from September 2009 to May 2012. All of the operations were performed by a certain surgical team. The patients were divided into two groups: In group A (n=40) on pump CABG was performed with hypothermic cardiopulmonary bypass and cold blood cardioplegic arrest and in group B (n=40) the patients had off pump coronary artery bypass (OPCAB) surgery.

Exclusion criteria included emergency or urgent operation, combined valve surgery, history of renal insufficiency (Cr >2 mg/dl), stroke or transient ischemic attack (TIA) within 1 month. Data including age, gender, demographic variables and early postoperative complications such as occurrence, duration and frequency of recurrence of atrial fibrillation were recorded. All patients underwent Holter monitoring after ICU discharge during their hospital stay. Continuous variables are expressed as mean ± standard deviation. For categorical variables, analysis included frequencies and percentages. All tests of significance were paired t-test, t-test, Fisher's exact test, and Chi-square test for discrete variables and analysis of variance (ANOVA) for continuous variables. Statistical significance was measured with *P*-values of ≤ 0.05.

Results

80 patients over 70 years old with three vessels disease and severe left ventricle dysfunction undergoing on pump (n=40) or off pump (n=40) CABG surgery. The average age of patients was 79.5±7.5 years. The prevalence of risk factors in all patients in both groups overall were; diabetes (45.3%), hypertension (40.3%), hyperlipidemia (48.6%), family history of coronary artery disease (26.7%), cigarette smoking (33.5%), therefore, There were no significant differences between the groups based on preoperative variables. As shown in the both groups were balanced preoperatively with respect to age, gender, diabetes mellitus, cigarette smoking, hypertension, hyperlipidemia. Post-operative AF (POAF) occurred in 24 cases (30%); 17 cases (42.5%) related to on pump CABG group and 7 cases (17.5%) related to off pump CABG group (*P*=0.03). The frequency of the recurrence of AF which totally was 3.1±1.25 days; in the on pump group was 3.8±1.3 days and in the off pump group was 2.4±1.1 days (*P*=0.02). This data shows that on pump CABG could increase incidence and frequency of recurrence of AF compare to off pump CABG in patients over 70 years old. Early complications after operation compared between two groups in table 2. ICU stay in on pump group was 3.6±1.80 days, while for the off pump was 2.5±0.6 days (*P*=0.001). Also hospital stay duration was 8.5±2.1 days for the on pump group compared to the other group that was 6.34±1.06 days (*P*=0.001).

Table1. Post-operative atrial fibrillation (POAF) and early complications after both type of surgery.

variables	On pump CABG (N=40)	Off pump CABG (N=40)	*P*-value
Incidence of POAF [n (%)]	17 (42.5%)	7 (17.5%)	0.03
Recurrence of AF	3.8 ± 1.3	2.4 ± 1.1	0.023
Bleeding [n (%)]	19 (47.5)	9 (22.5)	0.03
Infection [n (%)]	8 (20)	2 (5)	0.001
Vomiting [n (%)]	7 (17.5)	9 (22.5)	NS
Resp. dysfunction [n (%)]	7 (17.5)	6 (15)	NS
Renal dysfunction [n (%)]	5 (12.5)	8 (20)	NS
Mortality [n (%)]	3 (7.5)	2 (5)	NS
ICU stay (day)	3.6 ± 1.8	2.5 ± 0.6	0.001
Hospital stay (day)	8.5 ± 2.1	6.34 ± 1.06	0.001

NS: not significant

Therefore, off pump CABG could significantly reduce ICU and hospital stay compare to on pump CABG in these high risk patients. Early mortality occurred in 5 cases (6.25%) in hospital after the operation; 2 case (5%) in the off pump group and 3 cases (7.5%) in the control group (Table 1). There was not significant relationship between on pump CABG and post-CABG early mortality.

Discussion

Cardiovascular disease is the leading reason of morbidity in older people. Coronary artery bypass graft surgery is as surgical treatment for severe multivascular involvement. AF is one of the most common arrhythmia after CABG and this arrhythmia following surgery is important causes of morbidity and mortality. There is significant relationship between postoperative AF and type of surgical operation and quality of post-operative management and monitoring (1-4). This study was designed to compare status of patients with three vessels disease and over 70 years old suffered from severe left ventricle dysfunction undergoing on pump *vs.* off pump CABG. Our findings show that off pump CABG in patients with three vessels involvement and severe LV dysfunction and over 70 years old is safer than on pump CABG. Off pump *vs.* on pump had lower incidence of postoperative AF, moreover, frequency of recurrence of AF also is more in on pump compare to off pump. In a study carried out by Chen *et al.* indicated that significantly reduce of postoperative AF in off pump CABG compare to conventional coronary surgery (6). This study is in line with our finding about AF after CABG, therefore, heart with low ejection fraction in elderly patients' response to beating cardiac surgery rather than induction of cardiac arrest and utilization of CPB. Our study reports that infection and bleeding significantly increase following on pump CABG, however, renal and respiratory dysfunction and vomiting were same in both surgical techniques. In a study conducted by Forouzannia *et al.* in our cardiovascular surgery center indicated that bleeding in non selective patients undergoing on pump and off pump CABG had not differences statistically (7). This present study indicates that durations of ICU and hospital stay in off pump are lower than on pump CABG. Previous studies suggest that POAF need further treatment and longer stay in hospital, and can increase hospitalization 2-4 days, thus heightening treatment costs. About early mortality, our findings report that there isn't significant differences between conventional and off pump CABG. Regarding that stroke is one of the most important causes of mortality after major surgery, therefore, Chen *et al.* in a meta analysis about CABG reported that incidence of stroke is same in both groups (6). This meta analysis is in line with our findings, thus, risk of stroke after on pump and off pump CABG in elderly high risk patients is similar in both groups. In a study carried out by Rocha *et al*. indicated that patients over 70 years old are at increased risk of death and surgical complications in the CABG in comparison to younger patients (8). According this study we select this category of patients for our study. Moller *et al*. in their study suggest that off pump reduces the incidence of AF after surgery compared with on pump surgery (9). A big study about on pump *vs*. off pump CABG by Chu *et al.* reported that off pump does not reduce post-operative mortality or stroke rates than on pump CABG. Furthermore, longer hospital stays and higher hospital costs following off pump (10). This evidence is in line with our study about mortality after surgery but is controversy about ICU and hospitalization stay. Reason of this difference can be type of patients, regarding that our study focus on high risk patients. One year of follow-up study that carried out by Shroyer *et al*. indicated that patients in the off pump group had worse outcomes than patients in the on pump group (11). This study is in controversy with other study in results of surgery and suggests that on pump is better than off pump. In a study conducted by Lemma *et al.* about coronary artery bypass surgery in high-risk patients indicated that mortality, myocardial infarction, stroke, renal failure following off pump is lower than on pump CABG surgery (12). Long term mortality in off pump *vs.* on pump is low rate, but, early mortality in our patients had not differences between both groups. Finally, we concluded that off pump in patients over 70 years old with three vessels disease and severe left ventricular dysfunction is safer than on pump and can reduce POAF, ICU and hospital stay and some early surgical complications.

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