

# Early Outcomes of On-Pump versus Off-Pump CABG

## Abstract:

**Background:** A post-surgical complication after on-pump and off-pump Coronary Artery Bypass Grafting (CABG) is a controversial issue among different cardiac surgeons to re-vascularize ischemic myocardia.

**Objective:** The aim of this study is comparing early outcome after on-pump and off-pump CABG.

**Methods:** This is a randomized clinical trial in ischemic heart disease patients who divided into 2 groups according to surgical method. Early outcomes for 30 days are evaluated in 104 patient undergone on-pump and off-pump CABG. SPSS analysis is used to compare incidence of stroke, infection, exploration surgery, myocardial infarction, renal failure, rate of survival and so on between two groups.

**Result:** Among 104 patients who underwent CABG, 36 patients were treated by on-pump surgery and 68 patients by off-pump surgery. Homogeneity for demographic characteristics and risk factors are observed between two groups. Among 30 days, after surgery EF (p: 0.735), stroke (p: 0.465), infection (p: 0.201), exploration surgery (p: 0.795), ICU and hospital stay (p: 0.123, p: 0.082), ICU and hospital readmission (p: 0.946, p: 0.644), bleeding volume during 24 h after surgery (p: 0.186) did not show significant statistical difference between two groups.

**Conclusion:** In this clinical registry, early outcome for 30 days after on-pump and off-pump CABG showed no significant differences within complications after surgery between on-pump and off-pump groups.

**Keywords:** On-pump and off-pump Coronary Artery Bypass Grafting • Myocardia; Coronary Artery Disease (CAD) • CABG

## Introduction

The traditional treatment for patients with multivessel Coronary Artery Disease (CAD) is CABG with cardiopulmonary bypass (on-pump) along cardioplegic arrest which can increase the survival rate of patient *via* improvement of reperfusion into ischemic area [1]. Though, this procedure along with aortic manipulation lead to some complications including stroke, elevated systemic inflammatory response that made interests to CABG on the beating heart (Off-pump CABG). It is thought that this procedure can overcome some post-surgical complications of on-pump CABG like cerebral dysfunction, myocardial depression, hemodynamic instability and inflammatory responses [1,2]. However, Main concerns about Off-pump CABG technique are quality of coronary anastomosis and integrity of revascularization. There are some data over lower graft potency for off-pump technique during long-term outcome [1,3,4].

In spite of different studies over short and long outcomes of these two procedures, debate continues for superiority of on-pump or off-pump procedure. This dichotomy is observed *via* discrepancy in the rate of off and on pump, about 20% of CABG in United Kingdom are performed off pump while this is about 95% in India [2]. Here, we evaluated short term outcome for 30 days in patients who undergone CABG on-pump and off-pump.

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### Methods

A prospective randomized clinical trial done for patients who undergone CABG under on-pump or off-pump. Out of 104 patients, 36 patients were treated with on-pump CABG and 68 patients with off-pump. Emergency surgery for ongoing myocardial ischemia or significant valvular disease considered as exclusion criteria. Post-surgical complications monitored during 30 days follow up. Base line characteristic of patients is shown in Table 1.

**Table 1: Base line characteristics and preoperative risk factors.**

	On pump (n=36)	Off pump (n=68)	p Value
Base line characteristics			
Mean age, y	61.36	62.38	0.070
Male, %	75	76.5	0.744
Family history, %	31	35	0.627
Hypertension, %	72	66	0.529
Diabetes, %	39	56	0.099
Smoking, %	28	38	0.286
Hyperlipidemia, %	47	53	0.579
BMI, mean	27.361	27.493	0.903
Preoperative risk factors			
CVA, %	13.89	4.412	0.084
RF, %	2.77	0	0.167
PCI, %	14	9	0.424
MI, %	14	6	0.176
COPD, %	0	1	0.176
PVD, %	8	3	0.221

All surgeries have been performed by one surgeon which is experienced enough for on-pump and off-pump procedures.

Outcomes for 30-days death and 30-days complications evaluated. The most important complications included coma, stroke, prolonged ventilation, renal failure (new requirement for dialysis or more than 50% increase in creatinine over base line), mediastinitis (deep sternal infection), and reoperation for bleeding.

All statistical analyses were performed using SPSS version 26. The results of this study were analyzed using descriptive statistic and inferential statistic. Continues variables compared by T test and non-normally distributed continues data compared with Mann-Whitney test.

### Results

30 days follow-up for CABG performed for 104 patients which

36 patients undergone on-pump and 68 patients undergone off-pump procedure. Base line characteristics and preoperative risk factors are compared between on-pump and off-pump CABG which is reported in Table 1. The off pump patients were a few older, more likely to be male, with higher rate of family history and diabetes and HLP while the on-pump patients were likely to have HTN with less smoking rate. The on-pump group had a greater rate of CVA, RF, PCI, MI, and PVD in comparison to off-pump group. However differences between 2 groups were not statistically significant.

About the procedure related data, Left Internal Mammary Artery (LIMA) grafts used in 100% of patients in both groups. Mortality during surgery were not observed in both groups and also no death reported during 30 days follow-up for 2 groups.

Incidence of major complications after surgery for both groups is reported in Table 2. Mortality have not observed in on-pump and of-pump groups during 30 days after surgery. Post-operative CVA have been reported in one patient in off-pump group, no case of CVA reported in on-pump group. Post-surgical creatinine increased up to 1.5 in 11 patients for off pump group which observed just in 1 case in on-pump group, however no one needs dialysis. There was no case of mediastinitis in on-pump group, but in off-pump group 3 patients got involved in mediastinitis. Major complications did not have significant difference between 2 groups.

**Table 2: Major complications after surgery.**

Post-surgical complications	On pump (n=36)	Off pump (n=68)	p Value
Post-operative renal failure (average of Cr in on and off pump)	1.07	2.55	0.448
Infection (mediastinitis) %	0	4.4	0.201
Cardiac (post-operative arrest, AF) %	13.9	4.4	0.084
Respiratory failure	1.47	5.55	0.236
Bleeding (re-exploration)%	5.5	4.4	0.183
ICU stay	2.19	2.53	0.126
ICU readmission	5.6	5.9	0.946
Hospital readmission	2.8	1.5	0.158

### Discussion

Medical therapy, Percutaneous Coronary Intervention (PCI) and Coronary Artery Bypass Grafting (CABG) are three main strategies for treatment of CAD. CABG is a procedure that can be used for

myocardial revascularization *via* on-pump or off-pump. In spite of substantial advances in surgical strategies, severe complications are along with cardiac surgery [5].

A CABG procedure without using a pump, on a beating heart, was introduced to reduce detrimental effects of cardiopulmonary bypass. However, off-pump CABG is a difficult procedure and hemodynamic instability can occur during this procedure [6-8]. Reduction the cost of surgery especially in developing countries is one of the reasons that led to a shift to off-pump strategy versus on-pump. Another reason is reduction of deleterious effects following the contact of blood with the artificial extracorporeal circuit [5]. In addition, manipulation of the great vessels is reduced with off-pump CABG. Considering that preferred site for CPB is ascending aorta, iatrogenic aortic dissection, bleeding or malperfusion of end-organ is not avoidable. This topic is a controversial issue between cardiac surgeons which led to different studies that evaluate post-surgical short term and long term outcome of these tow procedures.

BHACAS I and II and SMART trials showed less need for transfusion and reduced ICU and hospital stay in off-pump. No significant difference observed in OCTOPUS trial, though off-pump group had lower cost during 1 year follow-up. Al-ruzzeh trial revealed no significant differences between on-pump and off-pump procedures, however off-pump group showed shorter ICU stay and mechanical ventilation with fewer transfusion. While ROOBY trial showed no significant reduction in transfusion [9]. It is declared by PROMISS study that graft potency is lower in off-pump procedure [10], same results reported by other studies for early graft patency, however no difference reported in long term result over graft patency [11]. In a review analysis, Fudulu declared that off-pump procedure is associated with lower incidence of renal dysfunction, stroke rate, bleeding, respiratory complication and transfusion requirement [11]. Another study over postoperative outcome for 30 days reported lower incidence of myocardial infraction, peri-operative bleeding, need for inotropic support and longer ICU stay in off-pump group [12]. However other studies reported superior survival [2] and lower repeat revascularization [13] in long term follow up for on-pump.

Other studies showed no significant difference for post-surgical complications between on-pump and off-pump for early [7, 14] or long term outcome [15]. However, fewer number of graft in off-pump [16,17], greater blood loss in on-pump and lower transfusion and reoperation for bleeding for off-pump [18-20], lower new acute kidney injury and respiratory complications for off-pump are reported [20].

Our study as a prospective randomized clinical trial compared post-surgical complications for 30 days in 104 patients who undergone on-pump (36 patients) and off-pump (68 patients) CABG. No mortality reported within 30 days after surgery in both groups. Statistical analysis showed no significant differences between on-pump and off-pump group.

Despite numerous studies over revascularization methods for CAD, choosing preferred technique is a matter of debate. However it is declared that off-pump CABG can be superior to on-pump CABG for high risk patients [21,22].

### Conclusion

Evaluation of post-surgical complications during 30 days follow up revealed no significant difference between on-pump and off-pump procedures.

### Conflict of Interest

The authors declare that they have no conflict of interest.

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