



**ORIGINAL ARTICLE**

## Early Outcome of On-Pump Versus Off-Pump CABG in Patient With Early Stage Renal Impairment

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### ABSTRACT

**Objectives:** Coronary artery bypass grafting (CABG) is crucial in the management of ischemic heart disease, this work aimed to relate the early post-operative effects of off-pump versus on-pump coronary artery bypass in patients with early stage renal dysfunction. **Methods:** Our Primary outcome variables were; requirement of inotropic support, duration of ICU stay, stroke, renal failure, myocardial infarction and death within 30 days after operation. There were two groups of patients; Group-I (On-pump group) and Group-II (Off-pump Group). SPSS V17 was used for data analysis. **Results:** There was statistically significant difference between the two studied groups as regard mean operative time it was  $224.6 \pm 57.54$  in on-pump and  $175.25 \pm 43.07$  in off-pump group. The number of grafts conducted in off-pump group was significantly fewer. There was no statistically significant difference between the two studied groups as regard post-operative follow up data including mechanical ventilation, hospital stay, myocardial infarction, stroke, surgical reopening and hospital mortality. Statistically significant difference between the two studied groups as regard other post-operative complications including dobutamine use, arrhythmia, blood transfused, creatinine level and dialysis. **Conclusions:** Off pump technique appears to be a better procedure in patients with preoperative renal dysfunction. **Key words:** Coronary artery disease; Off-pump CABG; On-Pump CABG;; Renal impairment.



### INTRODUCTION

Coronary artery disease occurs as result of the progression of atherosclerosis, which produces an obstruction in the coronary arteries. Many complications occur as result of myocardial ischemia as angina, myocardial infarction, left ventricular dysfunction, valvular dysfunction secondary to papillary muscle ischemia, and congestive heart failure [1]. CABG is important in the treatment of ischemic heart disease patients, using Cardiopulmonary bypass (CPB) help surgeons to offer a quiet and bloodless environment for better anastomosis of coronary arteries. on-pump CABG has shown improvements in ischemic symptoms and prolonged survival in selected patients. With peri-operative mortality is about 2%, additional complications are myocardial infarction, stroke, and renal failure [2].

Although the cause of post-CABG renal failure is multifactorial and depends on many factors like the patient's clinical status, age, associated morbidities, recent exposure to nephrotoxic drugs, and other factors, CPB-related occasions such as hypotension, hypo perfusion, release of proinflammatory substances, loss of pulsatility, haemolysis also play a role [3]

Off-pump coronary artery bypass grafting (OPCAB) was introduced in the mid-1990s to diminish operative mortality and postoperative morbidity correlated to the use of cardiopulmonary bypass, including systemic inflammatory response, neurologic complications, global myocardial ischemia, renal dysfunction, hemodynamic instability and lung injury [4].

The use of off-pump CABG decreased the rate of intraoperative mortality and the

hospital stay after surgery, and perioperative blood loss and usage when compared to on pump technique [5].

## METHODS

Our study is a prospective study, included 60 patients undergoing CABG surgery with elevated creatinine level (1.6 - 2.5) divided into 2 groups. Each group included 30 patients which are matched regarding demographic data and risk factors conducted in Cardiothorathic surgery Department, El- Ahrar Teaching Hospital during the period between January 2016 to December 2019. The study was done according to The Code of Ethics of the World Medical Association (Declaration of Helsinki) for studies involving humans. All patients underwent a careful clinical history, preoperative routine blood examination and radiological examination. Written informed consent was obtained from all participants and the study was approved by the research ethics committee of the faculty of medicine, Zagazig University. The work was carried out in the accordance with The code of Ethics of the World Medical Association (Declaration of Helsinki) for studies involving humans.

Patients having similar pre-operative characteristics were selected for study to minimize the effect of these on postoperative outcomes. Patients who were scheduled to undergo CABG were eligible to participate in this study if they required isolated CABG with median sternotomy.

**Surgical technique:** All procedures were carried out through median sternotomy. For On-pump CABG surgery, in all patients standard cardiopulmonary bypass (CPB) was established with an ascending aortic straight tip arterial cannula and a two stage single venous cannula in the right atrium, aortic-cross clamp and cardioplegic arrest was applied in every patient. For off-pump surgery, various stabilization devices were used to provide a motionless surgical field. The necessity of inotropic support on weaning from cardiopulmonary bypass (CPB), and in Intensive Care Unit (ICU) was noted.

**Data Analysis:** Data collected throughout history, basic clinical examination, laboratory investigations and outcome measures coded, entered and analyzed using Microsoft Excel software. Data were then imported into Statistical Package for the Social Sciences (SPSS version 20.0) (Statistical Package for the Social Sciences) software for analysis.

## RESULTS

There was no significant difference regarding demographic characteristics of patients. Risk factors were same between the two groups. Similarly Angio-graphic, Echocardiographic data **Table (1)** Number of grafts applied for revascularization was high in on-pump group, these were  $3.75 \pm 0.94$  versus  $2.63 \pm 0.81$  in off-pump group with significant difference. Both groups experienced complete revascularization.

Regarding post-operative outcomes, need and duration of inotropic support, mechanical ventilation time and ICU stay was longer in on pump group but without significant difference.

Peri-operative blood loss and blood transfusion was also significantly high in on-pump CABG group (p-value 0.007). Regarding immediate postoperative complications, arrhythmia occurred in 23.33% (7.0) patients in on-pump CABG group and in 16.67% (5.0) patients in Off-pump group. Incidence of stroke complications was the same between both groups **Table (2)**

Postoperative renal failure that required dialysis incidence was significantly greater in the on-pump group compared to the off-pump group ( $P < 0.001$ ). Arrhythmia is also more common in on-pump patients, with a substantial difference between the two groups. **Table (3)**

There is statistically significant difference of creatinine level between both groups. Pump on group according time sequence of operation  $p < 0.05$ . Post hoc test indicates significant between both (pre & post-operative creatinine level), (Pre-operative & e)  $p < 0.05$  but insignificant (post-operative & follow up after one month  $p > 0.05$ ). **Table (3)**

**Table (1):** preoperative patient profiles

Variables	CCAB (N=60)	OPCAB N=(60)	P
Age per years	62±8	69±7	0.45
Male Sex no(%)	20(66.7)	22(73.3)	.057
Weight per kg	92±15	85±13	0.8
Smoking	8(26.67%)	9(30%)	0.57
Hypertension	27(90%)	24(80%)	0.6
diabetes mellitus	18(60%)	18(60%)	0.59
Dyslipidemia	22(73.3%)	22(73.3%)	0.45
History of MI	14(46.6%)	10(30.3%)	0.54

**Table (2):**perioperative details

Variables	CCAB (N=60)	OPCAB N=(60)	P-value
<b>Total operative Time</b> min	224.60±57.54	175.25±43.07	0.004*
<b>Number of grafts.</b>	3.75± 0.94	2.63± 0.81	0.001
<b>Ventilation time(hrs.)</b>	18±9.2	12±6.8	.021
<b>ICU stay (days)</b>	8± (26.67%)	9± (30%)	0.57
<b>Hospital Stay (Days)</b>	27± (90%)	24± (80%)	0.6
<b>Dobutamine use</b>	11(36.67%)	8 (26.67%)	.0001
<b>Total blood and blood product transfusion (in units)</b>	5±1.2	2±1.5	.007
<b>Myocardial infarction</b>	3(10)	2(6.67)	0.321
<b>Arrhythmias</b>	7(23.33)	5(16.67)	<0.001
<b>Re-opening</b>	4(13.33)	2(6.67)	0.316
<b>stroke</b>	1 (3.33%)	1 (3.33%)	0.425
<b>Dialysis</b>	3(10)	2(16.67)	<0.001
<b>Hospital mortality</b>	1 (3.33%)	1(3.33%)	0.534

**Table( 3):** Comparison creatinine of pump on group and pump off group.

Creatinine level	CCAB	OPCAB	MW	p
<b>Preoperative creatinine</b> mean± SD minimum-maximum	1.87±.24 (1.61-2.3)	1.87±0.22 (1.45-2.6)	0.06	0.95
<b>Post-operative creatinine</b> mean± SD minimum-maximum no(%) >2.8 1.5-2.8	2.62±0.87 (1.69-3.9) 6(20) 24(80)	1.98±0.66 (1.5-2.8) 0 30(100)	2	0.002
<b>Creatinine level after 1 month</b> mean± SD minimum-maximum	2.3±0.5 (1.7 -3.5) 4(13.3)	1.92±0.37 (1.3-2.5) 0	2.7	0.009

no (%)	26(86.7)	26(86.7)		
>2.8	0	4(13.3)		
1.5-2.8				
<1.5				

**DISCUSSION**

Patients suffering from chronic kidney disease (CKD) have more incidence of coronary heart disease, which is the prominent cause of death in these patients. The effect of CKD on the early outcomes of off-pump CABG is not well-studied [6].

Multiple studies have compared peri-operative mortality and outcome for Off pump CABG and on-pump CABG .that typically conducted in low-risk patients, found no significant differences in mortality, and other post-operative impediments with off pump CABG [5,7].

CABG is the key in protecting renal function and improving postoperative survival rates in patients with CKD; however, whether to select off-pump or on-pump CABG is controversial. According to current research, off-pump CABG is advantageous because it has a protective effect on renal function perioperative in avoiding cardiopulmonary bypass, and reduces complications related to blood transfusion, acute kidney injury, and respiratory problems[4].

In our study, the operation time and number of grafts were less in off-pump group with significant difference between both groups but with complete revascularization. Off pump CABG has demonstrated decreased blood loss and need for transfusion, decreased length of stay less renal dysfunction in addition to decreased cost. **Alauddin and his colleagues** [8] report comparing early outcomes found that off pump CABG is associated with reduced length of hospital stay, operative morbidity, and operative mortality as compared with on pump CABG. Our study supports the results of these studies as in our study, blood loss with subsequent requirement of blood transfusion was significantly low in Off-Pump Group(p-value=0.007). We found significant difference regarding post-operative arrhythmia and dialysis.

More blood and blood products transfusion was required in on-pump group with

significant difference between both groups ,the reason for the reduced postoperative blood loss observed in the off-pump group is certainly multifactorial. Thrombocytopenia and platelet dysfunction are well identified in association with CPB.

In our study, we recorded no statistical difference of stroke rate, post-operative MI and hospital mortality between the on pump group and the off pump group. Mechanical ventilation time , ICU stay time and hospital stay time, all were high in on-pump CABG group. This goes in line with **Raja et al in 2020**and **Dieberg et al in 2019**[9,10]On the other hand, other studies **Kowalewski et al in.2020**,and **Dominici et al in 2017**[11,3]reported a significant decrease in stroke when avoiding CPB in high-risk group that could be explained by selection bias in some Meta-analysis. Also, it is required to have a high sample size to notice significant differences in rare events such as stroke, and even the largest randomized studies are under-powered to prove a possible advantage of one technique over the other.

**Elmahrouk et al** [12]showed less operation time, less need for transfusion and reduced ICU and hospital stay in off-pump but the number of grafts conducted in the OPCAB group was substantially lower. **Fudulu** declared that off-pump procedure is associated with lower incidence of renal dysfunction, stroke rate, bleeding, respiratory complication and transfusion requirement [13] Other studies showed no significant difference for post-surgical complications between on-pump and off-pump for early outcome However, fewer number of graft in off-pump, The difference in patient population in these studies and their pre-operative parameters could explain this contradiction[14].

Our results go with most of the recent studies comparing blood loss and transfusion requirement between on-pump and off-pump patients. **Rocha etal in 2020**[6]in his study



reported that off-pump was associated with lower rate of blood transfusion in the current study, we demonstrated a decrease in the incidence of early postoperative arrhythmia in the off pump group **Kowalewski** reported the same findings[11].

Our study defined renal failure as increasing postoperative serum creatinine more than 2 mg/dL associated with urine production less than 0.5 mL/kg/hour  $\geq 12$  h, or patients demanding dialysis. In the current study, a significant decrease of postoperative renal dysfunction among the OPCAB group was noticed. Performing CABG without CPB can protect renal function through avoiding non-pulsatile flow, interactions between the inflammatory, coagulation, and fibrinolytic cascades. This could affect positively, chiefly in high-risk patients.

In terms of pre-operative, post-operative, and one-month follow-up creatinine levels for both groups, we discovered that there is a statistically significant difference in creatinine levels between them

Our results were similar to **Garg et al and Zahra** [15,16]who reported that Off-pump CABG technique resulted in a less rise in blood creatinine concentration compared on-pump CABG surgery. While the study by **Nezami et al.**, [17]reported that creatinine level was no significantly differed between pre and postoperatively in both groups.

### CONCLUSIONS

Off-pump CABG surgery had a lower rate of postoperative complications than on-pump CABG surgery. Patients receiving off-pump CABG have better renal function than those getting on-pump CABG. this technique may carry potential remunerations without compromising their clinical outcomes.

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