Abstract: Background: Off-pump coronary artery bypass grafting, avoiding the use of cardiopulmonary bypass, has attracted the interest of an increasing number of surgeons and patients, and has assumed an increasing role in surgical practice. Whether Off-pump coronary artery bypass grafting have better outcome in high-risk patients as compared to Conventional coronary artery bypass grafting remains to be confirmed. We describe an analysis of early clinical outcomes of high-risk CAD patients, subjected to both techniques.

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Conclusion: we recommend Off-pump coronary artery bypass grafting in high-risk coronary disease patients, as this technique may carry potential benefits without compromising their clinical outcomes.

Keywords: CABG, Off-Pump, High-risk, short term outcome
Dear, the Editorial Board of Heart, Lung and Circulation

I would like to submit this retrospective clinical observational trial to be published in the journal; We study the early outcome of High risk Coronary artery Disease patients underwent OPCAB, and compare it with same subset group of patients underwent conventional CABG.

This study was conducted in two big Cardiac institutes, each of them is considered as a referral center in its region with high flow of patients. King Faisal Specialist Hospital and research Center in Jeddah Saudi Arabia, and Nasser Institute in Cairo Egypt.

I am looking forward to hearing from you

Regards

Dr Ahmed EL-MAHROUK, M.D.

Associate professor Of Cardiothoracic Surgery

Tanta University Faculty of Medicine
Short term outcome of Conventional versus off-pump Coronary Artery Bypass Grafting for High-Risk Patients

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2. Cardiothoracic Surgery Department, Tanta University, Tanta, Egypt.
3. Cardio-thoracic Surgery Department, Benha University, Benha, Egypt
4. Cardio-thoracic Surgery Department, Mansoura University, Mansoura, Egypt
5. Cardiac Surgery Department Naser Institute Cairo, Cairo, Egypt

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There is no potential Conflict of interest in this case.
Total Word Count: 4880

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Glossary: Coronary artery bypass grafting (CABG), cardiopulmonary bypass (CPB) Off-pump coronary artery bypass grafting (OPCAB), Coronary Artery Disease (CAD), Prospective Controlled Trials (PCT), Atrial fibrillation (AF).
**Background:** Off-pump coronary artery bypass grafting, avoiding the use of cardiopulmonary bypass, has attracted the interest of an increasing number of surgeons and patients, and has assumed an increasing role in surgical practice. Whether Off-pump coronary artery bypass grafting have better outcome in high-risk patients as compared to Conventional coronary artery bypass grafting remains to be confirmed. We describe an analysis of early clinical outcomes of high-risk CAD patients, subjected to both techniques.

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Introduction:

Coronary artery bypass grafting (CABG), using cardiopulmonary bypass (CPB) with cardioplegic arrest and aortic cross-clamp, has been the standard procedure for surgical revascularization. Off-pump coronary artery bypass grafting (OPCAB), avoiding the use of CPB, has attracted the interest of an increasing number of surgeons and patients, and has assumed an increasing role in surgical practice.\(^1\) especially meeting the challenges posed by the progressive evolution of percutaneous procedures.

Since the development of OPCAB in the 1960s and its reintroduction in the 1990s, it was expected to reduce inflammatory response, myocardial injury and the incidence of serious post-operative morbidity and mortality.\(^2\)

Despite its promising results, several randomized trials comparing OPCAB and conventional CABG (CCABG) have failed to demonstrate any significant differences in mortality, stroke, myocardial infarction, or new renal failure.

These randomized controlled trials were conducted in relatively low-risk patients\(^3,4\).

In high-risk Coronary Artery Disease (CAD) patients, surgical myocardial revascularization often produces poor results leading to significant mortality and morbidity\(^5\). There are an increasing number of studies demonstrating the benefit of OPCAB, and the resulting decreases in surgical mortality and morbidity, particularly in this group of patients.\(^5-8\)

On the contrary, another randomized clinical trial demonstrated that mortality seemed higher after off-pump CABG; in addition, no significant difference in major adverse cardiac and cerebrovascular events was found between OPCAB and CCABG in patients with a high-risk operative profile.\(^9\)

Management of high-risk patients remains unclear. Whether OPCAB have better outcome in high-risk patients as compared to CCABG remains to be confirmed.

We describe an analysis of early clinical outcomes of high-risk CAD
patients, comparing the results of CCABG with OPCAB.

**Patients Selection**

From December 2009 to January 2015, 1345 consecutive patients suffering from CAD underwent primary isolated CABG in King Faisal Specialist Hospital and research Center in Jeddah, Saudi Arabia and Naser Institute, Cairo Egypt, were investigated. Patients were considered to be high-risk if they had a preoperative Standard Additive Euro-score of ≥5 on admission. All diseased vessels with a diameter of ≥ 1 mm were completely revascularized. Individual surgeons made their technique selections, based on their experience and preference.

Using the propensity score-matching method, high-risk patients with similar pre- and intra-operative characteristics were selected. A total of 450 patients with high risk stratification according to additive EuroSCORE were selected. We carried out a comparative analysis of patients underwent CCABG and those who underwent OPCAB with regard to their early clinical outcomes.

**Clinical data collection**

Our patients were divided into 2 groups; Group A included patients underwent CCABG (260 patients), and Group B was assigned for patients underwent OPCAB (190 patients).

Data, including gender, age, demographic variables and postoperative morbidity and mortality were extracted from the medical records. All patients transferred to the telemetry floor for monitoring after discharging from ICU during their hospital stay.

**The exclusion criteria**

We excluded patients with cardiogenic shock requiring emergency surgery, concomitant cardiac or non-cardiac surgical procedures, history of transient ischemic attack (TIA) or stroke within 1 month.

We also excluded patients with radiographic evidence with a diseased (porcelain) ascending aorta.
We had 14 patients intraoperatively switched to on-pump after been initially planned for OPCAB due to hemodynamic instability. Another 5 cases were performed off-pump after have been allocated for on-pump due to heavily calcified ascending Aorta. Those patients were excluded from the study to avoid potential bias.

Definitions: (We adopted the definitions used in other studies) 10, 11, 12),

In-hospital mortality was defined as death within the same hospital admission or within 30 days of operation regardless of the cause. 10).

Neurologic complications were described as a transient ischemic attack (neurologic deficit lasting<24 hours) or stroke (a focal neurologic deficit lasting>24 hours with positive computed tomography findings) occurring post-operatively. 10).

Postoperative myocardial infarction was defined as the appearance of a new Q-wave on 2 or more contiguous leads on the electrocardiogram, or an increase in creatine-kinase myocardial band isoenzyme fraction greater than 100 UI/L and/or more than 10% of the total creatine-kinase level and/or with documented new wall motion abnormalities other than septal on the echocardiogram. No evidence of left ventricular failure (wedge pressure<18 mm Hg), and no other pathologic features explaining these findings 10).

Postoperative renal failure was defined as an increased plasma creatinine ≥ 2 associated with urine production less than 0.5 mL/kg/hour ≥ 12 hours, or patients requiring dialysis. 10).

Bleeding requiring re-opening for exploration was defined as the need for chest reopening in the presence of more than 500 ml of blood from chest tubes within the first hour, more than 400 ml/h within two consecutive hours, or more than 300 ml/h within three hours.

Postoperative pneumonia was defined as a positive result in a sputum culture requiring anti-infective treatment, or chest X-ray diagnosis of pneumonia following cardiac surgery 11).

Postoperative respiratory failure was considered as duration of mechanical ventilation more than 48 hours or re-intubation following cardiac surgery 12).
**Cardiogenic shock** was defined as hypotension (a systolic blood pressure < 90 mmHg) and/or a cardiac index < 2.0 for at least 30 minutes, or the need for added measures to keep a systolic pressure >= 90 mmHg or a cardiac index > 2.0.

**Deep sternal wound infection** any purulent discharge from the sternotomy wound 'bone-related', and Sternal Dehiscence.

**Operative technique**
Standard median sternotomy was done for all patients. The coronary anatomy was assessed for assignment to OPCAB or CCABG. Pedicled Left internal mammary artery and saphenous vein grafts were harvested.

**On-pump technique**
After the standard median sternotomy, CPB was established with a single two-stage right atrial cannulation and an ascending aorta cannulation. Heparinization with 3 mg/kg to get an activated clotting time > 480 seconds. Heparin reversal with 1 mg protamine sulfate /1 mg heparin before coming off the pump. Patients then cooled to 32°C.
The type of cardioplegic solution and method of delivery, type of proximal (aortic or composite) and distal (single or sequential) anastomoses, and the medication regimen were chosen according to the participating institute clinical practice.

**Off-pump technique**
The pericardium was retracted using three deep sutures, and we placed sponges under the heart. This was aimed for a better exposure of lateral and posterior vessels.
Heparinization with 1.5 mg/kg intravenously to reach activated clotting time > 300 seconds. Changes of body position (left and right table rotations, Trendelenburg), with the use of vasoactive medications, were given to stabilize the patient hemodynamically during OPCAB. Coronary arteries stabilization were achieved by Octopus II. tissue stabilization system (Medtronic, Minneapolis, MN). Intracoronary shunts (Medtronic Clearview Shunt; Medtronic) with the appropriate size were used to have a bloodless operative field and to maintain distal perfusion. In cases where a bloodless field can not be obtained with proximal target vessel occlusion using Silicone snare sutures A CO2-blower/NaCl mister device was used. A side occlusion clamp in the ascending aorta was used for proximal anastomosis avoiding areas with sclerosis or calcification.
**Statistical analysis:**
Statistical analysis was performed using the SPSS 19.0 statistical software package (SPSS, Inc., Chicago, IL). Quantitative variables are expressed as a mean ± standard deviation and the qualitative values as percentages. Univariate analysis, using the unpaired t-test to compare measurement data and Fisher’s exact test to compare enumeration data, was performed to assess statistically significant variables. All P values < 0.05 were considered statistically significant. Stepwise multivariate logistic regression was also performed.

**Results:**
From December 2009 through January 2015, All patients with additive euro-score ≥5, suffering from CAD underwent primary isolated CABG in both academic centers were enrolled in the study. Patient subjected to OPCAB (190 patients) were assigned to group A, and patients subjected to conventional CABG (260 patients) were assigned for group B. Based on preoperative variables, no significant differences were noted between the two groups correspond to age, gender, smoking, Diabetes mellitus, dyslipidemia, or renal hemodialysis. The mean Euro-Score was 6.59 for the OPCAB group, 6.98 in Group B. (P = .771). (Table 1). The operation time was significantly less in the OPCAB group (P 0.002). Complete revascularization was achieved in both groups, however, the number of grafts performed in the OPCAB group was significantly lower (2.46± 2.1) compared to the conventional CABG group (3.61 ± 1.8) (P< 0.001).

A total of 14 patients (3.1%) initially planned for OPCAB were intraoperatively switched to on-pump due to hemodynamic instability, in contrarily, 5 patients (1.1%) were allocated for on-pump was performed off-pump due to heavily calcified ascending Aorta. Intraoperative serum lactate, troponin I and creatine-kinase were higher significantly in the CCABG group in comparison to the OPCAB group (P < 0.001). Operative data are illustrated in (table 2). The Conventional CABG group had significantly longer duration of mechanical ventilation as compared to OPCAB group, (< 0.0001). Also, ICU stay was significantly longer in the conventional CABG group (47.87 ± 8.96 hours), compared to OPCAB group (29.90 ± 9.78 hours) (P<0.001). Hospital stay was significantly longer (12.86± 9.86 days) for the Conventional CABG group compared to the OPCAB group (9.80 ± 5.64 days) (P<0.001). Similarly, the use of dobutamine and other inotropic drugs was also more significant in group B than group A.
Postoperative renal failure was significantly greater in the on-pump group compared to the OPCAB group (7(3.68%) Vs 18(6.9%), P < 0.001). Postoperative Neurologic complications were slightly higher in the conventional CABG group, (3% versus 2.6%) but this difference was of no significance statistically (P < 0.425).

Atrial Fibrillation occurred in the early postoperative period was significantly higher in the Conventional CABG group (21.9%) compared to OPCAB group (16.84%) (P < 0.001).

In-hospital mortality occurred in 13 cases (2.88%); 5 cases (2.6%) in the OPCAB group and 8 cases (3.07%) in the CCABG group (Table 3). The causes of death were cardiogenic shock with low cardiac output in 11 patients, pneumonia in two patients, Sepsis in four patients and arrhythmia one patient. There was no statistically significant difference regarding in-hospital mortality between both groups.

Bleeding requiring re-opening for exploration in the on-pump Group was 16 patients (6.1 %) compared to 9 patients (4.7%) in the other group, with no statistically significant differences between the two groups (P =0.215).

Although not statistically significant, Myocardial infarction events within one year follow up was higher in OPCAB group (2.3%) compared to (1.9%) in the other group, (P =0.321).

Similarly, there were no statistically significant differences between the two groups with regards to, pneumonia, Deep sternal wound infection or the use of a postoperative intra-aortic balloon pump.

The comparison of early complications postoperatively between the two groups is illustrated in (table 3).

Follow up Echo within one year elucidated no significant difference between the two groups with regard to the change in left ventricular end-diastolic diameter or left ventricular ejection fraction (LVEF), compared to the preoperative measurements.

**Discussion:**
Coronary patients tend to be older and more ill, with a high frailty index, a high predicted risk of mortality, and complex 3-vessel coronary artery disease. Patients requiring CABG of this high-risk subgroup are subject to much greater operative risk.10)

There has been a greater emphasis in the recent literature comparing high-risk CAD patients undergoing OPCAB versus Conventional CABG. Several retrospective analyses of large databases favor OPCAB in high-risk patients as they revealed an overall mortality benefit over the Conventional CABG. 8,11)
In theory, Organ damage resulting from CPB and hypothermia, as well as systemic inflammatory response and blood component damage, are well avoided by adopting OPCAB technique. Many surgeons believe that high-risk patients will benefit from OPCAB over Conventional technique. In this retrospective research, we report our data in CAD patients with an additive EuroSCORE of >5, subjected to OPCAB and compare it with those who had conventional on-pump CABG with similar risk score. The preoperative characteristics and baseline demographics were well balanced across the two groups.

Neurological Deficits are common complications after cardiac surgery with stroke incidence ranging from 3% to 9%. This can significantly increase mortality from 4% to 19%. Proposed mechanisms for post-cardiac surgery stroke, could be cerebral hypo-perfusion or embolic events. Thus, CPB plays a major role in these mechanisms. Calafiore et al., showed that “the use of CPB increased the risk of stroke by 4.6 times in patients with a EuroSCORE 5, They attributed that to avoiding aortic manipulation in the off-pump patients”. Moreover, Patel and his group showed that OPCAB significantly had lower stroke rates in comparison to conventional CABG, regardless of aortic manipulation and the obvious benefit of OPCAB is due to the absence of generating emboli by the bypass circuit during the procedure.

Embolization of atherosclerotic plaque may result from aortic cannulation or cannulation of femoral vessels or it may be as a result of the CPB turbulent. In that case, the manipulation of aorta during clamping or establishment of proximal anastomoses is blamed for post-cardiac surgery strokes.

In our study, we recorded no statistical difference of neurologic complications between the conventional CABG group and the OPCAB group. This goes in line with Chen et al. in their meta-analysis mentioned that the stroke incidence is same in OPCAB and Conventional CABG. More important, the CORONARY trial, proved no significant difference in the stroke rate among 2 groups in after 30 days (1.0% for OPCAB vs 1.1% for CABG) and one year. On the other hand, several studies reported a significant decrease in neurological complications, and stroke when avoiding CPB in high-risk groups.

This contradiction in the results 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 vantage of one technique over the other.

For that reason, there was no considerable difference between the two groups when a Meta-analysis was concised to studies with low risk of bias by the COCHRANE database review. 24) The authors found that from 86 trials inculded in that review, only ten had a low possibility of bias. Another explanation for these discrepancies was the various definitions used by individual studies to describe neurological deficits.

We defined renal failure as postoperative serum creatinine of ≥2 mg/dL with urine production less than 0.5 mL/kg/hour ≥ 12 hours, or patients requiring dialysis. In the current study, a significant decrease of post-operative renal failure among the OPCAB group was reported.

The systemic inflammatory response related to the use of CPB has been claimed to adversely affect multiple organ systems, including the kidney. Ascione’ et Al., recognized CPB as an independent predictor of acute renal failure 12)

Performing CABG without CPB can prevent impairment of renal function through avoiding non-pulsatile flow, interactions between the inflammatory, coagulation, and fibrinolytic cascades. This could result in a positive impact, particularly in high-risk patients.

Our results support the earlier studies of Yokoyama et al. 6) who reported reduced rates of renal complications in OPCAB recipients, Al-Ruzzeh et al. studied elderly patients underwent OPCAB also demonstrated a significant reduction in renal dysfunction requiring dialysis 25)

Recently, CORONARY multicenter study, illustrated the significant reduction in occurrence of acute renal failure, in the OPCAB population. 4)

There has been a debate whether OPCAB ther is a significant benefit with regards to mortality. While, many reports recorded significantly decrease mortality in off-pump patients 6,15,25), others recognized no significant difference between the two groups 6,12). We have failed to reach a statistical significance between both groups in hospital mortality as well as 6 months and one-year survival. These results were in agreement with two Prospective Controlled trials conducted on patients over 75 years 26,27). Similarly, Cavallaro et al. 22), studied 80,000 revascularizations in high risk patients (≥ 85 years, COPD, renal failure, peripheral artery disease and aortic atherosclerosis) with and without CPB, they observed no difference in early mortality between the two groups.

Of note that, although these reports, including ours, showed that
OPCAB was not superior to the on-pump CABG with regard to mortality or survival, OPCAB otherwise did not incur increased risk of mortality.

In the current study, Atrial fibrillation (AF) was the commonly reported arrhythmia post operatively within both groups; we demonstrated a decrease in the incidence of early postoperative AF in the OPCAB group. This goes in accordance with a Meta-analysis by Moller et al., 21). Chen et al., reported the same findings, moreover, they added that the recurrence of AF is more frequent in Conventional CABG patients. 17).

In the controversy with these results, data from randomized trials by Puskas et al., 28), van Dijk et al., 29), and Al-Ruzzeh et al., 30), reported that the incidence of postoperative AF did not show an advantage in OPCAB over to conventional CABG with regards to the incidence of postoperative AF. The difference in patient population in these studies and their preoperative parameters could explain this contradiction.

High-risk patients undergoing OPCAB compared with Conventional CABG in this study, had a significant reduction in the level of Intraoperative serum lactate, troponin I and creatine-kinase.

We also recorded the reduction in Operation time, duration of mechanic ventilation and ICU stay, the use of inotropic drugs as well as hospital stay in high risk OPCAB patients. These results are maybe attributed to better pulmonary and renal protection; that may be conducive to postoperative recovery in this subset of patients.

On the other hand, In the current study, we found no statistical difference between both groups in the prevalence of postoperative acute myocardial infarction or the use of intra-aortic balloon pump postoperatively, we also could not demonstrate significant difference between the two groups in postoperative pneumonia, deep sternal wound infection, or Bleeding requiring re-opening for exploration. These results were in line with several other publications and meta-analyses. 4, 18,22,26,27)

**Limitations**

This study is a retrospective clinical observational trial, the treatment selection was not randomized, cases and controls frequently show some imbalances in patient characteristics, which can create substantial bias in treatment comparisons.

We used propensity score in order to adjust for potential treatment selection bias, and accurately estimate the treatment effect. However, a properly designed randomized control trial is better than propensity score adjustment.

It is of note that propensity score matching can only control for
observed covariates. (e.g. older age, hypercholesterolemia and the number of grafts). Any unobserved patient characteristics like the quality of coronary vessels and the distal coronary disease can affect the treatment selection and patient outcomes and may still create selection bias. Another selection bias was the surgeon’s preference to choose the kind of procedure in the participating center.

**CONCLUSION**

Many prospective and retrospective data favor OPCAB for patients with high risk operative profile, in the belief that CPB could be dangerous for them. However, the majority of CABG patients are still performed with CPB. Despite the fact that we could not show the advantage of OPCAB over the CCABG with regard to mortality or survival, it otherwise did not incur increased risk of mortality, and the technique could be adopted safely without placing patients at increased risk.

On the other hand, OPCAB showed better results with regard to intraoperative enzyme leakage, postoperative Atrial fibrillation, and postoperative renal failure. Also the reduction in the time of mechanical ventilation, intensive care unit and hospital stay. These reductions in morbidity improve utilization of resources, and this can have a significant impact on the financial costs.

So, we recommend OPCAB as an alternative for CCABG in coronary disease patients with a high-risk operative profile, as this technique may carry potential benefits for this subset of patients without compromising their clinical outcomes.

**Declarations:** Study protocol was approved by the Institutional Review Board Committee of King Faisal Specialist Hospital and Research Center Jeddah, Saudi Arabia Reference Number. IRB 2016-66, CVD-J/237/38

**Availability of data and materials** Data are available on request to the authors

**Competing interests** The authors declare that they have no competing interests.

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**Consent for publication:** Not applicable.

**Author Contributions:**

Ahmed Elmahrouk: Conceived and designed the study, conducted the literature search, was
involved in the analysis and interpretation of data and drafted the manuscript

**Tamer Hamouda:** Conceived and designed the study, was involved in the analysis and interpretation of data

**Mohamed Ismail:** Conceived and designed the study, conducted the literature search, was involved in the analysis and interpretation of data and drafted the manuscript

**Ibrahim Kasab:** Involved in the analysis and interpretation of data, supervised the study in Nasser Institute Egypt

**Amr M Badr:** Involved in the analysis and interpretation of data.

**Ahmed Jamjoom:** were involved in the analysis and interpretation of data Supervised the Study in King Faisal Specialist Hospital and Research Center.

All authors read and approved the final manuscript.

**Acknowledgements:** Not applicable

**References:**


### TABLE 1 PEROP DATA

<table>
<thead>
<tr>
<th>Variable</th>
<th>Group A (260)</th>
<th>Group B (190)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean age (y)</td>
<td>63.4±7.4</td>
<td>65.3±6.32</td>
<td>0.617</td>
</tr>
<tr>
<td>Female</td>
<td>63 (24.2%)</td>
<td>45 (23.7%)</td>
<td>0.756</td>
</tr>
<tr>
<td>hypertension</td>
<td>148 (56.9%)</td>
<td>131 (68.9%)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>diabetes</td>
<td>91 (35%)</td>
<td>73 (38.4%)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Hypercholesteremia</td>
<td>162 (62.3%)</td>
<td>112 (58.9%)</td>
<td>0.579</td>
</tr>
<tr>
<td>Smoking</td>
<td>153 (58.8%)</td>
<td>109 (57.3%)</td>
<td>0.705</td>
</tr>
<tr>
<td>Dialysis</td>
<td>8 (3.1%)</td>
<td>6 (3.2%)</td>
<td>0.238</td>
</tr>
<tr>
<td>EuroSCOR</td>
<td>6.98±1.6(12-16)</td>
<td>6.59±1.41(12-16)</td>
<td>0.771</td>
</tr>
<tr>
<td>E.F.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt;0.50</td>
<td>82 (31.5%)</td>
<td>65 (29.4%)</td>
<td>0.002</td>
</tr>
<tr>
<td>0.30-0.50</td>
<td>60 (23.1%)</td>
<td>61 (32.1%)</td>
<td>0.664</td>
</tr>
<tr>
<td>&lt;0.30</td>
<td>118 (45.4%)</td>
<td>73 (38.4%)</td>
<td>0.004</td>
</tr>
<tr>
<td>Unstable angina</td>
<td>69 (26.5%)</td>
<td>53 (27.8%)</td>
<td>0.072</td>
</tr>
<tr>
<td>Variable</td>
<td>Group A</td>
<td>Group B</td>
<td></td>
</tr>
<tr>
<td>--------------------------------</td>
<td>-------------------------------</td>
<td>--------------------------------</td>
<td></td>
</tr>
<tr>
<td>Cross clamp time (min)</td>
<td>59.75 ± 19.06 (23 –108)</td>
<td>_____</td>
<td></td>
</tr>
<tr>
<td>Bypass Time (min)</td>
<td>99.85 ± 23.86 (55 -168)</td>
<td>_____</td>
<td></td>
</tr>
<tr>
<td>Coronary lesion (n)</td>
<td>3.87 ± 0.87 (1-5)</td>
<td>3.64 ± 1.31 (1-5)</td>
<td></td>
</tr>
<tr>
<td>Coronary Grafts (N)</td>
<td>3.61 ± 18 (1-6)</td>
<td>2.46 ± 2.1 (1-4)</td>
<td></td>
</tr>
<tr>
<td>Lactate intraop. (mmol/L)</td>
<td>3.96 ± 1.89 (1-9.8)</td>
<td>1.97 ± 1.97 (1-8.2)</td>
<td></td>
</tr>
<tr>
<td>Troponin I introp (ug/L)</td>
<td>0.96 ± 1.98 (0.21-2.9)</td>
<td>0.42 ± 0.13 (0-1.01)</td>
<td></td>
</tr>
<tr>
<td>Creatine Kinase intra op. (U/L)</td>
<td>532.98 ± 457.65 (490-1998)</td>
<td>453.78 ± 418.42 (30-18922)</td>
<td></td>
</tr>
<tr>
<td>Creatine Kinase- MB mass intr op. (ng/mL)</td>
<td>56.97 ± 45.86 (5.9-198.6)</td>
<td>42.3 ± 21.52 (5.9-178.1)</td>
<td></td>
</tr>
</tbody>
</table>
### TABLE 3 Post-Operative DATA

<table>
<thead>
<tr>
<th>Variable</th>
<th>Group A</th>
<th>Group B</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hospital mortality</td>
<td>8 (3.07%)</td>
<td>5 (2.6%)</td>
<td>0.643</td>
</tr>
<tr>
<td>Myocardial infarction</td>
<td>5 (1.9%)</td>
<td>6 (2.3%)</td>
<td>0.321</td>
</tr>
<tr>
<td>Pneumonia</td>
<td>6 (2.30%)</td>
<td>5 (2.63%)</td>
<td>0.146</td>
</tr>
<tr>
<td>Bleeding and exploration</td>
<td>16 (6.1 %)</td>
<td>9 (4.7% )</td>
<td>0.215</td>
</tr>
<tr>
<td>Atrial fibrillation</td>
<td>57 (21.9%)</td>
<td>32 (16.84%)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Renal Failure</td>
<td>18 (6.9%)</td>
<td>6 (3.15%)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Neurologic complications</td>
<td>8 (3%)</td>
<td>5 (2.6%)</td>
<td>0.425</td>
</tr>
<tr>
<td>IABP use</td>
<td>17 (6.5%)</td>
<td>12 (6.3%)</td>
<td>0.534</td>
</tr>
<tr>
<td>ICU Stay (Hours)</td>
<td>47.87± 8.96</td>
<td>29.90 ± 9.78</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Hospital Stay (Days)</td>
<td>12.86± 9.86</td>
<td>9.80 ± 5.64</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Dobutamine use</td>
<td>93 (35.7%)</td>
<td>47 (24.7%)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Inotropic drugs use</td>
<td>254 (97%)</td>
<td>171 (90%)</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>