

ICU Stay in Patients with Low Ejection Fraction Undergoing Cardiac Revascularization: Comparison of On-Pump Versus Off-Pump Coronary Artery Bypass Grafting

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ABSTRACT

Background: Coronary artery bypass graft (CABG) surgery can result in serious complications for the patients. It is being currently performed with cardiopulmonary bypass with cardiac arrest in 80% of the cases across the world. There have debate in the past regarding the cardiac revascularization via CABG approaches.

Aim: The aim of this study is to study the difference in the patient's ICU stay who have low ejection fraction and are undergoing cardiac revascularization between off pump and on pump coronary artery bypass grafting.

Methodology: A sample size of 60 patients has been taken in the study with 30 patients' in the on-pump surgery group and 30 patients' in the off-pump surgery group. The data has been collected from department of Cardiac Surgery AFIC/NIHD, Rawalpindi.

Results and Conclusion: The study concludes that the on-pump CABG patients tend to have shorter ICU stay than the off-pump CABG patients who have low ejection fraction and are undergoing cardiac revascularization. Therefore, on-pump treatment is recommended in the study.

Keywords: Off pump, on pump, coronary artery bypass grafting, ICU stay, low ejection fraction, cardiac revascularization

INTRODUCTION

Coronary artery bypass graft (CABG) surgery can result in serious complications for the patients. It is being currently performed with cardiopulmonary bypass with cardiac arrest in 80% of the cases across the world. There tends to be a systematic inflammatory response of the cardiopulmonary bypass which usually takes place due to contact of extracorporeal circuit's artificial surfaces and circulating blood [1]. In order to avoid the systematic inflammation complications, in the 1990s the off-pump CABG was introduced again in the clinical practice.

There have debate in the past regarding the cardiac revascularization via CABG approaches.

Usually cardiopulmonary bypass is used in CABG. In this manner, the rate of mortality is greatly reduced i.e. it is 2% [2]. Off-pump CABG was developed in order to reduce the perioperative complications [3].

On the other hand, the ICU is the most expensive hospital area and the number of beds availability is also limited. Therefore, it is essential to identify the patients who require a long duration of ICU care. Moreover, in previous studies the factors that contribute to prolonged ICU stay after cardiac procedures have been identified but the impact of the prolonged stay in ICU after the discharge of patient has not been examined [4].

Various studies have identified that coronary artery bypass surgery has the ability to rescue a person who is having a heart attack, however, the benefit of bypass surgery in comparison with the medical therapy has not been found. Bypass surgery can result in loss of the mental function in the elderly [5]. The bypass surgery that does not make use of cardiopulmonary bypass is known as the off-pump coronary artery bypass (OPCAB) [6]. OPCAB has been further refined and it has resulted in in minimally invasive direct coronary artery bypass surgery (MIDCAB).

In MIDCAB 5-10cm incision is used for the bypass surgery. Moreover, there tend to be some complications associated with CABG which includes postperfusion syndrome [7], nonunion of the of the sternum, myocardial infarction, stroke, hemothorax etc. On the other hand, general surgical procedures have complications which include infections, keloid scarring, chronic pains, stress and even death.

There has been debate on the two approaches of cardiac revascularization via CABG which needs to be figured out. The aim of this study is to study the difference in the patient's ICU stay who have low ejection fraction and are undergoing cardiac revascularization between off pump and on pump coronary artery bypass grafting. The aim is also to identify the treatment option that is better for the patients.

The hypothesis of the study is: There is a difference between off pump and on pump coronary artery bypass grafting in term of ICU stay in patients with low ejection fraction undergoing cardiac revascularization.

MATERIAL AND METHODS

The study has been carried out by taking sample from the department of cardiac surgery, Peshawar Institute of Cardiology. The study was carried out over a period of 6 months starting from December 2020 to May 2021. A randomized control trial has been carried out in the study. The sample size has been calculated using the WHO calculator. The population mean of the patients' ICU stay who have low ejection rate (off-pump) = 8.73 days [8]. The population mean for the on-pump patients' having low ejection fraction= 2.45 [9]. The standard deviation of population is 0.17, the power of test value is 80 percent, the confidence level is 95% and a sample size of 30 in

each of the group has been taken into account which makes the total sample size of 60.

Those patients' have been included in the sample who are aged between 40-80 of any gender. Moreover, those patients' have been considered who have an ejection fraction which is equal or less than 35% and are undergoing CABG. Those patients' have not been included in the study who have more than 35% of the ejection fraction or patients' that tend to have chronic kidney disease or sleep apnea or have history of the cardiac revascularization. Two groups of the patients were made i.e. on-pump CABG patients' (Group A) and off-pump CABG patients' (Group B). Analysis has been done using SPSS. T-test and chi square tests have been carried out in order to obtain suitable results.

RESULTS

The two groups means have been compared using independent sample t-test.

Table 1. Demographics of Group A and Group B

AGE	GROUP A	GROUP B
40-60 years	10(33%)	11(37%)
61-80 years	20(67%)	19(63%)
Total	30(100%)	30(100%)
Mean and SD	64 year ± 12.77	66 year ± 11.12

Table 2. Characteristics of Group A and Group B

BMI DISTRIBUTION P value = 0.2298		
	GROUP A	GROUP B
<25 Kg/m ²	12(40%)	13(43%)
>25 Kg/m ²	18(60%)	17(57%)
Mean and SD	26 Kg/m ² ± 3.27	27 Kg/m ² ± 3.11
VESSEL INVOLVEMENT P value = 0.0010		
< 2 vessels	11(37%)	10(33%)
≥ 2 vessels	19(63%)	20(67%)
Mean and SD	2 ± 1.19	3 ± 1.04
DIABETES P value = 0.7744		
Diabetic	21(70%)	22(73%)
Non diabetic	9(30%)	8(27%)
HYPERTENSION P value = 0.7813		
Hypertensive	20(67%)	21(70%)
Non-Hypertensive	10(33%)	9(30%)
ICU Stay P value = 0.0126		
Mean and SD	3 days ± 4.2	6 days ± 4.8
STRATIFICATION OF MEAN ICU STAY W.R.T AGE DISTRIBUTION		
40-60 years	2 days ± 3.82	5 days ± 3.68
61-80 years	3 days ± 4.5	6 days ± 5.02
STRATIFICATION OF MEAN ICU STAY W.R.T GENDER DISTRIBUTION		
Male	3 days ± 4.12	6 days ± 4.91
Female	3 days ± 4.37	6 days ± 5.01
STRATIFICATION OF MEAN ICU STAY W.R.T BMI DISTRIBUTION		
<25 Kg/m ²	3 days ± 3.88	5 days ± 4.57
>25 Kg/m ²	3 days ± 4.97	6 days ± 4.82
STRATIFICATION OF MEAN ICU STAY W.R.T VESSEL INVOLVEMENT		
< 2 vessels	2 days ± 3.79	5 days ± 4.12
≥ 2 vessels	3 days ± 3.81	6 days ± 4.77
STRATIFICATION OF MEAN ICU STAY W.R.T DIABETES MELLITUS		
Diabetic	3 days ± 3.97	6 days ± 5.04
Non diabetic	2 days ± 3.67	5 days ± 4.10
STRATIFICATION OF MEAN ICU STAY W.R.T HYPERTENSION		
Hypertensive	3 days ± 3.83	6 days ± 4.99
Non-Hypertensive	2 days ± 3.48	5 days ± 4.37

The table indicates that in Group A there were 33% of the respondents aged 40-60 years, 67% respondents aged 61-80 years and the mean was 64. In group B, 37% of the respondents were aged 40-60 years, 63% were aged 61-80 years, and the mean was 66.

The results reflect that in Group A, 40% patients had BMI less than 25 kg/m², 60% had BMI more than 25 kg/m². 37% of the patients had less than 2 vessels in vessel involvement whereas 63% had equal or more than 2 vessels in vessel involvement. In group A, 70% of patients were diabetic and 30% were non-diabetic, 67% were hyper tensive whereas 33% were non hyper tensive. More the mean ICU stay of Group A was 3 days. The mean was same for both males and females. The mean ICU stay of patients' aged 4-60 years was 2 days and for patients' aged 61-80 years was 3 days. The mean ICU stay of patients' who had less than 2 vessels was 2 days and the ones with equal or more than 2 was 3 days. The patients' who had BMI distribution less than 25 kg/m² had a mean ICU stay of 3 days and patients' who had BMI distribution more than 25 kg/m² had mean ICU stay 3 days. The ICU stay of diabetic was 3 days whereas of non-diabetic was 2 days. Lastly, the mean ICU stay of hypertensive patients was 3 days and non-hypertensive patients was 2 days.

The results reflect that 43% of the patients' in Group B had BMI distribution less than 25 kg/m² and 57% had BMI distribution more than 25 kg/m². 33% of the patients had less than 2 vessels in vessel involvement and 67% had equal or more than 2 vessels in vessels involvement. In group B, 73% of patients were diabetic and 27% were non-diabetic, 70% were hyper tensive whereas 30% were non hyper tensive. Moreover, the mean ICU stay of Group B patients was 6 days. The mean was same for both males and females i.e. 6 days. Mean ICU stay of patients' aged 40-60 years was 5 days and patients' aged 61-80 days was 6 days. The mean ICU stay of patients' who had less than 2 vessels was 5 days and the ones with equal or more than 2 was 6 days. The patients' who had BMI distribution less than 25 kg/m² had a mean ICU stay of 5 days and patients' who had BMI distribution more than 25 kg/m² had mean ICU stay 6 days. The ICU stay of diabetic was 6 days whereas of non-diabetic was 5 days. Lastly, the mean ICU stay of hypertensive patients was 6 days and non-hypertensive patients was 5 days.

DISCUSSION

The study found the ICU stay is shorter in the on-pump CABG patients than the off-pump CABG patients who have low ejection fraction and are undergoing cardiac revascularization .There have been some agreements and disagreements of our results with the past studies. The results obtained in the current study are compared to the prior studies which includes that of Gupta et al [10] in which the mean ICU stay was found to be 8.73 days amongst the patients' who had low ejection fraction [off-pump]. For on-pump coronary artery bypass grafting, Ahmedi [11] found the mean ICU stay to be 2.46 days in patients with low ejection fraction. The length of hospital stay for on-pump surgery patients' in the study of Paparella D et al [12] was found to be 12 days on average and the ICU length was 3.4 days. The same study also concluded that patients'

undergoing OPCAB tend to have a stay in ICU shorter than the on-pump patients.

Wijeyesundera et al [13] compared the OPCAB with the on-pump CABG in their research study and the results showed that there was lesser myocardial damage with OPCAB. Cheng's [14] study compared the OPCAB with the conventional group of CABG and their results revealed that OPCAB group tends to have a shorter duration of ventilatory support as compared with the CABG group. [15] on the other hand carried out a comparison of the OPCAB group with the on-pump and concluded that there was increased risk of graft occlusion in the OPCAB group. Furthermore, the research study of Ercan et al [16] concluded that off-pump was not superior than the on-pump surgery. The study also concluded that there were some advantages of off-pump over on-pump for a short term but the mid and long-term outcomes tend to be the same.

CONCLUSION

The study concludes that the on-pump CABG patients tend to have shorter ICU stay than the off-pump CABG patients who have low ejection fraction and are undergoing cardiac revascularization. For on-pump the mean ICU stay was 3 days whereas it was 6 days for off-pump patients. The results also that the results do not differ based on the gender as the mean ICU stay for both the genders was similar. The results reflected that patients with a higher age tend to stay in ICU for longer duration i.e. patients' in age group 61-80 years had longer stay than patients' in age group 40-60 years. The results show that BMI distribution does not impact the duration of stay of patients' in ICU in Group A but does have an impact on the off-pump patients. It is also concluded that patients with vessels less than 2 tend to have a lower mean ICU stay than the ones who have vessels equal or greater than two for both on-pump and off-pump patients. Moreover, diabetic patients tend to have longer ICU stay than the patients' who are non-diabetic for both on-pump and off-pump surgery. Lastly, patients' that are hypertensive has longer mean ICU stay than non-hypertensive patients for both on-pump and off-pump. Therefore, based on the results, on-pump treatment is recommended in the study.

Limitations & Recommendations: The study was carried out on a limited sample of 60 patients therefore the results cannot be generalized. The duration of study was limited to six months hence, the difference could not be studied for longer duration.

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