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ORIGINAL ARTICLE

Neo-onset myocardial infraction in patients undergoing coronary artery bypass graft with and without long cross clamp time.

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ABSTRACT… Objective: To compare the frequency of new onset perioperative myocardial infarction in patients undergoing coronary artery bypass graft with and without long cross clamp time. **Study Design:** Randomized Control Trial. **Setting:** Department of Cardiac Surgery at the CH. Muhammad Akram Teaching and Research, Lahore. **Period:** 10th Feb 2023 to 10th June 2023. **Methods:** Patients were admitted through out-patient department one week prior to the operation and randomized to Group L (longer aortic cross-clamp time) and Group S (shorter time). Preoperative electrocardiogram was recorded for every patient. After surgery patients were shifted to intensive care unit. Development of perioperative myocardial infarction was the major outcome variable. **Results:** In our study, frequency of perioperative myocardial infarction in both groups was 7% in Group-L and 3% in Group-S with a p value was 0.19. **Conclusion:** In summary, our study sheds light on the notable difference in the frequency of perioperative myocardial infarction among patients undergoing CABG, particularly in relation to cross clamp time. While our findings present valuable insights, the necessity for further validation through multicenter trials with a larger sample size is evident.

Key words: CABG, Long Cross Clamp Time, Myocardial Infarction.

INTRODUCTION

Modern CABG with cardiopulmonary bypass is successful. However, prolonged aortic cross-clamp time has been linked to poor cardiac surgical outcomes. Cross-clamping causes widespread myocardial ischemia and reperfusion damage. This injury can cause myocardial shock, arrhythmia, early postoperative myocardial performance alterations requiring inotropic support, and acute lung injury requiring various mechanical ventilation durations.[1,2]

Peri-operative MI is a highly significant complication that can occur following CABG, with incidence of ranging from 5 to 30% varying with the hospital circumstances and patients co-morbid conditions. Additionally, factors such as inadequate myocardial protection, reperfusion injury, or prolonged cross clamp time can also contribute to its occurrence.[3,4] Short cross clamp time, adequate myocardial protection, urgent angiography and complete myocardial revascularization can also decrease the incidence of POMI.[5,6]

Despite the implementation of modern cardio protection techniques, the duration of aortic cross clamp time remains a critical independent indicator of mortality in patients with preserved pre-operative contractile function (EF >40%), with an overall mortality rate of 2.2%.[7] Among patients who undergo elective CABG, there is a clear and linear correlation between the duration of aortic cross clamp time and the levels of post-operative Troponin I. A proposed safety limit for aortic cross clamp time in elective CABG is set at 50 minutes.[8]

In this study, the frequency of perioperative myocardial infarction in patients undergoing

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CABG with long cross clamp time will be addressed and will be compared with patients undergoing CABG with short cross clamp time. POMI has been studied in regional literature. But the role of cross clamp time in POMI has not been studied well in our part of the world.

METHODS

This study was designed as a randomized controlled trial and took place at the Department of Cardiac Surgery, at the CH. Muhammad Akram Teaching and Research, Lahore, from the 10, Feb, 23 to 10 June, 23 after the approval of the synopsis. The sample size comprised two hundred participants, with one hundred individuals allocated to each group. The calculation of the sample size was based on a 5% level of significance and 8% power of study, considering the expected population proportions of POMI in the long cross clamp time group (13.7%) and in the short cross clamp time group (1.4%).[13]

The main purpose of this research is to compare the frequency of new onset perioperative myocardial infarction in patients undergoing CABG with long cross clamp time (defined as cross clamp time more than sixty minutes) and those with short cross clamp time (defined as cross clamp time less than forty-five minutes). The hypothesis posits that there is a difference in the frequency of perioperative myocardial infarction between the two groups. Perioperative myocardial infarction is characterized by elevated biomarkers exceeding five times the 99th percentile within the initial 72 hours following CABG, along with one of the following criteria:

1. New pathological Q waves or LBBB
2. Newly developed segmental wall motion abnormalities on echocardiography
3. Imaging evidence of new loss of viable myocardium.

Through this study, researchers aim to investigate the potential impact of cross clamp time on perioperative myocardial infarction rates in CABG patients. The sampling technique used was on-probability consecutive. The study's inclusion criteria involved patients undergoing elective CABG surgery, aged between twenty five to sixty tears years, of both genders, with a pre-operative ejection fraction greater than 50% as assessed by Echocardiography. Exclusion criteria comprised cases of emergency surgery, patients with prior myocardial infarction, those with preoperative ejection fraction less than 50%, and individuals undergoing redo operations.

After approval from hospital ethical committee and informed consent (MS/02/23/1053), two hundred (one hundred in each group) patients were admitted through out-patient department or from cardiology department, one week prior to the operation. Detailed history including demographic details and preoperative electrocardiogram was recorded for every patient. After surgery patients were shifted to intensive care unit. Development of perioperative myocardial infarction was the major outcome variable. This was recorded as defined in operational definition. Cardiac enzymes were recorded immediately before surgery and after surgery and also on 1st post-operative day. Echocardiography of patient was done on 1st post-op day. Patients were divided in two groups by lottery method. Group L with clap time around 60 minutes and Group S with around 40 minutes. Data collection tool was a performa which is annexed. Patients were followed up for 72.

The information was input into SPSS version 23 for analysis. Qualitative variables, including gender, cigarette smoking (>5 packs/year), Diabetes Mellitus (BSR > 200mg/dl), Hypertension (160/90), and occurrence of perioperative myocardial infarction, were presented as frequency and %age for both groups. Chi-square analysis was utilized to examine the significance of differences between groups, with a significance level set at $P \leq 0.05$. The data was stratified based on age, gender, smoking, Diabetes mellitus, Hypertension, and pre-op EF to address any effect modifiers. Post-stratification, Chi-square tests were applied, and a P-value ≤ 0.05 was considered statistically significant.

RESULTS

A total of two hundred cases (100 in each group) fulfilling the selection criteria were enrolled to

compare the frequency of new onset perioperative myocardial infarction in patients undergoing coronary artery bypass graft with and without long cross clamp time.

The distribution of age revealed that 36% in Group-L and 37% in Group-S fell within the age range of 25 to 45 years, while 64% in Group-L and 63% in Group-S were aged between 45-60 years. The calculated mean and standard deviation were 47.7 $\pm$ 6.3 years for Group-L and 46.9 $\pm$ 5.7 years for Group-S (as shown in the Table-I). Regarding gender distribution, 48% in Group-L and 44% in Group-S were male, while 52% in Group-L and 66% in Group-S were females.

The mean ejection fraction level was found to be 47.8% in Group-L and 49% in Group-S. The average BMI of the patients was calculated as 31 in Group-L and 31. in Group-S. In terms of cigarette smoking, 31% of participants in Group-L and 45% in Group-S were smokers. Regarding diabetes mellitus, 49% of individuals in Group-L and 44% in Group-S had this condition, while the remaining 51% in Group-L and 46% in Group-S showed no signs of the condition. The prevalence of hypertension was documented in 41% of individuals in Group-L and 48% in Group-S, while the remaining 59% in Group-L and 52% in Group-S did not show any signs of this condition. Comparing the incidence of perioperative myocardial infarction between the two groups, it was observed that 7% in Group-L and 3% in Group-S experienced this complication, with a p-value of 0.19. (Table-II). Males were 48 and 44 in the two groups while Females were 52 and 66 in the two groups.

Stratification of the outcome of the data was done in terms of various effect modifiers like age, gender, history of smoking, diabetes, hypertension, and chi-square test applied to determine whether these factors influence in the outcome. Difference among various factors like age groups, gender, presence and absence of diabetes and hypertension were seen statistically insignificant. Only history of smoking was seen to affect the outcome. (p value was 0.09). Table-III

Age (in years)	Group-L (n=100)		Group-S (n=100)	
	No. of patients	%	No. of patients	%
25-45	36	36	37	37
46-60	64	64	63	63
Mean$\pm$SD	47.73$\pm$6.36		46.97$\pm$5.74	

Table-I. Showing the age distribution of the patients (n=200)

Perioperative Myocardial Infarction	Group-L (n=100)		Group-S (n=100)	
	No. of Patients	%	No. of Patients	%
Yes	7	7	3	3
No	93	93	97	97
Total	100	100	100	100

Table-II. Comparison of frequency of perioperative myocardial infarction in both groups (n=200) P value=0.19

Variables		Group-L (n=100)	Group-S (n=100)
		No.	No.
Gender	Male	48	44
	Female	52	66
Smoking	Yes	31	45
	No	69	55
Diabetes	Yes	49	54
	No	51	46
Hypertension	Yes	41	48
	No	59	52

Table-III. Showing details of all the various effect modifiers / risk factors (n=200)

DISCUSSION

The health of the heart muscle during and after surgery plays a crucial role in determining how well patients recover from heart operations. When the heart is undergoing surgery, there's a part called the aortic cross-clamp, which is used to temporarily stop the blood flow to the heart. Unfortunately, when this cross-clamp is left in place for a long time, it can lead to damage in the heart muscle due to a lack of blood supply, and this condition is known as perioperative myocardial damage.[9]

We planned this study to record the frequency with long cross clamp time to compare with patients undergoing CABG with short cross

clamp time. POMI has been studied in regional literature; however, the role of cross clamp time in POMI has not been studied well in our part of the world.

In our study, when comparing the occurrence of perioperative myocardial infarction in both groups, it was found that 7% in Group-L and 3% in Group-S experienced this complication. The p-value obtained from the analysis was 0.019. Vito G. Ruggieri et al. conducted a study to assess the predictive effect without additional procedures. They found that a considerable proportion of patients now undergo isolated CABG with prolonged XCT, which appears to be a contributing factor to unfavorable early results.[9]

Our findings are in agreement with other studies reveals that POMI is one of the most serious complication following CABG and the reported incidence between 2-10%.[2,3] Bilgehan Erkut et al.[10] conducted a study involving 91 patients who underwent elective CABG operations to investigate the relationship between aortic cross clamp time and Troponin I levels. The participants had an average age of 54. The mean values for operation time, cross clamp time, cardiopulmonary bypass time, and intubation time were 195.7 minutes, 55.1 minutes, 124.9 minutes, and 151.9 minutes, respectively. For coronary anastomosis, all patients received internal mammary artery and saphenous vein grafts. The average length of stay in the intensive care unit was 3.6 days, while the average duration of hospitalization was 6.6 days. Troponin I measurements were found to be significantly higher with longer cross-clamping time. The researchers concluded that in patients with CABG operations, there is relation with clamp time and Troponin levels. They strongly recommended using a threshold of 50 minutes for safety. Mean cross clamp time was 346 ± 45 min, and total bypass time was 421 ± 70 minutes. Mortality rate was 12.4%. Among these patients of CABG, the incidence of perioperative MI was 2% (4 of 202 patients).[11]

However, despite the general belief that long cross clamp times is bad for patients, sometimes doctors need to keep the cross-clamp in place for a longer duration in order to fix complex surgical issues. It's a challenging balance for the medical team because they want to limit the damage to the heart muscle but also ensure they can successfully complete the surgery. Previous studies have shown that the duration of the aortic cross-clamp is an independent predictor of various negative events, which means it can be an indicator of potential problems that patients might experience after surgery.[12] Longer cross clamp times showed less acceptable performance after surgery, which means that patients might face more complications or have a harder time recovering if the cross-clamp is in place for a prolonged period.[13]

Considering the above, our hypothesis that "there is a difference in frequency of perioperative myocardial infarction in patient undergoing CABG with long cross clamp time or with short cross clamp time" is justified. However, we did not find a significant difference; the reason is small sample size which can be increased in future trials.

CONCLUSION

We concluded that there is a difference in frequency of perioperative myocardial infarction in patient undergoing CABG with long cross clamp time or with short cross clamp time. However, multicenter trials with larger sample size are required to validate our results. These future endeavors will contribute to a more comprehensive understanding of the implications and applications of our observations, ultimately enhancing the precision and reliability of clinical outcomes in CABG procedures.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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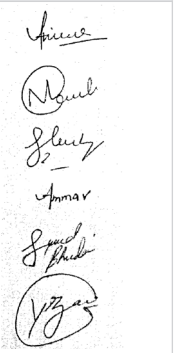
1	Muhammad Ammar	Proposal writing, Data collection, Analysis.	
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