DOI: https://doi.org/10.53350/pjmhs2023171245

**ORIGINAL ARTICLE**

# To Compare Early Outcomes of Warm Verses Cold Blood Cardioplegia in Patients Undergoing Elective Coronary Artery Bypass Graft Surgery (CABG)

GOHER BASHIR[1], AJWAD FAROGH[2], MUHAMMAD IRFAN KHAN[3], ASMA HASSAN[4], NASEEM AHMAD[5]
[1]*PGR Cardiac Surgery Cardiac Center QAMC, Bahawalpur*
[2]*Associate Professor Cardiac Surgery Cardiac Center QAMC, Bahawalpur*
[3]*Associate professor Pathology, QAMC, Bahawalpur*
[4]*Consultant Pulmonologist Cardiac Center, QAMC Bahawalpur*
[5]*Professor of Cardiac Surgery, SZMC Rahim Yar Khan*
*Correspondence to: Dr. Goher Bashir, Email: goharbaloch14@gmail.com, Cell: 300-9684369*

## ABSTRACT

**Objective**: To compare the effects of warm versus cold blood cardioplegia on the myocardium of patients undergoing elective Coronary Artery Bypass Graft (CABG) surgery.

**Study Design**: The study was the Prospective Observational study.

**Place and Duration of Study**: At the Punjab Institute of Cardiology in Bahawalpur, Pakistan, 100 patients with ischemic heart disease was scheduled for open-heart surgery.

**Methodology:** From the 25th of October 2021 to the 25th of October 2022, this prospective observational study was carried out in the Cardiac surgery Department of the PIC in Bahawalpur. One hundred patients participated in this research project overall. The means and standard deviations of the continuous variables were reported, while the frequencies of the categorical variables were given in percentage. SPSS 24 version was utilized for the statistical analysis. The All *P* values <0.05 were considered statistically significant

**Results**: Our results showed that out of 100 patients the mean age of the cases in Group-A was 57.12±3.9 and in Group-B was 55.45±2.6 with insignificant p-value. The findings of current study showed that the male 41(82.0%) and female 9(18.0%) patients in Group-A while male 38(76.0%) and female 12(24.0%) in Group-B with p-value 0.659. Clinical characteristics i.e. The hypertensive 39(78.0%) in Group A while 35(70.0%) in Group B with significant p-value 0.017. Similarly hyperlipdemia in Group A as 11(22.0%) compared with 15(30.0%) with 0.069. Renal failure patients in Group A was 4(08.0%) while in Group B 3(06.0%) observed with p-value 0.032**.** The clinical characteristics i.e. (CPB time, cross clamp time, cardioplegia dose, number of grafts and complete revascularization) were statistically significantly as p-value < 0.05.

**Conclusion**: According to the available data, the surgeon can make the call between warm and cold cardioplegia when it comes to patient safety.

**Keywords:** CK-MB, CPB, CABG.

## INTRODUCTION

Many postoperative complications have been connected to the use of cardiopulmonary bypass (CPB), cardioplegic arrest, and reperfusion of the heart, all of which trigger a systemic inflammatory response and ischemia-reperfusion injury. Diastolic arrest of the heart can be induced and maintained by injecting a potassium-rich solution into the coronary arteries. When the fluid is administered at room temperature, oxygen consumption by the heart drops by roughly 90%; however, this practice has significant postoperative complications. The first use of cold crystalloid solutions were in the early 1950s. Until cold potassium solutions produced from blood were released in the 1980s, they were often utilized. Surrogate endpoints were improved by myocardial damage biomarkers such CK-MB, but not clinical outcomes. Crystalloid solutions were nevertheless used by many surgeons despite this.

In the context of coronary revascularization, many clinical trials have been done to look at how to protect the myocardium during cardiac arrest. Fewer studies have been done on people with left ventricular hypertrophy, so it's still not clear what kind and how cold of cardioplegia is best for them.[1] Cardioplegia is the most effective method for preserving myocardial function during cardiac surgery, allowing surgeons to work in a calm environment. As a first-line treatment for hypothermic hyperkaliemic arrest, cardioplegia was implemented. This led to the realisation that blood plays a crucial role in transporting potassium cardioplegia to the heart. During a cardiac arrest, the use of cardioplegia solution is intended to prevent damage to the myocardium, which might result in weak contractions and an abnormally high production of cardiac biomarkers enzymes. Advantages of mild to moderate hypothermia-associated cold crystalloid cardioplegia include reduced oxygen demand, myocardial protection during periods of low flow or low perfusion pressure, low cost, and convenience of administration. The use of warm blood cardioplegia (WBC) to shield the heart muscle has also been proposed. This is due to the fact that blood more closely mimics normal physiology than crystalloid solution, which may lead to better cardiac outcomes following surgery. Cardioplegia type, solution temperature (cold or warm), or route of administration (antegrade or retrograde) did not significantly differ in protecting hypertrophic myocardium during heart surgery to replace a damaged aortic valve, according to multiple trials conducted in the 1980s and 1990s[5].

## MATERIAL AND METHODS

This was a prospective observational study, conducted at the Cardiac surgery Department, PIC, Bahawalpur from 25 October 2021 to 25 Oct, 2022.

**Inclusion Criteria:**

1. All cases aged 18-75 years with normal ejection fraction.
2. Both genders undergoing CABG.

**Exclusion criteria:**

1. Preoperative renal failure.
2. Severe Mital Regurgitation having TR.
3. LVEF< 30%.
4. Right Ventricular Dysfunction.
5. Previous history of cardiac procedure

**Data Collection:** After receiving verbal informed consent, a total of 100 patients who met inclusion criteria were enrolled, and data were collected. Using a computer-generated random list, patients were divided equally between two groups. Mild Hypothermia Cardiopulmonary bypass was employed on all patients undergoing CABG surgery, as well as all aortic cross-clamping and ascending aortic arterial cannulation. The cold blood group received anterograde cold (4 °C) crystalloid cardioplegia. Cardioplegia with warm (34-35 °C) blood was administered intermittently to the warm blood every 16-20 minutes.

**Statistical analysis:** The frequencies and percentages of the categorical variables were displayed in the tables, while the means of the continuous variables were displayed in the text. The statistical analysis was performed in SPSS 24. Chi-square test was used to compare patient groups. P values below 0.05 were regarded to be significant.

## RESULTS

There was no statistically significant difference between the means of Group-A (mean age 57.123.9) and Group-B (mean age 55.452.6) . According to the results of the current study, there were 38 men and 12 women in Group-A, and 41 men and 9 women in Group-B, with a p-value of 0.659. There were 39 hypertension patients in Group A (78.0%), but only 35 (70%) in Group B (p = 0.017). Group A had 11 people with hyperlipdemia (22.0%), while Group B had 15 people with hyperlipdemia (30.0%). Patients with renal failure were more common in Group A 4(8.0%) than Group B 3(6.0%) with p-value 0.032. (Table 1)

CPB time was also similar between the two groups, with the warm cardioplegia group taking somewhat less time (93.2 34.9) than the cold group (105.1 32.1). This difference was not statistically significant (p = 0.246). The p value for the difference between the two groups' cross clamp times was 0.099, with one group's time being 55.1 19.8 seconds and the other group's time being 62.7 21.5. A high p-value is associated with a higher cardiopleia dosage, more grafts, and full revascularization. (Table 2)

The results regarding myocardial damage according to the research groups the cardiopulmonary bypass showed that post CKMB (0 hour) as 85.0±13.66 compared with cold group 70.87±16.34 with p-value 0.718, at 8 hours with insignificant p-value as 0.498 as well as at 24 hours 50.08±21.39 compared with in cold group 45.43±10.45 with p-value 0.325. (Table 3).

Table 1: Descriptive Statistics of Demographics and Intra-opertaive variables

| Variables | | Warm (Group A) | Cold (Group B) | p-value |
|---|---|---|---|---|
| Age | | 57.12±3.9 | 55.45±2.6 | 0.289 |
| Gender | Male | 41(82.0%) | 38(76.0%) | 0.659 |
| | Female | 9(18.0%) | 12(24.0%) | |
| Hypertension | | 39(78.0%) | 35(70.0%) | 0.017 |
| Diabetes Miletus | | 38(76.0%) | 33(66.0%) | 0.419 |
| Smoking | | 30(60.0%) | 29(58.0%) | 0.134 |
| Obesity | | 42(84.0%) | 38(76.0%) | 0.426 |
| Family History of IHD | | 16(32.0%) | 19(38.0%) | 0.382 |
| Hyperlipidemia | | 11(22.0%) | 15(30.0%) | 0.069 |
| Renal Failure | | 4(08.0%) | 3(06.0%) | 0.032 |

Table-2: Clinical characteristics of the patient with respect to Research groups

| Variables | Research Groups | | P-value |
|---|---|---|---|
| | Warm Cardioplegia | Cold Cardioplegia | |
| CPB time (min) | 93.2 ± 34.9 | 105.1 ± 32.1 | 0.246 |
| Cross-clamp time( min) | 55.1 ± 19.8 | 62.7 ± 21.5 | 0.099 |
| Cardiopleia dose/ per patient | 2.1 ± 0.5 | 2.5 ± 1.8 | 0.043 |
| Number of grafts | 2 ± 1.1 | 3 ± 4.8 | 0.001 |
| Complete revascularization, *n*(%) | 23(46%) | 31(62%) | 0.056 |
| Hemoglobin pre- CPB, (g/dL) | 24(48.0%) | 19(38.0%) | 0.195 |
| Hematocrit pre-CPB (%) | 33(66.0%) | 27(54.0%) | 0.734 |

## DISCUSSION

Preventing muscle injury (such as impaired ventricular contraction) and perioperative myocardial infarction is crucial for a successful outcome in cardiac surgery (e.g., elevated myocardial enzymes). More efficient myocardial preservation techniques are largely responsible for the progress made in cardiac surgery. However, there are several open questions about the appropriate approach, such as whether to use warm or cold blood cardioplegia, antegrade or retrograde injection, and intermittent or continuous perfusion.

Cardiothoracic surgeons and researchers have argued about the optimal cardioplegic solution, temperature, and administration technique for myocardial protection for decades. It has been proven that blood cardioplegia is more effective than cold cardioplegia in experimental circumstances. Several randomized clinical trials have been performed to investigate which cardioplegia solution best protects the myocardium; some of them have showed that blood cardioplegia, either cold or warm, is useful for some patients, while others have found the opposite to be true.

Over the course of the previous few decades, there has been heated discussion on which cardioplegia solution, temperature, or administration route offers the best myocardial protection during cardiac surgery. In experimental trials, cold blood cardioplegia performed better than warm cardioplegia. Several randomized clinical trials have been conducted to determine whether cardioplegic solution provides the best myocardial protection, and blood (cold or warm) cardioplegic has been reported to be effective in some of these trials.

Recent clinical meta-analyses have shown that cold blood cardioplegia has a better outcome than warm blood cardioplegia, while it is still unclear which type of cardioplegia gives the most protection. These discrepancies may be attributable to a variety of factors, from the varied types of patients studied (e.g., those with and without coronary artery disease, those with different types of valve pathologies, those with other diseases, etc.) to the various surgical techniques employed and the lengths of time spent in the cross clamp.

Although the duration of ischemic arrest was shorter in the cold group, Jacquet et al 200 patients undergoing coronary artery bypass grafting found that antegrade warm cardioplegia was a more effective method of myocardial protection than combined antegrade and retrograde cold cardioplegia on the release of cardiac enzymes following surgery.[7]

A prospective randomised study conducted by Ovrum et al. on 1,440 patients undergoing coronary artery bypass indicated no significant difference in clinical outcome. Only 34 minutes on average was observed on a cross clamp, which may not be long enough to notice a difference. In order to examine the myocardial protection provided by two popular kinds of cardioplegia, we selected a homogenous group of patients who had undergone cardiac surgery with a relatively long cross clamp period and were plagued by myocardial hypertrophy. We looked at factors including how often CABG is performed at the same time, how long on average the aorta is clamped, and how much left ventricular septal and posterior wall myocardial hypertrophy was present.[8-9]

These results are consistent with what we saw in our investigation; although cardiac enzyme release favoured cold cardioplegia, perioperative outcomes were similar across the two groups. Retrograde cold blood cardioplegia was found to have similar effects on blood loss, transfusion requirements, perioperative myocardial infarction, stroke, renal function, infections, and mortality in a prospective randomised study of 345 patients by Ovrum and colleagues.[9] In contrast, a study conducted by Calafiore and colleagues on 271 patients having aortic valve replacement found that WBC was linked to a decreased risk of cardiac-related mortality than cold blood cardioplegia.[10]

## CONCLUSION

According to the available data, the surgeon can make the call between warm and cold cardioplegia when it comes to patient safety.

**Recommendation:**

**Funding:** This research received no external funding.

**Conflicts of interest:** The authors declare no conflict of interest.

**Ethical Approval:** Not Applicable

## REFERENCES

1. Nardi P, Vacirca SR, Russo M, Colella DF, Bassano C, Scafuri A, Pellegrino A, Melino G, Ruvolo G. Cold crystalloid versus warm blood cardioplegia in patients undergoing aortic valve replacement. Journal of thoracic disease. 2018 Mar;10(3):1490.
2. Buckberg GD, Athanasuleas CL. Cardioplegia: solution or strategies? Eur. J. Cardiothorac. Surg. 2016;50:787–791.

3. Nardi P, Pisano C, Bertoldo F, Vacirca SR, Saitto G, Costantino A, Bovio E, Pellegrino A, Ruvolo G. Warm blood cardioplegia versus cold crystalloid cardioplegia for myocardial protection during coronary artery bypass grafting surgery. Cell Death Discovery. 2018 Feb 14;4(1):1-6.
4. Hunziker L, Radovanovic D, Jeger R, Pedrazzini G, Cuculi F, Urban P, Erne P, Rickli H, Pilgrim T., AMIS Plus Registry Investigators are listed in alphabetic order with the names of the local principal investigators. Twenty-Year Trends in the Incidence and Outcome of Cardiogenic Shock in AMIS Plus Registry. Circ Cardiovasc Interv. 2019 Apr;12(4):e007293
5. Wernly B, Seelmaier C, Leistner D, Stähli BE, Pretsch I, Lichtenauer M, Jung C, Hoppe UC, Landmesser U, Thiele H, Lauten A. Mechanical circulatory support with Impella versus intra-aortic balloon pump or medical treatment in cardiogenic shock-a critical appraisal of current data. Clin Res Cardiol. 2019 Nov;108(11):1249-125
6. Nardi P, Vacirca SR, Russo M, Colella DF, Bassano C, Scafuri A, Pellegrino A, Melino G, Ruvolo G. Cold crystalloid versus warm blood cardioplegia in patients undergoing aortic valve replacement. Journal of thoracic disease. 2018 Mar;10(3):1490.
7. Jacquet LM, Noirhomme PH, Van Dyck MJ, et al. Randomized trial of intermittent antegrade warm blood versus cold crystalloid cardioplegia. Ann Thorac
8. Øvrum E, Tangen G, Tølløfsrud S, et al. Cold blood cardioplegia versus crystalloid cardioplegia: a prospective randomized study of 1440 patients undergoing coronary artery bypass grafting. J Thorac Cardiovasc Surg 2004;128:860-5.
9. Øvrum E, Tangen G, Tølløfsrud S, et al. Cold blood versus cold crystalloid cardioplegia: a prospective randomized study of 345 aortic valve patients. Eur J Cardiothorac Surg 2010;38:745-9.
10. Calafiore AM, Teodori G, Bosco G, et al. Intermittent antegrade warm blood cardioplegia in aortic valve replacement. J Card Surg 1996;11:348-54.