COMPARISON OF RETROGRADE VERSUS ANTROGRADE-RETROGRADE COLD BLOOD CARDIOPLEGIA: A RANDOMIZED CLINICAL TRIAL IN PATIENTS WITH CORONARY ARTERY BYPASS GRAFTING

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Abstract

INTRODUCTION: The quality of myocardial protection during Coronary Artery Bypass Grafting (CABG) has a direct effect on post-operative cardiac function, recovery and complications. This study aimed to reveal the benefits of retrograde cardioplegia alone or with antrograde in CABG for myocardial function.

METHODS: A total number of 90 patients that underwent CABG between 2005 and 2006 were assigned randomly into two groups according to myocardial protection technique; Antrograde cold blood cardioplegia (ACBC) and retrograde cold blood cardioplegia (RCBC). The results were assessed considering clinical outcome, assessment of early systolic function by means of cardiac output (CO), stroke, left ventricular and atrial fibrillation and transient atrioventricular block after coming off bypass.

RESULTS: The mean of age, gender, diabetes, hypertension, euro score, anatomical pattern of coronary disease, indexed left ventricular mass and ejection fraction (EF) were similar in the two groups. Complete LAD occlusion (95% in cross-sectional area of proximal LAD) of grafts was 95.55% in the RCBC group and 97.77% in the A/RCBC group. There were no patients suffering from severe impairment of left ventricle function and EF less than 35%. The cross-clamp time was same in both groups.

CONCLUSION: The main findings of this study showed no significant difference between RCBC and A/RCBC procedure on myocardial function and EF also in patient with normal condition.

Keywords: Retrograde, Antrograde, Cardioplegia.

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Introduction

The quality of myocardial protection during coronary artery bypass grafting (CABG) has a direct effect on post-operative cardiac function, recovery and complications. Antrograde cold blood cardioplegia and ACBC-RCBC are two strategies that normally used for myocardial protection during CABG.[1] However, some studies have revealed disadvantages of RCB against ACB cardioplegia in myocardial protection.[2] Therefore, RCBC becomes an vital adjunct in myocardial protection.[3,4] Some studies have shown that in the presence of coronary stenosis, RCBC outcomes are better considering allocation, myocardial cooling and complete recovery of myocardial function in the areas beyond the occlusion.[4] However some surgeons believe that the use of RCBC together with ACBC is usual, while others do not suggest it for standard procedure. RCBC is assumed not only an additional option to ACBC, but also a unique one in special composite cases.[3,5] The existing disagreement is consequential to the different results among various protocols which have considered the effect of ACBC and RCBC perfusion. Additionally, most of the published data studying cardioplegic arrest offer only a gross inference of the microcirculatory perfusion, which is the basis of myocardial protection. The aim of our Study was to reveal the benefits of RCB alone or with ACB cardioplegia in CABG for myocardial protection.

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Materials and Methods

A total number of 90 patients who underwent CABG between 2005 and 2006 were divided randomly into two groups according to myocardial protection technique; group 1: ACBC, AND A/RCBC, and group 2: Antrograde, RCBC cold blood cardioplegia. Operations were performed by a single team in the Department of Cardiac Surgery of the Chamran Hospital in Isfahan, Iran. The study was approved by the Isfahan University of Medical Sciences ethics committee. Informed consents were taken from all patients.

An initial dose of 1500 ml of high-potassium (20 mmol: l) blood cardioplegia was antrogradely given at the rate of 300 ml: min. The temperature of the solution was between 25 and 28°C (a solution of 4:1 blood with St. Thomas cardioplegia). During the cross-clamp time, 200-400 ml of low potassium (5–10 ml) cardioplegia was retrogradely given every 10 min, while coronary sinus pressure was maintained below 50 mmHg.

The results were assessed considering clinical outcome, assessment of early systolic function by means of cardiac output (CO), stroke, left ventricular and atrial fibrillation, and transient atrioventricular block after coming off bypass.

SPSS v 10 was used for analysis of data. Statistical analysis was made by means of Student's t-tests. Mean ± standard deviation (SD.) was used to show qualitative data and frequency for quantitative.

Results

Pre-operative and intra-operative data is shown in table 1. Pre-operative parameters were similar; cross-clamp time and needed volume of cardioplegia were equal in both groups.

The mean of age, gender, diabetes, hypertension, euro score, anatomical pattern of coronary disease, indexed left ventricular mass, ejection fraction, were similar in both groups. Complete LAD occlusion (95% in cross-sectional area of proximal LAD) of grafts was 95.55% in the RCBC group and 97.77% in the A/RCBC group.

No patient had severe impairment of left ventricle function and ejection fraction less than 35% in both groups. The cross-clamp time was the same in two groups ($P < 0.05$). The vessel score was somewhat higher in the A/RCBC group.

Table 1 indicates that patients had a slightly greater number of significant stenosies of 82.7% versus 57.4% in A/RCBC grope. On the other hand, there were more patients with reduced global ventricular function in the A/RCBC group.

Table 2 shows clinical outcomes such as ischemic events, using inotropes and ventricular fibrillation on reperfusion. It seems that arterial fibrillation was significantly more frequent in the Antrograde group. Early myocardial recovery was better in the antrograde/RCBC group with coronary compliance. There were no differences considering ICU, hospital stay and mortality.

Table 1. Pre-operative and intra-operative parameters of patients in both groups

	RCBC n =45	**A/RCBC n=45**	**P value**
No. of patients	45	45	
Mean age ± SD	58.9 ± 9.9	58.6 ± 15.1	0.884
Sex (M/F)	74/13	54/7	0.164
Euro score	3.6 ± 2.2	40 ± 2.0	0.228
Diabetes	29	26	0.07
Hypertension	63	41	0.114
Unstable angina	45(51.7%)	44(72.1%)	0.006
AMI < 4 weeks	20	19	0.08
Left main stem 50%-75%	72(82.7%)	35(57.4%)	0.0001
Left main stem > 75%	15(17.2%)	26(42.6%)	0.001
Right coronary stenosis	32	22	0.137
EF < 40%	25	18	0.145
Wall motion score index	1.43 ± 0.36	1.63 ± 0.26	0.0001
Postoperative EF	21.5 ± 8.7	51.2 ± 10.1	0.098

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Table 2. Clinical outcome in both groups

	RCBC n = 45	A/RCBC n = 45	P value
Aortic cross clamp time	39.2 ± 14.3	41.6 ± 11.9	0.294
Cardiopulmonary	72.9 ± 25.3	75.1 ± 18.1	0.559
No. of diseased vessels	3.2 ± 0.9	3.2 ± 0.8	0.422
No. of grafts	3.3 ± 0.8	3.3 ± 0.9	0.855
Complete arterial revascularization	12(13.8%)	15(24.6%)	0.129
No. of left ventricle defibrillation	4(4.5%)	5(8.2%)	0.287
Inotropes low dose	31(35.7%)	23(37.7%)	0.465
Inotropes medium dose	21(24.1%)	8(13.1%)	0.07
Inotropes high dose	10(11.5%)	0	0.004
No inotropes	25(28.7%)	30(49.2%)	0.009
Intra-aortic balloon pump	2(2.3%)	1(1.6%)	0.402
Perjoperative QAMI	2(2.3%)	2(3.2%)	0.547
Atrial fibrillation	30(34.5%)	10(16.4%)	0.015
Transient atrioventricular block	-	-	-
Intensive therapy unit stay	2.9 ± 1.3	3.3 ± 2.4	0.144
In hospital stay	8.7 ± 1.9	8.2 ± 3.0	0.267
Postoperative EF	54.3 ± 6.8	54.7 ± 8.2	0.291

Discussion

The findings of this study showed no significant difference between RCBC and A/RCBC procedure on myocardial function and EF also in patients with normal condition. Our results agreed with many studies which support the benefits of A/RCBC procedure.

To overcome the limitations of either ACBC or RCBC alone, this two procedure was given intermittently in animals and patients.[6] Irregular infusions of ACBC and then RCBC every 20 minutes provided more homogeneous myocardial cooling, complete left and right ventricular functional recovery in animals, and excellent clinical outcomes in patients.[6] However, our results (Table 2) showed that this cardioplegic technique can be useful for myocardial function more than either ACBC or RCBC alone in left main patients.

Results of other in vitro studies revealed that RCBC perfusion reaches the myocardial cells simply especially in conditions that the major artery's occlusion is less than 100%.[5] Although the effectiveness of myocardial protection can be gauged to a large degree by the safe-period of aortic occlusion that it affords the surgeon.[7,8] The temperature of blood cardioplegia is another controversy in cardiac surgery. Blood temperature between 20 and 25°C seems to be the best option.[6] Other studies revealed that requires optimal intra-operative protection of myocardium to consistent release of cardioplegia during the heart surgery.[6] It seems that to avoid myocardial dysfunction, the best way is infusion of cardioplegic solution through the aortic root. It can overcome by coronary sinus cardioplegia, when the unobstructed coronary venous system can be used as a route for homogenous distribution.[9] The advantages of A/RCBC perfusion used in our study to protect and cool of entire heart, establishment of aerobic arrest, protection in areas distal to IMA, ungraftable vessels and distal to acute occlusion, elevation of the heart and dissection of coronaries while giving cardioplegia. In our study, however, we have not found an increase in AV blocks postoperatively (Table 2). Although other studies described delay in cardiac arrest as a major disadvantage of RCBC, but we removed this problem with the use of the RCBC/ACBC method. The heart is fibrillating during this prolonged initial infusion interval, and this may cause a reduction in high-energy metabolites and late ventricular dysfunction.[6] In our study, this trouble

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was solved by initial aortic root cardioplegia to achieve early diastolic arrest and followed by coronary sinus infusion. The effectiveness of the Euro-score has been demonstrated and allowed to compare the observed mortality rate with the expected one.

Study Limitation:

A major limitation of was the difference observed in the overall impedance and compliance of the micro-circulatory unit when we switch from ACBC to RCBC distribution. To the best of our knowledge, no data exist describing these impedance differences between ACBC and RCBC perfusion.

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