Original Article
Pak Armed Forces Med J 2016; 66(Suppl):S1-6

ORIGINAL ARTICLES

OUTCOMES OF PATIENTS WITH POOR LEFT VENTRICULAR FUNCTION IN OFF PUMP (OPCAB) AND ON PUMP(CCAB) CORONARY ARTERY BYPASS GRAFTING

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ABSTRACT

Objective: To compare the clinical characteristics and in hospital outcomes of patients with left ventricular ejection fractions of less than 40% who underwent coronary artery bypass graft with or without cardiopulmonary bypass.

Study Design: Descriptive cross sectional.

Place and Duration of Study: This study was conducted at Army Cardiac Centre Lahore from January 2013 to October 2014.

Material and Methods: The data pertaining to the pre, per and post operatives characteristics of the enrolled patients were collected at the time of operation and entered into SPSS database for descriptive and inferential analysis.

Results: Mean age in group A Off pump coronary artery bypass graft (OPCAB) was 57 yrs ± 8.61 versus group B on pump coronary artery bypass graft (CCAB) 55± 10.5 with the gender distribution of males and females in group A as [Males 132(86.3%)Females 21(13.7%)] and group B [Males= 192(91.2%) females = 19(8.8%)]. The number of patients with hypertension and diabetes was higher in group B 92 (43.6%) and 65 (30.8%) respectively. The mortality of the patients undergoing intervention with CCPB was 9(4.2%) versus 5(3.3%) in the off pump OPCAB group. There were statistically significant differences in the postoperative complications among the two groups.

Conclusion: Coronary artery bypass grafting without cardiopulmonary bypass is preferred in patients with severe left ventricular dysfunction. It is valid and safe in our local population and promotes less morbidity and mortality in comparison with conventional operative technique.

Keywords: Coronary artery bypass, Cardiopulmonary bypass, Off-pump surgery, Ejection fraction, Poor LV function

INTRODUCTION

The frequency of patients presenting with severe left ventricular dysfunction is rising together with a growing profile of co-morbidities. Left ventricular (LV) dysfunction has been reported as an independent predictor of operative mortality in patients undergoing coronary artery bypass grafting[1]. Coronary artery bypass graft (CABG) with cardiopulmonary bypass (CCAB) has been reported to carry numerous risks for patients with poor left ventricular (LV) function. Cardiopulmonary bypass (CPB) results in the activation of inflammatory mediators exacerbating myocardial damage in impaired ventricles. In addition, other factors have been identified as contributing to myocardial injury post cardiopulmonary bypass, such as direct harm to myocardial cells during operation and cannulation, effect of potassium and hypothermia or fibrillation on cell membrane and cellular function, and variation of coronary blood flow[2,3]. It is also reported that CCAB results in more distinct endothelial dysfunction and disruption of vasodilatation. Even in uncomplicated procedures, biventricular dysfunction occurs immediately after revascularization and persisted after 24 hrs[4]. It is assumed that preoperative ejection fraction (EF) and the extent of dyssynergy are the two predictors of postoperative ventricular dysfunction. Reduced left ventricular function is also considered as an independent predictor

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of mortality post CABG[6]. myocardial revascularization without

Table-1: Demographic, clinical pre operative characteristics of group A and group B.

Sr. #	Variables	Group A (Off pump) n = 153	Group B (On pump) n = 211	*p*- value
1	Age (mean ± SD) years	56.91 ± 8.61	55.2 ± 10.5	0.32
2	Gender n(%)			
	• Males	132 (86.3%)	192 (91.2%)	0.35
	• Females	21 (13.7%)	19 (8.8%)	0.28
3	Weight (mean ± SD) kg	73.53 ± 11.38	73.96 ± 14.28	0.4
4	Co-morbids N(%)			
	• Hypertension	71 (46.4%)	92 (43.6%)	0.33
	• Diabetes Mellitus	31 (20.1%)	65 (30.8%)	0.25
5	Smokers N (%)	53 (34.5%)	70 (33.2%)	0.34
6	Euro score N (%)	4.0 ± 2.3	3.4 ± 2.25	0.5
7	CCS class N(%)	2.1 ± 0.39	2.2 ± 0.47	0.31
8	NYHA class N(%)			
	• Class I	2 (1.3%)	1 (0.4%)	0.4
	• Class II	128 (83.7%)	176 (83.4%)	0.3
	• Class III	23 (15%)	33 (15.6%)	0.4
	• Class IV	0 (0%)	1 (0.4%)	0.07
9	LV ejection fraction N(%)			
	• < 30%	33 (19.6%)	39 (18.3%)	0.34
	• 31 – 39%	123 (80.4 %)	172 (81.7%)	0.28
10	LV ejection fraction (mean ± SD)	38.0 ± 6.27	38.5 ± 5.4	0.4
11	LIMA graft N(%)	153 (100%)	193 (90.5%)	0.1
12	Saphenous Vein graft (mean± SD)	1.87 ± 0.83	2.20 ± 0.98	0.4
13	Endarterectomy N (%)	9 (5.6%)	16 (7.5%)	0.1
14	Conversion to On Pump N(%)	4 (2.614%)	Nil	

Table-2: Post operative characteristics of group A and group B.

Sr. #	Variables	Group A (Off pump) n = 153	Group B (On pump) n = 211	*p* – value
1	Extubation time (mean± SD) mins	180.08 ± 194.68	363.34 ± 599.6	0.0001
2	Length of hospital stay (mean± SD) days	3.0 ± 2.6	5.2 ± 5.1	0.001
3	IABP N(%)	13(8.496%)	30 (14.218%)	0.08
4	Renal failure N(%)	1(0.653%)	5(2.369%)	0.05
5	Dysrhythmias	14 (9.150%)	40(18.957%)	0.06
6	Transfusion of RCC N(%)			
	Nil	45	nil	
	One unit	68	42	0.1
	2 or more units	40	169	
7	Sternal wound infection N (%)	5 (3.267%)	7 (3.31%)	0.7
8	Pleural Effusion N (%)	8 (5.228%)	9 (4.26%)	0.5
9	Re exploration for bleeding N (%)	3 (1.960%)	7(3.317%)	0.08
10	Post-operative inotropes N (%)	41 (26.79%)	68 (32.22%)	0.1
11	Stroke N (%)	nil	1 (0.47%)	0.09
12	In hospital Mortality N (%)	5 (3.3%)	9 (4.26%)	0.2

The aim of this descriptive cross sectional study is to assess the safety and efficacy of cardiopulmonary bypass in patients with distinctly low ventricular function (<40%) by

comparing the results with a series of patients operated upon in the conventional manner.

MATERIAL AND METHODS

This study was conducted at Army Cardiac Centre Lahore from January 2013 to October 2014 after approval of the institutional ethical review board .The patients were enrolled into the study according to inclusion criteria and after having informed consent .All the data were collected prospectively at the time of operation and entered into a database. During a period of two years a total of 1012 patients underwent isolated coronary artery bypass grafting at our organization. Of these patients, 269 patients had reduced left ventricular function, LVEF < 40% as calculated by 2D-echocardiography were retrospectively study. According to the operative technique used, these patients were divided into two groups. Group 1 (n=153) patients had revascularization using off-pump technique and group 2 (n=211) using cardiopulmonary bypass technique. The choice of the technique was based on surgeon's preference. The decision was made during the preoperative evaluation based principally on the coronary anatomy (mainly diameter and position of the target vessel). Decreased vessel diameter and more diffuse disease were observed in the pump group.

In hospital mortality was defined as death during the same hospital stay. The definition of stroke for this study was the occurrence of a new focal deficit or a comatose state lasting more than 24 hours. Acute myocardial infarction was defined as high creatine kinase MB (CKMB) five times the upper limit of normal, the presence of new electrocardiographic changes indicative of necrosis,. Acute renal failure was defined as a postoperative creatinine level greater than 2.0 mg/dL (with a record of previous normal renal function). for the patients with preoperative co-morbidities like renal insufficiency, history of chronic obstructive pulmonary disease, obesity and cerebrovascular accident, an OPCAB technique was preferentially used. The mean Euro SCORE for OPCAB patients was 4.0 ± 2.3 and for on pump patients CCAB was 3.4 ± 2.25 (p=0.5) and both groups were comparable in terms of surgical risk stratification.

Operative Technique

The choice to perform cardiopulmonary bypass was a personal assessment made by the surgical team. Standard protocols were followed once the decision has been made, including the administration of heparin at a dose of 3 mg/kg. Cardiopulmonary bypass was established through a cannula inserted in the ascending aorta and right atrium, with non-pulsatile blood flow of approximately 2.4 L/min/m2 associated with moderate hypothermia (32°C) and a membrane oxygenator. Myocardial protection was attained by anterograde blood perfusion at systemic temperature, with a hyperkalemic blood cardioplegia infusion, repeated during 3 minutes every 15 minutes to maintain an average pressure above 70 mmHg at the aortic root. Polypropylene monofilament continuous 7-0 sutures were placed for distal anastomosis. Vein grafts were anastomosed to obtuse marginals, diagonals followed by right coronary arteries. Left internal mammary artery (LIMA) was anastomosed to left anterior descending (LAD) after the vein grafts were done. Proximal saphenous vein anastomoses were created in the aorta with a cross clamp during the cardiopulmonary bypass using 6/O Prolene suture.

In the patients who underwent revascularization without cardiopulmonary bypass, suction stabilizer devices Octopus 3 or 4 or Evolution (Medtronic Inc. Minneapolis MN, USA) were used along intracoronary shunts (Medtronic Inc. MN USA). Heparin was administered at a dose of 1.5 mg/kg. A mean systemic arterial pressure was maintained around 60-70 mmHg. Additional maneuvers were applied during cardiac exposure in order to maintain cardiac output, including the opening of the right pleural space and the use of a deep pericardial traction suture. Continuous 7-0 polypropylene monofilament sutures were used for distal anastomosis. The coronary artery grafting strategies were to graft left internal mammary artery to left anterior descending artery first followed by either

diagonal arteries or obtuse marginal arteries r right coronary artery whichever was critically stenosed. The target vessels were approached by intermittent instillation of saline with a syringe. Proximal anastomoses were accomplished using a limited occlusion clamp using 6/O Prolene sutures. Site selection was performed by ascending aorta palpation to steer clear of plaques. The left internal mammary artery was used in all cases (unless it had been used before or obtainable with insufficient flow after dissection) for connection to the anterior descending artery.

Statistical analysis was performed using the IBM SPSS 21 version. Frequency and percentages were expressed for catagoric data whereas mean and standard deviation were used to express continuous variables. Parametric and non parametric tests were applied when appropriate.

RESULTS

Mean age in group A OPCAB was 57 yrs ± 8.61 versus group B CCAB 55± 10.5 with the gender distribution of males and females as group A [Males =132(86.3%) Females = 21(13.7%)] group B [Males= 192(91.2%) females = 19(8.8%)]. The number of patients with hypertension and diabetes was higher in group B 92 (43.6%) and 65 (30.8%) respectively as shown in table-1.

The in hospital mortality of patients undergoing intervention with OPCAB was 5(3.3%) versus 9(4.2%) in the CCPB group. There were differences in the postoperative complications among the two groups. In OPCAB patients 5(3.2%) had sternal wound infection as compare to CCPB group 7(3.31%) (*p*-value 0.7); re exploration for bleeding was found to be 3 (1.9%) in the OPCAB group and 7(3.3%) in the CCPB group (*p*-value 0.08). There was statistically significant difference in the occurrence of renal failure in both the groups 1(0.6%) in OPCAB whereas in CCPB it was 5(2.3%) *p*-value 0.05. The postoperative variables presented highly significant differences were extubation time as in OPCAB group it was (mean 180.08 min ± SD 194.68) versus CCPB group (Mean 363.34 min ± SD 599.6) *p*- value 0.0001 and length of stay in ICU in OPCAB group was (mean 3.0 ± SD2.6 days) as compare to CCPB group with (Mean 5.2 ± SD 5.1) *p*- value 0.001.

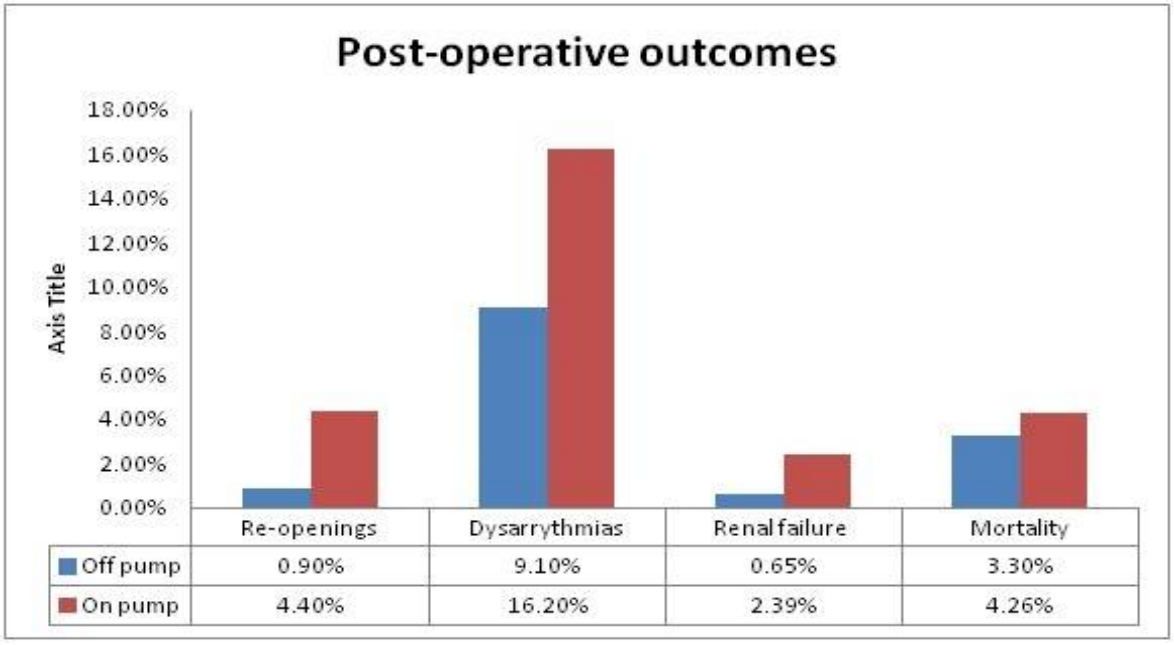

Figure-1: Postoperative outcomes of group OPCAB and CCAB.

DISCUSSION

Surgical treatment of coronary artery disease in patients with ventricular dysfunction is one of the persistent challenges. It is

identified that the clinical management yields meager results with high postoperative mortality. CABG in these patients is challenging, with reduced ventricular function directly linked to procedural risks representing an independent risk factor for morbidity and mortality. Interestingly, these are the patients in which surgical treatment is more effective[6,7,8,].

The definition of left ventricular (LV) dysfunction is controversial. We have taken ejection fraction (EF) of <40% as the criterion for severe LV dysfunction. In our population the prevalence of patients having coronary artery disease (CAD) with severe left ventricular dysfunction is increasing with high risk profile. This is a high risk subset for surgical revascularization with few viable alternatives like medical management and heart transplantation[6,8].

Previously, CABG in patients with severe LV dysfunction has been associated with high mortality. However, recent studies have shown encouraging early, mid and long term results due to advancement in surgical techniques and postoperative management. The benefit of OPCAB is apparent for patients at high risk for complications associated with CPB and aortic manipulation. Recent studies have demonstrated improved outcomes in higher risk patients undergoing off pump CABG. This has demonstrated better myocardial protection compared to on pump technique in a randomized study. Many non-randomized comparisons of off pump CABG with on pump CABG have reposted statistically significant reduction in risk adjusted mortality, stroke, dysrhythmia, acute renal failure, prolonged ventilation and re exploration for bleeding with OPCAB[9,10].

In the present study, we observed that the mortality rate, extubation time, ICU and total length of stay were significantly better in the OPCAB group. The considerably lower frequency of complications in the OPCAB group applied to postoperative complications like transfusion requirements, reoperation for bleeding, acute renal failure, hemodialysis, and stroke. These findings were consistent with the published literature. Factors such as shorter extent of intubation and less pulmonary complications can be explained by the likelihood of cardiopulmonary bypass instigating pulmonary dysfunction resulting in complement activation, neutrophil sequestration in pulmonary microcirculation and enhanced pulmonary capillary permeability, and interstitial pulmonary edema [11,12].

The neurological impediments in our study population were more in CCAB group as compared to OPCAB group and did not reach statistical significance. A better sample size might be able to more evidently state this difference. However, it is consistent with previous documented findings (1%–5%) showing that most catastrophic events are related to embolic episodes occurring during cannulation, cardiopulmonary bypass, and aortic surgical manipulation[13,14].

Several limitations are intrinsic to this study design, such as the fact that there is no randomization. Randomized controlled trials in patients with severe ventricular dysfunction are unlikely to be conducted, given the multiplicity of the technical confines of off-pump CABG, especially in circumflex artery territory in patients with severe LV dysfunction. Another bias is the selection procedure, based on the surgeon's selection of intraoperative clinical circumstances, his or her personal experience, vessel diameter, the position and presence of diffuse disease, and whether or not the procedure was performed using CPB.

CONCLUSION

Coronary artery bypass grafting without cardiopulmonary bypass is preferred in patients with severe left ventricular dysfunction. It is valid and safe in our local population and promotes less morbidity and mortality in comparison with conventional operative technique.

CONFLICT OF INTEREST

This study has no conflict of interest to declare by any author.

AUTHORS CONTRIBUTION

Muhammad Waseem, basic design, Imtiaz Ahmed Chaudhry,manuscript writing,

inteellectual contribution, Farrah Pervaiz, substantial data analysis, Muhammad Bakhsh, supervision, Safdar Ali Khan, inteellectual contribution.

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