OUTCOME OF CORONARY ENDARTECTOMY OF THE LEFT ANTERIOR DESCENDING ARTERY: OPEN VERSUS CLOSED TECHNIQUE. COMPARISON AT A TERTIARY CARDIAC CARE FACILITY

Ali Gohar Zamir, Farrah Pervaiz, Imtiaz Ahmad Chaudhry, Afsheen Iqbal, Asif Mahmood Janjua, Noor Shah, Mashhood Hashmi

Armed Forces Institute of Cardiology/National Institute of Heart Diseases (AFIC/NIHD)/National University of Medical Sciences (NUMS) Rawalpindi Pakistan

ABSTRACT

Objective: To compare the outcome of Coronary Artery Bypass Graft surgery (CABG) after Coronory Endartectomy (CE) of the Left Anterior Descending Artery (LAD) using the open technique with that employing the closed technique.

Study Design: Reterospective Comparative cross sectional study.

Place and Duration of Study: Department of Adult Cardiac surgery of Armed Forces institute of Cardiology, Rawalpindi, from September 2011 to June 2015.

Material and Methods: Total 52 patients with diffuse atheromatous disease of the LAD who underwent CABG surgery necessitating CE of the LAD were investigated retrospectively. These were divided into 2 groups on the basis of technique of CE utilized: Group (Gp) I underwent open CE of the LAD and GpII had closed CE. All patients were followed up for evaluation of peri-operative mortality and morbidity and freedom from recurrent angina, myocardial infarction (MI) and death at 18 months.

Results: There was no peri-operative mortality in group I whereas there were two (7.69%) early deaths in Group II. One patient (3.84%) in Gp I had a non-fatal peri-operative MI as compared to two (7.69%) in Gp II. At 18 months follow-up there was no late death or fresh MI in either group. Two patients (7.69%) in Gp II and none in Gp I had recurrent angina.

Conclusion: We conclude from this study that both the open and closed techniques of CE and equally safe in the short and medium- term after CABG surgery in a sub-group of patients with diffuse CAD who are otherwise at a high risk of fatal outcome if left untreated.

Keywords: Coronary-endartectomy techniques, Diffuse coronary artery disease, Left anterior descending artery (LAD), Outcome.

INTRODUCTION

Management of diffuse coronary artery disease (CAD) has always perplexed the cardiologist and the cardiac surgeon. Incomplete revascularization is associated with worse outcome[1,2] while the placement of multiple stents in a diffusely diseased LAD tends to hamper flow in the diagonal and septal branches[3]. Coronary endarterectomy (CE) has been performed to address the issue with variable results[4-11]. Due to the loss of coronary endothelium and its consequences. CE can be done via a small arteriotomy and separating the atheromatous core from the coronary wall. This is followed by traction on the plaque until it is extracted in to; this is called the "closed" method. The "open" technique ensues opening the coronary using a long arteriotomy beyond the distal limit of the plaque and then removing the plaque under direct vision. The basic aim of both techniques is to remove the entire plaque to produce a lumen for anastomosis in a coronary that cannot otherwise be grafted due to diffuse disease.

Correspondence: Dr Ali Gohar Zamir, Dept of Surgery, Armed Forces Institute of Cardiology Rawalpindi Pakistan
Email: aligoharzaman488@hotmail.com

MATERIAL AND METHODS

Study Population and Clinical outcomes

The descriptive study was conducted at the Armed Forces Institute of Cardiology and National Institute of Heart Diseases (AFIC/

NIHD), Rawalpindi, from Sep 2011 to May 2015. To compare the results of the open and closed techniques of CE, 52 patients were selected so that 2 groups could be formed with comparable demographic characteristics: Gp I underwent open CE of the LAD as an adjunct to CABG surgery and Gp II had closed CE of the LAD with CABG. The left internal mammary artery (LIMA) was used as a conduit to graft the LAD and conventional grafting with saphenous vein was done to revascularize the circumflex and right coronary arteries.

Excluded from the study were patients with severe multiorgan dysfunction, severe immune-deficiency state, reoperations, those having predominantly nonviable anteroseptal myocardium or requiring multi-vessel CE and patients who required surgery for associated valvular or LV aneurysmal disease.

The data was collected and reviewed retrospectively. This included demographics, operative data, early mortality (within 30 days of surgery) and significant postoperative morbidity. All patients were followed-up for 18 months for survival, angina status, recurrence of MI, and re-intervention.

Surgical Indication And Technique

The decision to perform CE was generally made preoperatively when the coronary angiogram showed diffuse stenotic lesions in the LAD. However the final decision was often an intra-operative one after physically assessing the nature of the plaque. Complete or sub-total occlusion and dense calcification were strong determinants of performing CE.

All procedures were performed using cardiopulmonary bypass (CPB) and moderate hypothermia. Intermittent antegrade and retrograde tepid blood cardioplegia was used for myocardial protection. After bypassing the stenoses in the circumflex and right coronary artery territories the LAD was exposed. The extent of the longitudinal arteriotomy incision in the LAD was limited (1 to 1.5 cm) in Gp I and 2.5 to 7 cm in Gp II where it was extended distally until the disease-free distal segment was reached. The proximal extent of the arteriotomy is downstream to a critical stenosis. The pedicled LIMA was than incised to match the length of the LAD arteriotomy and anastomosed as an onlay graft using 2 continuous 7-0 polypropylene sutures in an over-and-over fashion.

Intravenous heparin infusion was started within 4 hours of arrival in the postoperative intensive-care unit as soon as mediastinal hemorrhage was not significant. Asprin 300 mg was given orally or via nasogastric tube within 6 hours and then 100 mg per day continued indefinitely. Warfarin was added on first post-operative day and heparin stopped once INR was 2 to 2.5. Warfarin was omitted after 6 months.

Operational Definitions

Operative mortality was defined as death within 30 days of the surgery or death before hospital discharge; LV dysfunction as LV ejection fraction <40%; respiratory failure meant requirement of mechanical ventilation for more than 48 hours or the advent of pneumonia. Peri-operative MI was defined as the occurrence of new Q waves in the ECG or peak CPK-MB levels five times or more than the upper limit.

Review of Clinical Data And Statistical Analysis

This study was conducted using a retrospective single-center design. Statistical analysis was performed with the SPSS software package (version 23). Continuous variables are described as mean ± standard deviation. Continuous variables were compared using Student's t-test and the discrete variables with the chi-square -test or Fischer's exact test; differences were considered significant at p-value<0.05. This study was approved by the institutional review board of the documented medical institution. Patients were counselled about CE of the LAD and informed consent obtained.

RESULTS

Patient demographics are presented in the table-I. Demographics in both the groups were

similar. The intra- and post-operative data are given in table-II & III respectively.

The CPB and cross-clamp times were on average 30 minutes longer in Gp I than in Gp II, due to the longer suture line of the LIMA-LAD anastomosis in the former. There were 2 (7.69%) peri-operative deaths in Gp II but none in Gp I. Both of these patients had low EF (less than 30%) pre-operatively. One had ventricular fibrillation that did not respond to attempts at cardioversion and the other suffered from MI in the LAD territory with further deterioration of EF leading to multi-organ dysfunction and sepsis. Two (7.6%) patients in Gp II and 1 (3.84%) in Gp I had non-fatal peri-operative MI in the LAD territory[14]. (53.8%) patients in GpI and 16 (61.5%) patients in GpII required ionotropes, while intraaortic balloon pump (IABP) was inserted preoperatively in 4 (15.38%) in Gp 1 and 3 (11.5%) in GpII. Post-operatively, IABP was placed in 1 patient (3.84%) in Gp I and in 3 (11.5%) in Gp II, due to difficult weaning from CPB. Transient atrial fibrillation was present in 1 (3.84%) patient in Gp I and 4 in (15.38%) in Gp II, while ventricular dysrhythmias were observed in 1 (3.84%) in Gp I and 3 (11.5%) in Gp II. Two (7.69%) patients in Gp I and 4 (15.38%) in Gp II required prolonged ventilatory support for more than 48 hours .

Table-I: Demographic characteristics N=52.

S. No.	Characteristics	Number of Patients	
		Group 1	n=26
		Group 2	n=26
1.	Age in Years Mean Range	 59.38 ± 11.4 42-73	 56.8 ± 13.7 38-69
2.	Gender Male Female	 20 (76.9%) 6 (23.0%)	 19 (73.0%) 7 (26.9%)
3.	Hypertension	18 (69.2%)	15 (57.6%)
4.	Diabetes Mellitus	16 (61.5%)	17 (65.38%)
5.	Dyslipidemia	18 (69.2%)	16 (61.5%)
6.	Smoking	13 (50%)	12 (46.1%)
7.	Previous MI	17 (65.38%)	16 (61.5%)
8.	History of congestive cardiac failure (CCF)	3 (11.5%)	1 (3.84%)
9.	Unstable Angina	8(30.7%)	7 (26.9%)
10.	Emergency CABG	1 (3.84%)	0 (0%)
11.	Left Main stem Disease	4 (15.38%)	3 (11.5%)
12.	Poor left ventricular function (LVEF<30%)	3 (11.5%)	2 (7.6%)

Table-II: Intra-operative characteristics patients (n=52).

S. No.	Characteristics	Group 1	Group 2
1	CPB time (minutes) Mean	 145.62 ± 16.53	 117.77 ± 10.324
2	Cross-clamp time (minutes) Mean	 103.92 ± 11.71	 75.31±7.57
3	No.ofAnastomas 3 4	 8 (30.7%) 18 (69.2%)	 10 (38.4%) 16 (61.5%)

Reexploration for haemorrhage was done in 2 (7.69%) patients of Gp I, whereas only 2 (7.69%) patients in each group had superficial sternal wound infection.

In-hospital and out-patient documents of each patient were evaluated retrospectively.

Angina status, record of medication, readmissions and re-interventions, and relevant laboratory and other investigations such as electrocardiograms (ECG), echocardiographic and nuclear perfusion scans were recorded to determine the medium-term morbidity. At 18-months follow-up there was no mortality and no incidence of fresh MI in either group. Two (7.69%) patients in Gp II had recurrent angina; this was Canadian Cardiovascular Society (CCS) Class II. These patients responded well to anti-anginal medication.

Table-III: Post-operative outcome (n=52).

S. No.	Characteristics	Group 1	Group 2	*p*-value
1.	ICU stay (hours) Mean	16±7.3	23.6±8.4	0.001
2.	Hospital Stay (days) Mean	8.4±2.5	9.6±3.8	0.18
3.	Ventricular dysrhythmias	1 (3.84%)	3 (11.5%)	0.305
4.	Atrial fibrillation	1(3.84%)	4 (15.38%)	0.175
5.	Re-exploration for hemorrhage	2 (7.69%)	0 (0%)	0.245
6.	Perioperative Non-fatal MI	1(3.84%)	2(7.69%)	0.500
7.	Ventilatory support >48 hours	2 (7.69%)	4 (15.38%)	0.334
8.	Stroke	0 (0%)	0 (0%)	
9.	Sternal wound infection	1(3.84%)	1 (3.84%)	0.755
10.	Mortality	0 (0%)	2 (7.69%)	0.245

Table-IV: Follow up characteristics (n=52).

At 18 months follow-up		
Characteristics	**Group 1**	**Group 2**
Angina	Nil	2 (7.69%)
MI	Nil	Nil
Mortality	Nil	Nil

DISCUSSION

Coronary endarterectomy, however meticulously done, has the intrinsic drawback of removing the coronary endothelium and, hence, jeopardizing early graft patency due to increased thrombo-genicity and formation of intimal flaps[12,13]. Concomitantly, the extent of completeness of grafting during CABG surgery is directly proportional to successful early and late outcome[14,15]. CE should therefore be resorted to only, when conventional anastomosis of the conduit to the coronary is not possible.

The main advantage of the closed method of CE is a shorter cross-clamp timeand easier anastomosis, but in the LAD this may cause breaking-up of the plaque especially at the junction of the septal and diagonal branches. The open method has the distinct superiority of pulling the atheroma from these branches under direct vision, enabling a more thorough and complete removal, thus, ensuring better patency of these important branches. It also prevents the formation of intimal flaps that can potentially cause acute graft closure due to dissection. Nishi *et al*[8] have reported a 2.9% incidence of early mortality in those undergoing open CE of the LAD as opposed to 6.8% in the closed CE group. The occurrence of perioperative MI in this study was 2.9% in the open and 3.4% in the closed group, and the late (21 ± 16 months) angiographic patency of grafts was 89.1% in the open and 81% in the closed goups. Whichever method is employed, the fundamental principle is to remove the plaque completely until its tapered distal end is evacuated.

The use of LIMA as a conduit has the advantage of not only remodeling itself according to the distal run-off but the diameter of the reconstructed LAD has been shown to decrease to become comparable to the LIMA and the distal LAD[16]. Furthermore the release of vasodiloators

from the LIMA endothelium has a beneficial effect on the patency of the graft as well as the enarterectomized LAD[17,18]. Schwann *et al*[19] demonstrated that after CE, the incidence of graft failure was much higher for vein grafts than with arterial.

Our results correlate favorably with other studies. Myers *et al*[11] using open CE and LIMA onlay patch report a 4.1% incidence of perioperative mortality, 4% of perioperative MI and a 5-year survival of 87.1%. Byrne *et al*[20] used the closed CE and LIMA in 72% of his CE patients and an open CE in 28%. In the latter group they used a vein patch to reconstruct the LAD and then LIMA was anastomosed to the patch. They quote a 3% incidence each of early death and perioperative MI, and 94% survival at 1 year. Nishigawa *et al*[21] using open CE and LIMA reported a 1.1% incidence of early death, 4.8% of perioperative MI, and a mean survival of 89.3 ± 2.4% at 5 year, whereas Takanashi[10] and associatesreport perioperative mortality at 2.7% and early MI at 12.2% in patients undergoing open CE with LIMA as the conduit. Our study shows that although the incidence of complications such as postoperative dysrhythmias, MI, prolonged ventilatory support and peri operative mortality was higher in the closed technique, the difference was statistically not significant. Furthermore at 18 months follow up the results in terms of recurrent angina, MI and mortality were also similar. The only significant clinical outcome was the longer duration of ICU stay after surgery in Gp II.

CONCLUSION

We conclude from this study that both the open and closed techniques of CE and equally safe in the short and medium- term after CABG surgery in a sub-group of patients with diffuse CAD who are otherwise at a high risk of fatal outcome if left untreated.

LIMITATION OF STUDY

This was retrospective observational study, and the follow-up period was relatively short. Coronary angiography was not done during the follow-up due mainly to social reasons, as the patients were reluctant to undergo this investigation in the absence of significant symptoms. Moreover the number of patients was small due to selection of comparable demo-graphics in the two groups.

CONFLICT OF INTEREST

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

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