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Outcome of Left Anterior Descending Artery Reconstruction with Internal Mammary Artery

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Abstract: Background: Coronary targets' quality is a standard concern to surgeons while performing coronary bypass surgery, due to ongoing advances in interventional techniques, quality of the target vessels has become a major concern while performing coronary artery bypass grafting procedure. One of frequently attempted tactics is LAD reconstruction by a long on lay patch created by the internal mammary artery, the aim of this research is to evaluate the outcome of LAD reconstruction using this technique. **Methods:** This descriptive analysis was conducted retrospectively and the study was held between January 2014 and January 2018, it was instituted to involve a group of 105 patients who underwent coronary bypass surgery which entailed LAD reconstruction by internal mammary graft in the form of on lay patch. One year Follow up by multi-slice CT angiographic catheterization was performed in 46 cases (46.9%). **Results:** The mean length of the LIMA to LAD anastomosis was 3.9±1.7 cm. In-hospital mortality was (1.9%). Postoperative morbidities included low cardiac output (11.4%) and myocardial infarction (1.9%) during ICU stay. One year Follow-up revealed freedom from cardiac or cerebrovascular events (90.8%), LIMA to LAD patency rate after surgery (92.3%) and survival rate (97.9%). **Conclusion:** Reconstruction of a poor quality LAD by a mammary patch is a safe and performable technique, our one year evaluation in this study was adequate to establish that procedure as an applicable option in cases with diffusely diseased coronary targets.

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1. Introduction:

As a result of progressive and advanced techniques of coronary intervention, there is increase in number of patients with advanced and diffusely atherosclerotic coronary artery lesions presenting for Coronary Artery Bypass Grafting (CABG). [1] As the diffusely diseased left anterior descending coronary artery (LAD) is frequently encountered in such patients, the conventional surgical bypass techniques may not be able to achieve complete myocardial revascularization. [2]

Previous experience with coronary endarterectomy has been limited dueto poor clinical results in the early years and controversial results reported in the literature. [3] LAD reconstruction using long-segmental anastomosis technique is an option while dealing with diffusely diseased coronaries. The great advantage of such maneuver is to recruite the ostia of the side branches of the diffusely diseased target and thus maintaining highest possible distal run – off to the supplied myocardial mass.

In this study we share our experience with the outcome of LAD reconstruction using an internal mammary artery (IMA) graft.

2. Patients and methods:

Study Population:

Between January 2014 and January 2018, 105 patients underwent CABG at our hospital with LAD reconstruction using IMA graft. Cases associated with any other significant valvular diseases necessitating surgical intervention were not included. Our study was approved by the institutional ethical committee board and consents of patients were taken.

Preoperative characteristics of the patients are shown in Table 1.

Table 1: pre-operative data of the study group

Characteristic	Number / Value
Age (years)	54.5± 10.3
Sex (Male)	75 (71.4%)
Hypertension	73 (69.52%)
Diabetes mellitus	62 (59.04%)
Hyperlipidemia	67 (63.8%)
Smoking	78 (74.28%)
Unstable angina	16 (15.23%)
Previous MI	27 (25.71%)
Left main coronary artery stenosis	19 (18.1%)
Ejection fraction	0.51 ± 0.16
Previous stroke	5 (4.76%)

Surgical Technique:

The decision of performing a long anastomosis on the LAD was constituted upon the presence of multiple occlusive lesion along the course of the LAD in pre-operative angiogram. In some patients, this angiogram was not being helpful and the decision was made intraoperatively for such cases. The operations were performed using cardiopulmonary bypass (CPB) with the patient's temperature was kept around 35 degrees.

Myocardial protection was achieved with antegrade warm blood cardioplegia. LIMA was utilized for LAD reconstruction along our study group. The LAD was tackled by performing a long arteriotomy, and the length of this arteriotomy was decided intra-operatively, base on the idea that its tip should exist in a disease free zone distally. LIMA was then longitudinally opened with an equal length and land over the long opened LAD in what is referred to as on-lay patch configuration which is sutured using 7-0 polypropylene stitch. Then proximal anastomoses were performed after declamping the aorta. After completion of surgery, all patients were admitted to the intensive care unit. Aspirin and Clopidogrel were started on postoperative day 1.

One year follow-up of the patients was achieved through outpatient clinics and telephone calls for clinical and angiographic assessment.

Statistical analysis:

Data were encoded and then entered into the SPSS (Statistical Package for the Social Sciences). Quantitative data are summarized using the mean ± standard deviation, while categorical data are presented as frequency (count) and relative frequency (percentage).

3. Results:

The mean length of LAD reconstruction by on lay patch created by the internal mammary artery was 3.9 ± 1.7 cm. The graft used for LAD anastomosis is left internal mammary artery (LIMA) in 100 patients (95.2%) and right internal mammary artery (RIMA) in 5 patients (4.8%). The mean CPB time was 96.2 ± 7.4 minutes. The mean aortic cross-clamp time was 72 ±4.5 minutes. Weaning from CPB was difficult and an intra-aortic balloon pump (IABP) was required in 4 patients (3.8%).

Re-exploration for bleeding was required in 5 patients (4.8%). Postoperative MI was observed in 2 patients (1.9%). Low cardiac output syndrome was in 12 patients (11.4%). The remaining postoperative complications included: stroke in 3 patients (2.9%), prolonged mechanical ventilation in 11 patients (10.5%) and renal failure requiring transient dialysis in 6 patients (5.7%). The mean duration of ICU stay was1.9 ± 9.4 days.

There were 2 postoperative deaths within the first 30 days (1.9%). One patient died 6 days after surgery, this patient had a perioperative MI and post-operative echocardiographic assessment revealed an ejection fraction of 35%. Intra-aortic balloon was inserted together with pharmacololgical support with poor response and death due to low cardiac output. The other patient died of pneumonia and sepsis 12 days after the operation.

Five patients were unreachable on follow up, so the study included 98 (95.1%) of 103 patients. The mean follow-up period was 11 ± 3.2 months, 2 patients (2.04%) died of congestive heart failure and new MI during the follow up period. Two patients (2.04%) had recurrentangina, 4 (4.1%) had congestive heart failure, and 1 (1.02%) had a stroke. Freedom from cardiac or cerebrovascular accidents was 90.8%. Survival rate was 97.9%.

During the follow up period, Multi-slice CT (MSCT) was possible in 34 patients while angiographic catheterization was feasible in 12 patients. Patency rate of both IMA and LAD was

92.3%. Occlusion of the IMA with a patent LAD was observed in 1 patient, and occlusion of distal LAD with a patent IMA was observed in 2 patients.

Table 2: result data of the study group

Item	Value
Length of LAD reconstruction, cm	3.9 ± 1.7
CPB time, min	96.2 ± 7.4
Aortic cross-clamp time, min	72 ± 4.5
IABP	4 (3.8%)
Re-exploration for bleeding	5 (4.8%)
Postoperative myocardial infarction	2 (1.9%)
Low cardiac output	12 (11.4%)
Postoperative stroke	3 (2.9%)
Prolonged mechanical ventilation	11 (10.5%)
Need for hemodialysis	6 (5.7%)
ICU stay, days	5.9 ± 3.4
In-hospital mortality	2 (1.9%)

4. Discussion:

The core principal of CABG is to revascularize all coronaries putting the LAD on top of the list being the cardinal coronary of which under – revasularization is a major predictor of operative and post- operative mortality. [5 & 6] Ngaage and colleagues stated that a diffusely diseased LAD thart is inadequately revasularized is a main predictor of post CABG cardiac events. [7] In our study, freedom from cardiac or cerebrovascular events was 90.8% while survival rate was 97.9% during the follow-up period.

We do believe that putting a long on-lay mammary patch on the LAD guarantees that the ostia of all LAD branches either diagonals, septals or RV branches, could easily be visualized and perfused. Coronary endarterectomy is one of the techniques used for diffusely diseased LAD reconstruction. However, we were confronted by a high perioperative mortality rate when we – in other studies – applied this technique. The prohibitive disadvantage of this technique is constituted on the concept of endothelial exposure which causes early ignition of coagulation cascade and consequently, late myofibrointimal proliferation. [8] In our study, LAD reconstruction was performed using LIMA graft in the form of on lay patch without endarterectomy.

Fukui and colleagues preferred to use the LIMA than the right IMA while performing this surgical technique, simply because the LIMA is more recruitable length wise and more in line with the LAD. [5] In our study, the graft used for LAD anastomosis is left IMA in 100 patients (95.2%) while the right IMA was used in the rest of the patients.

Ogus and colleagues reported postoperative morbidity especially MI (6.9%) higher than that reported in our study (1.9%). [9]

We believe that the perioperative mortality in our study was slightly lower than similar researches. Barra and colleagues, reported a 3.7% in-hospital mortality rate in their study which applied the same technique on a study group of 108 patients. [10]

Inour study, follow-up results exhibited both IMA and LAD patency rate of 92.3%. LIMA was occluded with a patent LAD in 1 patient, and distal LAD was occluded with a patent IMA in 2 patients. Fukui and colleagues have patency rates of LAD and IMA (93.8%) similar to our study. Thrombosis, intimal proliferation, flow competition and disease progression are potential causes of graft failure. [11]

Limitations of our research include that it was a retrospective observational study. The absence of control group; as we did not compare the reconstruction with the conventional CABG with multiple anastomoses to LAD in patients with a diffusely diseased one. Only 46.9% of the patients underwent either MSCT or coronary angiography catheterization during the follow-up period.

Conclusion:

Reconstruction of LAD using IMA graft in the form of on lay patch is safe, effective and feasible especially in patients who may not be optimal candidates for conventional technique with multiple anastomoses to the LAD. The angiographic follow up results of such technique was excellent.

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