# The Comparison Between Two Surgical Methods for Left Internal Mammary Artery (LIMA) Anastomosis on Left Anterior Descending (LAD) Artery in Patients with Severe Diffuse Lesions: Short to Mid-Term Results

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**Abstract-** Coronary artery disease is the leading cause of death worldwide. In this study, we compared two surgical methods of left internal mammary artery (LIMA) anastomosis on left anterior descending (LAD) artery in patients with severe diffuse lesions. A total of 40 patients were included in our study and randomly assigned into two groups. In group A, after a long arteriotomy on LAD, the posterior surface of left internal mammary artery (LIMA) was opened by the same length and was anastomosed along the LAD course through normal and diseased parts. In group B instead of complete opening of LAD, a small arteriotomy was done only in areas where the wall of the vessel was nearly normal (especially the anterolateral wall), and LIMA was anastomosed to these areas in a sequential (Jump) method. The patients were then followed for post-operation results. The two groups showed equal results regarding early mortality, post-operation bleeding, and infection, pleural and pericardial effusion. There were two cases of myocardial infarction (MI) in group A with one mortality after 18 months, while no MI was reported in group B. Group B demonstrated significantly superior results regarding the rise in ejection fraction and the improvement in functional class. In this study it was demonstrated that diffuse coronary artery lesions of LAD should be preferably operated using LIMA with the sequential-jump anastomoses method and the surgeon should avoid long arteriotomy with single long anastomosis because of lower chance of long-term patency.



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## Introduction

Coronary artery disease is one of the most widespread groups of chronic diseases worldwide and a leading cause of death in developing and developed countries (1). Coronary artery bypass grafting (CABG), a well-known treatment strategy to increase the life expectancy and quality of life in these patients, has been modified extensively in the course of time.

The common method of CABG is limited arteriotomy and conduit anastomosis using arterial or venous grafts (2). However in diffuse and long-segment diseases of left anterior descending artery (LAD), the use of this method is not possible and the surgeon is obliged to perform other procedures such as endarterectomy, long arteriotomy with long anastomosis or opening the vessel in multiple sites and performing sequential anastomoses (3-5). In this single-blinded clinical trial, we tried to compare the results of the last two methods.

## Materials and Methods

From October 2009 to May 2012, a total of 40 patients were included in our study. The patients were randomly assigned to two groups. Conventional angiography was done for all the patients. All the patients had the diffuse left anterior descending artery (LAD) disease in addition to the involvement of left circumflex artery (LCX) and right coronary artery

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(RCA) or their branches.

LAD involvements were nearly the same in all the subjects.

The two groups were equalized according to age, sex and coronary artery disease risk factors such as diabetes, hypertension, and smoking. After complete pre-operation evaluation and obtaining informed consent, all the patients underwent CABG using the cardiopulmonary bypass. If during operation the patients in any groups were found not suitable for the pre-selected surgical method, he or she was excluded from the study and a proper surgical approach aside from our study would be performed. After the operation, all the patients were followed by a cardiologist who was blind to the patients' group. In group A, after a long arteriotomy on LAD, the posterior surface of the left internal mammary artery (LIMA) was opened by the same length and was anastomosed along its course. As a result, the anastomosis site passed intermittently through normal and diseased parts. In group B instead of complete opening of LAD, a small arteriotomy was done only in areas that the wall of the vessel was nearly normal (especially the anterolateral wall), and LIMA was anastomosed to these areas in a sequential (Jump) method.

In those cases that LIMA was not suitable for sequential anastomoses on LAD artery due to small length or thinning, initially we attached the selected parts on LAD artery sequentially using a saphenous vein graft (SVG) and finally anastomosed LIMA to the SVG. So in this group of patients, nine had two sequential anastomoses, six had three anastomoses and three patients had four anastomoses. In two patients due to above mentioned reasons, first more normal regions of LAD were anastomosed using an SVG and then LIMA was anastomosed to that SVG.

After the procedure, routine closure was done, and the patients were transferred to the ICU and then to the ward and after discharge were followed regularly in the clinic. The follow-up visits were arranged on day 7, then monthly for 3 visits, semi-annually for one visit and then annually.

All the patients underwent echocardiography at the end of the second-month post-operation and the findings such as ejection fraction (EF), and wall motion were documented. Thereafter considering the patients' conditions, they underwent echocardiography every 6 months or annually. The risk factor modification was done for all the patients. This study was approved by Shiraz University of Medical Sciences Ethics Committee.

## Results

The range of patients' age was 42-83 years and included seven (35%) females and thirteen (65%) males in group A and eight (40%) females and twelve (60%) males in group B. In none of the study subjects, early mortality (during the first month), post-op bleeding, pleural or pericardial effusion or infection was noticed (Table1).

**Table 1. Postoperative early results**

| Postop early results | Group A | Group B |
|---|---|---|
| **Mortality during the first month** | 0 | 0 |
| **Post-op complications*** | 0 | 0 |
| **Myocardial infarction** | 2 | 0 |
| **Symptoms (Dyspnea) during the second month** | 3 | 0 |

*Including bleeding, infections, pleural and pericardial effusions

During the first 24 hours after operation, electrocardiographic (ECG) changes and rise of cardiac enzymes indicative of myocardial injury in the territory of LAD was seen in two of the patients in group A who were managed and stabled medically. In 3 of the patients in group A, including the two patients who suffered myocardial injury, dyspnea was a prominent complaint in the second month after the operation. In these patients, the functional class had decreased by at least one stage in comparison to the pre-operation period (Table2) and echocardiography revealed akinesia or dyskinesia of the anterolateral wall of Left ventricle in LAD territory.

**Table 2. Changes in the stages of Functional class**

| Change in stage of functional class | Group A | Group B |
|---|---|---|
| **-1** | 6 | 13 |
| **0** | 11 | 7 |
| **1** | 2 | 0 |
| **2** | 1 | 0 |

Anti failure therapy was initiated for these patients but eventually we were obliged to perform coronary angiography in the second year after the operation which revealed total occlusion of the LAD artery with no run-off. Unfortunately, one of the patients died after 18 months due to intractable heart failure unresponsive to medical therapies. There were no other prominent complaints in group A patients. The change in ejection fraction (EF), as measured by echocardiography in this group of patients, was in the range of -12% - 10% (mean 3.40% ± 1.38%). None of the patients in group B had

any prominent complaints. Their functional classes increased or had no change compared with a pre-operation period (Table 2). Echocardiography also showed increased EF in the range of 0% - 10% (mean 8.35% ± 2.45%) in comparison to a pre-operation period which was statistically superior to group A (*P*-value=0.001). In this group of patients during the two year follow-up there was no need to perform angiography.

## Discussion

Reperfusion of the ischemic cardiac muscle, by increasing the coronary blood flow, results in enhanced myocardial contractility, MI prevention and improvement of the patient's quality of life (6). In lieu of the advances in open heart surgery, medical treatments and interventions such as stenting has advanced recently and can address the problem in a large group of the patients. In line with advances in medical and percutaneous coronary interventions, the indications and methods of open heart surgery have been modified. In addition, the extent and type of involvement of coronary vessels have evolved in such a way that some cases are not only unsuitable for non-surgical interventions, but also a great challenge to surgical treatments. Diffuse and long segment LAD artery lesions are just one example. There are several studies comparing different approaches to these lesions. In some of these, long arteriotomy and conduit anastomosis even on diseased regions are advised (3,7). Other studies are against this and suggest alternatives such as arterial endarterectomy or multiple anastomoses on these lesions (4,5,8,9).

In our study, the results are against the approach of the long arteriotomy and long anastomosis. We encountered increased post-operation myocardial injury, decreased functional classes, less improvement in ejection fraction and finally angiographically proven increased LAD artery occlusion. On the other hand, no patients in the sequential anastomosis group demonstrated such complications in the 2-year follow-up pointing to enhanced myocardial protection with this method. Although theoretical, these findings can be attributed to the intra-operation surgical technique; in long arteriotomy and long anastomosis, the surgeon is obliged to use larger caliber prolene sutures in order to decrease the chance of suture disruption or needle breakage. In addition, in some areas especially larger plaques, the surgeon have to insert the needle in LAD artery farther than the vessel free edge or even in some cases from the vessel base.

This will cause a great volume of suture material being lodged in anastomosis area and leads to accelerated vessel occlusion. Moreover, plaque fracture may lead to imminent dissection in the anastomosis area and further occlusion. However, in the second method diffuse lesions are managed by using small arteriotomies in seemingly normal LAD artery areas or anterolateral wall with fewer plaque densities and then side to side LIMA anastomosis and multi-segment jump anastomosis are performed. Therefore, the surgeon can use thinner prolene sutures and place the sutures within the vessel wall edge. This results in the less foreign body in the anastomosis area and less chance of inflammation and later stenosis.

We concluded in this study that diffuse coronary artery lesions of LAD artery should be preferably operated using LIMA and sequential-jump anastomoses and the surgeon should avoid long arteriotomy and single long anastomosis because of more early complications and lower chance of long-term patency.

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