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Original Article

Alternative option in patients with multisegmental left anterior descending coronary artery disease for providing complete myocardial revascularization

Arif Gucu[1], Tuğrul Goncu[1], Senol Yavuz[1], Ozlem Arican Ozluk[2], Cuneyt Eris[1], Tamer Turk[1], Ahmet Ozyazıcıoglu[1], Hakan Vural[1]

[1]Department of Cardiovascular Surgery, Bursa Yuksek Ihtisas Training & Research Hospital, Bursa, Turkey; [2]Department of Cardiology, Bursa Yuksek Ihtisas Training & Research Hospital, Bursa, Turkey

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Abstract: Objectives: The basic aim of surgical interventions in patients with coronary artery disease is to complete myocardial revascularization. In such patients, however, complementary revascularization techniques may require in patients with multisegmental left anterior descending disease. Among the different procedures, we performed an alternative option in patients with multisegmental lad disease for providing complete myocardial revascularization. Methods: This study consists of retrospective analysis of consecutive eight patients between january 2008 and august 2013. In all patients, the surgical procedure consisted of standard aortic and right atrial cannulations followed by coronary artery bypass grafting with cardiopulmonary bypass. At the lesions of non-lad vessels distal anastomoses were performed with saphenous vein graft. After that lad arteriotomies were performed at the proximal and the distal segment of coronary stenosis, and a bridge was formed with a short segment valveless svg. The left internal mammary artery was anastomosed on the bridge. Results: This innovative technique was performed successfully in all the patients. There were no morbidity and in-hospital mortality. At follow-up 1 year control, all the patients have no complications. In 2 patients, control angiogram showed a patent lima to a bridge anastomosis. Conclusions: Although our series has a small group population, we advocate that this is a safe, easy, and efficient technique for providing complete revascularization in multisegmental lad disease. This technique could be performed with the good result and easy implementation. It perfuses both the proximal and the distal segments of the multisegmental lad stenoses.

Keywords: Coronary artery bypass grafting, revascularization techniques, complete myocardial revascularization

Introduction

The basic aim of surgical interventions in patients with coronary artery disease is to complete revascularization for ensuring blood flow to viable myocardial cells. However, complete revascularization is not practicable with standard coronary artery bypass grafting (CABG) techniques in the presence of multisegmental left anterior descending (LAD) disease. In particular, residual lesions in the LAD are an important parameter affecting early and late postoperative period mortality. In such patients, complementary revascularization techniques may require. Some alternative procedures, such as the use of multiple or sequential anastomoses, composite grafts, coronary endarterectomy and/or saphenous vein patch reconstruction may have been proposed to revascularize the LAD system in the existence of multisegmental disease [1-4].

In this study, we aimed at sharing the results of our innovative technique performed in consecutive eigth patients.

Patients and methods

Patients

This study consists of retrospective analysis of consecutive eight patients between January 2008 and August 2013. Six of the patients were male and 2 patients were female. Age ranged between 43 and 67 (mean; 58.3 ± 7.7)

Table 1. Demographic Data of the Study Group

Age (years):	43 and 67 (58.3 ± 7.7)
Male/Female:	6/2 (75%/25%)
Diabetes Mellitus:	4/8 (50%)
Hypertension:	6/8 (75%)
Hyperlipidemia:	6/8 (75%)
COPD:	3/8 (37.5%)
Family History:	2/8 (25%)
Previous MI:	4/8 (50%)
Smoking:	6/8 (75%)

COPD: Chronic Obstructive Pulmonary Diseas.

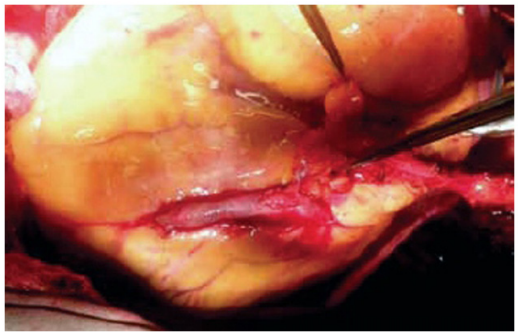

Figure 1. Intraoperative view of the bridge.

years (**Table 1**). Preoperative ejection fraction ranged between 35% and 55% (mean; 47.5 ± 7.5%). Four patients (50%) had diabetic and hypertension in 6 (75%). This study was approved by the Institutional Review Board and written informed consent was obtained from all patients. Demographics data of the study group were demonstrated in **Table 1**.

Surgical technique

The sternum was opened with median sternotomy incision. The left internal mammary artery (LIMA) and saphenous vein graft (SVG) was harvested simultaneously. Following systemic heparinization, the LIMA was prepared and was kept in papaverine-soaked sponge until its use. The cardiopulmonary bypass was initiated with aortic and right atrial cannulations. Following a period of cooling to 28-32°C, the aorta was cross-clamped and cardioplegic arrest was established with crystalloid cardioplegia infused through the aortic root and subsequently blood cardioplegia was repeated every 20 minutes. At the lesions of non-LAD vessels distal anastomoses were performed with SVG. After that LAD arteriotomies were performed at the proximal and the distal segment of coronary stenosis, and a bridge was formed with a short segment valveless saphenous vein graft. LIMA was anastomosed on the bridge (**Figure 1**). To ensure the flow to both sides through a SVG, a valveless part of the saphenous graft was used. Neither endarterectomy nor saphenous patch plasty was used in the patients. The aortic clamp was opened and the proximal anastomoses were performed under a partial aortic clamp. Following the warming period, the cardiopulmonary bypass was terminated and the chest was closed after completion of hemostasis.

Results

There were no morbidity and in-hospital mortality. The mean aortic cross-clamp time was 66.6 ± 18.1 minutes and the mean cardiopulmonary bypass time was 96.6 ± 8.6 minutes. The mean number of distal anastomoses performed per patient was 4.1 ± 0.8. For the postoperative myocardial ischemia, the patients were followed up clinically and were monitored with electrocardiography (ECG) and cardiac enzyme changes (CK-MB, troponin I). No patients had clinical symptoms and none of them displayed significant change in their ECG and cardiac enzyme levels. The patients did not required IABP support. Preoperative, operative and postoperative data of the study group were demonstrated in **Table 2**. Statistical data given as mean ± standard deviation.

Follow-up period

All patients were called for clinical control by telephone on the first and 6th months and 1st year. One patient could not be reached for the 6th month control. Patients were evaluated by clinically. At the 6th month and 1st year control, exercise ECG test were performed all patients. All patients had no problems. Randomly selected two patients control coronary angiography was performed in 6th months and 1st year follow-up periods. There was no significant anastomotic stenosis or occlusion at follow-up 6th month control angiography (**Figure 2**). There was no complications and grafts was patent at follow-up 1st year control angiography in another patient (**Figure 3**).

Discussion

Whereas a number of coronary artery revascularization procedures decreases in the last years, the complexity and severity of each procedu-

Table 2. Preoperative, Operative and Postoperative Data of the Study Group

Preoperative left ventricular ejection fraction (%):	35% and 55% (47.5 ± 7.5%)
Coronary artery bypass graft:	4.1 ± 0.8
Cross-clamp time (minute):	66.6 ± 18.1
Total Perfusion time (minute):	96.6 ± 8.6
Inotropic support:	4/8 (50%)
IABP support:	None
Postoperative ECG change:	None
Postoperative cardiac enzyme level change:	None
In-hospital mortality:	None

re increases in surgery population. Cardiac surgeons are confronted with patients suffering from multisegmental coronary artery diseases [5]. In this patient population where the possibilities of conservative coronary artery surgery are limited, cardiac surgeons must add complementary revascularization techniques in order to provide the full benefits of complete revascularization of these patients. LAD revascularization is very important because of its direct relationship with early and late mortality, decreasing recurrent angina, and related deaths. In multisegmental coronary artery disease of the LAD, residual lesions due to incomplete revascularization are among the most important parameters for perioperative and postoperative mortality [6].

If the coronary artery disease is not multisegmental, arterial grafts can be anastomosed to the appropriate site directly. Nevertheless, when lesions are multisegmental in nature, different techniques are essential for complete revascularization. Direct LIMA anastomosis may be technically feasible in the presence of multisegmental coronary artery lesions, although the long-term results are fully known. To overcome this problem, vein patch with or without endarterectomy may be used. There is an ongoing debate over two techniques of coronary artery endarterectomy. The closed endarterectomy technique requires a small arteriotomy, and its reconstruction is easier. The greatest risk involved in this technique is the incomplete removal of distal plaque leading to a postoperative decrease in septal branch blood flow [7]. On the other hand, in the open technique, this disadvantage doesn't exist because of the complete removal of the plaque in the main artery and its septal branches [7, 8]. In the open endarterectomy technique with saphenous vein patch, the arteriotomy is extended distally to the beginning of the normal lumen, and the endarterectomy is performed on this diseased segment. A variation is reconstruction with saphenous vein patch after endarterectomy and the SVG or LIMA anastomosed to this patch [9]. Some surgeons prefer proximal LIMA bypass and saphenous vein patch plasty for an existing distal stenotic lesion [7].

Residual obstruction, intimal flap thrombosis, and atheroemboli are the main causes of ischemia after endarterectomy-related procedures [10]. CABG surgery with coronary artery endarterectomy has higher morbidity and mortality rates compared with standard CABG surgeries [11]. Studies have shown that the mortality rate is even higher when the LAD is the artery on which the endarterectomy is performed [12, 13]. Qureshi et al. [14] reported the in-hospital mortality of 4% among patients who underwent an endarterectomy on the left coronary artery system. All techniques are time-consuming and prolong the myocardial ischemic period. These drawbacks have led some surgeon to advocate the multiple sequential anastomoses in multisegmental LAD disease [4, 15, 16].

Early phase graft occlusion takes place prior to hospital discharge in approximately 10 percent of grafts. This complication may be related to severity of bypassed proximal artery stenosis and technical factors, such as kinking from excessive length of the graft or tension from short lenght of the graft and poor distal artery run-off. Another 5 to 10 percent of grafts constitutes occlusion between one month and one year after surgery and called as intermediate phase graft occlusion. A variety of factors contribute to this process including platelet aggregation, growth factor secretion, endothelial dysfunction due to reduced endothelial production of nitric oxide and prostacyclin, decreased local fibrinolytic potential resulting from upregulation of plasminogen activator inhibitor-1, luminal foam cell accumulation, and marked intimal hyperplasia [17-20].

In this study, patients with multisegmental LAD lesions operated using this procedure had no clinical symptoms, no significant change in their ECG's and cardiac enzyme levels in the early and intermediate periods. Also control

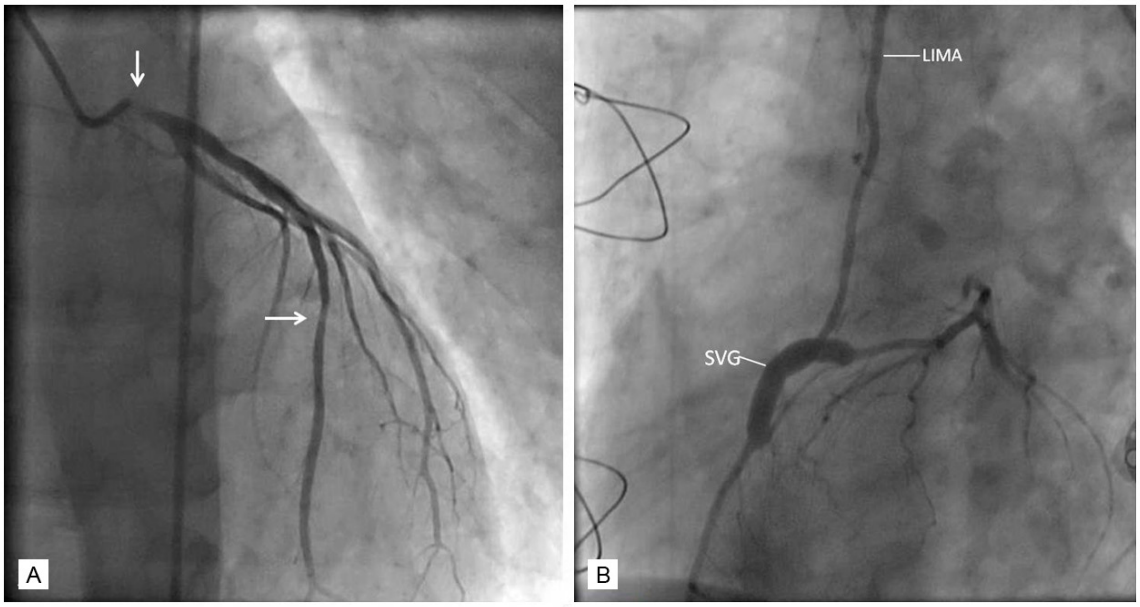

Figure 2. Preoperative coronary angiography of patient (A) and at follow-up 6th month postoperative control coronary angiography of the bridge (B). There was no significant anastomotic stenosis or occlusion.

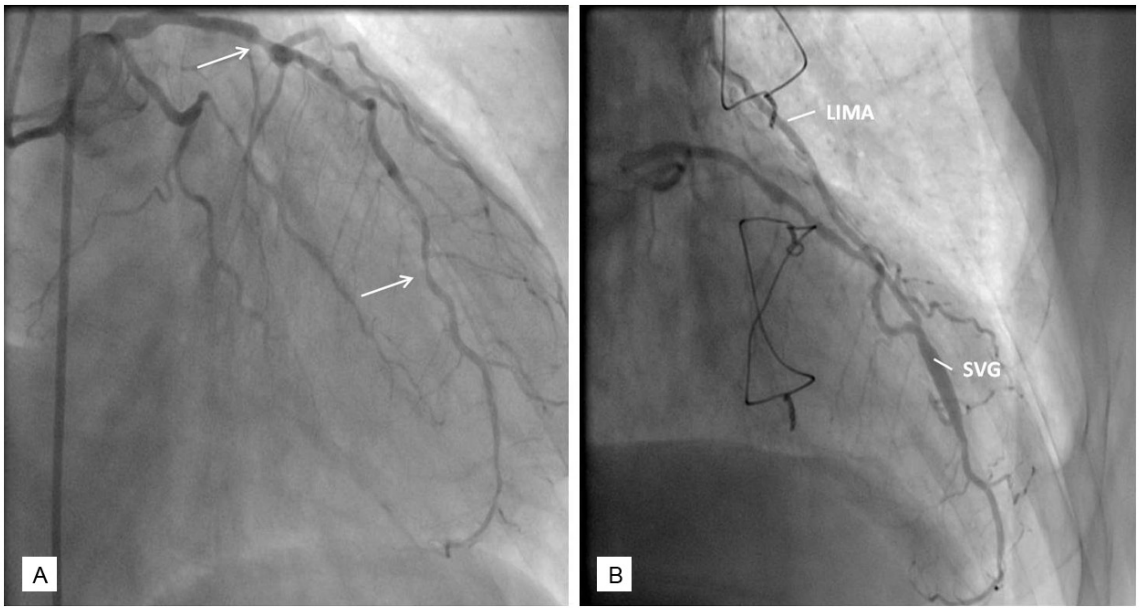

Figure 3. Preoperative coronary angiography (A) and at follow-up 1st year postoperative control angiography in another patient (B). There was no complication and grafts were patent.

coronary angiographies in two patients revealed that there was no significant anastomotic stenosis or occlusion in the 6th month and one year follow-up periods. Consequently, we believe that the decribed technique may be helpful in avoiding the risk of coronary endarterectomy, avoiding the risk of graft kinking or tension, decreasing the myocardial ischemic period, and thus provide complete revascularization.

Although our series has a small group population, we advocate that this is a safe, easy, and efficient technique for providing complete revascularization in multisegmental LAD disease. This technique could be performed with

the good result and easy implementation. It perfuses both the proximal and the distal segments of the multisegmental LAD stenoses.

Study limitations

This study has some drawbacks. Firstly, an important limitation is the number of patients but in further period we have aimed to increase of number of patients. Secondly, of the eight patients evaluated, we have performed a postoperative angiographic control randomly selected only two patients.

Disclosure of conflict of interest

None.

Address correspondence to: Dr. Arif Gucu or Tuğrul Goncu, Department of Cardiovascular Surgery, Bursa Yuksek Ihtisas Training & Research Hospital, Tezok Caddesi, No=1 Yildirim, 16330 Bursa, Turkey. Tel: +90.224.3605050; Fax: +90.224.3605055; E-mail: dr.arifgucu@gmail.com (AG); drgoncu@gmail.com (TG)

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