

Vein patch angioplasty combined with left internal thoracic artery bypass to left anterior descending artery in patients having diffuse complex atherosclerotic lesions

Yaygın kompleks aterosklerotik lezyonu olan hastalarda sol ön inen arterin sol internal torasik arter bypas ile kombine edilen venöz patch anjioplastisi

Tolga DEMİR

ABSTRACT

In this study we analyzed the surgical outcomes of reconstruction of the diffusely diseased left anterior descending artery (LAD) with saphenous vein patch, and by left internal thoracic artery (LITA) grafting on to the patch during on-pump coronary artery bypass surgery. Between 2009 and 2014, 21 patients (mean age 65.1 years) underwent vein patch angioplasty combined with left internal thoracic artery bypass. Five of them (24.8%) had a history of myocardial infarction, and 2 patients (9.5%) had unstable angina and 1 patient (4.8%) acute antero-septal myocardial infarction. Twelve patients (54.0%) were Canadian Cardiovascular Society class III or IV, and 10 patients (48.0%) were New York Heart Association class III or IV. The mean number of distal anastomoses per patient was 3.24 ± 0.62 . The mean length of vein patch was 4.14 ± 0.82 cm. The 30-day mortality rate was 4.8% (n=1). There were 3 late cardiac-related deaths observed at postoperative 2., 11., and 40. month. The actual survival was 90.0% at 2, and 81.0% at five years. Follow-up angiogram (15 patients, 71.4%) revealed patent LITA graft in 93.3% of the patients. Long segmental LAD reconstruction with autologous saphenous vein patch without endarterectomy, provides alternative approach with acceptable long-term results to the patients who have diffusely diseased coronary arteries.

Keywords: Coronary artery surgery, left anterior descending artery, vein patch angioplasty

ÖZ

Bu çalışmada, yaygın hasta sol ön inen arterin, koroner arter bypas cerrahisi sırasında, safen ven patch ile rekonstrüksiyonu ve sol internal torasik arterin patch ile anastomozunun cerrahi sonuçlarını analiz ettik. 2009 ve 2014 yılları arasında 21 hastaya (ortalama yaş 65.1 yıl) sol internal torasik arter bypas ile kombine edilen venöz patch anjioplastisi yöntemi uygulandı. Hastaların 5'inde (%24.8) geçirilmiş miyokard enfarktüsü öyküsü vardı. İki hastada (%9,5) kararsız angina ve 1 hastada (%4.8) akut antero-septal miyokard enfarktüsü vardı. On iki hasta (%54.0) Kanada Kardiyovasküler Cemiyeti sınıf III veya IV ve 10 hasta (%48.0) New York Kalp Birliği sınıf III veya IV idi. Hasta başına yapılan ortalama distal anastomoz sayısı 3.24 ± 0.62 idi. Ortalama ven patch uzunluğu 4.14 ± 0.82 cm idi. Otuz günlük mortalite oranı %4.8 (n=1) idi. Takiplerde, 2'si kardiyak kökenli olmak üzere sırasıyla 2. ay, 11. ay ve 40. aylarda toplam 3 geç dönem ölüm oldu. Gerçek yaşam oranı 2 yılda %90.0 ve 5 yılda %81 idi. Kontrol anjiyografisi (15 hastada, %71.4) hastaların %93.3'ünde çalışan sol internal torasik arter greftini ortaya koydu. Sol ön inen arterin endarterektomi yapılmadan, otolog safen ven patch ile uzun segment rekonstrüksiyonu, yaygın hasta koroner arteri olan hastalarda kabul edilebilir uzun dönem sonuçlarıyla, alternatif bir yaklaşım sağlar.

Anahtar kelimeler: Koroner arter cerrahisi, sol ön inen arter, venöz patch ajioplastisi

INTRODUCTION

Surgical treatment of left anterior descending artery (LAD) with complex and diffuse atherosclerotic lesions, is a challenging situation for the cardiac surgeons¹. Percutaneous coronary intervention (PCI) with

stenting has rapidly increased nowadays. Coronary blood flow can impair and may cause major problems when long segmental stents are used in diffusely diseased LAD. However, the conventional surgical revascularization techniques can not provide adequate blood supply to diffusely diseased coronary arteries².

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The recent studies in these groups of patients provide data that surgical revascularization can only be performed in limited patients with very high risk^{3,4}. However, different revascularization techniques of LAD, using left internal thoracic artery (LITA) or autologous vein as an onlay patch with or without endarterectomy, have been introduced to provide complete myocardial revascularization^{2,5-8}.

According to many published reports that demonstrate reconstruction of LAD using LITA with endarterectomy can be performed safely, the aim of our study is to assess the clinical and angiographic outcomes of CABG of LAD with LITA, using saphenous vein as an onlay patch without endarterectomy.

MATERIAL and METHODS

The study was conducted with the approval of the institutional ethics committee. Between 2009 and 2014, 549 surgical myocardial revascularizations were performed. LITA grafting with vein patch angioplasty technique were used in 21 patients (3.8%) for long segmental reconstruction of the LAD.

Patient Demographics

Preoperative characteristics of the patients are shown in Table 1. The age of the patients ranged from 48 to 74 years (mean, 61.1±7.0 years) and 4 of 21 patients (19%) were women. Preoperatively, the patients were smokers (n=16; 76.2%), and had diabetes mellitus (n=16; 76.2%), hypertension (n=13; 61.9%),

Table 1. Patient demographics.

Variables	(n=21)
Age (years)	65.3±9.1
Male/female	15/6
BMI	29.2±4.7
BSA	1.85±0.11
Smoking (n)	16
Type II DM (n)	16
Recent MI (n)	5
EF (%)	49.5±10.2

BMI = body mass index; BSA = body surface area; DM = diabetes mellitus; EF = ejection fraction; MI = myocardial infarction.

hypercholesterolemia (n=14; 66.6%), and history of old myocardial infarction/n=5; 24.8%). Twenty patients (54%) were in Canadian Cardiovascular Society class III or IV. Poor left ventricular function (ejection fraction <30%) was identified in one patient (4.8%). Preoperatively two patients (9.5%) had unstable angina and one patient (4.8%) acute antero-septal myocardial infarction. On the preoperative angiogram, single- (n=1; 4.8%), two- (n=3; 14.2%), and three-vessel (n=17; 80.9%) coronary artery disease were observed (Figure 1). Concomitant surgical procedures were performed in three patients (9.6%), including carotid endarterectomy in two and left ventricular restoration in one patient. The study protocol was approved by the Institutional Review Committee, and informed consent was obtained from each patient.

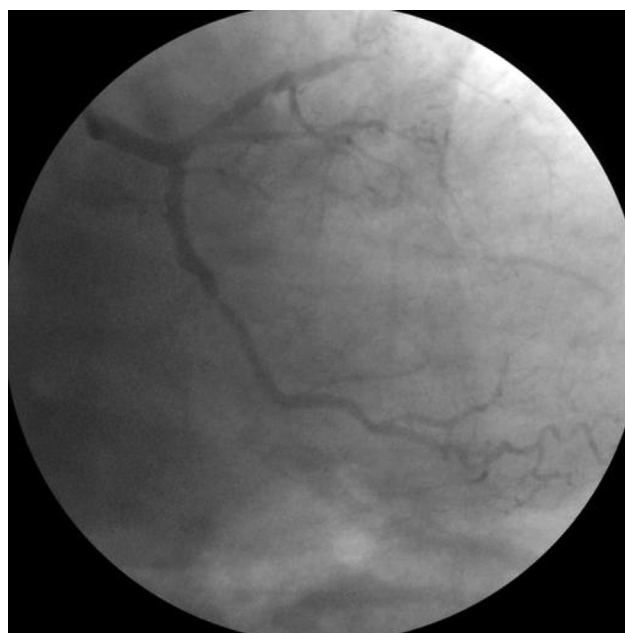


Figure 1. Preoperative coronary angiography demonstrating a diffusely diseased left anterior descending artery.

Surgical Technique

Cardiopulmonary bypass (CPB), with moderate hypothermia (28-30°C) and antegrade blood cardioplegia was used in all patients. The long segmental reconstruction of the LAD with a venous patch was made intraoperatively.

The unsuitability criteria were defined as diffusely diseased LAD with no anastomotic zone for anastomosis with LITA and inability to advance 1-mm coronary probe down to the LAD. The patients eligible for LAD anastomosis, such as sequential anastomosis or placing two separate grafts individually, were excluded from the study.

After establishing cardiopulmonary bypass, prior to LAD reconstruction, other coronary arteries were bypassed to achieve complete revascularization. A mini arteriotomy was made on the proximal or middle segment of the LAD and gradually extended distally until the non-diseased arterial lumen was reached. We performed this technique when anastomosis to the LAD was not possible with a conventional technique, due to diffuse involvement with lesions. The prepared vein graft was sewn as an onlay patch with 7-0 running polypropylene sutures. Then a meticulous attention was devoted to trim the patch to avoid creation of an open lumen. Lastly the LITA graft was anastomosed to the venous patch through a 5.0 to 7.0 mm incision in the vein patch with continuous

8/0 polypropylene sutures (Figure 2).

All patients received anticoagulation therapy postoperatively. Heparin was administered 4 hours after the operation. Warfarin was started to be used second postoperative day (targeting an international normalized ratio between 2 to 2.5). It was continued to use for three months and replaced by Aspirin thereafter.

Follow-Up

Patients were followed up in our outpatient clinic or could be reached directly by telephone for interview. Survival and any adverse cardiac events including recurrent angina, re-intervention or myocardial infarction were assessed or inquired from the patients.

Statistical Analysis

Continuous variables were reported as means \pm standard deviations. The Kaplan-Maier method was used to analyze survival and freedom from any adverse cardiac events. A commercial statistical software package (SPSS for Windows, version 17.0, SPSS, Inc., Chicago, IL, USA) was used for data analysis.

RESULTS

Intraoperative Data

The intraoperative variables are listed in Table 2. The mean number of distal anastomoses per patient was 3.2 ± 0.6 . The mean length of the vein patch was 4.2 ± 1.2 cm (range 3.2-7.0 cm). Mean CPB, and the mean aortic cross clamp times were 124.5 ± 24.8 (ran-

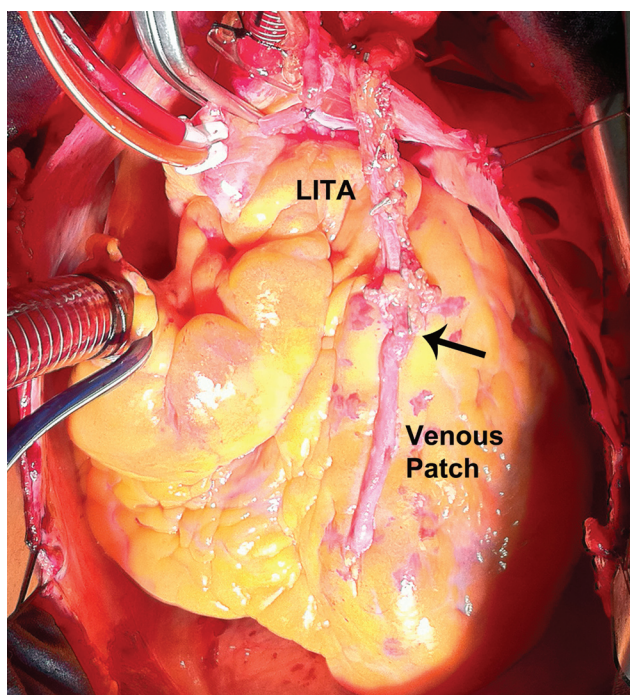


Figure 2. Surgical view of the left anterior descending artery reconstructed with a venous patch. Black arrow shows the anastomotic site of left internal thoracic artery with proximal portion of the vein patch. LITA: Left internal thoracic artery.

Table 2. Operative parameters of the patients.

Variables	(n=21)
CPB time (minutes)	124.5 \pm 24.8
Aortic cross-clamp time (minutes)	91.5 \pm 18.9
Number of distal anastomoses (n)	3.2 \pm 0.6
Length of the saphenous patch (cm)	4.2 \pm 1.2

CPB = cardiopulmonary bypass.

ge, 76 to 170 min) and 91.5 ± 18.9 minutes (range, 65 to 130 min), respectively.

Early Outcome

The postoperative data are listed in Table 3. There was one early death (which was defined as death within 30 days after the surgical operation) giving an overall early mortality rate of 4.8%. Creatine kinase-myocardial band (CK-MB) levels were documented in all patients, with a mean value of 45.1 ± 22.2 mg/dL (range, 12.3-88.2 mg/dL). Any postoperative myocardial infarction (MI), (defined as new q waves on electrocardiography or postoperative CK-MB greater than 100 IU/L) was not observed. None of the patients required re-exploration for bleeding. Moreover, none of the patients experienced massive bleeding which was defined as blood loss of 100-200 mL per hour, on average, for the first four hours, or more than 2 liters in 24 hours following surgery. On an average 0.8 ± 0.5 units of blood were transfused postoperatively. No patient required prolonged ventilation. Atrial fibrillation developed in 3 patients (14.2%). Mean intensive care unit stay was 19.2 ± 1.6 hours (range, 15-21 hours), mean hospital stay was 6.5 ± 0.6 days (range, 5-7 days).

Table 3. Postoperative data.

Variables	(n=41)
Duration on MV (hours)	5.3 ± 2.1
Chest tube drainage	463.4 ± 228.1
Surgical infection (n)	0
Postoperative AF (n)	3
Stay in ICU (hours)	19.2 ± 1.6
Stay in hospital (days)	6.5 ± 0.6

AF = atrial fibrillation; ICU = intensive care unit; MV = mechanical ventilation.

Late Outcomes

The mean follow-up period was 39.4 ± 21.5 months (range 2-72 months). There were 3 late deaths (2 of which were cardiac-related) at the 2., 11. and 40. months of the follow-up period, respectively. Overall survival rates at 2 and 5 years were 90.0%, and 81.0% respectively (Figure 3). Midterm patency of

the LITA graft was evaluated in 15 patients (71.4%) by coronary angiography at a mean follow-up period of 39.4 ± 21.5 months (range, 2-72 months) and revealed patent LITA graft in %93.3 of the patients (Figure 4). One patient had a late MI involving the LAD territory and was found to have an occluded LITA 8 months after the operation which required urgent PCI. No other adverse cardiac events have been observed.

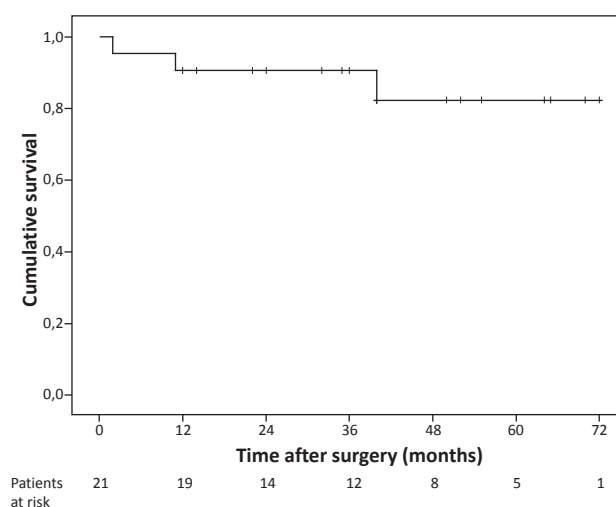


Figure 3. Actual survival rates including all deaths.

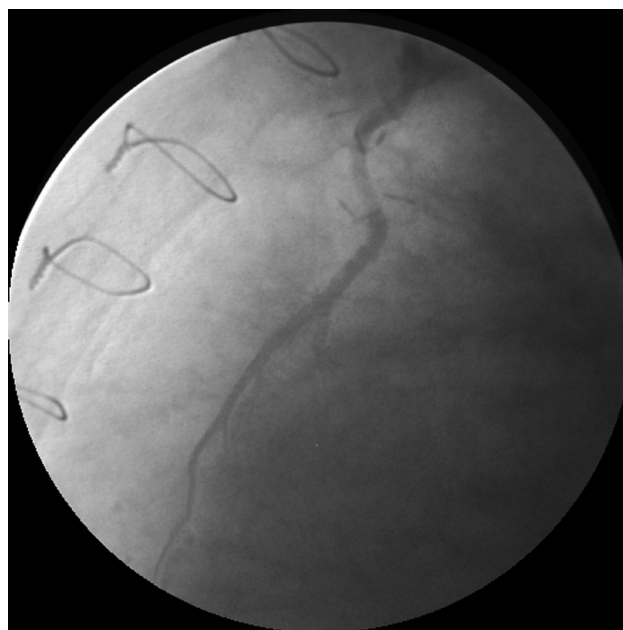


Figure 4. Coronary angiography of a patient who had left anterior descending artery reconstruction with saphenous vein patch.

DISCUSSION

Since the number of patients who have diffusely diseased coronary artery are increasing, there are still high percentage of them frequently referring to surgery for CABG due to unsuitability of their lesions for PCI¹. The principle goal of CABG is to maintain complete myocardial revascularization. However, the long-term mortality and morbidity after CABG are strongly associated with incomplete revascularization of the territory of LAD^{2,9-11}. Therefore, full myocardial revascularization of the LAD territory is considered as a crucial determinant for long-term survival and beneficial effects. However, providing sufficient blood supply to the important side branches may not be achieved with conventional techniques in diffusely diseased LAD. In an effort to expand surgical indication in this group of patients, several surgical techniques have been introduced, including extended LITA patch reconstruction with or without endarterectomy, multiple LAD bypass via jumping anastomosis or using more than one graft, and conventional endarterectomy and venous patch reconstruction followed by an onlay LITA anastomosis on the patch^{12,13}.

Coronary endarterectomy is the preferred surgical technique with favorable outcomes for patients having diffuse and widespread coronary artery disease^{14,15}. Major concern with this technique is triggering of the coagulation cascade due to the absence of endothelium, and myo-fibrointimal proliferation. Besides, the clot formation due to poor run-off in highly diseased LAD requires an anticoagulation and antiplatelet therapies which may also lead to additional risk of bleeding. Despite the promising results of recent studies, this surgical procedure still add an additional risk and complexity (such as longer arteriotomy and operative time, more blood loss) to the current traditional surgical technique. Therefore, we limit endarterectomy to only those vessels with severely calcified wall.

Unfortunately, in-stent restenosis is still a challenging issue. Both interventional cardiologists and cardiac surgeons have been greatly interested in revasculari-

zation procedures for the treatment of this pathology. As shown in our previous study, stent extraction with an open endarterectomy, and saphenous vein patch reconstruction followed by LITA anastomoses to the vein patch provide blood flow to the side branches with excellent outcome in patients with “full-metal jacket” diseased LAD where revascularization cannot be achieved using standard surgical techniques¹⁶.

Reconstruction of LAD with either saphenous vein or LITA is also a subject of important discussion¹⁷. The necessity of long LITA arteriotomy for extended LAD patchplasty may induce spasm in LITA. Additionally, stiffness of calcified LAD wall may cause challenging trouble during LAD-LITA anastomosis such as laceration because of delicate structure of LITA. On the other hand, using venous patch for LAD reconstruction has some advantages. Pliable structure of vein patch which allow positional manipulations during anastomosis might be a convenience to the surgeon.

In our study, we have demonstrated that saphenous vein patch reconstruction with LITA anastomosis is a safe and an effective method yielding satisfactory outcomes with a 81.0% 5 year survival rate for diffusely diseased LAD. At this point, we would like to explain the advantages of our technique. Firstly, creating new intraluminal wall with saphenous vein maintains the intimal continuity which may be associated with long-term patency of reconstructed LAD. Secondly, we directly observed the ostia of side branches after extensive coronary arteriotomy and completed our saphenous-LAD anastomosis without obstruction of these vessels. Conventional bypass techniques cannot supply sufficient blood flow to these important side branches including septal branches.

Avoidance of acute thrombosis in patients undergoing coronary endarterectomy by using heparin and/or warfarin during the postoperative period has been very well recognized¹⁸. However, there are no guidelines regarding optimal antiplatelet or anticoagulation strategy in patients undergoing vein patch reconstruction of the left anterior descending artery. In our routine protocol low molecular weight heparin

was administrated 4 hours after the operation. Warfarin was started to target an international normalized ratio between 2 to 2.5 on the 2nd postoperative day, maintained for 3 months and then discontinued to be replaced with aspirin.

The major limitations of our study are its retrospective design, small sample size, and the absence of a control group.

In conclusion; long segmental reconstruction of LAD with saphenous vein, can be performed in patients with diffusely diseased LAD and may represent an alternative approach for complete revascularization with acceptable long-term results.

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