

How to do it?

Nasıl yapılır?

## A new bridge bypass technique for multisegmental left anterior descending coronary artery disease

*Multisegmental sol ön inen koroner arter hastalığında yeni bir köprü bypass yöntemi*

Arif Gücü, Tamer Türk, Yüksel Beşir, Önder T. Bozkurt, Orhan Rodoplu, Ömer Tetik

Department of Cardiovascular Surgery, Bursa Yüksek İhtisas Training and Research Hospital, Bursa

There is an increase in cases with complex, multisegmental left anterior descending (LAD) coronary artery lesions in coronary artery bypass graft (CABG) surgery. In these cases, further reconstructive surgical procedures are needed for complete revascularization. In four cases (3 males, 1 female, mean age  $58\pm 3.3$  years) with multisegmental LAD lesions, extra surgical intervention was employed to the LAD artery in conjunction with standard coronary surgical procedures between January 2008 and September 2010. All cases presented with class 3 or 4 stable angina pectoris. In all cases, the surgical procedure consisted of standard cannulation followed by CABG under cardiopulmonary bypass. In cases with complex multisegmental LAD lesions, a short saphenous vein graft was bridged between the mid and distal portions of the LAD as a new technique. The prepared left internal mammarian artery was anastomosed to this bridge which was created over the LAD. The remaining coronary anastomoses were performed with the standard technique. The postoperative period passed without any problem in all patients. We believe that this is a successful technique for providing complete revascularization in patients with complex, multisegmental LAD lesions.

**Key words:** Coronary heart surgery; left anterior descending coronary artery; multisegmental stenosis.

The basic aim of surgical interventions in coronary artery disease is to revascularize the viable myocardial tissue that is supplied by the occluded or stenotic coronary artery.<sup>[1]</sup> Complete revascularization is not feasible with standard bypass techniques in the presence of multiple and complex lesions. In particular, residual

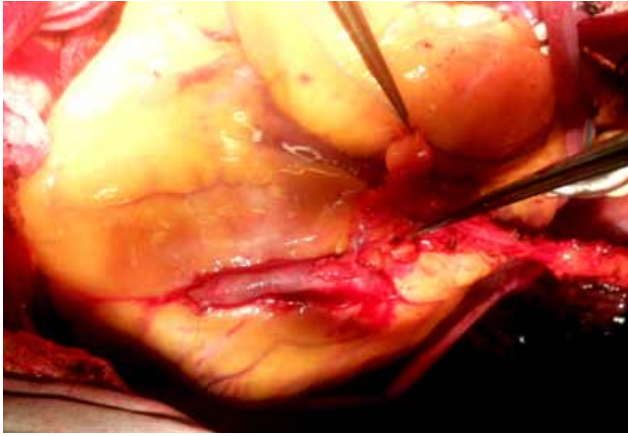
Koroner arter bypass greftleme (KABG) cerrahisinde kompleks multisegmental sol ön inen (LAD) koroner arter lezyonlu olgularda artış vardır. Bu olgularda tam revaskülarizasyon için ilave rekonstrüktif cerrahi işlemlere gereksinim duyulmaktadır. Ocak 2008 - Eylül 2010 tarihleri arasında multisegmental LAD lezyonlu dört olguda (3 erkek, 1 kadın; ort yaş  $58\pm 3.3$  yıl) standart koroner cerrahi yöntemlerle birlikte LAD artere ekstra cerrahi girişim uygulandı. Olguların hepsi evre 3 ya da 4 kararlı anjina pektorisine sahipti. Cerrahi işlem tüm olgularda standart kanülasyonu takiben kardiyopulmoner bypass altında KABG'den oluşmaktaydı. Kompleks multisegmental LAD lezyonlu olgularda yeni bir yöntem olarak, LAD'ye orta segment ve distal segment arasına kısa bir safen ven greftiyle köprüleme yapıldı. Hazırlanan sol iç meme arteri LAD üzerinde oluşturulan bu köprüye anastomoz edildi. Geriye kalan koroner anastomozlar standart teknikle uygulandı. Ameliyat sonrası dönem tüm hastalarda sorunsuz geçti. Kompleks multisegmental LAD arter lezyonlu hastalarda yeterli revaskülarizasyonu sağlamak açısından bu tekniğin başarılı bir yöntem olduğuna inanıyoruz.

**Anahtar sözcükler:** Koroner kalp cerrahisi; sol ön inen koroner arter; multisegmental stenoz.

lesions in the left anterior descending artery (LAD) are an important parameter affecting perioperative and late period mortality.<sup>[2]</sup> Thus, to establish sufficient distal run-off, an endarterectomy or further reconstructive procedures are required.<sup>[3]</sup> We present four cases with multisegmental LAD lesions in which we performed a

Received: February 28, 2011 Accepted: April 27, 2011

Correspondence: Arif Gücü, M.D. Bursa Yüksek İhtisas Eğitim ve Araştırma Hastanesi, Kalp ve Damar Cerrahisi Kliniği, 16260 Yıldırım, Bursa, Turkey. Tel: +90 224 - 220 00 39 e-mail: gucuarif@hotmail.com



**Figure 1.** Intraoperative view of the bridge.

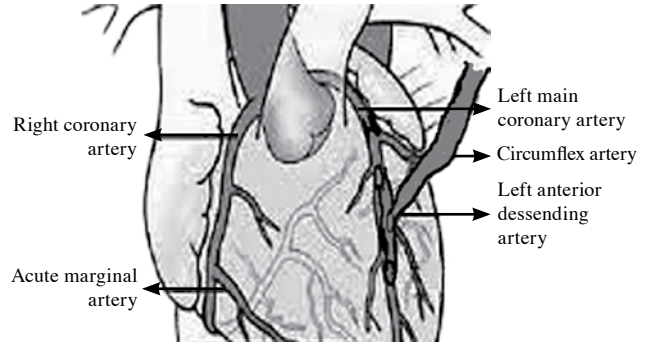
bridge between the mid and distal LAD segment with a saphenous vein graft which was anastomosed to the left internal mammary artery (LIMA), (Figure 1, 2).

## PATIENTS AND METHODS

With the aforementioned technique, both the mid and distal segments of the multisegmental stenotic LAD were perfused. Three of the cases were male and one case was female with an average age of  $58 \pm 3.3$  years. All patients were in class 3 or 4 stable angina pectoris. Preoperative demographics findings of the patients were demonstrated in table 1. All cases had borderline left ventricular ejection fraction (EF) values. The mean left ventricular ejection fraction (LVEF) was  $41 \pm 4\%$ . The internal mammary artery and saphenous vein were used as grafts, and the surgical procedure was standard cannulation and coronary artery bypass graft (CABG) surgery under cardiopulmonary bypass (CPB). During CPB, moderate hypothermia was instituted and first cold cardioplegia, intermittent cold blood cardioplegia, and terminal warm blood cardioplegia were applied. The other diseased coronary arteries were revascularized, and the calcific sites of the LAD were identified. Two arteriotomies were made at the mid and distal segment of the LAD, and a bridge was formed with a short saphenous vein segment. The internal mammary artery was anastomosed to this bridge (Figure 1, 2). To ensure the flow to both sides through a saphenous vein graft, a valveless part of the saphenous graft was used. Neither endarterectomy nor saphenous patch plasty was used in the patients. The postoperative period was normal with regard to the hemodynamics and cardiac enzymes. All patients were discharged without morbidity.

## RESULTS

Myocardial ischemia was monitored with electrocardiography (ECG) and enzyme changes (cTnI)



**Figure 2.** Illustration of the bridge.

in the perioperative and postoperative periods, and none of the patients displayed significant changes in their ECG or enzyme levels. Ventricular arrhythmia was observed in two patients postoperatively. The average intensive care unit (ICU) stay was  $45 \pm 5.2$  hours, and the average hospital stay was  $7.2 \pm 0.4$  days. There was no early mortality. All of the patients were in sinus rhythm, and none displayed ischemic changes in their ECGs or enzyme levels analyze at their postoperative outpatient visits. Perioperative and postoperative findings of patients are illustrated in table 2.

## DISCUSSION

The increase in percutaneous interventional procedures has changed the anatomic profile of lesions among surgically revascularized patients. Patients that are not correctable with percutaneous intervention and who require surgery present with more advanced and difficult lesions. Therefore, in patients with multisegmental lesions that are not suitable for grafting, complex surgical techniques are mandated.<sup>[4]</sup>

The primary goal in coronary surgery is complete revascularization. Left anterior descending artery revascularization is very important and, because of its direct relationship with early and late mortality, decreasing recurrent angina, and related deaths, the LIMA must be the choice of bypass graft.<sup>[5]</sup> In

**Table 1. Preoperative demographics of the patients**

	Case 1	Case 2	Case 3	Case 4
Age (year)	59	54	62	57
Gender	F	M	M	M
Diabetes mellitus	+	+	+	-
Hypertension	+	+	+	+
Hyperlipidemia	+	+	+	+
Family history	-	+	-	-
Previous MI	+	+	+	+

F: Female; M: Male; MI: myocardial infarction.

**Table 2. Preoperative and postoperative findings of the patients**

	Case 1	Case 2	Case 3	Case 4
Coronary artery bypass graft	X4	X5	X5	X4
Preoperative left ventricular ejection fraction (%)	40	45	45	35
Perfusion time (min)	85	90	92	95
Cross-clamp time (min)	47	55	58	52
Inotropic support	5 µgr/kg dopamine	None	None	5 µgr/kg dopamin
Postoperative electrocardiography changes	None	None	None	None
Preoperative cTnI	0.01 ng/mL	0.03 ng/mL	0.01 ng/mL	0.04 ng/mL
Postoperative cTnI	1 ng/mL	0.53 ng/mL	1.02 ng/mL	2.02 ng/mL
Intensive care unit stay (hours)	48	36	48	48
Hospital stay (day)	8	7	7	7
Early mortality	None	None	None	None

cTcI: Troponin I; X: CABG X4 or CABG X5.

multisegmental and diffuse coronary artery disease of the LAD, residual lesions due to incomplete revascularization are among the most important parameters for perioperative and postoperative mortality.<sup>[6]</sup> If the coronary artery disease is not multisegmental and diffuse, arterial grafts can be anastomosed to the appropriate site directly. Nevertheless, when lesions are calcific, diffuse, and multisegmental in nature, different techniques are essential for complete revascularization. Direct LIMA anastomosis may be technically feasible in the presence of calcific and multisegmental diffuse lesions, although the long-term results are disappointing. To overcome this problem, vein patch with or without endarterectomy may be used.<sup>[7,8]</sup> 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.<sup>[9,10]</sup> 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.<sup>[9,11]</sup> 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 saphenous vein graft or LIMA anastomosed to this patch.<sup>[12]</sup> Some surgeons prefer proximal IMA bypass and saphenous vein patch plasty for an existing distal stenotic lesion.<sup>[13]</sup>

Residual obstruction, intimal flap thrombosis, and atheroemboli are the main causes of ischemia after endarterectomy-related procedures.<sup>[14]</sup> Coronary artery bypass graft surgery with coronary artery

endarterectomy has higher morbidity and mortality rates compared with standard CABG surgeries.<sup>[15,16]</sup> The mortality rate is even higher when the LAD is the artery on which the endarterectomy is performed.<sup>[17,18]</sup> Studies have shown a 2-8% mortality rate in the early postoperative period in such patients. Qureshi et al.<sup>[19]</sup> have noted the in-hospital mortality as 4% among patients who underwent an endarterectomy on the left coronary artery system.

All techniques are time consuming and prolong the myocardial ischemic period.<sup>[20]</sup> These drawbacks have led some authors to advocate the bridge technique (multiple sequential anastomosis) for patients with multisegmental stenosis at the LAD system.<sup>[21,22]</sup> Technical difficulties arise in multiple sequential anastomosis with a single graft from adjusting the length of the graft in order to avoid kinking or tension. With our technique, we not only avoid the risk of endarterectomy but also decrease the myocardial ischemic time. Furthermore, the difficulty with arranging the length of the single graft in a multisequential anastomosis technique is absent if our technique is used.

The anatomic lesions suitable for that we have mentioned above are rarely seen. Although our series is small, with the good result of our cases and easy implementation, we strongly advocate that this technique should be preferred in diffuse multisegmental LAD coronary artery pathologies.

#### Declaration of conflicting interests

The authors declared no conflicts of interest with respect to the authorship and/or publication of this article.

#### Funding

The authors received no financial support for the research and/or authorship of this article.

## REFERENCES

1. Hutchins GM, Bulkley BH, Moore GW, Piasio MA, Lohr FT. Shape of the human cardiac ventricles. *Am J Cardiol* 1978;41:646-54.
2. Jatene AD. Left ventricular aneurysmectomy. Resection or reconstruction. *J Thorac Cardiovasc Surg* 1985;89:321-31.
3. Nagaoka H, Innami R, Hirooka K, Ohnuki M, Funakoshi N, Fujiwara A. Experiences of reoperative coronary artery bypass grafting by left thoracotomy without aortic clamping. *Kyobu Geka* 1995;48:113-8. [Abstract]
4. Santini F, Casali G, Lusini M, D'Onofrio A, Barbieri E, Rigatelli G, et al. Mid-term results after extensive vein patch reconstruction and internal mammary grafting of the diffusely diseased left anterior descending coronary artery. *Eur J Cardiothorac Surg* 2002;21:1020-5.
5. Fiore AC, Misbach GA, McKeown PP, Allen MD, Swartz MT, Ivey TD. As originally published in 1988: The use of autologous pericardium for ventricular aneurysm closure. Updated in 1996. *Ann Thorac Surg* 1996;61:271-2.
6. Lawrie GM, Morris GC Jr, Silvers A, Wagner WF, Baron AE, Beltangady SS, et al. The influence of residual disease after coronary bypass on the 5-year survival rate of 1274 men with coronary artery disease. *Circulation* 1982;66:717-23.
7. Cooley DA, Collins HA, Morris GC Jr, Chapman DW. Ventricular aneurysm after myocardial infarction; surgical excision with use of temporary cardiopulmonary bypass. *J Am Med Assoc* 1958;167:557-60.
8. Levinsky L, Arani DT, Raza ST, Kohn R, Schimert G. Dacron patch enlargement of anterior wall of left ventricle after aneurysmectomy with concomitant infarctectomy. *J Thorac Cardiovasc Surg* 1979;77:753-6.
9. Goldman BS, Christakis GT. Endarterectomy of the left anterior descending coronary artery. *J Card Surg* 1994; 9:89-96.
10. Taşdemir O, Kiziltepe U, Karagöz HY, Yamak B, Korkmaz S, Bayazit K. Long-term results of reconstructions of the left anterior descending coronary artery in diffuse atherosclerotic lesions. *J Thorac Cardiovasc Surg* 1996;112:745-54.
11. Mills NL. Coronary endarterectomy: surgical techniques for patients with extensive distal atherosclerotic coronary disease. *Adv Card Surg* 1998;10:197-227.
12. Sezer H, Kuzgun A, Akel S, Öztürk C, Kuzucan S, Sezer S. Kompleks LAD lezyonlarında cerrahi seçenekler ve sonuçları. *Türk Göğüs Kalp Damar Cer Derg* 1999;7:36-41.
13. Goldman BS, Christakis GT. Endarterectomy of the left anterior descending coronary artery. *J Card Surg* 1994;9:89-96.
14. Djalilian AR, Shumway SJ. Adjunctive coronary endarterectomy: improved safety in modern cardiac surgery. *Ann Thorac Surg* 1995;60:1749-54.
15. Gill IS, Beanlands DS, Boyd WD, Finlay S, Keon WJ. Left anterior descending endarterectomy and internal thoracic artery bypass for diffuse coronary disease. *Ann Thorac Surg* 1998;65:659-62.
16. Atik FA, Dallan LA, de Oliveira SA, Lisboa LA, Platania F, Cabral RH, et al. Myocardial revascularization with coronary endarterectomy. Stratification of risk factors for early mortality. *Arq Bras Cardiol* 2000;75:269-80.
17. Brenowitz JB, Kayser KL, Johnson WD. Results of coronary artery endarterectomy and reconstruction. *J Thorac Cardiovasc Surg* 1988;95:1-10.
18. Livesay JJ, Cooley DA, Hallman GL, Reul GJ, Ott DA, Duncan JM, et al. Early and late results of coronary endarterectomy. Analysis of 3,369 patients. *J Thorac Cardiovasc Surg* 1986;92:649-60.
19. Qureshi SA, Halim MA, Pillai R, Smith P, Yacoub MH. Endarterectomy of the left coronary system. Analysis of a 10 year experience. *J Thorac Cardiovasc Surg* 1985;89:852-9.
20. Erdil N, Tamim M, Çetin L, Demirkılıç U, Şener E, Tatar H. Diffüz koroner arter hastalığında sol ön inen artere genişletilmiş endarterektomi ve internal mammaryan arter bypass: erken dönem anjiyografik sonuçlar. *Türk Göğüs Kalp Damar Cer Derg* 2000;8:756-9.
21. Minale C, Nikol S, Zander M, Uebis R, Effert S, Messmer BJ. Controversial aspects of coronary endarterectomy. *Ann Thorac Surg* 1989;48:235-41.
22. Alamanni F, Parolari A, Agrifoglio M, Valerio N, Zanobini M, Repossini A, et al. Myocardial revascularization procedures on multisegment diseased left anterior descending artery: endarterectomy or multiple sequential anastomoses (jumping)? *Minerva Cardioangiol* 1996;44:471-7.