

Segmentation of the Left Internal Thoracic Artery: A New Technique for Maximal Arterial Grafting

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ABSTRACT

The left internal thoracic artery (LITA) is the preferred graft with the best patency rate in coronary artery bypass grafting (CABG). To maximize its use, we developed a technique of grafting 2 distant coronary arteries with the LITA, using its distal portion segmented to construct a Y graft with either the in situ LITA or right internal thoracic artery (RITA). We applied this technique in 51 patients. The distal segment of the LITA was used to create a Y graft in 4 different configurations according to coronary pathology. Off-pump grafting was performed in 11% of cases. The use of a distal segment of the LITA was thus extended not only to the left anterior descending artery and branches but also to the circumflex and right coronary artery territories.

INTRODUCTION

The conduit of choice for coronary artery bypass grafting (CABG) is the internal thoracic artery (ITA) [Buxton 2000]. Use of both ITAs has been demonstrated to be superior to single ITA [Lytle 1999]. Although the classic configuration is anastomosis of the LITA to the left anterior descending (LAD) artery and the right ITA (RITA) to marginal or right coronary artery, additional coronary arteries can be bypassed with sequential grafts, given that the 2 arteries in question are fairly close to each other and oriented in a way that allows such an anastomosis.

Harvesting the ITA in a skeletonized manner and freeing its proximal part gives an excess of length. This length can be sectioned, and the subsequent anastomosis of the distal segment to either the LITA or RITA in situ in a Y graft allows bypass of 2 distant coronary artery territories.

TECHNIQUE

The ITAs are harvested through a midline sternotomy. The technique requires 3 steps.

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A. Skeletonized Harvesting of ITAs

The endothoracic fascia is incised all along the ITA and dissected from it downward, preserving pleural integrity. The veins are kept in situ and the ITAs are separated by blunt dissection with section of collateral branches by electrocoagulation or the harmonic scalpel and fine clips. The ITAs are harvested distally to their bifurcation. The essential part of the harvesting concerns the proximal dissection, which is continued behind the left subclavian vein up to the origin from the left subclavian artery, taking care to avoid damage to the phrenic nerve. Division of the extrapleural fat alongside the left innominate and subclavian veins allows a direct and smooth passage of the LITA to the left side of the heart.

B. Segmentation

Dissection of the anastomotic site on the LAD is necessary to determine the required length of LITA for the bypass. The LITA is sectioned and the cut distal segment conserved.

C. Y Grafting of the LIMA Segment

This step depends on the artery requiring bypass. Thus a Y graft is crafted either with the in situ LITA to bypass the diagonal, ramus intermedius, or proximal marginal arteries (Figures 1A and 1B, respectively), or with the RITA when bypass of the distal marginal or left posterior descending arteries is indicated (Figures 1C and 1D, respectively). We have observed that keeping the in situ ITA filled with blood by applying bulldog clamps proximal and distal to the site of the Y-graft anastomosis and using a sharp-point 15° knife to perform the arteriotomy in the side of the ITA considerably reduce the risk of damaging the posterior wall or inducing dissection in the arterial wall.

RESULTS

From December 2001 to February 2003, we applied this technique in 51 patients. The mean patient age was 62.6 years (range, 43-85 years). There were 47 male patients. The mean ejection fraction was 60% (range, 24%-79%). One third of the patients were diabetics, and an equal percentage had a history of myocardial infarction. Forty-five percent were obese, 37% had 2-vessel disease, and the majority had triple-vessel disease. Off-pump CABG was performed in 7 patients (11%).

Four configurations can be distinguished (Figure 1):

- A. LITA to distal LITA Y graft for LAD and diagonal (n = 9) and ramus intermedius (n = 20) artery CABG (Figure 1A).
- B. LITA to distal LITA Y graft for LAD and proximal marginal artery CABG (n = 17) (Figure 1B).

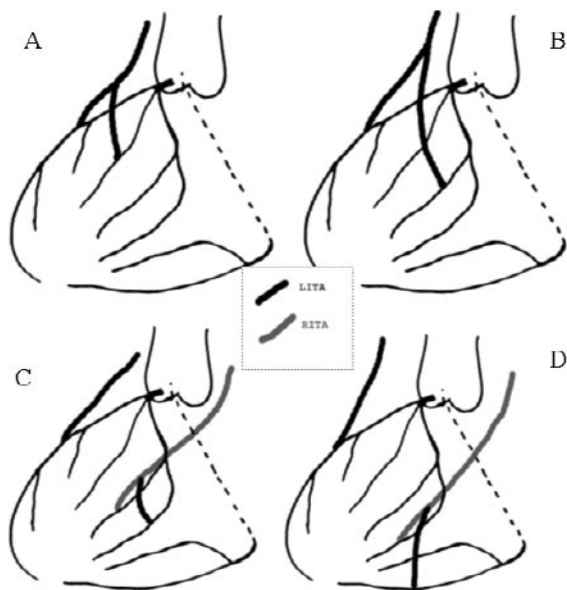


Figure 1. Configurations of left internal thoracic artery (LITA) segment anastomoses (A-D) (see text). RITA indicates right internal thoracic artery.

C. RITA to distal LITA Y graft for distal marginal artery CABG (n = 4) (Figure 1C).

D. RITA to distal LITA Y graft for posterior descending and marginal artery CABG (n = 2) (Figure 1D).

The mean number of grafts per patient was 3.152 (range, 2-5). In 4 patients, replacement of the aortic valve accompanied CABG. Carotid endarterectomy was performed as well in 2 other patients.

Other conduits besides the ITA were used. They consisted of the radial artery in 4 patients with single ITA and 11 patients with double ITAs and the saphenous vein in 1 patient with single ITA and 3 patients with double ITAs.

One patient died postoperatively of preoperative cardiogenic shock and multiorgan failure. There were no postoperative myocardial infarctions. We noticed superficial wound infections in 2 patients. No neurological complications were reported. Angiographic control was obtained in 10 patients with 100% patency (Figure 2).

COMMENTS

Total arterial revascularization is a trend that is catching on and is used with the hope of improving long-term patency compared with venous grafts. With the described technique of harvesting and skeletonization it is not unusual to be left with an excess of the LITA, and this distal segment should be considered as having the potential for more than 1 bypass in the presence of favorable coronary anatomy.

The use of distal segments of the LITA has been described [Bonchek 1996] but exclusively for the LAD to diagonal CABG as an alternative to sequential grafting. We have extended its use to be applied not only on the LAD and its branches but also to the circumflex and right coronary artery territories.

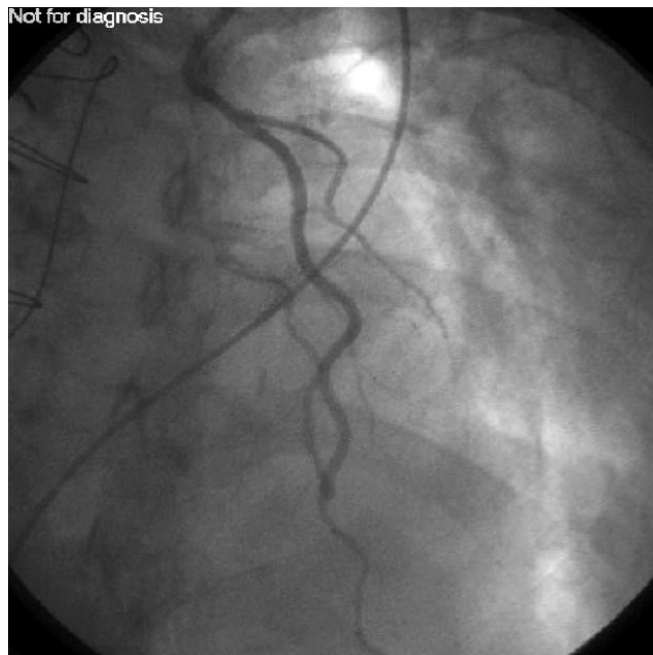


Figure 2. Angiographic control showing the left internal thoracic artery (LITA)-to-distal LITA Y graft. The left anterior descending and diagonal arteries are grafted sequentially with the in situ LITA, and the distal marginal artery with the LITA segment.

The confection of the Y graft is performed prior to establishing cardiopulmonary bypass and therefore has no consequences on the aorta cross-clamping time, and when performed by an experienced surgeon adds only a dozen minutes to total operating time.

A further advantage incurred from this grafting technique would be to reduce the rather important graft failure rate associated with free grafts anastomosed to the aorta [Buxton 2000].

Another advantage of this technique is that it facilitates multiple anastomoses in beating-heart surgery. Because the anastomoses on the heart are all end to side, they are easier to perform, and the need to manipulate the aorta is obviated.

The major limitation to this technique is in large hearts because the ITAs may fall short of their target vessels.

In conclusion, skeletonized harvesting of the LITA often allows an excess of length, permitting its segmentation and the crafting of a Y graft for end-to-side coronary anastomoses of 2 distant territories. The early patency is excellent, and with this technique optimized use of the ITA can be achieved.

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