Case Reports

Free Internal Mammary Artery Graft Reimplantation

on the Same Vessel in Repeat Coronary Revascularization

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We describe the case of a 62-year-old man who needed a 3-vessel coronary artery bypass reoperation and mitral valve replacement. The patient's existing free left internal mammary artery graft was not functioning because of a critical stenosis in the native vessel just after the distal anastomosis. The free graft itself was in perfect condition, and we decided to reuse it. Because the course of the graft was so tortuous, we concluded that skeletonization would yield the extra length needed for reimplantation. After reimplanting the graft, we performed venous grafting and mitral valve replacement. The patient was well and had no signs of ischemia at 29 months postoperatively.

There have been few reports on recycling internal mammary artery grafts in repeat coronary artery bypass grafting. To our knowledge, ours is the first report of the reimplantation of a free internal mammary artery graft on the same vessel. We describe the procedure and our decision-making process. ***(Tex Heart Inst J 2015;42(2):162-5)***

Key words: *Coronary artery bypass, off-pump/methods; coronary disease/surgery; equipment reuse; mammary arteries/transplantation; myocardial revascularization/methods; reoperation/methods; replantation/methods; thoracic arteries/transplantation; treatment outcome; vascular patency*

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The recycling of internal mammary artery (IMA) grafts in repeat coronary artery bypass grafting (CABG) was first described in 1993.[1] To our knowledge, only 9 papers have been published on this topic, 8 from Europe and one[2] from Japan. The authors more often referred to recycling than to reimplantation and did not report the reimplantation of a free IMA graft.

The apparent lack of enthusiasm for reimplantation probably arises from concern that the recycled IMA would be too short to graft onto the same vessel more distally. Skeletonization has been proposed to overcome this challenge, but only in reference to in situ IMAs.[3] We report our use of skeletonization to sufficiently elongate a free IMA graft to reimplant it on the same vessel more distally.

Case Report

In May 2012, a 62-year-old man was hospitalized because of cardiac arrest. He was resuscitated, intubated, and given a tracheostomy. In 1999, he had undergone quadruple CABG: a free left IMA (LIMA) graft to the left anterior descending coronary artery (LAD), and segments of greater saphenous vein to the diagonal artery, the obtuse marginal branch (OM), and the right coronary artery. The patient's comorbidities were diabetes mellitus, renal insufficiency (serum creatinine level, 2.41 mg/dL), and vasculopathy from previous aortobifemoral bypass surgery. He recovered well neurologically from the cardiac arrest and had no cerebral lesions, so coronary angiography and echocardiography were performed. The coronary angiogram showed proximal occlusion of the LAD, left circumflex coronary artery, and right coronary artery; occlusion of all existing venous grafts; and a critical stenosis in the LAD just distal to the free LIMA graft anastomosis. The free LIMA graft had a good diameter, did not seem diseased, and had a tortuous course (Fig. 1). The echocardiogram revealed severe mitral regurgitation and a left ventricular ejection fraction of 0.45.

The indication for reoperation was clear, so the patient was transferred to our hospital in July 2012. The surgery was to include mitral valve replacement with a bioprosthesis, saphenous vein grafts to the posterior descending artery and OM, and reimplantation of the existing free LIMA graft more distally to the LAD.

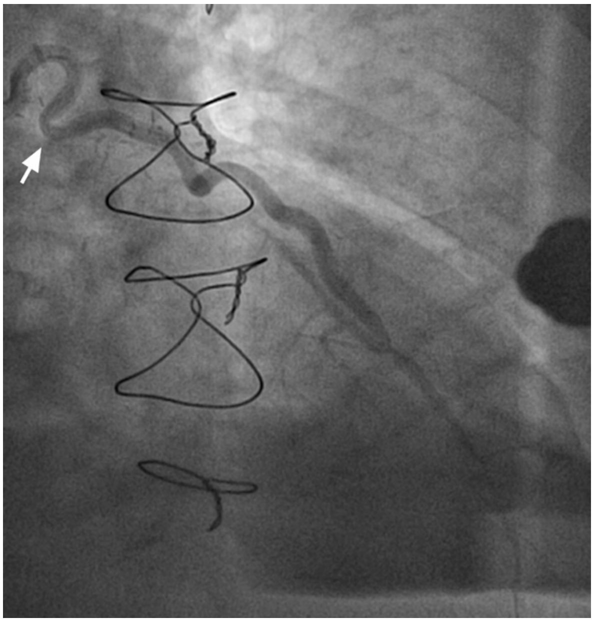

Fig. 1 *Preoperative angiogram shows a critical stenosis in the left anterior descending coronary artery just after the free left internal mammary artery graft anastomosis. The arrow indicates the most tortuous part of the graft.*

First, we dissected the anterior and diaphragmatic walls of the heart and prepared the ascending aorta and right atrium for cannulation. We then undertook the skeletonizing dissection of the free LIMA graft. When the skeletonization was completed, we administered heparin and implemented cannulation and pumping. After establishing cardioplegic arrest, we completed the dissection of the heart, clipped the free LIMA graft just before the distal anastomosis, and sectioned it just before the clip. We incised the hood of the previous anastomosis and extended the incision distally across its apex and down the recipient LAD, crossing the stenosis and going beyond it until the LAD lumen was no longer narrowed. We then sutured the distal end of the properly beveled and fully mobilized free LIMA graft to the wide incision, patching and overstepping the stenosis to enable blood to flow freely to the distal and proximal LAD (Fig. 2). Last, we constructed the distal and proximal anastomoses of the venous grafts, and replaced the mitral valve.

The patient's postoperative course was uneventful. His renal function recovered sufficiently to enable coronary angiography. The angiogram revealed that all grafts—in particular the reimplanted free LIMA graft (Fig. 3)—were patent and functioning correctly. On the 10th postoperative day, the patient was transferred for cardiac and pulmonary rehabilitation; his serum creatinine level was 1.41 mg/dL. Three months postoperatively at the first clinical follow-up appointment, there were no residual signs of ischemia, and the tracheostomy cannula had been removed. Through October 2014, the patient had no clinical signs of myocardial ischemia, and an echocardiogram showed a normally functioning mitral prosthesis.

Discussion

The recycling of IMA grafts in repeat CABG has not gained the popularity that might be expected, despite several factors: IMA use in primary CABG is increasing; IMA grafts can remain patent even if flow is diminished because of progression of disease in the native vessels; and other grafts—even arterial—do not typically have the same long-term patency rate. One possible explanation for this lack of interest is that recycling takes time and requires appropriate surgical skill. However, the chief reason is probably that the recycled IMA would be unsuitably short. In that instance, the too-short IMA could be rerouted to another vessel[4,5] or be used as the proximal anastomotic site of a new Y arterial graft[4]; alternatively, a segment of the greater saphenous vein could be interposed.[5] However, the first option usually implies grafting a lesser artery, and the other options hardly justify the recycling of IMA grafts.

Two techniques have been described in regard to gaining the extra length needed for reimplanting an IMA graft on the same artery more distally: additional dissection toward the graft's origin from the subclavian artery, and its skeletonization.[3] When the graft does not arise from the subclavian artery, as in the case of free IMA grafts, only skeletonization is feasible. However, free IMA grafts are shorter than in situ grafts. The shorter the initial length, the less extra length skeletonization can provide, so this might be why reimplantation of a free IMA graft on the same vessel has never been described.

We considered surgical and percutaneous solutions for treating the obstructive lesion in the LAD. In the end, we opted for reimplantation, for the following reasons:

- In our view, any acute failure of a percutaneous procedure would have had unacceptable consequences, whatever the timing. Tried before surgery, it would have exposed the patient to the risk of death, because all the other grafts and native vessels were occluded and a quick rescue operation (redo) was not possible; tried after surgery, a percutaneous procedure would have exposed the patient to the risk of an early repeat reoperation.
- Any angioplasty might have compromised the circulation to the proximal LAD and septal branches, whereas surgery afforded several options to ensure complete revascularization of the LAD.
- So far, no percutaneous procedure has yielded the long-term patency rate typically assured by IMA grafts.

After we decided to treat the LAD lesion surgically, we had to choose one of 3 possible avenues. The first option was to implant a vein; however, venous grafts typi-

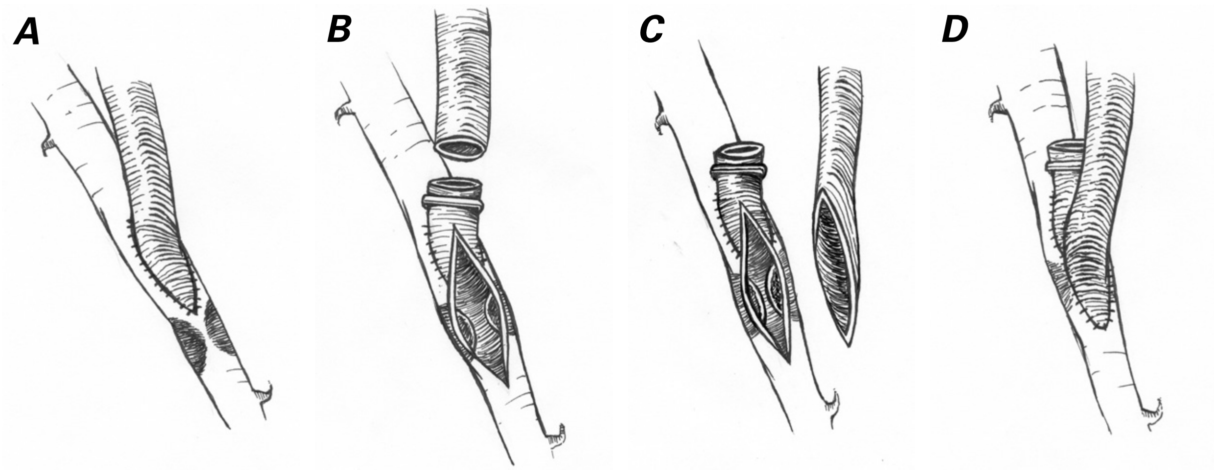

Fig. 2 *Drawings illustrate how the recycled free left internal mammary artery (LIMA) graft was reimplanted on the left anterior descending coronary artery (LAD).* ***A****) Preoperative depiction.* ***B****) The free LIMA graft was clipped just before the heel of the distal anastomosis and was sectioned before the clip. A long incision was made in the hood of the anastomosis and was extended distally, across the apex of the previous anastomosis and down the recipient LAD, extending across the stenosis and beyond it to where the LAD lumen was no longer narrowed.* ***C****) The distal end of the recycled graft was properly beveled for anastomosis to the wide incision.* ***D****) The new anastomosis was completed. The overriding hood acted as an enlarging patch of the stenosis.*

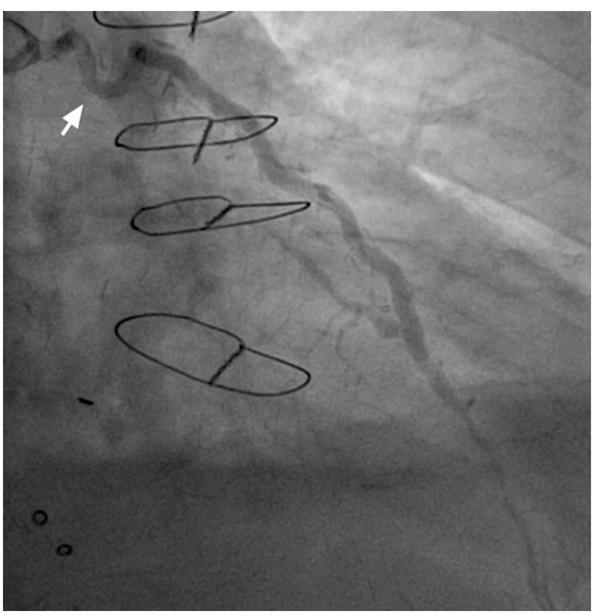

Fig. 3 *Postoperative coronary angiogram shows blood flowing freely from the free left internal mammary artery graft to the distal and proximal left anterior descending coronary artery, without residual perianastomotic stenosis. The arrow indicates the unwinding of the graft after skeletonization.*

cally have shorter-term patency than do IMA grafts. The 2nd option was to harvest the right IMA and graft it to the LAD. However, harvesting the right IMA would have diminished the vascularization of the right side of the sternum; furthermore, we wanted to spare that vessel for possible future surgical use in this relatively young patient. We therefore concluded that recycling the LIMA graft was the best choice.

The long, bridging, and patching anastomosis seemed the simplest and quickest way to perfuse the LAD adequately with the same graft, both proximal and distal to the stenosis. A sequential graft would have required more elongation and an additional anastomosis.

We dissected the malfunctioning IMA with the patient entirely off-pump, before the administration of heparin but after the ascending aorta and right atrium had been freed from adhesions and were ready to be cannulated. The skeletonization could have been performed in other ways: off-pump with heparin given and the heart cannulated,[5] on-pump with the heart beating, or on-pump with the heart arrested. All these options necessitated heparin administration and had the common disadvantage—essential, in our view—of creating a bloodier operating field that would reduce visibility and hamper an intricate dissection.

In timing the skeletonization as we did, we considered other factors. The venous cannula itself sometimes destabilizes a patient's hemodynamic status; the graft lay on the anterior surface of the heart and could be easily reached; skeletonizing the graft during cardioplegic arrest would have prolonged the aortic cross-clamp time; and our situation enabled prompt cannulation and a rapid start of the pump, if needed—other authors[3,4] had already used this timing safely.

Ultimately, the entire operation went well and so did the patient's postoperative course. Although the long-term results are pending, the first postoperative angiographic findings and the early clinical follow-up observations were satisfactory. We acknowledge the limitations previously discussed, yet we think that the reimplantation of IMA grafts in repeat CABG can be considered in more patients, with more reliance on skeletonization to gain the necessary extra conduit length.

Acknowledgments

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