ECRONICON OPEN ACCESS

EC CARDIOLOGY
Case Report

Percutaneous Treatment of Chronically Occluded Internal Mammary Artery Grafts: A Utopia?

Marie-Jeanne Bertrand, Olivier Wittenberg, Philippe Terraube and Franck Barbou*

Centre de Cardiologie Interventionnelle Belledonne, Clinique Belledonne, Saint-Martin-d'Hères, Isère, France

***Corresponding Author:** Franck Barbou, Centre de Cardiologie Interventionnelle Belledonne, Clinique Belledonne, Saint-Martin-d'Hères, Isère, France.

Received: September 22, 2020; **Published:** October 15, 2020

Abstract

Atherosclerosis is rarely encountered in IMA grafts; however, it may account for late graft closure. Percutaneous angioplasty of chronic total occlusions of IMA grafts is a feasible revascularization alternative to reoperation. The authors present 2 cases of CTO-PCI of IMA grafts that were successfully treated with DES.

Keywords: *Chronic Total Occlusion; Internal Mammary Artery; Atherosclerosis; Percutaneous Transluminal Coronary Angioplasty*

Abbreviations

CABG: Coronary Artery Bypass Surgery; CAD: Coronary Artery Disease; CCTA: Coronary Computerized Tomography Angiography; CTO: Chronic Total Occlusion; DES: Drug-Eluting Stent; ECG: Electrocardiogram; GEA: Gastroepiploic Artery; IMA: Internal Mammary Artery; ITA: Internal Thoracic Artery; LAD: Left Anterior Descending; LCX: Left Circumflex; LIMA: Left Internal Mammary Artery; MACE: Major Adverse Cardiovascular Events; OCT: optimal coherence tomography; PCI: Percutaneous Coronary Intervention; PDA: Posterior Descending Artery; PTCA: Percutaneous Transluminal Coronary Angioplasty; RCA: Right Coronary Artery; RIMA: Right Internal Mammary Artery; SVG: Saphenous Vein Graft; TIMI: Thrombolysis and Myocardial Infarction

Introduction

The internal mammary artery (IMA) has become the preferred conduit for coronary artery bypass surgery (CABG) due to its unique structural, hemodynamic and physiologic properties that confer long-term patency rates [1]. By comparison to saphenous vein grafts (SVG), IMA-grafts are associated with low incidence of atherogenesis, less major cardiac events and increased late survival [2]. Notwithstanding that atherosclerosis in IMA is scarce, early and late graft failure can occur either from stenosis located at the proximal and/or body portion of the IMA or at its anastomosis site, requiring subsequent revascularization [3,4]. In late graft failure following CABG, either PCI or CABG is indicated in patients with severe symptoms or extensive ischemia despite optimal medical therapy [5]. Reoperation of the by-passed native vessel is the recommended revascularization approach when multiple grafts are occluded, when the native coronary artery appears unsuitable for PCI and in absence of a patent arterial graft [5,6]. However, due to the initial higher mortality rate in redo CABG patients group demonstrated in the AWESOME RCT and registry [7], the guidelines favors PCI as the revascularization strategy of choice in patients with patent LIMA or suitable anatomy [5]. Percutaneous coronary intervention (PCI) of the IMA-graft has been shown to be a safe and feasible alternative method to reoperation with high procedural success and low major adverse cardiovascular events (MACE) [3,8]. In recent years, tremendous improvements in chronic total occlusion (CTO) PCI outcomes have been observed due to the refinement of equipment and recanalization techniques, in conjunction with low rates of restenosis and thrombosis with new-generation drug-eluting stents (DES). Accordingly, we hereby report on two IMA-graft CTO angioplasty procedures.

Case Report

Patient 1

A 57-year-old man with a history of smoking and previous CABG was referred for new onset of angina. In the preceding year, the patient underwent quadruple bypass which consisted in left IMA (LIMA) to the left anterior descending artery (LAD) and first diagonal, the right IMA (RIMA) to an occluded obtuse marginal artery, and gastroepiploic artery (GEA) to the posterior descending artery (PDA). The patient's symptoms recurred 15 months following CABG. Resting electrocardiogram (ECG) and treadmill stress test were unremarkable and left ventricular ejection fraction was normal. Coronary angiogram showed a CTO of the mid-portion of the RIMA-obtuse marginal graft with distal vessel visualization from homolateral bridging collateral filling (Fig. 1A, C), and patency of both the LAD and right coronary artery (RCA) grafts. Due to poor visualization of the native left circumflex (LCX) distal bed in the absence of collaterals (Fig. 1B), percutaneous treatment of the RIMA graft was performed using a right radial approach with a 6-Fr internal mammary guide catheter. The CTO lesion was easily crossed with a non-coated polymer jacket Cross-it 100XT guidewire (Abbott Vascular, Illinois, U.S.) and predilated with a 1.5-mm compliant balloon (3 inflations). In order to ensure proper guiding catheter seating in the ostium of the RIMA and to increase support, a 6-Fr Guidion rapid exchange guide extension (IDMS, Roden, NL) was advanced on the guidewire in the proximal portion of the graft using the balloon-assisted tracking technique (2.0-mm compliant balloon). A 2.5 x 48 mm DES was implanted from the proximal- to distal portion of the RIMA, followed by post-dilatation with a noncompliant (NC) 2.5-mm balloon for appropriate stent expansion (Fig. 1D). At 6 months, the patient was free of symptoms and a coronary computerized tomography angiography (CCTA) confirmed the patency of the RIMA-obtuse marginal graft (Fig. 1F, G).

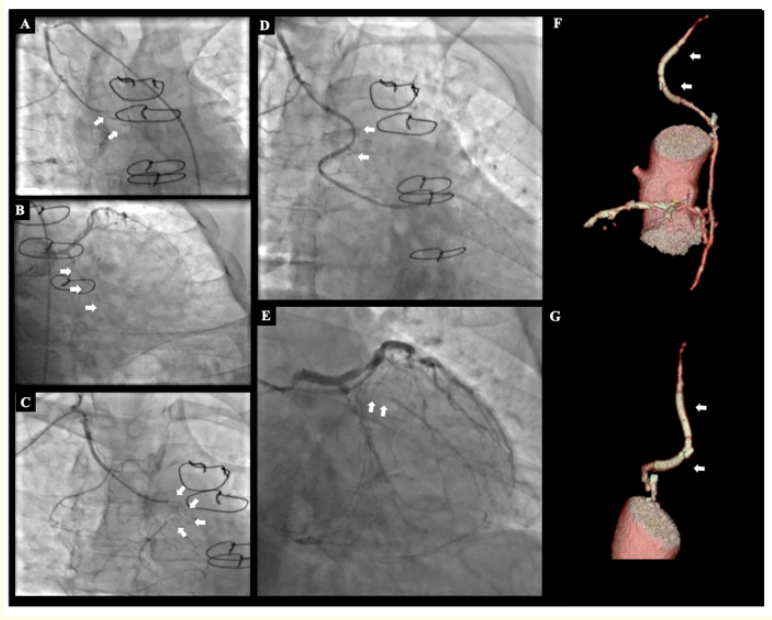

Figure 1: *CTO of RIMA graft to LAD. (A, C) CTO of the mid-portion of the RIMA graft, with bridging collaterals filling the distal body of the graft (arrows); (B) CTO of the proximal LCX without visualization of the distal vessel due to absence of collaterals (arrows); (D) Angiogram post-stenting of RIMA with a TIMI 3 flow (arrows); (E) Native left coronary artery prior to CABG, showing a severe diseased LCX and a CTO of the first obtuse marginal (arrows); (F, G) CT coronary angiogram at 6-month follow-up confirming graft patency (arrows).*

Patient 2

A 70-year-old man with arterial hypertension and dyslipidemia presented with recurrent typical angina upon exertion. Ten years prior to his admission, the patient was referred for unstable angina, which led to surgical revascularization with a LIMA to the LAD and a GEA to the PDA. The ECG at rest was normal and left ventricular ejection fraction was preserved. However, a treadmill stress test revealed the presence of ischemia. Coronary angiography showed a long occlusion in the body of LIMA-LAD graft upstream of the anastomosis site with severe calcified disease of the ostial LAD and in-stent restenosis of the mid-LAD, as well as an occluded GEA-PDA graft (Fig. 2A,B). Due to the severity of native vessel disease, it was decided to first attempt a recanalization of the LIMA graft while performing dual coronary angiography for better assessment of the native LAD in case of procedural failure. A right radial artery access was used with a 6-Fr Judkins left guide catheter, as well as a right femoral artery approach with a 6-Fr internal mammary guide catheter. Crossing of the CTO lesion was easily performed with a Versaturn workhorse guidewire (Abbott Vascular, Illinois, U.S.), while advancement of the guidewire further down the graft towards the native LAD was challenging due to graft tortuosity and absence of bridging collateral filling (Fig. 2C). Proper guidewire positioning in the distal LAD was achieved from simultaneous dual injection allowing visualization of the left coronary system and by using the surgical clips as landmarks (Fig. 2D). Both CTO lesion and graft anastomosis site were predilated with a 2.0-mm compliant balloon, and the proximal and body segments of LIMA-LAD were then treated with 3 DES (2.5 x 18 mm, 2.5 x 38 mm, 2.5 x 15 mm) with optimal angiographic result and TIMI 3 flow (Fig. 2E). At 6 weeks follow-up, PCI of the native RCA was performed and a control angiogram confirmed the patency of LIMA-LAD graft with TIMI 3 flow in the native distal LAD (Fig. 2F).

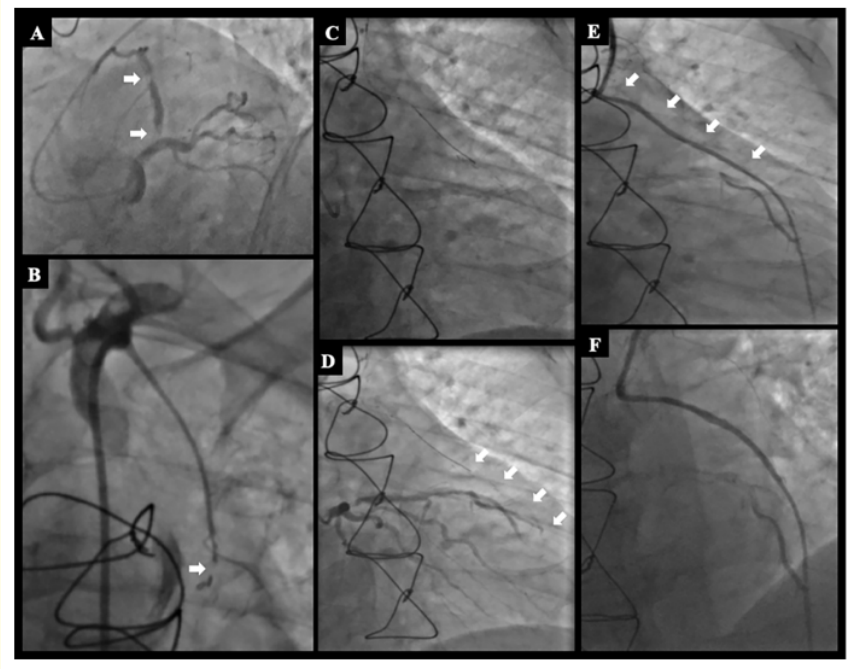

Figure 2: *CTO of LIMA graft to LAD. (A) Severe calcified stenosis in ostial LAD, with severe ins-stent restenosis of mid-LAD (arrows); (B) Long occlusion of the body of the LIMA graft (arrow); (C, D) Guidewire advancement towards the native LAD following surgical clips as landmarks and from visualization of the anastomosis site from injection of the left coronary system (arrows); (E) Angiogram post-stenting of the LIMA with TIMI 3 flow (arrows); (F) A control angiogram at 6-week follow-up showing a patent graft (arrows).*

Discussion

These clinical cases illustrate the feasibility of CTO recanalization of both left and right IMA grafts in 2 distinct patients. Although IMA grafts are associated with long-term patency, late closure rates between 5% to 25% have been reported beyond 10 years follow-up [9] and could be the result of fibrointimal proliferation, "disuse atrophy", folds present in tortuous grafts and atherosclerosis [2,3,4,8]. The resistance of IMA to atheroma has been attributed to several anatomic and physiologic characteristics that may prevent lipoproteins and inflammatory cells from entering the subendothelial space [3,8]. Yet, a recent case report has shown similar features to native coronary artery atherosclerosis depicted by optimal cohence tomography (OCT) in a long stenosis located in the proximal segment of the IMA of a 59-year-old man referred for worsening angina [4]. Previous necropsy studies have reported that fibroatheroma proliferation alone was more frequent in IMAs than in diseased SVGs; however only mild intimal thickening with few foam cells and lipid infiltrates were observed in the neointima [4,5]. Thus, it is plausible that the pathologic nature of atherosclerotic lesions encountered in IMAs are predominantly non-advanced "soft" plaques with little or no calcifications, facilitating the crossing of chronic occlusions with workhorse/non penetrating CTO guidewires. As in the cases presented, PCI of IMA lesions have previously shown good angiographic and satisfying immediate clinical outcomes. Nevertheless, extensive data is lacking in regard to stent healing and long-term patient prognosis. Therefore, further information will need to be gathered on CTO procedures and outcomes of IMA grafts, perhaps with the use of intracoronary imaging such as OCT, in order to better understand the pathophysiology of these atherosclerotic lesions and proper tailoring of patient management.

Conclusion

CTO recanalization of an IMA graft is feasible and has been safely performed in two distinct patients, without procedural difficulties usually encountered in CTO procedures of native coronary arteries.

Learning Objectives

- Atherosclerosis in the IMA is infrequent but can occur in late settings, resulting in graft failure.
- CTO-PCI of an IMA graft is feasible and should not be discarded over revascularization of the native coronary artery.
- Dual coronary angiography with selective injection of the IMA graft are mandatory for planning and safely performing CTO recanalization.

Funding

None to declare.

Disclosures

Marie-Jeanne Bertrand has received honoraria as a clinical consultant for SoundBite Medical Solutions Inc. The remaining authors have nothing to disclose.

Bibliography

1. Cameron A., *et al.* "Coronary bypass surgery with internal-thoracic-artery grafts- effects on survival over a 15-year period". *The New England Journal of Medicine* 334 (1996): 216-219.
2. He GW. "Arterial grafts for coronary artery bypass grafting: biological characteristics, functional classification, and clinical choice". *The Annals of Thoracic Surgery* 67 (1999): 277-284.

3. Otsuka F., *et al.* "Why is the mammary artery so special and what protects it from atherosclerosis?" *Annals of Cardiothoracic Surgery* 2 (2013): 519-526.

4. Ali FI. "Internal mammary artery atherosclerosis. Use of optical coherence tomography to characterize lesions and guide intervention". *Journal of the American College of Cardiology Cardiovascular Interventions* 8 (2015): e114-e114.

5. Wijns W., *et al.* "Guidelines on myocardial revascularization". *European Heart Journal* 31 (2010): 2501-2555.

6. Rener SJ., *et al.* "Propensity analysis of long-term survival after surgical or percutaneous revascularization in patients with multivessel coronary artery disease and high-risk features". *Circulation* 109 (2004): 2290-2295.

7. Morrison DA., *et al.* "Percutaneous coronary intervention versus repeat bypass surgery for patients with medically refractory myocardial ischemia: AWESOME randomized trial and registry experience with post-CABG patients". *Journal of the American College of Cardiology* 40 (2002): 1951-1954.

8. Lozano I., *et al.* "Immediate and long-term results of drug-eluting stents in mammary artery grafts". *The American Journal of Cardiology* 116 (2015): 1695-1699.

9. Windecker S., *et al*. "EST/EACTS Guidelines on myocardial infarction: The task force on myocardial revascularization of the European Society of Cardiology (ESC) and the European Association for Cardio-Thoracic Surgery (EACTS) Developed with the special contribution of the European Association of Percutaneous Cardiovascular Interventions (EAPCI)". *European Heart Journal* 35 (2014): 2541-2619.

Volume 16 Issue 11 November 2020