JACC: CASE REPORTS VOL. 1, NO. 2, 2019

CASE REPORT

INTERMEDIATE

CLINICAL CASE

The Left Internal Mammary Artery Graft

Durable and Self-Reparative

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ABSTRACT

After an unsuccessful left internal mammary artery (LIMA) to left anterior descending percutaneous coronary intervention (PCI) in an outside hospital, a patient presented with ST-segment elevation myocardial infarction. The patient was found to have LIMA occlusion and underwent a second PCI. However, there was a residual disruption of LIMA, subsequently, the patient was found to have complete LIMA recanalization, which emphasized the self-reparative nature of LIMA. (**Level of Difficulty: Intermediate.**) (J Am Coll Cardiol Case Rep 2019;1:168–70) © 2019 Published by Elsevier on behalf of the American College of Cardiology Foundation. This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/).

Several studies have revealed that the left internal mammary artery (LIMA) is not a simple conduit for blood but also has active biological functions that lead to its protection against atherosclerosis (e.g., enhanced endothelial function and excellent wall remodeling properties) (1,2). Furthermore, it has been shown that LIMA can grow in length and diameter when used during coronary artery bypass grafting (CABG) in children (3). In a study of patients with severe stenosis at the LIMA to left anterior descending (LAD) anastomosis site early post-operation, the stenosis resolved in most of these patients with no intervention, as seen on follow-up angiography (4). This late regression of stenosis suggests a dynamic nature for LIMA grafts. However, despite the overall excellent patency rates, diffuse or distal narrowing of LIMA grafts, also known as "string phenomenon," can occur if there is a significant competitive flow between the LAD and the LIMA, which happens when the degree of stenosis in the LAD is not severe to begin with (5). Currently, data are limited on how to address stenotic lesions of LIMA-to-LAD grafts at a later time after surgery. Re-operation, plain balloon angioplasty (PBA), and percutaneous coronary intervention (PCI) with placement of either a bare metal stent (BMS) or drug-eluting stent (DES) have all been used with varying degrees of success.

LEARNING OBJECTIVES

- To learn various causes of LIMA graft lesions.
- To appreciate the self-reparative ability of LIMA and its effects on management of LIMA graft lesions.

HISTORY OF PRESENTATION

A 73-year-old male with history of single-vessel CABG 9 years earlier presented to an outside hospital with unstable angina. Cardiac catheterization revealed occlusion of the proximal LAD and significant stenosis of the LIMA-to-LAD graft at the anastomosis site (**Figure 1A**, Video 1). PCI through the LIMA graft was attempted; however, the graft was tortuous, the lesion could not be reached, and the procedure was aborted. One month later, the patient presented to our institution with anterior ST-segment elevation myocardial infarction and septal Q waves (**Figure 2A**).

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Manuscript received April 11, 2019; revised manuscript received May 18, 2019, accepted May 23, 2019.

ISSN 2666-0849 https://doi.org/10.1016/j.jaccas.2019.05.033

INVESTIGATIONS

Cardiac catheterization revealed occlusion in the mid-LIMA graft (**Figure 1B**, Video 2) and akinesis of the left ventricular (LV) apex (Videos 3A and 3B). The patient's chest pain resolved. Due to the perception of a completed infarction and incomplete information regarding what had happened 1 month earlier, the procedure was terminated. A subsequent cardiac perfusion study indicated that the LV was completely viable, with a 27% ischemic defect at the apex.

MANAGEMENT

PCI of the occluded LIMA graft was attempted. In brief, a 0.014 Choice PT guidewire (Boston Scientific, Marlborough, Massachusetts) was backloaded with a 2.0- × 15-mm Over The Wire Trek balloon (Abbott, Lake Bluff, Illinois) that was advanced into the LIMA using a 6-F guideline for extra support. Once the guidewire was carefully navigated through the LIMA graft and positioned into the distal LAD, the 2.0 × 15 Trek balloon was used to perform sequential inflations to pre-dilate the distal LIMA graft and the native LAD beyond the anastomosis site. Consequently, a Resolute Integrity 2.25- × 30-mm DES (Medtronic, Boston, Massachusetts) was deployed to the native mid-LAD. Then, a second Resolute Integrity 2.25- × 30-mm DES was deployed into the distal LIMA (proximal to the anastomosis site). A third Resolute Integrity 2.25- × 30-mm DES was also deployed into the LIMA graft (proximal to the previous stent). Finally, a fourth Resolute Integrity 2.5- × 30-mm DES was deployed into the mid-LIMA graft. A final angiogram of the LIMA graft revealed 0% residual stenosis and Thrombolysis In Myocardial Infarction 3 flow. However, 2 enlarged segments that suggested disruption of the LIMA wall were recognized (**Figure 1C**, Video 4). No further PCI was attempted. The patient subsequently remained asymptomatic.

FOLLOW-UP

Twenty months later, the patient experienced chest discomfort during an equivocal exercise stress test. Repeat catheterization revealed wide patency of LIMA-to-LAD graft and no evidence of the previously noted LIMA injuries (**Figure 1D**, Video 5). Moreover, significant resolution of ischemic changes, based on 12-lead electrocardiography (**Figure 2B**) and wall motion abnormalities on left ventriculography (Video 6), were observed.

Two years later, the patient continued to have good functional capacity. A follow-up cardiac perfusion study showed a small fixed apical defect

ABBREVIATIONS AND ACRONYMS

BMS = bare-metal stent(s)

CABG = coronary artery bypass grafting

DES = drug-eluting stent(s)

LAD = left anterior descending

LIMA = left internal mammary artery

OTW = over the wire

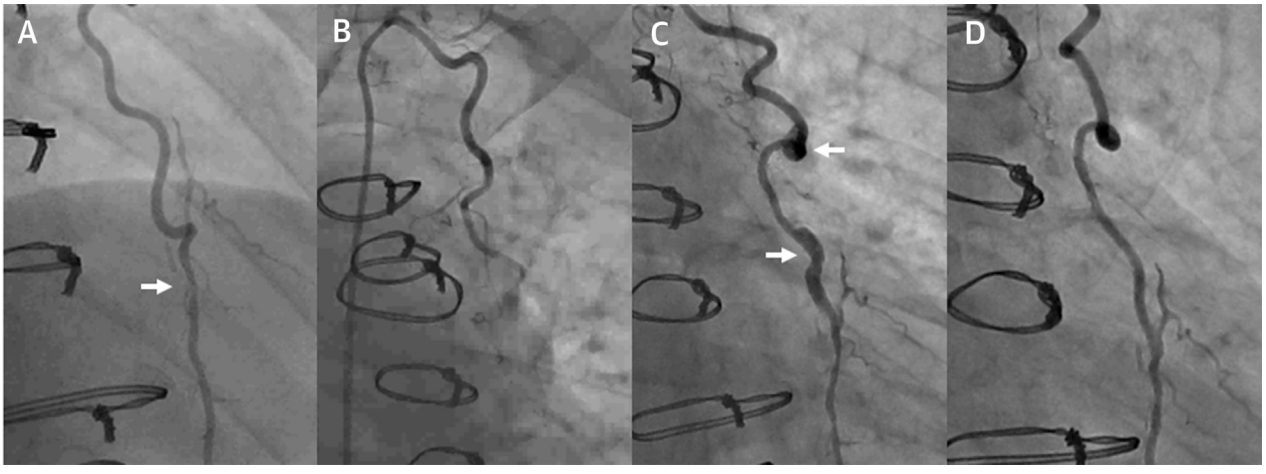
PBA = plain balloon angioplasty

PCI = percutaneous coronary intervention

STEMI = ST-segment elevation myocardial infarction

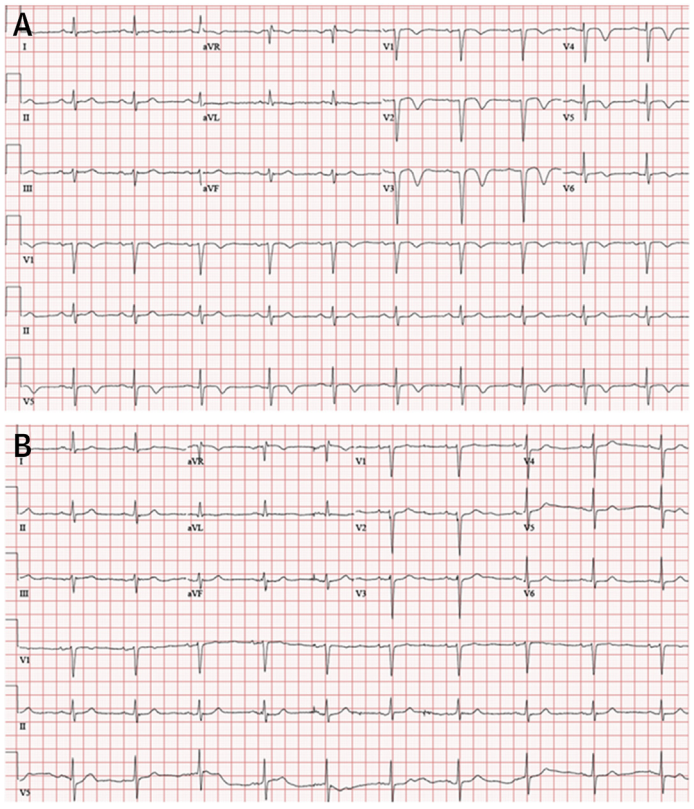
TIMI = Thrombolysis In Myocardial Infarction

FIGURE 1 LIMA-to-LAD Graft



(A) Right anterior oblique view of the left internal mammary artery (LIMA) to left anterior descending (LAD) graft at presentation to an outside hospital. Note stenosis at the LIMA-to-LAD anastomosis **(arrow)**. **(B)** Occluded LIMA graft on presentation to our hospital 1 month later. **(C)** LIMA graft after recanalization and stent implantation. Note the 2 enlarged segments suggesting focal arterial wall disruption **(arrows)**. **(D)** Healed and repaired LIMA graft at 20 months following stent implantation. See Videos 1, 2, 3A, 3B, 4, and 5.

FIGURE 2 12-Lead ECGs



(A) Significant electrocardiographic (ECG) changes, including anterior ST-segment elevation myocardial infarction and septal Q waves consistent with significant myocardial injury at presentation to our hospital. **(B)** Significant resolution of previously seen ECG changes at 20-month follow-up. See Video 6.

consistent with his old myocardial infarction without evidence of reversible ischemia. His ejection fraction remained normal at 55%.

DISCUSSION

Although the durability of LIMA as a bypass graft is widely appreciated, less attention is given to its dynamic nature with self-reparative properties. We presented a case in which the initial PCI of the LIMA-to-LAD was unsuccessful and resulted in significant injury to the graft. However, a delayed re-intervention was carried out with success at long-term follow-up, despite the suboptimal immediate angiographic result.

CONCLUSIONS

It is important to consider the self-reparative nature of the LIMA to decide on proper interventional approaches to deal with LIMA-to-LAD graft stenosis. Such approaches may include avoiding any intervention: at the early post-CABG period; using PBA without a stent especially at difficult to reach anastomosis sites; or limiting the extent of PCI and accepting the initial angiographically suboptimal results, for the greater possibility of eventual resolution of the stenosis, which we observed in the present case.

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KEY WORDS coronary artery bypass, coronary circulation, percutaneous coronary intervention

APPENDIX For supplemental videos, please see the online version of this paper.