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The Unligated Left Internal Mammary Artery Side Branch as the Cause of Angina after Coronary Artery Bypass Grafting

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ABSTRACT

The left internal mammary artery (LIMA) is a widely used conduit during coronary artery bypass graft (CABG) surgery because of its excellent long-term patency. Although large LIMA side branches are typically ligated during the surgery, the occurrence of a coronary steal phenomenon related to these side branches following surgery remains controversial. Advocates for occlusion of LIMA side branches in the setting of left anterior descending artery (LAD) ischemia indicate that anginal symptoms often improve and that objective measures of LAD ischemia frequently resolve. We present a patient with ischemia in the LAD distribution secondary to coronary steal from a large LIMA side branch that was successfully treated using the Embolization Coil-IMWCE-3-PDA5 (Cook Medical, Bjaeverskov, Denmark).

INTRODUCTION

The left internal mammary artery (LIMA) is a widely used conduit during coronary artery bypass graft (CABG) surgery because of its excellent long-term patency. Causes of angina after CABG might be incomplete revascularization at the time of surgery, progression of atheromatous disease, or occlusion of the grafts. A rare cause of angina is coronary steal because of unligated side branches [Cay 2008].

Although large LIMA side branches are typically ligated during the surgery, the occurrence of a coronary steal phenomenon related to these side branches following surgery remains controversial. If objective evidence for ischemia exists, a variety of devices, including coil embolization, have been used in the percutaneous treatment of LIMA side branch induced coronary steal [Cay 2008]. It remains controversial whether proximal side branches that originate from a LIMA graft can cause a coronary steal phenomenon and ischemia in the left anterior descending (LAD) artery distribution [Weinberg 2008]. Initial case reports describing the benefits of occlusion of LIMA side branches focused solely on the resolution of clinical symptoms to justify this as a distinct clinical syndrome [Weinberg 2008]. We recently used the Embolization Coil-IMWCE-3-PDA5 (Cook Medical, Bjaeverskov, Denmark) to occlude a large LIMA side branch in a symptomatic patient with presumed coronary steal.

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CASE DESCRIPTION

The patient was a 64-year-old man with hypertension arterialis, hypercholesterolemia, and obesity (body mass index [BMI] = 31 kg/m2) after several percutaneous coronary angioplasties of the right coronary artery and the left circumflex in 2008 and 2009. He had undergone coronary artery bypass grafting (MIDCAB) using LIMA 2 years ago and presented with new onset angina. His electrocardiogram showed 2 mm ST segment depression in lead V2, V3, and V4. In his echocardiography, he had hypokinetic wall motion in the anterior region with an ejection fraction of 52% and mild degree mitral insufficiency. Pulmonary artery systolic pressure was calculated from the tricuspid jet signal by continuous wave Doppler and found to be at 30 mm Hg. An exercise myocardial perfusion scan showed severe ischemia involving the anterior wall. Coronary angiography showed totally occluded LAD after the first diagonal branch and good results of the percutaneous coronary intervention (PCI) of the left circumflex and right coronary artery and a patent LIMA graft to the mid LAD. A large side branch arose within the proximal portion of the LIMA graft and extended to the lateral chest wall suggesting coronary steal (Figure 1). Given continued medically refractory angina, percutaneous occlusion of the LIMA side branch was recommended.

The LIMA was selectively engaged via the left brachial artery using a 6 French MS guide catheter. MP 4F was advanced into the distal LIMA side branch and Embolization Coil-IMWCE-3-PDA5 was implanted 20 mm from the LIMA trunk. Angiography confirmed excellent position of the device with complete occlusion of distal flow in the LIMA branch and preserved flow from the LIMA to the LAD (Figure 2). Following the procedure, the patient had complete relief of angina, and a repeat myocardial perfusion scan

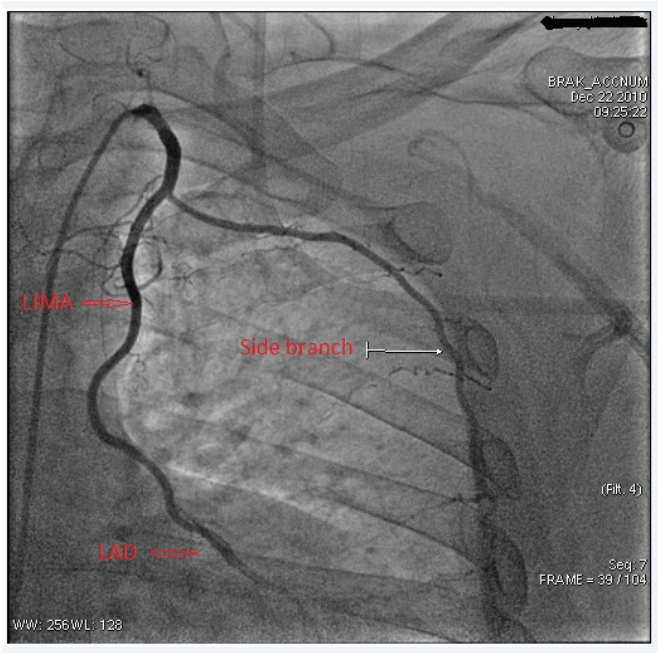

Figure 1. Angiography of left internal mammary artery (LIMA) graft showing patent flow to the left anterior descending artery (LAD) (red arrows) and a large proximal side branch (white arrow) extending to lateral chest wall.

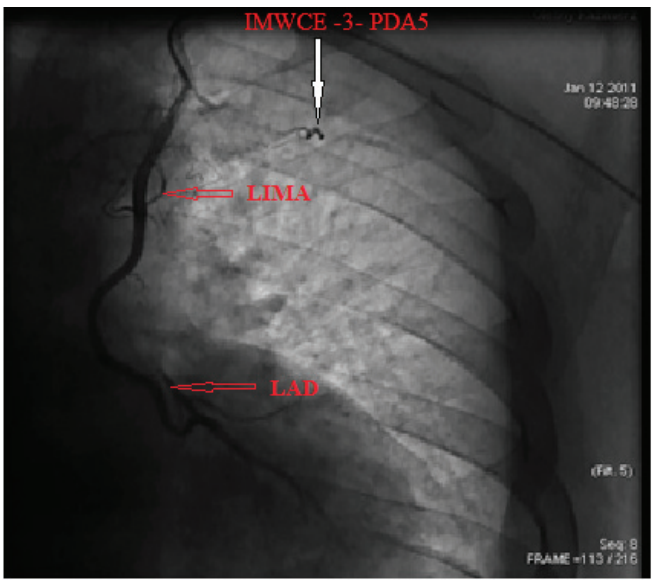

Figure 2. Following implantation of the Embolization Coil-IMWCE-3-PDA5 (Cook Medical, Bjaeverskov, Denmark) (white arrow), showing no flow within side branch distal to device and patent flow from the left internal mammary artery (LIMA) graft to left anterior descending artery (LAD) (red arrows).

showed normal perfusion to the anterior wall. After 4 months of follow-up, he continues to do well.

DISCUSSION

This case illustrates the functional significance of large LIMA side branches that are not appropriately ligated at the time of cardiac surgery. The treatment options include medical therapy, PCI, and surgery. We present a patient with ischemia in the LAD distribution secondary to coronary steal from a large LIMA side branch that was successfully treated using the Embolization Coil-IMWCE-3-PDA5. The diagnosis and treatment of coronary steal after LIMA bypass surgery remains controversial [Raja 2011]. Advocates for occlusion of LIMA side branches in the setting of LAD ischemia indicate that anginal symptoms often improve and that objective measures of LAD ischemia frequently resolve. On the other hand coronary flow measurements often fail to document impaired flow to the LAD even in the setting of large LIMA branches [Guzon 2004]. The embolization coils are made of stainless steel with haemostatic fibers embedded throughout the length of the coil. There are 5-, 6.5-, and 8-mm diameter coils available. They also have the advantage of small caliber delivery systems. The special delivery system consists of a central mandril, which when withdrawn allows the coil to assume its preformed curls, and a delivery wire that screws on to the coil. By rotating the delivery wire counter-clockwise, the coil can be released. However, as long as the coil has not been released, it can be retrieved and repositioned if necessary.

The unligated LIMA side branch is a rare condition that should be considered in the differential of recurrent angina in post-CABG. If this complication is suspected, then selective injection of the LIMA graft at the time of cardiac catheterization is essential for the diagnosis. The coil deployment is a safe, technically easy, successful method of LIMA side branch embolization [Peter 2006].

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