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CASE REPORT

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The use of Amplatzer Vascular Plug® to treat coronary steal due to unligated thoracic side branch of left internal mammary artery: Four year follow-up results

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Abstract

Left internal mammary artery (LIMA) is the most commonly used graft during coronary bypass surgery. LIMA side branches are clipped during surgery in order to prevent coronary steal. In cases of patent LIMA side branches, there are differingapproaches. Herein, we report a case with patent thoracic side branch of LIMA graft, occlusion of this side branch by Amplatzer Vascular Plug® because of documented myocardial ischemia, and long term follow-up results. (Cardiol J 2012; 19, 2: 197–200)

Key words: left internal mammary artery, vascular plug, myocardial ischemia

Introduction

Left internal mammary artery (LIMA) is frequently used in coronary artery bypass graft (CABG) surgery due to long-term patency rates. LIMA side branches are generally ligated during surgery in order to prevent coronary steal. Despite reports of clinical benefit regarding occlusion of LIMA side branches, there is disagreement as to the optimal therapy in cases of patent side branch. In a Doppler study, Guzon et al. [1] showed that there was no clear evidence for coronary steal phenomenon after rest or following adenosine hyperemia.

To date, there has been a variety of percutaneous treatment options in patients presenting with objective myocardial ischemia due to patent LIMA side branch, including Amplatzer Vascular Plug® (AVP), detachable coils and and gel foam [2, 3]. This study reports the long-term follow-up results of AVP for percutaneous treatment of LIMA graft side branch causing myocardial ischemia.

Case report

A 37 year-old man had undergone CABG to his left anterior descending artery (LAD), major obtuse marginalis (OM), intermediate and diagonal arteries after a non ST segment elevation myocardial infarction six years previously. Two years after CABG, our patient presented with complaints of chest pain and dyspnea. Transthoracic echocardiography revealed normal left ventricular end diastolic and end systolic dimentions with an ejection fraction of 62%. However, there was mild hypokinesia at anterior wall from the parasternal short axis view. Thallium scintigraphy revealed reversible perfusion defects on the anteroseptal and apical region. Coronary angiography was performed, which disclosed

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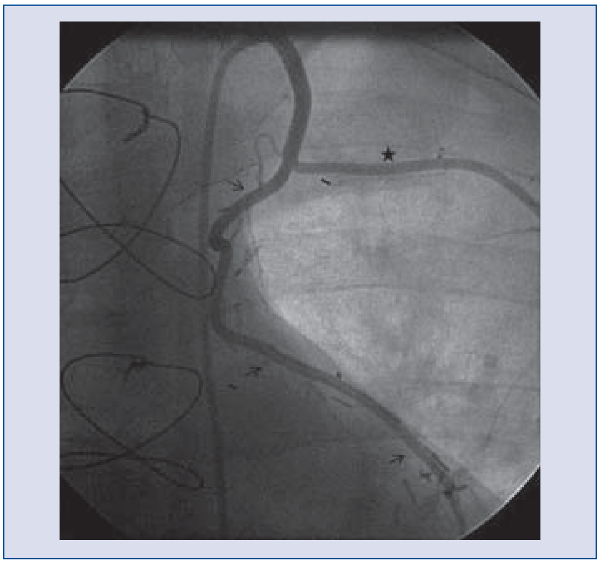

Figure 1. Angiography of left internal mammary artery graft showing patent flow to left anterior descending artery (arrows) and a large proximal side branch (asterisk) extending to the lateral chest wall.

critical stenosis at the middle segment of the LAD and at the proximal segment of the intermediate artery, major OM and diagonal arteries, whereas the right coronary artery was filling retrogradely from the LAD. All of the grafts were patent (saphenous vein graft to intermediate artery, saphenous vein graft to OM, radial artery graft to diagonal artery and LIMA graft to LAD).

However, a large unligated thoracic side branch was originating from the proximal portion of the LIMA-LAD graft (Fig. 1). Because of the reversible ischemic area located at anteroseptal and apical origin, the unligated side branch of the LIMA was considered to be the etiologic factor responsible for the clinical presentation. Occlusion of LIMA side branch was planned to relieve myocardial ischemia and the patient's symptoms. The LIMA was selectively cannulated with a 6 F guiding catheter (Boston Scientific Inc., Natick, MA, USA) via the left brachial artery. The AVP (AGA Medical, Golden Valley, MN, USA) was preloaded in a loader and delivered through currently available guiding catheter. Once positioned by holding the delivery shaft steady and pulling the outer guiding catheter back, a 6 mm device was released into the side branch with a diameter of 4 mm by rotating the delivery cable counter clockwise (Fig. 2). Control angiography revealed complete occlusion of side branch flow which was achieved with a preserved flow from LIMA to the LAD. Four years after the initial intervention, our patient was admitted to our department complaining of atypical chest pain. Coronary angiography revelaed patent grafts with completely occluded LIMA side branch (Fig. 3).

Discussion

The LIMA graft is especially preferred for the myocardial revascularization of the LAD with established long term patency survival rates when compared to saphenous grafts [4]. On the other hand, increased use of LIMA causes a variety of problems including graft malfunction, resulting in myocardial ischemia at LAD territory. Acute malfunction of graft was mainly due to intraoperative technical problems, spasm or stretch of graft. However, long-term malfunction is related to a variety of causes including progression of atherosclerosis, kinking of graft, competitive flow and steal due to unligated side branches.

Although the sternal, intercostal and perforating branches of LIMA are of small caliber, and the patency of those branches is not associated with clinically evident ischemia, the lateral internal thoracic artery is a large caliber vessel and has the potential to cause significant coronary steal phenomenon if remaining patent. The lateral internal thoracic vessel is a large side branch of LIMA which is found in 10–20% of people [5]. Lower resistance in the lateral internal thoracic vessel compared to the coronary vascular bed causes myocardial ischemia by diverting blood from LAD to low resistance lateral branch. However, there is controversy about the stealing phenomenon after bypass surgery when a large branch of the LIMA is not ligated. In a study by Guzon et al. [1], LIMA to LAD flow velocity and coronary flow reserve were evaluated by Doppler measurements after balloon occlusion of the LIMA side branch, revealing no significant change during rest or after adenosine infusion. After anastomose to the LAD, an appropriately grafted LIMA has a diastolic-to-systolic flow pattern mimicking the coronary arterial bed. However, LIMA side branches that are not supplying the coronary vasculature retain the systemic artery systolic predominant flow pattern [6, 7].

The AVP is a self-expanding cylindrical device that adjusts to the shape of the vessel due to the flexible nitinol wire mesh. The AVP is increasingly used for transcatheter embolizations in either the coronary or peripheral vasculature [8]. Devices should be approximately 30–50% larger than the vessel diameter to prevent device migration. The AVP allows targeted delivery and more precise

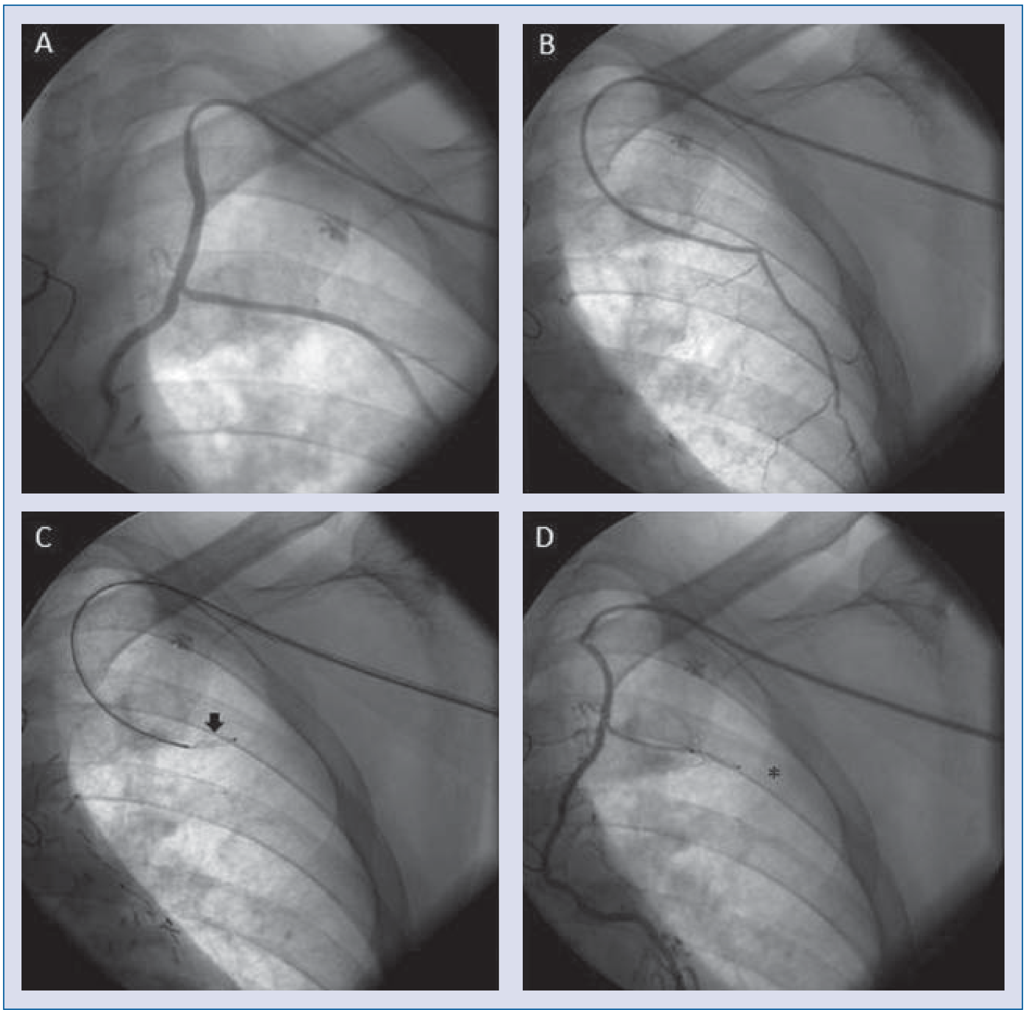

Figure 2. A. Cannulation of left internal mammary artery (LIMA) with 6 F guiding catheter from left subclavian artery; **B.** Selective engagement of guiding catheter to large lateral side branch of LIMA graft; **C.** Amplatzer Vascular Plug — AVP (arrow) deployed at the proximal portion of LIMA; **D.** Total occlusion was observed beyond AVP at angiography following deployment (asterisk).

placement within the artery. In cases of inappropriate location, the device can be repositioned or removed. The AVP is the therapeutic choice in moderate to large vessels, whereas coils are used in small vessels. The risk of device migration is less and total occlusion of the target vessel can be achieved with a single device with AVP. Additionally, AVP is magnetic resonance imaging compatible.

In conclusion, despite disagreement as to the optimal management of patent lateral branches of LIMA graft, exertional angina after exercise of upper extremity and myocardial perfusion scintigraphy revealing reversible anteroseptal and apical ischemia made the suspicion of steal from LIMA. This case illustrates that percutaneous closure of a LIMA side branch using Amplatzer Vascular Plug® is a reliable and effective method, with excellent long-term follow-up results.

Conflict of interest: none declared

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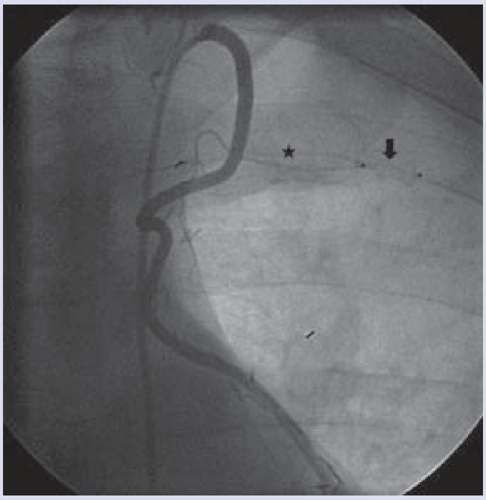

Figure 3. Four years after the deployment of Amplatzer Vascular Plug (arrow) illustrating no residual flow beyond the device with thinned proximal portion of lateral side branch (asterisk).

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