Saphenous Vein Graft Dissection Using the GuardWire Distal Protection Balloon

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The higher rate of periprocedural adverse events and lower rate of event-free survival of saphenous vein graft (SVG) intervention compared with native coronary artery intervention is primarily due to distal embolization. Distal embolic protection devices have been shown to reduce the incidence of no flow/slow flow and procedure related myocardial infarction during percutaneous intervention of diseased SVGs. The GuardWire system is a temporary distal balloon occlusion and aspiration device for distal embolic protection. Inflation of the distal elastomeric compliant balloon of the GuardWire system prevents debris embolization downstream and is supposedly atraumatic to the vessel wall. We report the inadvertent dissection of an SVG by GuardWire balloon inflation.

Key Words: Distal protection device • Saphenous vein graft • Coronary artery disease

INTRODUCTION

Distal embolization of atheromatous and thrombotic material is primarily responsible for the higher rate of periprocedure adverse events and decreased event-free survival after saphenous vein graft (SVG) intervention compared with native coronary artery intervention. Distal embolic protection devices have been shown to reduce the incidence of no flow/slow flow and procedure-related myocardial infarction during percutaneous intervention for diseased SVGs. Such devices also have been employed in many vascular interventions, including those of native coronary arteries, carotid arteries, and renal arteries. The GuardWire system is a temporary distal balloon occlusion and aspiration device approved by the US Food and Drug Administration for distal embolic protection. Inflation of the distal elastomeric compliant balloon of the GuardWire system prevents debris embolization downstream and is supposedly atraumatic to the vessel wall. We report the inadvertent dissection of an SVG by GuardWire balloon inflation.

CASE REPORT

A 79-year old man with coronary artery disease (CAD; left main and triple-vessel disease) and a history of coronary artery bypass graft (CABG) surgery (SVG to left anterior descending artery; SVG to obtuse marginal artery, and posterior descending artery) in 1995, presented with a one-month history of exertional dyspnea. Electrocardiogram (ECG) revealed normal sinus rhythm, with ischemic changes noted in the inferior leads. A Thallium-201 single-photon emission computed tomography (TI-201 SPECT) myocardial perfusion scan showed inferior (basal level) and anterolateral (apical level) reversible perfusion defects and an apical fixed defect. Angiography revealed the distal left main artery to be 80% stenotic, the proximal left anterior descending (LAD) artery 90% stenotic, the ostial left circumflex (LCx) artery 90% stenotic, the proximal right coronary artery (RCA) 100% stenotic, and the SVG to the LAD...
completely occluded ostially. In addition, the SVG to the obtuse marginal (OM) artery anastomosis was totally occluded, and the SVG to the posterior descending artery (PDA) was diffusely degenerate and 90% stenotic in the proximal segment, as well as 90% stenotic in the middle region, with TIMI grade 2 to 3 flow (Figure 1). A left ventricular (LV) angiogram demonstrated an ejection fraction of 55%.

Based on the ECG and Tl-201 SPECT myocardial perfusion scan, PCI of the SVG PDA was elected. Because of potentially significant atheromatous plaque and thrombus in the degenerated SVG and attendant high risk for distal embolization, it was decided to perform percutaneous revascularization with the GuardWire distal protection device.

Intravenous heparin was used to maintain an activated clotting time (ACT) between 250 and 300 seconds. After prepping the patient in the usual sterile manner, a 7 French right Judkin guide catheter was introduced into the SVG to the PDA. The GuardWire was negotiated through the proximal and middle stenoses and was placed in the distal vein graft segment. The distal protection balloon was inflated to 5 mm in diameter, and successful dye stasis was achieved. A 3.5 × 28-mm VISION stent (Guidant, Santa Clara, CA) was deployed directly in the middle stenotic segment at 12 atmospheres (atm).

After removal of debris with manual aspiration using the Export catheter (Medtronic Inc., Santa Rosa, CA), the distal balloon was deflated for intermittent ischemic relief. Angiography confirmed successful stent deployment in the middle stenotic segment of the SVG to the PDA with TIMI grade 3 flow (Figure 2).

The distal balloon was then repositioned at the site just proximal to that of stent deployment and was again inflated to 5 mm in diameter (Figure 3). A 3.0 × 33-mm ZETA stent (Guidant, Santa Clara, CA) was deployed directly in the proximal stenotic segment at 12 atm. The distal GuardWire balloon was again deflated after manual aspiration with the Export catheter. The ischemic interval was less than 3 minutes.

Post-procedural angiography revealed a filling de-
fect at the site of the distal protection balloon and TIMI grade 2 flow (Figure 4). The ACT was within the target range (i.e., 286 seconds), and the filling defect persisted despite the intragraft injection of 200 μg nitroglycerine and repeated aspiration with the Export catheter. Thus, a 3.5 × 15-mm VISION stent was deployed at the site of the filling defect under the protection of a distal occlusion balloon (Figure 5). Final angiography found no evidence of a filling defect, and TIMI grade 3 flow was noted (Figure 6).

The patient tolerated the procedures well and was discharged 2 days later in stable condition. Twelve months after discharge, he was enjoying event-free recovery.

DISCUSSION

The distal embolic GuardWire temporary occlusion system is a 190 cm-long, 0.014-inch (outside diameter) hollow guidewire with a central lumen connected to an elastomeric compliant distal occlusion balloon. The sizes of the distal occlusion balloon range from 2.5 to 5 mm in length and 3 to 6 mm in diameter. Nominal size is reached at an inflation pressure of 2 atm. During in vitro testing of this balloon, porcine coronary artery segments were found to have denuded endothelium when the vessel wall was assessed using scanning electron microscopy.9 Endothelial denudation may be associated with vessel thrombosis and restenosis.10

While adverse effects related to compliant low-pressure balloons have been reported (including thrombus formation or plaque compression in SVGs and restenosis or aneurysm formation at the site of the balloon inflation in native coronary arteries), other studies report that angiographically normal segments of native coronary arteries or SVGs do not develop acute or mid-term adverse events at the sites of balloon inflation.8,11-15 In addition to technical reasons for adverse events (e.g., choosing too large a balloon, or over-inflating the device), it is possible that the discrepancy between these above-cited reports is related to the presence of angiographically vis-
ible atherosclerotic disease.

In the case presented herein, the unexpected angiographic filling defect at the site of the distal occlusion balloon inflation could have resulted from either plaque dissection, plaque shift, focal spasm, localized calcium or thrombus formation. Since the filling defect developed under adequate anticoagulation, and persisted following the intragraft injection of 200 μg nitroglycerine and repeated aspiration with the Export catheter, it was concluded that a plaque dissection, rather than thrombus formation, had occurred. Additionally, IVUS has been able to discriminate the features that do not require intervention (localized calcium or no abnormality) from those that warrant further stenting (plaque dissection or thrombus). The filling defect was successfully managed via stenting, which also supports the diagnosis of dissection of the distal region of the diseased SVG to the PDA.

Pregowski et al. suggested that plaque rupture may be a part of the natural history of vein graft disease, and that plaque rupture may correlate with graft aging. Furthermore, degeneration or lumen compromise may not always be evident angiographically. Vein graft atheromas have also been shown to contain foam cells and inflammatory cells with a poorly developed or absent fibrous cap, making the grafts prone to rupture. As a result, it can be challenging to identify diseased segments of SVGs that may be more friable than non-diseased SVG or native tissue via angiography. Thus, selection of a safe “landing zone” for distal occlusion balloon placement is clinically challenging, and the potential for adverse consequences if an inappropriate “landing zone” is selected exists.

Yamaguchi et al. have described four techniques to protect against aneurysm formation at the site of the distal occlusion balloon. These techniques are also useful for minimizing chances of dissecting diseased SVGs. First, an export aspiration catheter can be employed to estimate the vessel size and direct appropriate balloon size and volume. Second, the distal embolization balloon should be filled slowly and just until antegrade flow has stopped. Third, the distal protection balloon should not be placed at a site that is calcified or plaque-rich. Finally, it is imperative to maintain the distal protection balloon stationary at all times.

The third point described above is similar to what the authors of this report suggest regarding appropriate “landing zone” selection. In this regard, intravascular ultrasound (IVUS) has emerged as an attractive and complementary diagnostic tool, with the unique ability to visualize the coronary wall in vivo. This is certainly an important topic worthy of further study, particularly since the use of the distal occlusion balloon is anticipated to increase over the next several years.

CONCLUSION

We have reported herein the inadvertent dissection of the distal region of a diseased SVG to the PDA following the use of the GuardWire distal embolization system during the PCI for diseased SVGs. This report highlights the importance of not over-inflating the distal occlusion balloon, and in selecting a non-diseased segment of the diseased vessel as a safe “landing zone” in which to place the balloon. This report is clinically relevant given that the use of distal occlusion balloons is anticipated to increase in coming years.

REFERENCES


