Saphenous Vein Graft Interventions

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KEYWORDS

• Saphenous vein graft • Percutaneous coronary intervention • Distal embolization
• Embolic protection • No-reflow phenomenon • Drug-eluting stent

KEY POINTS

- Knowledge of anatomic details and appropriate patient selection based on clinical and noninvasive data are imperative.
- Percutaneous coronary intervention of saphenous vein graft is associated with worse outcomes when compared with native coronary arteries.
- An embolic protection device should be used when technically feasible.
- Smaller stent size, avoidance of predilation, and use of an embolic protection device may reduce the likelihood of distal embolization.
- Treatment of the no-reflow phenomenon includes vasodilators like adenosine, nitroprusside, and calcium channel blocker.

INTRODUCTION

Saphenous vein graft (SVG) is the most common conduit used during coronary artery bypass graft surgery (CABG). Relative to arterial graft conduits, long-term patency of SVG is adversely affected by accelerated atherosclerosis, intimal fibrosis, and thrombotic occlusion. By 18 months after CABG, SVG failure rates have been reported to be near 25%.[1–4]

Despite the increase in percutaneous coronary intervention (PCI) for select patients with unprotected left main coronary artery disease, CABG remains the gold standard for complex coronary artery disease.[5] SVG intervention will, therefore, remain an important skill set in the interventional cardiologist's armamentarium.

PATHOPHYSIOLOGY

The high rate of SVG failure compared with arterial graft conduits, specifically the left internal mammary artery, can be attributed to[6–10]

- Harvesting
  - Loss of the vasa vasorum
  - Endovascular approach, possibly from endothelial damage
- Vascular biology
  - Exposure to arterial pressure promoting accelerated atherosclerosis
  - Endothelial dysfunction due to reduced production of nitric oxide
  - Neointimal hyperplasia and thrombosis
  - Increased lesion bulk with friable fibrous caps
- Target and graft anatomy
  - Poor distal runoff
  - Pre-existing venous dysfunction
- Technical failure
  - Excessive graft length causing mechanical torsion and kinking
  - Early anastomotic occlusion
  - Longer operative duration
  - Bypass grafting of nonischemia producing coronary artery lesions

LESION SELECTION

Similar to lesions in native coronary arteries, indications to intervene include ischemia on

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noninvasive testing; patient symptoms, including in the setting of acute coronary syndrome; and angiographic evidence of a significant stenosis. Myocardial perfusion imaging (MPI) has good specificity but variable sensitivity for detecting ischemia after CABG.[11] Results should be interpreted cautiously because ischemia may be present in vascular territories not amenable to CABG or proximal to the anastomosis.

Fractional flow reserve (FFR) is widely used in native coronary arteries to assess hemodynamic significance of intermediate coronary stenosis. However, data are insufficient to guide the use in SVG intervention. In limited studies, FFR has a high specificity but low sensitivity for identifying lesions associated with ischemia on MPI.[12]

Intravascular ultrasound (IVUS) may be helpful with stent selection, particularly because balloon predilation may be detrimental.[13,14] Positive remodeling on IVUS is a strong predictor of postintervention no-reflow warranting adequate preparation with embolic protection device (EDP) and pharmacotherapy before stenting.[15]

In a substudy of the stenting of saphenous vein grafts trial, patients with an intermediate (30%–60%) lesion who were noted to have lesion progression on follow-up angiography had a high rate of acute coronary syndrome (64%) and PCI (73%).[16,17] Although it is difficult to draw conclusions because of the small number of patients in this study, FFR and IVUS have limitations in predicting SVG lesion progression.

The comparison of plaque sealing with paclitaxel-eluting stents versus medical therapy for the treatment of moderate nonsignificant SVG lesions: the Moderate Vein Graft Lesion Stenting with the Taxus Stent and Intravascular Ultrasound (VELETI) trial randomized 57 patients with moderate (30%–60%) SVG stenosis to medical therapy or revascularization with drug-eluting stents (DES).[18–20] On average, patients were 12 years after CABG. IVUS was performed during the index coronary angiogram and again at 1-year follow-up. Both minimal luminal diameter and percent stenosis were decreased in the intervention group. Major adverse cardiac events (MACE) were nonsignificantly higher in the medical therapy group (19% vs 3%, $P = .091$). Although the VELETI I trial was underpowered for clinical end points, the results suggest improved outcomes with SVG intervention of intermediate stenoses. The ongoing VELETI II trial may shed further light on the issue because the primary end point is clinical rather than angiographic.[21] Although treatment of moderately diseased SVGs remains controversial, these studies have established the very rapid progression of intermediate lesions in SVGs.

INTERVENTION TECHNIQUE

Preparation

Knowledge of previous angiograms and details of the operative report can be very helpful, including graft location, number, and anatomy as well as any challenges encountered during CABG. On identification of appropriate patients with established ischemia, the SVG may be engaged with a variety of guide catheters, including the multipurpose catheter for right coronary graft intervention and the Judkins right catheter for left coronary graft intervention. Amplatz and left coronary bypass guide catheters are also frequently chosen for their ability to provide backup support. Right coronary grafts are best imaged in a left anterior oblique projection, whereas left coronary grafts are best viewed in a right anterior oblique projection.

Intervention of the native coronary artery should be considered whenever feasible because of the rapid progression of SVG stenoses and inferior long-term outcomes with SVG intervention.[22,23]

Predilation Versus Direct Stenting

Predilation, although frequently used as a lesion preparation strategy in non-SVG interventions, might be suboptimal in this setting. In a registry of patients who underwent SVG intervention, direct stenting was associated with a marked reduction in postprocedural myocardial infarction.[24]

Choice of Stent

The ISAR-CABG (Drug-eluting versus bare-metal stents in saphenous vein graft lesions) trial, which was the largest randomized trial comparing bare-metal stents (BMS) to DES in SVG intervention, reported a significantly lower target vessel revascularization rate in the DES group (7% vs 13%, $P = .01$).[25] The Reduction in Restenosis in Saphenous Vein Grafts with Cypher Sirolimus-Eluting Stent (RRISC) trial reported a lower rate of target lesion revascularization in patients randomized to DES at 6 months (5.3% vs 21.6%, $P = .047$) without a difference in mortality.[26] However, at the 3-year follow-up (DELAYED RRISC), the benefit in target lesion revascularization was lost, with an increase in mortality in the DES group. However, the trial was underpowered to demonstrate a difference in mortality (75 patients vs 610 in the ISAR-CABG trial).[27]

These studies were preceded by the Saphenous Vein de Novo (SAVED) trial, which