

# Successful Revascularization of Chronic Total Occlusion in Native Coronary Arteries through an Occluded Saphenous Bypass Vein Graft: A Retrograde Alternative Approach

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Saphenous vein graft (SVG) failure secondary to degeneration can cause significant problems after coronary artery bypass surgery (CABG). Repeat revascularization by percutaneous coronary intervention can be performed after SVG failure but is often associated with less favourable clinical outcome. Treatment for chronic total occlusion (CTO) of native vessels after SVG failure among patients with prior CABG is frequently performed. However, revascularization of CTO vessels in patients with prior CABG may be more complex and require more frequent use of the retrograde approach. Good septal or epicardial collateral channels are usually needed for the retrograde CTO approach. However, suitable native collateral channels may be absent and alternative retrograde routes should be considered. In this case report, we described a patient who had prior CABG and developed recurrent angina after SVG failure. His native CTO lesion was successfully revascularized by using a totally occluded vein graft as a retrograde conduit.

**Key Words:** Chronic total occlusions • Coronary artery bypass grafts • Percutaneous coronary intervention • Saphenous vein graft

## INTRODUCTION

Saphenous vein graft (SVG) failure secondary to degeneration can cause a significant problem after coronary artery bypass surgery. Within 10 years after surgery, only 60% of SVGs are patent in comparison to 90% of grafts using internal mammary artery.<sup>1</sup> Repeat revascularization by percutaneous coronary intervention

(PCI) can be performed after SVG failure. However, percutaneous interventions of SVGs are often associated with less favourable clinical outcomes because the rate of in-stent restenosis, target vessel revascularization, myocardial infarction, and death are higher in PCI of SVG compared with PCI of native coronary arteries.<sup>2,3</sup> Treatment of chronic total occlusion (CTO) of native vessels is frequently performed on patients with prior coronary artery bypass surgery (CABG). More frequent use of the retrograde approach is required because the success rate of antegrade approach in CTO intervention is limited to only 60-70%.<sup>4</sup> Studies have suggested that retrograde CTO PCI can achieve high success and low complication rates after prior CABG.<sup>5</sup> However, good collateral channels are required for retrograde CTO approach to be used, and such channels are occasionally absent. The alternative retrograde routes using a patent or occluded vein graft can be considered but the data is

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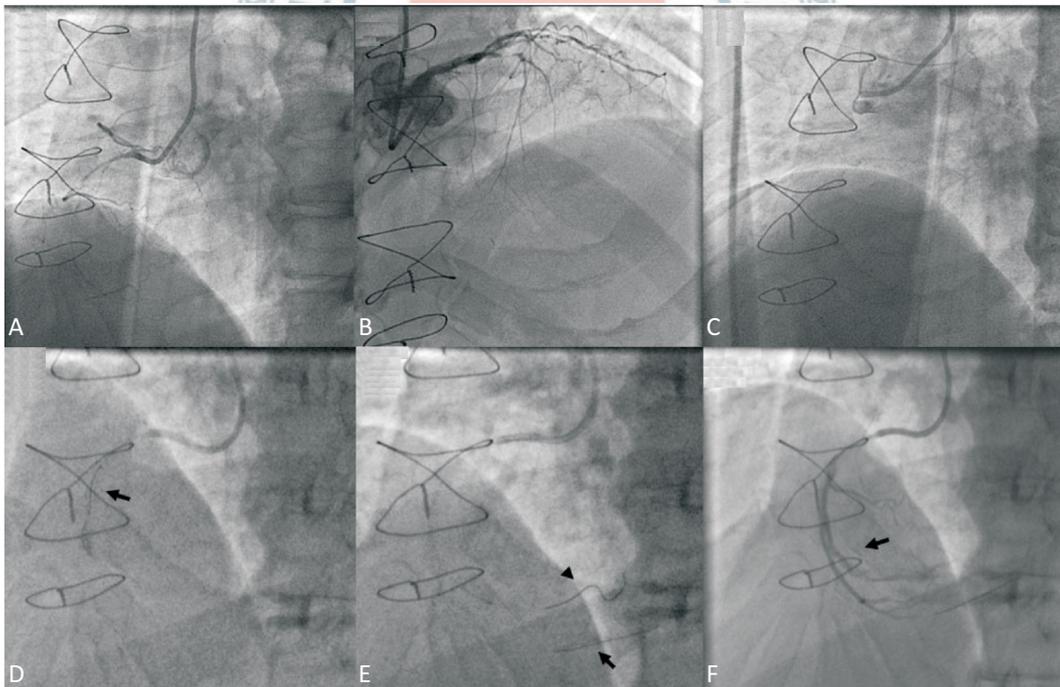
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lacking. In this case report, we present a CTO case where the patient was successfully revascularized through a totally occluded vein graft.

## CASE REPORT

We herein report the case of a 41-year-old man presenting to our hospital with stable angina (CCS III) who had CABG 8 years ago for multivessel coronary artery disease (CAD). Diagnostic coronary angiography demonstrated critical stenosis in the shaft of SVG connected to posterior descending artery (SVG-PDA) and the native right coronary artery (RCA) was totally occluded. We treated the critical stenosis of SVG-PDA with a  $3.5 \times 32$  mm paclitaxel-eluting stent (TAXUS Liberte, Boston Scientific, Maple Grove, MN, USA). Four years later, the patient developed recurrent exertional angina and diagnostic coronary angiography demonstrated a de novo stenotic lesion over the ostium of SVG-PDA. A  $3.5 \times 24$  mm Biolimus A9-eluting coronary stent (BioMatrix) was implanted to treat the ostial SVG-PDA lesion and over-

lapped with the previous paclitaxel-eluting stent at the shaft. Three months after the procedure, the patient again developed exertional angina. Diagnostic coronary angiography demonstrated native chronic total occlusions of RCA and left coronary artery (Figures 1A, B). Left internal mammary artery was patent and SVG-PDA bypass was totally occluded at the ostium with a short stump (Figure 1C). Due to the poor response to the drug-eluting stent (DES) treatment and the high degeneration score in the totally occluded SVG, we decided to attempt revascularization of the native RCA CTO lesion. The native RCA was engaged with a 6 French AL-1 guiding catheter through the right radial artery. Antegrade approach was performed by first advancing a Fielder FC wire. The Fielder FC guidewire failed to pass through the lesion (Figure 1D) and was left in RV branch as an anchored wire (Figure 1E). We switched to a Progress 40 guidewire (Abbott Vascular, Abbott Park, IL, USA) and tried to advance the wire through the CTO lesion under the support of a Finecross microcatheter (Finecross, Terumo, Somerset, NJ, USA). But the Progress 40 guidewire went into subintimal space (Figure 1E) and caused



**Figure 1.** Coronary angiography showed proximal RCA total occlusion (A). Both native LAD and LCX were occluded without good collateral vessel to RCA (B). SVG to PDA was also totally occluded (C). The first guidewire (Fielder FC) was unable to pass antegradely through the lesion (arrow, D). It was left as an anchored wire in the RV branch (arrow, E). The second guidewire (Progress 40) was tried but went into the subintimal space (arrowhead, E) and caused a long dissection (F). CAD, coronary artery disease; LCA, left coronary artery; PDA, posterior descending artery; RCA, right coronary artery; SVG, Saphenous vein graft.

a long dissection (Figure 1F). We were unable to cross antegradely and retrograde PCI was then attempted. Because there were no suitable native collateral channels we used the totally occluded SVG-PDA as a conduit for the retrograde PCI. The SVG-PDA was engaged with a second 6F AL-1 guiding catheter through a 6F sheath inserted into the radial artery. A 300 cm ChoICE PT wire (Terumo) was advanced retrogradely to the middle RCA successfully through the occluded SVG-PDA under the support of a 150 cm Cosair microcatheter (Figure 2A). Reverse controlled antegrade and retrograde subintimal tracking technique (reverse CART) was performed by antegrade balloon dilatation with a  $2.5 \times 15$  mm semi-compliant balloon in the proximal RCA (Figure 2B). The retrograde ChoICE PT wire (Terumo) successfully penetrated into the native RCA and entered the antegrade guiding catheter (Figure 2C). A Cosair microcatheter was then advanced into the antegrade AL1 guiding catheter following the ChoICE PT guidewire. We used a modified Rendezvous technique in the guiding catheter and put another antegrade Runthrough floppy wire into the

retrograde Cosair microcatheter (Figure 2D). The antegrade wire was advanced further through the retrograde microcatheter to the distal RCA, PDA, and venous graft (Figure 2E). Four overlapping everolimus-eluting stents (Xience Prime, Abbott Vascular) were successfully implanted and an excellent angiographic result was obtained (Figure 2F). The patient was discharged without complications after two days of hospitalization. He has not had any recurrent angina during 6 months of follow-up.

## DISCUSSION

Saphenous venous bypass grafts are often used as conduits for CABG. However, ten years after CABG only 60% of venous grafts remain patent. Saphenous vein graft patency continues to be a significant problem after CABG because only half of them are free of significant stenosis.<sup>1</sup> For revascularization after CABG, both surgical and percutaneous methods have limitations. Early mor-



**Figure 2.** Retrograde guidewire went into the native RCA through the total occluded SVG. The guidewire could not cross the lesion in the proximal RCA (arrow, A). Reverse CART technique was performed with an antegrade  $2.5 \text{ mm} \times 15 \text{ mm}$  balloon (arrow, B). After balloon dilatation the retrograde guidewire (PT wire) penetrated through the lesion successfully into the guiding catheter (arrow, C). After modified Rendezvous technique (arrow, D), the antegrade wire advanced to PDA through the retrograde microcatheter (D and E). Four overlapping everolimus-eluting stents were implanted and final coronary cinegram demonstrated an excellent angiographic result (F). CART, controlled antegrade and retrograde subintimal tracking; PDA, posterior descending artery; RCA, right coronary artery; SVG, Saphenous vein graft.

tality and complication rate is markedly higher in CABG reoperation.<sup>6</sup> Percutaneous intervention over saphenous venous graft is also associated with significant morbidity and mortality.<sup>2</sup> Restenosis is more frequent in saphenous venous grafts than in native vessels, especially in older graft and ostial lesion.<sup>3</sup> According to earlier studies, binary angiographic restenosis can occur in half of bare-metal stent (BMS)-treated lesions.<sup>7</sup> Although some studies demonstrated that drug-eluting stents reduce the risk of adverse events compared with bare-metal stents, the long-term safety and efficacy of DES versus BMS in patients undergoing PCI of SVG are still to be elucidated.<sup>8</sup> In our reported case, the SVG lesion treated by DES failed after three months from the previous intervention. SVG was not further attempted because of poor response to previous DES in ostial SVG. In addition, the elevated degeneration score of the totally occluded SVG predicted a higher chance of procedural failure and complication in our case.<sup>9</sup> The use of PCI to open up a totally occluded SVG with high degeneration score may result in thrombosis and distal coronary embolization, which can lead to no-reflow phenomenon and myocardial injury.<sup>3</sup> Even using a distal protection device, the thrombus burden is substantial in this patient due to the long, totally occluded, degenerated SVG. In this case, the use of PCI over the native vessel CTO should be more suitable compared to PCI over the totally occluded SVG.

Antegrade revascularization of CTO vessels in patients with prior CABG may be more complex due to the anatomical distortion of the native vessels and the long duration of CTO native vessel.<sup>10</sup> The Retrograde approach in failed cases of the antegrade recanalization was often required.<sup>4</sup> The septal branch is the most common route for retrograde intervention, followed by the epicardial collateral artery. Selection of suitable collateral routes is the key to success in retrograde PCI. In this case, however, suitable septal or other epicardial collaterals were absent for retrograde intervention. The native collateral channels (CCs) grade was zero in this patient which predicted a likelihood of failure for the retrograde intervention.<sup>11</sup> The alternative retrograde conduit that can be used for treating native RCA CTO in our patient is the occluded SVG-PDA.

Previously, a patent or critically stenotic SVG was sometimes used as a conduit for the retrograde intervention of native CTO vessel.<sup>12</sup> A search of PubMed re-

vealed only two successful cases of PCI to native CTO vessels through acutely occluded SVG conduits.<sup>13,14</sup> Our patient was different in that he presented with stable angina and the SVG may not be acutely occluded. In both reported cases of PCI through acutely occluded vein graft occurred after percutaneous attempts to recanalize the saphenous vein graft had failed. In our case, we avoided the attempt to PCI over the occluded SVG at the beginning so the possibility of thrombosis and embolization by balloon dilatation was minimized. In addition, the reverse CART technique was chosen instead of the CART technique in our case to avoid balloon delivery through the occluded SVG, which may increase the risk of distal embolization.

A common but potentially catastrophic complication of SVG PCI is perforation.<sup>15</sup> The risk of perforation in the thin wall of vein graft after PCI was minimized because the occluded SVG is used only as a conduit and balloon dilatation was not performed. Even if the guidewire exits and perforates the thin wall of SVG, significant blood extravasation is unlikely to occur in the occluded SVG and the risk of cardiac tamponade is very low. Furthermore, it was reported that retrograde PCI for CTO may be safer in patients with prior CABG because pericardial adhesion may reduce the likelihood of tamponade in case of collateral vessel perforation.<sup>4</sup> In our case the CholCE PT guidewire passed through the occluded vein graft smoothly with the assistance of a Cosair microcatheter. By using the totally occluded SVG we were able to uneventfully advance the guidewire all the way up to the proximal RCA. The advancement through SVG may be easier and safer than the native collaterals.

To the best of our knowledge, this is the first description of a successfully performed CTO PCI through a totally occluded venous graft in Taiwan. Despite the improvement of operator technique and equipment, a patient with chronic total occlusion of native vessel and occluded SVG after CABG is still considered a difficult candidate for PCI. In this case, we demonstrated that recanalization of the native coronary artery CTO can be performed through the totally occluded SVG successfully and safely.

#### CONFLICT OF INTEREST

None.

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