

“DK Crush” Technique for a Tightly Stenosed Conjoined SVG Lesion in a Patient with Acute Coronary Syndrome and Cardiogenic Shock

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Coronary artery bifurcation disease of saphenous venous graft (SVG) is extremely rare. SVG disease remains a challenging lesion to treat because of increased morbidity and mortality with repeated coronary artery bypass graft surgery (CABG), high rates of periprocedural complications, and in-stent restenosis or occlusion requiring repeat revascularization with percutaneous coronary intervention. Herein, we present the first reported case of using the “DK crush” technique to treat an inverted Y-shaped SVG bifurcation disease in a patient with a prior CABG and new-onset acute coronary syndrome. Arising from our treatment, favorable immediate and mid-term angiographic and clinical outcomes were obtained.

Key Words: Coronary artery bypass surgery (CABG) • “DK crush” technique • Saphenous venous graft (SVG)

INTRODUCTION

Coronary artery bifurcation disease (CABD) of native coronary arteries is not uncommonly found in daily practice, and accounts for approximately 15-20% of cases.^{1,2} However, CABD is extremely rare in saphenous venous graft (SVG). Such SVG disease remains a challenging lesion to treat because of increased morbidity and mortality with repeat coronary artery bypass graft surgery (CABG), high rates of periprocedural complications, and in-stent restenosis or occlusion requiring revascularization with percutaneous coronary intervention (PCI). In a patient who has undergone CABG for triple-vessel coronary artery disease and subsequently ex-

perienced failed SVG, the treatment is highly complex in an acute setting. Herein, we report a patient with a prior CABG and new-onset acute coronary syndrome (ACS), who was successfully revascularized using the “DK crush” technique for an inverted Y-shaped SVG bifurcation lesion. Our case demonstrated the feasibility of performing the “DK crush” technique to treat an SVG bifurcation lesion in an emergency setting. Our treatment resulted in a tangible benefit for the patient demonstrated by the favorable immediate and intermediate angiographic and clinical outcomes.

CASE REPORT

A 57-year-old man presented to the emergency room of our hospital with severe chest pain, dyspnea and general weakness for 3 hours. He had a medical history of hypertension, type 2 diabetes mellitus, chronic kidney disease, and triple-vessel coronary artery disease treated with CABG. According to the previous operation note, an inverted Y-shaped SVG with a common orifice connecting to the aorta was constructed to supply the anterior descending (LAD), left circumflex (LCX) and

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right coronary arteries (RCA). In the emergency room, the patient's blood pressure was 88/56 mmHg and heart rate was 130 beats per minute. The 12-lead electrocardiogram showed sinus tachycardia, old anteroseptal wall myocardial infarction, ST segment elevation of V1 to V3 and ST segment depression of V5 to V6 (Figure 1). Aspirin 300 mg orally, clopidogrel 300 mg orally, and heparin 4000 IU intravenously were administered immediately. We performed emergency coronary angiography (CAG) before attempting primary PCI. The baseline CAG revealed diffusely diseased coronary arteries of the native left main (LM), LAD, LCX, and RCA, and very critical disease of SVG grafts, including the conjoined SVGs and anastomosis of the SVG and first diagonal artery (Figure 2A to 2E).

Considering the serious clinical condition of the patient, the difficulty in reconstructing CABG, and diffuse disease of native coronary arteries, revascularization of the SVG lesion by PCI was performed. Given the degree of atherosclerosis involving conjoined SVGs and the segment of the SVG connecting to the aorta, a two-stent strategy using a "DK crush" technique was considered to be the most appropriate method. The "DK crush" technique has been described in the previous literature.³ Briefly, two wires are positioned distal to lesions in both the main vessel and side branch. A balloon in the main vessel is inflated to crush the side branch stent after im-

planting the side branch stent and removing the stenting balloon. The protruding side branch stent is crushed against the main vessel. The first kissing balloon inflation is undertaken immediately after successfully rewiring the side branch. The stent in the main vessel is then inflated to further crush the side branch stent. Final kissing balloon inflation is undertaken after successfully rewiring the side branch. In our case, the venous graft supplying the territory of the first diagonal, first obtuse marginal and posterior descending arteries was deemed to be the main branch and labeled as SVG1, while the one originating from SVG1 and supplying the LAD was considered to be the side branch and labeled as SVG2. Initially, an intra-aortic balloon pump (IABP) was implanted from a left femoral approach to enhance the coronary blood flow and stabilize the hemodynamic condition. An SCR 3.5 X 7 French guiding catheter with two hand-made side holes was inserted into the SVG. Both branches of the graft were wired using Sion (Asahi Intecc Co., Ltd, Thailand) and balance middle-weight (BMW) Elite (Abbott Vascular International BVBA, Belgium) wires to distal SVG1 and SVG2, and the bifurcated lesion was simultaneously pre-dilated with a 2.0×12 mm and a 2.0×20 mm balloon. Then a filter wire was inserted into the middle SVG1 and deployed at that location. The "DK crush" technique was performed pursuant to the following steps (Figure 2F to J): a 2.5×12 mm



Figure 1. The 12-lead electrocardiogram. 12-lead electrocardiogram showed sinus tachycardia, old anterior wall myocardial infarction, ST segment elevation of V1 to V3 and ST segment depression of V5 to V6.

everolimus-eluting stent was deployed over the ostial to proximal SVG2 and crushed by a 3.0×15 mm non-compliant (NC) balloon. The BMW wire was then pulled back and re-wired into the SVG2 and the first kissing balloon inflation was performed by 3.0×15 and 2.0×20 mm balloons for SVG1 and SVG2. The Sion wire was pulled out and the ostial to proximal SVG1 lesion was scaffolded by a 3.5×18 mm everolimus-eluting stent. Again, the BMW wire was pulled back and re-wired into the SVG2 and the final kissing balloon inflation was performed by 3.5×15 and 2.5×15 mm NC balloons for SVG1 and SVG2. Afterward, the filter wire was retrieved and the Sion wire was inserted into the distal SVG1. The anastomosis of SVG1 and the first diagonal artery was scaffolded by a 2.75×18 mm everolimus-eluting stent. Thereafter, it was observed that the post-operative coronary flow was good. The IABP was removed the next day and the patient was discharged uneventfully 10 days later. Dual antiplatelet drugs, clopidogrel 75 mg daily and aspirin 100 mg daily, were prescribed. Four months

later, controlled coronary angiography revealed good flow of the SVG and supplying territories (Figure 2K and 2L).

DISCUSSION

It is not uncommon for clinicians in daily practice to have patients with diagnosed CABD of native coronary artery, which can account for a full 15-20% of their cases;^{1,2} but this condition is extremely rare in SVG. CABD has remained a difficult lesion to treat because it has poorer outcomes, lower procedural success and higher complication rates than less complex diseases that require PCI. "DK crush" is one of the most widely used techniques in treating CABD³ because it can provide immediate patency of both branches, can be used in a wide variety of bifurcation morphologies, is suitable for cases involving a significant mismatch between a main vessel and a side branch, reduces deformity of side branch ostium and has favorable long-term clinical out-

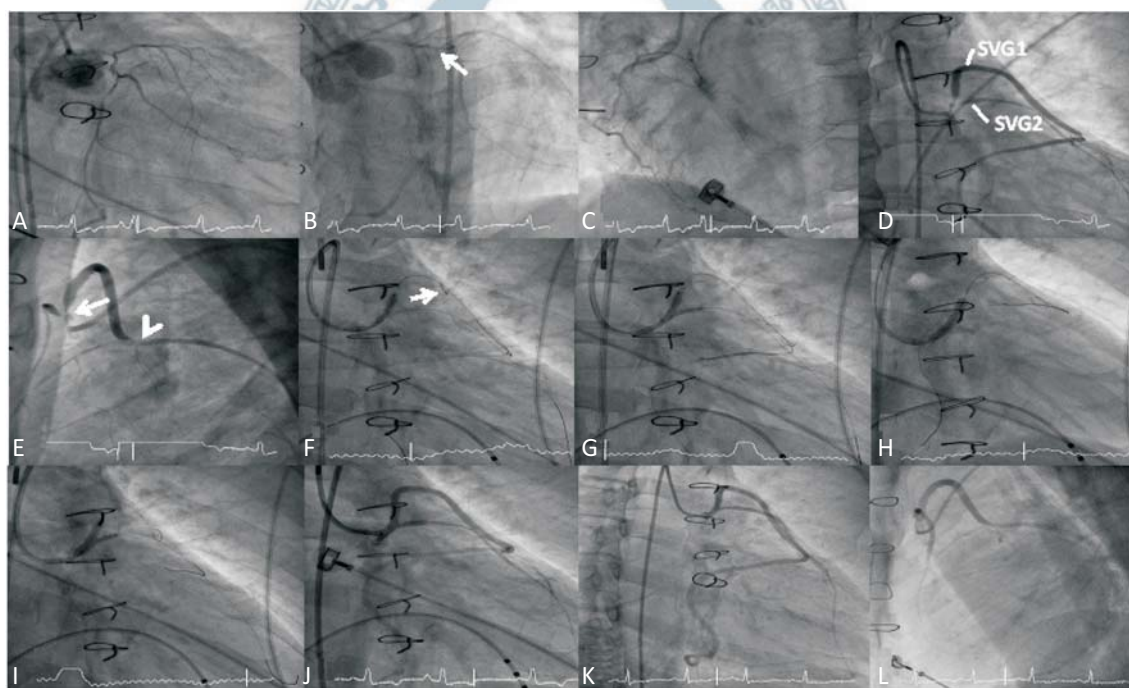


Figure 2. Diagnostic coronary artery angiography (A to E), percutaneous coronary intervention (F to J) and coronary angiographic follow-up (K and L). (A) and (B) Diffusely diseased native coronary arteries, including left main (LM), left anterior descending (LAD) (white arrow) and left circumflex (LCX). (C) Total occlusion of the right coronary artery (RCA). (D) Severe aorto-ostial stenosis with involvement of anastomosis of the first saphenous venous graft (SVG1) and second SVG (SVG2). (E) Severe stenosis of the anastomosis of SVG1 and SVG2 (white arrow), and severe stenosis of the anastomosis of SVG1 and the first diagonal branch (white arrow head). (F) Crushing of the SVG2 stent by a balloon positioned at the SVG1. The filter wire (white arrow) was positioned at the middle of SVG1. (G) First kissing-balloon Inflation. (H) Stenting of aorto-ostial to proximal SVG1 with simultaneous second crushing of the SVG2 stent. (I) Final kissing-balloon inflation. (J) Final angiographic result. (K) and (L) Angiographic follow-up at four months post-intervention.

comes.³⁻⁵ In our case, we demonstrated that using the “DK crush” technique for the treatment of a tightly stenosed conjoined SVG lesion provided immediate patency in a mismatched main vessel and a side branch, and obtained favorable immediate and mid-term angiographic results and clinical outcomes.

SVGs are commonly used conduits for surgical revascularization of coronary arteries but are associated with poor mid- and long-term patency rates. SVG intervention remains technically challenging and is associated with high rates of periprocedural myocardial infarction, in-stent restenosis, target vessel revascularization, in-hospital mortality, and occlusion compared with PCI of native coronary arteries. This is largely because of the friable, degenerated atheromatous and thrombotic debris that develop when SVGs deteriorate. The ACC/AHA joint guidelines⁶ recommend PCI as a Class II indication to treat diseased SVGs in unstable angina/non-ST elevation myocardial infarction patients who are undergoing medical therapy and who are poor candidates for repeated surgery. In addition, the ACC/AHA guidelines⁷ recommend using embolic protection devices as a Class I indication to decrease the risk of distal embolization, no-reflow phenomenon, and periprocedural myocardial infarction when performing SVG intervention. In our case, the patient presented with acute myocardial infarction and was found via angiography to have failed SVGs and diffusely diseased native coronary arteries. Emergency PCI was performed to treat the extremely complex bifurcated SVG disease rather than attempt treatment of native coronary arteries or repeated CABG, thereby achieving revascularization more easily and quickly under emergency conditions. Use of a distal embolic protection device to protect the SVG1 during the intervention reduced the risk of distal embolization and provided a good post-procedural TIMI flow.

In conclusion, we have demonstrated that the application of the “DK crush” technique for a tightly stenosed

conjoined SVG lesion in a patient with prior CABG presenting with ACS and cardiogenic shock is feasible and can provide a satisfactory angiographic result and a favorable clinical outcome.

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