Saphenous Vein Graft (SVG) Stenosis Revascularization with Percutaneous Coronary Intervention (PCI)

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ABSTRACT

Coronary artery bypass grafting (CABG) is the most ideal and frequently performed procedure for multi-vascular coronary artery stenosis, but its long-term prognosis is unfavorable. A 64-year-old male with a history of coronary artery graft surgery seven years ago complained of recurrent chest pain radiating to the jaw, relieved by isosorbide dinitrate. Physical examination, electrocardiography, and echocardiography test results were within normal limits. Laboratory results showed critical blood urea nitrogen (BUN) values requiring hemodialysis, on angiographic examination showed stenosis in all grafted and native coronary arteries. The diagnoses were grade III coronary artery disease and renal failure. Percutaneous coronary intervention using a drug-eluting stent (DES) in the saphenous vein graft conduit of the right coronary artery was performed, along with dual antiplatelet agents, b-blockers, nitrates, and statins.

Keywords: Coronary artery bypass grafting, drug-eluting stent, percutaneous coronary intervention, saphenous vein graft stenosis.

ABSTRAK

Bedah pintas arteri koroner (CABG) adalah tata laksana paling ideal dan sering dilakukan pada penyempitan pembuluh darah koroner multi-vaskular, tetapi prognosis jangka panjangnya tidak terlalu baik. Seorang pria berusia 64 tahun dengan riwayat operasi cangkok arteri koroner 7 tahun yang lalu mengeluh nyeri dada berulang yang menjalar ke rahang, keluhan berkurang dengan obat *isosorbid dinitrate*. Hasil pemeriksaan fisik, rekaman jantung dan ekokardiografi masih dalam batas normal. Hasil laboratorium menunjukkan nilai nitrogen urea darah (BUN) kritis, sehingga perlu hemodialisis, pada angiografi didapatkan gambaran penyempitan pada semua saluran cangkok ataupun koroner asli. Pasien didiagnosis penyakit arteri koroner derajat III dan gagal ginjal. Dilakukan tindakan intervensi koroner perkutan menggunakan *stent* bersalut obat (*drug eluting stent*/DES) pada saluran cangkok *vena saphena* dari arteri koroner kanan, disertai pemberian *antiplatelet* ganda, *beta-blocker* nitrat, dan *statin*. Amalia Nurjanah, Wynne Putradana, Djoen Herdianto. Revaskularisasi *Saphena Venous Graft Stenosis* (SVG) dengan *Percutaneous Coronary Intervention* (PCI).

Kata Kunci: Bedah pintas arteri coroner, *stent* bersalut obat, intervensi koroner perkutan, stenosis cangkok *vena saphena*.

Introduction

Coronary artery bypass grafting (CABG) is a surgical procedure that involves harvesting a vein or artery to be used for bypassing the blocked blood vessel.[1] Several blood vessels can be used as graft conduits, including veins, especially the saphenous vein, and arteries, such as the mammary and radial arteries.[2]

The saphenous vein is easily accessible, and its wall characteristics are suitable; it is often used as a graft conduit in multi-vessel stenosis or in situations where the internal mammary artery cannot be used.[2] Despite its widespread use, the long-term patency of a saphenous vein graft (SVG) is unfavorable, as it is more prone to atherosclerosis than arterial grafts. The incidence of SVG stenosis remains high and often requires revascularization.[1,2] Revascularization can be done with percutaneous coronary intervention or re-bypass with medical therapy. This case report discusses the management of stenosis in the saphenous vein graft conduit by the PCI method.

Case

A 64-year-old male with hypertension was admitted to the cardiology department with intermittent chest discomfort that radiated to the jaw over the past year and worsened in the past month. It occurs mainly during mild activities and is relieved with isosorbide dinitrate (ISDN) 5 mg sublingual and rest. He had undergone coronary artery bypass graft (CABG) surgery with the left internal mammary artery (LIMA) as a graft to the left anterior descending artery (LAD), saphenous vein graft (SVG) to the left circumflex artery (LCX), and right coronary artery (RCA) seven years ago. He is a non-smoker but admitted that he could not maintain his diet and often ate fatty foods.

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On examination, he was alert, afebrile, with a blood pressure (BP) of 140/80 mmHg, a heart rate (HR) of 64 bpm, a regular respiration rate, and a SpO_2 of 97% on room air. Other physical examinations were unremarkable; a 12-lead resting electrocardiogram revealed non-significant ischemia. Echocardiography suggests dilatation of the left atrium and left ventricle with a normal left ventricular ejection fraction (LVEF) of ~72%, normal contractility, and mild mitral insufficiency. Serum biochemistry was within normal limits except for a critical value for urea of 87.7 mg/dL and creatinine of 9.9 mg/dL. Thorax radiography revealed cardiomegaly.

He takes ISDN 5 mg three times daily, dual anti-platelet clopidogrel 75 mg od with aspirin 80 mg od, amlodipine 10 mg od, atorvastatin 20 mg od, bisoprolol 5 mg od, and hydrochlorothiazide (HCT) 25 mg od. Angiography was planned after hemodialysis due to critical creatinine values. Clopidogrel was replaced with ticagrelor before the procedure.

Coronary angiography was performed with a right trans-radial approach and revealed normal left main artery (LM), a total occlusion in the mid left descending artery (LAD), diffuse stenosis from proximal to distal up to 90% in left circumflex (LCX) and intermediate artery, total occlusion in osteal LAD graft and LCX graft. Diffuse stenosis RCA up to 95%, diffuse stenosis up to 98% in RCA graft **(Figure 1)**. He was diagnosed with CAD grade III with multiple stenosis on a graft with end-stage renal disease.

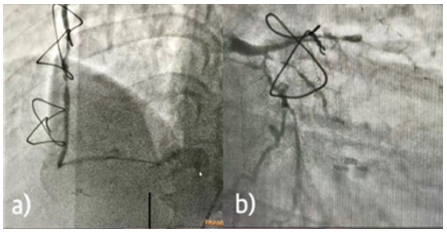

Figure 1. a) Diffuse stenosis from osteal proximal to distal up to 98% in RCA graft (orange arrow). b) Total occlusion in mid-LAD (blue arrow), diffuse stenosis from proximal to distal up to 90% in LCX (purple arrow), and intermediate (yellow arrow).

Angiography was followed by SVG stenting of the RCA because diffuse stenosis was found in the osteal to proximal up to 98%. There was also calcification and diffuse stenosis from the base to the distal >95% in the RCA native vessel.

The procedure was started by inserting a guidewire into the right coronary artery. Pre-dilatation was performed using a sapphire balloon 1.0x10 mm and a Maya balloon 1.5x15 mm. Critical stenosis of SVG-RCA was successfully treated using DES Cre 8 implantation size 2.75x20mm and DES Combo 3.0x28mm. An excellent angiographic picture was obtained, there was no significant complication during or after the procedure, and the patient's hemodynamics were stable.

Figure 2. Before stent placement (Right with yellow arrow) and after stent placement (left with orange arrow).

Chest pain disappeared in the last 12 hours after the procedure. The evaluation was continued until 48 hours post-procedure before the patient was finally discharged. A week after the procedure, the patient felt better with an occasional 'heavy' chest. The patient was advised to continue his previous medications.

Discussion

The long-term patency and success of vein grafts in bypass surgery remain challenging due to the faster rate of atherosclerosis than arteries.[3,4] The incidence of vein graft failure in post-CABG patients is relatively high. Over 50% of all CABG patients will develop ischaemic symptoms, mainly angina and venous graft stenosis, within the first ten years, and many will require revascularization.[3,5]

The pathophysiological process of stenosis in vein grafts is thought to have occured since the beginning of the procedure because perioperative manipulation of the saphenous vein may cause endothelial cell damage.[4] After the vein is successfully placed, a sudden pressure increase may cause more endothelial cell damage, triggering the activation of platelet aggregation and some other clotting factors to stimulate tunica intima hyperplasia. These events result in an imbalance between antithrombotic and prothrombotic systems characterized by decreased production of nitric oxide (NO), prostacyclin (PGI2), thrombomodulin, and heparin-like substances by the injured endothelium, resulting in increased expression of adhesion molecules and sensitivity of vascular smooth muscle cells (VSMC) to constriction.[6,7] The combination of these processes is estimated to cause 3-12% occlusion in early-stage grafts.[6]

Non-invasive examination modalities are electrocardiography to detect new-onset branch blocks and echocardiography to assess anatomical dysfunction, coronary computed tomography (CCTA), single-photon emission computed tomography, and cardiac magnetic resonance. Invasive investigations such as coronary angiography are the most common examination to confirm the presence of CAD.[8]

After stenosis diagnosis, risk selection should be based on the existing algorithm for advanced CAD to determine the risk of all potential therapies, ranging from medication alone, percutaneous revascularization, and surgery.[9] Patients with a >5% mortality risk during the revascularization procedure are considered non-operable.[9] Patients who have undergone CABG surgery and used the left mammary artery as a conduit are advised to use percutaneous revascularization if required. Assessing the potential benefits of revascularization is also important; too many comorbidities may result in no meaningful clinical benefit from revascularization procedures.[9]

Treatment

Preventing venous graft stenosis (VGS) is the cornerstone of management. Several factors can be modified to reduce the possibility of graft re-stenosis: tight control of blood pressure, blood sugar, blood lipid levels, and body weight; regular exercise; a healthy diet; avoiding smoking; and taking medication regularly.[1] At an advanced stage, most patients require revascularization accompanied by medication. However, if revascularization is too risky and not possible, only medication is given.

- Revascularization
  Revascularization includes percutaneous coronary intervention (PCI) or repeat coronary artery bypass surgery (CABG).[10] PCI is currently preferred for revascularization in post-CABG patients, as re-bypass has a higher morbidity and perioperative mortality risk.[3,6] Although PCI of the graft is often associated with re-stenosis risk, several studies have shown that stent selection, such as drug-eluting stents (DES), reduces thrombosis complications compared to conventional metal stents.[11] Basically, stenting can be performed on the graft or native vessel. Some studies have shown that stenting the native vessel has a better prognosis as the graft is considered more susceptible to atherosclerosis, leading to re-stenosis of the stent.[12,13] However, if extensive coronary calcification to total occlusion is found, stenting will be more feasible in grafts.[13,14]

- Dual Antiplatelet Therapy (DAPT)
  In addition to revascularization measures, the administration of DAPT is essential to prevent thrombosis and minimize the risk of ischaemic events. Antiplatelet options are aspirin and P2Y12-ADP receptor blockers such as clopidogrel, ticagrelor, and prasugrel. Clopidogrel was originally the first generation recommended along with aspirin, but it is gradually displaced by ticagrelor and prasugrel because several studies showed them to be superior in preventing ischaemic events by improving endothelial function and reducing the risk of vascular death, myocardial infarction, and stroke in the first year.[15-17] However, the bleeding risk is also higher.[15,18] DAPT, recommended by the 2016 ACC/AHA guideline, is a combination of ticagrelor and aspirin, given for at least 12 months.[18]

- Statin
  Statins used to control hyperlipidemia are considered essential to prevent intimal hyperplasia and atheromatous plaque formation.[4] Current guidance recommends statins for all patients without contraindications, as they could improve outcomes and slow down the process of vein graft stenosis.[19] The American Heart Association/American College of Cardiology and the National Cholesterol Education Program Adult Treatment Panel III guidelines target LDL values of less than 100 mg/dL after CABG.[19] This is supported by the results of a study conducted by Kulik and his colleagues, showing that more intensive LDL reduction to 70 mg/dL can improve cardiovascular outcomes. While LDL values less than 70 are not considered to provide more benefit.[19]

Special Consideration for Patients with Low e-GFR

Glomerular filtration rate (eGFR) <90 mL/min/1.73 m2 can be a risk factor for heart disease complications and triggers symptoms such as severe angina and other severe cardiac complaints.[20]

Management for this condition varies from medication alone to percutaneous revascularization if deemed feasible and beneficial.[20] Due to the high risk of bleeding in CKD patients, the choice of antiplatelet regimen and duration must be adjusted.[21] Although only a few studies support that ticagrelor and prasugrel are more beneficial in advanced CKD than clopidogrel, their use is still necessary if the ischaemic risk is greater than the bleeding risk.[21] In this case, a DAPT combination of ticagrelor and aspirin was administered to reduce ischaemic risk with close monitoring, especially in the first three months after PCI, to detect bleeding risk.[21]

Prognosis

Patients with PCI on a vein graft had a higher 2-year risk of all ischemic events, including death, cardiac death, and stent thrombosis.[22] Therapy with potent and longer-acting antiplatelet agents is expected to be beneficial.[7,22] In this case, chest pain complaints were significantly reduced after PCI, so the goal of palliative therapy was considered achieved. However, regular monitoring and control are needed to ensure a favorable prognosis.

Conclusion

SVG failure rates within ten years are high and often require revascularization.[3,5] Treatment options include PCI, repeat CABG surgery, or medical therapy alone. PCI is more commonly chosen as it is safer than re-bypass surgery, especially in patients with multiple comorbidities.[3,6] Stenting can be performed in the native vessel or graft, but if stenting in the native vessel is not possible, stenting in the graft may be performed. Drug-eluting stents (DES), DAPT, and statin administration are considered to have benefits in reducing complications.[11,15,19]

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