Case Report

Staged Hybrid Revascularization in an Octogenarian Male with Chronic Kidney Disease and Three-vessel Coronary Artery Disease with Left Main Coronary Artery Involvement☆

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SUMMARY

Ischemic heart disease is a major cause of death in nonagenarians. These patients frequently present with comorbid conditions, including chronic kidney disease, increasing the complexity of the treatment. Both percutaneous coronary intervention and coronary artery bypass graft surgery are therapeutic options with different advantages and disadvantages. We herein report an experience of treating an octogenarian gentleman with three-vessel coronary artery disease involving the left main coronary artery, in whom the coronary lesion and deteriorated renal function were high risk factors for transcatheter intervention. We planned and performed a staged hybrid strategy: first, off-pump minimally-invasive coronary artery bypass surgery for the left anterior descending artery, and second, 2 months later, a transcatheter intervention for the left main coronary artery and left circumflex artery. We achieved complete relief of symptoms and prevented the deterioration of the patient's renal function. We reviewed the advantage of this modality and its impact on renal function.

1. Introduction

As the older population is growing in number, ischemic heart disease is becoming a major cause of death, with 83% of patients dying from this disease being over 65 years old1, and many having multiple systemic diseases, such as chronic kidney disease (CKD), complicating the treatment of ischemic heart diseases. Percutaneous coronary interventions (PCIs) and coronary artery bypass graft surgery are viable therapeutic options, as a multicenter study has shown2, but the left ventricular function, renal function, the acuity of the procedure, and age itself are factors that affect the outcome in nonagenarian patients receiving PCIs or coronary artery bypass graft. We herein report the case of an octogenarian male with essential hypertension and stage 4 CKD, who suffered from essential hypertension and stage 4 CKD, who had a batwing appearance compatible with pulmonary edema. Electrocardiography revealed critical stenotic left main (LM) coronary artery disease in bifurcation to the left circumflex (LCX) and left anterior descending artery (LAD). We treated him with an infrequent strategy: a staged hybrid approach performing off-pump coronary artery bypass (CAB) surgery with minimally invasive direct coronary bypass, then, 46 days later, PCI for the remaining LM-LCX lesion. The clinical course and outcome are presented and analyzed. The literature concerning bypass surgery and hybrid approach is reviewed.

2. Case report

An 81-year-old man was admitted because of progressive dyspnea for 10 days. Orthopnea and effort-related angina had been noted since some months before. He has been a smoker for decades, has suffered from essential hypertension for years without regular control, and was previously told he had impaired renal function. At the emergency room, physical examination revealed a pulse rate of 119 beats/minute, blood pressure of 120/80 mmHg, and respiratory rate of 30 breaths/minute. Breathing sound showed rales on the bilateral basal areas of the chest. Heart sound was regular, with 2/6 systolic murmur on the left lower sternal border and apex. Edema was noted on both legs. Chest film showed cardiomegaly and tortuous aorta and the bilateral lung field had a batwing appearance compatible with pulmonary edema.

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showed sinus rhythm, ST segment depression on leads V4–6. Laboratory data revealed creatinine phosphokinase (CPK) 295 U/L (reference: 26–174 IU/L), creatinine kinase (CK)-mass 29.9 ng/mL (reference: 0.1–6.3 ng/mL), and troponin-I 1.87 ng/mL (reference: <0.5 ng/mL). The patient’s serum creatinine was 3.66 mg/dL and his estimated creatinine clearance was 17 mL/minute. Echocardiography showed global hypokinesia, moderate systolic dysfunction with an ejection fraction of 44% by M-mode tracing, left and right ventricular enlargement, moderate mitral regurgitation and mild aortic and tricuspid regurgitation. Non-ST segment elevation myocardial infarction was suspected.

At the intensive care unit, the patient was given oxygen therapy, oral dual antiplatelet therapy (aspirin plus clopidogrel), subcutaneous enoxaparin with the dosage adjusted to estimated creatinine clearance, intravenous nitroglycerin, and diuretics. The respiratory distress improved but the angina persisted.

The thrombolysis in myocardial infarction risk score was 4, so early coronary angiography was considered. Informed consent was obtained. Coronary angiography showed a critical stenosis of 80–90% on LM in bifurcation to LCX and LAD. Chronic total occlusion (CTO) was noted on the distal LCX, which receives collateral from the right coronary artery. The proximal segment of the LAD and posterior descending artery of the right coronary artery had 70–75% stenosis, and a 50% stenosis was noted on proximal right coronary artery (Fig. 1). Triple-vessel disease with involvement of LM bifurcation was diagnosed.

The SYNTAX score for multi-vessel and left main coronary artery percutaneous coronary interventions was 32, which means he patient was at high risk for intervention. On evaluation by a cardiovascular surgeon, the patient’s European System for Cardiac Operative Risk Evaluation score (EuroSCORE) was 10 points, which is equivalent to a mortality rate of 16.25%. We were concerned about the effect of the contrast dye on the patient’s CKD, the risk related to the treatment of the LM bifurcation lesion, and the fact that the patient was economically unable to afford drug-eluting stent, which is not covered by the insurance. In agreement with the patient, off-pump and minimally invasive direct coronary bypass via the anterolateral minithoracotomy approach was performed with the left internal mammary artery to the proximal LAD. The surgical procedure was uneventful, blood loss was 300 mL, and urine output was more than 50 mL/hour during the surgery.

After the surgical intervention, ventilator support was withdrawn the morning after. The patient had an uneventful recovery and was discharged from hospital 5 days after the surgery. We kept using aspirin, carvedilol, isosorbide mononitrate, and furosemide. No further symptoms were noted.

The angina recurred weeks after the bypass surgery. The coronary angiography showed the bypass from the left internal mammary artery to proximal LAD was patent (Fig. 2). We decided to treat the severe stenosis of LM to the proximal LCX and distal LCX CTO 46 days after the bypass surgery. We used a 6Fr Kimny guiding catheter (Boston Scientific Corp., Natick, MA, USA) through left radial artery approach. The Fielder FC wire (Asahi Intecc, Aichi, Japan) successfully crossed the lesion from the LM to LCX distal CTO lesion. The Rafale 1.5 × 20 mm balloon (Hexacath, Rueil Malmaison Cedex, France) failed to dilate the distal LCX CTO lesion with

![Fig. 1.](attachment:image)
pressure of 4–14 atm, despite crossing the lesion successfully. We decided to leave the distal LCX CTO without further intervention to avoid further loading of the contrast dye. Our next step was deployment of the Vision stent 3.0 × 18 mm (Abbott Vascular, Santa Clara, California) at a pressure of 18 atm to treat the distal LM to proximal LCX lesion (Fig. 2). Coronary flow was improved in all of the LCX except in the distal LCX CTO. The patient became free of angina after the procedure, and we continued using aspirin and clopidogrel, beta blocker, nitrates and diuretics. He remained stable and without any symptoms. His estimated creatinine clearance remained between 10 and 17 mL/minute, with adequate daily urinary volume in the months following the PCI, up to the date at which this report was submitted.

3. Discussion

Ischemic heart disease is a major cause of death in nonagenarians1. Therapeutic options include medical treatment, coronary artery bypass graft and PCI. Despite the fact that these last two modalities are viable options, the clinical decision is often difficult due to multiple comorbidities. A study conducted by Bridges et al3 suggested that operative mortality for cardiac surgery is highest for nonagenarians and centenarians. Among the risk factors for the operative mortality, renal function and emergency/salvage surgery are important factors. Peterson et al2, in their multicenter study, concluded that age and left ventricular function are also key factors affecting the outcome of ischemic heart disease treatment.

The result of the SYNTAX trial suggests that when scored for anatomic complexity, patients with multi-vessel coronary disease with a higher score (>27) have a significantly worse outcome with PCI and these patients should consider coronary artery bypass surgery4. Patients suffering from non-ST segment elevation myocardial infarction with a high SYNTAX score undergoing PCI have a worse prognosis5. It is well known that a high EuroSCORE (>6) suggests a higher surgical risk and worse outcome. Added to this, contrast-induced nephropathy increases both 30-day and 1-year mortality6. Advanced age, renal insufficiency and hypertension are important risk factors for serious complications, such as ischemic embolic stroke, during cardiac catheterization and PCI7. We planned an alternative therapeutic modality for this octogenarian male with stage 4 CKD and triple-vessel disease involving LM bifurcation. The goal was to minimize the perioperative complications and exposure to contrast dye. We adopted a hybrid approach in two-stages.

Hybrid coronary revascularization is defined as the planned combination of minimally-invasive left internal mammary artery—left anterior descending artery revascularization with PCI to non-LAD targets. This approach has been proven to be safe and feasible. In a study conducted by Holzhey et al, the hybrid procedure was completed in all patients included, with a 5-year freedom from a major adverse cardiovascular event level of 75.5% and a survival of 84.8%9. Minimally-invasive direct coronary bypass has the advantage of shorter period of ventilator use and a shorter hospital stay9, with lower in-hospital mortality even in intermediate and high risk EuroSCORE patients10. Off-pump CAB surgery may avoid the deleterious effects of cardiopulmonary bypass. There is a trend towards less blood loss, atrial fibrillation, release of myocardial enzyme, perioperative neurocognitive dysfunction, respiratory failure, renal dysfunction and better intra-hospital outcome11,12, but the preventive effect on the postoperative renal dysfunction relating to off-pump CAB surgery on CKD patients is still inconclusive. Demari et al in their retrospective study had observed that for octogenarians undergoing urgent bypass surgery, off-pump CAB surgery offers lower risks of operative mortality and stroke13.

There are three hybrid coronary revascularizations strategies: PCI first then minimal-invasive-direct coronary bypass; minimally-invasive direct coronary bypass first, followed by PCI; and simultaneous PCI and CAB in a hybrid operative suite. The optimal timing for PCI following minimally-invasive-direct coronary bypass is still in debate14. Avoiding PCI within few days after minimally invasive direct coronary bypass seems to be prudent to avoid the inflammatory status that increases concern relating to acute stent thrombosis. In our institution, we do not have a hybrid operating room. This patient’s LM bifurcation lesion meant that the PCI-first strategy carried a high risk. We opted to perform off-pump CAB with minimally invasive direct coronary bypass first. We observed that the renal function remained stable after the bypass surgery. We then carried out the coronary intervention just after the new onset of symptoms, as this patient was not mentally and physically prepared for second procedure within a short period of time.

In conclusion, a hybrid-staged revascularization combining off-pump minimally-invasive direct coronary bypass, followed by PCI, is an option for nonagenarians suffering from CAD with high risk anatomic and clinical features. With careful selection of a patient,

Fig. 2. (A) Post stenting from left main to proximal left circumflex. (B) LIMA to left anterior descending artery middle segment was patent and showed adequate flow.
CAD can be performed with safety, helps to shorten hospital stay, has a tendency for fewer complications, requires less use of contrast dye for PCI thereby helping to reduce incidence of contrast-induced nephropathy, has acceptable short- and long-term outcomes and, finally, relieves ischemia-related symptoms secondary to CAD.

References


