Unprotected Left Main Coronary Artery Stenting under Extracorporeal Membrane Oxygenation Support in a Patient with High-Risk Acute Myocardial Infarction

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Although coronary artery bypass grafting (CABG) is the main choice in patients with unprotected left main (LM) coronary artery stenosis, unprotected LM stenting has been suggested as alternative treatment for patients who refuse the surgery or who are poor surgical candidates. We report an elderly male suffering from acute myocardial infarction. Percutaneous coronary intervention (PCI) was performed in this case and severe LM stenosis was noted. Ventricular fibrillation occurred during angiography and cardiopulmonary resuscitation (CPR) was done. Extracorporeal membrane oxygenation (ECMO) was instituted for unstable hemodynamics and further angioplasty with stenting was performed successfully. However, the patient finally died several days later because of multiple co-morbid diseases. Unprotected LM stenting under ECMO support in high-risk patients is rarely reported, and there is also no literature discussing the comparison of PCI under ECMO support and CABG in high-risk patients; further clinical utility of ECMO for these high-risk patients warrants more investigation.

Key Words: Acute myocardial infarction • Coronary artery bypass grafting • Extracorporeal membrane oxygenation • Percutaneous coronary intervention • Unprotected left main stenting

INTRODUCTION

CABG remains the treatment of choice for unprotected LM coronary artery stenosis under current guidelines.1 But the risk of perioperative morbidity and mortality is still high if patients have multiple co-morbid conditions. In these cases, PCI and further stenting has good short- and long-term results in selective low-risk cases.2 However, mortality is higher in cases under emergency, especially in patients with poor left ventricular function. Some circulatory support techniques have been used to improve the poor prognosis in high-risk PCI patients, such as intra-aortic balloon pump (IABP), ECMO, and ventricular assist device (VAD).3 Case reports mentioning unprotected LM coronary artery stenting under ECMO support during emergent circumstances are rare. Now we report a case of unprotected left main stenting in an elderly male during acute myocardial infarction episode.

CASE REPORT

This 73-year-old man initially presented with chest pain, dyspnea and orthopnea, and was brought to a local
hospital for evaluation. There, vital signs were pulse 81 beats/min and blood pressure 150/83 mmHg. Electrocardiogram showed ST depression over V3-V6, lead I, aVL, and ST elevation in aVR (Figure 1). Laboratory data revealed serial cardiac enzyme change with initial creatinine kinase MB (CK-MB): 22 U/L, troponin I: 20.5 ng/mL. Elevated white blood cell (WBC) count, C-reactive protein (CRP) and impaired renal function were also noted (WBC: 13060/ul, CRP: 130.9 mg/L, blood urea nitrogen: 40.6 mg/dl, creatinine: 3.52 mg/dl). Chest X-ray showed cardiomegaly, pulmonary edema, and superimposed pneumonia. Respiratory failure followed and endotracheal intubation was done. Both aspirin and clopidogrel 300 mg were loaded as antiplatelet therapy under the impression of non-ST elevation myocardial infarction, and heparin was also used for anticoagulation. Shock developed after 2 days' treatment at the local hospital, and high-dose vasopressor was used for blood pressure support. Due to unstable hemodynamic status, the patient was then transferred to our cardiac care unit for intensive care.

In our cardiac care unit, bedside echocardiography revealed impaired left ventricle systolic function (ejection fraction around 40%). Recurrent chest pain and progressive elevation of cardiac enzymes (peak CKMB: 75.3 U/L, troponin I: 73.8 ng/mL) were observed despite being under medical treatment. Because this case was a high-risk patient according to the Thrombolysis in Myocardial Infarction (TIMI) risk score evaluation (TIMI risk score: 4), early invasive strategy was arranged within 2 hours after shock onset. Emergent coronary angiography revealed LMCA disease with around 90% stenosis from the distal LM trunk to the proximal left anterior descending artery (Figure 2a). During angiography, ventricular fibrillation developed and CPR was performed. Initial defibrillation was successful, and sinus rhythm was recovered. IABP was also implanted for hemodynamic support. Nevertheless, unstable hemodynamics with low blood pressure (60/40 mmHg) were still noted even under emergent medication use and IABP. ECMO was instituted via right femoral vein and left femoral artery to replace IABP, and blood pressure improved (up to 95/75 mmHg) later. However, emergent CAGB was not suggested due to multiple co-morbid conditions. So, unprotected LM coronary artery stenting was performed under the ECMO support, and a great result, with TIMI flow 3, was noted during angiography (Figure 2b).

After transfer of the patient back to cardiac care unit, oliguria and marked metabolic acidosis developed and continuous venovenous hemodialysis (CVVHD) was started. In addition, antibiotics were adjusted for sepsis progression according to the gradual elevation of CRP level (130.9 → 227.1 mg/L). The origin of sepsis was most likely due to previous pneumonia. Left lower leg cyanosis was also noted eventually. Because of ongoing profound shock, multiple co-morbid disease and possible complication of ECMO (suspected femoral artery occlusion), the patient finally died three days later even under the support of ventilator, ECMO, and CVVHD.

![Figure 1. Electrocardiogram showed ST depression over V3-V6, lead I, aVL, and ST elevation in aVR.](image-url)
DISCUSSION

Medical therapy of patients with LM coronary artery disease is associated with a poor prognosis, and CABG remains the procedure of choice for the treatment of patients with unprotected LM disease and improves survival.\(^1\) Early experience with PCI for unprotected LM disease was frustrating due to poor long-term results despite high procedural success rates.\(^4\) But recent experience in the treatment of unprotected LM disease in low-risk patients had satisfactory short-term and long-term results.\(^2\) Although in-stent restenosis still remains an issue to be resolved, advances in recent procedural devices, such as drug eluting stents (DES), have recently shown promising results in LM disease.\(^5,6\)

How to more safely manage unprotected LM disease in high-risk patients during coronary intervention is now under evaluation. Nevertheless, PCI and stenting of LM lesions is still technically feasible in these patients and has gradually become an alternative treatment for patients who refuse surgery, or have high surgical risk due to multiple co-morbid conditions.

LM lesion is considered one of the most challenging lesions in patients with acute myocardial infarction. Mortality is very high, especially in cases with cardiogenic shock. The key to survival in these cases, according to the literature, includes factors such as shorter onset-to-treatment time, dominant right coronary artery, presence of intercoronary collaterals, renal failure, age, and so on. Mechanical support for cardiogenic shock is also important in these cases. There are several devices and techniques, such as IABP, ECMO, and VAD, which have been mentioned in the literature for hemodynamic support during high-risk PCI.\(^3\) IABP is the most commonly used method. ECMO is also a feasible alternative to IABP and has been utilized to lower complications in high-risk patients during PCI.\(^7,8\) It can be safely used for weeks in the intensive care unit, and has become an ideal support system in patients who need longer recovery time under unstable hemodynamics.

Some studies have reported ECMO use in high-risk PCI patients with reduced left ventricular ejection fraction.\(^7\) However, prophylactic ECMO has been associated with an access complication rate of up to approximately 13%.\(^8\) This included hematoma, infection, femoral artery occlusion, deep vein thrombosis, arteriovenous fistula, etc. So, prophylactic ECMO is not warranted in low-risk patients with normal left ventricular function due to the high rate of complications and the lack of proven benefit. There are some strategies which could improve the complication rate of ECMO. For example, using the technique of distal limb perfusion has been found to be safe and effective in preventing lower leg ischemia for patients with prolonged femoral cannulation.

ECMO was also once successfully used in PCI and invasive electrophysiologic procedures which were complicated with ventricular fibrillation but unresponsive to electrical defibrillation.\(^9\) However, it is less used as a support strategy for unprotected LM disease. Nicolas et al. reported a case of unprotected LM stenting in an elderly female with left ventricular dysfunction and a totally occluded right coronary artery using ECMO support under a prophylactic situation.\(^10\) There were no procedural complications and no cardiovascular events at 6-month follow-up.

In our case, early invasive strategy using coronary angiography was arranged according to ACC/AHA 2007 guideline for unstable angina (UA)/non-ST elevation myocardial infarction (NSTEMI). The guidelines state that an early invasive strategy (diagnostic angiography with intent to perform revascularization) in UA/NSTEMI patients who have refractory angina or hemodynamic or electrical instability is a class I indication.

In addition, use of PCI is also reasonable in patients with UA/NSTEMI with significant left main coronary artery disease who are candidates for revascularization but are not eligible for CABG or who require emergency intervention at angiography for hemodynamic instability, which is a class IIa indication and is comparable with

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**Figure 2.** (A) Angiography revealed LMCA disease with around 90% stenosis from distal LM trunk to proximal LAD. (B) LMCA was successfully stented under mechanical support.
the situation in our case. Intravenous glycoprotein (GP) IIb/IIIa inhibitor was not used in our case because of the risk of bleeding complications in a fully anticoagulated patient under ECMO support, multiple comorbid disease, and old age. According to REPLACE-2 trial, in patients undergoing elective or urgent PCI, major hemorrhage was an independent predictor of 1-year mortality, and independent baseline predictors of major hemorrhage included advanced age, female gender, impaired creatinine clearance, and anemia. Despite unprotected LM stenting under ECMO support being successful under the emergent situation, and with no obvious residual stenosis being found after the LM stenting, this patient still died three days later after the procedure due to multiple co-morbid conditions.

For unprotected LM coronary artery disease, ECMO may provide effective hemodynamic support in high-risk patients and make the procedure of unprotected LM stenting become technically feasible. However, prognosis and outcome is still not clarified in these high-risk patients under emergent situations because of the scarcity of case reports. In addition, there is no literature discussing the comparison of PCI under mechanical support and CABG in high-risk patients under emergency conditions; further clinical utility of ECMO for unprotected LM stenting in high-risk patients warrants more investigation.

REFERENCES