

Culprit-Only Versus Complete Revascularization in STEMI Multi-Vessel Disease: A Case Report

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Abstract

Objective: To revisit data and highlight management of STEMI multi-vessel disease and explore culprit-only versus multi-vessel PCI and optimal timing to achieve complete revascularization.

Methods: A 67 years old male with chest pain at rest 2 hours before admission with a history of smoking one pack of cigarette everyday, was presented to the hospital. Physical examination was within normal limit with normal hemodynamically; however, elevated cardiac troponin was identified. Electrocardiogram showed STEMI antero-septal wall with ischemic inferior wall, leading to STEMI antero-septal wall, Killip I diagnosis. Primary PCI was performed and multi-vessel disease was found. A complete revascularization single-staged procedure was performed due to his persistent chest pain. PCI of these coronary stenoses is beneficial to reduce risk of cardiac death and recurrent infarction. However, some issues related to PCI of non-culprit coronary arteries lesion and optimal timing to do complete revascularization is still a dilemma.

Results: Related to data from some trials, e.g PRAMI, CvLPRIT, DANAM-3-PRIMULTI, COMPARE-ACUTE, COMPLETE, and some meta-analyses, showed benefit and safety of routine PCI of non-culprit lesions as a preventive strategy to reduce morbidity and mortality. Data showed reduce future morbidity and mortality in this setting. Meanwhile, the optimal timing of complete revascularization is still a matter of debate, although some data showed benefit of index procedural PCI.

Conclusion: PCI of non-culprit lesions of myocardial infarction is consistently beneficial over culprit-only revascularization in patients with STEMI multi-vessel disease, despite the debate on the optimum timing for complete revascularization in this setting.

Keywords: Complete revascularization, multivessel disease, percutaneous coronary intervention, STEMI

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Introduction

ST-segment elevation myocardial infarction is a myocardial cell death due to prolonged ischemia.¹ Incidence of STEMI was 58 per 100.000 populations annually.² In patients with STEMI, sometimes atherosclerosis is not limited to single lesion, but involves multi-

vessel. Approximately 40% - 65% patients who admit to hospital with STEMI have multi-vessel disease. Multi-vessel disease is a combination of culprit lesion and one or more significant stenosis ($\geq 50\%$ stenosis) non-culprit lesions on invasive coronary angiography.³ Percutaneous Coronary Intervention (PCI) has contributed in improving prognosis patients with STEMI. Therapy strategy of patients with STEMI multi-vessel disease caused dilemma as there are vary strategies.³ Culprit-only PCI strategy has low contrast volume and complications, but associated with increased risk of repeated revascularization. Complete revascularization strategy has improved prognosis and

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decreased risk of revascularization procedure and future morbidity.³ Meanwhile, safety concerns including prolong procedure which results in contrast overload and radiation needed to be noticed.³ This case report and literature study will be interesting and informative to discuss a management perspective, especially in management of STEMI multi-vessel disease in decision of culprit-only or complete revascularization and also timing in this particular patients.

Case

A 67 years old male was admitted to hospital with chest pain at rest 2 hours before admission. Patient had history of smoking one pack of cigarette per day. There was no history of dyspnoea, palpitation, syncope or near syncope. Hemodynamic was within normal limit and with normal physical findings.

Laboratory results showed elevated cardiac troponin, others were within normal limits. Electrocardiogram showed STEMI anteroseptal wall with ischemic inferior wall (Fig. 1). Trans-thoracic echocardiography showed normal all chambers, reduced left ventricle systolic function (LVEF 44% Biplane), with severe hypokinetic anteroseptal wall to apical, hypokinetic anterior, and anteroseptal mid to apical. All these findings led to diagnosis of STEMI anteroseptal wall, Killip I.

OCT guided primary PCI was performed through access right radial artery with Diagnosed Catheter JR 3.5 6 Fr and Guide Catheter BL 3.5 6 Fr with contrast iohexol.

Coronary angiography showed normal Left Main (LM) coronary artery; acute total occlusion with haziness at proximal portion of Left Anterior Descending (LAD) coronary artery; diffuse stenosis at mid distal and critical stenosis at distal of Left Circumflex (LCx) coronary artery; and normal Right Coronary Artery (RCA). Intervention was performed to LAD lesion using Wire Runthrough Intermediate (Terumo, Japan) conveyed to distal LAD and Wire Runthrough Floppy (Terumo, Japan) was placed on Diagonal 1 branch. Thrombosuction was done at LAD and showed TIMI flow 2. Predilation from mid to ostial LAD was performed using Sprinter Legend balloon 2.5 x 20 mm (Medtronic, Mexico) inflated to 8 atm and Sprinter Legend modified jailed balloon 2.5 x 15 mm (Medtronic, Mexico) inflated to 10 atm on ostial Diagonal 1. Provisional stenting was performed using DES Xience Prime 3.0 x 38 mm (Abbott, USA) placed on mid to ostial LAD. OCT post stenting showed distal reference diameter 3.0 mm and under expansion with white thrombus (Fig. 2). Proximal Optimization Technique (POT) was carried out proximally with a Sprinter Legend balloon 3.5 x 15 mm (Medtronic, Mexico) inflated to 10 atm. OCT post dilation showed good apposition and expansion with tissue protrusion at mid stent, MSA 6.4 mm² without stent edge dissection.

During procedure patient experienced chest pain with normal hemodynamic and operator decided to perform another intervention at LCx non-culprit lesion using Wire Runthrough Floppy (Terumo, Japan) placed at distal Obtuse Marginal and Wire Pilot 50 (Abbott, USA) at

Table 1 Randomized Controlled Trials Comparing Revascularization Strategies in Patients with Multivessel STEMI.⁸⁻¹¹

Study	Sample	Strategy	Non-Culprit Lesions	Main Endpoints
PRAMI	465	Culprit-only VS complete revascularization PCI	% diameter stenosis $\geq 50\%$	22.9% vs 9.0% (p<0.001) at 23 months
CvLPRIT	296	Culprit-only vs complete revascularization index or staged PCI	% diameter stenosis > 70% in 1 view or > 50% in 2 views	21.2% vs 10.0% (p=0.0009) at 12 months
DANAMI-3-PRIMULTI	627	Culprit-only vs complete revascularization with staged PCI	% diameter stenosis > 50% with FFR ≤ 0.80	22.0% vs 13.0% (p=0.004) at 27 months
COMPARE-ACUTE	885	Culprit-only vs complete revascularization index or staged PCI	% diameter stenosis $\geq 50\%$ with FFR ≤ 0.80	20.5% vs 7.8% (p<0.001) at 1 year

FFR=Fractional Flow Reserve

Table 2 Risks and Benefits of Single-Staged Procedure vs Multi-Staged Procedure¹⁸

	Single-staged Procedure	Multi-staged Procedure
Favorable	Preventing of recurrent ischemia / infarction	Better assessment of non-culprit lesion and the risks
	Decreasing length of hospital stay	Using non-invasive testing to non-culprit lesion
Non Favorable	Longer procedure and higher contrast volume and radiation	Additional cost to hospital stays and procedure
	Poor assessment of benefit in non-culprit lesion	Late staged PCI may not be beneficial

Table 3 Factors Affecting Timing of Non-Culprit PCI²⁰

Factors favoring index procedure	Factors favoring staged procedure
Ongoing chest pain	Stable symptoms
Infarct artery required short time and contrast	Chronic kidney disease
Unstable non-culprit lesion with large area of myocardium at risk	Prolonged and complex procedure to open non-culprit lesion
Simple PCI of non-culprit lesion	Complex lesion in non-culprit lesion
Patient preference	Patient preference

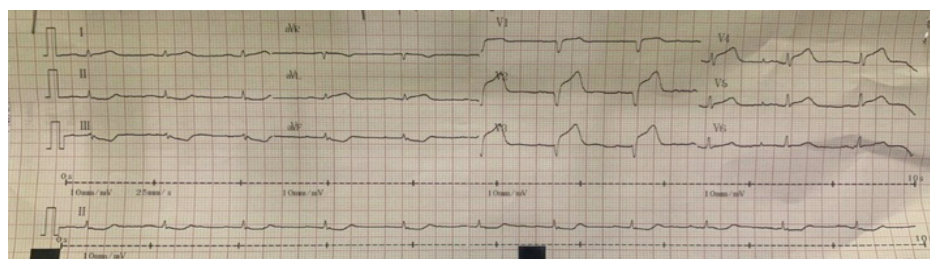
distal LCx. Predilation was carried out using Ryujin Plus balloon 1.5 x 15 mm (Terumo, Japan), Sprinter Legend balloon 2.0 x 12 mm (Medtronic, Mexico), and Sprinter Legend balloon 2.5 x 20 mm (Medtronic, Mexico) at distal to proximal LCx. Stenting was performed at proximal to distal LCx using Xience Prime 2.5 x 38 mm (Abbott, USA). Contrast injection showed TIMI flow 2 with thrombus (Fig. 3). After PCI, patient did not experience any chest pain and treated with Eptifibatide for 24 hours after procedure. Operator decided to evaluate angiography on the 5th day.

Coronary angiography evaluation showed normal LM; LAD showed stent patent in situ with 50% stenosis at distal LAD; LCx showed stent patent in situ; Normal RCA. There was no thrombus, dissection, or residual stenosis, with TIMI flow 3. Patient was discharged on the 9th day without any episode of chest pain

or complication. Informed consent was signed by patient himself allowing data publication.

Discussion

Current guidelines STEMI recommends PCI as a preference treatment strategy.⁴ PCI was beneficial to reduce the risk of future morbidity and mortality.⁵ Despite this benefits, there are some dilemmatic and controversial issues related to its benefit for non-culprit lesion and optimal timing.⁶ Recent myocardial revascularization guideline recommends to achieve complete revascularization in cases with cardiogenic shock with presence of multiple critical stenosis, highly unstable lesions which angiographic signs of thrombi or rupture of the lesion, or evidence of persistent ischemia despite angioplasty of the affected

**Fig. 1 Electrocardiogram Showed STEMI Anteroseptal Wall, Ischemic Inferior Wall**

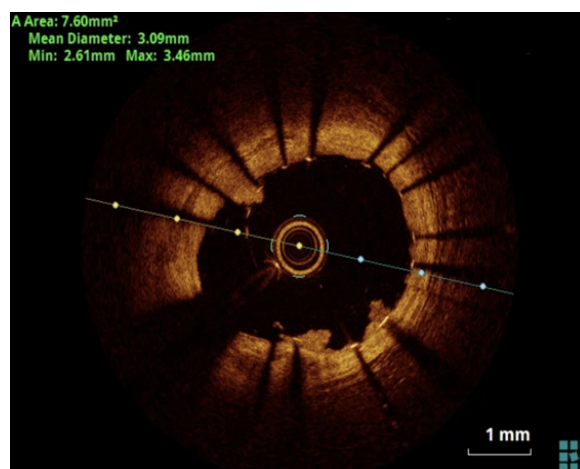


Fig. 2 OCT Post Stenting Showed Distal Reference Diameter 3.0 mm and Under Expansion with White Thrombus

artery.⁷

Trials and meta-analyses demonstrated conflicting results about beneficial of PCI in non-culprit lesion. Four multicenter randomized controlled clinical trials studied strategies in management of STEMI multi-vessel disease, such as PRAMI, CvLPRIT, DANAMI-3-PRIMULTI, and COMPARE-ACUTE. These RCTs showed a significant reduction in cardiovascular death, recurrent MI, and repeat revascularization associated with complete revascularization strategy (Table 1).^{8,9,10,11}

Despite these supportive results, there were some limitations of these RCTs as patients had low-risk features in inclusion criteria and sample sizes. Therefore, statistical

power to detect differences events of death or myocardial infarction was low. COMPLETE trial was conducted to resolve previous trials limitation, with total of 3,900 patients treated with DES and optimal medical therapy. Result showed primary outcome of cardiovascular death and myocardial infarction at 3 years was lower in complete revascularization group compared to culprit-only group. Complete revascularization was associated with decreased need of repeated revascularization and in mortality and subsequent myocardial infarction in STEMI multi-vessel disease.^{12,13} Meta-analysis between 2002 to 2019 was performed with 10 RCTs and 7030 patients. This meta-analysis showed benefit of routine

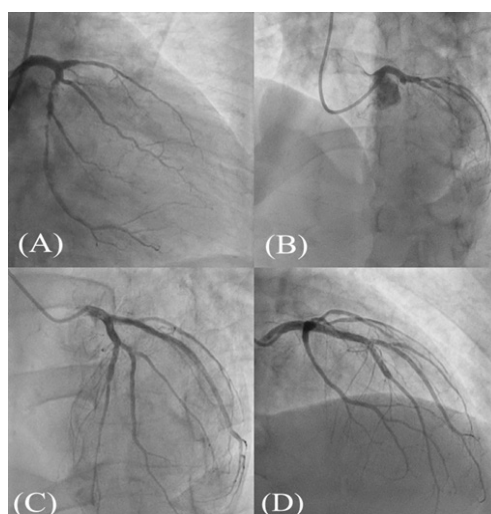


Fig. 3 Coronary Angiography Before and After Stent Deployment, (A) LCx before stenting, (B) LAD before stenting, (C) LCx after stenting, (D) LAD after stenting

non culprit-lesion PCI as a preventive strategy that reduce subsequent myocardial infarction and improve survival.¹⁴ In order to conclude results of these trials and meta-analyses, ESC guidelines supports complete revascularization strategy as Class IIa recommendation, and ACC/AHA guidelines as Class IIb recommendation.^{15,16} These guidelines allow staged revascularization of non-culprit lesions. In our patient, operator found STEMI multi-vessel disease and decided to do complete revascularization.

Dilemmatic strategy in patients with STEMI multi-vessel disease was slightly resolved using previous data which showed complete revascularization was more superior than culprit-only revascularization in reducing future morbidity and mortality. Meanwhile, optimal timing of this strategy remains debatable. Potential options included performing complete revascularization index procedural/single-staged or elective procedural/multi-staged during in hospital stay or after discharge. Large meta-analysis by Zhenwei Li *et al.* showed multi-staged revascularization had lower incidence of MACE, all-cause death and/or myocardial infarction. It also stated that single-staged procedure complete revascularization was associated with greater mortality risk.¹⁷ CvLPRIT trial showed in hospital stay complete revascularization of non-culprit lesion, resulted in improvement of clinical outcomes compared to culprit-only lesion. Potential risks and benefits of the two strategies are summarized in Table 2.¹⁸ Network meta-analysis by Pieter *et al.*¹⁹ using 4 prospective and 14 retrospective studies between 1985 to 2010 and 40,280 patients successfully identified patients who underwent multi-staged PCI had lower rates of all-cause mortality, TIMI major bleeding, and also less

MACE. Overall, mentioned meta-analyses and studies suggested multi-staged procedure as better option compared to single-staged procedure.

Another meta-analysis including 11 RCTs stated that single-stage complete revascularization was safe. This strategy had significantly greater LVEF compared to multi-stage complete revascularization and reduced hospitalization days and medical costs. Despite its benefits, single-stage procedure associated with longer time and larger contrast volumes and radiation, and increased rates of contrast-induced nephropathy (CIN) and procedural complication. There are some factors affecting operator in choosing whether complete revascularization index procedural or staging (Table 3).²⁰ In our patient, operator decided to do single-staged procedure due to patient's complained ongoing chest pain.

Our case was comprehensively managed by using intracoronary imaging to help operator identify culprit and non-culprit lesion better.

This study is lacking ability to identify non-culprit lesion using non-invasive stress imaging, particularly in STEMI multi-vessel disease. FFR is necessary to identify which lesion is responsible for patient's symptoms, meanwhile in this patient PCI was not guided by FFR.

Complete revascularization in STEMI multi-vessel disease should be considered when feasible and applicable. The decision of strategy using strategy index procedural or elective procedural is based on individually factors condition. Best timing of non-culprit complete revascularization in this setting still remains dilemmatic and debatable, therefore further research is needed. It could understand better that complete revascularization is the best management in patient with STEMI multi-vessel disease.

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