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

Mega Amanda Putri, Achmad Fauzi Yahya, Triwedya Indra Dewi

Department of Cardiology and Vascular Medicine, Faculty of Medicine Universitas Padjajaran-Dr. Hasan Sadikin General Hospital Bandung, Indonesia

pISSN: 2302-1381;
eISSN: 2338-4506;
http://doi.org/10.15850/ijihs.v9n2.2249
IJIHS. 2021;9(2):89–94

Received:
December 25, 2020

Accepted:
September 27, 2021

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 anteroseptal wall with ischemic inferior wall, leading toSTEMI anteroseptal 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

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 (≥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

Correspondence:
Triwedya Indra Dewi,
Department of Cardiology and Vascular Medicine,
Faculty of Medicine Universitas Padjajaran/Dr. Hasan Sadikin General Hospital Bandung, Indonesia
e-mail: adeindradewi@gmail.com

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-thoracal 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 Cathtere 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 Runthough Floppy (Terumo, Japan) was placed on Diagonal 1 branch. Thrombosuction was done at LAD and showed TIMI flow 2. Predilation from mid to osteal 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 osteal Diagonal 1. Provisional stenting was performed using DES Xience Prime 3.0 x 38 mm (Abbott, USA) placed on mid to osteal LAD. OCT post stenting showed distal reference diameter 3.0 mm and under expansion with white thrombus (Fig. 2). Proximal Optimalization 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	Mace Endpoints
PRAMI	465	Culprit-only VS complete revascularization PCI	% diameter stenosis ≥ 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 ≥ 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 Procedure[18]

	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-invasing 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 PCI[20]

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 Eptifitabatide 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

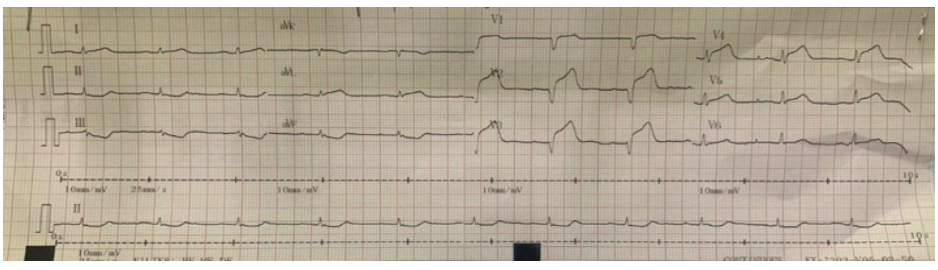

Fig. 1 Electrocardiogram Showed STEMI Anteroseptal Wall, Ischemic Inferior Wall

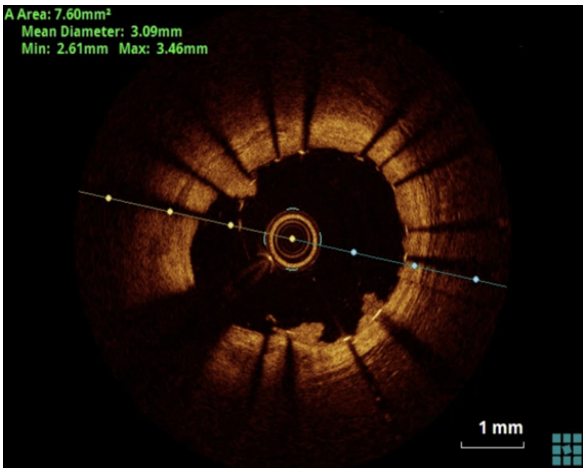

Fig. 2 OCT Post Stenting Showed Distal Reference Diameter 3.0 mm and Under Expansion with White Thrombus

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

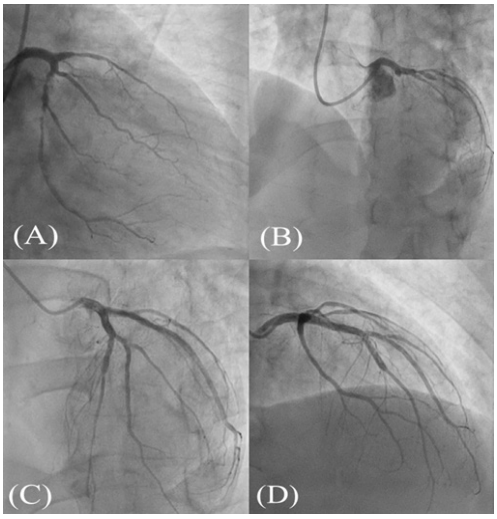

Fig. 3 Coronary Angiography Before and After Stent Deployment, (A) LCx before steting, (B) LAD before stenting, (C) LCx after stenting, (D) LAD after stenting

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.

References

1. Thygesen K, Alpert J, Jaffe A, Chaitman B, Bax J, Morrow D, *et al*. Fourth universal definition of myocardial infarction. Circulation. 2018;138(20):237–69.
2. Widimsky P, Wijns W, Fajadet J, de Belder M, Knot J, Aaberge L, *et al*. European Association for Percutaneous Cardiovascular Interventions. Reperfusion therapy for ST elevation acute myocardial infarction in Europe: description of the current situation in 30 countries. Eur Heart J. 2010;31(8):943–57.
3. Paradies V, Smits PC. Culprit-Only artery versus multivessel disease. In: Watson TJ, Ong PJL, Tcheng JE, eds. Primary angioplasty: a practical guide. Singapore: Springer; 2018. p. 167–78.
4. Switaj TL, Christensen SR, Brewer DM. Acute coronary syndrome: current treatment. Am Fam Physician. 2017;95(4):232–40.
5. O'Gara P, Kushner F, Ascheim D, Casey D, Chung M, de Lemos J, *et al*. 2013 ACCF/AHA Guideline for the management of ST-elevation myocardial infarction. Circulation. 2013;127(4):362–425.

6. Steg PG, James SK, Atar D, Badano LP, Lundqvist CB, Borger MA, *et al*. ESC Guidelines for the management of acute myocardial infarction in patients presenting with ST-segment elevation: The Task Force on the management of ST-segment elevation acute myocardial infarction of the European Society of Cardiology (ESC). Eur Heart J. 2012;33(20):2569–619.
7. Neumann FJ, Sousa-Uva M, Ahlsson A, Alfonso F, Banning AP, Benedetto U, *et al*. 2018 ESC/EACTS Guidelines on myocardial revascularization. Eur Heart J. 2019;40(2):87–165.
8. Wald DS, Morris JK, Wald NJ, Chase AJ, Edwards RJ, Hughes LO, *et al*. Randomized trial of preventive angioplasty in myocardial infarction. N Engl J Med. 2013;369(12):1115–23.
9. Gershlick AH, Khan JN, Kelly DJ, Greenwood JP, Sasikaran T, Curzen N, *et al*. Randomized trial of complete versus lesion-only revascularization in patients undergoing primary percutaneous coronary intervention for STEMI and multivessel disease: the CvLPRIT trial. J Am Coll Cardiol. 2015;65(10):963–72.
10. Engstrøm T, Kelbæk H, Helqvist S, Høfsten DE, Kløvgaard L, Holmvang L, *et al*. Complete revascularisation versus treatment of the culprit lesion only in patients with ST-segment elevation myocardial infarction and multivessel disease (DANAMI-3—PRIMULTI): an open-label, randomised controlled trial. Lancet. 2015;386(9994):665–71.
11. Smits PC, Abdel-Wahab M, Neumann F-J, Boxma-de Klerk BM, Lunde K, Schotborgh CE, *et al*. Fractional flow reserve–guided multivessel angioplasty in myocardial infarction. New England Journal of Medicine. 2017;376(13):1234–44.
12. Bainey K, Mehta S, Lai T, Welsh R. Complete vs culprit-only revascularization for patients with multivessel disease undergoing primary percutaneous coronary intervention for ST-segment elevation myocardial infarction: A systematic review and meta-analysis. Am Heart J. 2014;167(1):1–14.
13. Pavasini R, Biscaglia S, Barbato E, Tebaldi M, Dudek D, Escaned J, *et al*. Complete revascularization reduces cardiovascular death in patients with ST-segment elevation myocardial infarction and multivessel disease: systematic review and meta-analysis of randomized clinical trials. Eur Heart J. 2019;41(42):4103–10.
14. Pinilla-Echeverri N, Mehta S, Wang J, Lavi S, Schampaert E, Cantor W, *et al*. Nonculprit lesion plaque morphology in patients with ST-Segment–elevation myocardial infarction. Circ Cardiovasc Interv. 2020;13(7):e008768.
15. Ibanez B, James S, Agewall S, Antunes MJ, Bucciarelli-Ducci C, Bueno H, *et al*. 2017 ESC Guidelines for the management of acute myocardial infarction in patients presenting with ST-segment elevation: The Task Force for the management of acute myocardial infarction in patients presenting with ST-segment elevation of the European Society of Cardiology (ESC). Eur Heart J. 2018;39(2):119–77.
16. Levine GN, Bates ER, Blankenship JC, Bailey SR, Bittl JA, Cercek B, *et al*. 2015 ACC/AHA/SCAI Focused Update on Primary Percutaneous Coronary Intervention for Patients With ST-Elevation Myocardial Infarction: An Update of the 2011 ACCF/AHA/SCAI Guideline for Percutaneous Coronary Intervention and the 2013 ACCF/AHA Guideline for the Management of ST-Elevation Myocardial Infarction. J Am Coll Cardiol. 2016;67(10):1235–50.
17. Li Z, Zhou Y, Xu Q, Chen X. Staged versus one-time complete revascularization with percutaneous coronary intervention in stemi patients with multivessel disease: a systematic review and meta-analysis. PLoS One. 2017;12(1):e0169406.
18. Khan JN, Nazir SA, Greenwood JP, Dalby M, Curzen N, Hetherington S, *et al*. Infarct size following complete revascularization in patients presenting with STEMI: a comparison of immediate and staged in-hospital non-infarct related artery PCI subgroups in the CvLPRIT study. J Cardiovasc Magn Reson. 2016;18(1):85.
19. Vlaar PJ, Mahmoud KD, Holmes DR, Jr., van Valkenhoef G, Hillege HL, van der Horst IC, *et al*. Culprit vessel only versus multivessel and staged percutaneous coronary intervention for multivessel disease in patients presenting with ST-segment elevation myocardial infarction: a pairwise and network meta-analysis. J Am Coll Cardiol. 2011;58(7):692–703.
20. Gaffar R, Habib B, Filion KB, Reynier P, Eisenberg MJ. Optimal timing of complete revascularization in acute coronary syndrome: a systematic review and meta-analysis. J Am Heart Assoc. 2017;6(4):e005381.