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REVIEW

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Complete Revascularization of the Patient with ST-Segment–Elevation Myocardial Infarction

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Abstract

Background: *The 2017 European Society of Cardiology (ESC) guideline update on treatment of patients with ST-Segment Elevation Myocardial Infarction (STEMI) suggested that Routine revascularization of non- culprit lesions should be considered in STEMI patients with multivessel disease before hospital discharge (Class IIa). A Non-culprit PCI during the index procedure should be considered in patients with cardiogenic shock (class IIa). Recent randomized controlled trials, however, suggest strong evidence supporting complete revascularization before or after discharge in stable patients and only culprit lesion revascularization in cardiogenic shock.*

Methods: *A systematic search was conducted in PUBMED, MEDLINE and EMBASE for randomized controlled trials and contains patients number > 200 comparing complete versus culprit lesion only revascularization in patients with STEMI. A meta-analysis was performed using the data extracted from each study. Summary Risk Ratios (RR) and 95% Confidence Intervals (CI) were calculated for (MACE, total mortality, nonfatal myocardial infarction and revascularization).*

Results: *Five trials fulfilled the inclusion criteria yielding 6314 patients. The incidence of Major Adverse Cardiac Events (MACE) was significantly lower in the complete revascularization group compared to the culprit lesion only revascularization (9.2 % vs. 18.5 %, RR = 0.54; 95% CI: 0.47-0.61, P < 0.0001). It was attributed to significantly lower repeat revascularization rate in the complete revascularization group (2.9% vs. 11 %, RR =0.27; 95% CI: 0.22- 0.35, P < 0.0001). This meta-analysis also showed a significant reduction in non-fatal myocardial infarction (2.9% vs. 6.8%, RR = 0.68; 95% CI: 0.56-0.84; P = 0.0003. No significant of Total mortality (4.3% vs. 4.5%, RR = 0.95; 95% CI: 0.76-1.2; P = 0.68) in the complete revascularization group, compared to the culprit lesion revascularization group.*

Conclusions: In patients who present with STEMI, complete revascularization is associated with lower rates of MACE, ischemia driven revascularization and nonfatal myocardial infarction as compared to revascularization of the culprit lesion alone. There were no significant differences in the all-cause mortality between the two groups.

Keywords: *Complete revascularization, Culprit lesion, ST-Segment Elevation Myocardial Infarction (STEMI)*

Introduction

About 40-65% of patients presenting with ST-segment elevation myocardial infarction (STEMI) undergoing primary Percutaneous Coronary Intervention (PCI) have Multivessel Disease (MVD) [1,2]. The2015 focused update of the American College of Cardiology Foundation/American Heart Association (ACCF/AHA) guidelines for patients with STEMI recommend PCI of the non-culprit artery at the time of primary PCI as a class IIb (weak) recommendation if the patient is hemodynamically stable [3] and 2017 European Society of Cardiology (ESC) Guidelines for the management of acute myocardial infarction in patients presenting with ST-Segment Elevation Myocardial Infarction (STEMI) suggested that Routine revascularization of non- culpritlesions should be considered in STEMI patients with multivessel disease before hospital discharge (Class IIa). A Non-culprit PCI during the index procedure should be considered in patients with cardiogenic shock (class IIa) [4].

The search was conducted in PUBMED, EMBASE and MEDLINE databases. The search terms used were “complete revascularization”, “multi-vessel revascularization”, “culpritonly revascularization”, “target vessel revascularization”, “preventive angioplasty”, “non-culprit lesion”, “ST-segment elevation myocardial infarction” and “randomized controlled trial”. Only human studies and study patient number > 200 patients were included. the optimum strategy for treating non-culprit vessels continues to be debated. Resulting in divergent clinical practice. Patients may have:

(1) index procedure: complete revascularization during the primary PCI.

(2) index hospitalization: complete revascularization as a staged procedure during the hospitalization before discharge.

(3) staged procedure:complete revascularization as a staged procedure after discharge.

(4) Culprit vessel-only primary PCI and Non-culprit vessel PCI for spontaneous ischemia or intermediate/high risk findings on noninvasive testing

These findings led researchers to investigate whether revascularization of the non- culprit lesion in patients with STEMI improves overall prognosis in these patients.

Observational trials

The earliest Observational Studies Comparing Culprit vessel only with Multivessel Primary PCI : These observational studies suggested that multi-vessel revascularization may be harmful. In a pooled analysis of these studies, culprit vessel only revascularization was associated with a non-significant reduction in long-term mortality (Odds Ratio (OR) = 0.83, 95% CI: 0.62-1.09) [5].

Another large observational study represents the largest reported analysis comparing 3 common revascularization strategies (Multivessel primary intervention MVI, Culprit vessel only CLO, and Culprit vessel intervention with staged PCI CVS-S). found that CVI-S was associated with lower mortality when compared with either MVI or CLO, and with lower repeat revascularization rates when compared with CLO [6].

Moderate size randomized trials for culprit-only revascularization versus complete revascularization during the index procedure

The findings of these observational studies have been largely refuted by moderate sized randomized trials. The first of these trials was the Preventive Angioplasty in Acute Myocardial Infarction (PRAMI) Trial in the United Kingdom [7]. In the Preventive Angioplasty in Acute Myocardial Infarction (PRAMI) trial, a total of 465 patients were randomly assigned to culprit-only revascularization (n = 231) and complete revascularization during the index procedure (n = 234). The study defined the presence of multivessel Coronary artery diseases as a non-infarcted-related artery lesion of ≥ 50% by angiography. After a mean follow-up of 23 months, this study reported a 65% reduction in the primary endpoint (cardiovascular death, new Myocardial Infarction (MI) and refractory angina defined as angina despite medical therapy supported by evidence of objective ischaemia) in complete revascularization group compared to the culprit-only revascularization group. The complete revascularization was mainly driven a significant reduction in refractory angina and non-fatal MI; however, no significant reduction in mortality was shown.

Another moderate size trial. The Complete versus Lesion-only Primary PCI (CvLPRIT) trial randomized 296 STEMI patients presenting with MV CAD to culprit-only strategy (n = 146) or complete revascularization (n = 150). This study reported a 55% reduction of the primary composite endpoint of all-cause mortality, recurrent MI, heart failure and ischaemia-driven revascularization by PCI or CABG within 12 months in the complete revascularization group as compared to the culprit-only group. Complete revascularization was performed either at the time of index procedure (64%) or before hospital discharge (36%).

In both the PRAMI and CvLPRIT trials, the severity of the non-culprit lesion was assessed angiographically and both studies did not incorporate physiological assessment of lesion severity using Fractional Flow Reserve (FFR). CvLPRIT has demonstrated that in a population of patients with STEMI treated by contemporary

Primary PCI, in-hospital complete revascularization of angiographically significant non-culprit lesions results in improved clinical outcomes compared with treatment of the culprit lesion only. There was no significant reduction in death or MI [8].

Randomized trial for culprit lesion-only treatment versus fractional flow reserved (FFR)-guided complete revascularization

In the Third Danish Study of Optimal Acute Treatment of Patients with STEMI: Primary PCI in Multivessel Disease (DANAMI-3 PRIMULTI), 627 patients were randomized to receive culprit lesion-only treatment (n = 314) versus fractional flow reserved (FFR)-guided complete revascularization (n = 312). Patients with an angiographic diameter stenosis > 50% in one or more non-culprit lesion were enrolled and randomized after successful PCI of the culprit lesion. The FFR-guided staged revascularization was performed 2 days after the index procedure and during the index hospitalization. The investigators demonstrated a significant 44% reduction in the composite primary endpoint of death, MI or ischaemia-driven revascularization within 12 months in the FFR-guided complete revascularization group, which was largely driven by a 69% reduction of ischaemia-driven revascularization of the non-culprit lesions. There were no significant differences in the all-cause mortality or non-fatal MI rates between the two groups [9].

Another trial, The Comparison Between FFR-Guided Revascularization Versus Conventional Strategy in Acute STEMI Patients with MVD (COMPARE-ACUTE) trial assigned 885 patients with STEMI and multivessel disease who had undergone primary PCI of an infarct-related coronary artery in a 1:2 ratio to undergo complete revascularization of non–infarct-related coronary arteries guided by Fractional Flow Reserve (FFR) (295 patients) or to undergo no revascularization of non–infarct-related coronary arteries (590 patients). The FFR procedure was performed in both groups, but in the latter group, both the patients and their cardiologist were unaware of the findings on FFR. The primary end point was a composite of death from any cause, nonfatal myocardial infarction, revascularization, and cerebrovascular events at 12 months. The primary outcome occurred in 23 patients in the complete-revascularization group and in 121 patients in the infarct-artery-only group that did not receive complete revascularization, a finding that translates to 8 and 21 events per 100 patients, respectively (hazard ratio, 0.35; 95% Confidence Interval [CI], 0.22 to 0.55; P < 0.001). This finding was mainly supported by a reduction in subsequent revascularizations [10].

Randomized trial for fractional flow reserved (FFR) guided complete revascularization versus culprit lesion revascularization only was largely driven by a reduction of ischaemia-driven revascularization of the non-culprit lesions. There were no significant differences in the all-cause mortality or non-fatal MI rates between the two groups.

Large Multicenter Randomized COMPLETE trial for culprit-only revascularization versus complete revascularization

Complete Revascularization with Multivessel PCI for Myocardial Infarction (COMPLETE Trial) randomly assigned 4041 patients with STEMI and multivessel coronary artery disease who had undergone successful culprit-lesion PCI to a strategy of either complete revascularization with PCI of angiographically significant nonculprit lesions or no further revascularization.

Randomization was stratified according to the intended timing of nonculprit- lesion PCI (either during or after the index hospitalization). The first coprimary outcome was the composite of cardiovascular death or myocardial infarction; the second coprimary outcome was the composite of cardiovascular death, myocardial infarction, or ischemia-driven revascularization. At a median follow-up of 3 years, the first coprimary outcome had occurred in 158 of the 2016 patients (7.8%) in the complete-revascularization group as compared with 213 of the 2025 patients (10.5%) in the culprit-lesion-only PCI group (hazard ratio, 0.74; 95% Confidence Interval [CI], 0.60 to 0.91; P = 0.004). The second coprimary outcome had occurred in 179 patients (8.9%) in the complete-revascularization group as compared with 339 patients (16.7%) in the culprit-lesion-only PCI group (hazard ratio, 0.51;

95% CI, 0.43 to 0.61; P < 0.001). For both coprimary outcomes, the benefit of complete revascularization was consistently observed regardless of the intended timing of nonculprit-lesion PCI (P = 0.62 and P = 0.27 for interaction for the first and second coprimary outcomes, respectively) [11].

Randomized Controlled Trials of Culprit-Only Percutaneous Coronary Intervention Versus Complete Revascularization in Patients Undergoing Primary Percutaneous Coronary Intervention for ST-Segment–Elevation Myocardial Infarction

Randomized trial complete revascularization versus culprit lesion revascularization only were largely driven by a reduction of ischaemia-driven revascularization of the non-culprit lesions Table 1.

Pooled analysis of multivessel intervention versus culprit lesion intervention only in patients with STEMI

Randomized trials for Fractional Flow Reserved (FFR) guided complete revascularization or routine complete revascularization (either during primary PCI or during hospitalization or after the index hospitalization) versus culprit lesion revascularization only were largely driven by a reduction of ischaemia-driven revascularization or non-fatal MI rates of the non-culprit lesions. There were no significant differences in the all-cause mortality between the two groups Table 2.

STEMI Patient with cardiogenic shock

CULPRIT- SHOCK trial randomly assigned 706 patients who had multivessel disease, acute myocardial infarction, and cardiogenic shock to one of two initial revascularization strategies: either PCI of the culprit lesion only, with the option of staged revascularization of nonculprit lesions, or immediate multivessel PCI. The primary end point was a composite of death or severe renal failure leading to renal-replacement therapy within 30 days after randomization. Safety end points included bleeding and stroke. At 30 days, the composite primary end point of death or renal-replacement therapy had occurred in 158 of the 344 patients (45.9%) in the culprit-lesion-only PCI group and in 189 of the 341 patients (55.4%) in the multivessel PCI group (relative risk, 0.83; 95% Confidence Interval [CI], 0.71 to 0.96; P = 0.01). The relative risk of death in the culprit-lesion-only PCI group as compared with the multivessel PCI group was 0.84 (95% CI, 0.72 to 0.98; P = 0.03), and the relative risk of renal-replacement therapy was 0.71 (95% CI, 0.49 to 1.03; P = 0.07) [12].

	PRAMI	CvLPRIT	DANAMI-3–PRIMULTI	COMPARE-ACUTE	COMPLETE
No. of patients	465	296	627	885	4041
Lesion Criteria	> 50% DS	> 70% DS or > 50% DS in 2 view	50%-90% DS and fractional flow reserve ≤ 0.80 or > 90% DS	> 50% DS and fractional flow reserve ≤ 0.80	70% DS On visual estimation or with 50 to 69% DS stenosis and fractional flow reserve < 0.80
Primary end point	Death/MI/refractory ischemia	Death/MI/heart failure/ischemia-driven revascularization	Death/MI /ischemia-driven revascularization	Death from any cause, nonfatal MI, revascularization, and cerebrovascular events	first cardiovascular death or MI second cardiovascular death, MI, or ischemia-driven revascularization.
Result	23% reduced to 9% (65% RRR)	21% reduced to 10% (55% RRR)	22% reduced to 13% (44% RRR)	20.5 % reduced to 7.8 % (65 % RRR)	First: 10.5% reduced to 7.8% (26% RRR) Second: 16.7% reduced to 8.9% (49% RRR)

DS: indicates Diameter Stenosis, MI: Myocardial Infarction, RRR: Relative Risk Reduction

Table 1. Contemporary Randomized Controlled Trials of Culprit-Only Percutaneous Coronary Intervention Versus Complete Revascularization in Patients Undergoing Primary Percutaneous Coronary Intervention for ST-Segment–Elevation Myocardial Infarction.

Trial	MVI/ CLO	MACE	Mortality	MI	Revascularization
PRAMI	234/231	21/53	12/16	7/20	16/46
CvLPRIT	150/146	15/31	2/6	0/2	7/12
DANAMI-3-PRIMULTI	314/313	40/68	15/11	15/16	17/52
COMPARE-ACUTE	295/590	23/121	4/10	7/28	18/103
COMPLETE	2016/2025	179/339	96/106	109/160	29/160
Total	3009/3305	278/612	129/149	138/226	87/373
P value		0.0001	0.68	0.0003	0.0001

MVI: Multivessel Intervention, CLO: Culprit Lesion Revascularization only, MI: Myocardial Infarction, MACE: Major Adverse Cardiac Events

Table 2. Pooled analysis of multivessel intervention versus culprit lesion intervention only in patients with STEMI.

Summary and future directions

The revascularization approach for STEMI patients with Multivessel diseases has evolved. The initial paradigm was to perform a culprit lesion only approach in stable patients and a complete revascularization approach in patients with cardiogenic shock.

The recently published COMPLETE trial showed that a complete revascularization approach reduces the risk of cardiovascular mortality or MI driven by a reduction in MI. Based on the findings of this trial, as well as the other moderate sized RCTs will probably provide society guidelines with stronger evidence to support the recommendation for a complete revascularization approach.

However, we also learned that the non-culprit lesion's revascularization timing does not have an influence on the improved outcomes with a complete revascularization approach.

In contrast, patients with cardiogenic shock would benefit from an culprit lesion only revascularization approach.

References

1. Cardarelli F, Bellasi A, Ou FS, Shaw LJ, Veledar E, et al. Combined impact of age and estimated glomerular filtration rate on in-hospital mortality after percutaneous coronary intervention for acute myocardial infarction (from the American College of Cardiology National Cardiovascular Data Registry). *Am J Cardiol.*2009; 103: 766-771.
2. Rasoul S, Ottervanger JP, de Boer MJ, Dambrink JH, Hoorntje JC, et al. Predictors of 30-day and 1-year mortality after primary percutaneous coronary intervention for ST-elevation myocardial infarction. *Coron Artery Dis.* 2009; 20: 415-421.
3. Levine GN, Bates ER, Blankenship JC, Bailey SR, Bittl JA, 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: 1235-1250.
4. Ibanez B, James S, Agewall S, Antunes MJ, Bucciarelli-Ducci C, et al. 2017 ESC Guidelines for the management ofacute myocardial infarction in patients presenting with ST-segment elevation of the European Society of Cardiology (ESC). *European Heart Journal*. 2018; 39: 119-177.
5. Eric R. Bates MD, Jacqueline E. Tamis-Holland MD, John A. Bittl MD, Patrick T. O'Gara, MD, Glenn N. Levine MD. PCI Strategies in Patients With ST-Segment Elevation Myocardial Infarction and Multivessel Coronary Artery Disease. *J Am Coll Cardiol*. 2016; 68: 1066-1081.
6. M. Bilal Iqbal MD, Imad J. Nadra MD, Lillian Ding MSC, Anthony Fung MD, Eve Aymong MD, et al. Culprit Vessel Versus Multivessel Versus In-Hospital Staged Intervention for Patients With ST-Segment Elevation Myocardial Infarction and Multivessel Disease. *Am Coll Cardiol Intv.* 2017; 10: 11-23.
7. O'Gara PT, Kushner FG, Ascheim DD, Casey DE Jr, Chung MK, et al. 2013 ACCF/AHA guideline for the management of ST-elevation myocardialinfarction: a report of the American College of CardiologyFoundation/American Heart Association Task Force on Practice Guidelines. *Circulation.* 2013; 127: 362-425.
8. Wald DS, Morris JK, Wald NJ, Chase AJ, Edwards RJ, et al. Randomized trial ofpreventive angioplasty in myocardial infarction. *N Engl J Med.* 2013; 369: 1115-1123.
9. Ntalianis A, Sels JW, Davidavicius G, Tanaka N, Muller O, et al. Fractional flow reserve for the assessment of nonculprit coronary artery stenoses in patients with acute myocardial infarction. *JACC Cardiovasc Interv.* 2010; 3: 1274-1281.
10. ngstrom T, Kelbaek H, Helqvist S, Høfsten DE, Kløvgaard 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: 665-671.
11. Shamir R. Mehta MD, David A. Wood MD, Robert F. Storey MD, Roxana Mehran MD, Kevin R. Bainey MD, et al. Complete Revascularization with Multivessel PCI for Myocardial Infarction. *N Engl J Med.* 2019; 381: 1411-1421.
12. Ibanez B, Halvorsen S, Roffi M, Bueno H, Thiele H, et al. Integrating the results of the CULPRIT-SHOCK trial in the 2017 ESC ST-elevation myocardial infarction guidelines: viewpoint of the task force. *Eur Heart J.* 2018; 39: 4239-4242.

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